

FISHES

of COLORADO



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W. Harry Everhart, *Professor*
and *Chairman*, Fishery Major

Department of Fishery and Wildlife Biology
Colorado State University

and

Wayne R. Seaman, *Chief*
Fishery Research

Colorado Game, Fish and Parks



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Foreword

THIS publication of *The Fishes of Colorado*, published by the Colorado Game, Fish and Parks Division, is intended to help fishermen identify the fish they catch and observe in our lakes and streams. The descriptions and life histories will add interest and additional pleasures to the observations fishermen make as they seek the many game fishes that live in Colorado. We planned the book to also be of value to all who are curious about fish they see, to help teachers open the world of fish to their students, and to help all young people increase their understanding and appreciation of the world around them.

Fisheries men from the Game, Fish and Parks Division have logged many years of experience in the field and laboratory investigating life histories and habitat requirements of our fish fauna. This combination of good men and good working conditions has resulted in more and more information about Colorado fishes. Life histories presented here have been prepared by the men most qualified — the professionals who have been working with them. Authors are acknowledged with each of their contributions.

Help and information have been obtained from the *Guide to the Fishes of Colorado* authored in 1952 by Dr. William C. Beckman. The keys to the families and kinds of fishes were modified from those presented in the *Fishes of the Great Lakes Region* by Dr. Carl L. Hubbs and Dr. Karl F. Lagler, and published by the Cranbrook Institute of Science. We are particularly grateful to the Maine Department of Inland Fisheries and Game for permission to borrow some of the line drawings used in the keys to families and species. We thank Mrs. Doris Rust, draftsman and artist, for her care and concern in preparing the remainder of the line drawings. Dr. Robert Behnke, Colorado Cooperative Fishery Unit, provided information on the taxonomy and distribution of some of the suckers and minnows and helped with a review of the entire text. Mrs. Dolores Hall, Colorado Game, Fish and Parks, and Mrs. Grace Strass, Colorado State University, took especial care in the final preparation of the manuscript.

Our book is dedicated to all who appreciate and care for the outdoors. If we add to your recreational experiences then we are satisfied, and our work is justified.

W. Harry Everhart

Wayne R. Seaman

Denver, Colorado
1971

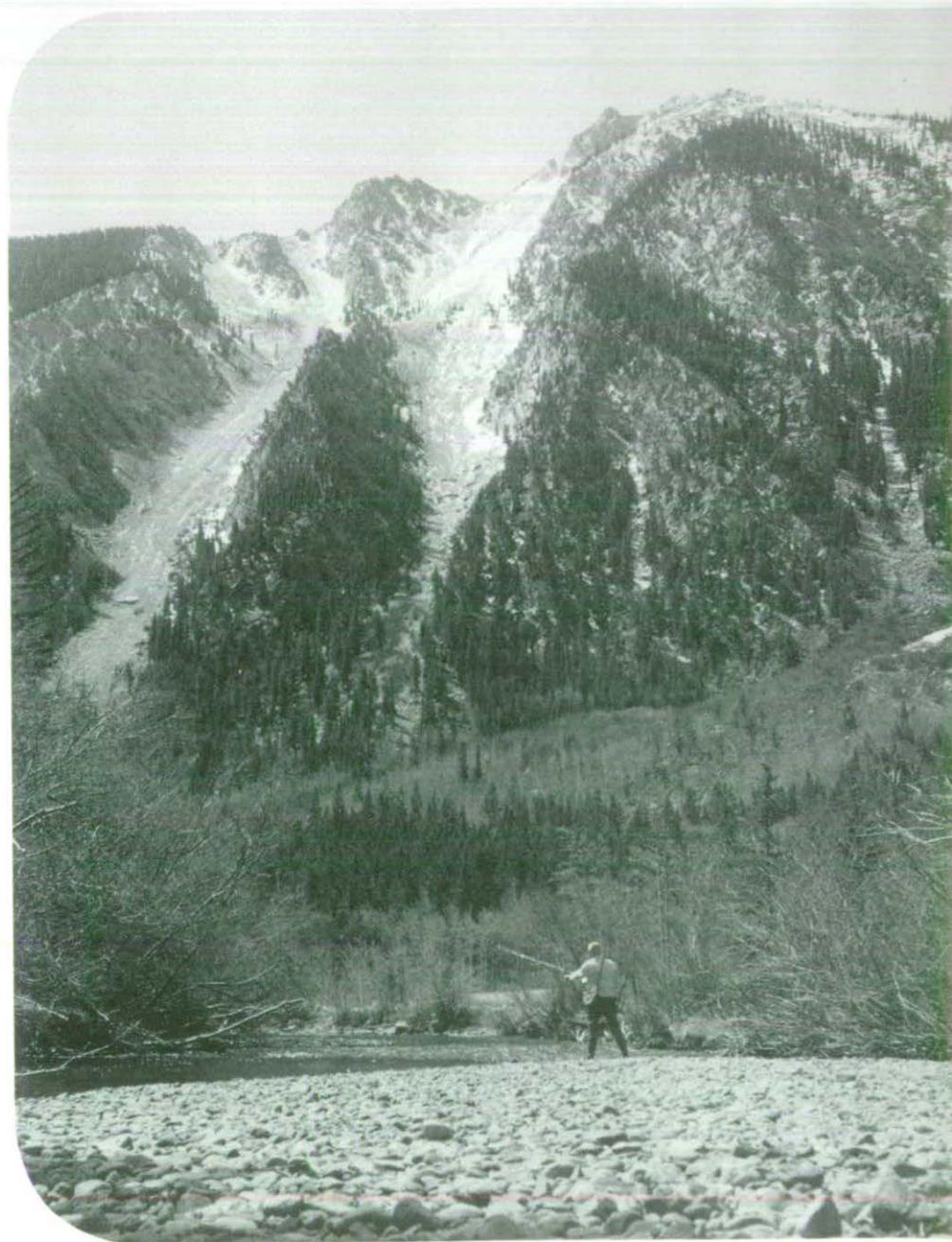


Table of Contents

	Page
General Notes About Fish	6
Fishing in Colorado	9
Identification of Colorado Fishes	12
Key to Families of Colorado Fishes	14
Life Histories of Colorado Fishes	19
Index to Common Names	74
Index to Scientific Names	75

About FISH

Fishes easily outnumber all other vertebrates (animals with backbones) combined, including the amphibians, reptiles, birds, and mammals. The number of different kinds of fishes in the world today is estimated to be around 40,000, but the number changes as new kinds are discovered. To be a fish an animal must be back-boned (or at least have a dorsal supporting column), cold-blooded, adapted for life in the water with fins, and have gills which function throughout life to obtain oxygen from the water.

Colorado fishes are ideally streamlined for moving through the water; a fact you can easily confirm by observing their swimming movements. In general their shape may be described as torpedo or cigarlike. Some fish are more rounded as the eels and some are more flattened from side to side as the sunfishes which we call compressed. Fishes of Colorado are either rounded or compressed in body form.

Covering the fish externally is a layer of mucus secreted by the glands of the skin. Mucus protects fish from external infection. Fishermen have long been cautioned to wet their hands before handling fish they intend to return to the water. Handling with dry hands could remove a large amount of this protective covering and leave the fish exposed to fungus and bacterial invasions. Immediately under the mucus lies a thin layer of epidermis covering the embedded scales.

Scales are laid down shortly after the fish is hatched and reflect changes in the life history. Age of fish can be determined from the number of year marks, and periods of good growth and poor growth can be detected from the spacing of the growth rings on the scale. Ages in this book refer to the number of completed year marks on the scale and conform to the manner in which we ordinarily report human age. Scales of Colorado fishes are either cycloid or ctenoid. Cycloid scales are usually small and embedded deeply in the skin. Trout and salmon are examples of fish with cycloid scales. Ctenoid scales have several rows of spines along their posterior or exposed edge. These spines, or ctenii, give the fish a rough or spiny feeling. Bass and sunfish are examples of fish with ctenoid scales. Among fishes of Colorado, only catfish and sculpin are without scales.

Fish fins are thin folds of skin supported by rays, spines, or both. Fish are frequently classified either as "soft-rayed" fish such as trout, or as "spiny-rayed" fish such as bass. Rays are finely segmented and often branched while spines are unsegmented, unbranched, and usually hard. Counts of rays and spines, since their number is reasonably constant, are frequently of value in identification of closely related fishes. Paired fins include the pectorals, located behind the gill openings, and the pelvic fins, located on the lower side of the body. Fish are frequently identified and classified according to whether the pelvic fins are positioned posteriorly or anteriorly on the ventral side or belly of the fish. More advanced fishes have the pelvic fins placed under, or nearly under, the pectoral fins; this location is described as thoracic. If the pelvic fins are in front of the pectoral fins, the location of the pelvic fins is described as jugular. When the pelvic fins are posterior, their position is considered abdominal. Unpaired fins include

the dorsal, adipose, caudal or tail fin, and the anal fin. Although a fish swims primarily by muscular movements of its body, it depends on the caudal fin lending power to the movements, on the dorsal and anal fins for stabilizing the movement, and on the pectoral and pelvic fins for steering and maneuvering.

Fish obtain their oxygen from water passing over the gills. Closing the gill covers, opening the mouth, and expanding the cheeks causes water to flow in. Closing the mouth, contracting the cheeks, and opening the gill covers causes water to flow out over the gills. Gills are made up of a fine network of capillaries or very small blood vessels with walls so thin that oxygen can pass from the water into the blood and carbon dioxide can pass from the blood into the water.

Fish reproduction is interesting and of great importance to correct management of the fishery concerned. Although internal fertilization and development are known in fishes, all Colorado fishes fertilize their eggs externally. Development, therefore, takes place outside the body of the female. In some fishes, the males take on spawning coloration or "breeding plumage" near and during spawning time. Approach of spawning season is the signal in most fishes for a migration to the spawning area. Distances traveled may be many miles as with Pacific salmon or only a few feet as with lake trout. Certain fishes, particularly minnows and suckers, develop tubercles on the fins and head during the breeding season. These tubercles are more pronounced on males and are used in grasping the female and in defending the spawning area. Some fishes build nests. Female trout and salmon have the job of preparing the nest, but neither parent assumes any responsibility once the eggs are fertilized and covered. Males of the sunfish family prepare the nest and remain to guard the eggs and young. Many fishes, pike and white bass for example, prepare no nest but merely broadcast the eggs which lie on the bottom among the rocks or aquatic plants. Most fish are polygamous with several males fertilizing the eggs of the female or with the eggs of several females fertilized by a single male.

Fishes eat almost every conceivable form of food. The mouth and dentition serve as clues to the food habits of fish. Large teeth in the mouth of the northern pike leave no doubt about the carnivorous food habits of this species. Likewise, lack of teeth in the mouth of a gizzard shad leaves little doubt this fish is primarily a plankton feeder. Fishes may travel together and feed in schools or may seek their food alone. Some species make characteristic daily migrations, coming into the shallow areas in the evening where they are readily taken by hook and line. Temperature plays an important part in feeding of fish. Extreme lows and highs tend to "throw fish off their feed."

Fishes perceive the world around them with the same set of sensory systems we have, but we must remember that fishes are adapted and specialized to life in water. Fishes detect colors much as we do, but their eyes are adapted to best see light rays modified when passing from air into water.

To most fishes, the sense of smell plays an important role, and the olfactory sense is developed to a much higher degree in fishes than in land animals. Fish nostrils lead into sacs containing the olfactory organs, and

the nostrils are used only for the sense of smell — they cannot pass water through them to the gills for respiration.

A fish has no visible ear (external ear) as we do, nor is there a middle ear to help transmit sound waves to the inner ear where the sound waves are actually picked up and transmitted to the brain. Despite the lack of external and middle ears, fishes hear sounds of somewhat the same frequencies we do on land. This is because sound waves are transmitted much better in water than in air, and a fish's body is only slightly denser than the water around it so sound waves encounter little interference in passing directly into the inner ear. Some fishes, such as minnows, suckers, and catfishes, have an apparatus consisting of a series of delicate bones linking the inner ear with the air bladder so the air bladder serves as an amplifier. The air bladder is primarily a hydrostatic organ in fish to help maintain position in water. An important sensory organ for life in water is the lateral line, prominent on the sides of fishes and radiating out onto the head. Tiny sensory pores of the lateral line open to the external environment to detect minute pressure changes.

The degree of development of the sense of taste in fishes is correlated with the importance of this sense in the lives of different fishes. In catfish, for example, the sense of taste is of major importance. A striking difference between fishes and land animals is that the taste buds are not restricted to the mouth in fishes, but may be found on the barbels, fins, and even on the body surface as in catfish.

The air bladder is an important organ for life in water. In most fishes the air bladder serves to equalize internal pressure at different depths. The air bladder is also used by some fishes to produce grunting sounds by vibrating muscle fibers over the surface. Some fish can supplement the respiration of the gills by gulping air from the surface into the air bladder as a lung.

Fishermen and scientists alike will continue to study fish. The more we learn, the more likely we are to improve the quality of fishing even as numbers of fishermen increase and habitat alterations reduce productive water areas. Research by trained professionals working with fishermen and other recreationists will provide the methods for better fishery management.

Fishing in Colorado

W. R. SEAMAN, Chief, Fishery Research

Colorado, the Centennial State, is a land of contrast in climate and geography. The eastern third of the state is mostly rolling, treeless prairie. Rainfall in this area is low, and natural lakes and streams are scarce. The western two-thirds of the state comprise the highest area in the Rocky Mountain chain.

Colorado is almost a perfect rectangle with dimensions approximately 387 miles by 276 miles totaling 104,247 square miles in area. Elevation varies from 3,400 feet to over 14,400 feet. Fifty-two of the 67 highest mountains in the United States occur in Colorado, and 75 percent of the land area over 10,000-foot elevation in the U.S. is located here.

As the climate and terrain contrast, so does fishing opportunity. Colorado is generally thought of as a trout fishing state, but extensive irrigation reservoir development on the eastern plains has created warm-water fish habitat as well. A year round fishing season is in effect so fishing methods, of necessity, must vary with weather conditions. High-country fishing is governed by weather and snow melt. Many high lakes remain frozen until mid-June and high-country roads are seldom free of snow before the end of May. The weather and snow melt pattern greatly influence stream fishing. Once the spring runoff starts, most streams are high and roily until late June or early July.

Streams are seldom clear enough for fly fishing until late June. Early season bait and lure fishing are usually best in May and June during the runoff. However, little difference is noticed in lakes, and trout can often be taken in high lakes on flies right after ice-out. August and September are the best stream fly-fishing months. The days are clear and warm, and the streams are low and clear. Fishermen and tourists dwindle rapidly after Labor Day making September an ideal fishing month.

Warm water fishing is best in May and June. Walleyes, crappie, bass and other sunfish, and catfish seem most active during this period while the water is still on a warming trend.

Ice fishing is becoming more popular for both trout and warmwater species. Accessibility to trout lakes and reservoirs is the major problem. Increased use of snowmobiles is opening up many formerly inaccessible lakes to winter use. Safe ice cover on mountain lakes usually occurs from December through March and on warmwater lakes in January and February.

Trout fishing, despite stories to the contrary, is not difficult. There are many methods, but best success is related to trout feeding habits. A trout is essentially a sight feeder rather than a smell feeder. This means a moving bait or an attracting bait produces the best results. In streams trout wait for food to drift to them, and the best fishing results occur when the bait is carried to the fish by the current in as natural a manner as possible. In lakes, trout often cruise the shallows when feeding. The best producing method is to attract the fish by movement of the lure such as trolling and casting.

When I say bait in the above sense, I do not limit it to such things as

worms, minnows, or salmon eggs, but the whole gamut of myriads of types of spinners, flies, and plug lures. The lure doesn't matter as long as the fish grabs it either for food, because he's mad at it, or out of pure curiosity or astonishment.

In large lakes, trout are caught by the following methods in their order of success:

1. Trolling — usually tandem spinners with a natural bait or artificial lure at the end.
2. Casting — spinner or wobbler type lures.
3. Fly casting.
4. Still fishing with natural bait — worms, salmon eggs, etc.

In small lakes and streams this order changes slightly as follows:

1. Natural bait fishing — worms, salmon eggs, or natural aquatic insects (not essentially still fishing).
2. Fly casting.
3. Lure casting — spinners, etc.

Fishing equipment varies considerably, but rod length and line type are usually governed by the reel used. Modern day reels generally fall into four categories:

1. Fly reels — single action or automatic.
2. Spinning reels — usually open-faced with finger or bail line pickups.
3. Spin-casting reels — with thumb release control.
4. Spool casting reels.

The spin casting reel, because it is so easily mastered, has virtually replaced the old spool casting reel for most fishermen.

Effective fishing technique is an acquired knack coming only with practice. You progress only through performance and experience. There are a few generalities on fish behavior and feeding habits that help, however. Remember that trout are active, fast swimming fish with good eyesight. Always use a leader on any lure unless your line is a monofilament spinning line. Their strike is rapid and your own eyesight and wrist reflexes control much of your success. Trout have three general feeding periods during the day. An early morning feeding period starts soon after daylight and continues until about 9:00 a.m. A lag usually ensues until about midday. There is a short midday feeding period from approximately 11:30 a.m. to 1:30 p.m. The mid-afternoon is the most unproductive time to fish. Evening promotes the most surface feeding activity for trout. This continues from dusk on into darkness.

As fall approaches and the days shorten, you will find that midday with the warmest air temperatures is usually the most productive. This is essentially because the cool mornings and evenings limit insect emergence and activity to the warmer part of the day. Most of this feeding period business is quite logical since trout tend to time their eating to the periods when insects and other foods are easiest to obtain.

Another criterion for fishing success is to angle in the areas where the fish are when they are feeding. Fish seem to stake out territories in streams and stay in the same general areas. These areas usually encompass three requisites, however, which include feeding areas, resting areas, and cover or concealed fright areas. Many people waste too much time fishing the deep holes in streams which are primarily resting or cover areas. Feeding fish usually move to the head or foot of a hole to feed in the inlet and outlet riffles.

In lakes, people also tend to fish too much in deep water. Lake trout and kokanee do occupy the deep water areas, but most trout are caught near shore in water less than 15 feet in depth.

All fish seem to like to remain near shelter so always check out areas having stumps, downed logs, inundated bushes, rock outcrops, weed beds, and the like, regardless of the species you seek.

An avid angler is also an interested observer. Try to learn the habits of your quarry by observation and successful fishing experiences. Identification of the various fish species you catch is especially rewarding.

The purpose of this booklet is to help you in this identification and to acquaint you with their habits. Good luck and let's go fishing!

Identification of Colorado Fishes

While we're fishing we're little inclined to trouble ourselves with details of fish identification as practiced by the professional ichthyologist. However, knowing what fish you've caught, something of its life history, and some information about the kind of living quarters it requires can add to the overall pleasure of sport fishing. Taxonomic "keys" unlock the identification of unknown animals. Such keys are defined as a tabulation of those characteristics which will most readily and reliably distinguish the form. The illustrations and easily observed characteristics in the keys to Colorado fishes should minimize identification problems.

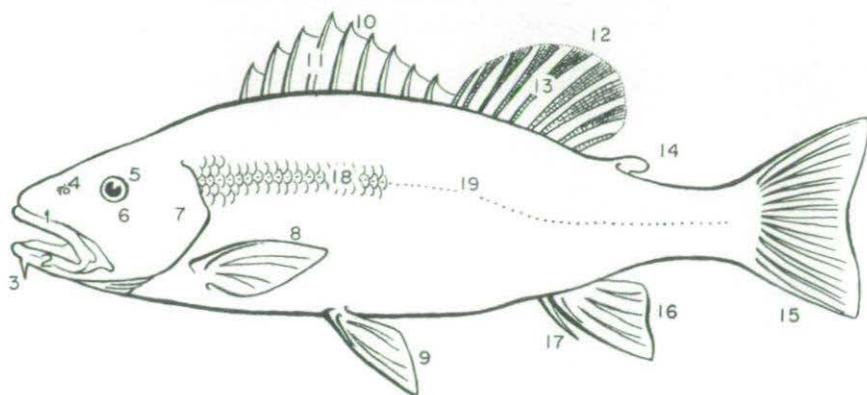
A great deal of confusion exists over common names of fishes. Common names used in this book are those proposed by the American Fisheries Society. Scientific names have been included, as they are generally standardized throughout the world.

It is suggested that before attempting an identification, the reader acquaint himself with the drawing on page 13 representing a generalized fish and illustrating the location of the principal characters used throughout the keys.

The identification keys are designed to provide you with two choices. One of these choices will fit the fish you are trying to identify. Following the choices which fit the fish at hand will lead to the name. First, determine the family to which the fish belongs by consulting the key to families on page 14. Some families of fish as found in Colorado have only a single representative; once the family is determined, the name of the fish will be known. Other families may have several representatives. In this case, determine the family to which the fish belongs, and then turn to the page indicated and proceed through the key to the members of that family until correct identification is reached. Good practice in learning to identify fishes correctly would be the "keying out" of a specimen familiar to the observer.

GENERAL CHARACTERS

Commonly Used in Identifying Fish



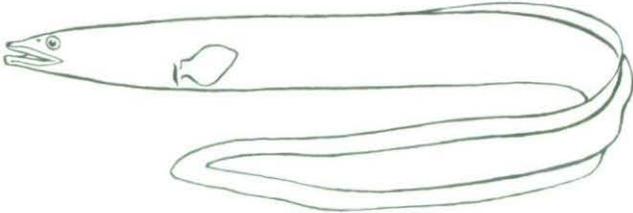
- | | |
|-------------------------------------------------|-------------------------|
| 1. Upper jaw (premaxillary and maxillary bones) | 10. Spiny dorsal fin |
| 2. Lower jaw (dentary bone) | 11. Fin spine |
| 3. Barbel | 12. Soft dorsal fin |
| 4. Nostril | 13. Fin ray |
| 5. Eye | 14. Adipose fin |
| 6. Cheek | 15. Caudal fin |
| 7. Gill cover | 16. Anal fin |
| 8. Pectoral fin | 17. Anal spine |
| 9. Pelvic fin | 18. Lateral line scales |
| | 19. Lateral line |

KEY

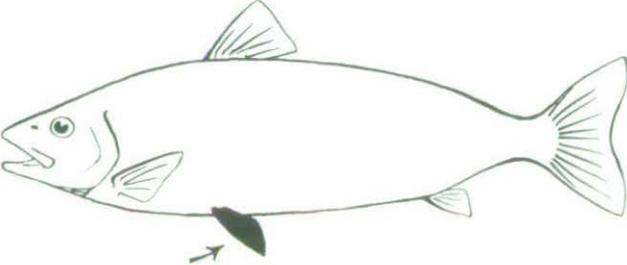
to the Families of Colorado Fishes

1. Body eel-shaped; pelvic fins absent

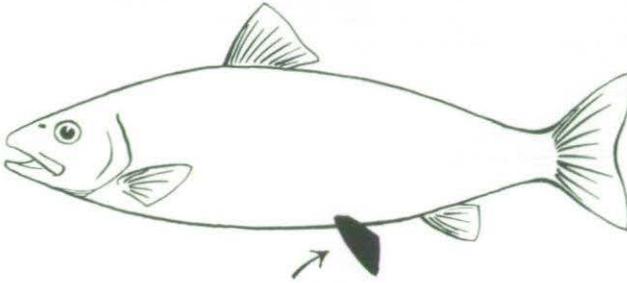
American Eel
Anguillidae
p. 54



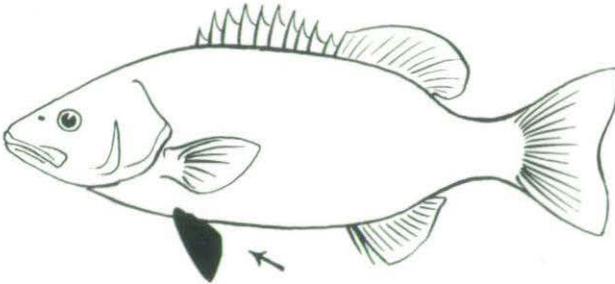
Body not eel-shaped; pelvic fins present..... 2



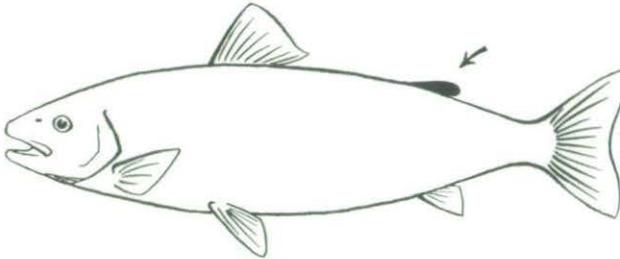
2. Pelvic fins abdominal (inserted a considerable distance behind the pectorals) 3



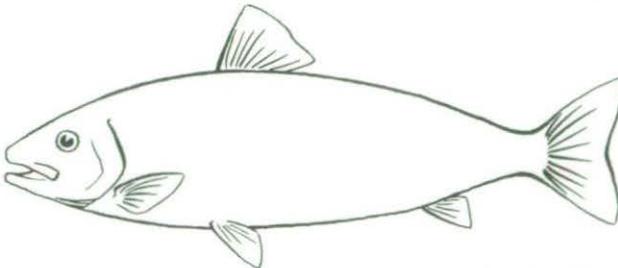
- Pelvic fins thoracic (inserted in close proximity to the pectoral fins) 9



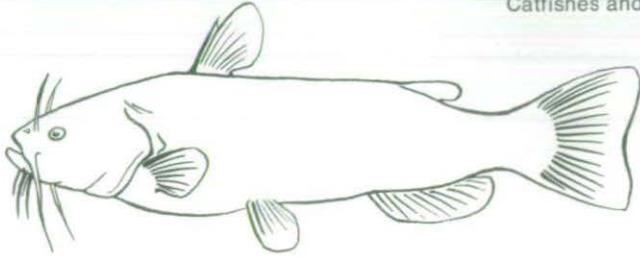
3. Adipose fin present 4



- Adipose fin absent 5

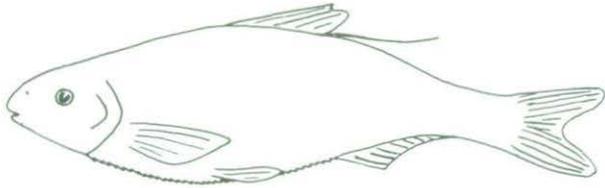


4. Barbels on head; scales absent; single stout spine in dorsal and pectoral fins
 Catfishes and Bullheads
 Ictaluridae
 p. 50



- Barbels absent; scales present; pectoral fins without spines
 Salmon and Trout, Whitefishes, and Grayling
 Salmonidae
 p. 20

5. Midline of belly provided with a saw-like keel; last dorsal ray greatly elongated
 Gizzard Shad
 Clupeidae
 p. 19

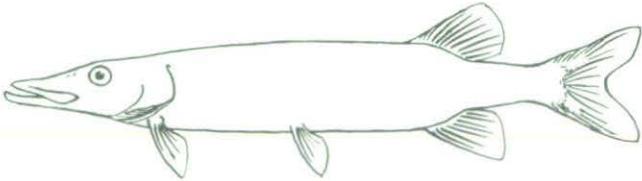


Midline of belly without a saw-like keel; last dorsal ray not greatly elongated 6

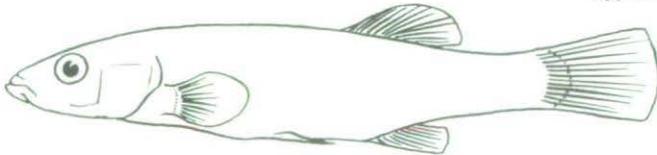
6. Head scaly or partially scaly 7

Head without scales 8

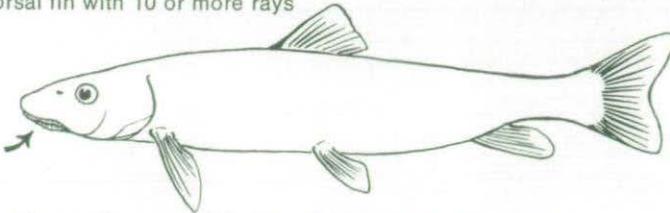
7. Jaws elongated, shaped like a duck's bill; large irregular teeth, caudal fin forked
 Pikes
 Esocidae
 p. 35



- Jaws not elongated; teeth weak; caudal fin more or less rounded
 Killifishes
 Cyprinodontidae
 p. 55

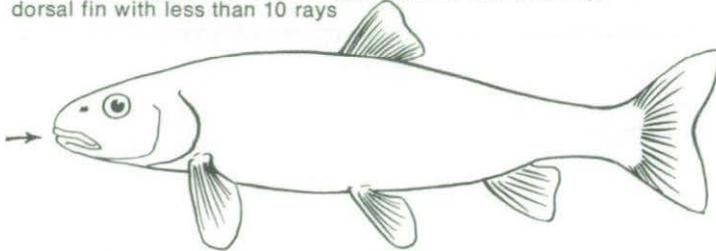


8. Mouth points downward (inferior), is sucker-like with thick, papillose lips; dorsal fin with 10 or more rays



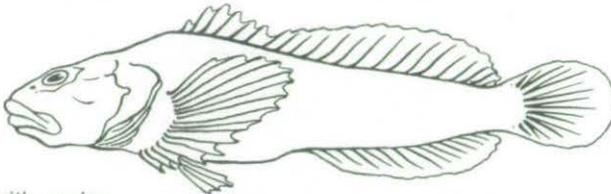
Suckers
Catostomidae
p. 45

- Mouth opening toward the front (terminal or subterminal); dorsal fin with less than 10 rays



Minnows
Cyprinidae
p. 37

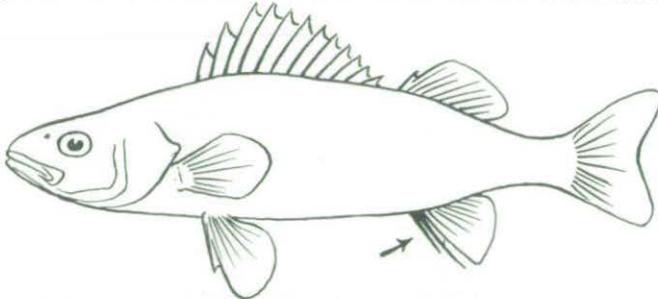
9. Body scaleless, but may be covered with spines or prickles; head large; eyes in top of head; pectoral fins large



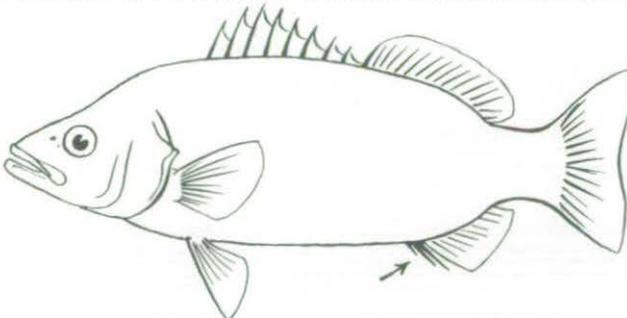
Sculpins
Cottidae
p. 73

Body with scales..... 10

10. Anal spines two or less..... 11

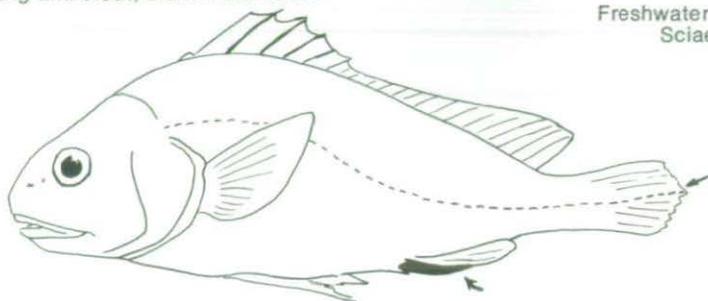


- Anal spines three or more (first spine short and sometimes difficult to observe) 12



11. Lateral line extending far out on caudal fin; second anal spine very long and stout; blunt molar teeth

Freshwater Drum
Sciaenidae
p. 73

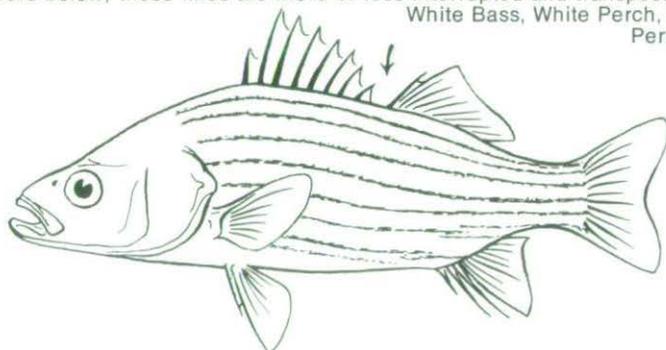


- Lateral line not extending far out on caudal fin; second anal spine, if present, not very long and not very stout; sharp teeth

Perches, Walleyes, and Darters
Percidae
p. 68

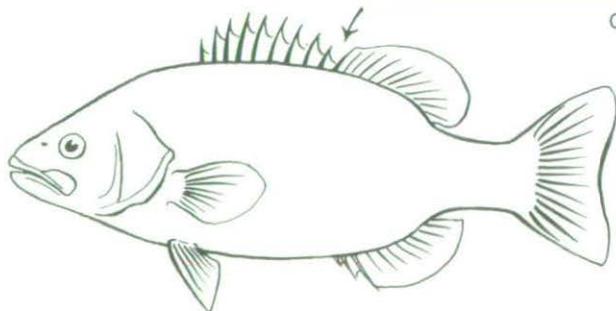
12. Dorsal fins entirely separated or but slightly joined; sides with narrow dusky lines, about five above the lateral line, one along it, and varying numbers below, these lines are more or less interrupted and transposed

White Bass, White Perch, and Striper
Percichthyidae
p. 56



- Dorsal fins confluent; without longitudinal dusky lines or with only one

Sunfishes
Centrarchidae
p. 57



Herring Family (*Clupeidae*)

Gizzard Shad *Dorosoma cepedianum* (Lesueur)

DONALD HORAK, Wildlife Researcher

The gizzard shad belongs to the herring family which usually consists of marine fishes entering fresh water only at spawning time. However, the gizzard shad completes its entire life cycle in fresh water. Shad were introduced into some eastern slope Colorado reservoirs by the Game, Fish and Parks Division primarily as a forage fish.

The gizzard shad is the only fish in Colorado whose belly tapers to a sharp ridge with scales projecting like teeth on a saw. The stomach is thick-walled (gizzard-like) which accounts for the common name of the species. A final identifying character is the greatly elongated last ray of the dorsal fin. This ray is undeveloped in the very small young and may be broken off on large adults. Their color is silver, bluish above with brassy or golden reflections from the scales.

Yearling shad are excellent food for game fish, inhabiting shallow water close to shore. Unfortunately, older shad are too large to be eaten by most predator fish and have a tendency to overpopulate their water areas. Older shad prefer deeper, turbid water. Shad often swim in large schools and may leap into the air when disturbed by a motorboat.

Gizzard shad spawn in open water, scattering their eggs without preparation of any nest site and without providing any parental care of the eggs or young. Spawning usually occurs in late May or June.

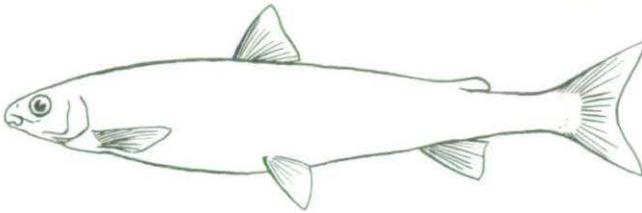
Long, filamentous gill rakers identify the shad as a plankton feeder filtering out the microscopic plants and animals that make up its primary food. Thus shad are caught only occasionally on hook and line as nothing in the angler's tacklebox resembles their natural food. Shad are rarely eaten because of the poor quality of the flesh.

Gizzard shad are not a hardy fish. They quickly succumb to abrupt water temperature changes and low oxygen resulting in large fish kills. Fishermen should not be alarmed at these common, natural die-offs.

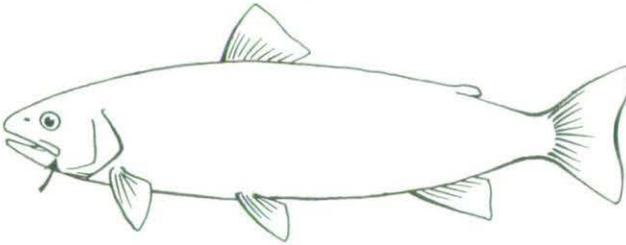
Salmon and Trout

(*Salmonidae*) Whitefish and Grayling

1. Mouth small, upper jaw not extending back to below center of eye; teeth on jaws and tongue weak..... 2

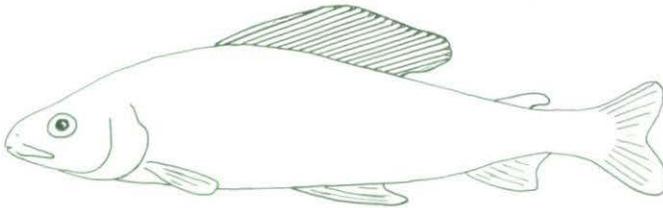


- Mouth large; upper jaw extending back at least to below center of the eye; strong conical teeth on jaws and tongue..... 3



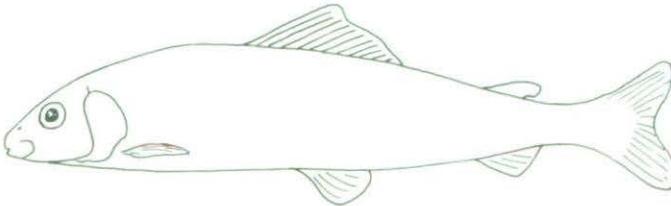
2. Dorsal fin high and long with more than 15 rays

Arctic Grayling
Thymallus arcticus (Pallus)
p. 24

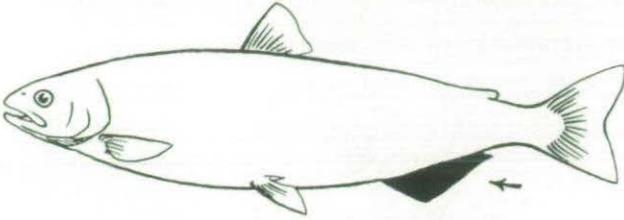


- Dorsal fin more usual with fewer than 15 rays

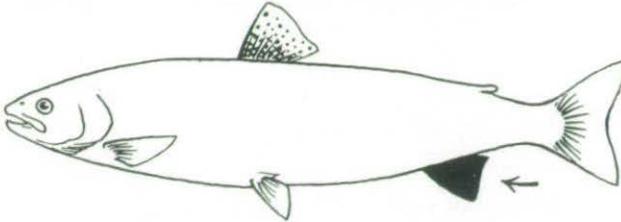
Mountain Whitefish
Prosopium williamsoni (Girard)
p. 24



3. Dorsal fin seldom spotted; anal fin longer than high with 14 to 16 rays..... 4



- Dorsal fin usually with many black spots in young and adults;
anal fin higher than long with 12 or less developed rays..... 5



4. Black spots on body and upper lobe of caudal fin; 19 to 25 rough, widely spaced gill rakers on first gill arch

Coho Salmon
Oncorhynchus kisutch (Walbaum)
p. 25

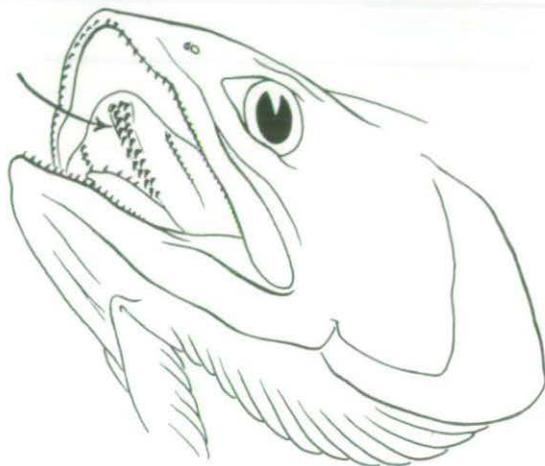


- No black spots; 30 to 39 long, slender gill rakers on first gill arch

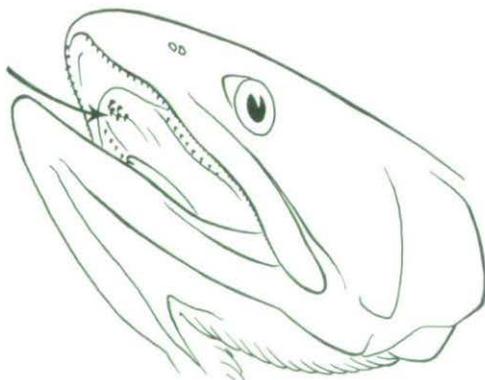
Kokanee Salmon
Oncorhynchus nerka (Walbaum)
p. 26



5. Black or red spots; vomer (bone in center of roof of the mouth) with a plain shaft bearing teeth in alternate rows; scales conspicuous..... 6



- Gray or red spots; vomer (bone in center of roof of the mouth) with shaft depressed, toothed only on anterior end; scales inconspicuous..... 8



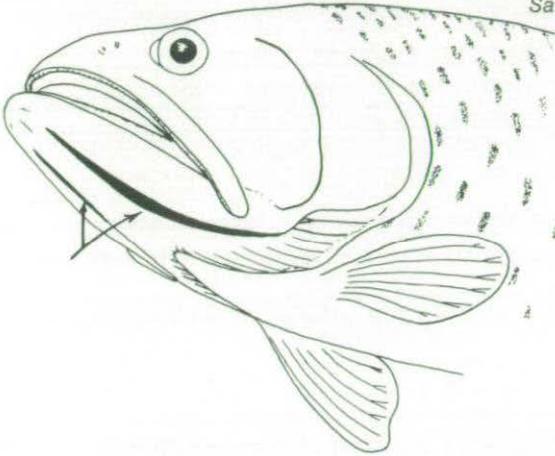
6. Caudal fin not spotted with black; adipose fin margined with red or orange, never with black; general color brownish yellow (silvery in lakes)

Brown Trout
Salmo trutta Linnaeus
p. 27

- Caudal fin heavily spotted with black; adipose fin spotted or margined with black, no red spots..... 7

7. Deep red or scarlet dash on each side of throat along inner side of jaw (cutthroat mark)

Cutthroat Trout
Salmo clarki Richardson
p. 28

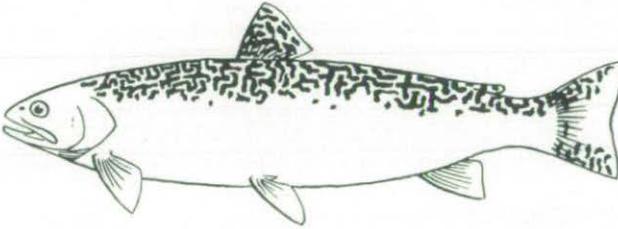


No deep red or scarlet dash on each side of throat along inner side of jaw; red striped on the sides of the body and gill covers of the spawning males (spring) turning to a faint pink band the remainder of the year

Rainbow Trout
Salmo gairdneri Richardson
p. 30

8. Obvious, dark, wavy, worm-like lines on the back; caudal fin not deeply forked; red or orange spots

Brook Trout
Salvelinus fontinalis (Mitchill)
p. 31



No obvious, dark, wavy, worm-like lines on the back; caudal fin deeply forked; large whitish spots on background of darker color; no red spots

Lake Trout
Salvelinus namaycush (Walbaum)
p. 33

Arctic Grayling *Thymallus arcticus* (Pallas)

The grayling, distinguished by its large, colorful dorsal fin, is an attractive game fish to many fishermen. Natural populations have all but disappeared in the United States through exploitation, interspecific competition (particularly from introduced rainbows, browns, and brooks), and by land-use and consequent changes in the aquatic habitat. Grayling have very specific habitat requirements. Several states, including Colorado, are attempting through hatchery programs and introductions to provide some grayling fishing. The introductions do reasonably well for the first year or two, but so far no self-sustaining permanent populations have been established. Nevertheless, sportsmen may take grayling where they have been introduced.

Grayling spawn from early spring to the first of June with a courtship similar to the trout. Although the nest building is not as elaborate as with many of the trout and salmon the grayling will clean off an area of gravel and in some instances even prepare a shallow depression. The eggs are not carefully covered as with many of the trouts. Spawning grayling may range from 7 or 8 inches up to 18 inches. Spawning migrations to tributary streams are often short as the grayling appear less particular about where they deposit their eggs than do trout.

Principal food of the grayling is aquatic insects with other invertebrates and small fish in that order.

Mountain Whitefish *Prosopium williamsoni* (Girard)

Mountain whitefish, a native of Colorado, are distributed on the western slope particularly in the Yampa and White Rivers. These whitefish prefer larger rivers with good pools three or four feet deep with riffle areas and gravel bottoms.

Mountain whitefish spawn in the fall moving only a short distance from the pools to riffle areas. If the fish are from a lake population then they will move into the streams. The eggs are scattered over the gravel bottom and left to incubate and hatch.

Lengths of 18 inches and specimens weighing four pounds have been reported. Colorado data indicate a length of eight inches in the fourth summer.

Typically the mountain whitefish feeds on the bottom at dusk and during the night. However, you may observe feeding behavior at the surface and right at midday. The major food is insects, particularly the caddisflies and other larvae. As with most fish, mountain whitefish are opportunists and consequently may even feed on small fish when available.

Although the mountain whitefish may not possess all the sportive qualities of a trout, they are challenging to catch and actually require more skill in setting the hook. The weak mouth of the whitefish is what makes them difficult to hook and land. Fishing for whitefish should be encouraged.

Coho Salmon *Oncorhynchus kisutch* (Walbaum)

LARRY M. FINNELL, Wildlife Researcher

The coho or silver salmon was on the scene in Colorado long before its cousin the kokanee. Experimental plants of silver salmon were made early in the twentieth century by both the state of Colorado and by private individuals. However, as with the kokanee, natural reproduction has failed to maintain the species, and the silver disappeared when artificial propagation stopped. In more recent years other attempts have been made to establish the silver in Colorado. Still on an experimental basis, plants numbering several hundred thousand have been made in Granby and Blue Mesa Reservoirs since 1963. Originally, eggs of Pacific ocean-run silvers were obtained from Oregon. These have been supplemented more recently by eggs from salmon successfully reared in freshwater Lake Michigan.

Silver salmon rely primarily on aquatic insects, amphipods, large crustaceans, and/or forage fish for food, seldom utilizing the plankton preferred by kokanee. Consequently, the silver inhabits, primarily, the shallow, littoral zone of lakes and reservoirs rather than open water areas where kokanee are found.

Little has been documented in Colorado concerning temperature preferences of the silver. However, this species has been taken in mid-summer near shore where water temperatures ranged from 70°-75° F; much higher than can be tolerated by kokanee.

Ocean-inhabiting silver salmon have been reported to reach a length of 33 inches and a weight of 25 pounds. Individuals comprising the Lake Michigan fishery also attain weights of over 10 pounds. Thus far, silver salmon introduced in Colorado waters have failed to exceed 14 inches in length and weigh slightly less than one pound.

The silver, often confused with kokanee or rainbow trout, possesses a number of physical characteristics which, upon close examination, distinguishes it from the others. The bluntly pointed snout of a freshly caught silver exhibits a silvery sheen; the sharply pointed snout of the kokanee lacks the silver color. The most easily recognized characteristic distinguishing the silver from the rainbow trout is black spots, profusely covering the dorsal and caudal fins of rainbow trout, but lacking in the silver. In younger specimens of silver salmon a dark band appears at the base of the caudal fin. This usually disappears in older fish.

Information is lacking regarding requirements for reproduction of the silver in Colorado, as spawning runs of this species have failed, thus far, to develop. Characteristically the silver ascends Pacific coastal streams in early September, the spawning run sometimes lasting until mid-November.

Management of this species by the Division continues on an experimental basis. Silver salmon enter the fishermen's catch in surprisingly large numbers considering the number of fingerlings planted. However, unless a suitable forage fish population can be established to substantially increase the size of the silver, it is doubtful this species will gain the prominence enjoyed by the kokanee in Colorado.

Kokanee Salmon *Oncorhynchus nerka* (Walbaum)

LARRY M. FINNELL, Wildlife Researcher

The kokanee salmon, a landlocked variety of the Pacific sockeye salmon, was introduced into Colorado in the early 1950's. Originally planted in Granby Reservoir on the Colorado River, the kokanee is now an important part of the fishery of more than 24 coldwater lakes and reservoirs located throughout the higher elevations of central Colorado. Some of the better kokanee fisheries include Grand Lake and Granby Reservoir at the headwaters of the Colorado River; Dillon and Green Mountain Reservoirs on the Blue River; Clear Creek Reservoir in the Arkansas River drainage; Antero and Elevenmile Reservoirs in the South Platte River drainage; Blue Mesa on the Gunnison River; and Vallecito Reservoir on the Los Pinos River.

Kokanee are the freshwater form of the anadromous sockeye salmon. Although the life cycle of the kokanee may vary from two to seven years, a four-year cycle predominates in the Colorado strain. During spawning, precocious two-year-old males may make up as much as 10 to 20 percent of the population. Occasionally, five- and six-year-old fish may be found, but only in very small numbers.

Size of kokanee at maturity is strongly dependent upon environmental factors. Numbers of individuals inhabiting a given body of water to a great extent determines size, regardless of the number of food organisms present. Under optimum conditions, a population large enough to contribute significantly to the fisherman's catch should, at maturity, range from 12-14 inches in length. Where predation or fishing pressure is excessive, maturing survivors may reach lengths of 18-24 inches. Occasionally, production of food organisms in a particular lake may be poor enough to result in lengths of only 6-10 inches.

The kokanee salmon has shown itself to be more ideally suited to life in large, fluctuating mountain reservoirs than many of the other species of game fish normally found there. The principal food utilized by the kokanee is zooplankton, small aquatic invertebrates which inhabit the open water portions of a reservoir. These remain relatively abundant throughout the year despite drastic fluctuations in the water level. On the other hand, aquatic insects, preferred by most other game fish, are often severely affected by reservoir drawdown, but these organisms make up no more than 10 percent of the kokanee's diet. Of the various types of zooplankton found in most mountain lakes and reservoirs, the larger cladocerans or "water fleas" appear to be utilized to a much greater extent than all others.

Throughout its entire life cycle the kokanee travel in large, compact schools in the open water portions of the lake or reservoir. Studies conducted at Granby Reservoir have shown that kokanee feed near the surface from dawn to dusk, migrating downward 60 feet or more at night to temperature zones ranging from 50°-55° F.

During the immature years of its life, the kokanee appears as a silvery streamlined fish with extremely weak jaws and large, easily removed scales. By the end of the third summer, a number of morphological changes take

place. As full maturity approaches, the jaws become stronger, and in the case of maturing males, hooked. The body deepens with sides becoming compressed. A hump develops before the dorsal fin in the male, and the scales, in the process of being resorbed, become difficult to remove. As full maturity is reached by mid-autumn, the silvery color of the kokanee changes to brick red in the males, reddish-gray in the females.

As is true of their anadromous ancestors, most kokanee spawn between late summer and early winter. In Colorado, spawning is most likely to occur from mid-October to late December, depending upon environmental conditions. Water temperature is very important and must range between 42° and 55° F. Kokanee usually ascend the tributary streams to spawn in gravel riffles, but spawning can take place over gravel bars in the lake or reservoir. The female, which may produce from 300 to 1500 eggs depending upon her size, constructs one or more depressions in the gravel. These nests vary from 2-5 feet in width and 6-10 inches in depth. After deposition, the eggs are covered with gravel. Incubations of the eggs may take 90 days or more depending upon water temperature. As is true with all Pacific salmon, the adults die after spawning. The newly hatched fry, upon emerging from the gravel, immediately migrate downstream to the lake or reservoir, seeking open water areas high in zooplankton.

Natural reproduction of kokanee in Colorado is severely limited by low water temperatures which normally occur during incubation of the eggs. Temperatures below 38° F usually result in complete mortality. Winter temperatures in most Colorado streams range from 33°-38° F. Therefore, the Colorado Game, Fish and Parks Division annually restocks the kokanee fishery through artificial propagation. Each fall Division personnel trap upstream migrating salmon, principally from tributary streams entering Granby and Vallecito Reservoirs. Eggs obtained from these spawners, numbering as many as 10 million in years of optimum runs, are taken to the Glenwood Springs Hatchery for incubation and hatching. The resulting fry are planted at the rate of 100-200 per acre to maintain Colorado's kokanee salmon fishery.

Brown Trout *Salmo trutta* Linnaeus

W. D. KLEIN, Wildlife Researcher

The brown trout, also called German brown and Loch Leven, originally from Europe, was introduced into Colorado in the 1890's. Over the years it has become established in every major drainage in the State. Brown trout differ from other Colorado trout by the presence of both orange to red and black spots.

No other trout has demonstrated the versatility of the brown in the variety of habitats to which it has adapted and become a permanent resident. Beaver dams at lower elevations are a favorite haunt, and they have succeeded even in subalpine lakes. About the only place where they have made way for another species is in the cold feeder streams (above 8,900 feet) where brook trout are normally dominant.

Much of the success of brown trout in Colorado waters can be attributed to fall spawning, normally in October. Streams are low and clear at this time and remain so until the spring runoff. By the time high and muddy water hits, which can smother trout eggs, young brown trout are ready to emerge or have emerged from their nest in the gravel of the streambed. Once free-swimming, the fry can withstand considerable turbidity.

Spawning frequently occurs for the first time in streams at the end of the third or fourth summer of life when the fish are between 8 and 15 inches in length. The number of eggs will vary with the size of the trout, approximately 300 to 1,500 at the first spawning.

Brown trout under good stream conditions can be expected to reach a length of about 4.0 inches in one year, 8.0 in two, 11.0 in three and 14.0 in four years. Under favorable conditions, brown trout may live well over 10 years and reach weights in excess of 10 pounds in either rivers or lakes. The Colorado record brown trout, 36 inches long and weighing 23 pounds, was caught from the Animas River at Durango on October 17, 1961.

Brown trout consume a wide variety of aquatic and terrestrial organisms. They take food as small as free-swimming minute crustacea (zooplankton) when larger items are not available, but insects and larger crustacea are the usual staple foods. Bigger trout seek larger food organisms, often fish of suitable size, and may seriously interfere with survival of plants of trout fingerlings, or even of creel-size fish.

Wherever they are found, brown trout are respected by competent anglers, and rank high in the elite of game fish. Every fishing method will work on them at the right time and place when accompanied by sufficient skill. They are often a favorite with fishermen because of their natural inclination to strike a fly, particularly a dry fly. In most situations, brown trout are considered less vulnerable to angling than rainbow, native, or brook trout.

Management of brown trout in Colorado will consist mostly of regulatory measures, occasionally to give added protection, but more often to improve the harvest. Additional stocking will seldom be necessary because of their present wide distribution and ability to reproduce successfully. They are not as desirable as rainbow trout as a put-and-take fish as returns to the creel are usually less. Also, brown trout are more difficult than rainbow trout to mass produce under hatchery conditions. In the long run, those fish capable of maintaining themselves are the most valuable. For this reason brown trout can be expected to become a more important part of Colorado's trout fishery in the future.

Cutthroat Trout *Salmo clarki* Richardson

ROBERT J. BEHNKE, Assistant Leader, Colorado Cooperative Fishery Unit

The colorful cutthroat trout named for the crimson slash-mark on each side of the throat beneath the lower jaws is now restricted to the high mountain regions. Cutthroat were the only trout found in Colorado when

the white man arrived on the scene. Unfortunately, this beautiful fish is extremely susceptible to environmental changes wrought by Man. Reduced flows, increased temperatures, pollution and siltation of streams, and the introduction of other species of trout have caused a drastic reduction in the original range of Colorado's only native trout.

The natural distribution of this species extends from southern Alaska to northern California on the Pacific Coast, and inland across North America from the South Saskatchewan River, Canada, southward throughout the upper Columbia and Missouri river basins, the upper Colorado River and Rio Grande drainages, the Great Basin, and on the east slope of the Rockies in Colorado in the Arkansas and South Platte river systems. The wide geographical distribution and local variability in coloration and other characters caused numerous species of cutthroat trout to be described. Presently all these varied forms from diverse river basins are recognized as a single species, *Salmo clarki*.

Originally in Colorado, cutthroat trout were found in suitable waters in the Colorado River basin, the Rio Grande drainage, and the upper sections of the Arkansas and South Platte river systems. Evidently no trout were present in the North Platte basin until introduced by Man.

The general life history and ecology of the cutthroat trout are similar to their near-relative, the rainbow trout, except that the cutthroat prefer colder waters and are typically found in the very headwaters of high mountain streams and in mountain lakes, whereas the rainbow trout thrive in warmer lakes and streams at lower elevations.

The cutthroat trout spawns in the spring from April to June depending on water temperature. Spawning takes place in gravel areas in running water. The female constructs a nest by scooping out a depression in the gravel with her body and fins. The fertilized eggs are buried in the gravel by the female and the fry emerge later in the summer.

In small streams, the maximum size may be no more than 9 or 10 inches, but in lakes with an adequate food supply, cutthroat trout may attain weights of five pounds or more.

The cutthroat is opportunistic in its feeding; a wide range of aquatic and terrestrial insects and invertebrate animals typically form the staple diet, but small fish, mice, and frogs are consumed for variety when available. The cutthroat trout is quite susceptible to angler's lures and baits in streams, but in high mountain lakes larger cutthroat trout may become extremely difficult to catch by the average fishermen.

Cutthroat and rainbow trout freely hybridize if they occur together. The resultant offspring is a rather gaudily colored trout possessing characteristics of both parent species.

Most cutthroat trout streams are remote from civilization and the populations are maintained by natural reproduction. Most high mountain lakes, however, do not have adequate tributary streams for successful spawning and the cutthroat trout fishery is maintained by periodic stocking of young fish dropped into the lakes from a plane. Eggs are taken from wild populations, hatched in a State fish hatchery and the young fry and fingerlings stocked soon after.

Rainbow Trout *Salmo gairdneri* Richardson

WALTER T. BURKHARD, Wildlife Researcher

Rainbow trout, introduced from California in 1882, are now the most common coldwater game fish in Colorado. Their original distribution was from southern California to southern Alaska, but the successful propagation in hatcheries has resulted in introductions throughout the United States and the world. From this modest first introduction of 10,000 eggs the Colorado rainbow program has grown to an annual production of nearly two million pounds.

Rainbow trout spawn in the spring when they prefer to migrate into streams to build their nests and deposit and bury their eggs. The majority of the spawning run is made up of fish mature for the first time, but some adults may spawn as many as three or four times. The male rainbow will have vivid, red lateral stripes while the female will appear more silvery with the stripes less prominent. The eggs are large with an average female producing over 1,000. Nests are constructed in fast moving water in the riffle areas where gravel and rubble are free of silt. The nest, constructed by the female, will vary from one to two feet wide and from two to four feet long, depending on the size of the spawning fish. Study of the eggs in rainbow nests confirms the efficiency of fertilization in naturally spawned eggs.

At a water temperature of 50° F the eggs will hatch in about 30 days. After hatching, the young rainbows will remain buried in their gravel nest obtaining nourishment from their yolk sac which they slowly absorb. When the yolk sac is used up, the young rainbows will wiggle up through the gravel to the flowing stream.

Their first food will consist of minute particles that flow by as the small fry remain on, or near, the stream bottom. Gradually the diet will change to larger items such as insects and crustaceans, and as the trout increase in size they may feed on fish half their own size. Rainbows do most of their feeding in early morning and late evening, but they can be caught any time during the day. Fishermen should be prepared to change lures and bait frequently until they find the right combination.

Although rainbows can withstand temperatures even as high as 85° F for short periods, they prefer water in the 50° to 60° F range. With these temperatures they will reach 8-10 inches during their second summer and under exceptionally good growing conditions may reach 15-20 inches. You might expect the largest fish to come from inaccessible high lakes, but Colorado's largest rainbows come from the lower, warmer, and richer lakes and rivers. Record rainbows approach 30 pounds, and trophy fish in the 10-18 pound class are not unheard of in Colorado.

The largest rainbows are usually those taken from coastal streams and represent the populations that run to salt water, known to fishermen as steelheads. All of the salmon and trout, including even the lake trout, may migrate to salt water, and this is not considered enough of a difference to call these salt water and fresh water rainbows different species.

When rainbow trout are introduced into cutthroat trout water the two fish may interbreed and produce hybrids. Thus, fishing in the same lake or pool you may catch rainbows, cutthroats, and hybrids between the two.

Colorado Game, Fish and Parks Division concentrates much of the resources of its hatchery program on producing fingerling rainbows for reservoir stocking and catchable rainbows for stream stocking. The fingerlings are available to fishermen the year following stocking. Catchable trout are there for immediate fishing in areas where extremely heavy fishing pressure depletes the natural population.

Some work has been done by Game, Fish and Parks to establish a close relative of the rainbow trout, the golden trout (*Salmo aguabonito*). These beautiful trout have been introduced into several lakes in Colorado including Crystal, Kelly, and South Golden Lake. This past summer fishery biologists sampled the population in South Golden Lake (northwest of Gunnison in the West Elk Wilderness area). Two year classes of goldens were checked, the results indicating some natural reproduction had taken place. The largest golden taken was 13½ inches in length.

Brook Trout *Salvelinus fontinalis* (Mitchill)

W. C. NELSON, Wildlife Research Leader

The brook trout, originally only in the eastern part of North America, has been introduced throughout the world. Introduced into Colorado late in the nineteenth century, brook trout are now found in over 400 lakes and many streams of the State. Distribution is primarily controlled by temperature. A range of from 33°-77° F is tolerated but from 55°-66° F is optimum. While brook trout may be found at lower elevations, typically, they flourish in montane and alpine (9-12,000 feet) waters of the State.

Brook trout are fall spawners, usually in October in Colorado. Populations in lakes with no cold tributaries may spawn in areas of spring seepage in the lake itself or move into the outlet. Males can mature during their first year whereas most females do not do so until the next year. Consequently, fish less than four inches long may be mature. In the higher Colorado lakes maturity may be delayed a year or two.

The courtship and spawning behavior is generally typical of the trout and salmon. The female makes her nest by digging egg pits while the males engage in antagonistic behavior to other males including biting and nipping. The female digs and cleans the 4- to 12-inch egg pit with her tail and fins by lying on her side and moving the broad tail fin rapidly up and down near the bottom. Bottom material loosened by this process is carried downstream by the current. During the actual spawning act, one or more males swim to the side of the female in the egg pit she has dug, and eggs and milt are extruded simultaneously. After spawning is completed, the female works quickly to cover the fertilized eggs by digging upstream from the

egg pit. Newly loosened bottom materials cover the eggs. The number of eggs produced by a female varies considerably but is usually a function of size, increasing from around 300 for a 7-8 inch fish to up around 1,000 for an 11-12 inch fish. At the wintertime temperatures prevailing in most Colorado waters, eggs may incubate for a period of more than five months before hatching. New hatched sac fry remain in the gravel nest nourished by the yolk sac which gives them their name. As the yolk sac is absorbed, young trout become more active and work their way up through the gravel and out of the nest.

Survival from egg to time of hatching is usually good — around 90 percent — but survival during the first summer is often very poor — five percent or less. Survival to a catchable size (6 inches) may vary from 20-80 percent depending on conditions. Subsequent survival depends chiefly on fishing mortality. Where it is great (70-90 percent) few fish will survive more than three years. Where it is less (40-60 percent) as in some of our high lakes, some fish survive 15 years or more. What this all means is that fishing competes with natural mortality so the sooner fish grow to a catchable size and are caught the greater will be the number harvested from any given year's hatch.

Since survival and growth interact, the maximum weight of all fish from a given hatch usually occurs in the second or third year. Growth rates of brook trout vary widely depending chiefly on population density and food conditions. Under average conditions it requires two years for a fish to reach catchable size (6 inches) as compared to three or four years for poor conditions and one year for good conditions. The time required to grow a nine-inch fish (four ounces) is usually around three years but varies from two to seven years. In some lakes fish never exceed 9-11 inches no matter how long they live. The average maximum size brook trout that may be expected from our better lakes is 12-14 inches (10-20 ounces). An occasional fish to 17 or 18 inches (2-3 pounds) may be caught. The State record is eight pounds.

Population densities of brook trout have not been estimated for Colorado streams but in those of other states, densities of from 20-3,500 fish (2-250 pounds) per acre — mostly small, young fish — have been found. Densities of from 40-700 fish (15-70 pounds) per acre have been found in Colorado and Wyoming lakes. In eastern streams fishermen have harvested up to 300-400 fish (50-60 pounds) per acre annually. In some California and Wyoming lakes annual harvests were from 15-150 fish (3-20 pounds) per acre.

Brook trout food habits are determined by the density and relative availability of food organisms. In streams these consist mainly of aquatic and terrestrial insects. In lakes aquatic and terrestrial insects are most important, but considerable quantities of small crustaceans may be eaten as well.

Brook trout are easily caught with the usual lures and baits and provide considerable fishing for unskilled anglers. While the average size fish caught is usually small, its fighting ability is good and its eating quality unexcelled.

Lake Trout *Salvelinus namaycush* (Walbaum)

WILLIAM BABCOCK, Wildlife Researcher

The lake trout or mackinaw, as it is more commonly called in Colorado, is the largest member of the trout and salmon family in North America. The lake trout is so closely related to the brook trout that they can be successfully crossed. The resulting hybrid, called a splake trout, is currently attracting considerable interest in Colorado and elsewhere.

The mackinaw is ordinarily a long slender fish and can be distinguished from other trout by its deeply forked tail. The head is large and the mouth is armed with conspicuous, sharp teeth. The color varies from gray to almost black and the body is covered with mottled light gray spots. Younger mackinaw sometimes resemble brook trout; however, there are no colored borders around the spots on the body. Although mackinaw frequently possess white margins on the leading edges of their fins, there is no black border behind the white as in brook trout.

Mackinaw trout were first introduced in Colorado waters in 1890, but very few plants have been made since 1940. However, the species is more abundant in the State than is popularly assumed. Fishery surveys show self-sustaining populations present in Twin Lakes, near Leadville; Loch Lomond and Steward Lakes, near Idaho Springs; Deep, Crater, Rim, Mackinaw, and Crescent Lakes on the Flattops; Savage, Lyle, and Weller Lakes in the Frying Pan drainage; and Lower Slate Lake in Summit County. Mackinaws have also been stocked in many other lakes in the State.

Lake trout were formerly abundant in the Great Lakes and the majority of our mackinaw originated from there. Before predation by the sea lamprey during the 1940's, commercial catches totaled 15 million pounds annually. Before this tragedy, mackinaws of over 100 pounds in weight were recorded. The record fish taken by rod and reel weighed 63 pounds 2 ounces. Colorado hook and line records include a "mack" which weighed 36 pounds and measured 39 inches; and one taken from Twin Lakes in 1967 that weighed 23¼ pounds and was 41½ inches long. The largest mackinaw checked during recent years in Colorado was a 25-pound female which was tagged and released during spawning operations at Twin Lakes.

Adult Colorado lake trout spend the greater part of the year in the deeper waters of the lakes, varying from 15 feet in Stewart Lake to 70-100 feet in Twin and Crater Lakes. There is a period in the spring and again during spawning season in the fall when they come into shallower waters. Temperature seems to be a primary controlling factor. Mackinaws are able to tolerate temperatures from 38°-55° F, but prefer temperatures between 45° and 50° F. During hot summer months, the only suitable temperatures are found within the thermocline (transition zone between surface and bottom waters). Water below the thermocline may be deficient in oxygen. Temperatures are more suitable throughout the lake at other seasons, and mackinaws apparently roam at all levels.

Small mackinaws eat plankton, immature insects, and many other forms of aquatic invertebrates. As these fish grow larger, they usually

change to a fish diet. However, in Colorado, invertebrates continue to make up an important part of their diet. While there is evidence of competition, mackinaws tend to consume deeper living organisms than are utilized by other trout.

Mackinaws, because they are coldwater fish, are slow growing. This is particularly true in Colorado where six-year-old mackinaws may average 17 inches in length and 1.5 pounds in weight. Colorado mackinaws reach sexual maturity at about this size and age. The spawning season occurs during late October and early November. Most of the activity is at night, with males preceding females to spawning areas. There is no nest preparation, and the eggs are laid in gravel beds, rocky areas, and possibly weed beds, usually in 5 to 20 feet of water. Mackinaws tend to move around considerably during the spawning season. One tagged fish traveled about three miles in a two-day period.

Fishing for mackinaws, particularly for the big ones, requires special planning and, to some extent, special equipment. Very few "macks" are taken by the average fisherman who gears his technique and equipment to catch rainbow or brooks. For this reason, mackinaw make up only a small percentage of the annual catch. There is a fraternity of dyed-in-the-wool "mack" fishermen in the State who consistently make good catches. One group took three large mackinaw from Deep Lake weighing 6, 8 and 23 pounds. Another fisherman took a 12-pounder from Crater Lake. In Twin Lakes, mackinaws have seldom contributed less than 10 percent of the annual catch.

Successful fishing techniques vary. Still fishing in deep water with salmon eggs is good. Trolling with pop-gear baited with sucker strips is a favorite Twin Lake technique. Casting and trolling daredevils, spinners, flatfish, and large spoons are also good methods. A plain brass finish for artificial baits is good and all rigs should be worked at a slow speed.

Considerable patience is a part of successful "mack" fishing. The time between bites can be shortened by fishing the correct level of the lake. Facts concerning temperature tolerances can directly aid the average fisherman toward increasing his catch. The 45° to 50° F temperature zone can be discovered very easily by using a thermometer. Persons fishing within this zone have an excellent chance of catching mackinaws, while persons fishing in other zones of the lake are likely to go home empty-handed. During the spring and fall, this zone may be near the surface, but during the mid-summer period, mackinaws inhabit deeper waters, and the successful fisherman must use enough weight to take his favorite rig to the correct level.

Pike Family (Esocidae)

Northern Pike *Esox lucius* Linnaeus

ROBERT A. JONES, Principal Fish Biologist

Northern pike were introduced into Colorado waters in the spring of 1956. A plant of 700,000 fry obtained from the Federal Hatchery at Guttenberg, Iowa, was made in Bonny Reservoir, Yuma County, Colorado. A second plant later in the spring of that year of 52 adult fish from Nebraska, ranging from 3 to 10 pounds, was made in this same reservoir.

Current distribution of northern pike in Colorado includes most large warmwater lakes and reservoirs on the eastern plains, several front range reservoirs, and large reservoirs at lower altitudes on the western slope. Northern pike have also been planted in two reservoirs above 9,000 feet. The fish grow well but are not able to spawn successfully in these colder reservoirs.

Northern pike spawn immediately after the ice leaves the reservoirs in Colorado. The females prefer to spawn over dense but short vegetation. Breeding fish may range from 15.0- to 16.0-inch males, entering their second year of life, to mature females weighing 35 pounds and 45 inches in length. The average female spawners are between three and four years in age and run between 4 and 10 pounds in weight. The average northern pike spawner produces 10,000 eggs per pound of fish. These eggs measure 0.1 inches in diameter.

Heavy mortalities of eggs are encountered each year. Fluctuating water levels may leave eggs high and dry. Cold weather may kill eggs or delay development of small crustaceans necessary as food for the first few weeks. Predators also take their toll; small perch and minnows follow the pike-run and prey on the eggs and fry. Losses of eggs on the breeding area have been estimated at over 95 percent of the spawn. Colorado Game, Fish and Parks has supplemented the natural spawns by stocking over 2 million northern pike fry each year for the past five years obtained from the Federal Hatchery at Cedar Bluffs, Kansas, and the State of North Dakota Hatchery, at Jamestown, North Dakota.

The young pike tend to move into denser vegetation after hatching. Small crustaceans make up their main food until they reach a length of 1.2 inches. From 1.3 to 2.6 inches in length they feed mainly on aquatic insect nymphs and larvae. From 2.6 inches they feed mainly on fish. Pike will eat other fish from one-half to one-third their length.

Northern pike young-of-the-year seined in Bonny Reservoir had grown to 17 inches in length by the middle of October. One pike achieved a length of 32 inches and 9 pounds after four years in Skaguay Reservoir. A record northern pike for Colorado was taken at Bonny Reservoir during spawning operations. This female weighed 30 pounds and was 43 inches long. Two other large northern pike are in the record book taken by angling; one from Bonny Reservoir, 22 pounds and 44 inches long, and the other from Boyd Lake, 22 pounds and 43 inches long.

Baits and lures for catching northern pike vary for every fisherman,

but one thing is agreed upon — a powerful rod to handle heavier baits and lures — lines from 15 pounds to 20 pounds test and a light steel leader to prevent the line severing from the pike's teeth. There should be plenty of swivel action to prevent the line from twisting as this is a characteristic of a hooked northern pike to free itself. Medium and shallow-running spoons and lures, and large, active live baits are generally the most productive for catching northern pike. The best time of the year is the spring, right after the ice goes out of the reservoirs, until early June. Most Colorado anglers do not use heavy enough gear for these large game fish, and quite a few nice fish are lost each year.

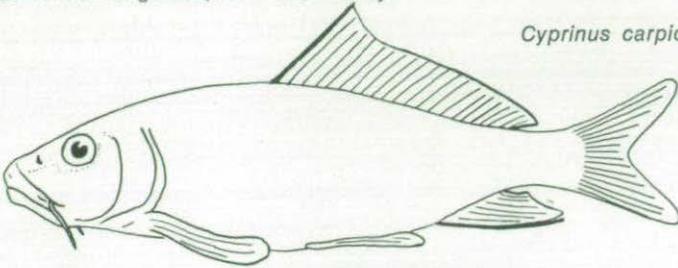
Northern pike taken from cold water have a flaky, firm, white flesh and are very good to eat, either pan-fried, deep-fried, or stuffed and baked.

Another member of the pike family, the grass pickerel (*Essox americanus vermiculatus*), was planted in Palmer Lake, El Paso County, Colorado, many years ago. This lake was treated with rotenone, a fish toxicant, in 1952 to remove the entire population of grass pickerel. The grass pickerel seldom attains a length of more than 12 inches and is very bony and poor quality for eating. No effort has been made to reestablish this species. You can distinguish between the northern pike and the grass pickerel by noting the scalation on the gill covers. Northern pike gill covers are scaleless on the lower half, and grass pickerel have the gill covers fully scaled.

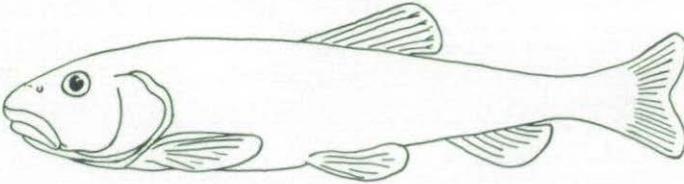
Minnow Family (Cyprinidae)

1. Dorsal and anal fins each with strong, toothed spine on leading edge; dorsal fin with long base, more than 15 rays

Cyprinus carpio Linnaeus
p. 41

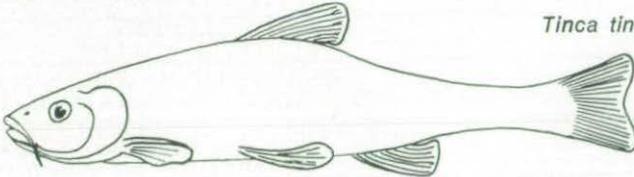


- No spines in anal or dorsal fin; dorsal fin with short base, fewer than 12 rays..... 2



2. Small barbels at each side of mouth; thick skin covering small scales feels smooth to touch

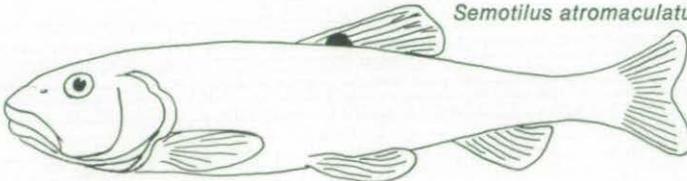
Tinca tinca (Linnaeus)
p. 41



- No barbels or not obvious; skin scaly to touch..... 3

3. Black spot at base of dorsal fin (not obvious in young)

Semotilus atromaculatus (Mitchill)
p. 42



- Black spot absent at base of dorsal fin..... 4

4. Lateral line scales fewer than 50..... 5

- Lateral line scales greater than 50..... 6

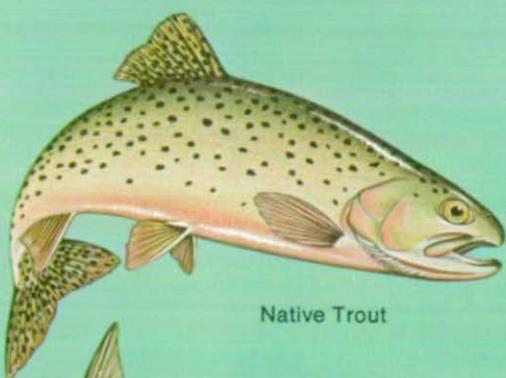
Popular Colorado Game Fish



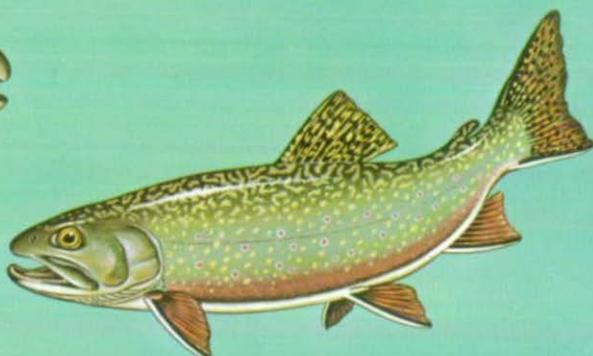
Brown Trout



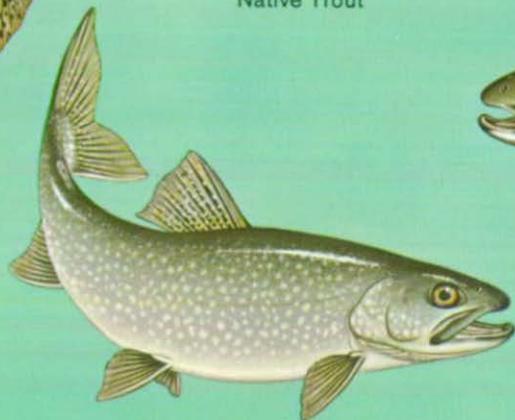
Rainbow Trout



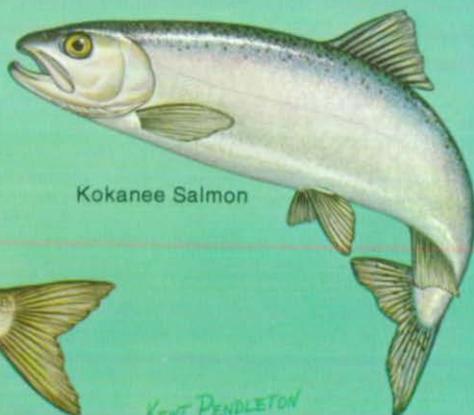
Native Trout



Brook Trout



Lake Trout



Kokanee Salmon

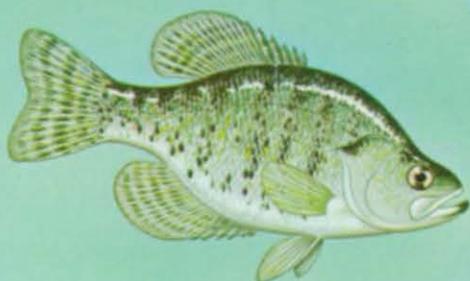


Whitefish

KENT PENDLETON



Walleye Pike



Crappie



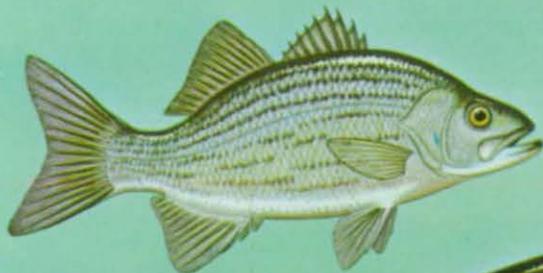
Channel Catfish



Yellow Perch



Largemouth Bass



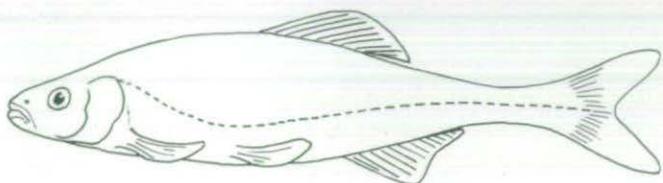
White Bass



Northern Pike

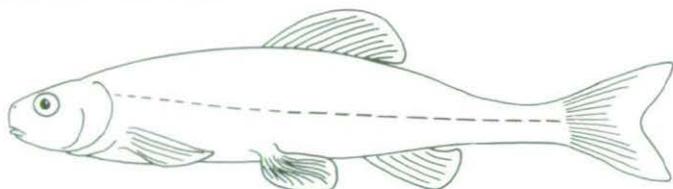
KENT PENDLETON

5. Lateral line strongly decurved



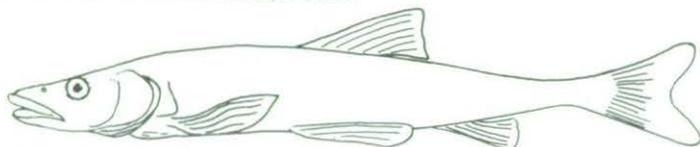
Red Shiner
Notropis lutrensis (Baird and Girard)
p. 43

Lateral line not decurved



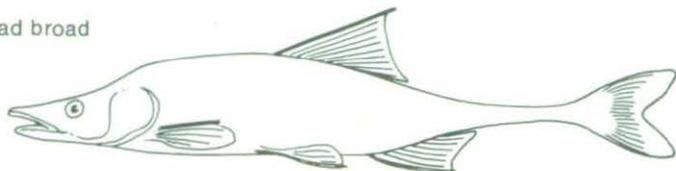
Fathead Minnow
Pimephales promelas Rafinesque
p. 43

6. Head slender and flattened, pike-like



Colorado Squawfish
Ptychocheilus lucius Girard
p. 44

Head broad



Bonytail Chubs
Gila spp. Baird and Girard
p. 44

Carp *Cyprinus carpio* Linnaeus

WILLIAM WEILER, Fish Biologist

Carp were one of the first fish to be cultured by Man. Special strains or pedigrees are recognized although the wild carp in Colorado have reverted back to the original of the species. Carp spread rapidly into most of the eastern slope waters, particularly the plains reservoirs after their introduction into Colorado in 1882.

You may find three varieties of carp in Colorado depending on whether they are fully scaled, partially scaled (called mirror carp), or completely scaleless (called leather carp).

There are records of carp living to nearly 50 years, but wild carp rarely live beyond 15 years. The North American record for the largest carp is 59½ pounds, and individuals weighing up to 25 pounds have been taken by Colorado Game, Fish and Parks seining crews.

Carp thrive best in warm, shallow water with plenty of aquatic vegetation. From late May into June carp scatter their adhesive eggs around the aquatic vegetation and debris that may be in the water. A four-pound female can lay as many as 500,000 eggs. Their rapid growth, as much as five inches in the first summer, and their heavy body make them a poor forage fish. Predators large enough and willing to eat five-inch carp are scarce in Colorado.

Insect larvae and nymphs, crustaceans, small mollusks, and aquatic plants make up the diet of carp. Their constant search for food and their large numbers result in roiled waters that make the habitat undesirable for most game fish.

Most anglers are prejudiced against carp and refuse to accept a good fight on light tackle or fish dishes prepared from carp taken from clean, cooler waters. Natural or prepared baits such as dough balls produce the catches.

Tench *Tinca tinca* (Linnaeus)

T. M. LYNCH, State Fish Manager

Tench were introduced into Colorado from Europe about 1894 in the Rio Grande River drainage and in a few ponds around Longmont. In recent years, tench have spread to Cherry Creek Reservoir in Arapahoe County and to a few ponds in Bent County. Tench are known as a hardy fish largely because they are able to survive low oxygen conditions.

Tench are generally small fish seldom exceeding a weight of one or two pounds. Three- to four-pounders are occasionally taken in large reservoirs. The few anglers who actually fish for tench use salmon eggs or worms fished near or on the bottom of ponds and reservoirs. Opinion as to edibility of tench varies from those who consider it good to others who classify it about the same as carp.

Spawning takes place from May through July depending on the tem-

perature. Eggs are small with between 200,000 and 300,000 per pound of fish.

Organic debris, small aquatic organisms, and aquatic insects make up the major food items.

Tench taken from clear waters are greenish to iridescent golden fading to darkish blue-green on head and yellow on the belly. In murky waters the fish are solid green to bluish to dark brown fading to white on the belly. They may appear golden brown when first taken from the water. The scales are very fine and may not be obvious at first glance.

Creek Chub *Semotilus atromaculatus* (Mitchill)

STEPHEN A. FLICKINGER, Assistant Professor, Colorado State University

The creek chub is a hardy fish preferring small tributaries rather than large main streams. Because of its value as a bait fish, this minnow has been introduced from eastern and central United States into many western states. Once found only in eastern Colorado, the creek chub is now common Statewide.

The preferred habitat is small streams with well-defined riffles and pools. Scoured bottoms of rock are necessary for spawning and deep water or brush provides cover. Spawning begins in early April — males in breeding condition have tubercles on the head and gill covers and tints of blue, green, and rose become apparent. The male builds a nest by moving pebbles to form a ridge. The nest is elongated downstream as successive batches of eggs are deposited. The male guards the nest and sometimes territorial defense proceeds to death.

The large mouth and carnivorous habits of the creek chub make this species an effective predator. Food items include insects, crayfish, snails, and small fish (sometimes their own).

The creek chub is frequently caught on worms and flies and in the Midwest it is referred to as the "poor man's trout." Many youngsters have thrilled at catching creek chubs while on "Huck Finn" outings. When taken from cold water, the flesh is firm, sweet and delicious. Maximum size is about 12 inches.

The greatest interest in the creek chub in Colorado is its use as a bait fish. Because of its hardy nature, the creek chub lives well in the bucket and on the hook. If not weighted down with too many sinkers, it is an active bait. Also the elongated, streamlined shape of the creek chub makes it an excellent trolling minnow. In spite of its desirable characteristics for use as bait, it is difficult to rear. The creek chub must have running water to spawn, and it becomes extremely cannibalistic when crowded into rearing ponds. Consequently, the creek chub is seldom sold by bait dealers, but it is generally available in adequate numbers to fishermen who seine small streams for bait.

Fathead Minnow *Pimephales promelas* Rafinesque

KENT ANDREWS, Assistant Leader, Oklahoma Cooperative Fishery Unit

This small minnow is native to the east slope of Colorado and has been widely introduced in the western part of the State. The fathead minnow, found in all the major river drainages below an elevation of 7,000 feet and in many lakes up to an elevation of 10,000 feet, may be the most generally distributed fish in the State. Typical habitat includes low water velocities (less than 0.1 ft/sec) and abundant vegetation. This species is very tolerant of silty, poorly oxygenated water and very intolerant of high water velocities and lack of good vegetative cover.

Spawning begins in the spring when water temperatures have reached a minimum of 55° F and continues until mid-August. Males and females usually spawn during their second year. Females deposit eggs up to 12 times during a breeding season. Nests are located on the underside of rocks, boards, and other material located near the bottom. Incubation time varies with temperature with eggs laid in 77° F water hatching in three days and eggs laid in 55° F water hatching in 15 days. Both males and females usually die after spawning.

Food habits are omnivorous with mostly animal material eaten in the spring with a gradual change to plant material in the fall. Most food items are dead and are picked up off the bottom.

Generally, fathead minnows will provide good forage for warmwater gamefishes if there is not too much vegetative cover for the minnows. Because of the long, sporadic breeding season they do well in our water storage reservoirs, and their small size assures they are never too large to be eaten. Except for brown trout, most of the other trouts do not utilize fathead minnows to a great degree.

The fathead minnow is a good bait fish when used in early spring for bass, crappie, and yellow perch and in the winter for trout (primarily in ice fishing). They live well in both the bait bucket and on the hook, and gamefishes show a definite preference for this small, soft minnow.

Red Shiner *Notropis lutrensis* (Baird and Girard)

The red shiner, one of the most abundant minnows in Colorado, is usually found in small streams and ponds. The abundance and survival of the red shiner are a reflection of their general habitat requirements and their wide range of spawning times and sites.

Although red shiners rarely get much over three inches in length, they are a hardy and attractive bait minnow. In fact, it is likely the spread of this eastern Colorado native to the western slope resulted from introductions via the bait pail.

Spawning takes place in June and July when the fertilized eggs are

deposited among debris, aquatic plants, and other substrates. The eggs are adhesive and adhere to whatever they contact. There is no parental care.

The red shiner is an omnivorous eater, feeding on aquatic vegetation, plankton, small insects, and crustaceans.

Bonytail Chubs *Gila spp.* Baird and Girard

There is some confusion in the speciation of this genus and in the treatment of the scientific names by ichthyologists. There are four members of the bonytail chub group in Colorado: the Rio Grande chub, the bonytail chub, the roundtail chub, and the humpback chub which is very rare. The bonytail chub is the most striking of the group with the arched back in the large adults and the very narrow, long caudal peduncle.

The Rio Grande chub is common in the Rio Grande drainage. The bonytail and roundtail are common in the Colorado River system. Bonytails have been reported up to 18 inches in length and roundtails up to 15 inches.

Colorado Squawfish *Ptychocheilus lucius* Girard

The Colorado squawfish is the largest minnow in North America with recorded weights up to 80 pounds and commonly reaching 15 pounds. Five-foot total lengths have also been reported. They are distributed in the Colorado drainage.

Squawfish are voracious minnows with pike-like habits. The scientific name *lucius* means pike. The adults feed mostly, if not exclusively, on other fish including trout and salmon. Although the squawfish, like all minnows, lack jaw teeth, they are quick to capture fish with their large mouths and crush them far back in the throat with pharyngeal teeth. Squawfish up to four inches in length feed almost entirely upon aquatic insects and small invertebrates. Squawfish from four inches to two feet feed more on fish with occasional insects.

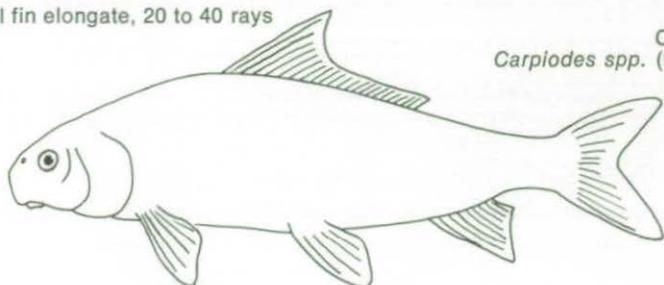
Squawfish spawn in the early spring in shallows. The fertilized eggs are adhesive and stick to the bottom.

Because the squawfish are such predators on game fish, control has long been a fishery management problem. Everything from dynamite to chemical control has been tried. The most recent development is a specific chemical called "Squoxin" for the control of these predators.

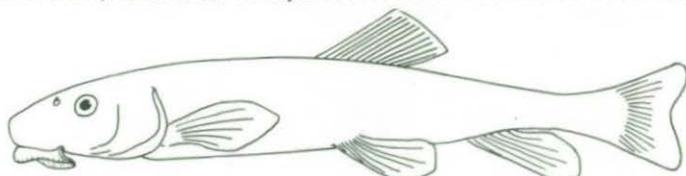
Sucker Family (Catostomidae)

1. Dorsal fin elongate, 20 to 40 rays

Carp suckers
Catostomus commersoni (Rafinesque)
p. 46

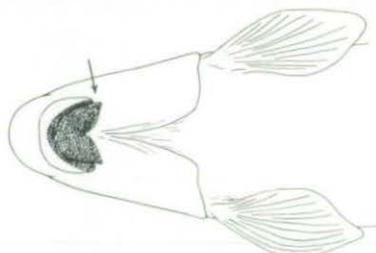


- Dorsal fin short, fewer than 19 rays..... 2

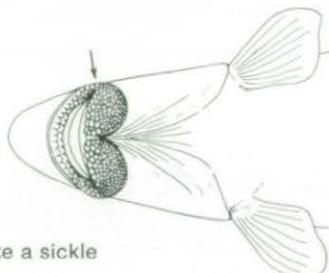


2. Distinct notch at corner of mouth between upper and lower lips

Mountain Suckers
Catostomus commersoni (Rafinesque)
p. 47

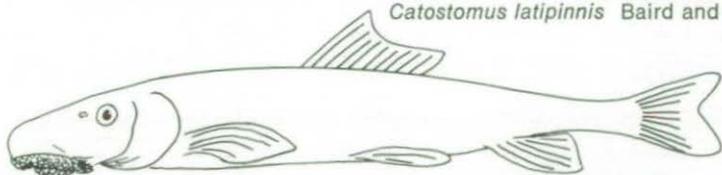


- Distinct notch at corner of mouth absent..... 3



3. Dorsal fin curved like a sickle

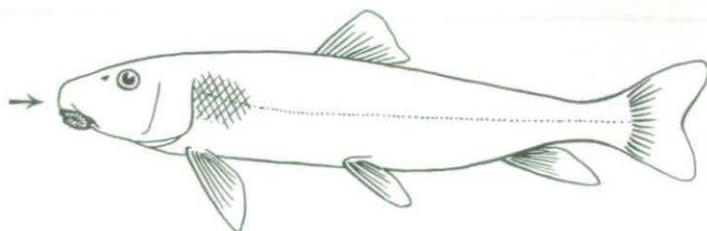
Flannelmouth Sucker
Catostomus latipinnis Baird and Girard
p. 47



- Dorsal fin not curved like a sickle..... 4

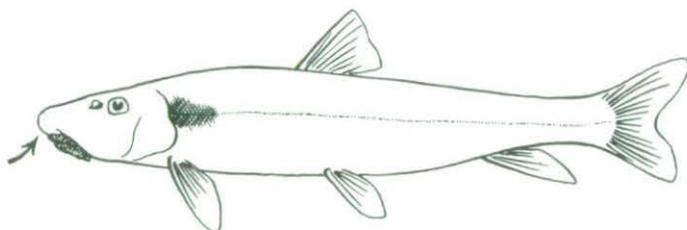
4. Scales large, fewer than 80 in the lateral line; snout not pointed

White Sucker
Catostomus commersoni (Lacépède)
p. 48



- Scales small, more than 80 in lateral line; snout pointed, extending considerably beyond the mouth

Longnose Sucker
Catostomus catostomus (Forster)
p. 49



Carp suckers *Carpoides* spp. (Rafinesque)

REX TALIAFERRO, Assistant, Field Operations

Carp suckers are found in the streams and eastern plains reservoirs in Colorado. The river carp sucker (*Carpoides carpio*) is the only one definitely known from Colorado.

These fish resemble carp in general body shape, but the carp sucker is silvery with smoky to olivaceous overtones dorsally. Also, the lateral and ventral colors are lighter than the carp.

Colorado studies report carp suckers reaching eight inches in length during their second summer of growth. Specimens over 20 inches in length and 10 pounds in weight have been taken during biological inventories of fish populations.

The carp sucker is not considered a desirable food fish, and apparently they are rarely, if ever, taken by anglers. We do not have a confirmed report of these fish being taken by hook and line in Colorado. Perhaps this is associated with the food habits and feeding habits.

Flannelmouth Sucker *Catostomus latipinnis* Baird and Girard

Flannelmouth suckers are confined to the Colorado River drainage and represent one of the most common suckers in the area. Taken only occasionally by fishermen, flannelmouths are not used to any extent as food. Their habitat requirements are similar to the white sucker so you can expect to find the adults in the pools of streams and rivers. The young fish will be in shallower water.

Actually, very little is known about their life history. A very early Colorado study describes the flannelmouth as a vegetarian feeding on algae, diatoms, and plant materials including seeds. They apparently spawn in the summer, but nothing definite is known about breeding behavior or exactly what spawning area requirements are.

Collections in the Black Canyon of the Gunnison River revealed coarse scaled (75-90 scales in lateral line) and the typical fine scaled (95-120) flannelmouths living together.

Mountain Suckers Subgenus (*Pantosteus*)

ROBERT J. BEHNKE, Assistant Leader, Colorado Cooperative Fishery Unit

A distinct group of suckers characterized by a pronounced notch between the upper and lower lips and a hard ridge of cartilage on the edge of the jaws are classified as a subgenus (*Pantosteus*) in the genus *Catostomus* to denote their evolutionary relationships.

Three species of mountain sucker are native to Colorado. One species is found in the Rio Grande drainage and two species are indigenous to the Colorado-Green River system. Most species of the mountain suckers are small fish less than 10 inches maximum size, but the bluehead sucker of the Colorado River basin may attain a length of 16 inches.

Typically, the mountain suckers live in more headwater areas than other suckers. They thrive in the smaller, colder, trout streams but may be common in larger rivers and lakes where they may co-exist and sometimes hybridize with the larger, non-native white sucker introduced from the east slope.

In general, the life history and ecology of mountain suckers are similar to the white sucker and longnose sucker, but the shape of the lips, the cartilagenous ridge on the jaws and a long intestine (about four times the body length) provide the specializations allowing a partition of the "sucker niche" so they may live together with the white sucker and longnose sucker avoiding direct competition. Mountain suckers scrape algae, diatoms, and organic material from the surface of rocks while other suckers, like animated vacuum cleaners, suck up their food. The mountain sucker's feeding habits can be considered more like a "scraper" than a "sucker".

During the spawning season, which may be from May to August, both

male and female mountain suckers develop a reddish-orange band on their sides, but the coloration in males is more pronounced than in females. Trout fishermen sometimes waste time casting lure or bait to a school of red-banded fish observed in a riffle area, under the mistaken assumption they are rainbow trout.

White Sucker *Catostomus commersoni* (Lacépède)

The white sucker is one of the most abundant of the larger fishes in the reservoirs, lakes, and tributary streams of Colorado. Suckers are easily observed throughout the year, but it is during the spawning migrations in the spring and early summer (when water temperatures range from 50° to 65° F) that almost unbelievable numbers gather in spawning concentrations. Most suckers spawn in streams, but spawning will also take place in the shallow margins of lakes. During this period the male suckers develop tubercles on the anal fin, on the lower part of the tail fin, and on the upper sides of the paired fins. Females are usually attended by more than one male. Eggs and milt are released when the males press on either side of the female. This actual spawning act takes place in shallow moving water, and the fertilized eggs simply drop to the bottom among the gravel with no nest constructed and with no parental care. Spawning is characterized by much movement, and spawning concentrations can often be located simply by the noise of the splashing water.

Young suckers hatch after an average incubation period of three weeks. These swarms of newly hatched suckers furnish the first fish food of many game fishes. However, the role of suckers as a forage fish is not as important to our game fish, particularly the salmon and trout, as we once thought. Many of our lakes and reservoirs have large populations of large suckers which are not utilized or certainly not controlled by game fish. These sucker populations take up space, compete with more desirable fish for energy, and are generally blamed for poor fishing, particularly in older reservoirs.

Suckers eat a wide variety of food organisms including small crustacea, simple one-celled animals, rotifers, insect larvae, filamentous algae, and even vascular plants. The sucker-like mouth is also adapted for cleaning diatoms and snails from rocks, a feeding habit you may have observed. Suckers are frequently condemned as an egg predator on salmon and trout, but actual studies of their stomach contents do not support this. Also, the only trout and salmon eggs available to a sucker would be those not properly covered in the nest and doomed to die anyway.

Most one-year-old suckers will be between two and three inches. There is a great deal of variation in the lengths of older suckers depending on the temperature and productivity of the water. Twenty-five-inch suckers may weigh as much as 6½ pounds and 22-inch suckers as much as 5¾ pounds.

Young suckers, whether in streams or lakes, occupy areas of low water velocity where there is abundant aquatic vegetation. Larger suckers are found throughout lakes and reservoirs. Larger suckers in streams are generally in deep or shallow pools where there is much cover from bank vegetation.

Western Longnose Sucker *Catostomus catostomus* (Forster)

LARRY M. FINNELL, Wildlife Researcher

The western longnose sucker, although quite abundant in a number of Colorado's high lakes, reservoirs, and streams, is relatively unknown to fishermen. The longnose, feeding primarily on small insect larvae and plant materials, is seldom taken by fishermen on hook and line. Originally native to eastern slope drainages such as the Arkansas and Platte River basins, the longnose is now established in large numbers in streams and impoundments of the upper Colorado River basin. This species may also be present in other major drainages of the western slope.

The longnose sucker, according to records, may attain a length of 30 inches and a weight of several pounds. However, lengths of 7 to 12 inches, and weights of less than one pound, are much more common.

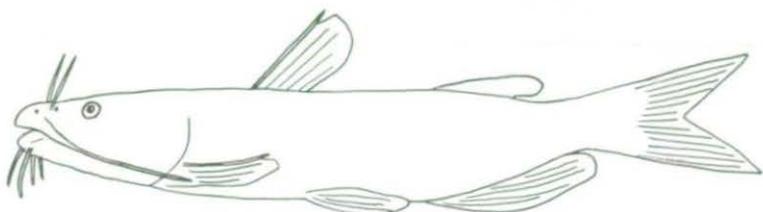
A member of a group of fishes known as finescaled suckers, the longnose is best distinguished from a close relative, the mountain sucker, by the absence of a distinct notch at the corner of the mouth between the upper and lower lips. Sometimes confused with the flannelmouth sucker, which also has very small scales (more than 90 in the lateral line), the longnose is identified by the relatively broad caudal peduncle. Also, the dorsal fin of the longnose is straight, not sickle shaped as in the flannelmouth. During the spring, spawning males exhibit a rosy lateral band with head and anal fin covered with tubercles or pearl organs.

Spawning generally takes place in late spring, usually in tributary streams. The eggs, as many as 50,000, may be produced by a 12-inch female, are scattered over the spawning grounds.

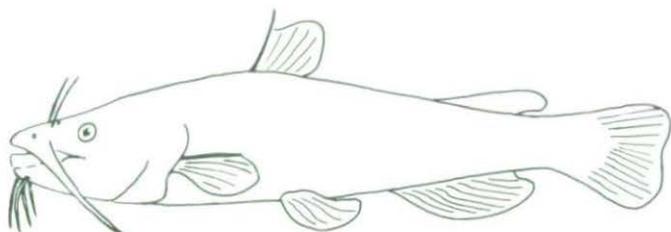
The importance of the longnose sucker as a forage fish has not been determined in Colorado, but it is doubtful that benefits in this respect exceed the detrimental effects of competition with game species for food and space. Occasionally, however, the longnose is included in the diet of the lake trout. Competition with game fish for space and food has long been the subject of argument. In waters such as Turquoise Lake in the upper Arkansas River drainage, where the longnose sucker is extremely abundant, serious competition with game fish must surely exist.

Catfish and Bullhead Family (*Ictaluridae*)

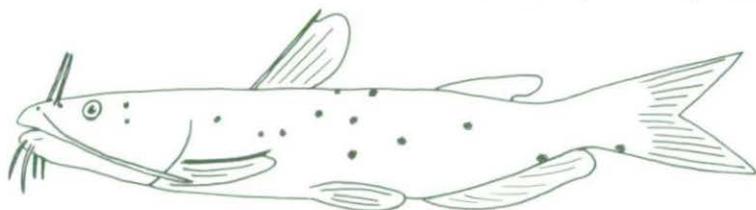
1. Caudal fin forked 2



- Caudal fin squared, little or not forked at all..... 3



2. Small irregular dark spots over upper half of body (except in some large adults, especially males), anal fin rays 25 to 30; color of body dark olive above
Channel Catfish
Ictalurus punctatus (Rafinesque)
p. 51



No dark spots over upper half of body; anal fin rays 32 to 35;
color of body blue-gray above

Blue Catfish
Ictalurus furcatus (Lesueur)
p. 51

3. Pectoral spines with strong posterior teeth; adults with white belly

Brown Bullhead
Ictalurus nebulosus (Lesueur)
p. 53

Pectoral spines without strong, definite teeth on posterior;
adults with yellow belly

Black Bullhead
Ictalurus melas (Rafinesque)
p. 53

Channel Catfish *Ictalurus punctatus* (Rafinesque)

Blue Catfish *Ictalurus furcatus* (Lesueur)

STEPHEN A. FLICKINGER, Assistant Professor, Colorado State University

Both the channel and blue catfishes are native to the Mississippi drainage, but only the channel catfish occurred naturally in eastern Colorado. The channel catfish was once abundant in the Platte and Arkansas Rivers, but de-watering for irrigational purposes has reduced its abundance there. The channel catfish has been introduced Statewide and has become established in many of the warmer reservoirs and rivers. Several introductions of blue catfish have been tried, but numbers are limited.

The channel and blue catfishes are the only forked tail catfishes in Colorado. The number of rays on the anal fin is the most dependable distinguishing characteristic for these two species. In specimens under four pounds, the dorsal portion of the channel catfish has a greenish cast while the same portion of the blue catfish is bluish or slatey gray. Also channel catfish of this size have irregular small round dark spots and the blue catfish has no spotting. Large channel catfish exhibit few or no spots and become dark blue or black. Another field characteristic is the color of the pectoral spine. Blue catfish have an ivory-white spine and channel catfish have a gray or dusky-brown spine.

Little is known about the spawning behavior of blue catfish, but it appears to be similar to that of channel catfish. Channel catfish spawn in late spring or early summer when water temperatures reach 70° to 75° F. Channel catfish spawn in dark secluded areas; hollow logs, rock ledges, and muskrat burrows are frequently used. It has long been thought that the male selects the nest site, but there is evidence the female may do this. Prior to spawning the male severely bites the female's belly, often producing shallow scratches. This behavior has led to the erroneous belief that the male had to bite a gelatinous plug from the female's vent. There is no scientific evidence to support this view. The biting behavior may serve to rupture the egg sac so that mature eggs flow freely. A spawning pair of channel catfish may emit eggs and sperm 15 to 20 times over a 4- to 6-hour period. Total number of eggs deposited is approximately 3,000 to 4,000 eggs per pound of female. The male guards and fans the eggs during the 6- to 8-day incubation period. Female catfish may return and try to eat the eggs. Newly hatched channel catfish remain for several weeks in a tight school guarded by the male.

Both the channel and blue catfish are omnivorous feeders, but crayfish are a choice item in their diet. Channel catfish over 50 pounds have been captured, but few in Colorado weigh over 20 pounds. In fact, most channel catfish in Colorado weigh less than 5 pounds. The blue catfish is one of the monsters of the fish world, attaining weights over 100 pounds. Successful establishment of the blue catfish should prove popular with Colorado fishermen! Because of the omnivorous feeding habits and highly developed sense of smell of catfish, a variety of baits has been used successfully. Each fisherman seems to have his own preference. A partial list would include: minnows, crayfish, nightcrawlers, leeches, clams (minus the shell), rotten chicken innards, liver, and a whole variety of cheese- or anise-flavored dough-ball types of bait. Dusk and after dark seem to be the best times to fish.

The channel catfish currently commands a commercial market over three times that of the rainbow trout. In 1969, over 35 million pounds of channel catfish were reared commercially. Because optimum growing temperature for channel catfish is 85° F, commercial production of catfish in Colorado would be limited to warmwater springs or wells or to heated effluents from thermal power plants.

Black Bullhead *Ictalurus melas* (Rafinesque)

Brown Bullhead *Ictalurus nebulosus* (Lesueur)

Stonecat *Noturus flavus* (Rafinesque)

STEPHEN A. FLICKINGER, Assistant Professor, Colorado State University

The most striking feature of the bullheads is their large bull-like head. Their tail is not forked like the channel and blue catfishes. Stonecat are easily distinguished by the fusion (except for a shallow notch) of the adipose and caudal fins. The stonecat possesses a poison gland at the base of each pectoral spine. The "sting" is as potent as that of a wasp but does not persist as long.

The black bullhead occurred naturally in eastern Colorado, but has been introduced to the western slope. It is now fairly common Statewide. The brown bullhead was not native to Colorado, and survival of its introductions has been spotty. The stonecat is quite rare in Colorado, occurring only in extreme eastern Colorado near the Nebraska border. Because of its small size there has been no interest in establishing stonecat in other waters.

Spawning behavior of these three catfish species is similar to that of the channel catfish, but both bullheads may spawn slightly earlier. Newly hatched black bullheads form a dense school guarded by the parents. The school may persist for most of the summer.

The black bullhead seldom exceeds 12 inches in length; the brown bullhead is slightly larger, obtaining a maximum size of 18 inches. The stonecat rarely exceeds 9 inches. Bullheads tend to overpopulate and become stunted. As with other members of the catfish family, these three species are omnivorous.

Worms are an excellent bait for bullheads, but grasshoppers, small minnows, and any of the foul-smelling catfish baits are good also. Although bullheads are more active at night, they frequently provide good fishing during the day. Though not a spectacular fighter, bullheads provide a strong tug.

Eel Family (Anguillidae)

American Eel *Anguilla rostrata* (Lesueur)

T. M. LYNCH, State Fish Manager

Historical records indicate the American eel was once common to the Rio Grande and Arkansas River drainages. Now eels are found only in the Arkansas River below John Martin Reservoir and in sandpits bordering the river. Catches of eels are relatively rare even in this area. Although good to eat, few, if any, fishermen intentionally fish for them. Most eels are caught by catfish fishermen, but if you use minnows, crayfish, worms, or cut bait you may find you've hooked an eel.

Basic color of the eel is brown, darker along the back and lighter below, with yellowish tinges along the sides. When taken from the water, eels have an overall greenish sheen that fades rapidly.

Eels have strong jaws and sharp teeth and a reputation for being a voracious fish. They are omnivorous, feeding on all forms of animal and plant life.

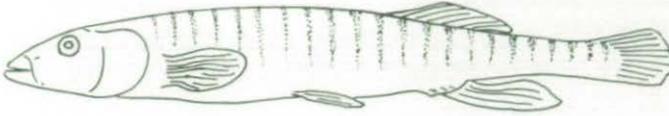
When adults reach sexual maturity, anywhere from 5 to 20 years of age, they grow darker, lose their voracious appetites, and begin their downstream migration. Their destination is the Atlantic Ocean southeast of Bermuda in the area between Bermuda and the West Indies. Eels spawn and die in this area known as the Sargasso Sea. The eggs float near the surface and hatch into larvae which drift with the currents to the coast of the United States. When they reach a length of about three inches they are known as elvers and are ready to move up the rivers in the spring.

Females commonly reach a length of three to four feet, and occasional large ones are taken six feet in length. Males are smaller. Elvers have been reared at the Las Animas Fish Production Unit in Bent County to adults ranging up to three feet in length.

Killifish Family (Cyprinodontidae)

1. Body crossed by 11 to 21 vertical dusky bars

Plains Killifish
Fundulus kansae Garman
p. 55



Body not crossed by vertical dusky bars

Plains Topminnow
Fundulus sciadicus Cope
p. 55

Killifish Family (Cyprinodontidae)

The plains killifish and the plains topminnow are the only Colorado members of the killifish family. These small fish usually average two to three inches in length and are probably considered by most fishermen as members of the true minnow family (Cyprinidae). The plains killifish is distinguished by its 11 to 21 crossbars from the plains topminnow which does not have the crossbars.

Both of these killifish are common in the streams of the plains area and are particularly noticeable during the spawning season which peaks in late July or early August. Schools of mature adults are easily observed at this time. The males take on a bright spawning coloration. There is no nest preparation or care of the young as the eggs are simply dropped to the gravel bottom.

Killifish are of little importance to the sport fisheries of Colorado.

Temperate Bass Family (Percichthyidae)

White Bass *Morone chrysops* (Rafinesque)

WILLIAM J. ADRIAN, Research Assistant

The white bass, striped bass, and white perch belong to the temperate bass family, well known for marine fish such as the sea basses and groupers. The freshwater species resemble members of the sunfish family.

The white bass (also called silver bass, black-striped bass, and barfish) is native to an area encompassing Minnesota, east to the lower Great Lakes and the St. Lawrence River drainage and south through Alabama and Texas. It has been introduced in numerous states and was first introduced into Colorado in 1948 in John Martin Reservoir and can now be found in both the Arkansas and South Platte drainages.

Three to four years seem to be the average life span of the white bass; however, exceptional individuals may live longer. The male matures at two years, the female at three.

They are spring spawners, March in the south and June in the north. In general, at a water temperature from 62° to 70° F, river fish migrate upstream to spawn; lake dwellers may enter streams or spawn near shore or on reef shoals. White bass do not build nests. Eggs are scattered in the water, fertilized by the male, and left to develop by themselves with no parental care. The female may lay from 500,000 to 900,000 eggs depending on her size. The eggs hatch in 7 to 10 days. The fry remain for a short time in the shallows before moving to deeper water.

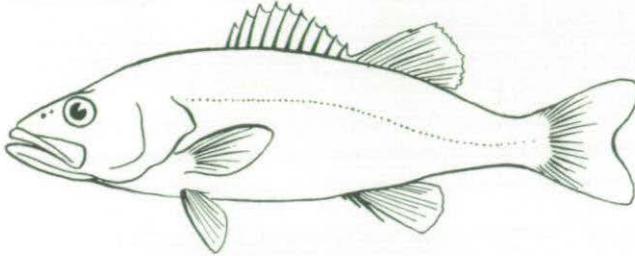
These small young fish feed heavily on insect larvae and small crustacea and will grow four to five inches by autumn and attain seven to nine inches by the end of the first year. Adults feed on insects, crayfish, and various small fishes. The official record for white bass is five pounds, two ounces, taken at Grenada Dam, Mississippi, in July, 1960. However, one to three pounds and 12 to 18 inches are more common.

The white bass has a good reputation as both a game and food fish. Schools of bass are usually inshore surface feeding in the morning and evening when they readily take small minnows, worms, small spinners, bucktails, and even dry flies. During the day the schools are in deeper waters, and trolling or still fishing with bait or lure just off the bottom can be effective.

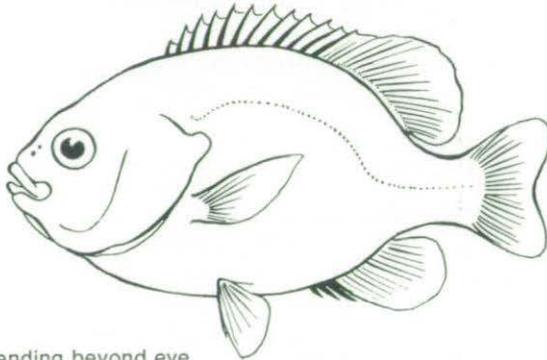
The striped bass (*Morone saxatilis*) and the white perch (*Morone americanus*) are close relatives of the white bass. Both have been introduced (1968) into Colorado waters by Game, Fish and Parks as part of the fishery management program. The striper is one of the largest members of the family, reaching 75 pounds in the ocean and as much as 30 pounds in freshwater. White perch are smaller fish and more nearly like the white bass. They may reach two to four pounds, but have a tendency to overpopulate which reduces their size. Fishermen find both of these fish fun to catch and excellent to eat.

Sunfish Family (Centrarchidae)

1. Body relatively long, depth being about one-third the length; dorsal fin deeply notched between the spiny and soft-rayed portion; scales small, 58 or more in lateral line..... 2

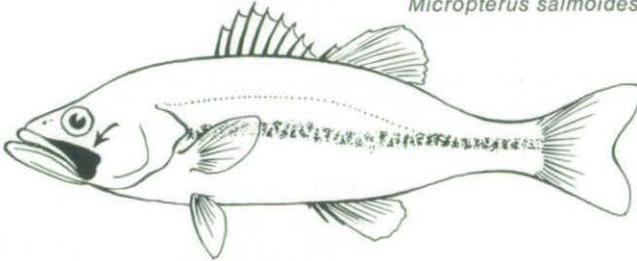


- Body short and deep; dorsal fin not deeply notched; scales larger, 53 or fewer in lateral line..... 3



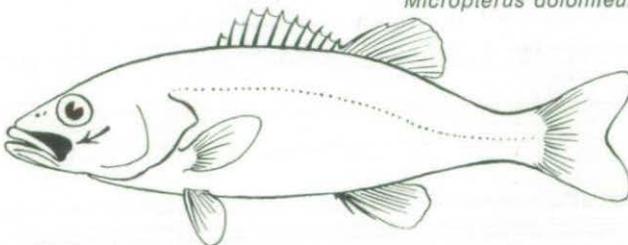
2. Upper jaw extending beyond eye

Largemouth Bass
Micropterus salmoides (Lacépède)
p. 60

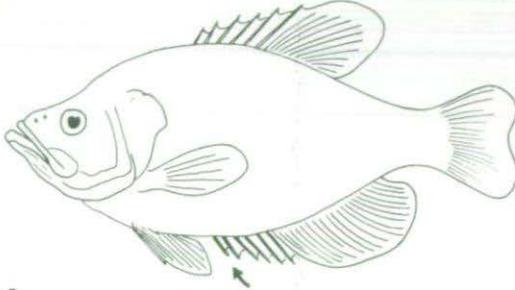


- Upper jaw not extending beyond the eye

Smallmouth Bass
Micropterus dolomieu Lacépède
p. 61

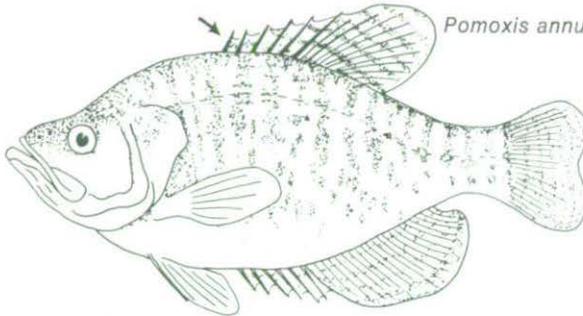


3. Anal spines 5 or more 4



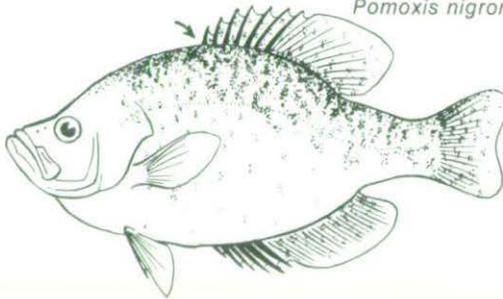
Anal spines 3 5

4. Dorsal spines usually 6; body more definitely cross-banded



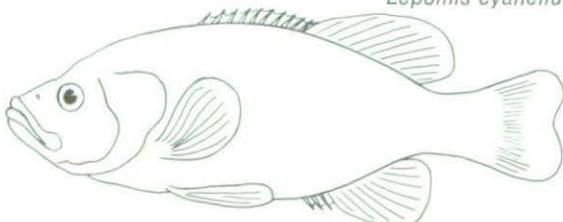
White Crappie
Pomoxis annularis Rafinesque
p. 62

Dorsal spines usually 7 or 8; body more mottled



Black Crappie
Pomoxis nigromaculatus (Lesueur)
p. 63

5. Pectoral fins short and rounded

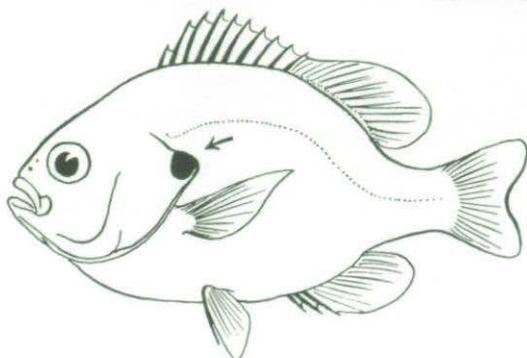


Green Sunfish
Lepomis cyanellus Rafinesque
p. 64

Pectoral fins long and pointed 6

6. Red spot on opercle; gill rakers short and stout;
opercular bone stiff posteriorly

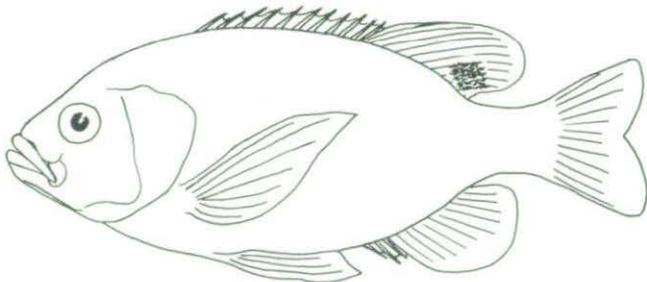
Pumpkinseed
Lepomis gibbosus (Linnaeus)
p. 66



Red spot absent; gill rakers long and slender;
opercular bone flexible posteriorly..... 7

7. Large black spot at posterior base of soft dorsal; long, soft, black
earflap; sides not orange spotted

Bluegill
Lepomis macrochirus Rafinesque
p. 67



No black spot at posterior base of soft dorsal; opercular bone sharply
rounded backward; sides with about 20 to 30 orange spots
irregularly distributed

Orangespotted Sunfish
Lepomis humilis (Girard)
p. 66

Largemouth Bass *Micropterus salmoides* (Lacépède)

DON WEBER, Wildlife Researcher

The largemouth bass or black bass is the largest member of the sunfish family in Colorado. The largemouth has the distinction of being the first fish introduced into the State. Four hundred and fifty-nine bass were obtained from Ohio in 1878 and were planted in numerous lakes from Fort Collins to Cuchara. Since that time bass have been stocked in all the major drainages of the State except the North Platte. The largemouth gets its name from the upper jaw bone which extends behind the eye. In the small mouth bass the upper jaw extends only to about the middle of the eye.

Like all the other sunfish the largemouth is a nest builder. The nest, really nothing more than a cleared area, is built in 18 to 36 inches of water on sand, gravel, roots, and aquatic vegetation. Nest building and spawning are triggered when the water temperature in late May and June reaches 60° F. The male escorts the female onto the nest, and spawning is accomplished. After spawning, the female retreats to deeper water, and the male is left to guard the young. Males and females may renest and respawn if the eggs are destroyed or if the female was not completely ripe at the first spawning. The eggs hatch in three to five days, and the young fry remain in the nest about a week before beginning to feed. The male guards the brood for about another week before they leave the nest site.

Young largemouths feed almost exclusively on zooplankton. After they reach two inches the diet changes to fish, crayfish, frogs, tadpoles, and larger insects.

In Colorado, largemouth may attain a length of from 8 to 10 inches during the second year of life. Sexual maturity is usually reached during the third year. Three- to five-pound bass are fairly common in Colorado, but a 10-pound largemouth would be a State record.

The largemouth appears better adapted to Colorado's warmwater, fluctuating, sparsely-vegetated reservoirs than the smallmouth bass. However, most reservoirs have never developed large populations of largemouths. Evidence collected by the fishery managers indicating successful spawning in most years, but mortality from unknown causes prevents most small bass from reaching adulthood. The Colorado Game, Fish and Parks Division carries on an extensive stocking program to supplement the natural reproduction.

In Colorado, the largemouth bass is probably the most prized of the warmwater fish. They will strike throughout the day, but early morning and evening fishing are best. Favorite baits and lures are frogs, minnows, crayfish, surface and underwater lures, flyrod-sized poppers, and underwater flies. Brush and weed areas are not extensive in Colorado reservoirs so the bass fisherman must either know his fishing areas or cover more reservoir area finding the best fishing areas.

Smallmouth Bass *Micropterus dolomieu* Lacépède

DON WEBER, Wildlife Researcher

Smallmouth have been stocked in the South Platte, Arkansas, and Colorado River drainages since their introduction into Colorado in 1951. The smallmouth gets its common name because the upper jaw does not extend much beyond the middle of the eye.

The nest building and spawning activities of the smallmouth and largemouth bass are similar. The smallmouth nest is usually a little more elaborate and larger, and the nest building and spawning activities commence at a slightly lower water temperature. The smallmouth male seems to prefer a gravel or sand lake bottom for nest building; however, if gravel or sand are not available it will construct the nest on other bottom materials. The nest is usually located near some object such as a rock, log, or stump.

After hatching, the fry remain among the rocks of the nest for several days after which they rise up from the nest. The school is guarded by the male until the young fish are $\frac{1}{2}$ to $\frac{3}{4}$ of an inch long. At this time the school disperses among the aquatic vegetation.

Fry bass feed entirely on zooplankton. After they reach several inches in length their diet consists mostly of small fish and insects. Adult smallmouth bass eat fish, frogs, tadpoles, crayfish, and insects. Fish seem to be the preferred food of the adult smallmouth.

An extensive stocking program is carried on by Colorado Game, Fish and Parks. Smallmouth appear well adapted to some of our cooler water foothills reservoirs. Although the evidence is not yet complete, it also appears that smallmouth may do well in some of the larger, deeper, plains reservoirs.

Fishing methods and baits used for largemouth bass will also work for the smallmouth. Frogs, minnows, crayfish, surface and underwater lures, flyrod-sized poppers, and underwater flies are popular. The smallmouth is not as big as the largemouth for even in the northern portion of their native range, the smallmouth rarely gets larger than three to four pounds.

White Crappie *Pomoxis annularis* Rafinesque

TOM POWELL, Assistant Wildlife Researcher

White crappie were first introduced to Colorado waters in 1882. These fish are widely distributed throughout eastern Colorado and in a few reservoirs in the west. They occur in most large reservoirs and make up a large portion of the warmwater fisherman's catch. Six- to ten-inch crappies are quite common in the angler's creel, although larger individuals occur. This fish, although not as strong a fighter as the bluegill, is more highly regarded in the skillet.

White crappie appear to be more tolerant of warmer and more turbid water than their close relative, the black crappie, which prefers clear, weedy lakes and reservoirs. Both species live together quite frequently with one usually being dominant, depending on the conditions of the particular body of water.

Sides of the white crappie are silvery-olive, shading into an olive-green on the back with eight to nine dark vertical bands. The white crappie usually has six distinguishing dorsal fin spines.

In the spring when the water temperatures reach 64° to 68° F the male develops spawning color which is a darkening of the sides of the head, lower jaw, and breast. He then selects the nest site, generally in water three to eight feet deep. These sites are usually located near brush piles, stumps, or rock outcroppings. There seems to be a preference of a plant material substrate for egg deposition. After spawning, the male guards the nest until the young are hatched. Young crappies seek heavy cover while the adults tend to frequent the edges of submerged or aquatic vegetation.

The young, at first, eat largely zooplankton and then change to aquatic insects. Later, fish become the most important food item. They compete with black bass more than other sunfish.

Most individuals captured by fishermen are less than five years old and a seven- or eight-year-old fish is rare. Growth of the white crappie in Colorado varies greatly between lakes. In the larger reservoirs, crappie between 9 and 12 inches long will, in general, be a minimum of four years old. Some populations, however, are too numerous for their food supply, and individuals never exceed seven or eight inches long.

Slow trolling or drifting with minnows in the early spring is one of the favorite methods of capturing these fish. Lead-headed flies bounced along the bottom are also effective. Fishing near brush piles, stumps, or over rock outcroppings in water up to 15 feet deep is generally most productive. The fly fisherman can do best by fishing about an hour before sunset to dark. During the summer months crappie are usually found in depths of 15 to 25 feet. Night fishing is most productive at this time of year.

Black Crappie *Pomoxis nigromaculatus* (Lesueur)

TOM POWELL, Assistant Wildlife Researcher

Black crappie are found in most of the ponds, lakes, and reservoirs in the eastern half of Colorado. They occur in only a few reservoirs on the western slope. Black crappie were introduced to Colorado along with the white crappie in 1882. They occur in all the reservoirs which have white crappie and are dominant in some. Black crappie prefer clear, weedy lakes which are not abundant in Colorado.

A distinguishing characteristic of the black crappie is the irregular dark mottlings on the silvery-olive colored sides that suggest an old calico print. For this reason it is sometimes called calico bass.

Spawning begins in the spring when the water temperature reaches 58° F and peaks at approximately 64° F. The male builds a nest, usually in gravel, but they can nest on mud or plant material usually unacceptable to other types of sunfish. The male guards the nest until hatching occurs. The young seek heavy cover to avoid predation and to obtain food.

Diet of the black crappie consists of insects, crustaceans, and as adults they are almost wholly piscivorous. The young usually grow two to four inches in their first year. Growth rate is highly dependent on the availability of food organisms. In some reservoirs, four-year-old crappie will be 13 inches long, while in other bodies of water they will be only eight inches long.

Spring fishing using small minnows or jigging lead-headed flies is generally most productive. Crappies are quite fussy about depth, speed, and lure action. Inlets to lakes and reservoirs usually contain concentrations of these fish and produce good catches.

During the summer months crappies are generally found in deeper water. Trolling or drift fishing in water 15 to 25 feet in depth is considered best. Night fishing at this time of the year is generally very productive. Fly fishing about an hour before sunset until dark is also good.

Green Sunfish *Lepomis cyanellus* Rafinesque

RICHARD IMLER, Wildlife Researcher Candidate

The green sunfish is probably the most abundant native Colorado sunfish. It is well adapted to all warmwater habitats and is present in the streams, rivers, and reservoirs of all drainages except the North Platte.

Though sometimes mistaken for a bluegill, the green sunfish can be readily distinguished by its heavy lips and large mouth which extends beyond the front of the eye. The green sunfish also has a short rounded pectoral fin whereas the bluegill has a longer, pointed fin.

The green sunfish spawns over an extended period, usually from June to mid-August. Nests are constructed in colonies in shoal areas with a preference toward gravel bottoms.

The food of the green sunfish is mostly immature and adult insects, small crustaceans, and small fishes.

In general, this fish tends to overpopulate and may hybridize with other sunfishes. The usual length attained by an adult is six to eight inches, although some individuals have been known to reach a length of 10 inches.

Whenever these fish are present they are usually easily caught. Effective baits for fishing include artificial flies and lures, worms, and minnows.

Sacramento Perch *Archoplites interruptus* (Girard)

RICHARD IMLER, Wildlife Researcher Candidate

The Sacramento perch was first introduced into a few reservoirs in the Platte River drainage of Colorado in 1965. This saline tolerant fish was introduced by the Division in an attempt to determine whether a sport fishery could be initiated in some lakes which are high in salinity and which are only mediocre fish producers. If the first introductions prove worthwhile, the Sacramento perch will then be distributed to other suitable environments in the State.

The Sacramento perch is a black or brassy colored fish with several dark irregular vertical bars on the sides. It is distinguished from all other Colorado sunfish by the 12 to 13 dorsal spines.

Sacramento perch will spawn in their second year of life. Spawning usually occurs from May through August. The Sacramento perch is unlike all other sunfish in spawning behavior in that it does not build a nest, but spawns on stones and submergent plants in water 8 to 24 inches in depth.

Small Sacramento perch feed mainly on zooplankton and insects while adults feed on fish and insects.

Sacramento perch of 15 inches length and weighing 4½ pounds have been taken in other states. In Colorado, however, the size will probably be much smaller, with the larger ones being 10 to 12 inches.

Anglers are apt to catch Sacramento perch in the same manner as other sunfish. Fishing with small artificial flies, lures, and live bait in shallow areas during the spring and summer months should be most productive.

Pumpkinseed *Lepomis gibbosus* (Linnaeus)

RICHARD IMLER, Wildlife Researcher Candidate

The pumpkinseed is a brilliantly colored sunfish which has been introduced into warm water reservoirs and streams in the Platte and Arkansas River drainages of eastern Colorado. The pumpkinseed is easily distinguished from other sunfish as its dark blue ear flaps end in a red border.

The spawning season of the pumpkinseed is May through July, with the peak of nesting in June. The males build saucer-shaped nests in colonies in shallow water. Several thousand eggs are deposited by one or more females in the nests. The male then guards the nest until incubation is complete.

The diet of the pumpkinseed is mainly small mollusks, insects, and occasionally small fish.

Pumpkinseeds prefer weedy areas, logs, and sandy bottoms where their food is most abundant, and they are less susceptible to predation. The usual length attained by an adult is six to eight inches. This sunfish is easy to catch as it stays close to shore and will hit artificial flies and lures, worms, grasshoppers, and other small live baits.

Orangespotted Sunfish *Lepomis humilis* (Girard)

RICHARD IMLER, Wildlife Researcher Candidate

The orangespotted sunfish is the smallest sunfish in Colorado. Rarely exceeding four inches in length, this native sunfish is present mainly in the Platte and Arkansas River drainages.

Distinguishing characters include 20 to 30 orange spots irregularly distributed on the sides of the fish, a spiny dorsal fin which has a crimson border, a soft dorsal which has a band of orange, and a black tabbed, white margined gill cover.

Spawning occurs from late May through August. Like many other sunfish, the orangespot spawns in colonies with the male building the nest on sand or gravel in water up to three feet in depth.

The orangespot feeds mostly on insects, small crustaceans, and infrequently on fish.

Very little fishing effort is exerted for them because of their small size. Where these fish are present in fair numbers, fishermen are sure to catch some as the orangespot inhabits shallow waters and will readily take a small artificial fly, lure, or live bait.

Bluegill *Lepomis macrochirus* Rafinesque

RICHARD IMLER, Wildlife Researcher Candidate

The bluegill was introduced into Colorado in the 1920's. Since that time they have been placed in suitable warmwater habitats of the Arkansas and Platte River drainages.

The bluegill varies greatly in coloration but can be distinguished from other sunfish by the six to eight vertical bars on the sides, a long black earflap which has no trim, and a black spot which is present on the posterior of the dorsal fin.

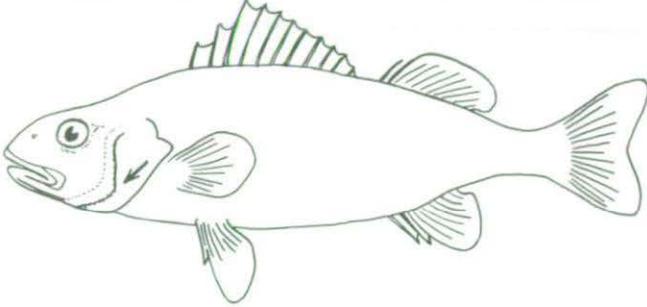
The spawning season of the bluegill is from late spring through August. Nests are built in colonies by the males in one to four feet of water on sand or gravel bottoms, dead leaves, sticks, or mud. The nests are saucer-shaped depressions with a usual diameter of one to two feet. One or more females will spawn in the nest which is closely guarded by the male.

Primary food of the bluegill is adult and immature insects. However, when available they will eat fish eggs, plant material, and larger bluegills will take smaller fish.

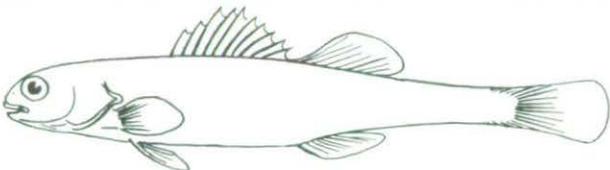
Bluegills tend to live and feed in shallower water, close to shore. The maximum length attained is usually about 12 inches, and the weight will be about a pound. Bluegill are rather easy to catch and will readily take a wet or dry fly, worms, grasshoppers, and other small live baits.

Perch Family (Percidae)

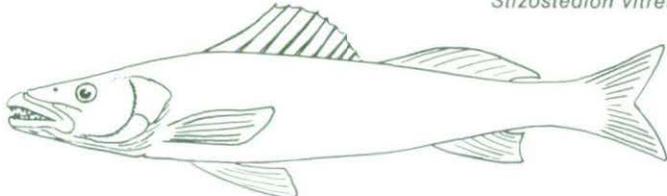
- 1. Preopercle strongly toothed; mouth large; fishes of medium to large size..... 2



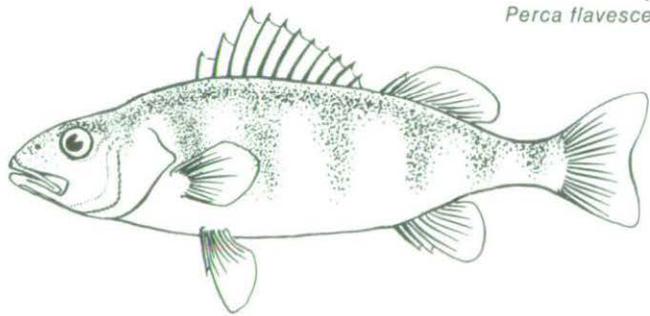
- Preopercle smooth edged; mouth small; very small fishes..... 3



- 2. Canine teeth well-developed; no spines in soft dorsal; no color cross bands
Walleye
Stizostedion vitreum (Mitchill)
 p. 69

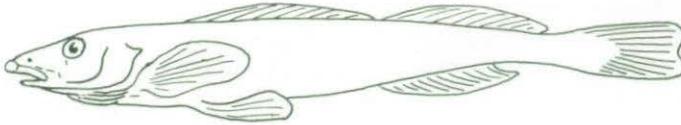


- No canine teeth; soft dorsal with 2 or 3 spines; sides with 6 or 7 broad dark bars
Yellow Perch
Perca flavescens (Mitchill)
 p. 70



3. Snout conic, pig-like, projecting beyond mouth

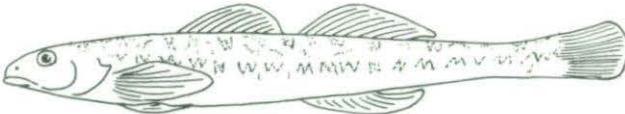
Logperch
Percina caprodes (Rafinesque)
p. 72



Snout blunt, not pig-like, not projecting beyond mouth..... 4

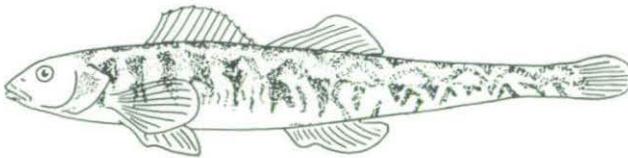
4. Ten or more irregular black marks (often resemble W, M, or N) cross lateral line; anal spines 1

Johnny Darter
Etheostoma nigrum Rafinesque
p. 72



Sides with 9 to 11 clove-brown bars, short somewhat broken; anal spines 2

Iowa Darter
Etheostoma exile (Girard)
p. 72



Walleye *Stizostedion vitreum* (Mitchill)

REX TALIAFERRO, Assistant, Field Operations

The walleye, distributed widely in Canada and the United States, was first introduced into Sterling Reservoir in Colorado in 1949, from Nebraska. Since that time walleyes have been transplanted into a number of warm-

water reservoirs on both sides of the continental divide including waters in the South Platte, Arkansas, Rio Grande, and Colorado River drainage basins. Colorado populations are maintained by a management program of stocking fry. Eggs are obtained in the spring during the spawning season from wild fish captured in gill nets. The eggs are incubated in the hatchery, reared until they reach a size of about 100,000 per pound, and then stocked.

Coloration of the walleye varies from olivaceous above to white below with brassy mottled sides. Distinctive characteristics include well-developed canine teeth and large eyes with milky white corneas; hence the name walleye.

Adult walleyes take a wide variety of food including crayfish, frogs, and snails, but the diet consists mainly of fish. Minnows, suckers, sunfish, and yellow perch are found most frequently in walleye stomachs. Young walleye begin their feeding on small crustaceans and insects, but at about two inches they begin to eat other small fish.

Walleyes spawn early in the spring shortly after ice-out when the water temperatures range between 45° and 50° F. Spawning usually takes place in water less than six feet deep over gravel areas and rocky reefs. In Colorado the walleyes frequently utilize the areas along banks and dams where large rock rip-rap has been placed to prevent wave erosion of the reservoirs. Most of the spawning activity takes place at night.

Large females accompanied by several males will move into the shallower water, scatter their eggs to be fertilized by the males, and then generally move back out of the shallows into deeper water. There is a great deal of random movement at this time so that males and females both ripe and spent may be taken over the spawning areas. Walleye eggs are small, and large females may have as many as 50,000 per pound of body weight. Colorado male walleyes are usually mature in their second year and females in their third year.

Fish lengths vary considerably in different water areas, but first year walleyes can reach six to eight inches and second year fish are usually over 12 inches. Trophy walleyes up to 13 pounds have been taken in Colorado.

Walleyes provide some of the best fishing to be found in the angling world. They are readily taken from April through June on a variety of baits and lures including jigs, spinners, nightcrawlers, minnows, and spinner-bait combinations. Their angling quality combined with their excellent eating quality make them one of the most desirable freshwater fish.

Yellow Perch *Perca flavescens* (Mitchill)

JOHN P. GOETTL, Assistant Wildlife Researcher

The yellow perch is probably Colorado's most abundant game fish. An introduced species, the perch is well adapted to the habitat of warmwater fluctuating reservoirs so common to Colorado and is found in all major drainages of the State. The yellow perch is most at home in a lake environ-

ment; however, it is found in large, slowly flowing, deep rivers in the eastern part of the United States. Young perch prefer the shallows and adults the deeper waters.

Food habits demonstrate the wide ecological tolerances of this species. Perch will eat nearly anything that moves and will fit into their mouth. Food includes fish (even their own young), aquatic insects, zooplankton, clams, and snails. This fish is a serious competitor of other game fishes.

Spawning in Colorado normally occurs after the perch reaches age three. In the spring when water temperatures reach 45°-52° F, males enter the spawning area and wait for the females. The males are also last to leave the spawning area. Each gravid female is followed by 15 to 25 males that fertilize the eggs as they are spawned. The eggs are laid in gobs which extend into accordion-like ribbons from two to seven feet in length, averaging about 23,000 eggs and weighing up to two and a half pounds per string. A 10-inch perch may lay as many as 50,000 eggs. There is no parental care of the eggs.

Perch eggs are usually laid on the bottom vegetation, but in fluctuating reservoirs lacking rooted vegetation the eggs are laid directly on the bottom and drift with water movement. This is one of the major adaptive features in the life cycle of the yellow perch and is a reproductive advantage over other fish in the reservoir environment.

Young perch hatch and are free from the egg mass in three to four weeks. They begin to feed voraciously on microscopic plants and animals.

Often the great reproductive success of the yellow perch leads to an overutilization of its food resources. When food supplies decrease, growth slows. If reproduction remains at a consistently high level, the population of perch will become stunted. An overabundance of perch can be detrimental not only to itself but also may stunt other more desirable species. This is a common problem in the mountain states when perch and trout are found in the same lake.

The average three-year-old yellow perch in Colorado is about seven inches in length. The all-time weight record for a yellow perch is four pounds, three and one-half ounces, taken from the Delaware River in New Jersey in 1865.

Colorado Game, Fish and Parks Division produces a limited number of perch young at its warmwater hatcheries. Most perch for the Division management program are obtained by seining an area with an overabundance and transferring them to desired areas. Yellow perch are often transferred from lake to lake in bait pails. Such transfers are frequently undesirable.

Most of their lives perch travel in schools of about 50 to 200 fish. This makes for action-packed fishing when a school is located. Perch may be caught with a minimum of expense for fishing tackle and by the novice fisherman. During the summer, worms appear to be the best bait for perch. If possible, fish in a shaded area and do not hesitate to give the worm some action. A small minnow fished near the bottom is often a great producer during the ice fishing season. Yellow perch are one of the most table-worthy species found in the United States.

Darters

Logperch, *Percina caprodes* (Rafinesque)

Johnny Darter, *Etheostoma nigrum* Rafinesque

Iowa Darter, *Etheostoma exile* (Girard)

Darters are colorful little fish. From their resting places on the bottom or in clumps of aquatic plants, they dart out in the short, rapid dashes that have given them their common name. Having lost the air bladder during their evolutionary history, darters spend most of their time on the bottom. While darters are usually found in streams, they may be present in lakes and ponds, particularly in the area near tributary streams.

The Iowa and Johnny darter reach lengths of about three inches and the logperch, the giant of the group, sometimes gets as big as 10 inches.

All of the darters are spring spawners. Logperch prefer to deposit the eggs in small pits in a sandy bottom in shallow water. The Iowa darter prefers to deposit the eggs on stones or in crevices in shallow water. Neither the logperch nor the Iowa darter provide any parental care for the eggs or young. The male Johnny darter guards the eggs and nesting area after the female has deposited the fertilized eggs under flat stones or other objects on the bottom.

Small crustaceans, aquatic insects, and algae make up the food of the darters.

Darters, because of their small size and small numbers, are of little economic importance.

Drum Family (Sciaenidae)

Freshwater Drum *Aplodinotus grunniens* Rafinesque

T. M. LYNCH, State Fish Manager

The freshwater drum was introduced into Colorado in 1951 when over 900 pounds of drum seined from Meade County State Park Lake in Kansas were placed in Bonny Reservoir in Yuma County. Current distribution of the species is still primarily limited to Bonny Reservoir. Some adult fish have been moved to other reservoirs in the eastern part of the State, but these introductions have been unsuccessful.

Drum are basically silvery-gray in overall coloration with a pearly-white iridescent luster. The back and head are often darkish green to olivaceous, the lower jaw and end of nose is white, as is the belly. This is a thick, bulky fish with considerable striking power. Fishermen still fishing or drifting with live bait rigs or with flatfish are most likely to catch drum.

Drum feed and spend considerable time in deep water near the bottom. Their food is primarily snails, crayfish, and aquatic insects found on the lake bottoms.

Two- to four-pound drum are the most common size taken by fishermen. Weights up to 60 pounds and lengths of four feet have been reported. Growth is slow with a longevity of 12 to 15 years. Smaller drum, one to four pounds, are better eating, but the fish has a strong flavor requiring an overnight soaking in salt water and lemon juice.

The drum spawns in late May and early June.

Freshwater Sculpins (Cottidae)

The freshwater sculpins are curiously ugly little fish usually not observed unless a special effort is made to collect them. Only the piute sculpin (*Cottus beldingi*) and the mottled sculpin (*Cottus bairdi*) are present in Colorado. These two Colorado sculpins are found only in the small mountain trout streams of the western slope. These little fish (rarely up to six inches) live on the bottom of our cold trout streams, usually hiding under stones. They must be dislodged before they can be collected. Occasional sculpins may be caught by the trout fisherman using bait.

Freshwater sculpins spawn in the spring, attaching the fertilized eggs in clumps of 100 to 500 eggs under stones. The male guards the eggs.

Food of the sculpin is listed as aquatic insects, small fish, and algae. The sculpin, probably because of his appearance, is frequently accused of eating trout eggs. There is no proof of this, and we must consider him innocent until proven guilty. Further, trout eggs, to survive, must be properly buried by the female in egg pits which makes the eggs unavailable to the sculpin.

Sculpins are of relatively little importance in Colorado sport fisheries although they may occasionally be eaten by trout.

Index to Common Names

	<i>Page</i>		<i>Page</i>
Bass, Largemouth	60	Pickereel, Grass	36
Smallmouth	61	Pike, Northern	35
Striped	56	Walleye	69
White	56	Salmon, Coho	25
Bullhead, Black	53	Kokanee	26
Brown	53	Silver	25
Carp	41	Sculpin, Freshwater	73
Carp suckers, River	46	Shad, Gizzard	19
Catfish, Blue	51	Shiner, Red	43
Channel	51	Squawfish	44
Chubs, Bonytail	44	Stonecat	53
Creek	42	Sucker, Bluehead	47
Humpback	44	Flannelmouth	47
Roundtail	44	Longnose	49
Rio Grande	44	Mountain	47
Crappie, Black	63	Rio Grande	47
White	62	White	48
Darter, Johnny	72	Sunfish, Bluegill	67
Iowa	72	Green	64
Drum, Freshwater	73	Orangespotted	66
Eel, American	54	Pumpkinseed	66
Grayling, Arctic	24	Tench	41
Killifish, Plains	55	Topminnow, Plains	55
Logperch	72	Trout, Brook	31
Minnows, Bonytail Chub	44	Brown	27
Carp	41	Cutthroat	28
Colorado Squawfish	44	Golden	31
Creek Chub	42	Lake	33
Fathead	43	Mackinaw	33
Red Shiner	43	Rainbow	30
Tench	41	Splake	33
Perch, Yellow	70	Whitefish, Mountain	24
Sacramento	65		
White	56		

Index to Scientific Names

	Page		Page
<i>Anguilla rostrata</i>	54	<i>Lepomis cyanellus</i>	64
Anguillidae	54	<i>gibbosus</i>	66
<i>Aplodinotus grunniens</i>	73	<i>humilis</i>	66
<i>Archoplites interruptus</i>	65	<i>macrochirus</i>	67
<i>Carpiodes carpio</i>	46	<i>Micropterus dolomieu</i>	61
Catostomidae	45	<i>salmoides</i>	60
<i>Catostomus catostomus</i>	49	<i>Morone americanus</i>	56
<i>commersoni</i>	48	<i>chrysops</i>	56
<i>discobolus</i>	47	<i>saxatilis</i>	56
<i>latipinnis</i>	47	<i>Notropis lutrensis</i>	43
<i>plebius</i>	47	<i>Noturus flavus</i>	53
<i>platyrhynchus</i>	47	<i>Oncorhynchus kisutch</i>	25
Centrarchidae	57	<i>nerka</i>	26
Clupeidae	19	<i>Pantosteus</i>	47
Cottidae	73	<i>Perca flavescens</i>	70
<i>Cottus bairdi</i>	73	Percichthyidae	56
<i>beldingi</i>	73	Percidae	56
Cyprinidae	37	<i>Percina caprodes</i>	72
<i>Cyprinus carpio</i>	41	<i>Pimephales promelas</i>	43
Cyprinodontidae	55	<i>Pomoxis annularis</i>	62
<i>Dorosoma cepedianum</i>	19	<i>nigromaculatus</i>	63
Esocidae	35	<i>Prosopium williamsoni</i>	24
<i>Esox americanus</i>	36	<i>Ptychocheilus lucius</i>	44
<i>lucius</i>	35	Salmonidae	20
<i>Etheostoma exile</i>	72	<i>Salmo aguabonito</i>	31
<i>nigrum</i>	72	<i>clarki</i>	28
<i>Fundulus kansae</i>	55	<i>gairdneri</i>	30
<i>sciadicus</i>	55	<i>trutta</i>	27
<i>Gila spp.</i>	44	<i>Salvelinus fontinalis</i>	31
Ictaluridae	50	<i>namaycush</i>	33
<i>Ictalurus furcatus</i>	51	Sciaenidae	73
<i>melas</i>	53	<i>Semotilus atromaculatus</i>	42
<i>nebulosus</i>	53	<i>Stizostedion vitreum</i>	69
<i>punctatus</i>	51	<i>Thymallus arcticus</i>	24
		<i>Tinca tinca</i>	41



Gene Ellis