

Colorado's Little Fish

*A Guide to the Minnows
and Other Lesser Known Fishes
in the State of Colorado.*



By John Woodling

Designed and Edited by Russ Bromby

Published June, **1985**, by the
COLORADO DIVISION OF WILDLIFE
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ACKNOWLEDGEMENTS

Many people helped in the preparation of this book. Without their aid, completion of the work would have been impossible. To these people I offer my most sincere thanks and appreciation. Charles Bennett, Gerald Bennett, Steve Burge, James Chadwick, Scott Chartier, Larry Finnell, John Goettl, Mike Japhet, Bob Judy, Rick Kahn, Robin Knox, Mike McAllister, Charlie Munger, Dave Ruitter, Jay Sarason, Clee Sealing, Jay Stafford, Roger Trout, Bill Weiler, Bill Wiltzius, Lawrence Zuckerman and others all spent time and effort in locating records, collecting, and in some cases, transporting live fish across large distances. Jim Bennett, Charles Haynes and Dave Miller not only helped locating specimens but reviewed large portions of text.

Wilbur Boldt provided needed assistance in obtaining and maintaining funds to produce this book.

Gil Dalrymple, Carol Dreitz and Pat Barnett spent many hours typing the manuscript.

Special thanks to Marian Herschopf, whose diligent efforts produced many obscure documents and materials essential to production of this text.

PREFACE

Colorado's Little Fish is a bit of a misnomer. Some species included in this book attain a length of greater than one foot and weigh in excess of three pounds. Specimens of one fish in the book, the Colorado squawfish, have been recorded up to 65 pounds. The title was chosen to differentiate between two groups of fish species—those actively sought by fishermen and those fish that anglers seldom see or don't desire. Perhaps another title could be "Colorado's Little Known Fish."

The term "Little Fish" was chosen in lieu of other names commonly used to describe these fish that have a negative connotation such as "trash fish" or "forage" fish. All of the suckers, minnows, darters, topminnows and members of other families infrequently noticed by fishermen are included in this book. Descriptions, characteristics, habitat needs and life history notes for each species are presented. Included are brief descriptions of the different riverine habitats found in Colorado and the historic distribution of fish species in the geographically separated drainage basins. Man's impact on both habitat and historic fish distribution patterns are discussed. The book is designed to be of use to bait dealers, general public, high school students and first year biology students in college.

SPECIES ACCOUNTS

The species descriptions presented are the result of an enormous amount of work by fishery biologists both from Colorado and from other states. Where possible, information specific to Colorado populations is given. However, in many cases information from Colorado was not available due to the lack of past studies and surveys within the state. In these cases information from other states was utilized.

Photographs for all but two of the species are presented. Photographs were taken of adult fish. If available, pictures of adult males in breeding colors are included. These photographs show the characteristics common to older fish.

Juvenile fish may look different (and in some cases, photographs are included) and there may be a great deal of variation in color and shape of adult specimens found in the wild. Rather than rely on photographs alone, the reader is encouraged to use both the taxonomic keys and species descriptions when identifying an unknown specimen.

The distribution maps indicate whether or not a species has been collected in a given county. The maps do not indicate specific waters from which specimens were taken, and the maps are not the final word on distribution. Distribution of any species may be wider than shown on the maps. Future field work will further define species' ranges. However, if a specimen is identified and the map shows no specimens have previously been collected within a several county range, perhaps the identification should be rechecked.

ON THE COVER: The southern redbelly dace. Photograph by John Woodling. Other photographs in this book, except as otherwise credited, were taken by John Woodling and Don Domenick. Artwork by Annette B. McCollum Vining.



Typical mountain stream habitat. Photo by John Woodling.

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Partially funded by the Commercial Fisheries Research and Development Act.
Project No. 1-161-R-1. National Marine Fisheries Service.

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INTRODUCTION

About 80 species of fish are found in Colorado, a tiny fraction of the 40,000-plus species as described by man throughout the world. Approximately 30 of the species in Colorado are commonly sought by anglers for food or sport. The remaining 50 species are, for the most part, little known or poorly understood. Often termed "Rough" or "Trash" fish, nothing could be further from the truth. Some represent untapped sources of protein available for human consumption. Others are abundant enough, and suitable, for harvest and sale as bait species.

Still others are beautiful in form and color. All are important in the intricate interweavings of the complex aquatic ecosystem.

This book deals with the various species, minnow, sucker, darter, and others, 50 in all, not commonly sought by the angler. Descriptions, county distribution maps and brief life history notes are provided. Several of these species are suitable for use as bait fish. Fishermen interested in gathering their own bait fish can use this publication to identify suitable

species and determine what habitat types support the species they want. Other individuals may be interested in the commercial possibilities that exist in terms of some of the species. Commercial fishermen can harvest some species for sale as bait or feed. Two minnow species can be reared in ponds, harvested, and sold profitably as bait fish. Prior to discussing individual species, an overview of Colorado's fish fauna is required to understand the current distributional status of fish species in Colorado.

Historic Studies of Colorado's Fish Fauna

Throughout the years there have been few studies of the fish fauna of Colorado. Notable are the studies of David Starr Jordan (1891) entitled "Report of Explorations in Colorado and Utah During the Summer of 1889 with an Account of the Fishes Found in each of the River Basins Examined," and by Max M. Ellis (1914) entitled "Fishes of Colorado". Neither these, or other early workers, had time or equipment to completely sample all streams within a specific river basin. As a result, not all species in a given drainage may have been collected. With the work of later investigators, additional species were found, but, by this time an extensive fish stocking program by governmental and private entities had introduced many exotic species. Thus, it is impossible in several cases to determine if a species is native to the state, or a result of accidental introduction.

Only recently have studies been performed in specific drainage basins which included sampling of all tributaries, large and small, permanently flowing as well as intermittent in nature. Propst (1982) analyzed the fish fauna of the North and South Platte rivers. Cancalosi (1980) reported on the fish fauna of the Republican River Basin in eastern Colorado. Currently, studies are being done on the

Arkansas and Rio Grande river systems. Both early and recent studies have shown that fish communities of each river basin differ in species composition. Also, the historic distribution of fish species has been greatly changed by habitat alteration, man's modification of the physical and chemical environment, and fish stocking programs.

A list of the species included in this book is presented in Table 1. The reader is referred to the individual descriptions for information pertaining to each species.

TABLE 1
Fishes of Colorado
Included in this publication

<i>Ictaluridae</i> Stonecat	<i>Noturus flavus</i>
<i>Osmeridae</i> Rainbow smelt	<i>Osmerus mordax</i>
<i>Gasterosteidae</i> Brook stickleback	<i>Culaea inconstans</i>

<i>Cyprinidae</i> Carp Goldfish Stoneroller	<i>Cyprinus carpio</i> <i>Carassius auratus</i> <i>Cam postoma anomalum</i>
*Northern redbelly dace *Southern redbelly dace	<i>Phoxinus eos</i> <i>Phoxinus erythrogaster</i>
Longnose dace Speckled dace	<i>Rhinichthys cataractae</i> <i>Rhinichthys osculus</i>
*Colorado squawfish	<i>Ptychocheilus lucius</i>
Roundtail chub *Humpback chub *Bonytail Rio Grande chub Creek chub	<i>Gila robusta</i> <i>Gila cypha</i> <i>Gila elegans</i> <i>Gila pandora</i> <i>Semotilus atromaculatus</i> <i>Hybopsis gracilis</i>
Flathead chub Suckermouth minnow	<i>Phenacobius mirabilis</i>
Fathead minnow Brassy minnow	<i>Pimephales promelas</i> <i>Hybognathus hankinsoni</i>
*Plains minnow	<i>Hybognathus placitus</i>

Redside shiner	<i>Richardsonius balteatus</i>	Catostomidae		Poeciliidae	
*Common shiner	<i>Notropis comutus</i>	River carpsucker	<i>Carpionodes carpio</i>	Mosquitofish	<i>Gambusia affinis</i>
*River shiner	<i>Notropis blennioides</i>	White sucker	<i>Catostomus commersoni</i>		
Red shiner	<i>Notropis lutrensis</i>	Longnose sucker	<i>Catostomus catostomus</i>	Cottidae	
Sand shiner	<i>Notropis stramineus</i>	Flannelmouth sucker	<i>Catostomus latipinnis</i>	Mottled sculpin	<i>Cottus bairdi</i>
Bigmouth shiner	<i>Notropis dorsalis</i>	Bluehead sucker	<i>Catostomus discobolus</i>	Paiute sculpin	<i>Cottus beldingi</i>
Spottail shiner	<i>Notropis hudsonius</i>	Mountain sucker	<i>Catostomus platyrhynchus</i>		
Golden shiner	<i>Notemigonus crysoleucas</i>	*Rio Grande sucker	<i>Catostomus plebeius</i>	Percidae	
Grass carp	<i>Ctenopharyngodon idella</i>	*Razorback sucker	<i>Xyrauchen texanus</i>	Johnny darter	<i>Etheostoma nigrum</i>
Tench	<i>Tinca tinca</i>			*Iowa darter	<i>Etheostoma exile</i>
				Orangethroat darter	<i>Etheostoma spectabile</i>
				*Arkansas darter	<i>Etheostoma cragini</i>
Clupeidae		Cyprinodontidae			
Gizzard shad	<i>Dorosoma cepedianum</i>	Plains killifish	<i>Fundulus zebrinus</i>		
Threadfin shad	<i>Dorosoma petenense</i>	Plains topminnow	<i>Fundulus sciadicus</i>		

River Basins in Colorado

There are several distinct river basins in Colorado. Each is physically isolated from other basins. Over the course of time different species communities developed in each basin. Stream capture, whereby direction of flow is changed from one drainage to another by earthquake, uplift or some other geologic phenomenon, accounts for some movement of species between basins.

Eventually each basin came to have a distinct fauna, adapted to various habitat types within the drainage. In most Colorado river drainages the fauna of a given system is rather unique. Several species are limited to only one drainage and others are found statewide. One interesting aspect of the fisheries of Colorado is the rather few number of species native to each drainage basin. Presently, over 40 species may be found in a drainage basin while less than a dozen are native to the system.

The Colorado River Basin drains all por-

tions of the state on the western slope of the Continental Divide. The White, Yampa, Green, Dolores, Gunnison, San Juan, and Animas rivers are all tributary to the Colorado River which drains about one-half the state's area. Despite the vast size of the Colorado River Basin, only nine species of fish were native in the drainage Ellis (1914). Behnke and Benson (1980) put this figure at 13 or 14 species.

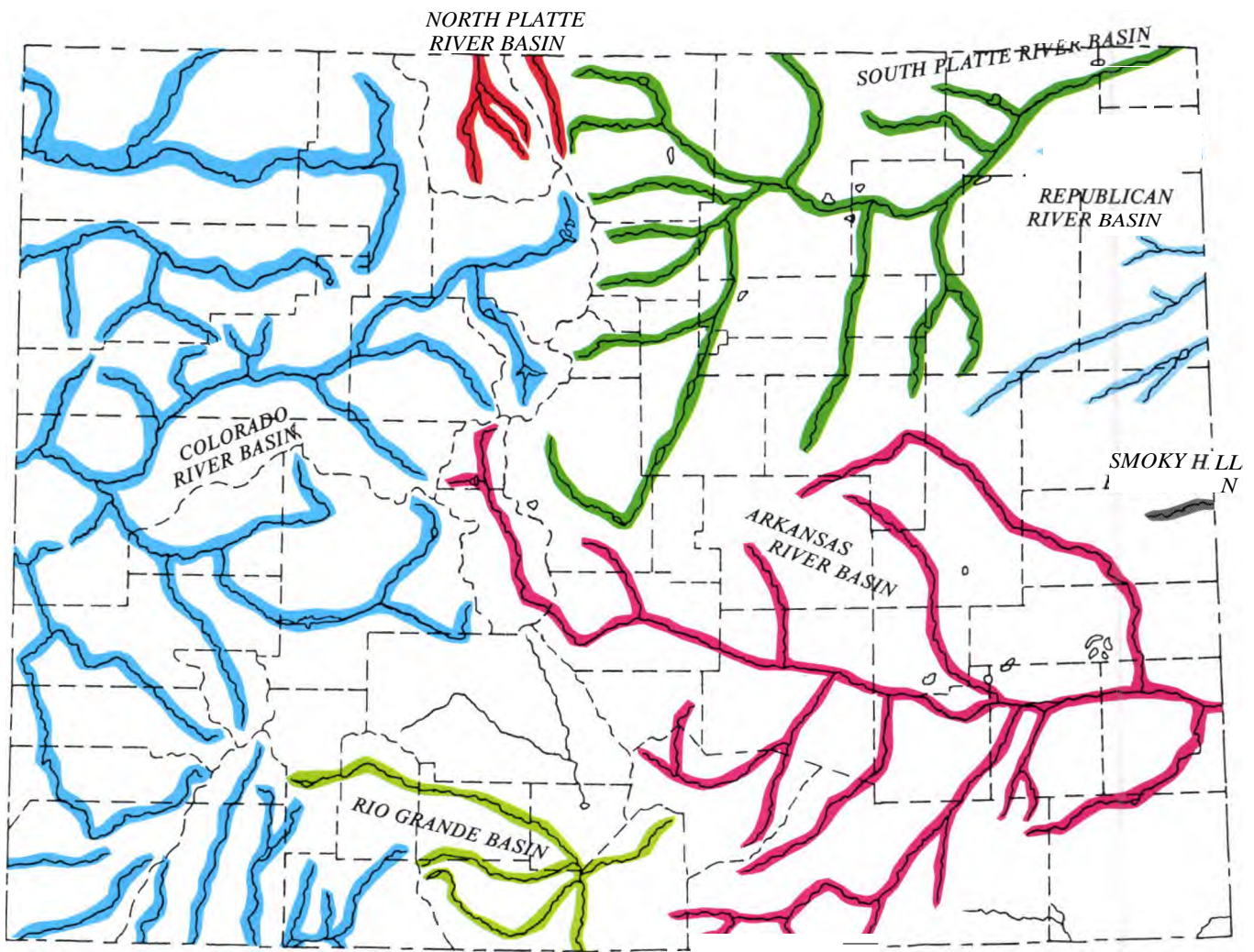
The Rio Grande drains the southern portion of the state. Not all streams in this drainage merge with the mainstem river, several streams which arise in the mountains in the north part of the drainage disappear into the arid sands of the San Luis Valley without ever reaching a larger river. Jordan (1891) collected only four species from the Rio Grande basin while Ellis (1914) described five species from the system.

The Arkansas River drains the southeast portion of Colorado. Originating in the mountains of central Colorado, the

Arkansas then flows across the arid eastern plains of the state. There are few permanently flowing tributaries that enter the Arkansas River on the eastern plains. The Fountain, Purgatoire, Huerfano and a few others are only a few inches deep and ten yards or so wide when they flow into the Arkansas mainstem. Seventeen species were listed as native to this drainage by Ellis (1914).

The Cimmaron River flows through the very southeast tip of Colorado. There is no permanent flow in the river segment inside Colorado. A few isolated potholes in the main channel or tributaries might contain water during periods of low flow. Only species that are able to tolerate the severe conditions in these potholes could survive in this drainage. Three species have been collected in the Cimmaron system.

The headwaters of the Smoky Hill River are in the eastern edge of Colorado, north of the Arkansas River Drainage. In western



Kansas the Smoky Hill River contained several species of fish which are either rare or not found in Colorado. There is no record of permanently standing water in either pools or streams in Colorado. Consequently, there are no records of fish in the Smoky Hill River of Colorado.

The Republican River also headwaters on the eastern edge of Colorado. Surfacing springs, fed by the Ogallala aquifer, maintain year-round flows in many of the basin streams. Cancalosi (1980) reported there were fourteen species of fish native

to the Republican River Basin.

The fish fauna of the South Platte River in Colorado is diverse in terms of Colorado rivers with 38 species reported as native to the state, though the actual number may be closer to 29 (Propst 1982). Misidentifications and taxonomic reclassification are thought to account for the difference. The South Platte drains the northeast portion of Colorado. Like the Arkansas, the South Platte originates in the mountains then flows out of the hills and across the arid plains to Nebraska.

Few permanently flowing tributaries enter the South Platte in the plains area of the state. Most are dry with only potholes holding water year-round. Most permanently flowing tributaries enter the Platte in the foothills area of the drainage.

There has been little study of the fishes of the North Platte River. The headwaters of this river system are in the North Park portion of Colorado on the northern border of the state. Propst (1982) recorded the presence of nine species in the drainage.

Habitat Types Found in Colorado Rivers

Though fish communities differ in the various river basins of Colorado, some of the habitat types are quite similar. Probably the most well known river habitat in the state is that of the coldwater mountain trout stream. The headwaters of four major drainages in the state, the Platte, Arkansas, Colorado and Rio Grande, are of this stream type. Cold, clear water flows rapidly downstream through an alternating series of rapids and pools. The river substrate is commonly composed of gravel-to-boulder size rubble. Dissolved oxygen levels are usually very high, with low dissolved solids and cold water temperatures. Streams are frequently shaded by trees and bordered by grasses.

On the western slope of Colorado, trout

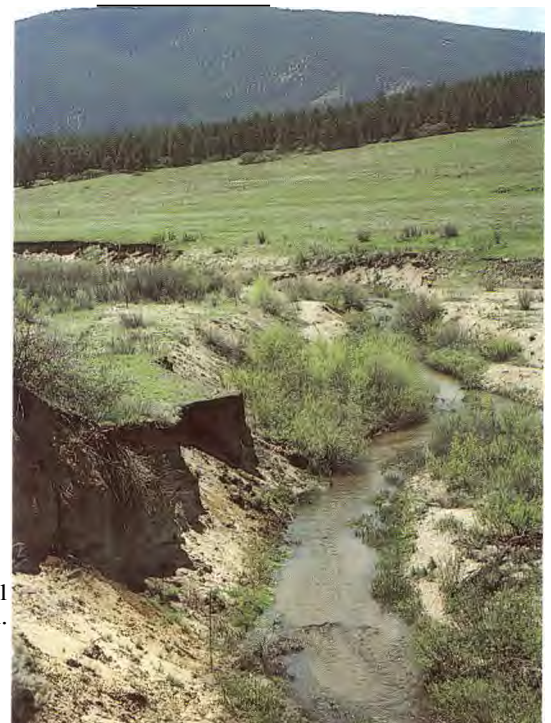
streams and smaller rivers merge to form the "Big River" habitat. These rivers including the Colorado, Yampa, White, Dolores, and Animas, small in comparison to other states, with low fall flows, (sometimes far less than 1,300 cubic feet per second) are indeed large for Colorado. Stream velocity still remains high, especially during the spring runoff as snow melts in the high country. During periods of low flow, stream velocity in eddies, pools and main channels can be quite slow and languid. Pools can be twenty or more feet deep while the rapids form whitewater areas favored by rafters. The stream substrate is composed of boulders and large rocks in the rapids. Gravel and sand bars are found in areas of slower

water. In pools and eddies the riverbed is usually covered by mud and silt. Oxygen content of the water is usually high, while dissolved salt concentrations are moderate and summer water temperatures are rather warm. In most locations there are no trees bordering the rivers. Stream banks are composed of sedimentary rock deposits or rubble, with some gravel and sand beaches.

As the "Big Rivers" flow through the western portions of Colorado, smaller tributaries join the mainstems. Following spring runoff, stream volumes of these small tributaries are often quite low. The substrate of these streams is usually composed of moderate-sized cobble, sedimentary rock gravel or silt and mud. During



The Arkansas River above John Martin Reservoir on the Eastern Plains.



West Plum Creek is a typical transition zone stream.

the summer, stream temperatures can be very warm. Dissolved salt concentrations can exceed 3,000 parts per million, and oxygen content is usually moderate. Riffle areas during low flow months are normally knee-deep while pools are several feet deep. Undercut banks are common, while streamside vegetation is usually composed of grass or brush.

When the streams and rivers on the eastern side of the Continental Divide flow out of the mountains and onto the plains these waters pass through a transition zone. In periods other than spring runoff, water velocities slow, water temperatures are moderate and the water is clear. Deep pools, undercut banks, streamside vegetation of grass and shrubs, and tree canopies are all common features of these waters. These stream reaches are a buffer between the upstream coldwater trout stretches and the downstream warmwater segments. The number of fish species found in the segment may be the highest of any stretch of the river as populations from the coldwater and warmwater portions are both present.

The two mainstem portions of the Arkansas and South Platte rivers that flow from the mountains out across the eastern plains present somewhat similar habitats. Once these rivers have left the transition zone from cold to warmwater the river changes in character. Instead of one main channel, the rivers may gradually subdivide into a braided series of parallel channels moving down a wide, sandy bottomed riverbed. As flows change, the various channel braids move back and forth across the stream merging and separating into different flow patterns. There are often islands within the stream bed while the riparian vegetation zone can be from two-to-several hundred yards wide. A tree canopy covers at least part of the river in many areas. Water depths may be only a few inches during low flow conditions and summer water temperatures are quite warm. Total dissolved salt concentrations increase to a level of more



Bijou Creek is an example of a sandy-bottomed Plains stream.

than 4,000 parts per million in the lower Arkansas. Species found in these river segments must be able to tolerate drought, flooding, high turbidity and changing habitat conditions.

Most tributaries of the Arkansas and South Platte in the eastern plains of Colorado are intermittent in nature. Fed by runoff or surfacing groundwater, some of these plains streams maintain permanent flows in the headwater regions while most have year-round water only in potholes. Windblown weeds or growths of aquatic vegetation choke many of these potholes. Water temperatures can be very high unless trees canopy the water. Stream substrate varies from sedimentary bedrock to mud and silt.

Throughout the state, a surfacing spring or surfacing groundwater may create a rather unique stream in any of the habitat regions previously described. Flows surface year-round assuring permanent flow, and stream banks tend to be rather stable since an established riparian zone reduces erosion. Water temperatures usually remain fairly cool in these stream reaches even in summer months and aquatic vegetation often flourishes. This situation is common in the Republican River Basin on the eastern edge of Colorado. These permanently flowing streams are a refuge for species requiring moderate environmental conditions which may not exist in a drainage basin drastically impacted by man's activities.

Alteration in Habitat Caused by Man

Historic zoogeographic distribution patterns of Colorado fishes have been altered by man's activities. Since 1859, when the discovery of gold initiated the settlement of Colorado by large numbers of humans, the number of fish species and numbers of fish in many of the state's waters have been reduced. In some waters, this reduction has been so severe that no fish remain. Individual species have become rare, some disappeared entirely. Other species (native and introduced) which are tolerant of altered habitat conditions, have expanded in range and number. Industrial, domestic and agricultural activities have all contributed to the reduction of the state's fish fauna.

Industrial effluents are varied in nature throughout Colorado. Chemical discharges from industrial sites may be toxic to fish if sufficient levels are introduced into a waterway. During the Colorado mining boom of the middle and late 1800's, no thought was given to the consequences of water pollution resulting from the mining industry. As a result, acidic, metal-containing effluents were dumped directly into hundreds of streams and rivers. Today, many of the now inactive mine portals and tailings piles still introduce toxic levels of acid and metals to Colorado waters. Fish populations in many rivers are reduced or gone altogether. Some modern mines have million-dollar, advanced treatment plants that remove toxicants prior to discharge.

Other discharges can be as unique as the industry involved. Cleaning compounds, petroleum products, photographic chemicals, materials from metal-plating operations, ammonia, pesticides and herbicides have all been discharged into Colorado waters. Another possible byproduct of industrial activity is heated water. Hot water, or thermal discharge, can raise the temperatures of receiving waters to the point where fish cannot survive or reproduce. All the causes described above

eliminated some, or all, fish species from individual waters in the state. The impact of this pollution can be reversed through elimination of the source or through construction and operation of waste treatment plants. The impacted waters can be restocked. Native species can be used if donor populations survive in other areas.

Urbanization of Colorado has also impacted the quality of the state's waters. Human sewage must be treated prior to discharge or the receiving water can become so foul that almost all aquatic life disappears. Over the years the treatment of human sewage has improved in Colorado with the development of fairly sophisticated treatment facilities. Some problems remain. Chlorine, used to sterilize sewage effluents, is toxic to fish in minute amounts. Ammonia is one of the end products of the purification of human nitrogenous waste products and, depending on other conditions, can be toxic to fish. Ammonia and/or chlorine have eliminated fish populations from some river segments. In the plains of Colorado where arid conditions result in low flow conditions the volume of sewage discharged by a moderate-sized town can result in toxic situations below the effluent pipe. Even if toxic conditions are not created, the nitrogen and phosphorus compounds from the sewage treatment plants can enrich the streams. Algal growths can cover the stream bed. At night as the algal growths utilize oxygen for respiration, dissolved oxygen levels fall. Nighttime oxygen levels can be so low that fish species are eliminated. If several communities discharge to a single river, nutrient enrichment often becomes a chronic problem. One such example is the South Platte River which receives treated domestic sewage from Denver, Greeley, Fort Collins and many other communities. Several species native to the South Platte mainstem are now restricted to foothills tributary streams upstream of sewage

discharges. Species able to withstand moderate enrichment continue to be found in stretches of the river where water quality problems are not too severe.

Surface water flows entering streams or rivers from urbanized areas is termed urban non-point runoff. These flows may be attributable to storm events, people over-watering lawns, car wash locations or other sources. Nutrients from fertilizers, spilled oil and gas, mud, silt, lead from automobile emissions are only part of the material that can be introduced into waterways. All such material can negatively impact fish populations.

Some of the problems associated with agricultural activities are similar to those related to human sewage. Nitrogen and phosphorous fertilizers may reach streams and rivers causing nutrient enrichment. Species not tolerant of such enrichment disappear from affected streams. In some areas, cattle have been intensively grazed on land for decades. In moving to-and-from a stream for water, stream banks are pounded flat by thousands of cattle hooves. Undercut banks, aquatic and terrestrial vegetation are eliminated. In many areas the riparian (streamside) vegetation has been removed to increase the amount of tillable land. Water temperatures increase in such areas since the shading provided by vegetation is no longer present. Increased erosion is a predictable result of plowing the land. Soil washed into waterways may settle to the bottom during the flow periods covering the stream substrate with silt. Also, irrigation return flows can introduce large amounts of silt and sediment. Turbidity of streams may increase, eliminating fish species that rely on sight to gather food. Many species discussed in this book require cool, clear, slow-flowing water and as this type of habitat has decreased, so have the populations of fish restricted to those environmental conditions. Conversely, a few species adapted to warm silty water have

increased in number and distribution.

There are two problems common to all man's development in Colorado: dewatering and channelization. During times of drought there is not enough water in the state for all uses. During times of flood there is usually too much, at least in terms of modern civilization. The native fish species are adapted to Colorado's extreme flow fluctuations. Man's constructions often are not.

To assure adequate water supplies for cities, agriculture and business, reservoirs have been built to store water for future use. The stream or river reach upstream of a dam is periodically inundated with standing water and fish requiring flowing water are eliminated. Species which must migrate through the area during spawning runs are stopped at the dam face and eventually may be eliminated. Water released from reservoirs is often drawn from the bottom of reservoirs. If the impoundment is deep enough, the temperatures of the water is cold, even in the warmest summer months and, these coldwater releases eliminate warmwater fish from river reaches downstream of the dam.

Two general types of water diversions impact Colorado fish populations. First, water is often diverted from one river basin to another drainage. Thousands of acre-feet of water are diverted from the west slope of the Continental Divide to supply the water needs of east slope cities. Natural water flow regimes are disrupted and species that need high spring flows to reproduce may be prohibited from spawning successfully. Secondly, water is also diverted from waterways for irrigation purposes and streams are often completely dewatered resulting in loss of downstream flowing water habitat. In many waters a series of diversion dams may be used to remove any irrigation return flows or surfacing groundwater for a stream length of several miles. Species

not able to withstand extensive dewatering are eliminated.

Transmountain water diversions have altered the flow regimes of the Arkansas and South Platte rivers. Prior to the modern colonization of Colorado beginning in the 1860's, the mainstem South Platte along the eastern edge of the state periodically dried completely in the fall and winter months. Only fish that could withstand such arid conditions would have been able to inhabit the South Platte in this part of the river. Since the advent of the transmountain diversions, the South Platte on the eastern plains is no longer intermittent in nature, but flows year-round. More species of fish are able to inhabit this river reach now than in the past. The Fryingpan-Arkansas project diverts water from the west side of the Continen-

tal Divide to the Arkansas River. Year-round flows in the Arkansas are likely to be higher, a factor which impacts the success or failure of a given species in maintaining viable populations.

Many streams and rivers have been channelized to contain rivers within stream beds during periods of excess flow. Waterways are also channelized to prevent them from naturally altering stream beds, endangering man's highways, railroads, buildings, and other property. Miles of rivers and streams have been channelized and in most cases when a stream bed is channelized, the meandering curves, undercut banks, pools and streamside vegetation are removed. Water will be warmer, flow velocities faster, and depths shallower. Species not able to tolerate such conditions disappear.



Introduction of Fish Species Through Stocking

Not only has the physical habitat of Colorado's waters been extensively altered, but biological conditions have been changed as well. Since the mid-1880's, man has been stocking native and exotic species throughout the state. The object of the stocking programs have been to increase fishing opportunity. Only a few species of fish that anglers prefer, two species of catfish, the orangespotted sunfish, the green sunfish, and cutthroat trout were native in the state. Since that time, many species have been stocked throughout the state. A list of fish introduced to

the state exceeds the scope of this book. Wiltzius (1982) outlined the known introduction of fish to Colorado and not only were species such as trout and bass desired by anglers stocked, but other species were accidentally introduced. Fish culturists of the time were not in the practice of sorting out extraneous species which may have gained access to their rearing ponds. Consequently, various minnows, suckers, and others have been transferred from other drainage basins and states.

Current Status of Colorado Fish Species

Alteration of the physical and chemical habitat of Colorado waters has been so extensive that four minnow species have disappeared from the state (Table 2). Although reported from the Arkansas or South Platte in the past, recent work has failed to find any of these species in either river system (Goettl 1980, Propst 1982, Miller 1983). These fish are not included in this book. Also excluded are fish species for which there is reason to doubt that the fish were ever actually found in Colorado, although some investigators have reported these species. (Table 2).

Of the 50 species of fish included in this book, 12 are extremely limited in range or numbers (Table 1-page 1). Rare species are noted in the table by an asterisk in front of the common name. Of these fish, four; the northern redbelly dace, southern redbelly dace, plains minnow, and river shiner—all found in eastern plains streams—are extremely rare in Colorado. Only one or two specimens of each of these four species have been collected in Colorado since 1980. Four other species; the common shiner, Rio Grande sucker, Iowa darter and Arkansas darter, are found in only a few isolated locales. Most of these species require cool, clear, permanently-flowing waters. The number of stream segments with this type of habitat has continually been diminished on the eastern plains during the last 120 years. Currently, parts of the Republican River Drainage, Plum Creek south of Denver and portions of the St. Vrain, the Poudre River and some other streams in the transition zone from mountains to plains provide refuges for these species. These river segments are situated in locales which are not heavily impacted by man's activities. If these remaining areas are dewatered or polluted in the future, these species too could disappear from Colorado.

Another group, the Colorado squawfish, the bonytail, the humpback chub and razorback sucker ("Big River" fishes) are

found rarely on the West Slope of Colorado. Restricted to the mainstem portions of the Colorado, White, Yampa, and Green rivers, these species have become rare for several reasons, including dewatering, river channel blockage, and lower water temperatures due to reservoir construction (Behnke and Benson 1980).

Because many potential bait species are extremely uncommon and others are reduced in distribution, care should be taken in harvesting bait fish for commercial harvest or personal use. There are ten species of fish in Colorado which are abundant enough to be harvested as bait fish (Table 3).

Except for the flannelmouth and bluehead suckers, these species can be collected in most rivers and streams of eastern Colorado and many are now present in western slope waters of the state. Two species, the golden shiner, and the

fathead minnow are suitable for pond culture to produce bait minnows.

Minnows and suckers are excellent bait for the many species of fish sought by fishermen in Colorado. A knowledge of these bait fish provides the basis for a fisherman to gather bait for personal use, or any individual, with the ability to harvest bait fish, to begin retail or wholesale business endeavors. Before using live fish as bait, or attempting to build a business involving sale of bait fish, all individuals should contact a representative of the Colorado Division of Wildlife and/or read current fishing season information. For example, the use of live minnows is prohibited in many areas of Colorado and a commercial fishing license is required of anyone harvesting and/or selling bait fish. The remainder of this book will help identify bait fish of Colorado and describe each species in detail.

Table 2

FISH SPECIES REPORTED FROM COLORADO IN PAST STUDIES

A. Extirpated Species	
Hornyhead chub	<i>Nocomis biguttatus</i>
Blacknose shiner	<i>Notropis heterolepis</i>
Lake chub	<i>Couesius plumbeus</i>
Arkansas River Speckled Chub	<i>Hybopsis aestivalis</i>
B. Species of fish reported to be in Colorado but for which there are no existing specimens in collections.	
Quillback	<i>Carpionodes cyprinus</i>
Northern redbhorse	<i>Moxostoma macrolepidotum</i>
Finescale dace	<i>Phoxinus neogaeus</i>
Silver chub	<i>Hybopsis storeriana</i>

Table 3

SPECIES ABUNDANT ENOUGH FOR USE AS BAIT FISH IN COLORADO

White sucker	<i>Catostomus commersoni</i>
Longnose sucker	<i>Catostomus catostomus</i>
Flannelmouth sucker	<i>Catostomus latipinnis</i>
Bluehead sucker	<i>Catostomus discobolus</i>
Creek chub	<i>Semotilus atromaculatus</i>
Fathead minnow	<i>Pimephales promelas</i>
Golden shiner	<i>Notemigonus crysoleucas</i>
Red shiner	<i>Notropis lutrensis</i>
Sand shiner	<i>Notropis stramineus</i>
Bigmouth shiner	<i>Notropis dorsalis</i>

FISH STRUCTURE

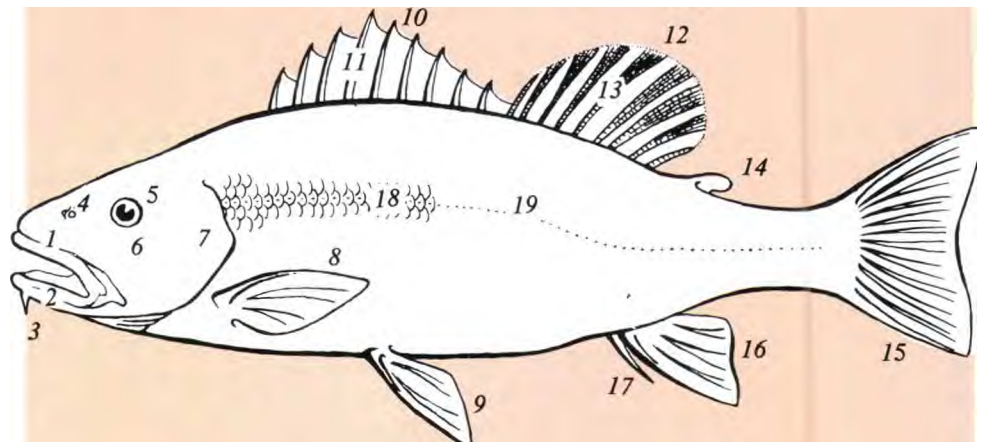
Fish are cold-blooded animals, meaning that body temperatures are the same as the water in which they live. Fish breathe through gills, swim by body motion, use fins for maneuvering, and usually have a covering of scales and an outer cover of mucus for protection from external infection.

There are three main groups of fish in the world: the jawless fish; the boneless or cartilaginous fish; and the bony fishes. Bony fish are those with an internal skeleton. Only bony fish are found in Colorado. Jawless fish, an example of which are lampreys, and boneless fish—sharks and rays—are not found within the state. The bony fish are further subdivided into soft-rayed fish and spiny-rayed fish. Catfish (despite their spines), trout, pike, minnows and suckers are soft-rayed fish, meaning their fins are supported by soft rays. Catfish spines are different in structure than those of the spiny-rayed fish. Spiny-rayed fish—bass, perch, sunfish, etc.—have at least some fins supported by sharp, stiff spines.

To obtain oxygen, fish pass water over the gills, which are made of a fine capillary system of very thin-walled blood vessels. These walls are so thin that oxygen can pass into the blood from the water while the carbon dioxide waste is expelled into the water. To breathe in, fish close their gill covers, expand their cheeks and open their mouth. Water flows in over gills. To breathe out, the mouth is closed, cheeks are contracted and gill covers opened. Water flows out, away from the gills.

The skin of fish is composed of two layers. The outer layer is called the epidermis, while the inner layer is the dermis. The thin, outer layer contains many pigment cells which form the color pattern, and many mucus cells. These single-celled mucus glands produce the mucus which protects the fish from external infection. The inner, or dermis, layer is thicker and produces the scales. Trout and salmon

GENERAL CHARACTERS Commonly Used in Identifying Fish



1. Upper jaw (*premaxillary and maxillary bones*)
2. Lower jaw (*dentary bone*)
3. Barbel
4. Nostril
5. Eye
6. Cheek
7. Gill cover
8. Pectoral fin
9. Pelvic fin

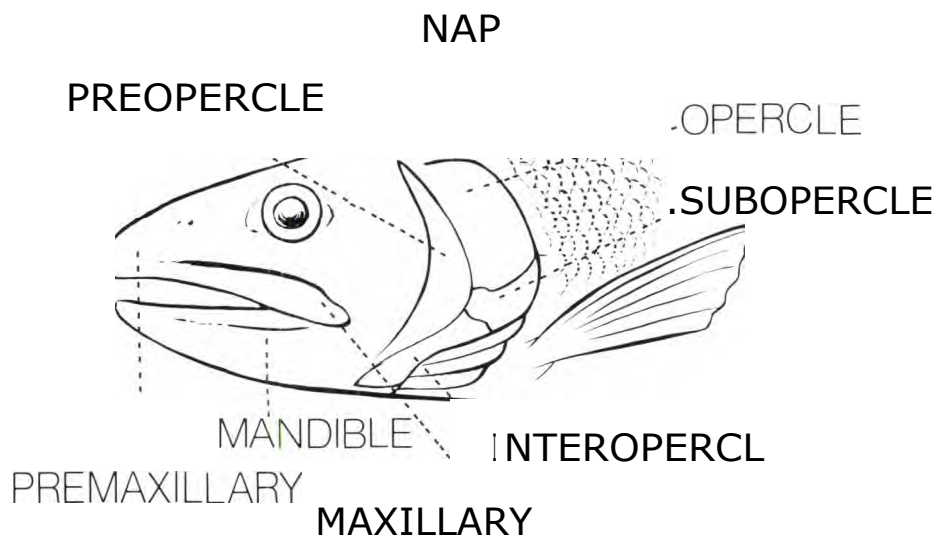
10. Spiny dorsal fin
11. Fin spine
12. Soft dorsal fin
13. Fin ray
14. Adipose fin
15. Caudal fin
16. Anal fin
17. Anal spine
18. Lateral line scales
19. Lateral line

have cycloid scales, which are small and deeply embedded in the skin. Sunfish, bass and perch scales have rows of spines along the exposed posterior margin. These are termed ctenoid scales. Some fish, like the sculpin and catfish in Colorado, lack scales.

Scales provide a very valuable tool in determining the age of fish. Scales form rapidly after a fish hatches, and grow in size as the fish grows. Small rings are laid down along the edges of the scale as they grow. Fish grow faster in the summer than in the winter. Thus, the rings are farther apart in the summer than in the winter. Each annual series of rings represents one year in the life of that fish. These scales can be read to determine the fish's age. Spines of catfish can be read in the same manner.

Fins are either single or paired. Single fins are located along the top, bottom and tail of the fish. The dorsal fin may be single, or divided into two parts, and is located on the top of the back. Behind the dorsal fin, trout have a fleshy fin called an adipose fin. The tail fin is termed the caudal fin. The anal fin is located on the belly behind the anus. There are two sets of paired fins, with one fin on each side of the fish. The pectoral fins are located just behind the gill cover and are attached by the "shoulder" bones to the skull. Fish at rest continually use the pectoral fins to backwater which offsets the forward thrust produced by expulsion of water from the gills. The pelvic fins are located on the belly of the fish. The pelvic fins are supported by bones which are suspended in the belly muscles. The pelvic fins are located on the rear of the belly in soft-rayed fish, and under the pectoral fins in spiny-rayed fish.

Fish swim principally by muscular movements of the body. The body muscle and caudal fin exert the power. Pectoral and pelvic fins provide steering and maneuvering, while dorsal, anal and even the caudal fin provide stabilization.



The organization of the digestive tract varies from group to group. In many fish, the intestine is fairly short and includes only one single s-shaped loop. In other species, the intestine is very long with many coils and loops. In general, fish with very long intestines tend to be mostly herbivorous in nature. Fish with the shorter intestine usually prefer plankton, invertebrates or *other* fish as foods. The lining of the body cavity (the peritoneum) which holds the viscera, may be dark or silvery, with or without speckles. Fish which consume large amounts of plant material tend to have a very dark peritoneum. Both the size of the intestine, and the color of the peritoneum, are important characteristics used in the iden-

tification of minnows and suckers.

This description of fish structure has been a very simple overview. Many textbooks and papers are available for more information on ichthyology, the study of fish.

USE OF KEYS





Many readers may not be familiar with the use of identification keys. The keys in this book are arranged in a series of couplets. Each couplet is composed of two statements. For example, the first couplet has two parts 1.a. and 1.b. When identifying an unknown fish, begin with the first couplet. Read the statements and decide which of the two best describes the fish

in question. Follow the instruction following the statement which best describes the fish. The instruction will direct the reader to another couplet. Read that couplet and decide again which statement describes the fish. Follow the instructions from couplet to couplet until the name of a family of fish is listed after the statement describing the unknown fish. This tells

you to which family the fish belongs. For minnows, suckers and some other families, an instruction will direct you to another key in the book dealing with that family. Follow this process until the fish is described to species. Before ending the identification process, examine the photographs, distribution map and description to make sure your identification is correct.

KEY TO THE FAMILIES OF FISH IN COLORADO

What follows is a taxonomic key. To use this key, take the fish in question and read the first two descriptive phrases, couplet 1.a. and 1.b. One of these two phrases will describe a character which fits the fish you are trying to identify. Decide which character fits the fish in question and read the instruction which follows the descriptive phrase. The instruction will either tell you what family the fish is or tell you to go to another couplet. If the key is followed correctly, matching the fish to various characters, the reader will eventually reach a "Dead-end" which identifies the fish. Occasionally an unfamiliar term may be encountered when using this key. The preceding section explains fish anatomy, defines terms and should provide proper explanation for all unfamiliarities. Reading a detailed description of each species and examining the various drawings and photographs will allow the reader to determine if a correct identification has been made.

1. a. Pectoral fins are absent.
Family **ANGUILLIDÆ**
Freshwater eels
Not described in this book
(See Beckman 1952)
b. Pectoral Fins present.
Go to Number 2.
2. a. Adipose fin present.
Go to Number 3.
b. Adipose fin absent
Go to Number 5.
3. a. Barbels present on chin and above dorsal lip.
ICTALURIDÆ
Catfish. See page 13.
b. No barbels present on chin or above dorsal lip.
Go to Number 4.
4. a. Pyloric caeca numerous and well developed. Pelvic axillary process present. If there are more than 100 lateral line scales teeth are well developed. If there are less than 100 lateral line scales the mouth is small with the maxillary not extending past middle of the eye and teeth are weak or absent.
Family **SALMONIDÆ**
Trout, grayling and whitefish
Not covered in this book.
(See Woodling 1980).
b. Pyloric caeca absent or few in number and not well developed. No pelvic axillary process. Less than 80 lateral line scales, while mouth is large, with maxillary extending past middle of eye and well developed teeth.
Family **OSMERIDÆ**
Rainbow smelt. See page 14.
5. a. Front portion of dorsal fin has four to six stiff dorsal spines not connected by a continuous membrane. Each spine has a small individual membrane. No scales on body.
Family **GASTEROSTEIDÆ**
Brook stickleback.
See page 15.
b. Dorsal fin may or may not have stiff spines. If spines are present a continuous membrane connects the spines.
Go to Number 6.
6. a. One dorsal fin,  , though there may be one  stout spine at the anterior (head) edge of dorsal fin. This single spine, if present, serrated along posterior edge.
Go to Number 7.
b. Two dorsal fins either well-separated, or united into one dorsal fin. If one dorsal fin then there are more than four spines at anterior edge of dorsal fin.
Go to Number 13.
7. a. Single dorsal fin with .
Goldfish and Carp.
Family **CYPRINIDÆ** (in part).
Minnows. See page 17.
b. Single dorsal fin without any spines.
Go to Number 8.

8. a. Head without scales
Go to Number 9.
b. Head with at least some scales on cheeks.
Go to Number 11.
9. a. Gill opening on underside of head (throat) extends forward to a point beneath the eye. Lower margins of gill covers overlap along the middle of the throat. Last ray of dorsal fin extended into a long slender filament (except in very small fish).
Family **CLUPEIDAE**
Herrings. See page 50.
b. Gill opening on underside of head does *not* extend forward to a point beneath the eyes. Lower margins of gill covers do *not* overlap along middle of throat. Last ray of dorsal fin not extended into a long filament.
Go to Number 10.
10. a. Dorsal fin usually with 8 rays, caudal fin normally with 19 rays, pharyngeal arch with one or two rows of teeth with never more than 7 teeth in a single row.
Family **CYPRINIDAE** (in part).
Minnows. See page 17.
b. Dorsal fin with 9-10 rays, caudal fin normally with 18 rays, pharyngeal arch with a single row of more than 15 teeth.
Family **CATOSTOMIDAE**.
Sucker. See page 52.
11. a. Tail deeply forked. Jaws duck-like in shape with many large sharp teeth.
Family **ESOCIDAE**.
Northern Pike.
Not covered in this book. (See Woodling 1980).
b. Tail rounded or oblong, jaws short, normal fish shape. Teeth are small.
Go to Number 12.
12. a. Third anal ray branched, anal fin of males and females similar.
Family **CYPRINODONTIDAE**.
Killifishes. See page 62.
b. Third anal ray unbranched, anal fin of male altered into an intromittant organ.
Family **POECILIIDAE**.
Mosquitofish.
See page 64.
13. a. Body without scales.
Family **COTTIDAE**.
Sculpin. See page 65.
b. Body with scales.
Go to Number 14.
14. a. Distance from rear margin of gill cover to the forward edge of the pelvic fin much greater than the distance from the forward edge the pelvic fin to forward edge of the anal fin.
Family **ATHERINIDAE**
Silversides.
Not covered in this book. Brook silversides have been stocked in Colorado, but there are no known, existing populations.
b. Distance from the rear margin of gill cover to the forward edge of the pelvic fin much less than distance from front edge of pelvic fin to front edge of anal fin.
Go to Number 15.
15. a. Anal fin with three spines.
Go to Number 16.
b. Anal fin with one or two spines.
Go to Number 17.
16. a. Spiny dorsal fin and soft dorsal fin well separated. Sharp spine at rear edge of operculum (gill cover).
Family **PERCICHTHYIDAE**.
White bass, Wiper. Not covered in this book.
(See Woodling 1980).
b. Spiny and soft dorsal fin connected. No spine at rear edge of operculum.
Family **CENTRARCHIDAE**.
Sunfish and Bass not covered in this book.
(See Woodling 1980).
17. a. Lateral line does not extend into anal fin. Soft dorsal fin (less than 23 rays) is not longer than spiny dorsal fin.
Family **PERCIDAE**.
Perch. See page 67.
b. Lateral line extends well into tail. Soft dorsal (more than 23 rays) is longer than spiny dorsal.
Family **SCIAENIDAE**.
Freshwater drum. Not covered in this book.
(See Beckman 1952).

Family Ictaluridae CATFISH

Catfish are a diverse, abundant family. Species such as bullheads and channel catfish are important as sport fish and to the aquaculture industry. Another group of small catfish, the madtoms and stonecats, are not important as a food source but are used as bait fish. There are three species of catfish native to Colorado—the channel catfish, the black bullhead and the stonecat. Other species have been introduced.

KEY TO THE FAMILY ICTALURIDAE

1. a. Adipose fin, a fin on the back between the dorsal fin and tail (caudal) fin, continuous with the caudal fin. **STONECAT** *Noturus flavus*.
 b. Adipose fin free posteriorly, separate from the caudal fin. Go to Number 2.
2. a. Caudal fin deeply forked. Go to Number 3.
 b. Caudal fin rounded, or squarish, not forked. **BULLHEADS** *Ictalurus* spp. (See Woodling 1980).
3. a. Anal fin with 25-30 rays, may have small spots on body. **CHANNEL CATFISH** *Ictalurus punctatus*. (See Woodling 1980).
 b. Anal fin with 32-35 rays, there are no small spots on the body. **BLUE CATFISH** *Ictalurus furcatus*. Note: The blue catfish has been introduced into Colorado but does not reproduce successfully here. A few fish are still found in some private waters in Lincoln County, Colorado.

Family Ictaluridae Genus Noturus

STONECAT

Noturus flavus (Rafinesque)

A small, slender catfish; head broad and flat; shallow notch between adipose fin and caudal present but *not* reaching the surface of the back; anal fin is short with 16 rays. The spines of the stonecat deliver a toxin which can cause a lot of pain to the unwary person who mishandles one of these fish.

Stonecats are yellow-brown in color with a dusky stripe through the center of the tail fin. Coloration is darker on the back, fading to white on the stomach. Maximum length from 8-12 inches.

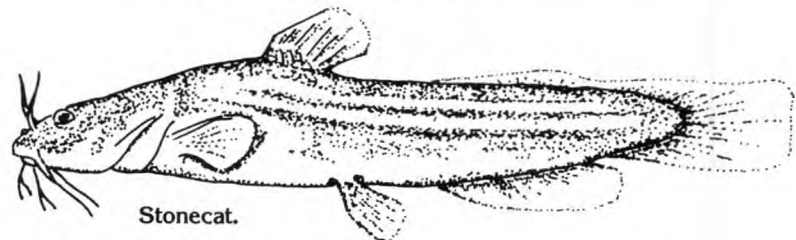
Range: Stonecats are found in the north-central United States from Montana to New York, south to Alabama through Oklahoma (Miller and Robison 1973). Found in Kansas, the species is rare in the western portion of the state (Cross and Collins 1975). The species Colorado distribution is not well known. Beckman (1952) reported the stonecat "was" collected from the Republican River near the Colorado border. In 1980, Cancalosi collected one stonecat from the North Fork of the Republican River. In 1984, one specimen was collected from the Saint Vrain River near Longmont, Colorado (K. Fausch, personal communication).

Habitat: Stonecat in Kansas are found in fast water riffles and runs of streams, hiding under rocks, woody debris, or along sandbars during the day (Cross and Collins 1975). This retiring nature may be the reason so few stonecats have been collected in Colorado. One specimen recorded in Colorado came from an area of swift current with a sand-gravel bottom (Cancalosi 1980).

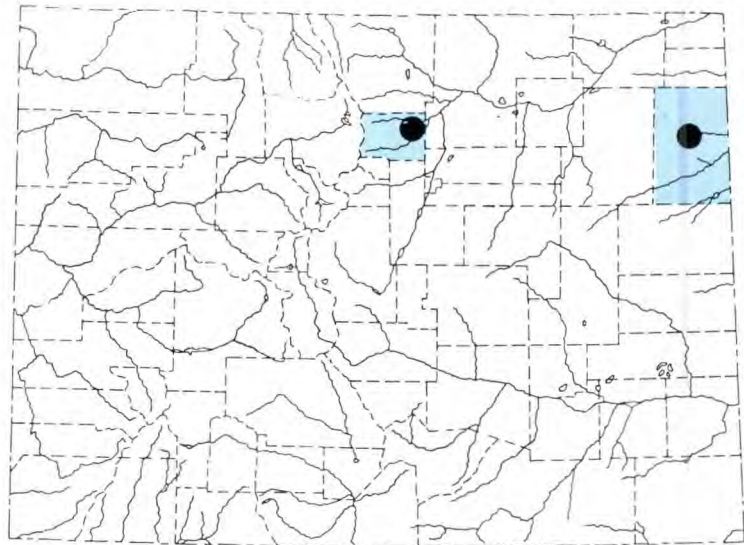
The eastern plains streams of Colorado with low flows, silt, and frequent dewatering do not provide an ideal habitat for the stonecat. Colorado is on the western edge of the stonecat's natural range.



Adult stonecat. Photo by LuRay Parker, Wyoming Game & Fish Department.



Stonecat.



Distribution by County of the stonecat.

Family *Osmeridae*

SMELT

Family *Osmeridae* Genus *Osmerus*

RAINBOW SMELT

Osmerus mordax (Mitch ill)

An elongate, laterally-compressed fish; mouth large, terminal with lower jaw protruding past upper jaw; dorsal fin located at the middle of the body; well developed adipose fin; caudal fin deeply forked; anal fin long in comparison to other fins; stomach lining silver with dark speckles, intestine short.

Smelt in Colorado range from dark green to silver on the back, fading to silver-white on the stomach. Freshly killed smelt may have a purple-pink coloration on the sides. Adults can exceed 8 inches in length.

Range: The rainbow smelt is found throughout the northern portions of North America, Europe and Asia in coastal areas (Scott and Crossman 1973). Rainbow smelt are found in both fresh and salt water. Like salmon, smelt living in the ocean migrate up rivers to spawn. In Colorado, smelt have been introduced to Quincy, Rampart, Trinidad, and Horse-tooth reservoirs to determine if the species can provide an adequate prey base for fish desired by anglers.

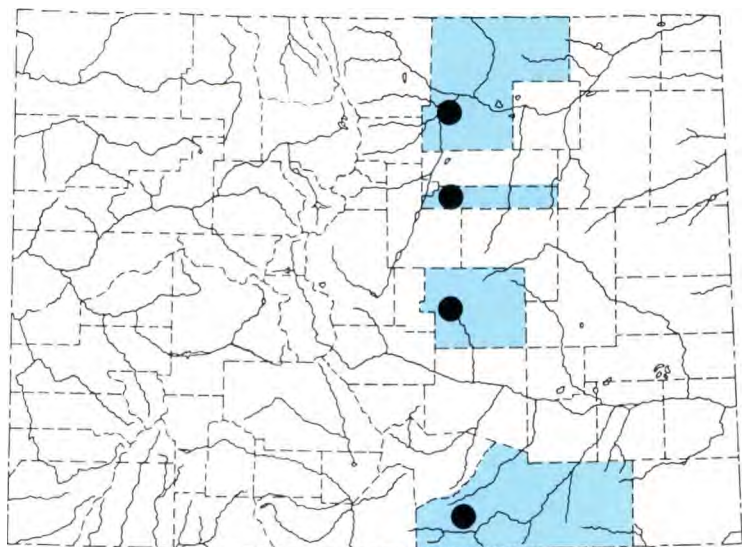
Habitat: In fresh waters, rainbow smelt are found in open, middle depths of a lake or reservoir during the summer months. In the spring and fall the fish venture into shallow waters close to shore.

Usually, rainbow smelt are carnivorous, taking a wide variety of crustaceans and small fish (Scott and Crossman 1973). In Colorado, rainbow smelt feed on zooplankton and dipteran larvae and appear to spawn during April with the fish first attaining sexual maturity at one or two years of age (J. Goettl, personal communication).

Because this is an open water fish it is being introduced to some Colorado reservoirs in an attempt to create a forage base for large predatory fish. Most Colorado impoundments are rather shallow and lack underwater structure or vegetation required by many forage species. Success or failure of the program has not yet been determined though smelt are successfully reproducing and are being preyed upon by largemouth bass, rainbow trout and brown trout (J. Goettl, personal communication).



Adult rainbow smelt.



Distribution by County of the rainbow smelt.

Family Gasterosteidae

STICKLEBACKS

Members of this family are found in shallow water, both salt and fresh, throughout North America, Europe, Asia and Algeria, (Scott and Crossman 1973). One species, the brook stickleback, is

found in Colorado. Another species, the threespine stickleback *Gasterosteus aculeatus* (Linnaeus) has been reported in Colorado.

Family Gasterosteidae Genus *Culaea*

BROOK STICKLEBACK *Culaea inconstans* (Kirtland)

A small, laterally-compressed fish; head conical with a truncate lower jaw; unique dorsal fin composed of (average 5) short, isolated backswept spines with individual membranes followed by 9 soft dorsal rays united by one membrane; rounded caudal fin, anal fin with one spine anteriorly; pectoral fins composed of one spine and one ray; body without scales although there are small plates by lateral line pores.

Adults are dark green to black with light spots on sides. Spawning males often appear completely black. A small fish, adults are about two inches long.

Range: The brook stickleback is found throughout north-central North America. Disjunct populations found in northeast New Mexico are considered native to that state (Koster 1957). Colorado populations are scattered throughout the South Platte drainage (Propst 1982), in parts of the Arkansas system (Miller 1983), and the Rio Grande (L. Zuckerman 1983). The presence of the species in areas where sport fisheries are absent led Propst (1982) to believe the brook stickleback is native to Colorado. The scattered populations of the stickleback in other portions of Colorado where there are no sport fisheries would tend to support the thesis that sticklebacks are native. Since there are no fisheries near locations where several stickleback populations are found, chances that the species originated in Colorado as a bait-bucket transfer are rather remote.

Habitat: Brook sticklebacks inhabit cool, clear, slow flowing small streams and ponds with large amounts of filamentous algae and other aquatic plants. A pugnacious fish, stickleback are generally found alone if in backwaters or in association with fathead minnows, creek chubs and plains killifish if inhabiting undercut

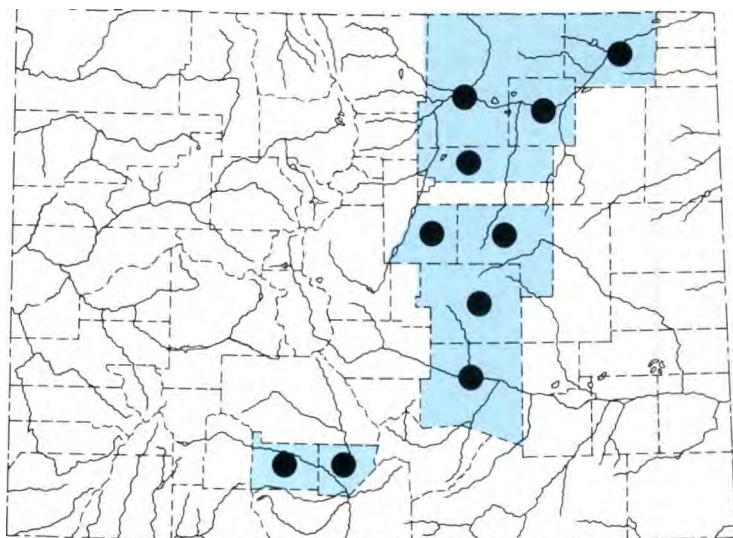
banks (Propst 1982). If streams containing brook stickleback are channelized or dewatered, the species disappears (Trautman 1957).

A carnivorous species, this fish eats a wide variety of aquatic invertebrates along with the eggs and larvae of other species (Scott and Crossman 1973). The following account of the spawning habitats of the brook stickleback was taken from Winn (1960). The species spawns from spring into summer halting when water temperatures exceed 66° F. Males move into shallow water and construct a nest about ³/₄ inch in diameter of stems or grass. A series of females is driven into the nest through nips and nudges by the male. The

females lay eggs after prodding by the male, and are then driven from the nest. Following fertilization the male guards eggs and fry until the young abandon the nest.

Brook stickleback are not a very good bait fish. Even so, they are occasionally found in bait buckets. Due to its pugnacious character and egg-eating habits the species' use as a bait fish is discouraged in order to avoid accidental range expansion.

For additional information regarding the brook stickleback see Winn, H.E. 1960. Biology of the Brook stickleback *Eucalia inconstans* (Kirtland). Am. Midland Nat. 63(2):424-438.



Distribution by County of the brook stickleback.



Adult sticklebacks. Note the darker male fish (below) in breeding colors.



Adult stickleback.

Family *Cyprinidae* THE MINNOWS

The minnows are the most diverse family of fish, in terms of species, in the world, as well as in Colorado. About 28 species of minnows are found in Colorado. As previously discussed, about five additional species of minnows that were native to Colorado are now believed to be extirpated from the state. Five species of minnow are native to the streams and rivers on the west side of the Continental Divide in Colorado. Three of these species are chubs of the genus *Gila*. One additional *Gila* species is found in the Rio Grande system. About 15 species of minnows native to streams and rivers of the eastern slope of the Continental Divide are still found in the state. Five of these species are shiners of the genus *Notropis*. Varying numbers of minnow species have been introduced to all the river systems of Colorado. In most cases these introductions were accidental. Other than *Gila* and *Notropis*, all other genera of minnows in Colorado are represented by one or two species.

KEY TO THE FAMILY CYPRINIDAE

1. a. A stout, serrated spine present at anterior (front edge) of dorsal and anal fins.
Go to Number 2.
- b. No stout, serrated spine at anterior of dorsal and anal spines.
Go to Number 3.
2. a. Upper jaw with two fleshy barbels at each corner of the mouth.
CARP
Cyprinus carpio, see page 18.
- b. Upper jaw lacks two fleshy barbels at each corner of the mouth.
GOLDFISH
Carassius auratus, see page 19.
3. a. Distance from the front of the anal fin to the tip of the snout is 3 or more times longer than the distance from the front of the anal fin to the base of the tail fin.
Go to Number 4.
- b. Distance from the front of the anal fin to the tip of the snout is 2 1/2 or less times longer than the distance from the front of the anal fin to base of the tail fin.
Go to Number 5.
4. a. Scales comparatively large, 44-47 scales in lateral line.
GRASS CARP
Ctenopharyngodon idella, see page 48.
- b. Scales comparatively small, more than 80 scales in lateral line.

COLORADO SQUAWFISH

Ptychocheilus lucius (in part), see page 25.

5. a. Anal fin with 10 or more rays.
Go to Number 6.
- b. Anal fin with less than 10 rays.
Go to Number 8.
6. a. A scaleless, fleshy keel running along the belly from the back of the pelvic fins to the anus. The anterior portion of the lateral line is strongly decurved. Mouth is oblique.

GOLDEN SHINER

Notemigonus crysoleucas, see page 47.

- b. No scales, fleshy keel on belly. Anterior portion of lateral line is not strongly decurved. Mouth is terminal.
Go to Number 7.



Fleshy keel on a golden shiner.

7. a. Scales crowded in predorsal area. Inguinal process present.
REDSIDE SHINER
Richardsonius balteatus, see page 39.
- b. Predorsal scales *not* crowded in the predorsal area though scales may be imbedded or partially absent. Inguinal process absent.
Genus *Gila* in part, see page 27.
8. a. Scales on top of the back and in front of the dorsal fin are smaller than those on the remainder of body and crowded together. A short ray at the front of the dorsal fin is separate from first principal ray.
FATHEAD MINNOW
Pimephales promelas, see page 35.
- b. Scales on the upper back are about the same size as on the rest of the body. The short ray at the front of the dorsal fin is closely attached to the first principal ray.
Go to Number 9.
9. a. Lower jaw with a prominent cartilaginous ridge inside the lower lip. Intestine looped around swimbladder.
STONEROLLER
Campostoma anornalum, see page 20.

- b. Lower lip without cartilaginous ridge. The intestine not looped around swimbladder.
Go to Number 10.
- 10.a. One or two small, slender barbels (A hand lense may be required to observe this structure) present at or near the angle of each jaw.
Go to Number 11.
- b. There is *not* a barbel at or near the angle of the jaw.
Go to Number 16.
- 11.a. Two barbels on each side of the mouth located at the edge of the jaw.
ARKANSAS RIVER SPECKLED CHUB
Hybopsis aestivalis (Girard). This species, reported once in the state by Jordan (1891) from the Arkansas River near Pueblo, is considered extirpated from Colorado.
- b. Only one barbel located on each side of the jaw.
Go to Number 12.
- 12.a. Caudal fin rectangular in shape, dorsal and anal fins convex, scales very small and imbedded, 95-100 along lateral line.
TENCH
Tinca tinca, see page 49.
- b. Caudal fin deeply indented, dorsal and anal fins rounded or falcate, scales comparatively larger, less than 80 along lateral line.
Go to Number 13.
- 13.a. A small and flap-like barbel located in front of the posterior tip of the maxilla in a groove, or slot, between the maxilla and head.
CREEK CHUB
Semotilus atromaculatus, see page 31.
- b. A small and round barbel located at, or just above, the posterior tip of the maxilla.
Go to Number 14.
- 14.a. Scale radii present in all fields of body scales.
Genus *Rhinichthys*, see page 23.
- b. Scale radii present in only posterior field of body scales.
Go to Number 15.
- 15.a. Pectoral and dorsal fins are falcate. The head is somewhat flat on top.
FLATHEAD CHUB
Hybopsis gracilis, see page 33.
- b. Pectoral and dorsal fins rounded. The head is *not* flattened on the top.
HORNYHEAD CHUB
Nocomis biguttatus (Kirtland) Reported from several transition-zone stream reaches in Colorado by Ellis (1914), this species is thought to be extirpated from Colorado.

- 16.a. Lower lips have fleshy lateral lobes, mouth suckerlike.
 SUCKERMOUTH MINNOW
Phenacobius mirabilis, see page 34.
- b. Lower lips without fleshy lateral lobes, mouth *not* suckerlike.
 Go to Number 17.



Ventral view of the mouth of the suckermouth minnow. Ventral view of the mouth of the Plains minnow.

- 17.a. Lateral line scales less than 50.
 Go to Number 18.
- b. Lateral line scales more than 50.
 Go to number 19.
- 18.a. The mouth is small, the jaw extends

only back to an imaginary line drawn vertically down from the nostrils. Intestine long, with many coils. Lining of body cavity is black. Genus *Hybognathus*, see page 36.

b. Mouth somewhat larger. The jaw extends back further, usually to an imaginary line drawn vertically down from the anterior edge of the eye. Intestine is short, with one single s-shaped loop.

- Genus *Notropis*, see page 40.
- 19.a. Lateral line incomplete.
 Genus *Phoxinus*, see page 21.
- b. Lateral line complete.
 Go to Number 20.
- 20.a. Lateral line scales less than 65. The interradial membranes pigmented. UTAH CHUB *Gila atraria*
 Reported from the Green River, this species is not discussed in this book.

b. Lateral line scales more than 65. The interradial membranes are *not* pigmented.
 Go to Number 21.

- 21.a. The head is long and slender. The mouth is large, extending back to an imaginary line drawn vertically down from the pupil of the eye. Young have a black spot at the rear edge of caudal peduncle.
 COLORADO SQUAWFISH
Ptychocheilus lucius (in part), see page 25.
- b. The head is relatively short. The mouth is smaller, ending at, or in front, of an imaginary line drawn vertically down from the anterior edge of the eye. Young do *not* have a black spot at edge of caudal peduncle.
 Genus *Gila*, see page 27.

Family Cyprinidae Genus Cyprinus

CARP

Cyprinus carpio (Linnaeus)

A large, deep-bodied minnow; head wedge-shaped; large subterminal mouth, two barbels at each side of mouth; long dorsal fin with 18-20 rays, and one spine anteriorly; large scales, 25-39 in lateral line; scales sometimes absent (leather carp) or enlarged and scattered (mirror carp).

Carp are brassy in color and can grow to large size. The Colorado fishing record is 22 pounds, caught at Cherry Creek Reservoir in Denver.

Range: Native to Europe, carp were introduced by settlers who admired the food quality of the species. Initial introduction in the United States spanned the period from 1831-1896 (Scott and Crossman 1973). Carp are now found in warmwater lakes and rivers throughout the United States and Canada. Initial introductions in Colorado were in 1879 (Wiltzius 1981). Currently carp are found in most warmwater rivers and impoundments throughout the state and in some cases the species has become established in coldwater mountain lakes. Elevenmile Reservoir in South Park, at an elevation of 8651 feet, has a thriving population of carp.

Habitat: Carp are able to tolerate and thrive in a variety of habitats but prefer quiet, shallow waters of rivers and lakes.

An opportunistic feeder, carp will suck up a mouthful of bottom mud, expel it and then take back any available food items. Any aquatic invertebrate is taken, as are various plant tissues. Schools of



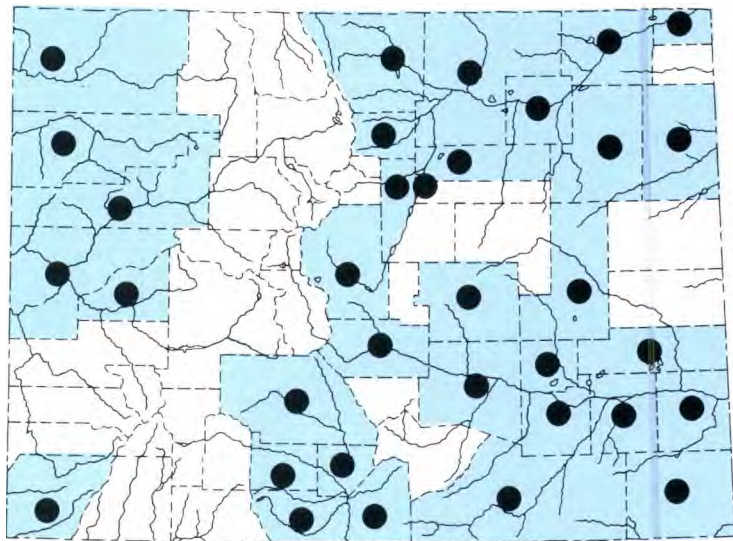
Adult carp.

carp feeding in shallows impact other species by causing increased turbidity, uprooting of vegetation needed by other fish species, and disrupting the spawning of other species. Carp spawn over a period of several weeks during spring and sum-

mer. Two or more males and a female move into shallow water and begin splashing and thrashing around, often with backs exposed to the air. Quite a commotion results. The adhesive, fertilized eggs, are abandoned, some to settle

onto objects of the lake bed and begin development. One reason for the success of carp is the large number of eggs produced. A 15-inch female was found to have 36,000 eggs while a 33-inch female had 2,208,000 eggs (Swee and McCrimmon 1966).

Although not an extremely popular sport fish in Colorado, the carp has devotees. In the spring, carp are sought by archers. When hooked by an angler, carp provide a more tenacious fight than many other popular sport fish. In many people's opinion, carp meat is as desirable as any other fish species. In 1980, Barr Lake near Denver was commercially fished for carp and the fish were shipped to Nebraska and sold with favorable results through a restaurant specializing in carp sandwiches. The common carp represents a largely untapped recreational and food resource in Colorado.



Distribution by County of the carp

Family Cyprinidae Genus Carassius

GOLDFISH

Carassius auratus (Linnaeus)

A medium-to-large, deep-bodied minnow; mouth relatively small, no barbels; long dorsal fin, usually 17 (15-18) soft rays, with one spine anteriorly; less than 30 scales in the lateral line.

Goldfish are black, white, red, gold or any combination of these colors. Fish spawned in the wild are often dark olive-brown on the back, fading to yellow on the stomach. Young goldfish may be green or brown.

Goldfish can grow to a fairly large size, reaching 10-11 inches in length and weighing 1-1.5 pounds. A length of 16 inches and weight of 3.5 pounds has been reported (Pflieger 1975).

Range: Native to eastern Asia, goldfish were introduced to Europe and commonly found on that continent by the 18th century (Scott and Crossman 1973). Brought to this continent as ornamentals and for bait, goldfish are now found throughout the United States. Goldfish were first introduced to Colorado in 1872 or 1879 (Wiltzius 1981). Released into ponds and lakes via bait buckets and by well meaning people tired of their pets, goldfish can be found in many municipal ponds, lakes and slow, meandering streams throughout the state.

Habitat: Goldfish are best suited for small ponds with an abundance of rooted aquatic plants.

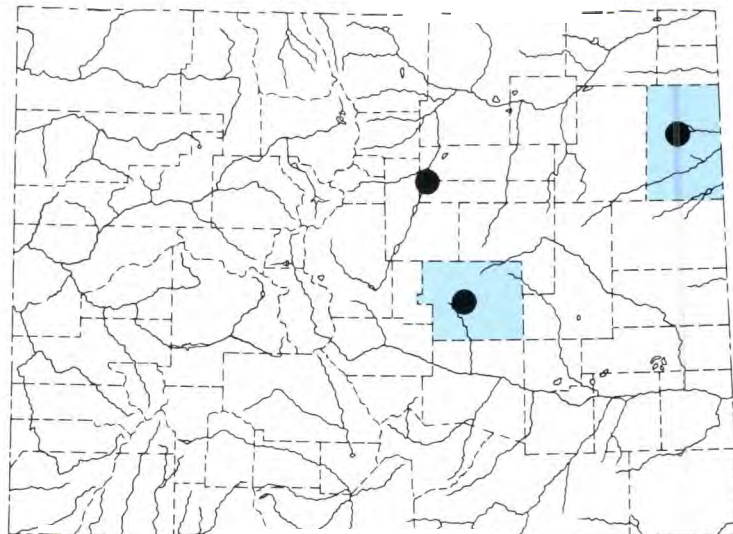
The goldfish is omnivorous, taking a wide variety of aquatic invertebrates and aquatic vegetation (Scott and Crossman 1973). A spring spawner, reproductive activities are much like the carp, although more subdued.



Adult goldfish. Photo by Richard Imler.

Used as bait in many regions, such a practice in Colorado is not encouraged. Native minnow species are more suitable

for use as live bait and just as hardy. Since goldfish are an exotic species, continued expansion of its range cannot be justified.



Distribution by County of the goldfish.

STONEROLLER

Campostoma anomalum (Rafinesque)

This species is slender when young, maturing into a stout minnow; the mouth is inferior, overhung by a bulbous snout; lower lip fleshy which almost covers a hard, plate-like lower jaw; 8 dorsal fin rays; 7 anal fin rays, lateral line scales usually more than 50(49-57); intestine very long and coiled around the air bladder, peritoneum is black; pharyngeal teeth 4-4.

Coloration changes with both age and season. The young are silvery with a dusky stripe on the sides while the back and sides of adults range from silver to tan or light brown with scattered black spots. The lower sides and stomach of adults are silver to white and adult males have a dark stripe along the lower half of the dorsal fin. Breeding males are conspicuous with distinct tubercles on head, orange eyes, with an orange and black stripe on the dorsal and anal fins. Adults are commonly 3-7 inches in length with males larger than females.

Range: Stonerollers are found from Wyoming east to the Appalachians, south to Alabama and west to New Mexico and northern Mexico. In Colorado, stonerollers are common in streams and rivers on the plains east of the mountains and into the foothills.

Habitat: Although more common in permanent streams, stonerollers are found in some intermittent plains streams. The species is absent from organically enriched stream reaches. Found in both pools and riffles over a sand-gravel substrate, stonerollers require some current. Often seen in large swirling groups at the bottom of pools and runs, this minnow will also concentrate along the banks of streams in submerged vegetation or other cover.

Starrett (1950) found the stoneroller in Iowa fed on bottom ooze composed of diatoms, fine sand and perhaps mud. The long coiled intestine of stonerollers is an adaptation common to plant-eating fish. Reaching maturity in the second or third year, stonerollers spawn in early to late spring (Pflieger 1975) when water temperatures exceed 60°F (Miller and Robison 1973). In Colorado, stonerollers have been observed spawning during the first week of May in a spring-fed tributary of the North Fork of the Republican River in Yuma County. Males constructed nests in shallow water of pools or riffles next to deeper water, into which the fish fled when frightened. The nests are irregular in



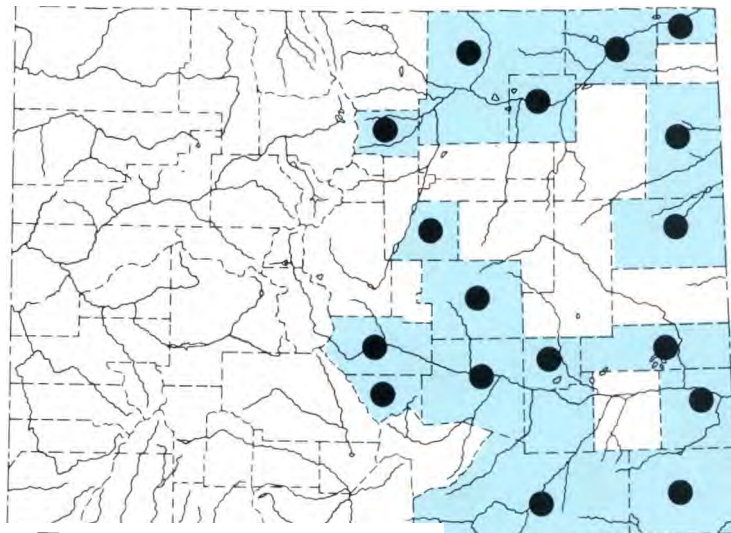
Adult male stoneroller about six inches long.



Adult female stoneroller about five inches long.

outline, several inches in diameter, and close to each other. Several males appear to work together building nests. The males take gravel into the mouth and transport it out of the nest, a vigorous thrashing motion is used to dislodge fine material which drifts away on faint water currents. When females swim out of deep water into a group of nests, one or more males press against the female. Eggs are

then deposited, fertilized, buried and abandoned. Creek chubs were often observed to drive smaller stonerollers from the spawning site and then nose around the bottom of the nest, perhaps feeding on deposited eggs. Orangethroat darters also congregate around the edge of stoneroller nests during periods of spawning activity, perhaps looking for an opportunistic meal.



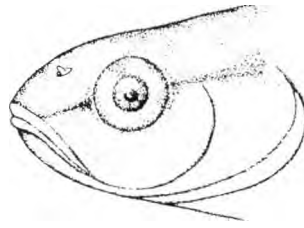
Distribution by County of the stoneroller.

G **P**

The genus *Phoxinus* is very interesting. Banarescu (1964) recommended combining this genus with the American minnow genus *Chrosomus*. This combination represents the only instance where minnows of the same genus are native to both Europe and North America, although some Eurasian species, such as carp or goldfish, have been introduced to North America by man. Two species are found in Colorado.

**KEY TO THE GENUS
PHOXINUS**

1. a. Angle of the mouth ranges from 57-61° from the horizontal. The



Detail of the head of a northern redbelly dace.



Detail of the head of a southern redbelly dace.

snout is comparatively shorter. Found in the South Platte drainage (Plum Creek) south of Denver.
NORTHERN REDBELLY DACE
Phoxinus eos

b. Angle of the mouth ranges from 48-50° from the horizontal. The snout is comparatively longer. Found in a tributary of the Arkansas River in Pueblo.
SOUTHERN REDBELLY DACE
Phoxinus erythrogaster

These species are very similar. For a complete discussion of meristic characteristics of these two *Phoxinus* minnows see Eddy and Underhill 1974 and Phillips 1969a.

From Eddy and Underhill 1974

Family Cyprinidae Genus Phoxinus

NORTHERN REDBELLY DACE

Phoxinus eos (Cope)

A small, round minnow, mouth terminal and oblique; angle of the mouth from 57-61° from the horizontal, snout relatively short, dorsal fin with 8 (sometimes 7-9) rays; anal fin with 8 (sometimes 7) rays; peritoneum dark, intestine long and coiled; scales very small, from 70-90 in the lateral line; pharyngeal teeth 0, 5-5, 0, very similar to southern redbelly dace, see next species account.

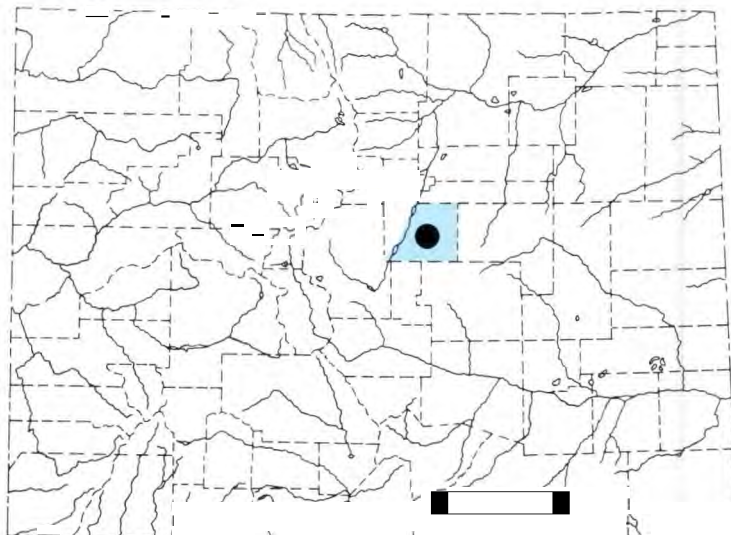
A colorful minnow, this dace has a dark olive or brown back with spots. Two dark, broad bands on the side. The space between the two bands is cream, reddish, or dark. The stomach is cream-colored except in breeding males where the stomach is yellow-orange to red. The northern redbelly dace is less than 2 inches in length.

Range: This minnow is found throughout Canada in British Columbia and in the Hudson Bay drainage, from Maine west through the Great Lakes and the upper Mississippi and Missouri rivers (Scott and Crossman 1973). Ellis (1914) found the northern redbelly dace to be native to the South Platte River Basin. In recent years only five specimens of the northern redbelly dace have been collected in Colorado. Propst (1980) collected two specimens from the Plum Creek drainage in the foothills south of Denver. Three others came from a pond adjacent to a Plum Creek tributary.

Habitat: The northern redbelly dace requires vegetation and slow flowing streams (Scott and Crossman 1973). The pond in the Plum Creek drainage that



An adult northern redbelly dace.



Distribution by County of the northern redbelly dace.

contains this dace has a sand substrate along the shoreline with submerged vegetation covering a substrate of decomposing material in the middle.

This minnow is herbivorous, feeding on aquatic vegetation. Scott and Crossman (1973) found that this species may spawn twice during a summer using algal mats

as a spawning substrate.

The northern redbelly dace is a very rare fish in Colorado and should not be used as a bait fish.

Family Cyprinidae Genus Phoxinus

SOUTHERN REDBELLY DACE

Phoxinus erythrogaster (*Rafinesque*)

A small, round minnow; mouth terminal and oblique, angle of the mouth ranges from 48-50° from the horizontal, snout relatively long; dorsal and anal fins usually have 8 rays; (a study in Oklahoma found a mean number of dorsal rays to be 10 while the mean number of anal rays was 11; Hill & Jensen 1968); peritoneum dark; intestine long and coiled; scales very small, more than 70 in the lateral line; pharyngeal teeth 0, 5-5, 0.

Like the northern redbelly dace, see previous account. *P. erythrogaster* is a very beautiful species. Olivaceous above with dark spots on the back, there are two dark, longitudinal stripes separated by a cream-colored interspace. The stomach is cream-colored. In much of the species, range the stomach of breeding males is red with yellow-tinted fins, while the space between the two longitudinal stripes on the side is red (Cross and Collins 1975, Pflieger 1975). The stomach of breeding males in Colorado remains cream-colored, or at most pale orange while the ventral fins are yellow. The southern redbelly dace can grow to 3 inches in length.

Range: The species is found throughout the central Mississippi drainage with isolated populations in Kansas, Oklahoma and New Mexico (Koster 1957, Miller and Robison 1973, Cross and Collins 1975, and Pflieger, 1975). In Colorado, one population of southern redbelly dace has been discovered in a single tributary of the Arkansas River in Pueblo (Miller 1982). This small tributary is little more than a small spring which surfaces at the base of a hill, flows alongside a railroad track for about a half mile and then enters the Arkansas River. Single individuals of the southern redbelly dace have been previously collected in 1965 in the Arkansas River in Pueblo and Canon City (J. Seilheimer, personal communication) and by Miller (1982) in Turkey Creek in Pueblo County. It is not known for certain if this population is native to Colorado. Since the coloration of southern redbelly dace collected in Colorado differs from specimens in other portions of the species' natural



An adult southern redbelly dace.

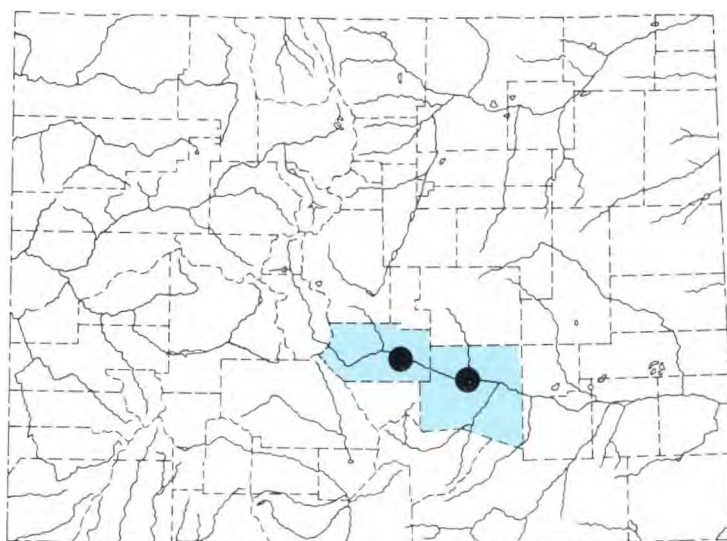
range, it is possible the population is a relict of the species' historic distribution pattern and has been isolated from other *P. erythrogaster* populations for many decades.

Habitat: The single Colorado population is found in a small, slow flowing, clear creek with abundant algal growths covering a stream substrate of deep silt deposits. In addition there is abundant riparian vegetation which provides shade. There are very few situations like this in the lower Arkansas Basin in Colorado. The stream containing this species becomes warm (76°F) and dissolved oxygen levels can be low (1.0 parts per million) during the summer.

The southern redbelly dace is herbi-

vorous and feeds mostly on microscopic vegetation taken from the stream bottom (Phillips 1969). In the same study, diatoms were found to be the most important food item, while blue-green algae, although taken, were undigested. The species spawns in late spring in swift, shallow riffles over a gravel substrate or using the nests of other minnow species (Cross and Collins 1975). Gravid and spent females were collected in late April in Colorado.

This beautiful species is very rare here and should not be used as a bait fish. The continued existence of this species in Colorado is extremely tenuous. An accidental spill of any toxicant into the stream could easily eliminate this population of southern redbelly dace.



Distribution by County of the southern redbelly dace.

Genus *Rhinichthys* DACE

There are two species of the genus *Rhinichthys* native to, and found in, Colorado.

KEY TO THE GENUS *RHINICHTHYS*

1. a. A frenum is present, so that the premaxillaries are not protractile (there is no groove completely across the snout). The skin across top of head is continuous with the upper lip.

LONGNOSE DACE

Rhinichthys cataractae

- b. There is no frenum present so that premaxillaries are protractile (There is a groove across the snout). The skin across top of head is not continuous with upper lip, a groove separates the two.

SPECKLED DACE

Rhinichthys osculus

Longnose dace - frenum present.



Speckled dace - frenum absent.



Family Cyprinidae Genus *Rhinichthys*

LONGNOSE DACE *Rhinichthys cataractae* (Valenciennes)

A streamlined, torpedo-shaped minnow; mouth inferior, overhung by snout, *frenum present*, small barbel hidden by a fold of skin at each corner of mouth; dorsal fin with 8 rays; lateral line complete and nearly straight, peritoneum is silver with brown specks.

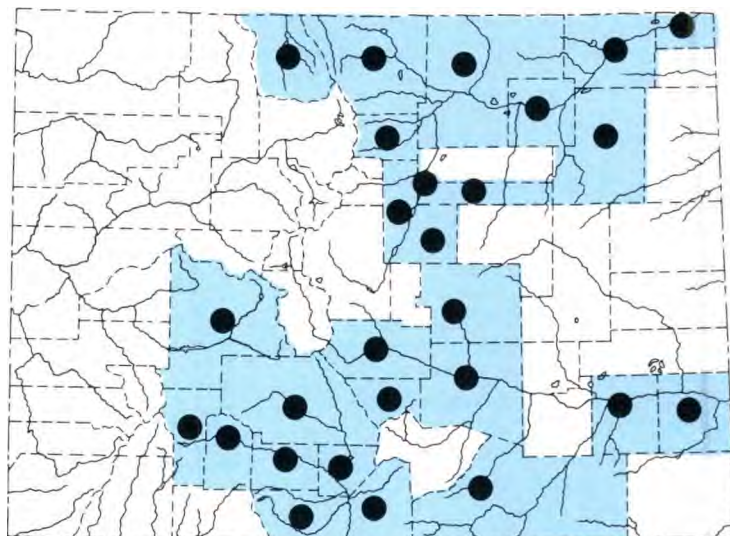
Coloration of adults varies. The back is tan to brown, fading to white on the stomach with dark speckles often present on back and sides. Breeding-colored males have red-orange on the corners of mouth, cheeks, and fins. The longnose dace is much like the speckled dace (see next species account). The longnose dace is a small minnow seldom exceeding 3.5 inches.

Range: The longnose dace is an extremely widely distributed fish, ranging throughout most of Canada south to Washington, east to New York, and south again through the Appalachians to Tennessee, to the Rocky Mountains, and to Texas (Scott and Crossman 1973). In Colorado, the species is native to the Arkansas River, Rio Grande, the Platte river system (Ellis 1914) and the Republican River (Cancalosi 1980). Propst (1982) found longnose dace in the transition zone streams of the South Platte as well as the mainstem river from the foothills to the Nebraska border, and in the North Platte drainage.

Habitat: The species is usually found in riffle areas of streams that have a rubble or gravel substrate. In the eastern plains areas of the South Platte, riffle areas of sand and gravel provide adequate habitat. Young are restricted to areas of



Adult longnose dace.



Distribution by County of the longnose dace.

shallow water and moderate current. Usually found in clean, clear waters, populations are found in some areas of high organic enrichment.

Longnose dace are omnivorous, taking what is available dependent on season and flow (Gerald 1966). Various aquatic invertebrates comprise the main portion of the diet. Longnose dace evidently have an extended spawning period since males in breeding colors have been collected from April to August in Colorado. In the Rio Grande the longnose dace has been found to hybridize with the Rio Grande Chub (Suttkus and Cashner 1981).

Though the longnose dace is abundant in portions of Colorado, fishermen do not normally use the species as a bait fish.



Adult male longnose dace in breeding colors.

Family Cyprinidae Genus *Rhinichthys*

SPECKLED DACE

Rhinichthys osculus (Girard)

A streamlined, torpedo-shaped minnow; mouth inferior, overhung by snout; *frenum absent*; small barbel at each corner of mouth; dorsal fin with 8-9 rays; lateral line complete and straight; peritoneum dark brown, or at least with dark patches. The speckled dace is much like the longnose dace (see previous account).

Coloration of adults varies. Speckled dace are tan to gray on the back, fading to white on the stomach with dark speckles often present on back and sides. Breeding-colored males have red-orange on the corners of the mouth, cheeks, and fins. Large individuals may be gray-black on their backs, fading to white on the stomach with a distinct dark band on sides extending from head to tail. Speckled dace may attain a length of 4.5 inches.

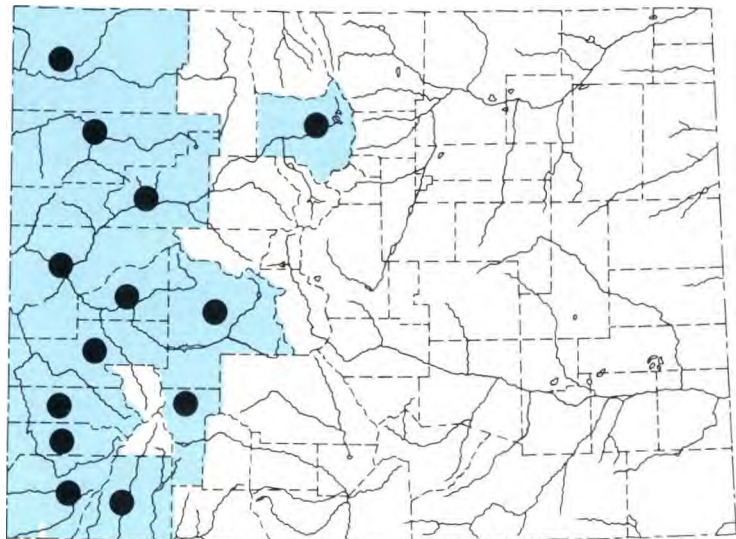
Range: Speckled dace are found in the western United States from Washington south to Colorado. In Colorado, the species is restricted to West Slope rivers and streams. The species is abundant in medium to small-sized trout streams.

Habitat: Like the longnose dace, the speckled dace is found in riffle areas with gravel substrates. The speckled dace can tolerate rather high nutrient enrichment attributable to effluents from sewage treatment plants. This dace is omnivorous and spawns in the spring and summer and is not widely used as a bait fish, despite its abundance.

The speckled dace and the longnose dace are alike. In 1891, Jordan noted that about half the speckled dace collected in western Colorado had a distinct frenum, which would make these specimens



Speckled dace.



Distribution by County of the speckled dace.

longnose dace according to the principal characteristic used to separate these two species. Wiltzius (1978) reported the longnose dace as being present in the Gunnison River system upstream of Blue Mesa Reservoir. If longnose dace are found in the Gunnison drainage, both species of dace would be maintaining reproductive isolation even though they often share the same stream reach. Accurate separation of these two species, knowledge of correct distribution patterns and verification of the presence or absence of sympatric populations requires more analysis.



Adult male speckled dace in breeding colors.

Family Cyprinidae Genus Ptychocheilus

COLORADO SQUAWFISH
Ptychocheilus lucius
(Girard)

An elongated minnow, body compressed somewhat dorso-ventrally; head flattened and elongated, large mouth, nearly horizontal; dorsal and anal fins with 9 rays; scales small, 80-95 in lateral line, small and embedded on nape, ventral area and chest; pharyngeal teeth fragile and delicate, 2, 5-4, 2.

Adults are darker than young, olivaceous above with a white stomach. Young squawfish, up to about 10 inches, have a dark blotch on the base of the tail. This blotch is absent in the roundtail chub, a species which can be mistaken for Colorado squawfish less than 10 inches in length.

Length at the end of the first year averages 2.9 inches, 15.8 inches at 6 years, and 24 inches at 11 years (Vanicek and Kramer 1969). In the past, specimens 6 feet long and 80 pounds have been reported although over the last decade fish over 15 pounds and three feet long have rarely been collected. (USFWS, in preparation).

Range: Historically, the Colorado squawfish was found throughout the Colorado River Drainage in mainstream channels extending into Colorado in the Green, Yampa, White, Colorado, Gunnison, Dolores and Animas rivers (Behnke and Benson 1980). Current distribution in Colorado is restricted to the lower reaches of the Green, Yampa, White, Colorado and Gunnison rivers (USFWS, in preparation).



Adult Colorado squawfish.

The Colorado Squawfish is listed as a federal and state endangered species.

Habitat: Adults are found in big, deep water inhabiting eddies, pools, and other areas adjacent to the main current flow, moving into main channel areas to feed. Young squawfish inhabit shallow, quiet backwater areas off main river channels (Haynes and Muth 1982).

Small invertebrates are the main source of food during the first year of life, then fish form an ever increasing portion of the diet. By the time the squawfish attains a length of 8 inches, fish make up the bulk of the squawfish's diet (Behnke and Ben-



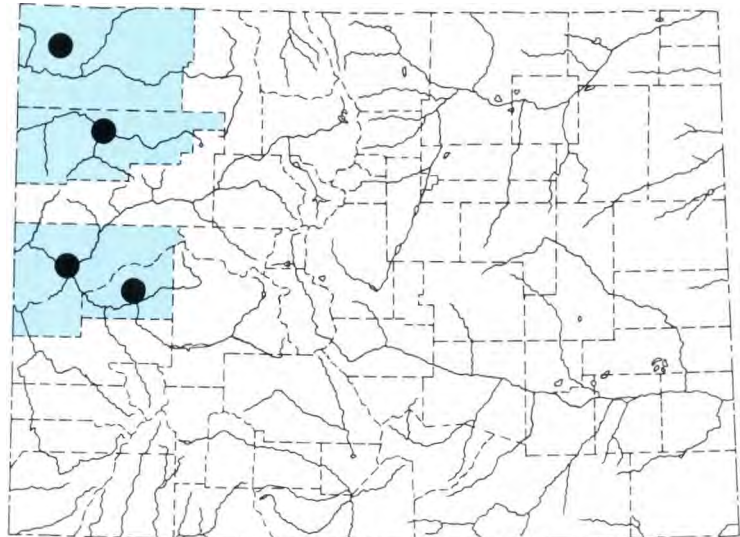
Detail of head of the Colorado squawfish.

son 1980). Squawfish spawn in early to mid-summer when water temperatures reach 68-72° F (Haynes, et al. 1984). Males and females gather over gravel bars in deep water to spawn (Haynes 1982). The same study indicates that spawning fish seek out the same spawning sites year after year, traveling long distances to reach these sites. Haynes, et al. (1984) believe squawfish spawn as spring flows subside and water temperatures rise, with spawning activity occurring from mid June to August in the Colorado and Yampa rivers.

Years ago when the squawfish was very common, it was sold commercially and called "salmon" or "white salmon". The cause of the species' decline to current levels is not completely understood, although many factors contributed. Dams have been constructed throughout the Colorado River Basin. These dams restrict spawning migrations. One tagged squawfish moved 136 miles in two weeks down the White River to the Green River, up the Yampa River and back to the White River apparently after spawning. Dams stop migrating fish from moving upstream and, as a result, many mature adults may not be able to reach the required spawning sites. Coldwater releases from dams could naturally be expected to eliminate some historic spawning sites as fertilized eggs would not develop in the lower temperatures. Irrigation and channelization practices have lowered summer flows. Lower flows mean a decrease in the backwater eddies needed for nursery areas. Also, many other fish species (see the red-side shiner) have been introduced into West Slope waters of Colorado. Biotic interaction with these additional species may also have impacted the Colorado squawfish in ways not yet understood.



Juvenile Colorado squawfish about seven inches long. Note the dark blotch at the base of the tail.



Distribution by County of the Colorado squawfish.

Genus *Gila*

Chubs of the Genus *Gila* are found throughout the southwestern United States and western Mexico. The taxonomic history of this group is long, clouded and uncertain, as are the current systematics. Principal cause of these problems has been lack of knowledge regarding geographic and individual variation (Rinne 1976). Members of the genus *Gila* have either been lumped together into "ecotypes" of "superspecies" or divided into a plethora of species and genera. In terms of species found in the upper Colorado River the bonytail, *Gila elegans*, was considered variant of the roundtail chub, *Gila robusta*, (Ellis 1914), or a subspecies of the *Gila robusta* complex (Miller 1946).

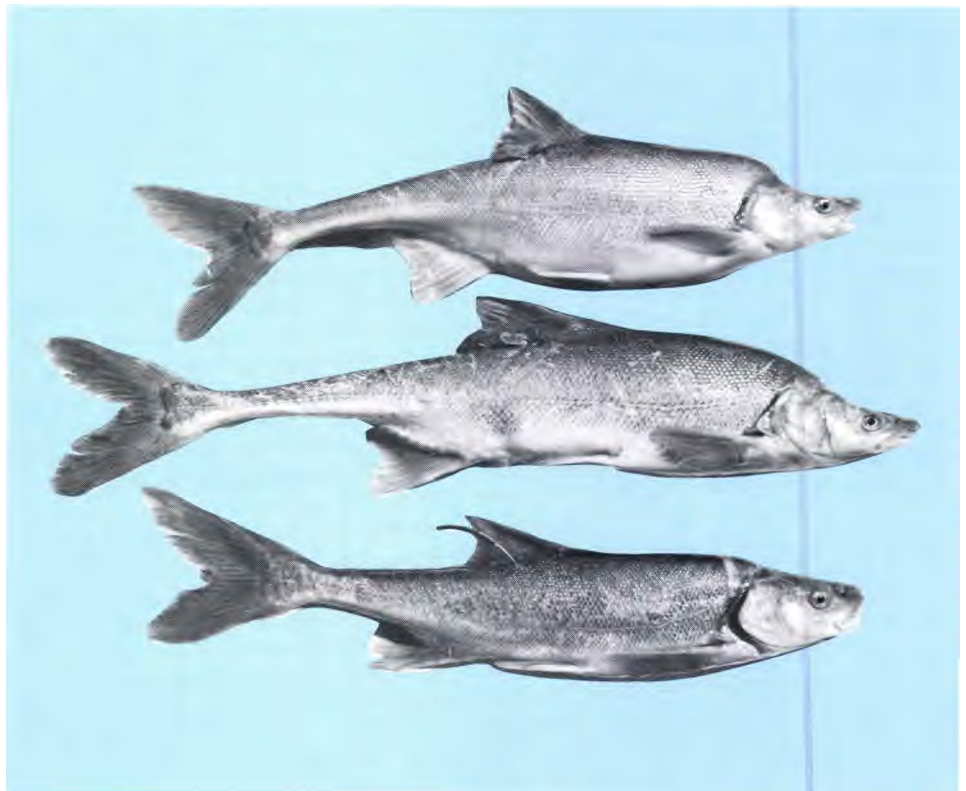
Recent investigators (Smith, et al. 1979) concluded that there are three separate and identifiable species in the upper Colorado River mainstem based on analysis of 34 morphometric and meristic characteristics. These are the roundtail chub, *Gila robusta*, the humpback chub, *Gila cypha*, and the bonytail, *Gila elegans*. All three are currently found in Colorado. A fourth member of this genus, the Rio Grande chub, *Gila pandora*, is found in the Rio Grande Basin of Colorado.

Much remains to be learned regarding exact taxonomic status of this genus. In the mainstem rivers where natural habitats and flow regimes are disturbed through construction of impoundments or water diversions, barriers separating these three species evidently breakdown and hybridization has resulted. In Colorado, chubs have been collected which exhibit a complete gradation of physical characteristics from the humpback to bonytail to the roundtail chub. Care must be taken when working with representatives of this genus, not only must physical characteristics be examined but geographic location should be taken into account.

For additional information regarding the genus *Gila* see Wick, E.J., T.A. Lytle, and C.M. Haynes. 1981. Colorado Squawfish and Humpback Chub Population and Habitat Monitoring, 1979-1980. Progress Report, Endangered Wildlife Investigations. SE-3-3 Col. Div. of Wildlife, Denver 156pp.

KEY TO THE GENUS *GILA*

1. a. Caudal peduncle deep, anal rays 8, limited to Rio Grande Basin.
RIO GRANDE CHUB *Gila pandora*.
- b. Caudal peduncle slender, anal rays usually more than 8, found in Colorado River Drainage System.
Go to number 2.
2. a. No nuchal hump, frontals nearly straight, dorsal and anal rays usually nine.
ROUNDTAIL CHUB *Gila robusta*
- b. Nuchal hump present in specimens over 5.9 inches, frontals concave above eyes in lateral profile, dorsal rays 9 or 10, anal rays 10 or 11.
Go to number 3.
3. a. Nuchal hump abrupt, dorsal rays usually 9, anal rays usually 10, in young less than 5.9 inches the eye diameter less than $\frac{2}{3}$ caudal peduncle depth, snout overhangs upper lip.
HUMPBACK CHUB *Gila cypha*.
- b. Nuchal hump not abrupt, dorsal rays usually 10, anal rays usually 10 or 11, in young less than 5.9 inches the eye diameter greater than $\frac{2}{3}$ caudal peduncle depth, snout not overhanging upper lip.
BONYTAIL *Gila elegans*.
Note: Key characteristics for *G. robusta*, *G. cypha*, and *G. elegans* taken from Smith, et al. 1979.



Gila chubs from top to bottom: humpback chub, bonytail, and roundtail chub. Photo by Patricia Shrader, U.S. Fish & Wildlife Service.

ROUNDTAIL CHUB

Gila robusta (Baird and Girard)

A moderately streamlined minnow; caudal peduncle not pencil thin; length of head divided by depth of keel is greater than 3. Scales minute, may be absent locally; fins falcate; dorsal and anal fins normally have 9 anal rays.

Adults silvery shading dorsally to dusky yellow or light green, spawning males have a pink cast to their fins. Adults can attain 18 inches in length and two pounds in weight.

Range: The roundtail has historically been the most common member of the genus *Gila* in the Colorado River Basin extending up to the mountain foothills (Holden and Stalnaker 1975). In Colorado, the roundtail chub is found in the Colorado River mainstem and larger tributaries (e.g., White, Yampa, Dolores, San Juan, and Gunnison rivers).

Although abundant in most waters where it is found, the roundtail is declining in the Gunnison River. Common in the late 1970's in the Gunnison River upstream in the North Fork of the Gunnison, roundtail chub were not found in that river reach in either 1981 or 1982 (B. Nehring, personal communication). The species was found to be declining in numbers in the Gunnison River downstream of the North Fork to the town of Delta during the same time period.

Habitat: A large river fish, roundtail occupy slow moving waters adjacent to areas of faster water. Groups of adult roundtail concentrate in quiet swirling water adjacent to fast moving water, swimming in small groups into the faster water "presumably to feed" (Minckley 1973). Young-of-the-year prefer shallow river runs while juvenile chubs concentrate in river eddies (Valdez, et. al. 1982) and irrigation ditches (Wiltzius 1978).

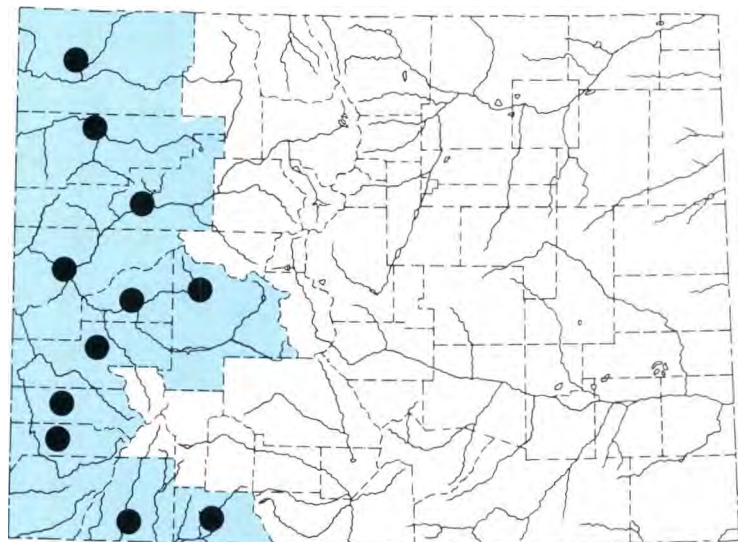
Not a great deal is known about this species. Young feed on small insects, and algal films, while older chubs take both terrestrial and aquatic insects along with filamentous algae (Minckley 1973). Large roundtails are predators and will take small fish. Spawning habits are probably similar to other minnows and spawning takes place over a gravel substrate. Fertilized eggs are randomly scattered over the substrate with no parental care. Roundtail spawn in early summer in warmer water than the humpback chub, as spring runoff is subsiding (Valdez, et al. 1982). Young-of-the-year chubs (0.4 inches in length), indistinguishable as to roundtail, humpback, or variant have been captured in



Adult roundtail chub. Photo by Robin Knox.



Adult male roundtail chub in breeding colors.



Distribution by County of the roundtail chub.

early June from the Colorado River and in late July (Haynes and Muth 1982). Such a reproductive pattern could explain the decline of roundtail populations in the

Gunnison River downstream of the Curecanti Project because coldwater releases result in lower water temperatures all summer.

HUMPBACK CHUB

Gila cypha (Miller)

A streamlined minnow; concave skull; a prominent nuchal hump at occiput (back end of head marked by a line separating scaleless and scaled portions of epidermis); caudal peduncle thin but not long; snout overhangs upper lip; scales often minute or absent on keel; fins falcate with 9 dorsal fin rays and 10 or more anal fin rays; in young less than 5.9 inches eye diameter less than $\frac{2}{3}$ caudal peduncle depth.

Adults are dark on top and light below. Fins rarely have yellow-orange pigment near base. Adults are usually 12-16 inches long and weigh from 3/4-2 pounds.

Range: Humpback chub historically ranged in the mainstem Colorado River downstream to below the Hoover Dam site (Miller, 1955). Present populations are restricted to areas in, and upstream, of the Grand Canyon. In Colorado, the humpback chub has been found in the Yampa, Gunnison, Green, and Colorado rivers. The greatest numbers of humpbacks in Colorado are taken at the Black Rocks area of the Colorado River downstream of Grand Junction. The humpback chub is a federal and state endangered species.

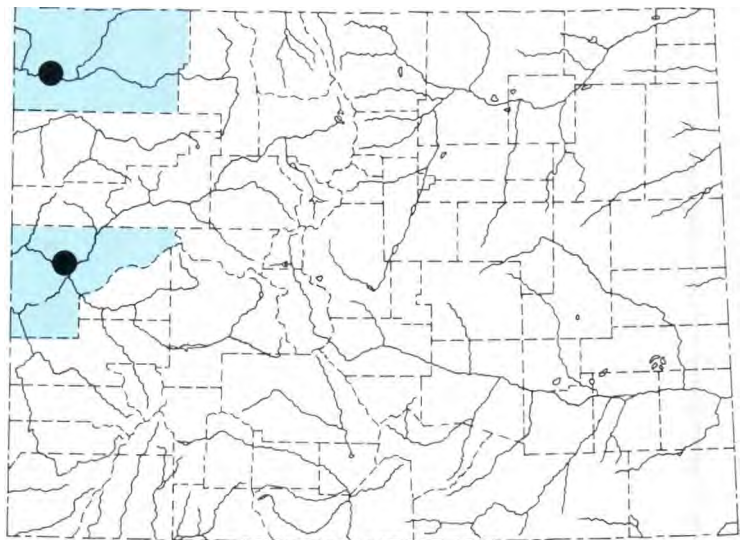
Habitat: This big river fish lives where water depth, velocity, and turbidity make direct observation difficult. The Black Rocks area is a river reach of deep, fast water with a sand, gravel, boulder bedrock stream bed. The fish are not found in areas of swift current, but prefer slower eddies and pools (T. Lytle, personal communication). Humpback chubs are found to be concentrated in such river areas, and not found in other habitat types. Conversely, exotic and other native species are not normally found in humpback habitats, (Valdez et al. 1982). Tagging studies show that humpback chubs in the Black Rocks area rarely move more than 0.5 miles from the spot they were first collected and marked (Miller et al. 1982).

Both young and adult chubs are taken in the Black Rocks area, indicating that the fish may reproduce at this site. Spawning takes place when water temperatures are 58-62°F (Valdez et al. 1982) and Hamman (1982) noted that 2% of humpback eggs are hatched when incubated at 54-56°F while 79-84% hatch in 66-68°F water.

One possible explanation of this fish's disappearance in some areas would be coldwater releases downstream of man-made impoundments. Valdez et al. (1982)



Adult humpback chub. Note the tag at the base of the dorsal fin.



Distribution by County of the humpback chub.

suggests that reduced river flows allow the roundtail chub, a fish of "shallower, less swift water than the humpback," to successfully inhabit some deepwater areas during low water periods where humpback chubs were previously isolated

resulting in competition and hybridization. For proof, Valdez notes the presence of a tentatively identified humpback x roundtail in the area of the Colorado River near the town of DeBeque.

BONYTAIL***Gila elegans*
(Baird and Girard)**

A highly streamlined fish; concave skull arching into a nuchal hump predorsally; caudal peduncle pencil-like, long and slender; snout does not overhang upper lip; scales often minute or absent from chest, stomach and caudal peduncle; fins falcate with 10 dorsal fin rays, and 10-11 anal fin rays; in young, less than 5.9 inches, eye diameter greater than $\frac{2}{3}$ caudal peduncle depth.

Adults are dark on top, light below. Often they are very dark in clear waters and pale in turbid waters. Fins are dusky with yellow pigment near base (Minckley 1973). Adults (7 years of age) can be 14 inches long and weigh more than one pound (Vanicek and Kramer 1969).

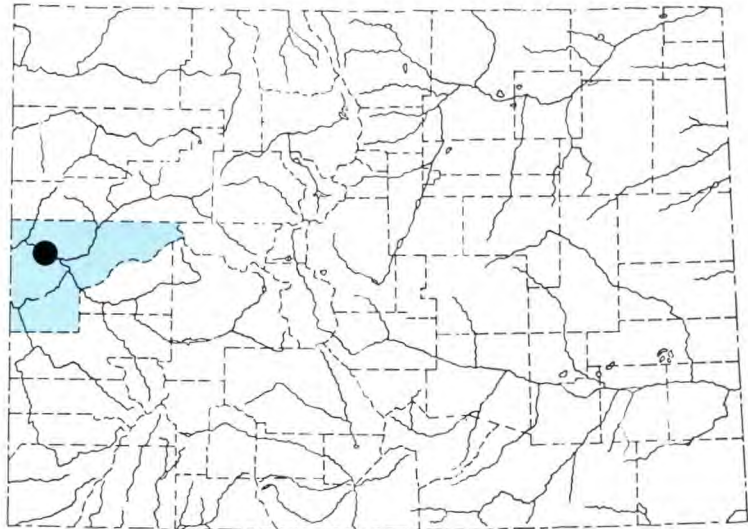
Range: Found historically throughout the Colorado River Drainage, in recent years bonytail have only been taken from the Green River in Utah and lakes Havasu and Mohave (Miller, et al. 1982). Jordan (1891) reported one bonytail from the Gunnison River near Delta and other specimens have been taken in the Green River in Colorado. No bonytails had been collected in Colorado for several years until 1984, when one individual was collected at the Black Rock area of the Colorado River west of Grand Junction, Colorado, (L. Keading, personal communication). The bonytail is listed as a federal and state endangered species.

Habitat: Little is known about this species. The bonytail prefers eddies and pools, not swift current (Vanicek and Kramer 1969).

The two factors thought to be tied to the decline of the bonytail are lower water temperatures (attributable to reservoir construction) and hybridization. After a reservoir is constructed, the water released from the impoundment is often taken from the deeper layers of the lake. These waters are much colder than the surface water and lower river temperatures downstream of reservoirs. Hamman (1982b) found that 96% of all bonytail eggs incubated in cold water (54-56°F) failed to hatch while optimal hatching and larval survival took place in warmer water (68-70°F). Juvenile bonytail, 3-5 inches, exhibited the greatest stamina in sus-



Bonytail. Photo by Patricia Shrader, U.S. Fish & Wildlife Service.



Distribution by County of the bonytail.

tailed swimming tests in 80°F water and least stamina in 58°F water (Bulkley, et al. 1982). Lower water temperatures downstream of many impoundments could negatively impact bonytail.

Several studies (Miller, et al. 1982 and Minckley 1973), note that investigation of

the genus *Gila* are hindered by the large number of hybrids that are found when two chub species of this genus are found together. As hybridization becomes more extensive in an area, the numbers of genetically "pure" individuals decrease, diluting the gene pool.

FLATHEAD CHUB

Hybopsis gracilis
(Richardson)

A large, vigorous minnow; large sub-terminal mouth, moderate-sized barbel located in the corners of the mouth, snout flattened with a broad, wedge-shaped head; pectoral fins large, sickle-shaped; eyes small, diameter of eye less than the length of snout; 44-50 moderate-sized scales in the lateral line; intestine short; lining of body cavity is silvery with few speckles.

Adults are silver, although the back may be tan-brown in color. This is a large minnow which can attain a length of nine inches.

Range: A widely distributed species, the flathead ranges from the Mackenzie River in Canada south through the plains states bordering the Rocky Mountains to New Mexico and Arkansas (Scott and Crossman 1973). Colorado populations are restricted to the Arkansas River Basin. In Kansas, the species is found in the Republican and Cimarron Rivers (Cross and Collins 1975) near the Colorado-Kansas border but has not been collected from the Colorado portions of these two systems. Ellis (1914) reported the flathead as common in the Arkansas River mainstem up to Salida, where the river is a coldwater trout fishery. Recent collections have shown the species does not extend up the mainstem Arkansas River past a large diversion structure west of Florence. Other populations are found in larger tributaries to the Arkansas such as Fountain Creek and the Purgatoire River.

Habitat: The flathead chub is found in mainstems of often turbid streams and rivers, in areas of fast water with sand or gravel substrates. This species is tolerant of organic enrichment. Specimens collected from Fountain Creek downstream of the Fountain wastewater treatment plant effluent appeared to be in excellent condition. Water chemistry data collected from that location reveal extensive organic enrichment and high ammonia concentrations.

Little is known about the biology of this species. Evidently, the flathead chub is an opportunistic feeder taking terrestrial insects, aquatic invertebrates and even some algae (Olund and Cross 1961). Pflieger (1975) observed that flatheads probably spawn in early spring since chubs less than one-inch long were collected in Missouri in late May.

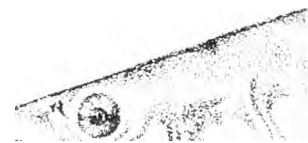
The disappearance of the flathead chub in the Arkansas River from Salida down-



Adult flathead chub.

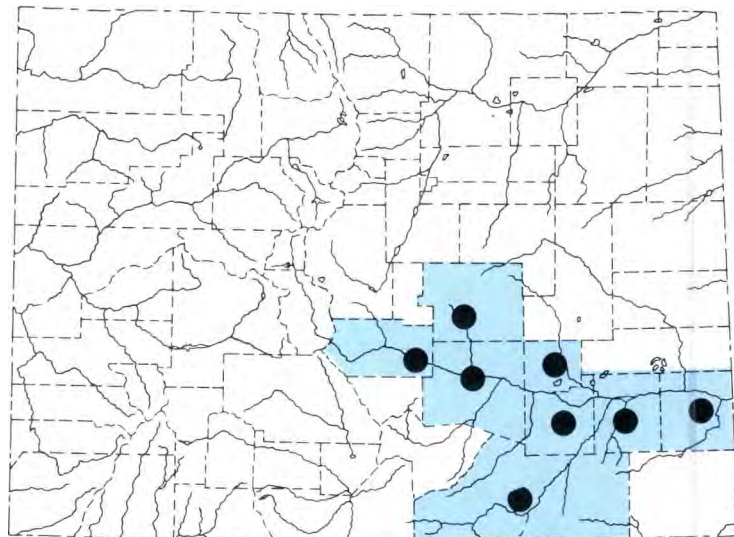


Detail of head of flathead chub.



Detail of head. the barbel at the corner of the mouth.

stream to Florence may be due to habitat alterations. Mining activities in the upper Arkansas Basin in the late nineteenth and early twentieth centuries resulted in severe water pollution. Most fish, including the flathead chub, may have disappeared from a long stretch of the upper mainstem Arkansas River. Water quality has greatly improved in the upper Arkansas and many fish species, not including the flathead, have been reintroduced and are now re-established upstream of Florence. A large diversion constructed by the Colorado Fuel & Iron Corporation just upstream of the town of Florence may have prevented the flathead from naturally re-establishing a population in the upper portion of its historic range in the Arkansas River.



Distribution by County of the flathead chub.

SUCKERMOUTH MINNOW

Phenacobius mirabilis
(Girard)

A slender minnow, mouth on underside of head with lobed, sucker-like lips, no cartilaginous ridge inside lower lip; no barbels; snout blunt, extending beyond upper lip; diameter of eye less than length of snout; 8 dorsal fin rays; 7 anal fin rays, lateral line scales usually less than 50 (40-48); intestine short with one s-shaped loop; peritoneum silvery; pharyngeal teeth 4-4.

There is often a darker-horizontal stripe running from the head to the end of the caudal peduncle. A conspicuous dark spot is located at the end of this lateral stripe. The fish is darker above this stripe and white below. The horizontal stripe may be obscure and the sides may appear silver. Adults range in size from 2-5 inches in length.

Range: Suckermouth minnows are found throughout most of the Mississippi River Basin from Ohio west to Wyoming and south to Louisiana and Texas. In Colorado, the species is limited to the eastern plains, in portions of the mainstem South Platte and lower mainstem and some tributaries of the Arkansas Rivers. In addition, the species is a rare inhabitant of the Arikaree River, a tributary of the Republican River (Cancalosi 1980).

Habitat: The suckermouth minnow is usually found in riffle areas of warm prairie streams of all sizes with low to moderate currents and year-round flows. This species is more tolerant of silty waters than many other fish (Miller and Robison 1973), but does appear to require permanent flows. Propst (1982) suggested that the suckermouth minnow is restricted to the mainstem South Platte because of the lack of permanent tributaries in the lower reaches of that stream in Colorado. The fish lives on the riffle bottoms in both mid-channel and side channel areas. Preferred stream substrate is gravel and sandy gravel.

This minnow uses its unusual snout and lips to root among stream bed materials for feed, harvesting insect larvae and other aquatic invertebrates (Starret 1950). Little is known about spawning behavior although there is a long reproductive period extending from April through August which may be an adaptation to extreme fluctuations in the flow of plains streams (Cross and Collins 1975).



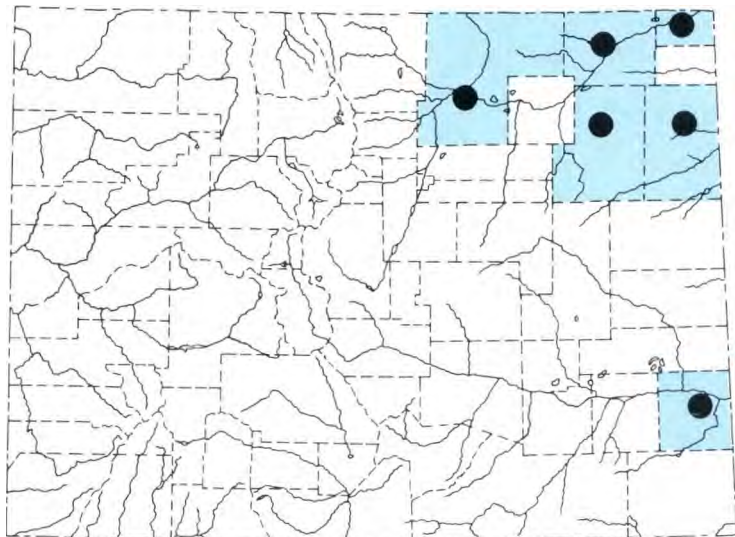
Suckermouth minnow.



Ventral view of the mouth of the suckermouth minnow.



Ventral view of the mouth of the Plains minnow.



Distribution by County of the suckermouth minnow.

The suckermouth minnow and stoneroller look similar and can be confused, but, upon close examination several characters differ. In comparison to the

suckermouth, the stoneroller has a cartilaginous ridge inside the lower lip, more than 50 lateral line scales, a long coiled intestine and a black peritoneum.

FATHEAD MINNOW
Pimephales promelas
(Rafinesque)

A full-bodied, stout minnow; mouth small, terminal, and oblique; snout round, blunt in adults; first ray of dorsal fin shorter, thick and split away from remainder of fin, connected by a membrane; lateral line incomplete ending below point of dorsal fin origin; intestine long, with several loops; lining of body cavity black; pharyngeal teeth 4-4.

Young females and non-breeding adult males dark above, fading to white on the stomach with a distinct dark stripe along the sides. Breeding males dark-brown, purple with two broad yellowish bars on body and tubercles on chin and snout. Adults are a little less than 3 inches in length, while one-year old fathead are about 1.5 inches long.

Range: The fathead minnow is widely distributed, ranging from central to eastern Canada, south through New York and Tennessee to Texas and northern Mexico up to Montana. The species is native to the east slope rivers of Colorado. Through bait bucket transfers and/or accidental inclusion with fish plants of other species, the fathead minnow is now found in waters throughout the western portions of Colorado. Presently, the fathead minnow may be the most widely distributed fish in Colorado, being found in almost every drainage in the state.

Habitat: Fathead minnows are tolerant of extremes in environmental conditions, able to withstand high temperatures, high nutrient concentrations, low dissolved oxygen levels, high turbidity and fairly stagnant conditions. In lakes or ponds, schools of adult fatheads can be observed on the bottom or at middle depths. Young-of-the-year school in the shallows. Propst (1982) found the fathead to be the most widely distributed species in the South Platte River Basin. The fish was found in foothills transition streams, the mainstream river, and potholes of intermittent high plains streams. In perennial streams fatheads are found along undercut banks or backwater areas with little or no current.

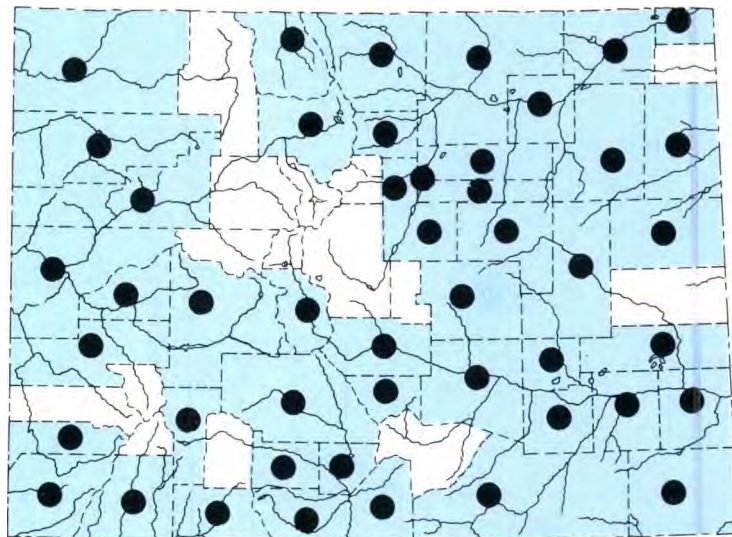
Fathead minnows are herbivorous, feeding on algae and other plant material. A prolific species, fatheads begin spawning in late spring when water temperatures reach 65 degrees Fahrenheit with spawning continuing through September unless water temperatures exceed 85 degrees Fahrenheit (Flickinger 1971). Spawning ceases at temperatures in excess of 85



Adult fathead minnow



Young fathead minnow.



Distribution by County of the fathead minnow.

degrees until temperatures decrease. Eggs are deposited on the underside of any material in or on the water. Females may spawn 12 or more times each summer with up to 12,000 eggs found in a single nest (Pflieger 1975). Hatching in about a week, young grow at a rapid rate and may mature sexually at the end of the first summer, though most fatheads spawn for the first time during the second summer of life (Flickinger 1971).

Fathead minnows are perhaps the best bait fish found in Colorado. They are very hardy and survive well on a hook as well as in a bait bucket. Once a fisherman locates water containing large numbers of fatheads, a few minutes work with a seine can provide all the bait needed for any fishing trip. A few fathead minnows introduced to a suitable small pond will reproduce providing a source of bait for several years. Commercial fishermen, who possess the required licenses from the Colorado Division of Wildlife, can harvest



Fathead minnow.

the abundant fathead for sale to bait stores. The species is also suited for intensive pond culture techniques. With proper facilities and expertise, the fathead can be reared like any domesticated animal to be sold on the commercial market.

For additional information regarding both biology and commercial potential of the fathead minnow see Flickinger, S.A. 1971. *Pond Culture of Bait Fishes*, Colo. Coop. Fishery Unit, Col. St. U., Ft. Collins, CO 80521. Bull. 478A. 39pp.

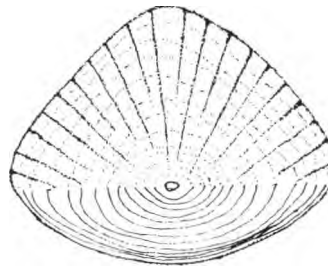
Genus *Hybognathus*

Two members of this genus are found in Colorado.

KEY TO THE GENUS *HYBOGNATHUS*

- | | |
|--|--|
| <p>1. a. Dorsal fin rounded at outer margin, first ray of dorsal fin shorter than second or third ray; scales of adults with about 20 radii (lines emanating from the center of the scale).
BRASSY MINNOW
<i>Hybognathus hankinsoni</i></p> | <p>b. Dorsal fin pointed at outer margin, first ray of dorsal fin longer than second or third; scales of adults with only about 10 radii.
PLAINS MINNOW
<i>Hybognathus placitus</i></p> |
|--|--|

The dorsal fin of the brassy minnow is rounded at the outer margin and the first ray is shorter than the second or third ray.



Brassy minnow scale with 20 radii.



Plains minnow scale with 10 radii.



Ventral view of the mouth of the sucker-mouth minnow.

From Cross and
Collins 1975



Ventral view of the mouth of the Plains minnow.

BRASSY MINNOW

Hybognathus hankinsoni (Hubbs)

A slender, slightly laterally-compressed minnow; small, subterminal mouth, slightly overhung by snout; dorsal fin slightly rounded with 8 rays; first ray of dorsal fin shorter than second or third ray; anal fin usually with 8 rays (sometimes 6, 7 or 9); lateral line complete, 36-41 scales in lateral line; scales with about 20 radii; peritoneum black; intestine long and coiled.

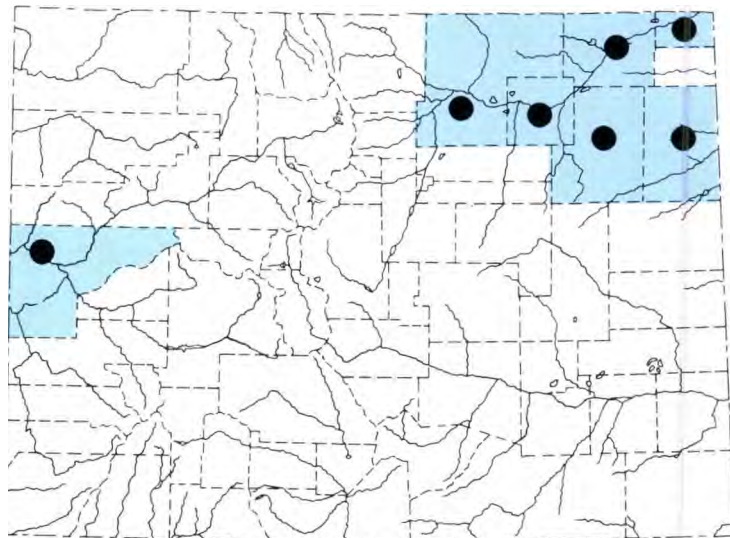
As the common name suggests, most descriptions state that this minnow is brassy in color. Pflieger (1975) describes the species as being yellow-olive on the back with a green-gold stripe on the sides and a silver-white belly, while Scott and Crossman (1973) state that the species has definite brassy reflections on the sides. Propst (1982) found that specimens in Colorado were silver with a dusky stripe developing on the sides after preservation in formalin. Specimens collected from the Republican River were a light emerald yellow on the back with a distinct dark band on the sides, and only a faint yellow color above and below the band, and a white ventral surface. Adults average 2.5 to 3.0 inches in length.

Range: The brassy minnow ranges from south-central Canada to Montana, south to Colorado, east to Missouri and north to Michigan. The species is native to Colorado and is currently found in low numbers in the South Platte, and Republican rivers. Propst (1982) found the brassy minnow in the South Platte to be mainly restricted to portions of the mainstem river and most abundant in the eastern portion of the plains region. The only tributaries of the Platte to contain brassy minnows were the lower St. Vrain River and Spottlewood Creek. In 1983, brassy minnows were collected in a backwater of the Colorado River near Debeque, (D. Ruiter, personal communication). These fish had the brassy coloration typical of the species.

Habitat: Cross and Collins (1975) found the species in Kansas in areas of cool, clear water with abundant aquatic vegetation and a gravel substrate overlaid by organic sediment. One location on the Arikaree River, in the Republican River Basin where the brassy minnow is locally abundant, has exactly these habitat conditions. Other locations in Colorado from which the brassy minnow is collected have different environmental conditions. Propst



Brassy minnow.



Distribution by County of the brassy minnow.

(1982) collected the species, in low numbers, from a variety of habitat types, observing the species can tolerate conditions "typical" of fluctuating plains streams, but, to be restricted in distribution and abundance by unknown factors. Brassy minnows eat primarily plankton and will spawn in the spring.

Due to the relative scarcity of this species, brassy minnows should not be used as a bait fish. Continued elimination of the preferred habitat of this species through dewatering, increased siltation and higher water temperatures can be expected to cause further decreases in distribution and abundance.

PLAINS MINNOW

Hybognathus placitus
(Girard)

A slender minnow; small subterminal-mouth, slightly overhung by snout; dorsal fin pointed, first ray of dorsal fin longer than second or third ray; dorsal and anal fins with 8 rays; lateral line complete, scales with about 10 radii; peritoneum black; intestine long and coiled.

Color is like that of the brassy minnow. (See previous account). The maximum length of adults is 5 inches (Cross and Collins 1975).

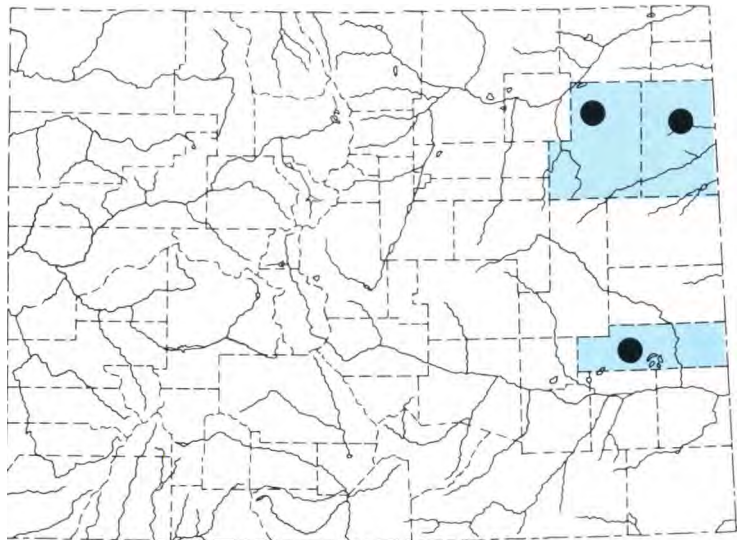
Range: Plains minnows are found in the Missouri River and western portions of the Mississippi system from Montana south to Texas (Miller and Robison 1973). The species is native to Colorado, but currently appears to be very rare. Propst (1982) and Goettl (1981) collected a few specimens from the South Platte mainstem east of Fort Morgan. Cancalosi (1980) collected a few specimens from the Republican Basin. The species has also been reported infrequently from the Great Plains reservoirs in the eastern plains portion of the Arkansas River (C. Bennett, personal communication).

Habitat: Plains minnows prefer main channel areas with some current and sandy bottoms. Not much is known about this species. The minnow eats aquatic plants, probably algae, and likely spawns in the spring.

The plains minnow should not be used as a bait fish due to the scarcity of the species. More information regarding the distribution, abundance, and habitat requirements of this species in Colorado is required.



Plains minnow. Photo by Gene Brehm, Kansas Fish & Game Department.



Distribution by County of the Plains minnow.

REDSIDE SHINER

Richardsonius balteatus
(Richardson)

A moderately deep-bodied minnow, laterally compressed; eyes are large about a third of head length; anal fin large, falcate with 10-13 rays; dorsal fin with 8-10 rays has its origin behind the insertion of the pelvic fins; scales moderately large with 50-60 in the lateral line.

Adults are normally very distinctive in color. Adults in breeding season have a definite pink-orange-red lateral stripe just below a dark band that extends from the head to the caudal fin base. This coloration is intense in males but also present on breeding females. Males in breeding color are orange-red at the upper edge of the gill slit with golden tints on the pectoral fins.

Adults average 3-5 inches in length, rarely attaining a length of 7 inches, (Scott and Crossman 1973). Young at the end of the first summer average 1 inch in length.

Range: The reidside shiner is native to waters west of the Rocky Mountains; from Alberta and British Columbia the species ranges south through the Columbia River Basin to the Bonneville River Basin in Utah and Nevada (Scott and Crossman 1973). The reidside shiner was introduced into the Green River by 1938 (Simon, 1946). In Colorado, the reidside shiner is found in the Yampa and Green river systems. The species is continuing to expand its range in Colorado and was collected for the first time in the Colorado River mainstem in 1981 below the town of Loma, (Haynes, et al., 1982).

Habitat: The reidside shiner is able to colonize a variety of habitats including lakes, streams and rivers (Sigler and Miller 1963). The species is often found in large schools in calm areas and sites of high water velocities. Clear or turbid waters, mud, silt, sand, gravel, rubble substrates are all colonized.

Active foragers, reidside shiners take a variety of food including zooplankton, aquatic and terrestrial insects, algae and, when large enough, fish eggs and small fish (Scott and Crossman 1973). Due to this species' impact on the eggs of other fish, the reidside shiner's life history has been extensively studied. Lindsey and Northcote (1953) found that the reidside matures in the third year of life with many fish surviving to spawn a second or third year. When water temperatures exceed 50° F, spawning activities begin with males and females moving into shallow



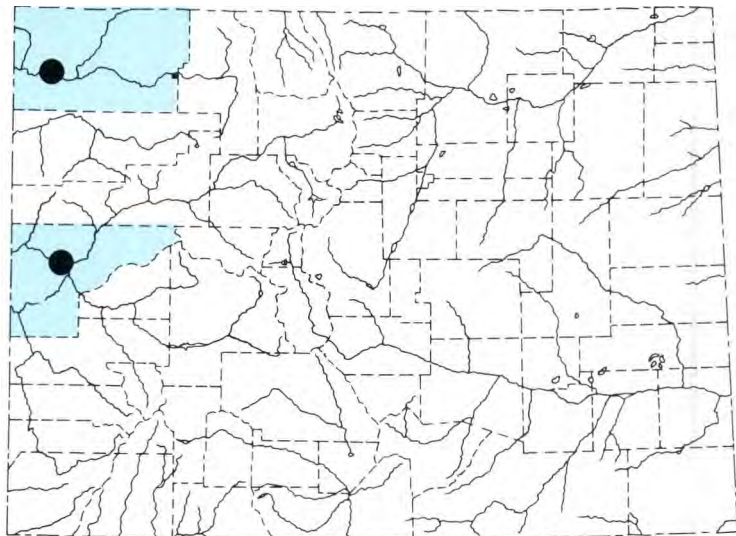
Reds ide shiner.

riffles. During actual spawning, one or two males and a female thrash side by side for a couple of seconds releasing eggs and milt. Eggs, released in small numbers, are fertilized and abandoned. No nests are built and the eggs adhere to the substrates and drift downstream.

These shiners predate not only upon their own eggs, but those of other species (Scott and Crossman 1973). Because of this habit, much has been said regarding the effect of the reidside shiner on rare species such as the Colorado Squawfish in waters of western Colorado where the reidside has been introduced. The actual impacts of the reidside shiner on populations of Colorado squawfish are not easily measured. These shiners may eat the eggs

of the squawfish and young reidsides may suppress the growth of young squawfish as they compete for the same food source and space. However, Behnke and Benson (1980) state that the reidside shiner is an important food source for adult squawfish. Beamesderfer and Congleton (1981), in laboratory studies, were unable to make definite conclusions pertaining to reidside shiner—squawfish behavioral interactions.

For additional information regarding the Redside Shiner see Lindsey, C.C. and T.G. Northcote 1963. *Life History of Redside Shiners, Richardsonius balteatus*, with particular reference to movements in and out of Sixteenmile Lake Streams. J. Fish. Res. Board Canada 20(4):1001-1030.

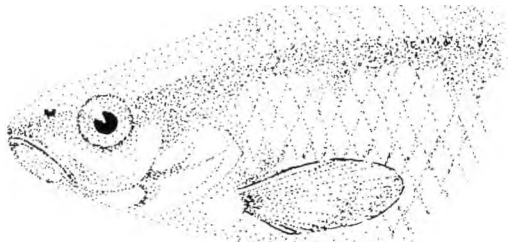


Distribution by County of the reidside shiner.

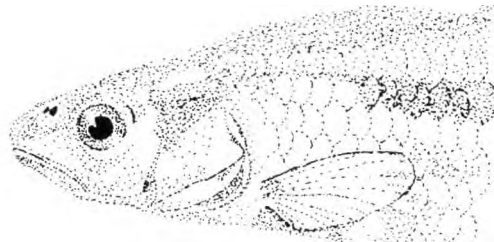
Genus *Notropis*

KEY TO THE GENUS *NOTROPIS*

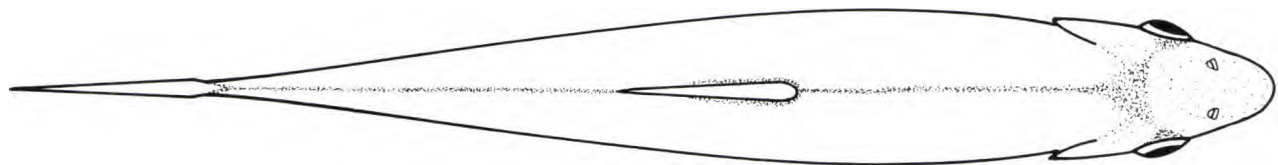
1. a. Base of tail fin with prominent round black spot as large as pupil of eye.
SPOTTAIL SHINER
Notropis hudsonius
- b. Base of tail fin without a prominent spot.
Go to number 2.
2. a. Dorsal fin with dark pigment speckles distributed uniformly on membranes.
RED SHINER *Notropis lutrensis*.
- b. Dorsal fin with dark speckles absent or confined to margin of fin rays.
Go to number 3.
3. a. Normally 8-9 anal fin rays.
Peritoneum is black.
COMMON SFUNER
Notropis cornutus
- b. Normally 7-8 anal fin rays. Peritoneum silvery, perhaps some dark speckles.
Go to number 4.
4. a. Eyes situated on upper portion of head such that lower edge of pupil often visible when fish viewed from above. The length of upper jaw greater than diameter of eye.
BIGMOUTH SHINER
Notropis dorsalis
- b. Eyes situated on sides of head. The length of upper jaw not greater than eye diameter.
Go to number 5.
5. a. Stripe down middle of back expanded into a wedge shape just in front of dorsal fin. Scales above midline dark-edged forming a cross-hatch pattern.
SAND SHINER *Notropis stramineus*.
- b. Stripe down middle of back not expanded into a wedge shape just in front of dorsal fin. Scales above midline not dark-edged forming a cross-hatch pattern.
RIVER SHINER *Notropis blennioides*



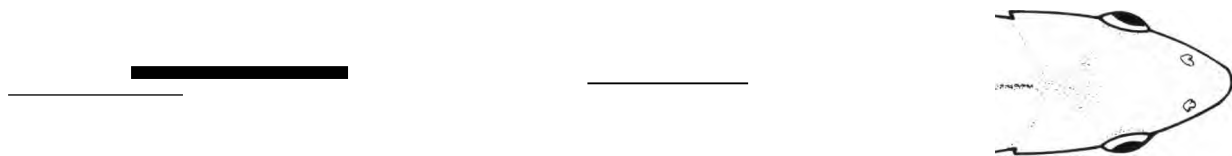
Detail of the common shiner showing diamond-shaped scales.



Detail of the river shiner showing round-edged scales.



Dorsal view of a river shiner. The stripe on the midline of the back goes around the dorsal fin.



Dorsal view of the sand shiner. Note the wedge-shaped mark in front of the dorsal fin.



Dorsal view of the bigmouth shiner shows no wedge-shaped mark and the stripe does not go around the dorsal fin.

SPOTTAIL SHINER

Notropis hudsonius
(Clinton)

A medium-sized, deep-bodied, laterally-compressed minnow; snout rounded, overhanging the subterminal mouth; large eyes make up 25-40% of head length; dorsal fin with 8 rays; origin of dorsal fin over origin of pelvic fins; anal fin normally with 8 rays (rarely 9); tail fin with large black spot at base; intestine short with a single s-shaped loop; lining of peritoneum is silver with scattered dark speckles; lateral line complete; pharyngeal teeth normally 2, 4-4, 2 but highly variable ranging from 0, 4-4, 0 to 0, 3-3, 1.

This is a silvery fish with yellow-gold tones. The back may be pale olive and the stomach silvery-white and there may be a dusky stripe down the middle of the back. In large adults the black spot at the base of the caudal fin may be inconspicuous. In Colorado waters large specimens exceed four inches in length.

Range: The spottail shiner occurs naturally in central Canada south to Georgia along the eastern seaboard and west to Missouri. The spottail has been introduced into Quincy Reservoir in the Denver area and Lon Hagler Reservoir in Larimer County.

Habitat: Found in large rivers and lakes throughout its natural range (Scott and Crossman 1973) the spottail is found over firm substrates of sand, gravel, and rubble in areas without current (Pflieger 1975).

Spottails spawn during late spring and early summer and live to a maximum of four years (Pflieger 1975). In Quincy Reservoir, spottails eat a variety of zooplankton, copepods, cladocerans, aquatic dipteran larva and adult terrestrial insects including beetles, ants and hemipterans (J. Goettl, personal communication).

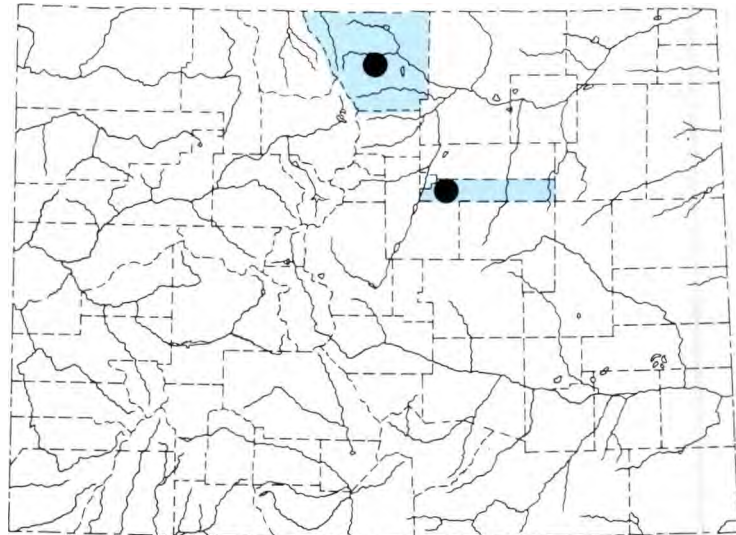
The spottail shiner has been introduced into Colorado to determine if self-sustaining populations will result. Many of the sandy-bottomed reservoirs on the eastern plains of Colorado lack the forage base to support the sport fish species desired by the angling public. Native minnow species are not able to thrive in a reservoir habitat which did not exist in Colorado prior to man's construction activities.



Adult spottail shiner.



Detail of two spottail shiners.



Distribution by County of the spottail shiner.

RED SHINER

Notropis lutrensis
(Baird and Girard)

A smallish, deep-bodied, laterally-compressed minnow; mouth typically terminal and oblique, mouth of males may be subterminal, overhung by pointed snout; dorsal fin with 8 rays; origin of dorsal fin over or slightly behind pelvic fins; anal fin normally with 9 (8-10) rays; intestine short with single s-shaped loop; peritoneum silver with scattered dark speckles; lateral line complete; pharyngeal teeth usually 0, 4-4, 0, occasionally 1, 4-4, 1; scales are diamond-shaped, outlined in black on back and sides.

Normally, adults are silver blue on the back with all silver sides and a white stomach. Breeding males are strikingly colored, with the top of the head and all fins except the dorsal bright orange-red, and a wedge-shaped purple area behind the gills and blue sides. Adults rarely exceed 3 inches in length.

Range: This species occurs naturally in the western Mississippi River drainage from Nebraska south to Texas and into northeast Mexico. In Colorado, the red shiner is native to the plains stretches of the Arkansas, Republican, Rio Grande and South Platte river drainages. Inadvertent introductions of red shiners have expanded the species range to West Slope rivers such as the Colorado, Dolores, Green, and White.

Habitat: The red shiner is a very hardy fish able to colonize a diverse range of habitats. The species is abundant in silty waters with fluctuating flows (Cross and Collins 1975), a situation typical of eastern Colorado streams and rivers. The species prefers deeper pools and backwaters (2-5 feet) in currents less than one-foot-per-second (Propst 1982). If a large number of red shiners are found in one location it is often the only species present. Cross and Collins (1975) found red shiners in rivers after severe pollution events and red shiners were not abundant in the relatively pollution-free Republican River (Cancalosi 1980). Colorado may be like Kansas where changes caused by man have reduced the number of other species while the red shiner thrives.

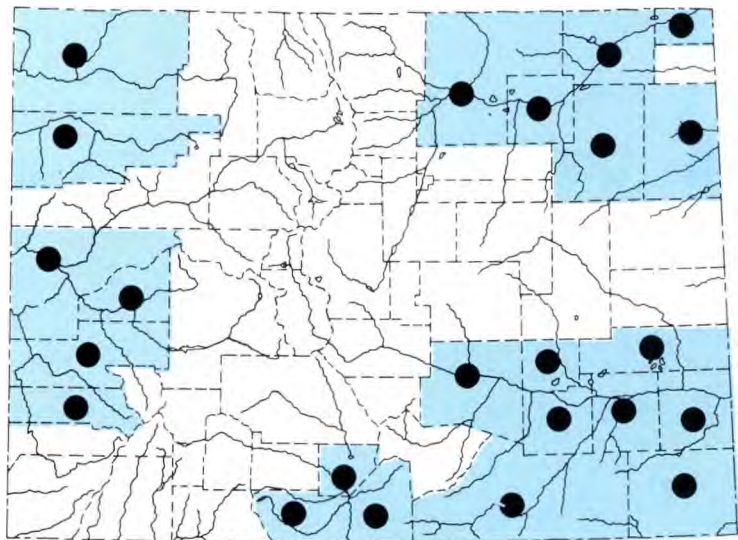
Primarily sight feeders, red shiners take a variety of invertebrates and some algae from all levels of water. Red shiners are sexually mature at one year of age, spawning throughout spring and summer when water temperatures range from 60-85°F (Cross and Collins 1975), using a wide variety of spawning substrates including



Adult male red shiner in breeding colors.



Adult red shiner.



Distribution by County of the red shiner.

vegetation, woody material, sand, gravel, or the nests of other fish. Pflieger (1975) found that males establish territories around the periphery of sunfish nests and guard these locations against the intrusion of other males.

The success of the red shiner in coloniz-

ing West Slope waters may be due to certain characteristics of the species. Red shiners are adapted to silty, warmer waters, a situation inherent to certain West Slope waters. Man's agricultural practices and impoundment constructions have increased the turbidity of many West Slope

waters. Since this generalistic species matures early, spawns throughout the summer, is an opportunistic feeder, and can withstand pollution, range expansion following accidental introduction would be likely in comparison to species with narrow habitat tolerances.

Family Cyprinidae Genus *Notropis*

COMMON SHINER

Notropis cornutus (Mitchill)

A medium-sized, stout, laterally-compressed minnow; large, terminal mouth; dorsal fin with 8 rays; anal fin with 8 or 9 rays; intestine short with single S-shaped loop; peritoneum is black; lateral line complete, decurved; pharyngeal teeth usually 2, 4-4, 2, occasionally 2, 4-4, 0 or 1, 4-4, 1; high, diamond-shaped scales.

A bright silvery fish, the common shiner has a bold stripe down the midline of the back, and often a broad lateral band. The back may be slightly olive in color. Breeding males have a deep blue head with rose-pink fins and body. Extensive breeding tubercles develop on the head, dorsal surface of the body, and rays of pectoral and dorsal fins. Colorado specimens reach six inches in length.

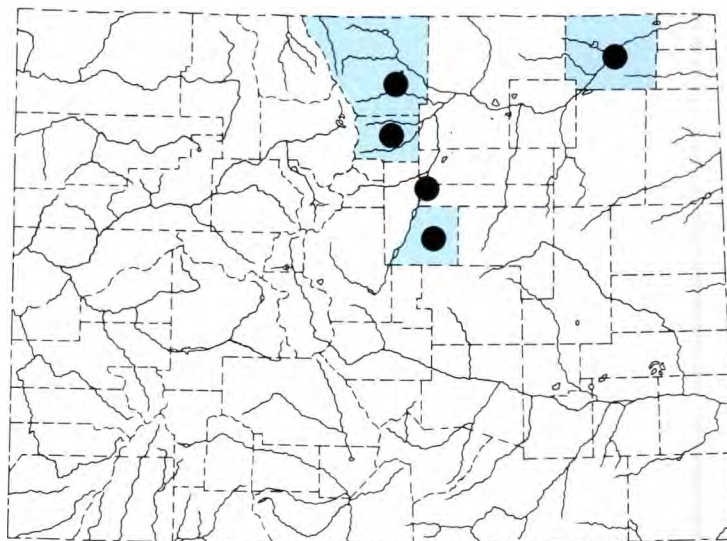
Range: The northern shiner is found from New England and Nova Scotia, south to Virginia and west to Saskatchewan and Colorado. Native to the South Platte in Colorado, Ellis (1914) noted specimens from several tributaries and the mainstem river from Denver to Ovid. Currently, the common shiner is not very abundant in the state. Propst (1982) found common shiners in only four streams, tributary to the South Platte River, and of those, only in West Plum Creek is the species fairly common. Common shiners are currently very rare in the mainstem South Platte River. In recent years only Goettl (1980 and 1981) reported common shiners in the mainstem, one individual near Sterling and one in Denver.

Habitat: This shiner requires streams of moderate gradient with cool, clear water, gravel bottoms and shaded by brush or trees (Trautman 1957). This habitat type is not common in Colorado where most streams are silted and sedimented to some degree. Miller (1964) reported that common shiners do not spawn where silt covers stream bottoms. The common shiner may only be able to survive in transition zone streams of Colorado, such as Plum Creek, where silt loads are still quite low.

The diet of the common shiner changes



Adult common shiner.



Distribution by County of the common shiner.

with the season. In the summer and winter, aquatic insects are most commonly taken, whereas plant material forms the bulk of the diet in the spring and plant material and small fish are eaten in the fall (Starrett 1950). The reproductive aspects of the common shiner's life history have been described in detail by Raney (1940). Common shiners spawn on gravel beds in flowing water, often at the head of a riffle area. Males defend a

small territory and may move a few stones to provide some clearing of the spawning site. Females move into the spawning site when ready to spawn. The male folds over the female forcing expulsion of a small number of eggs. Both males and females can repeat this procedure several times.

This species is commonly used as a bait minnow. Due to the scarcity of the species in Colorado such use should be discouraged.

BIGMOUTH SHINER *Notropis dorsalis* (Agassiz)

A small, stout minnow; body not compressed laterally; large, almost sub-terminal, horizontal mouth; the upper jaw is longer than diameter of the eye; no scales on nape of neck, dorsal fin normally with 8 rays; anal fin normally with 7-8 rays; intestine short with single s-shaped loop; peritoneum silvery with some dark speckles, lateral line complete; pharyngeal teeth normally 1, 4-4, 1. Resembles sand shiner (see next species account).

Adults are a silver-sand color on the back fading to silver-white on the stomach and the fins are transparent. A dark dorsal stripe extends from the head along the top of the back to the dorsal fin and from the back of the dorsal fin to the tail. Color resembles that of the sand shiner.

The young are less than an inch long at the end of the first summer. Adults are normally 2-5 inches long, and always less than three inches in length.

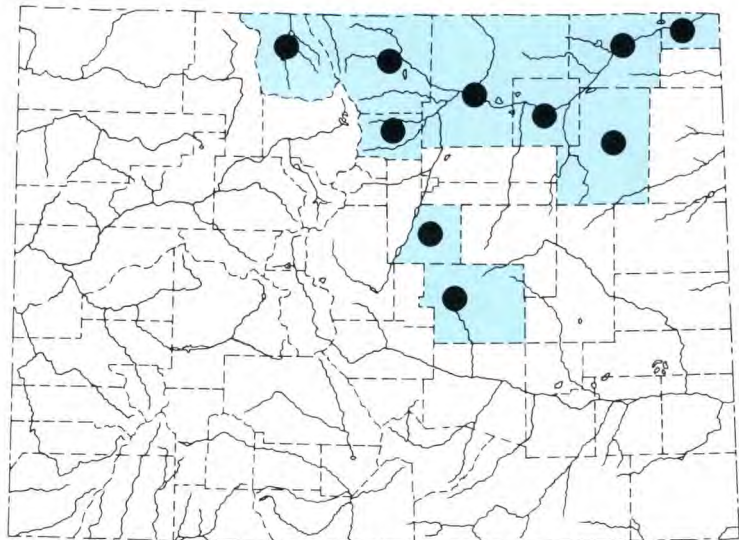
Range: The bigmouth shiner is found throughout the north-central United States north of the Missouri River (Pflieger 1975). This shiner is native to Colorado (Jordan 1891), found in the North Platte drainage and the mainstem South Platte and foothills tributaries. A population also has been found in Fountain Creek, a tributary of the Arkansas River (Miller 1984).

Habitat: In large streams, such as the mainstem South Platte, or smaller permanently flowing tributaries, bigmouth shiners are found in shallow water with a sand or small gravel bottom. Propst (1982) found bigmouth shiners to be widely, though unevenly distributed, throughout the South Platte drainage, and to be absent in organically enriched stream segments. Sand shiners and bigmouth shiners are often collected at the same sites in Colorado. The two species may be spatially separated in that bigmouth shiners have been reported to prefer shallow areas upstream of pools while sand shiners are found on the bottom in deeper water (Mendelson 1975). Propst (1982) reported both species were found in mixed schools on the South Platte River.

Bigmouth shiners feed on aquatic insect nymphs and larva during most of the year, but, in the fall, primarily bottom



Adult bigmouth shiner.



Distribution by County of the bigmouth shiner.

ooze and terrestrial insects are taken (Starrett 1950). Little is known about the reproductive phase of the bigmouth shiner's life cycle except that spawning takes place relatively late in the year around July and August (Starrett 1951). The combination of a late spawning season, which avoids spring runoff flows, and

a preference for small, sandy streams may in part account for the species' continued presence in many Colorado streams.

The bigmouth shiner can be used as a bait species. Though not as hardy as other minnows, its relative abundance and presence in shallow water makes it an easy fish to seine.

SAND SHINER

Notropis stramineus (Cope)

A small, stout minnow; the body not compressed laterally; small, slightly oblique mouth; the upper jaw usually shorter than the diameter of the eye; scales on nape of neck; dorsal fin normally with 8 rays; anal fin normally with 7 rays (sometimes 8); intestine short with single s-shaped loop; peritoneum silvery with some dark speckles; pharyngeal teeth usually 4-4, but highly variable, the formula of one Arkansas River specimen was 1-1. Resembles bigmouth shiner (see previous account). **Note:** sand shiner populations in the lower Arkansas River may closely resemble bigmouth shiners in several aspects. Care must be taken in identifying such populations.

Adults are a silver-sand color on the back fading to silver-white on the stomach and the fins are transparent. A mid-dorsal, dark stripe normally expands to a wedge shape just in front of the dorsal fin, but does not surround the base of the dorsal fin. There is a dark spot, often quite distinct, immediately above and immediately below the pore of each lateral line scale. The bigmouth shiner is similar to the sand shiner in coloration except that the dark wedge shape of the mid-dorsal line is lacking and the lateral line spots are absent.

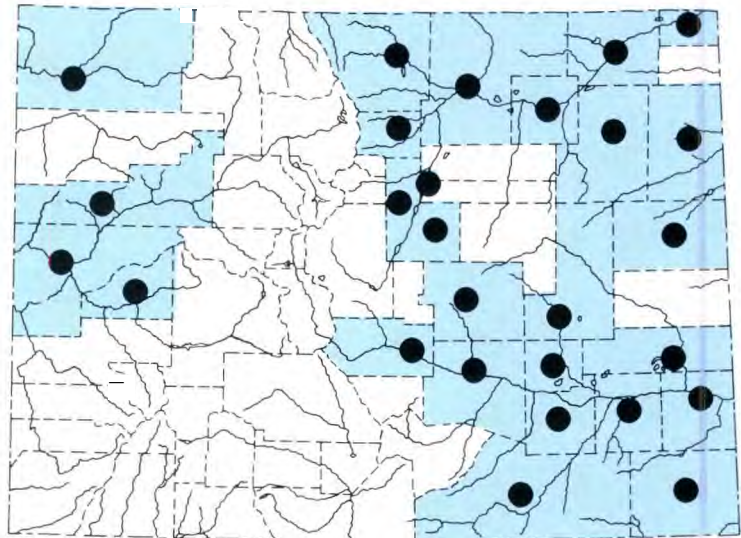
Young are usually less than an inch long at the end of the first summer. Adults are from 2.5-3 inches in length.

Range: The sand shiner is found throughout most of the Mississippi and Missouri river systems and into the Saint Lawrence Seaway (Trautman 1957). The species is native to the South Platte, Republican and Arkansas rivers in Colorado. Inadvertent introductions have expanded the species range to West Slope rivers such as the Colorado, Dolores, and Green.

Habitat: Sand shiners, as the name implies, are found in eastern plains streams with sandy bottoms and permanent flows. Schools of sand shiners are often seen in riffles, downstream of submerged sand bars, and in sandy backwaters. Often, the bigmouth shiner and the sand shiner are found at the same location, but the sand shiner may prefer to feed and remain in slightly deeper water than the bigmouth shiner (Mendelson 1975). Sand shiners are sometimes encountered in waters downstream from domestic sewage treatment facilities, demonstrating a tolerance



Adult sand shiner.



Distribution by County of the sand shiner.

to nutrient enrichment. Propst (1982) determined that sand shiners avoid silt-laden irrigation return flows.

Sand shiners feed on aquatic invertebrates. Mendelson (1975) found the common prey to be invertebrate species taken from the river substrate. Relatively late spawners, sand shiners reproduce from July through August (Starrett 1951). Spawning fish are usually 1 or 2 years of age with a few shiners living to an age of 3 years (Summerfelt and Minckley 1969).

The sand shiner is a shallow-water fish and therefore easily collected by seining and utilized as a bait species.

The sand shiner may be easily confused with the bigmouth shiner. Three characteristics should be noted when examining specimens thought to be one of these species. Sand shiners have dark spots above and below the pore of each lateral line scale, a characteristic lacking in the bigmouth shiner, and sand shiners have scales on the nape. Bigmouth shiners don't have scales on the nape. The line along the top of the back is expanded into a wedge shape just in front of the dorsal fin of the sand shiner. Bigmouth shiners do not have this wedge-shaped area.

RIVER SHINER

Notropis blennioides (Girard)

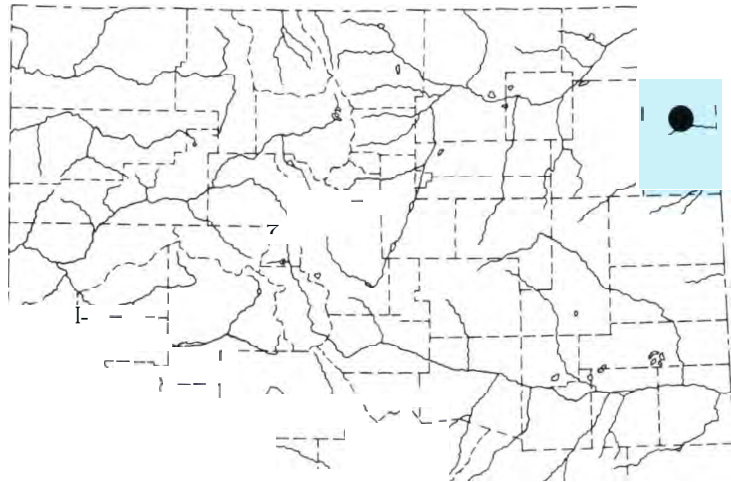
A small, stout minnow; body not greatly compressed laterally; head large and broad, nearly as wide as high; large, oblique, subterminal mouth; upper jaw usually longer than the diameter of the eye; anal fin with 7 rays; intestine short with single s-shaped loop; scales are rounded; peritoneum silver with dark speckles; pharyngeal teeth 2, 4-4, 2 but highly variable. Resembles bigmouth and sand shiners, see previous accounts.

Adults are a silver-sand color fading to silver-white on the stomach. Fins are transparent. A mid-dorsal, dark stripe on back is continuous around the dorsal fin base. Adults reach a length of 3¼ inches (Cross and Collins 1975).

Range: The river shiner is found primarily in large rivers from south-central Canada, south to the mouth of the Mississippi River (Pflieger 1975). In Colorado, river shiners have been reported from the Republican Basin, including the Arikaree River (Cancalosi 1980). The waters of the Republican River Basin are small streams, not the large river habitat normally required by the species. Cross and Collins (1975) report river shiners as being present in the Arikaree in northwest Kansas. If isolated populations of the river shiner are present in northwest Kansas it is probable the same species may be found a few miles west in Colorado.

Care should be taken not to collect this species in Colorado for use as bait.

*Photograph of the river shiner
not available*



Distribution by County of the river shiner.

GOLDEN SHINER *Notemigonus crysoleucas* (Mitch ill)

A large, deep-bodied minnow; small oblique mouth somewhat superior; strongly decurved lateral line; scaleless, fleshy keel extending from pelvic fins to anus; dorsal fin with 8 rays, pelvic with 9 rays and a long anal fin with 11-15 rays; moderate sized scales (45-55) along lateral line; pharyngeal teeth 0, 5-5, 0.

Adults are golden yellow, sometimes greenish on back that may fade to silver on the belly. Young may often have a dark lateral band (Miller and Robison 1973) on the side from head to tail.

In Colorado waters, maximum length is normally 6-8 inches, although the species may attain a length of 12 inches (Cross and Collins 1975). Normal length at the end of one year is from 3-6 inches (Flickinger 1971).

Range: The golden shiner is a widely distributed species encompassing a natural range from southern Canada down through the eastern seaboard to Florida, west to Texas, and north to the Dakotas. The species was first introduced in Colorado in 1953 (Wiltzius 1981). Other introductions, either via the bait bucket or on purpose to serve as a forage species, have expanded the species range in Colorado to many manmade eastern plains impoundments. One population has been found in a privately-owned pond in Montrose County on the Western Slope. (W. Weiler, personal communication).

Habitat: This species prefers lakes with clear water and submerged aquatic vegetation. Colorado populations appear to be restricted to reservoirs. No specimens have been taken from streams in the South Platte or Arkansas basins despite the presence of this shiner in reservoirs in both drainages (Probst 1982, D. Miller, personal communication).

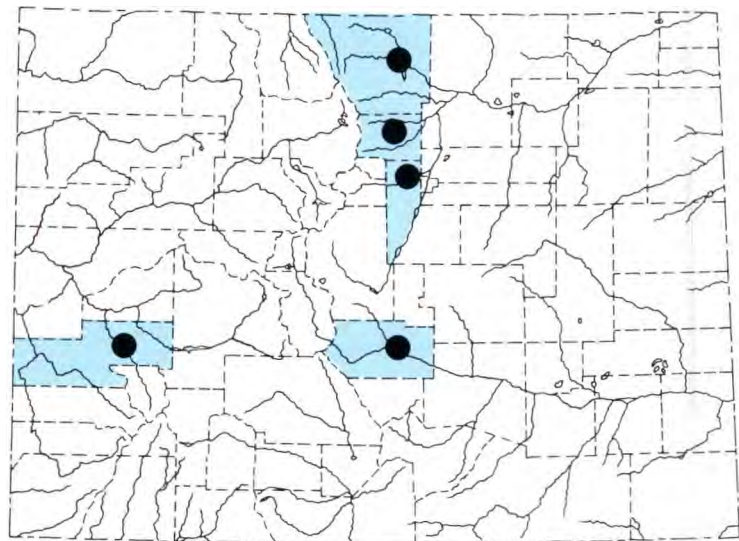
Keast and Webb (1966) in Ontario, Canada, determined that golden shiners are principally midwater or surface feeders taking aquatic zooplankton and insects, flying insects and some filamentous algae, dragonfly naiads and mollusks. Reaching maturity at one year, golden shiner spawn several times through late spring and summer when water temperatures reach 70°F (Flickinger 1971). The adhesive eggs are scattered randomly over aquatic plants after fertilization. No parental care is provided.



Adult golden shiner.



Note the decurved lateral line on this golden shiner.



Distribution by County of the golden shiner.

GRASS CARP *Ctenopharyngodon idella* (Valenciennes)

A robust, thick-bodied minnow; head broad, blunt; mouth large, terminal; scales very large, dark-edged; anal fin close to caudal fin, distance from the front of the anal fin to the tip of snout is 3 times or more longer than the distance from the front of the anal fin to the base of caudal fin; pharyngeal teeth 2, 4-4, 2, deep grooves in pharyngeal teeth of the main 4-4 row; 40-45 lateral line scales. (Note, the anal fin of the Colorado squawfish is located close to caudal fin; but in the Colorado squawfish, scales are relatively small with more than 80 in the lateral line, and the distance from the front of the anal fin to the tip of the snout is about 2.75 times, or less, than the distance from the front of the anal fin to the base of the caudal fin.)

Grass carp are golden or olivaceous in color on the back, fading to a yellow-white on the stomach. The scales on the back and side are dark-edged. As the fish age, colors gradually darken. A large minnow, adults can exceed 20 inches in length and 5 pounds in weight.

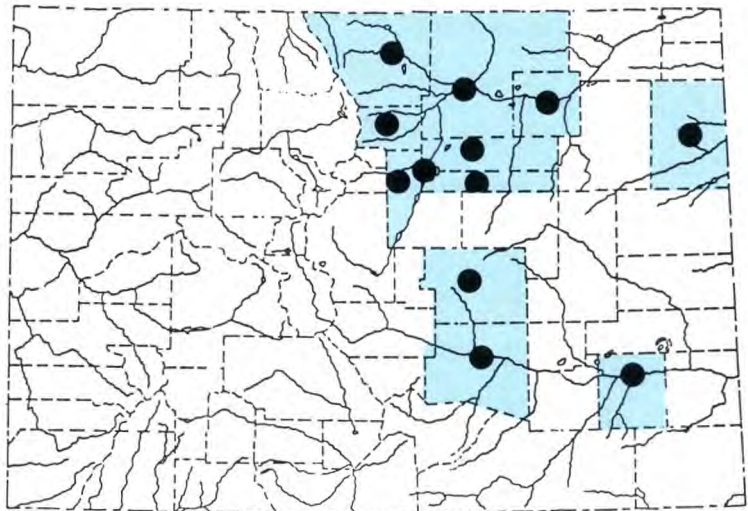
Range: Native to Asia, the species was introduced into the United States to control rooted aquatic vegetation. Grass carp have been released in a few locations in Colorado, regulated by a permit system administered by the Division of Wildlife. The species is prohibited from the western slope of the state.

Habitat: The grass carp is herbivorous, eating copious amounts of aquatic vegetation. It is not known if the species can successfully spawn in the rivers of the United States.

The grass carp is viewed by many as a panacea for aquatic weed control. The thesis has been advanced that if a few grass carp are stocked, aquatic vegetation problems will disappear. This idea is false, as grass carp will not eat well when water temperatures are less than 55-60 degrees Fahrenheit (Shireman and Smith 1981). Aquatic vegetation begins growing each spring at temperatures lower than 55 degrees several weeks before grass carp start eating. When grass carp grow to a large enough size the fish stops controlling aquatic plant growth and must be replaced with smaller individuals. Large



Adult grass carp.



Distribution by County of the grass carp.

numbers of small, one pound grass carp, 60 per acre, must be stocked. The costs of acquiring grass carp are high and a permit from the Colorado Division of Wildlife is required before the fish can be released. Care must be taken to avoid releasing grass carp into the wild. Even if the water in question is privately owned, a permit is required. If released in suffi-

cient numbers to some Colorado streams, grass carp may well eat the aquatic vegetation required by many fish or waterfowl species already threatened by diminishing habitat. For example, if the vegetation from the backwaters and springs of the Fountain River were to disappear, so would many of the Arkansas darter populations left in the state.

TENCH

Tinca tinca (Linnaeus)

A stout, round minnow; large oblique mouth; a single barbel located at each corner of the mouth; dorsal and anal fins convex at posterior edge; caudal fin rectangular with only a slight indentation along posterior edge; skin thick and slimy; lateral line scales very small, imbedded, 95-100 along lateral line; pharyngeal teeth 0, 5-5, 0 or 0, 5-4, 0.

Adults are olive-green or golden-yellow on back and sides with a cream-colored stomach. The iris of the eye is an orange-red. The coloration of the eyes coupled with the small imbedded scales and one barbel combine to make this a species easy to identify. Many people can correctly name the fish upon first inspection even if they have never before seen the fish or a picture.

Adults can become fairly large weighing up to 10-11 pounds (McClane 1965). Fish collected in Colorado have exceeded 13 inches in length and 2 pounds in weight.

Range: Native to Europe, the species was first introduced to Colorado in 1891 (Wiltzius 1981). Currently, populations are found in Cherry Creek Reservoir in the Denver area, Pueblo Reservoir, and some waters in the San Luis Valley. Other populations may exist.

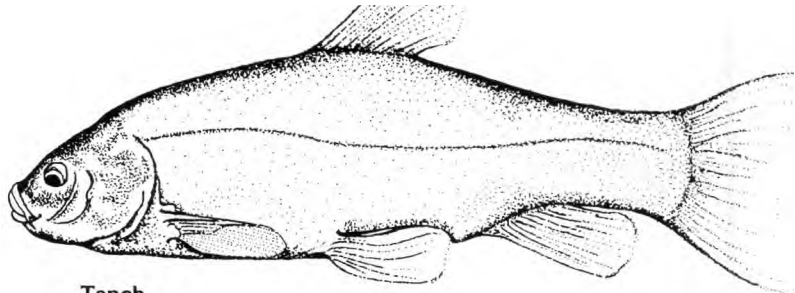
Habitat: There has been very little information gathered about this species in Colorado. Tench are found in lakes or reservoirs in areas of open water with a mud or gravel bottom and some aquatic vegetation.

Tench appear to be omnivorous, taking almost anything from the lake or reservoir substrate, including small invertebrates, mollusks and algae (McClane 1965). Horoszewicz (1983) found tench may spawn several times a summer once water temperature exceeds 66°F. During the same study, tench ceased spawning activities when temperatures exceeded 88°F.

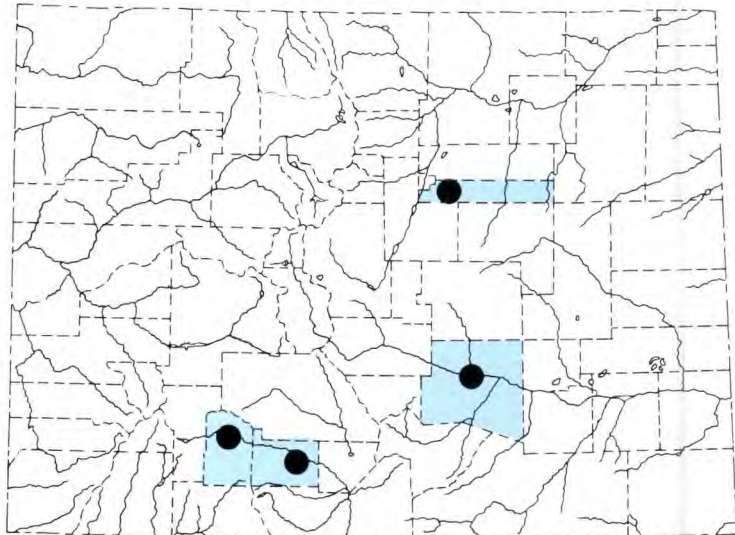
Tench are a popular game fish in Europe. Fishermen often clear a space in weed beds, then bait the area for several days to attract fish, a practice which is illegal in Colorado. The few tench caught in Colorado are usually taken on worms, salmon eggs, or slowly-fished jigs.



Adult tench.



Tench.



Distribution by County of the tench.

Family *Clupeidae* HERRINGS

Most members of this family are marine, living in the world's oceans and seas. Some, such as the highly prized Atlantic shad, are anadromous, spending most of their adult life in salt water and returning to freshwater only to spawn. Two species may be encountered in Colorado.

KEY TO THE FAMILY *CLUPEIDAE*

1. a. The lower jaw does not extend past tip of snout, normally more than 55 scales along lateral line, 29-35 rays in anal fin, when alive the tail fin is not yellow.
GIZZARD SHAD
Dorsoma cepedianum
- b. The lower jaw extends past tip of the snout, normally less than 50 scales along lateral line, 20-25 rays in anal fin, when alive the tail fin is bright yellow.
THREADFIN SHAD
Dorsoma petenense

Family *Clupeidae* Genus *Dorosoma*

GIZZARD SHAD *Dorosoma cepedianum* (Lesueur)

A fish that is strongly compressed laterally, body thin and deep; mouth small and subterminal, upper jaw with a deep notch at center, upper jaw extends past lower jaw; dorsal fin with 10-13 rays, last ray of dorsal fin modified into a long, thin filament; 29-35 rays in anal fin; more than 55 scales in lateral line.

Adults are silver or silvery-blue on the back, fading to silver on the sides, with a whitish belly. Young have a large purple-silver spot on the sides behind the upper edge of the operculum. Mature fish range from 9-13.5 inches in length and weigh about 12 ounces. Specimens longer than 18 inches have been taken in eastern Colorado.

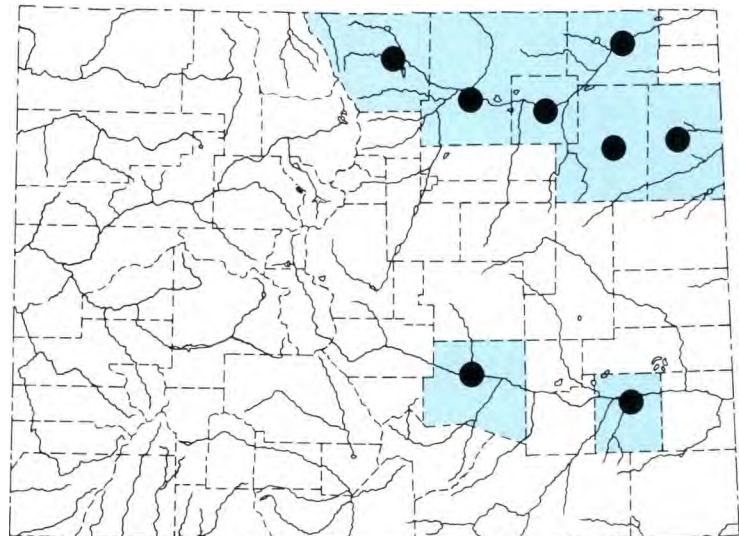
Range: The gizzard shad is a widely distributed fish ranging through most of the eastern United States from Florida north along the eastern seaboard and the Mississippi River drainage to the Saint Lawrence River, excluding the Appalachian Mountains. In the west, gizzard shad are found from South Dakota to Texas and the northern portion of Mexico. Gizzard shad in Colorado are restricted to reservoirs and mainstem river reaches in the Arkansas and South Platte drainages. Every life stage, from larvae to spawning adults, is found in many eastern plains reservoirs. Immature fish, to five inches in length, may be encountered in the mainstem South Platte River from Greeley upstream to the Saint Vrain River, and in the lower reaches of that tributary (Propst 1982). Wiltzius (1981) indicated that gizzard shad may be native to Colorado since specimens were collected in the Arkansas drainage prior to any known introductory plant of the species. Gizzard shad have been stocked in many eastern plains reservoirs as a forage species.



Adult gizzard shad.



Detail of the gizzard shad showing the long dorsal fin ray.



Distribution by County of the gizzard shad.

Habitat: Gizzard shad are found in many diverse Colorado waters, but principally in highly productive impoundments. Traveling in schools which generally are in continual motion, gizzard shad are found in areas of little or no current. This avoidance of current could explain the absence of mature shad in the mainstem South Platte River where low fall and winter flows leave few large pool areas.

Young, less than one inch in length, are carnivorous, feeding on zooplankton (Pflieger 1975). Larger fish are omnivorous, feeding on periphyton, phytoplankton, detritus and zooplankton. Drenner, et al. (1982), found that the presence of

zooplankton induces a change from natural respiratory movements to a series of rapid, intense suction actions. The suction response was random, not directed towards specific food items. Food taken in such a manner was determined in the same study to be macerated in the "gizzard", a modified stomach containing sand, and not in the mouth cavity. Spring spawners, gizzard shad are extremely prolific. Scott and Crossman (1973) report that maximum egg production occurs at two years of age when females contain an average of 379,000 ova. During May or June in shallow water, mixed schools of males and females release eggs and milt. The adhe-

sive, fertilized eggs sink to the bottom. No parental care is provided.

The prolific nature of gizzard shad makes the species an important tool in fisheries management. Young shad are a good forage fish for a variety of species such as walleye, crappie and white bass. However, this abundant food source rapidly loses the forage value since gizzard shad grow rapidly and attain a size where the fish are immune to predation. The species has no value as a food source, though the flesh and "gizzard" are often used as catfish bait. The extremely delicate young are not an acceptable live bait.

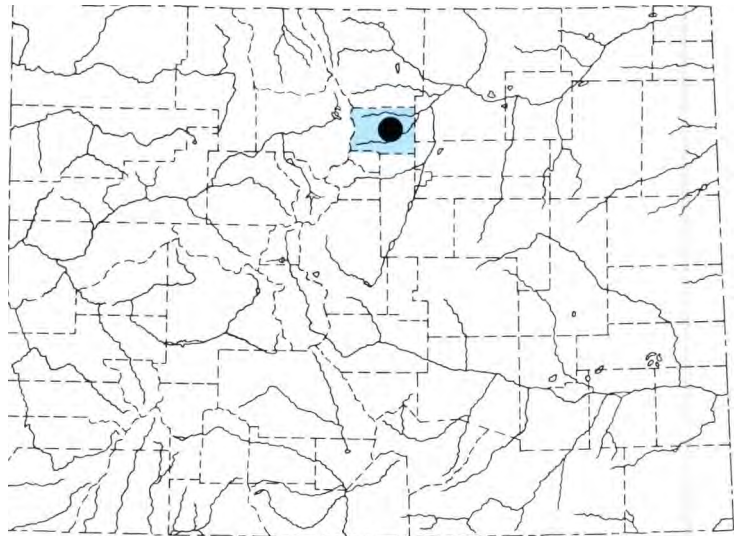
Family Clupeidae Genus *Dorosoma*

THREADFIN SHAD *Dorosoma petenense* (*Gunther*)

Threadfin shad look much like gizzard shad but differ by the characters shown in the key.

The Colorado Division of Wildlife is utilizing threadfin shad in an experimental program to increase forage fish populations in warmwater impoundments. The threadfin shad is native to the Gulf Coast states and lower Mississippi River drainage. Extremely prolific, threadfins spawn throughout the summer producing a vast number of progeny. Eggs hatch in about 3 days and young threadfin can average 2.1 inches at the end of one growing season (Pflieger 1975). Valmont Reservoir, near Boulder, is the only water which currently may have threadfin shad. When water temperatures fall to less than 45°F in the fall, the threadfin die. Although threadfin adults would have to be restocked each spring, a forage base could be provided without having a population of large mature shad which may compete in some way with other species more desirable to the angler.

*Photograph of the threadfin shad
not available*



Distribution by County of the threadfin shad.

Family *Catostomidae*

SUCKERS

Eight species of the family *Catostomidae* are found in Colorado. Two of these species, the river carpsucker, *Carpionodes carpio* and the razorback sucker, *Xyrauchen texanus*, are unique in appearance and easy to identify. Problems in identification and classification arise when dealing with the remaining six species, all currently considered to be members of the genus *Catostomus*. Three of these species, the Rio Grande sucker, *Catostomus plebeius*, bluehead sucker, *Catostomus discobolus*, and the mountain sucker, *Catostomus platyrhynchus* were formerly classified as mountain suckers of the separate genus *Pantosteus*. A revision by Smith (1966) advocating synonymization of *Pantosteus* and *Catostomus* has been accepted. Three other members of the genus, the white sucker, *Catostomus commersoni*, longnose sucker, *Catostomus catostomus*, and the flannelmouth sucker, *Catostomus latipinnis*, are also found in Colorado.

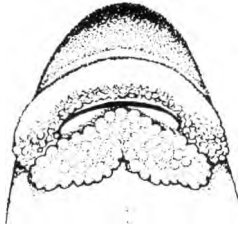
The exact taxonomic relationships of *Catostomus* species are not clearly known. The 16, or so, species of *Catostomus* in North America can be aligned in a progressive morphological series where closely related species are quite similar (Smith and Koehn 1971). Certain species, some not thought to be closely related, readily hybridize. Other populations currently listed as being in the same species may significantly differ from each other. Ferris, et al. (1982), indicated that geographically isolated populations of the Rio Grande sucker represent two species based on electrophoretic analysis of various enzymes. Such observations indicate the current taxonomic scheme may not accurately portray actual speciation within this genus.

Historically, the Rio Grande sucker was restricted to waters of the Rio Grande Basin in south-central Colorado. The white and longnose suckers were native to waters on the east side of the Continental

Divide, and the flannelmouth, bluehead, razorback and mountain suckers were found only in West Slope waters. In the massive fish stocking endeavors dating from the 1860-70's, man inadvertently introduced both the white and longnose suckers to the West Slope and Rio Grande basins. Construction of reservoirs further altered the natural distribution of the various sucker species by altering physical habitats of many rivers. Water temperatures are now lower in many river reaches due to coldwater releases from reservoirs. The native species have disappeared from several waters due to habitat alteration or competition with introduced sucker species. Hybrids are extremely common in other waters. Often 30% of the specimens examined at one collecting site are hybrids. When working with this book it is important to remember that any sucker may well be a hybrid exhibiting characters of various *Catostomus* species.

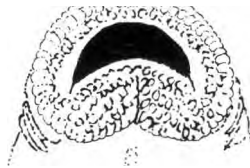
KEY TO THE FAMILY CATOSTOMIDAE

1. a. Dorsal fin long; 23-27 rays
RIVER CARPSUCKER
Carpiodes carpio
- b. Dorsal fin short; 19 rays
 Go to number 2.
2. a. Adults with well-developed sharp ridge on back
RAZORBACK SUCKER
Xyrauchen texanus
- b. Adults with no such ridge
 Go to number 3.
3. a. Distinct notch at connection between the upper and lower lips; inside the lips the edges of the jaw formed into a hard, cartilaginous ridge. (Mountain suckers)
 Go to number 4.



Mouth of the mountain sucker.

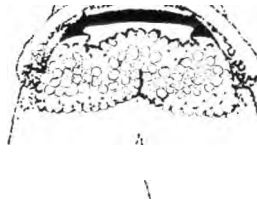
- b. No such notch at connection between upper and lower lips; no hard ridges along inside of the jaws.
 Go to number 6.



Mouth of the white sucker.

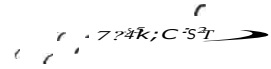
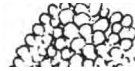
4. a. Lower jaw rounded vertically and horizontally; peritoneum silvery with a few melanophores; dorsal rays usually 9(8-10); median indentation of lower lip deep separated from margin of lower jaw by 2-3 rows of papillae.
RIO GRANDE SUCKER
Catostomus plebeius
- b. Lower lip truncate; peritoneum dusky to black; dorsal rays usually 10-12; median indentation lower lip shallow and separated from margin of lower lip by 4 or more rows of papillae.
 Go to number 5.

5. a. Pigment on caudal fins restricted to rays, inter-radial membrane is either immaculate or few melanophores; pelvic axillary process (a fleshy, small flap of skin in the axil of the pelvic fin, located dorsally of the first pelvic rays) well developed, head of adult not blue.
MOUNTAIN SUCKER
Catostomus platyrhynchus
- b. Pigment on caudal fins spread throughout rays and inter-radial membranes; pelvic axillary process absent, head of adult blue.
BLUEHEAD SUCKER
Catostomus discobolus



Mouth of the bluehead sucker.

6. a. Lateral line scales less than 75
WHITE SUCKER
Catostomus commersoni
- b. Lateral line scales more than 90
 Go to number 7.
7. a. Dorsal fin falcate; 11-13 rays in dorsal fin.
FLANNELMOUTH SUCKER
Catostomus latipinnis



Mouth of the flannelmouth sucker.

- b. Dorsal fin not falcate; 10-12 rays in dorsal fin.
LONGNOSE SUCKER
Catostomus catostomus



Axillary process on the mountain sucker.



Axillary process lacking on the bluehead sucker.

RIVER CARPSUCKER

Carpoides carpio
(*Rafinesque*)

A deep-bodied sucker with a long, falcate (sickle-shaped) dorsal fin; snout short and rounded; mouth short, wide and wholly inferior (on the ventral side of the head); lower lip with a nipple-like projection in the middle. There are 23-27 rays in the dorsal fins; scales are large.

The adults are a slate or olivaceous-silvery color. Fins are colorless or pinkish-yellow. Length at the end of the first year up to 6 inches. Adults in Colorado reach 18-19 inches in length. The average weight of an adult is in excess of 2 pounds ranging to a maximum of 5½ pounds.

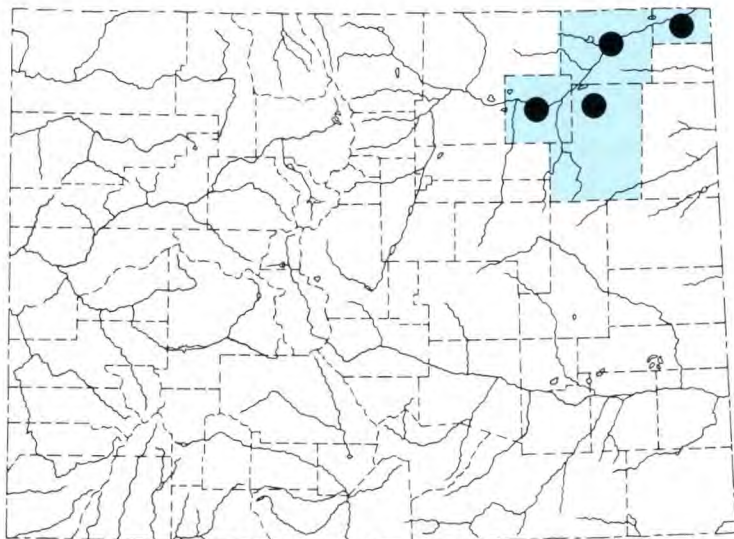
Range: River carpsuckers are found throughout the Mississippi River drainage. In Colorado, the species is restricted to the lower South Platte River on the eastern plains. Adults are common in Jackson, Jumbo and North Sterling reservoirs. Carpsuckers of all ages, from young-of-the-year to adult, are found in Prewitt Reservoir. Immature fish, 2.5-6 inches, are infrequently found in the South Platte mainstem from Fort Morgan downstream to the Nebraska state line (Propst 1982).

Habitat: In reservoirs, adult carpsuckers are widely distributed through the entire water body and are not restricted to one habitat type. Immature carpsuckers collected in the South Platte are found in quiet backwaters and sloughs over a mud bottom. One reason adult river carpsuckers are found only in reservoirs in Colorado may be that the extremely low flows during fall months leave very few large pools or backwaters required by river-dwelling mature fish of this species.

Carpsuckers feed on algae and small bottom organisms such as protozoans, chironomidae (bloodworms), and crustaceans associated with bottom ooze (Cross and Collins 1975). Adults have been found spawning at the inlet area of Prewitt Reservoir during late spring and early summer (J. Stafford, personal communication). Reproduction has not been observed in any other location in Colorado. Eggs are scattered at random and no parental care is provided. Carpsuckers are known to move upstream in the spring and downstream in the fall (Trautman, 1957). Move-



Adult river carpsucker.



Distribution by County of the river carpsucker.

ment of young fish from Prewitt to the South Platte River and subsequent migrations could account for the presence of immature river carpsuckers in the South Platte River. Having reached the Platte, some carpsuckers may move into reservoirs bringing about the needed recruitment to maintain populations in waters where no successful spawning has been documented.

Economic value: The carpsucker pro-

vides a forage base for species commonly sought by anglers but become too large at an early age to be an important forage source.

For additional information regarding the carpsucker see Jester, D.B. 1972. *Life History, Ecology and Management of the River Carpsucker, *Carpoides carpio* (Rafinesque)*, with reference to Elephant Butte Lake. New Mexico St. Univ. Agric. Exp. Sta. Resch. Rept. 243:1-120.

RAZORBACK SUCKER

Xyrauchen texanus (Abbott)

A large sucker with a sharp-edged ridge anterior to the dorsal fin; no other sucker has this characteristic. Lateral line scales are moderate in size ranging from 68-87. Dorsal fin large with 13-16 rays.

Adults are dark brown to olivaceous dorsally, fading to white on the belly. Head and ridge on back is very dark. A maximum length of 3 feet and up to 14 pounds in weight have been recorded. In Colorado, fish of 20 inches in length and weighing 2-3 pounds are average.

Range: Found historically throughout the Colorado River Drainage, this fish has become very rare above the Grand Canyon. In Colorado, recent specimens have been taken only from the lower, mainstem Colorado, Gunnison, lower Yampa and Green rivers. The species is listed as an endangered species in Colorado and less than 70 specimens have been collected in the state since 1979.

Habitat: This is a large river species not found in smaller tributaries and headwater streams. Found in water from 4-10 feet in depth, adults are associated with areas of strong current and backwaters. Many specimens taken in recent years are from off-stream impoundments and reservoirs.

The razorback sucker eats both invertebrates and algae. The spawning act is typical of most suckers in that a ripe female and attendant males settle to the bottom, eggs and milt are expelled and the fish leave the site. No nest is built and fertilized eggs adhere to the river bottom for incubation. Ripe adults have been observed in Colorado at several locations in late May and early June (Wick et al. 1981), although exact habitat requirements for successful spawning are unknown.

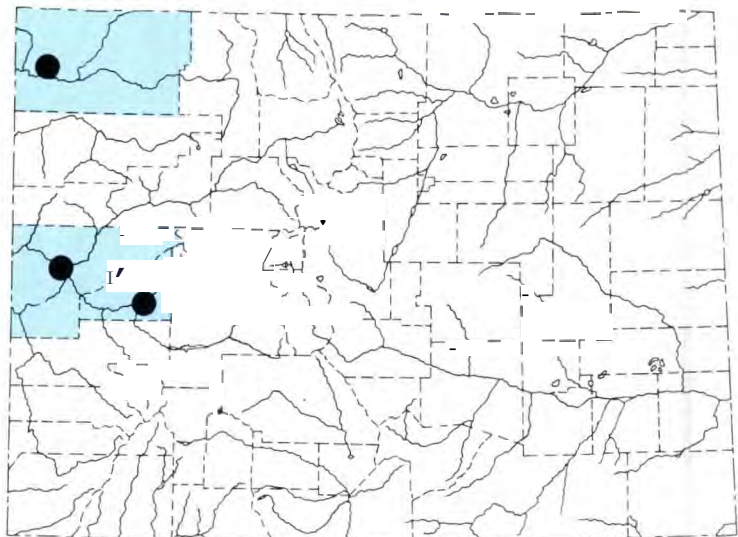
The reasons for the species' decline are not fully understood. Reproductive failure is probably the primary cause. Dams, impoundments and land and water use changes have drastically altered natural flows and river channel characteristics throughout the Colorado River Basin. Blockage of spawning migrations, loss of juvenile habitat, egg siltation, etc., are all possible reasons. Whatever the cause, in recent years only adult fish have been taken. Since 1977, not a single young specimen has been taken in Colorado.



Adult razorback sucker.



Head of the razorback sucker.



Distribution by County of the razorback sucker.

RIO GRANDE SUCKER

Catostomus plebeius
(Baird and Girard)

A stout fish; head large; snout broad, overhanging mouth by a short distance; lips small; median incision of lower lip fairly deep, separated from lower jaw by only 2-3 rows of papillae; there is no fontanelle that may be exposed by removing skin overlaying skull; an axillary process present at axil of pelvic fins; lateral line scales 70-100, usually 85; lining of body cavity silvery, with some speckles.

Adults are dusky to dark or greenish-brown dorsally, fading to yellow or white on the belly. Sides may be mottled. Breeding males are dark above with red lateral stripe and white bellies.

A small species, the few known Colorado specimens are less than 5.6 inches in length. Normally, the size of the adult fish ranges from 2.5-3.5 inches. A maximum of 12 inches has been reported (M. Hatch, personal communication).

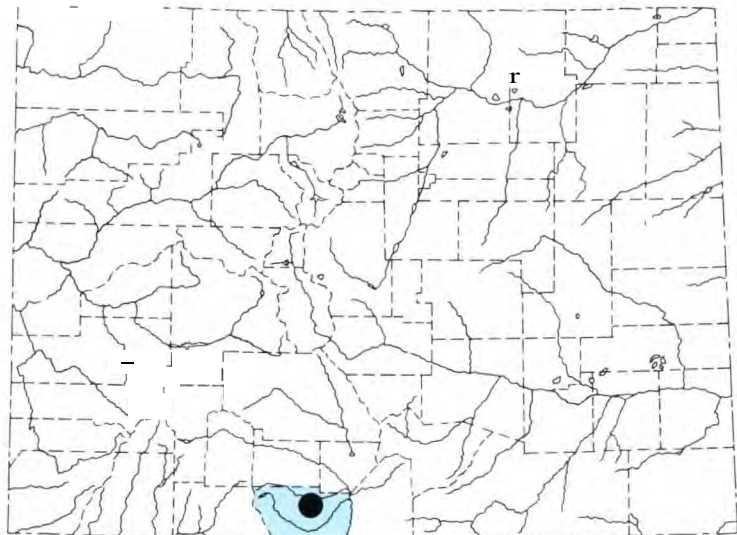
Range: This species, native to the state (Ellis 1914), is restricted to the Rio Grande from Colorado south through Mexico. In Colorado, the fish is restricted to the San Luis Valley and the Rio Grande Basin in Hot Creek and McIntyre Springs (Zuckerman 1983).

Habitat: This species is found in areas near rapidly flowing water. Backwaters or banks adjacent to fast waters provide holding areas during the day. These suckers move to swifter water at night (Minckley 1973). The Rio Grande sucker feeds on diatoms, detritus and aquatic invertebrates. The species is an early spring spawner, February through April, but may go through a second reproductive cycle later in the summer (Koster 1957).

More information regarding this species is needed. Ellis (1914) reported the species as common in the Rio Grande in Colorado. Currently, populations are found only in two small tributaries of the Rio Grande. The species has disappeared from the mainstem Rio Grande, replaced by the white sucker. If the species is as rare as it currently seems, special steps will be required to preserve the Rio Grande sucker and its habitat in Colorado.



Adult Rio Grande sucker.



Distribution by County of the Rio Grande sucker.

MOUNTAIN SUCKER

Catostomus platyrhynchus (Cope)

A stout sucker; head small and rounded; median incision of lower lip shallow; separated from margin of lower lip by 4 or more rows of papillae; there may be a well-developed fontanelle that can be exposed by removing skin overlaying skull; pigment on caudal fins mostly restricted to rays, inter-radial membranes may be clear or have a few small spots; an axillary process present; lining of body cavity black or dusky; lateral line scales 76-97, normally 80-85.

Adults are dark brown or tan fading to white on the belly. Dark mottling shaped like saddles across the back may be present in some specimens. Breeding males with a red-orange stripe on sides. Young less than 2 inches long are silver-tan on the back fading to silver-white on the stomach with dark speckles on the back.

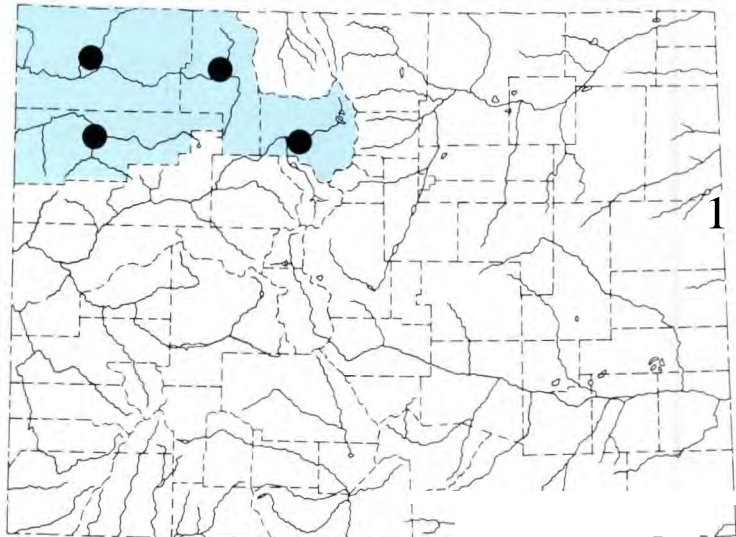
A smallish fish, this species attains a maximum length of about 8 inches (Sigler and Miller 1963) with a normal range of 3.2-6.3 inches for adults.

Range: A widely distributed species, the mountain sucker ranges from Washington north to Saskatchewan down to Montana, east to the western edge of South Dakota through Wyoming and west to Utah including the Green River in Colorado (Smith and Koehn 1971). Beckman (1952) listed *Pantosteus jordani* (Evermann), a species name now considered synonymous with *Catostomus platyrhynchus*, as a mountain sucker located in the South Platte River Drainage of Colorado. The specimen identified as *P. jordani* in Beckman's book was later re-identified as a Rio Grande sucker. The fish in question was probably the result of some fish stocking endeavor (Smith 1966). Although reported by many investigators in Colorado, there are few known specimens of the mountain sucker. Mountain suckers have been collected in the White River Basin (Piceance Creek) and the Yampa River Basin (Steamboat Lake). Only one record of mountain sucker (Snyder 1981) exists from the upper reaches of the Colorado River system. No specimens have been reported from the drainage south of the Colorado River mainstem.

Habitat: The mountain sucker is found in smaller rivers and streams with gravel, sand and mud bottoms. Colorado specimens are found in areas of undercut banks, eddies, small pools, and in areas of moderate current. Young prefer shallow



Adult mountain sucker.



Distribution by County of the mountain sucker.

backwaters and eddies. A population of mature adults is found in at least one Colorado impoundment, Steamboat Lake.

Scraping ridges on the jaws and a very long intestine indicate a diet composed of algae, diatoms and other material taken from stream or river substrates. Spawning takes place in early summer. Little else is known about this species.

The mountain sucker may easily be confused with the bluehead sucker, especially specimens less than eight inches long taken from smaller tributaries. Bluehead suckers are rather slender in form with a comparatively thin caudal peduncle while the mountain suckers are stouter and more robust with a relatively thicker caudal peduncle. The head of the bluehead is flattened dorso-ventrally while the head of a mountain sucker is comparatively blunt. A small fleshy flap

of skin (the axillary process) is found in the axil of the pelvic fin on the mountain sucker. This structure is not found on bluehead suckers. Care must be taken when looking for the axillary process in that the structure is not always evident when a mountain sucker is first removed from the water. The process becomes more evident as the fish slowly dries. The bluehead sucker has pigment spots located throughout the inter-radial membranes of the caudal fin. Mountain suckers may have pigmentation on the inter-radial membrane but the spots are generally smaller, fewer in number and located closer to the fin rays. Because of this overlap, the two best characteristics available to differentiate between the two appears to be depth of the caudal peduncle and presence or absence of the axillary process.

BLUEHEAD SUCKER

Catostomus discobolus (Cope)

An elongated, slender sucker; head short; snout bulbous; mouth large, ventral; upper lip broad; median incision or lower lip shallow, separated from lower jaw by 4-7 rows of papillae; there is a notch at the connection of the upper and lower lips; jaws have well-developed, cartilaginous scraping edges; no fontanelle (opening on top of the head where bones have not grown together) that may be exposed by removing skin overlapping skull; caudal peduncle relatively slender; pigment spots on caudal fin spread throughout rays and interradiation membranes; no axillary process in axil of pelvic fins; lining of body cavity black or dusky; lateral line scales number from 95-115. Small bluehead suckers, less than 8 inches in length may be confused with the mountain sucker (see mountain sucker account).

Adults vary according to habitat, ranging from grey-blue to tan to yellowish in color and are darker dorsally. The head, especially of adults, often has a blue cast. Young less than two inches are silver-tan on the back fading to silver-white on the stomach. Adults in large rivers range from 10-16 inches in length. In small streams, flannelmouths seldom grow larger than 7-8 inches (Holden and Stalnaker 1975).

Range: Found throughout the middle and upper Colorado River Drainage in Colorado, New Mexico, Arizona, Utah and Wyoming. In Colorado, the species is restricted to western slope waters. In some waters, such as the Gunnison River above Blue Mesa Reservoir, this species and the flannelmouth sucker seem to have been replaced by white and longnose suckers since the 1960's. The white and longnose suckers, native to East Slope waters of Colorado, were introduced by man to the western slope. Coldwater releases from reservoirs may also have been involved in the disappearance of the bluehead sucker from some West Slope waters (Wiltzius 1978).

Habitat: The bluehead sucker is found in a wide variety of areas from headwater streams to large rivers. It is absent in areas of standing water, requiring water of moderate-to-fast velocity. The species also prefers a rock substrate. If a river substrate is composed of sand, bluehead suckers are found where rock shoals created by talus slopes reach into the water (Holden and Stalmaker 1975). The shape of this species varies with the habitat. In waters of high velocity the caudal peduncle is very thin. Conversely, populations in tributaries with slower current have a thicker



Adult bluehead sucker.

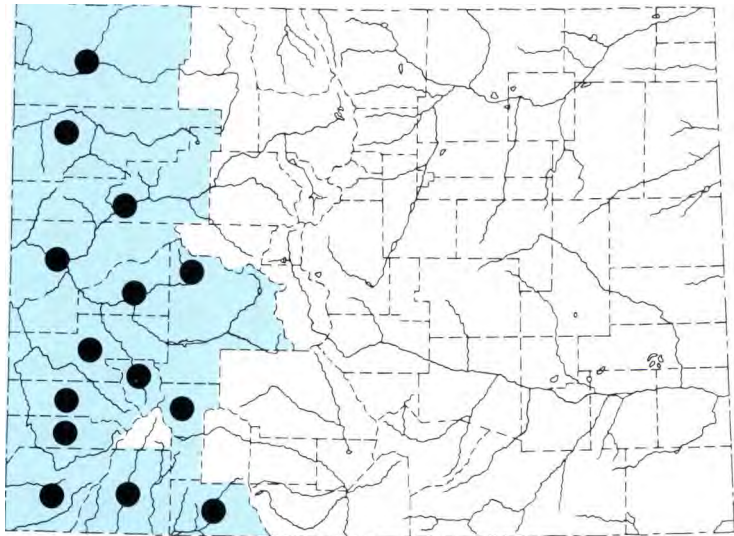
caudal peduncle. Both forms have been collected at the same sites.

The bluehead feeds on algae, invertebrates, and other material scraped from stones and rocks in the water. Blueheads can be seen feeding in areas of swift water pulling themselves along the bottom, often on their sides or upside down. Spring or summer spawners, not much is known of their breeding habits. Based on capture of young-of-the-year fish spawning in the Colorado River occurs in late April to early May (Haynes & Muth 1982).

This species is a good bait and forage fish.



Detail of head.



Distribution by County of the bluehead sucker.

WHITE SUCKER***Catostomus commersoni*
(Lacepede)**

A robust sucker, round to oval in cross section; snout rounded and fleshy, scarcely overhanging the mouth; mouth ventral; no notch or indentation at the lateral connection of lower and upper lips, thick upper lip with 4-8 rows of papillae, lower lip with deep median cleft, median indentation of lower lip separated from the edge of the lower jaw by two or less rows of papillae. The dorsal fin not falcate, with 10-13 rays. Scales are moderate in size; less than 75 scales along lateral line.

Adults are darker dorsally (olivaceous) fading to white on the stomach. Young are olivaceous to white. During spawning season, males and females may become very dark on the back and sides.

Length at the end of first year from 4-6 inches. Adults may be longer than 20 inches and weigh about 2-3 pounds.

Range: White suckers are found throughout Canada, the eastern United States south to Georgia, west to Oklahoma and north through Montana. In Colorado, the species is native and abundant on the eastern slope. Many introductions of this species and the longnose sucker, also an East Slope native, to West Slope waters occurred when the fish were mixed with trout plants from eastern hatcheries and through the fisherman's bait bucket. Populations of these East Slope suckers have become numerous on the West Slope while flannelmouth and bluehead suckers, native to the upper Colorado River Basin, have disappeared from some West Slope waters.

Habitat: The species inhabits lakes, streams and rivers throughout Colorado. In streams, adult white sucker are found in pools and runs but require low-to-moderate currents. Rip-rap banks, bridge abutments, boulders, and undercut banks are preferred locations in streams and rivers. Younger white suckers, less than 6 inches, are found in runs and riffles with moderate velocity and backwater areas (Propst 1982). White suckers tolerate a wide variety of conditions including river stretches greatly enriched from domestic sewage treatment plant effluents. Propst (1982) often found the white sucker to be the most common fish at such locations, although numbers were lower than at similar, unpolluted sites.

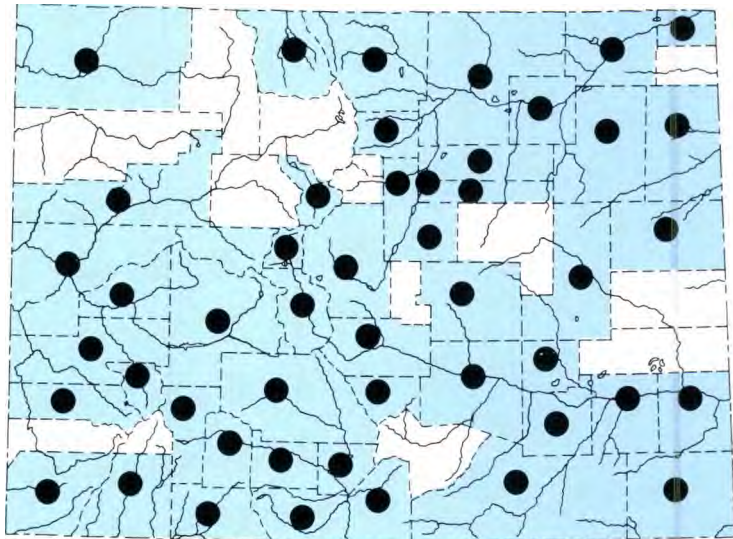
White suckers feed primarily on invertebrates, although plant material is often ingested by this indiscriminate bottom feeder. The species is a spring spawner. Generally, spawning sites chosen are in



Adult white sucker.



Detail of head.



Distribution by County of the white sucker.

moving water with a gravel bottom. In some reservoirs without an inlet stream, where water is piped to the impoundment, schools of ripe suckers, male and female, can be found in the spring moving along the shore, presumably attempting to spawn. Two-to-four males crowd around each female pressing against her during 3-4 second spawning acts that number 6-40 each hour (Scott and Crossman 1973). Nests are not built. In rivers, fertilized eggs drift downstream adhering to the substrate in pools and eddies. In lakes, fertilized eggs may be scattered on the

lake bed. Young white suckers, 0.4 inches total length, have been collected from the Colorado River (Mesa County) and Yampa River (Moffat County) in late May and early June (Haynes and Muth 1982).

The white sucker is often used as a bait for fish such as channel catfish and northern pike. Accidental release of the species in many mountain lakes and streams has impacted trout fishing. Suckers become overly abundant while trout diminish. A very underutilized food source, flesh of the white sucker is sweet and firm, especially if taken in the spring.

FLANNELMOUTH SUCKER

C 0 0 0 0 0 0 0 0 *latipinnis*

(B 0 0 0 0 0 0 G 0 0 0 0 0 0)

An elongated sucker, oval in cross section; snout blunt and broad, overhanging ventral mouth; no notch or indentation at the lateral connection of lower and upper lips, thick upper lip with 5-8 rows of papillae, median indentation of lower lip complete, at most one row of papillae separating indentation and edge of lower jaw; dorsal fin is falcate (sickle-shaped) with 11-13 rays; scales are small, crowded near head; more than 90 scales along lateral line.

Adults in clear water are greenish-blue-grey on the back, fading to yellow on the sides and to white on the belly. In turbid water, with a sand or mud bottom, flannelmouths are light tan on the back, white and silver on the sides and belly. Young are lighter colored. Anal and pelvic fins yellowish. Dorsal and tail fin dusky. A large species, one specimen attained a weight of 3.5 pounds and was 22 inches long (McDonald and Dotson 1960).

Range: The flannelmouth is restricted to larger streams and rivers in the middle and upper Colorado River Drainage, including parts of Wyoming, Colorado, New Mexico, Utah, Arizona and Nevada. In Colorado, the flannelmouth is found only in large rivers on the western slope. This species and the bluehead sucker have disappeared from some waters, such as the Gunnison River above Blue Mesa Reservoir, since the 1960's. The white and longnose suckers, introduced from East Slope waters, have replaced the flannelmouth and bluehead in the upper Gunnison River. Competition with the introduced species and/or cold water temperatures from reservoir releases probably led to the disappearance of the flannelmouth from the upper Gunnison.

Habitat: As noted above, the flannelmouth sucker inhabits larger streams and rivers in all habitat types including riffles, runs, eddies, and backwaters. The species does not appear to maintain viable populations in impoundments (Minckley 1973).

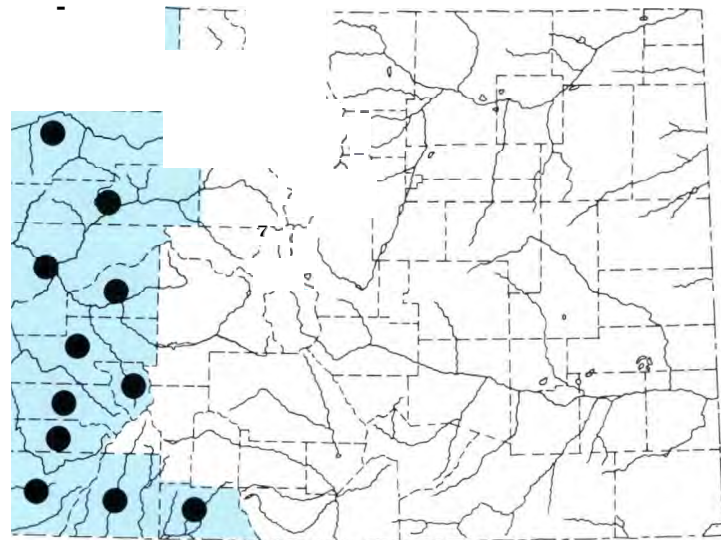
A bottom feeder, like the white and longnose suckers, the flannelmouth feeds



Adult flannelmouth sucker.



Detail of head.



Distribution by County of the flannelmouth sucker.

on invertebrates. Spawning takes place in early May to early August in the Colorado and Yampa rivers (Haynes and Muth 1982), although spawning habits or sites

have not been observed (Sigler and Miller 1963), with young moving to shorelines.

As with other suckers, this species could be used as bait or food.

LONGNOSE SUCKER

Catostomus catostomus
(Forster)

This is an elongated, cylindrical sucker; head tapering into a long snout overhanging the mouth; mouth ventral, no notch or indentation at lateral connection of upper and lower lips, thick upper lip with 5-8 rows of papillae, median indentation of lower lip complete; dorsal fin not falcate with 10-12 rays; scales are small in size, crowded near head, larger near the tails; more than 90 scales along lateral line.

Adults are generally dark, olive, or grey on the back shading to white on the ventral surface. During spawning periods, males and females develop a broad lateral band that is wine red in color. Young are dark tan in color.

Longnose reach a length of 9 inches in two years. Maximum length can be 30 inches and the fish may weigh several pounds (Beckman 1952).

Range: The longnose sucker is the only member of this family found in both North America and Asia. It ranges in North America from Alaska east to Labrador, south to Maryland west through Minnesota, south to Colorado and north through Washington. In Colorado, the species is native to the East Slope. Introduction to West Slope waters has expanded the range of the longnose sucker. As with the white sucker, the longnose has replaced and hybridized with species native to the West Slope.

Habitat: Common in both lakes and streams, the longnose is found in warm and cold waters. In the South Platte River, longnose suckers are usually found in the same areas as white suckers (Propst 1982). Although found in both pool and riffle areas, longnose suckers are apt to be in waters near areas of moderate to high flow velocities.

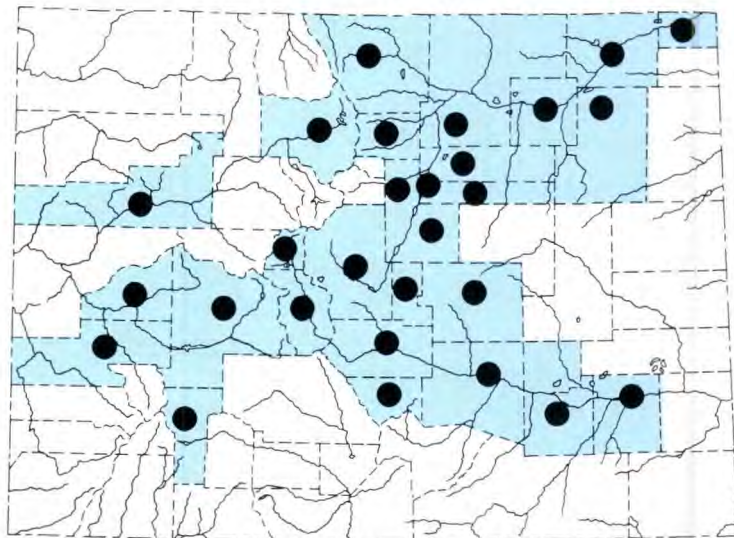
Bottom feeders, this species feeds on many types of invertebrates. Longnose suckers spawn earlier in the spring than the white sucker. The spawning period for the species is short. Large numbers of fish in breeding colors move into an area of slow, shallow water, with a gravel bottom, spawn and move downstream in a period of about one week. Spawning activity is similar to the white sucker. The longnose sucker appears to be a comparatively



Adult longnose sucker.



Detail of head.



Distribution by County of the longnose sucker.

long-lived fish, 22-24 years, attaining sexual maturity between the fifth and ninth year (Scott and Crossman 1973).

Economic value: The longnose sucker is often used as bait. Use of live fish is not

to be encouraged due to the species ability to establish itself wherever released. Longnose suckers represent an untapped food protein source and possess firm, white, sweet meat.

Family *Cyprinodontidae* TOPMINNOWS

Topminnows are an abundant family of fish that is most common in tropical areas. Two species are found in Colorado.

KEY TO THE FAMILY *CYPRINODONTIDAE*

- | | |
|--|---|
| <p>1. a. Dorsal fin with 14-15 rays. Has a series of narrow vertical bars on the side.
PLAINS KILLIFISH
<i>Fundulus zebrinus</i></p> | <p>b. Dorsal fin with 9-12 rays. No bars on sides.
PLAINS TOPMINNOW
<i>Fundulus sciadicus</i></p> |
|--|---|

Cyprinodontidae Genus *Fundulus*

PLAINS KILLIFISH *Fundulus zebrinus* (Jordan and Gilbert)

A small, stout topminnow; head broad and flat; mouth terminal and upturned; origin of anal fin fairly even with origin of dorsal fin; dorsal fin with 14-15 rays; anal fin with 13-14 rays; tail fin with rather squared angles; moderate-sized scales, 53-65 in lateral line.

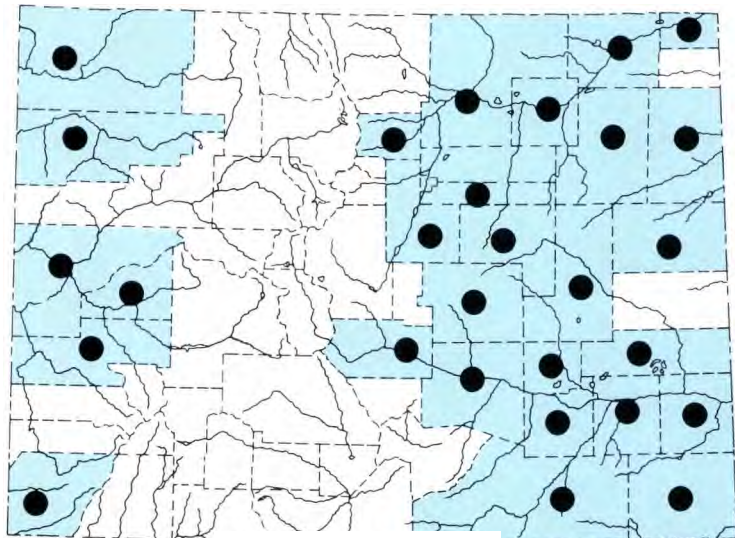
Adults are tan, yellow or black, fading to a yellow-white color on the stomach. There is a series of dark, thin bars on the side. During the breeding season, all fins (except the dorsal) in males may develop a yellow or orange coloration. This species is larger than the plains topminnow but still small, seldom exceeding 3.5 inches in length.

Range: The species is found in western plains states from South Dakota to Oklahoma and Texas. Native to the Colorado River in Texas (Moore 1968), the killifish has been recorded in the Little Colorado River (Minckley 1973) and is thought to be a species introduced to southeastern Utah (Sigler and Miller 1963). The plains killifish is a common, native species throughout east slope Colorado streams. Not reported in the mainstem Colorado or Gunnison rivers prior to 1968 (Wiltzius 1978), the species has since become abundant in the Colorado River and occasionally in the Gunnison River below Escalante (Kidd 1977). There are two possible explanations to the appearance and expansion of the plains killifish in west slope Colorado waters. The species may have been introduced via bait bucket transfers or stocked inadvertently with other species. Secondly, the species may be gradually expanding upstream from Utah waters. Either explanation, or a combination of the two, may be possible.

Habitat: The species is found in shallow, sandy bottom streams or along shallow banks and shoals in larger streams. Plains killifish are tolerant of some current, while plains topminnows require areas of minimal-to-no current. Killifish are usually a major component of the fish fauna where filamentous algal growths are present. Propst (1982) found



Adult male Plains killifish.



Distribution by County of the Plains killifish.

killifish to be common-to-abundant in diverse stream types ranging from intermittent high plains tributaries—to transition streams—to the mainstem South Platte River. The species is also tolerant of fairly extreme habitat variations being able to tolerate very warm water (86°F) and locations where run-off from cattle operations has created a stream substrate composed of oxygen-consuming organic

wastes. The ability to withstand severe conditions is partially responsible for the species' presence in the dewatered stream reaches common in Colorado.

Plains killifish are carnivorous, taking a wide variety of aquatic invertebrates including midge (*Chironomidae*) larvae. The fish feeds on both the surface of the water and on the stream bottom. Cross and Collins (1975) report the plains

killifish spawns from May through July during the day, when water temperatures exceed 80°F. Spawning activities take place over sand, in areas of slow current with the eggs scattered randomly over the substrate after fertilization.

Killifish do not make good bait. Although periodically sold as bait fish, killifish will often be ignored by a crappie or other species sought by the angler while a fathead minnow may rapidly be taken.



Adult Plains killifish.

Family Cyprinodontidae Genus Fundulus

PLAINS TOPMINNOW *Fundulus sciadicus* (Cope)

A small, stout topminnow; head broad and flat; mouth terminal and upturned; origin of anal fin only slightly forward of origin of dorsal fin; dorsal fin with 9-12 rays; anal fin with 12-15 rays; tail fin somewhat rounded, scales large, 33-37 in lateral line. Similar in appearance to the mosquitofish (see mosquitofish species account).

Adults are green-olivaceous in color on the back, fading to a white-silver stomach. Sides without bars. Fin iridescent in summer with red tips and blue-purple bands inside red tips. A small fish, this species is seldom larger than 2.5 inches in length.

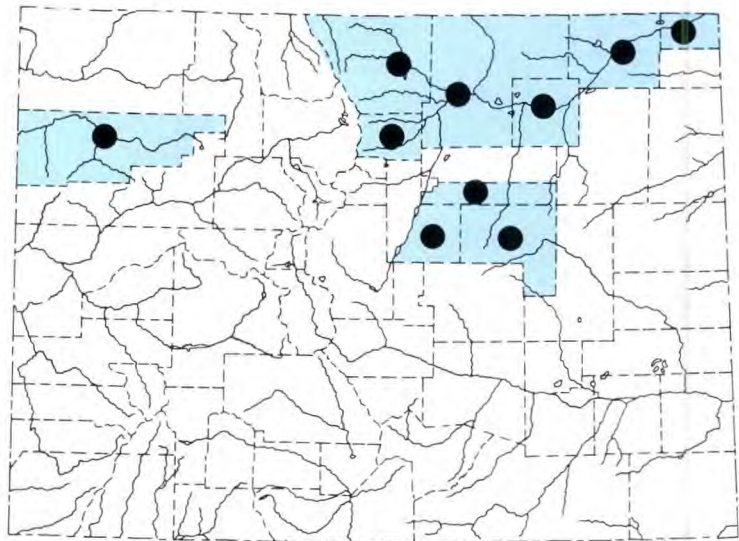
Range: The species has a very disjunct distribution, found in several plains states including Wyoming, South Dakota, Missouri, Kansas, Oklahoma and Colorado. The species is native to Colorado (Jordan 1891). Nowhere is the species reported to be widespread and is usually found in isolated colonies. Colorado populations are found in isolated colonies in cool, foothills streams, intermittent plains streams, and the lower mainstem South Platte River (Propst 1982). Recent collections have demonstrated the species is now present in the White River, undoubtedly the result of an inadvertent introduction by man (Wick et al. 1981).

Habitat: Plains topminnows have specialized habitat requirements. Populations in Colorado are found in waters where there is abundant filamentous algal growths and still, clear water. Propst (1982) found that the plains topminnow, usually collected alone at most sites, was sometimes collected with the plains killifish.

Little is known about the species life history except that spawning occurs in late spring and early summer with eggs deposited on aquatic plants (Pflieger 1975).



Adult Plains topminnow.



Distribution by County of the Plains topminnow.

F0 0 0 0 P0 0 0 0 0 0 0 0

THE LIVEBEARERS/ MOSQUITOFISH

Poeciliid fishes are livebearers, extremely popular among aquarium owners due to their colorful nature and ease of spawning. The family is native to the western hemisphere and reaches its

greatest diversity in and around Central America. Many of these species are released into the wild each year by well-meaning people who no longer want to care for the fish. Most of these fish can not tolerate cold water and die. In the San Luis Valley some feral populations of exotic livebearers have become permanently established in hot spring areas that have been used as rearing stations by people who commercially sell tropical fish. Zuckerman (1983) found the green swordtail and shortfin molly thriving in the

Valley View Hot Springs, while the green swordtail, shortfin molly, sailfin molly, and southern platyfish were found in canals, ditches, and ponds below the Weisbart and Weisbart Hog Farm where tropical fish are being reared. A key to these species is not presented here due to the complex nature of the characteristics involved. An assumption is made that most collectors will recognize these common aquarium fish especially since they will be found only in these isolated areas in the San Luis Valley.

F0 0 0 0 Poeciliidae Genus G0 0 0 0 0 0

MOSQUITOFISH

G0 0 0 0 0 0 0 0 0 0 0 0
(B0 0 0 0 0 0 G0 0 0 0 0)

A small, stout fish; terminal, upturned mouth; anal fin much farther forward than dorsal fin; dorsal fin with 7-10 rays; anal with 10 rays, first few anal fin rays in males elongated to form intromittant copulatory organ; tailfin rounded; scales large, 29-32 in lateral line. Similar to plains topminnow (see plains topminnow account).

Adults are drab, green-silvery or yellowish on the back, fading to a silver stomach. There is usually a teardrop-shaped bar beneath the eyes. Females may have a dark spot near the anal vent. Females can reach two inches in length while males are seldom greater than 1.25 inches long.

Range: The mosquitofish is native to the southern Mississippi River system. Used as a mosquito control system, the species has been widely introduced throughout the United States. Populations are now found in states neighboring Colorado such as Kansas (Cross and Collins 1975) and Arizona (Minckley 1973). This species has been released in Mesa County, the Rio Grande Basin and the Denver region and other areas to control mosquitos. Intolerant of cold, most populations do not survive the cold temperatures of Colorado winters. A few wild populations have been found surviving in Denver and the Rio Grande Basin where water temperatures in winter are relatively warm due to surfacing groundwater springs.

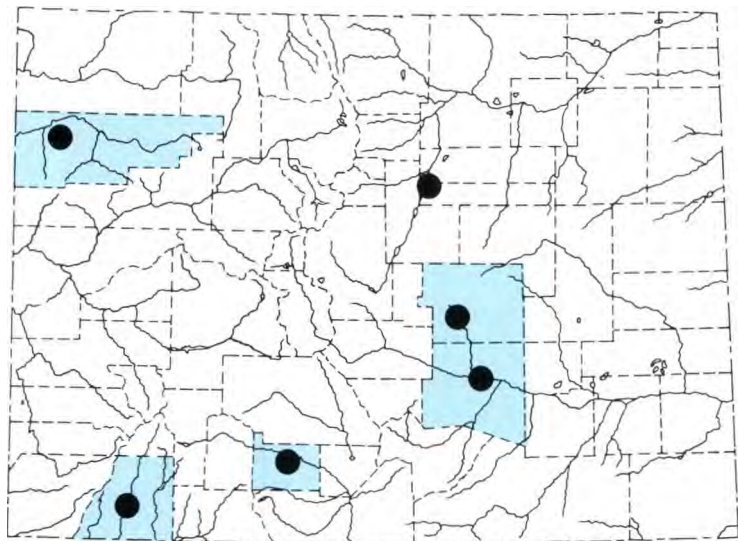
Habitat: Mosquitofish are able to colonize a variety of quiet, shallow pool situations or backwaters of slow moving streams. Cool, clear pools are successfully colonized as are hot, stagnating ponds and every other habitat type.

Mosquitofish are carnivorous, traveling and feeding an inch or so below the surface, they take a variety of aquatic invertebrates, including fish larvae. They are not



Adult male mosquitofish.

Adult female mosquitofish.



Distribution by County of the mosquitofish.

only cannibalistic, devouring their own young, but also feed on other species. Minckley (1973) linked the predatory habits of this fish to the disappearance of rare fish species in the desert southwest. Reproductive habitats are similar to the closely related, common guppy. Males

actively pursue and mate with females throughout the breeding season. Sperm from the male is stored within the female's body. Sperm from one mating may fertilize several successive broods of eggs during one summer. Each brood may produce 100 young (Cross and Collins 1975).

For additional information regarding the mosquitofish see Krumholz, L.A. 1948. *Reproduction in the Western Mosquito fish, Gambusia affinis affinis* (Baird and Girard), and its use in Mosquito Control. Ecol. Monogr., 18:1-43.

Family *Cottidae* SCULPIN

Most species of this large, diverse family live in saltwater. One genus, *Cottus*, is also found in freshwater systems, principally in the northern United States. Sculpin are widely distributed throughout the Colorado River Basin in Colorado. The taxonomic picture regarding sculpin in Colorado is not clear. Beckman (1952) reported that two species of sculpins were found in Colorado, the eagle sculpin, *Cottus annae* (Jordan and Starks) and the mottled sculpin, *Cottus bairdi*. Bailey and Bond (1963) stated that the Paiute sculpin, *Cottus beldingi* (Eigenmann and Eigenmann) and *C. annae* were different names applied to the same species, and that *Cottus beldingi* was the valid scientific name. Maughan (1978) determined that the mottled sculpin and the Paiute sculpin could be separated if several characteristics including the four above were examined:

	Palatine Teeth	Lateral Line	Preopercular Spines	Number of Pectoral Rays
<i>Cottus bairdi</i> Mottled Sculpin	well developed	normally complete	normally three	15-16
<i>Cottus beldingi</i> Paiute Sculpin	normally lacking	normally incomplete	usually 1	13-14

Sculpin taken from a variety of waters throughout western Colorado can not be separated into one of two species on the basis of these characteristics. Individuals often exhibit characteristics of both species, while a series of fish from the same locale often differ from each other. Two observations were made. Specimens from higher elevations (higher than 8,500 feet) in southwestern Colorado generally had characteristics typical of the mottled

sculpin. Secondly, a series of specimens from the Williams Fork above the Williams Fork Reservoir had characteristics of the Paiute sculpin. More research is needed to determine what species of *Cottus* inhabit Colorado waters, and their taxonomic relationships. For purposes of this publication one species, the mottled sculpin is described. Much of the information presented applies to all freshwater sculpin in a general sense.



Adult mottled sculpin. These small fish are usually found under stones on the bottom of trout streams.

MOTTLED SCULPIN

Cottus bairdi (Girard)

Head broad and flat, preopercle with three spines; one, large, sharp spine located at angle; two spines below are smaller and covered by skin; eyes on upper side of head; body depth and width towards the head about equal; toward the tail, body strongly compressed laterally; pectoral fins exceedingly large; dorsal fins joined but separated by deep notch.

Color is orange-tan, brown, to darker red-brown, mottled with darker spots. All but the pelvic fins are marked with pigment spots. Breeding males have a dark band on dorsal fin.

Adults average from 3-5 inches in length. One specimen from the San Miguel River was greater than 7 inches in length.

Range: This species has a vast, but not continuous distribution, in the United States and Canada. The species is found in Labrador, west to the Great Lakes and South to Tennessee. Mottled sculpin are also found in parts of the Missouri and Columbia River basins south to Utah in the Bonneville and Snake river systems. In Colorado, the mottled sculpin is restricted to the western slope in the San Juan, Animas, Yampa, White, Colorado and Dolores river drainages. In the Gunnison River, the species extends upstream only to about the area of the North Fork confluence (Wiltzius 1978). Ellis (1914) reported sculpin were found in the headwaters of the Arkansas River. No other collections of sculpin have been reported from the Arkansas drainage since that time, indicating the initial report from the Arkansas may have been erroneous.

Habitat: This fish prefers cool, clear, swift mountain streams and rivers (Sigler and Miller 1973). Sculpin are often found under rocks and in the rubble of stream bottoms. However, in portions of the Gunnison, Colorado and Yampa river mainstems where sculpin are taken, waters are often turbid and slow while summer temperatures exceed 80°F. Normally, cobble bottom appears to be a habitat prerequisite. Sculpin are not usually found in stream reaches where the interstitial spaces between the rocks of the cobble bottom have filled with silt, mud or other material. Erosion and discharges resulting from human activities can cause sedimentation which could eliminate sculpin from a particular river reach.

The mottled sculpin feeds almost entirely on aquatic macroinvertebrates from the benthos. Several authors have shown that sculpin do not feed extensively on the



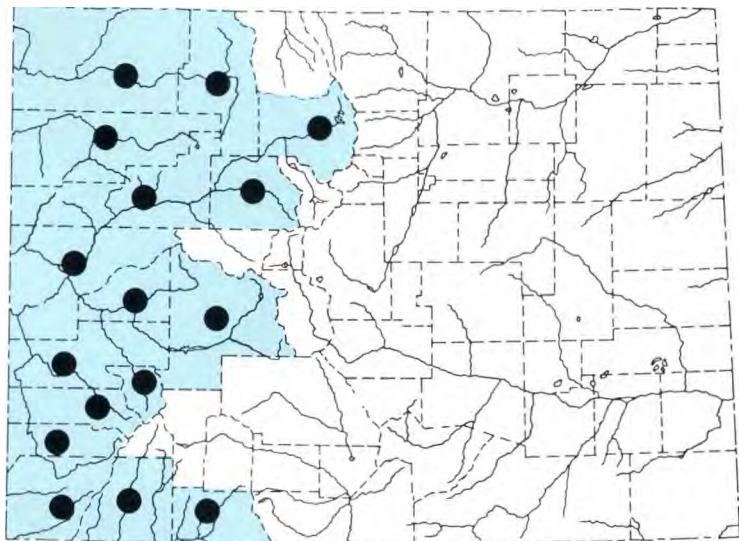
Adult mottled sculpin.

eggs of trout as often stated (Sigler and Miller 1963, Scott and Crossman 1973). Spawning begins when water temperatures reach about 50°F in the spring (Koster 1936). Koster found that sculpin spawn usually when three years old. The male picks a nest under an overhang rock. After courtship and spawning, the adhesive eggs are deposited on the underside of rocks in the nest. The male guards the nest until the eggs hatch.

Mottled sculpin are a food source for trout in Colorado. One fly pattern, the muddler minnow, is an imitation of the sculpin.



Detail of head.



Distribution by County of the mottled sculpin.

Family *Percidae*

THE PERCHES

The perch family is a large, diverse group found throughout North America, Europe, and Asia. Six species of this family are currently found in Colorado. Two species are delicious tasting gamefish, yellow perch and walleye. Four species, diminutive in size and often missed by fishermen, are collectively called darters. Only the darters are discussed in this book.

KEY TO THE FAMILY

PERCIDAE

1. a. Rear edge of preopercle strongly serrated (sawtooth in appearance); large mouth, the upper jaw extends to at least below middle of the eye; adults are usually longer than 5 inches in length.
Go to number 2.
- b. Rear edge of preopercle smooth; small mouth, the upper jaw does not extend to below middle of the eye; adults seldom exceed 3 inches in length.
Go to number 3.
2. a. Body has a series of conspicuous, dark regularly shaped bars across the back and down the sides; there are no teeth on roof of the mouth; eyes are dark.
YELLOW PERCH *Perca flavescens* (See Woodling 1980)
- b. Sides and back without bars; teeth on roof of mouth; eyes are opaque gray in color.
WALLEYE *Stizostedion vitreum* (See Woodling 1980)
3. a. Anal fin has one spine, w, or m-shaped markings on sides.
JOHNNY DARTER
Etheostoma nigrum, see page 67.
- b. Anal fin has two spines (rarely one), no v, w, or m-shaped markings on sides.
Go to number 4
4. a. Area in front of preopercle (cheek) lightly scaled.
IOWA DARTER *Etheostoma exile*, see page 69.
- b. Area in front of preopercle (cheek) scaleless.
Go to number 5
5. a. Opercles and preopercles scaleless, lateral line usually ending under first dorsal fin.
ARKANSAS DARTER
Etheostoma cragini, see page 71.
- b. Opercles have scales, preopercles scaleless, lateral line usually extending past first dorsal fin.
ORANGETHROAT DARTER
Etheostoma spectabile, see page 70.

Family *Percidae* Genus *Etheostoma*

JOHNNY DARTER

Etheostoma nigrum (*Rafinesque*)

A moderate-sized darter; mouth and snout small and inconspicuous; opercles have scales while preopercles (cheeks), nape and breast are scaleless; two dorsal fins, first spiny, second soft-rayed; caudal fin squarish; pectoral and pelvic fins located close to each other behind the gills, pectorals large and fanlike while pelvics are small and round; anal fin with one spine; lateral line complete.

Adults are almost translucent with yellow-brown or brown-black overtones, darker on the back fading to white on the stomach. There may be darker markings on the top of the back. In addition, along the lateral line are a series of distinctive 'W', 'M', or 'V' shaped markings. Breeding males are darker, especially on the front half of the body. The maximum size is about 2-2.5 inches, with only a few individuals reaching three inches in length.

Range: The johnny darter ranges from central Canada through the northeast and north-central United States south to Louisiana. Native to Colorado, this darter is found in isolated portions of the South Platte River Basin. Populations are encountered in the transition portions of several tributaries as the streams flow from the mountain areas out onto the plains (Propst 1982). The johnny darter has also been taken in the South Platte



Adult Johnny darter.

River below Chatfield Reservoir. Populations are abundant in the North Platte Drainage of Colorado. In addition, johnny darters are found in Haviland Reservoir north of Durango (M. Japhet, personal communication), and Shadow Mountain Reservoir in the headwaters of the Colorado River. These last two locations are undoubtedly the result of a bait bucket transfer or from accidental inclusion in a

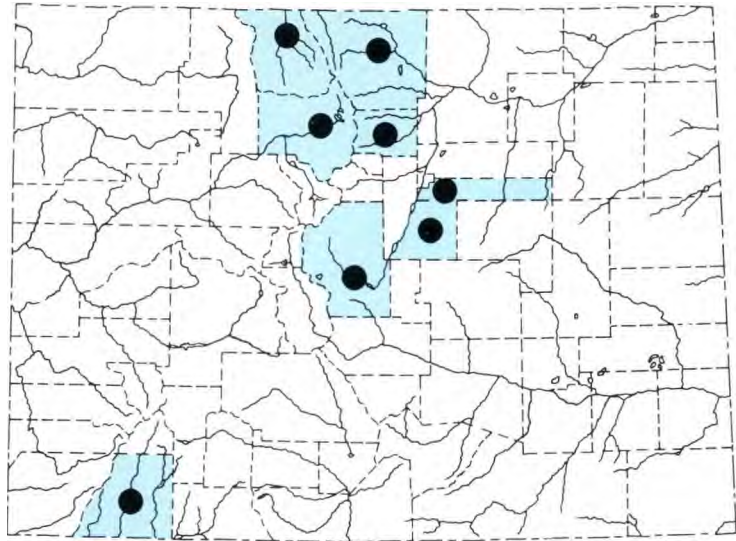
fish plant of some other species.

Habitat: Propst (1982) found that the species may be present in water from 6-18 inches deep with a moderate current and a sand and rubble substrate. Individuals are usually found along stream banks or in the shallow flat runs. Johnny darters are bottom-dwelling fish, often perching on rocks of the stream bottom, head oriented into the current.

Like most members of this group, johnny darters are predaceous, feeding on a variety of aquatic invertebrates. The johnny darter spawns in late spring with males establishing territories and building a nest under rocks (Cross and Collins 1975). Eggs are deposited on the underside of the rubble by females, then fertilized and guarded by the male.

The johnny darter is not as abundant in Colorado now as at the turn of the century (Propst 1982). The habitat required by the darter is not common in many parts of the South Platte Drainage. Dewatering, channelization and discharges containing varying levels of pollutants have all decreased the amount of habitat suitable for this species. For example, Propst (1982) found that in streams where the johnny darter was present, if a turbid irrigation return flow silted over the substrate the darter was absent from that stream reach.

The johnny darter is not suitable for use as a bait minnow because of the relative scarcity of the species and the sedentary nature of the darters. Johnny darters do not actively swim in the water column, attracting game species.



Distribution by County of the Johnny darter.

IOWA DARTER

Etheostoma exile (Girard)

A small darter; mouth and snout small and inconspicuous; opercles and cheeks are scaled; two dorsal fins, first spiny, second soft-rayed; caudal fin squarish; pectoral and pelvic fins located close to each other behind the gills; anal fin with two (rarely one) spines; lateral line incomplete.

Males and females have different color patterns. Males in breeding colors are brilliantly hued. Breeding males are olivaceous dorsally with darker splotches across the top of the back. The sides are red with blue, rectangular blotches. Ventrally, males are whitish with a dark wedge shape below the eye. The bottom half of the spiny, (first) dorsal fin has blue spots between spines. Above the blue spots there is a succession of three bands, orange, clear, and the outer band blue in color. Females and young are olive-brown dorsally with darker splotches across the top of the back, sides may be mottled fading to silver-white on the belly. A dark wedge shape below the eye is well developed. Adults are less than three inches long.

Range: Iowa darters are a northern species ranging from central Canada south to New York and west to Nebraska and Colorado. The species is native to Colorado (Ellis 1914). The species distribution in Colorado is limited. Populations are found in some plains streams in northeastern Colorado, Plum Creek and single locations on the Saint Vrain and Big Thompson rivers (Propst 1982) and Eleven Mile Reservoir in South Park. Iowa darters have been introduced to the upper Colorado River Basin (Shadow Mountain Reservoir) through a bait bucket transfer or inadvertant introduction through some regular fish plant. Johnny darters have been found in Plum Creek, the Big Thompson River and Shadow Mountain Reservoir at the same sites as the Iowa darter. No other darters in Colorado co-exist in the same water.

Habitat: Iowa darters prefer cool, clear water over a sand or organic matter substrate (Trautman 1957). Populations in Colorado are found in lakes, over mats of rooted aquatic plants and in streams with vegetation along the stream bank extending into the water (Propst 1982). Stream specimens are collected from undercut banks and the species is absent in reaches lacking undercut banks.

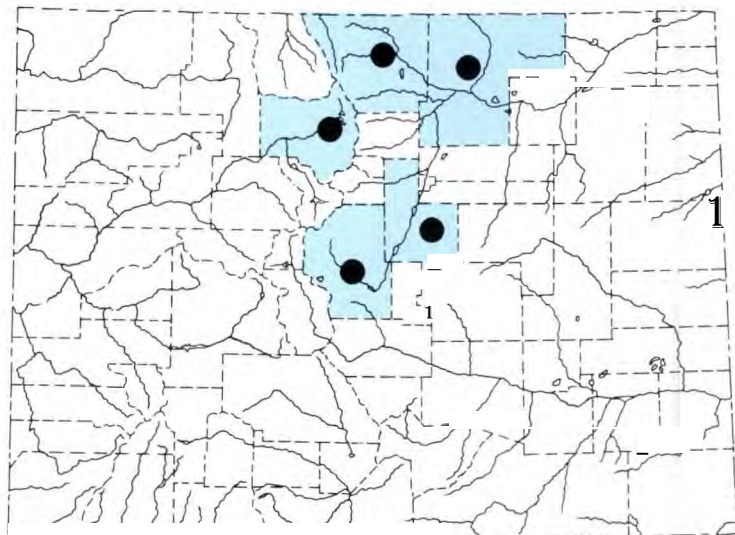
Little is known regarding the biology of the Iowa darter in Colorado. The species is predaceous, consuming various aquatic



Adult male Iowa darter in breeding colors.



Adult Iowa darter.



Distribution by County of the Iowa darter.

invertebrates and probably spawns in the spring.

The species is a northern, coolwater species and may never have been common in Colorado. Reduction in habitat

through dewatering, channelization, etc., has further reduced distribution. For example Propst (1982) did not find Iowa darters in Boulder Creek, a stream where Hendricks (1950) found the species.

ORANGETHROAT DARTER

Etheostoma spectabile (Agassiz)

A moderate-sized darter; mouth and snout small and inconspicuous; *opercles* have scales, *preopercles* scaleless; two dorsal fins, first spiny, second soft-rayed; caudal fin squarish; pectoral and pelvic fins located close to each other behind gills; *anal fin* with two spines; *lateral line* incomplete, but usually extending past spiny first dorsal ray.

Males and females have different color patterns. Males in breeding colors are brilliantly hued. There is a series of darker splotches across the back. The back is tan-to-olivaceous in color. The sides have a series of alternating red and blue-green marks. The gill covers and head, along with the stomach, are orange and the fins may have a series of differently-colored bands. Females are not as brilliantly colored, being tan on the back, splotches are found on the back and sides, and the gill covers may be orangish. Adults can attain a length of nearly three inches.

Range: The species is rather widespread in the central part of the United States ranging from Michigan to Tennessee south to Texas and into Colorado. The species is the most widespread of all the darters in Kansas (Cross and Collins 1975). In Colorado, the species is restricted to, and the only darter found in, the Republican River Basin on the eastern side of the state. The orangethroat was the second most abundant species in the Republican Basin (Cancalosi 1980).

Habitat: The orangethroat is found in the small streams of the Republican Basin where shallow riffles or runs pass over a sand-gravel substrate. The darters can be seen to orient themselves on the substrate, head upstream, periodically moving in short, rapid bursts. When disturbed, the darters will hide in undercut banks or detritus and aquatic plant growths. Cross and Collins (1975) report the species to be tolerant of warm water and able to withstand short periods of intermittent flows by taking refuge in remaining pools.

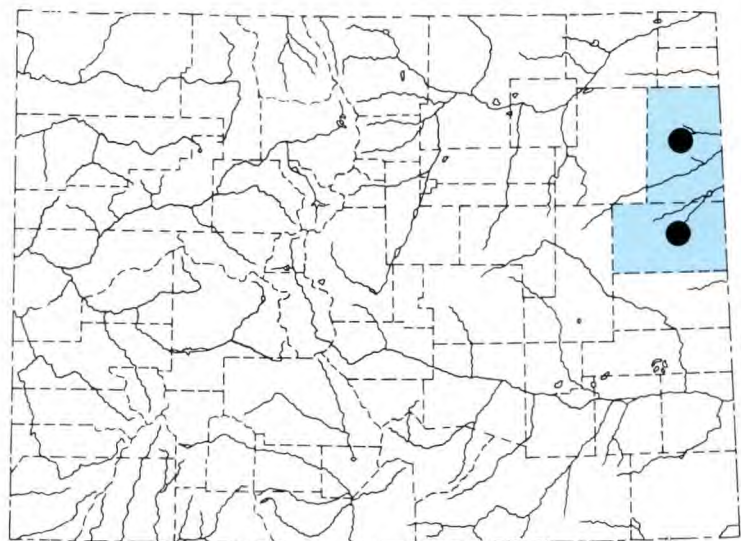
Like all darters in Colorado, the orangethroat feeds on a variety of invertebrates. Perching on the stream substrate, the orangethroat can observe potential prey items drifting downstream in the current



Adult male orangethroat darter in breeding colors.



Adult female orangethroat darter.



Distribution by County of the orangethroat darter.

and select preferred food items. Spawning probably occurs in spring as breeding-colored males are common from March through May. Orangethroat darters spawn in many situations, including headwaters

of springs over a sand and gravel substrate (Cancalosi 1980).

Although restricted to the Republican Basin, the abundance of the species in the drainage is probably due to the ability to

withstand warm water and periodic dewatering. Cancalosi (1980) found the orangethroat in a stream reach that had been recently channelized by a bulldozer. The species is not suitable as a bait fish.

Family Percidae Genus Etheostoma

ARKANSAS DARTER *Etheostoma cragini* Gilbert

A small darter; mouth and snout small and inconspicuous; *opercles and preopercles are scaleless*; two dorsal fins, first spiny, second soft-rayed, caudal fin squarish; pectoral and pelvic fins located close to each other behind the gills; *anal fin with two spines*; *lateral line incomplete, usually ending beneath spiny first dorsal ray*.

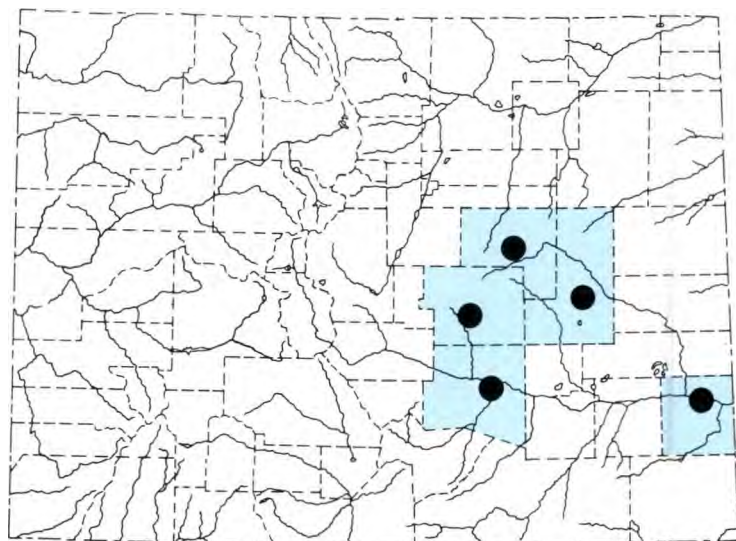
Males and females have different color patterns. Males in breeding colors are dark olivaceous on the back with darker splotches across top of the back and a line of dark spots along the sides. The stomach and gill membranes are orange. The fins may be multicolored with a series of red, blue and green bands. Females are dark tan with brown-black on the dorsal surface with the same splotches along the back and sides as found in the male. The stomach of the female is whitish. Both sexes have a dark, wedge-shaped mark below the eye. Arkansas darters are fairly small, seldom reaching length of 2.5 inches. Fish one year of age are about one inch long (Moss 1981).

Range: The Arkansas darter has a very restricted natural range. It is only found in tributaries of the Arkansas River in Colorado, Kansas, Missouri and Oklahoma. The species is on the Colorado list of threatened species. In Kansas, the fish is listed as threatened and is classified as rare and endangered in Oklahoma. In Colorado, isolated populations have been found in several spring areas adjacent to the Fountain River south of Colorado Springs and other small tributaries, Rush Creek and Big Sandy Creek, of the Arkansas River on the eastern portion of Colorado (Miller 1984). The Arkansas darter is the only darter found in the Arkansas River Drainage, and is native to Colorado (Ellis 1914).

Habitat: Most specimens are taken in clear waters of low current with sandy bottoms and abundant rooted aquatic vegetation. In one water course near the town of Lamar, a darter was collected from an area of moderate current in shallow water flowing over a sand bar though there was aquatic vegetation located nearby. Miller



Adult male Arkansas darter in breeding colors.



Distribution by County of the Arkansas darter.

(1984) found Arkansas darters in atypical darter habitat. Specimens were collected from the nutrient-enriched Fountain River over sandy bottoms with no vegetation.

The life history of the Arkansas darter in Kansas has been documented by Moss (1981). A wide variety of food including mayflies, dragonflies, caddisflies, dipterans, fish eggs, and small plant leaves and seeds are taken with mayflies being the dominant food source. Breeding is in early spring in open areas where organic ooze covers a sand substrate. Eggs are deposited in this ooze with several males performing the spawning act with individual females. Young and adults occupy different areas. Young are found in open areas while adults are taken in areas of dense vegetation.

The Arkansas darter's limited distribution is undoubtedly a function of the species' rigid habitat requirements. Dewatering and channelization have reduced available habitat throughout eastern Colorado. The species is probably able to withstand short periods of habitat disruption, indicated by Miller's 1981-82 collection of scattered individuals in an atypical habitat situation. Continued disruptions would lead to disappearance perhaps due to lack of spawning habitat or preferred aquatic vegetation.

The Arkansas darter should not be used



Adult female Arkansas darter.

as a bait species for three reasons. First, the relative scarcity of the fish. Second, the possibility of introducing the species into a drainage previously unoccupied by

darters. The last reason is that all darters make poor bait species due to the group's habit of sitting motionless on the substrate.

GLOSSARY OF TERMS

- ADIPOSE FIN**—a small rayless, fleshy fin behind the dorsal fin on the middle of the back.
- ANADROMOUS**—fish that return as adults from the ocean to spawn in fresh water.
- ANAL**—refers to the anus or vent.
- ANAL FIN**—the fin on the median ventral line behind the anus.
- AQUACULTURE**—the rearing of fish by man as a harvestable crop.
- AQUATIC MACROINVERTEBRATES**—invertebrates visible to the naked eye that spend part, or all, of their life cycle in water.
- AXILLARY PROCESS**—a fleshy projection of skin at the base of the pectoral fins.
- BENTHIC**—area on or close to bottom of stream, river, lake or reservoir.
- BENTHOS**—organisms inhabiting the substrate, or bottom, of lakes and streams.
- CAUDAL FIN**—the tail fin of a fish.
- CAUDAL PEDUNCLE**—the fleshy rear of the body behind (posterior) of the anal fin and in front of the tail fin.
- CTENOID SCALES**—the scales of most spiny-rayed fish where the posterior margin of each scale has a series of needle-like projections.
- CYCLOID SCALES**—the scales of most soft-rayed fish where the posterior margins are smooth.
- DEPRESSED**—flattened downward from above.
- DORSAL**—regarding the back of a fish.
- DORSAL FIN**—the fin on the back of a fish usually in the middle of the back with supporting rays and/or spines.
- ELECTROPHORETIC ANALYSIS**—a method of studying taxonomic relationships of organisms where the movement of molecules, various proteins, through a liquid under the action of an electric current is studied. Such an analysis usually produces a record of separated proteins on various materials such as a gel. Similar individuals produce similar records.
- EXTINCT**—no longer existing. In this case refers to a species which no longer exists.
- EXTIRPATED**—the status of a fish when no populations, or individuals, remain in a given drainage or region.
- EYE DIAMETER**—the horizontal diameter of the eye itself, not the horizontal distance between front and rear edges of the socket.
- FALCATE**—sickle or scythe shape.
- FIN RAY**—the slender rod-shaped structures supporting the fin membranes.
- FIN RAY COUNT**—the principle soft rays are counted, including all branched rays and one unbranched ray at the front of the fin. Frequently, the two main branches of the last ray are separated except at the base. They are still counted as one ray. All spines are counted, regardless of size.
- FRENUM**—fold of skin which limits movement, e.g. membrane across the snout of the longnose dace connecting the maxillary to the front of the head.
- GENUS**—a group of species determined by man to comprise a group of structurally phylogenetically related species. Genera is the plural form.
- GILL ARCH**—the bony support of the gill.
- GRAVID**—indicates a female fish with ripe eggs ready to spawn.
- HYBRID**—the offspring of two animals of different taxa.
- INGUINAL PROCESS**—a fleshy projection at base of pelvic fins.
- INTER-RADIAL MEMBRANES**—the thin, pliant, transparent plate of animal tissue between the supporting rays of the fins.
- LARVA**—indicates the young of a species when the organism differs greatly in shape from the adult. Larvae is the plural form.
- LATERAL LINE**—series of sensory pores extending from the head toward the tail along the side of the body. The lateral line may be: complete, extending to the base of the tail fin; incomplete, ending before reaching the base of the tail fin; or absent.
- LATERAL LINE SCALES**—the scales bearing the pores of the lateral line.
- LATERAL LINE SCALE COUNT**—begins with the first lateral line scale behind the head extending along the lateral line to the base of the tail fin which is determined by the crease formed when the tail fin is bent to one side. Do not count scales behind the crease. If the lateral line is missing or incomplete the count is made of the scales along the side of the fish where the lateral line would be.
- MILT**—the sperm of the male fish.
- MELANOPHORES**—a pigment cell in fish.
- MERISTIC CHARACTER**—the variation in number of parts of a fishes body.
- MORPHOLOGY**—the portion of fisheries sciences, or biology, which deals with the form and structure of an organism and its parts.
- MOUTH INFERIOR**—snout definitely extends over the mouth.
- MOUTH OBLIQUE**—when closed the line of the mouth is at a 45°, or greater, angle to the body.
- MOUTH SUBTERMINAL**—snout barely extends over the mouth.
- MOUTH TERMINAL**—the tips of mouth and lips are at the foremost tip of the body.
- MOUTH VENTRAL**—the mouth is on the bottom of the fish's head.
- OCCIPUT**—the area often marked by a line at the posterior top portion of the head that may separate scaled and unscaled parts of the skin.
- OPERCLE**—the large bone of the gill cover, usually the upper and rear plate.
- OPERCULUM**—the bony plates which cover the gill cavity, composed of the interopercle, opercle, preopercle and subopercle.
- PALATINE TEETH**—patches on teeth on the palatines. The palatines are a pair of bones on the edges of the roof of the mouth.
- PAPILLAE**—plural of papilla. Small fleshy projections, or knobs.
- PECTORAL FIN**—the anterior or upper most of the paired fins, sometimes above, or dorsal, to pelvic fins.
- PELVIC FINS**—the ventral paired fins situated below the pectoral fins or between them and the anal fin.
- PERITONEUM**—the membranous inner lining of the abdominal cavity.
- PHARYNGEAL TEETH**—bony projections from the last gill arch. The minnows vertical arch bears the teeth which point at right angles in towards the middle of the fish. Since these "teeth" may easily break off during dissection, empty sockets or broken bases should be included in the count.
- PHYTOPLANKTON**—small aquatic plants, sometimes microscopic.
- PLANKTON**—small aquatic plants and animals, sometimes invisible to the naked eye.
- PREOPERCLE**—the cheek bone. The most anterior of the opercular series, (see operculum).
- PROTRACTILE**—refers to the premaxillaries of fish indicating that the structure can be extended forward. Premaxillaries with this ability are separated from the front of the head by a groove.
- PYLORIC CAECA**—fingerlike projections attached to the pylorus. The pylorus is the portion of the fishes digestive tract immediately behind the stomach.
- SPINE**—fin rays which are not branched and are to some degree stiffened and sharpened at the point.

SNOUT-the portion of the head of a fish which is in front of the eyes.
SYNONYM-refers to a taxonomic name which has been rejected as being incorrectly applied, or incorrect in form.
SYSTEMATICS-the science of classification of organisms.
TAXONOMY-The study of the principles

of scientific classification, principally creating an orderly classification of plants and animals based on their presumed natural relationships.
TRUNCATE-roughly rectangular in form with squarish corners.
VENTRAL-the lower surface of the fish, particularly the belly.

VOMER-the anterior bone of the roof of the mouth.
VOMERINE TEETH-teeth on the vomer of the mouth. The vomer is a bone in the middle of the roof of the mouth.
ZOOPLANKTON-small aquatic animals, sometimes microscopic.

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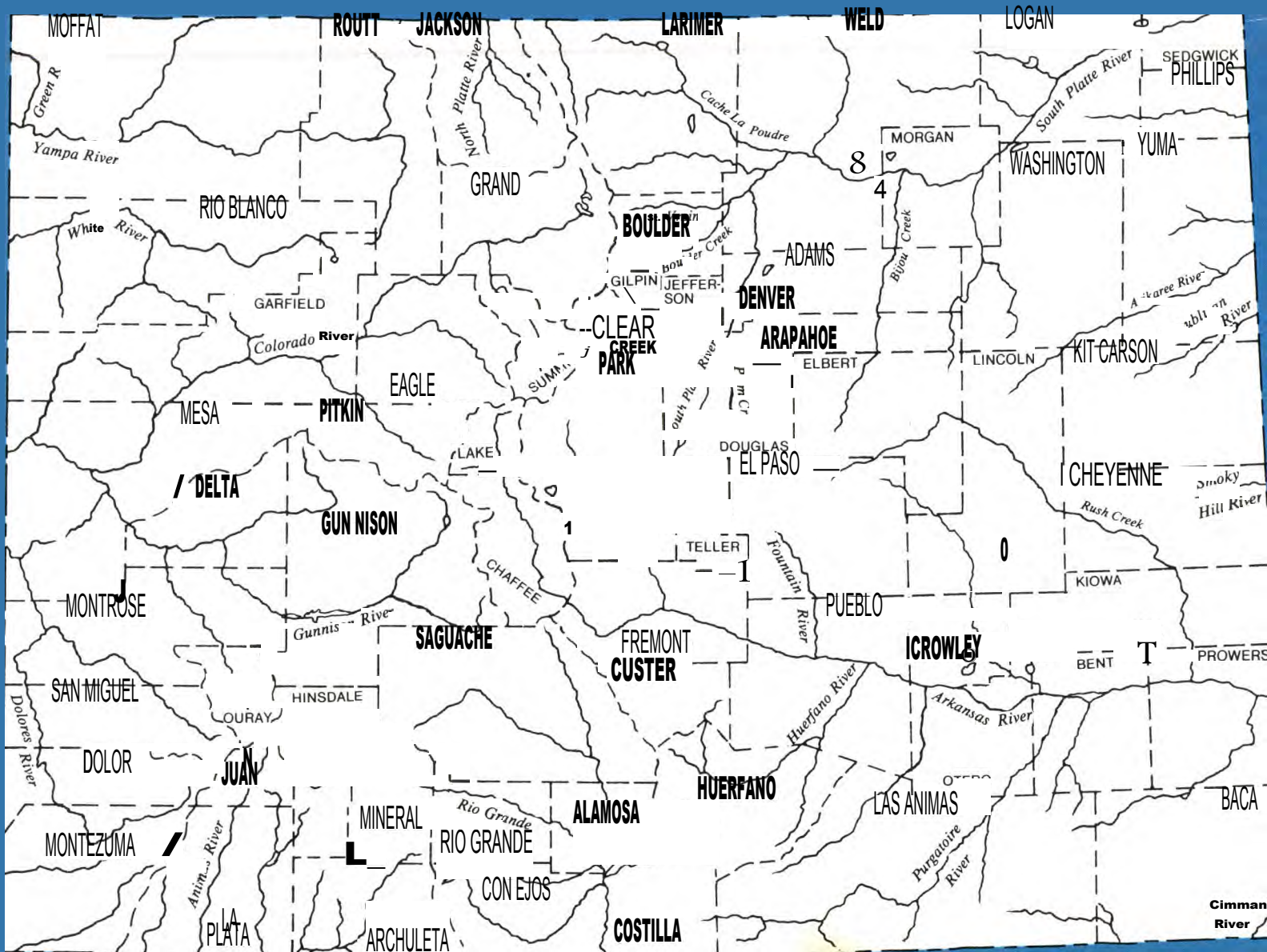
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