STATE OF MONTANA

DEPARTMENT OF
FISH AND GAME
8695 Huffine Lane
Bozeman, MT 59715

February 19, 1980

Dr. Robert J. Behnke
Colorado State University
Fort Collins, Colorado 80521

Dear Dr. Behnke:

I enjoyed reading your monograph of "The Native Trouts of the Genus Salmo of Western North America." Next time we have an opportunity, I'd like to discuss some of our findings on the Yellowstone cutthroat-rainbow relationships in the Yellowstone River just downstream from the Park boundary.

The question - can we provide the "super trout" by genetic manipulation and return to "the good old days?" is posed more frequently by the purist fishermen (see letter enclosed).

As you pointed out, genetic diversity should be considered a natural resource and I applaud your effort to educate the biologist and manager (myself included) in this area.

Sincerely,

Ron Marcoux kdb

Ron Marcoux
Regional Fisheries Manager

RM/kdb

Enc.

The Complete Fly Fisher
P.O. 105 Hwy. 43
wise river, montana 59762 · ph: 406 839-2243

1/25/80

RECEIVED JAN 29 1980

Dear Ron,

Enclosed is a copy of my letter to R.O. Anderson, suggesting a study on genetics of trout.

Please give me suggestions for "preliminary cost estimates and details of the structure of the study". I think a budget of $50,000 would be in the ball park. It should be broken down and not just a flat figure.

I really think this idea will appeal to them, and it will be an excellent way of getting our foot in the door.

Call me if you have any questions.

Best

January 25, 1980

Robert O. Anderson
Atlantic Richfield Co.
515 S. Flower Street
Los Angeles, CA 90071

Dear Bob,

For some time it's been on my mind to propose to you that the Anaconda Copper Company cooperate with the Foundation for Montana Trout in sponsoring a study on : Genetic Strains of Trout with Superior Growth and Longevity Traits.

The purpose would be to determine: 1. if such strains can be developed, 2. can these strains survive and dominate in the wild with suitable regulation and management techniques aiming at increasing the average size of the trout in our streams? There are many of us in the field who feel this program would be highly successful.

Reasons for this optimism are as follows:

- Average trout size has declined in most fisheries because the largest longer-lived wild fish are invariably killed by the sportsman as proof of his skill. Game and Fish departments unwittingly encourage this concept by establishing minimum size limits, i.e. return all fish under 7".
- Hatcheries have purposely developed early maturing trout strains for their catchable programs which grow rapidly to 8" - 10". After sexual maturation these trout are slow

As Sable
brook trout
- (brown)
- Yellowstone
- stock rainbow
- steelhead -

correct

. growing and short-lived. In contrast late maturing fish grow to greater size (as food is converted to growth rather than wasted in early reproductive capability) and a are longer-lived and more fecund.

. The combination of these problems coupled with certain habitat degradation has insidiously degraded the prime strains of trout we once had. Recent studies on the Madison River suggest this to be true.

If such studies confirm these ideas and are followed with a skilled public relations program to promote them and fishery management to implement them, they will show the sportsman how his fishery may be returned to its former glory. The Anaconda Copper Company is certain to come out shining like a "new penny" for its public service. Such a program would be a marvelous contrast to the days when the ACM periodically wiped out the fishery on the Clark's Fork.

I am planning to be in L.A. February 11th and 12th on my way to Chile and Argentina and if the idea appeals to you, I would like to talk further with you about this project.

In the mean time I'm working with people in the Montana Game and Fish department to get preliminary cost estimates and details of the structure of the study.

I've sent a copy of this letter to Dick Dressler as he and I discussed the idea last summer. He felt it had merit. Did he deliver the fly I sent you?

Best regards,

c Dressler
enc brochure Foundation for Montana Trout

inextricably
mixed - genetics - environment
- on Madison R. - warming waters
reduced growth
- No evidence genetic
- Arctic - brook
- browns brown down-

STATE OF MONTANA

DEPARTMENT OF

FISH AND GAME

1420 East Sixth Avenue
Helena, Montana 59601
February 28, 1980

Dr. Robert J. Behnke
Colorado State University
Fort Collins, Colorado 80523

Dear Bob:

Last October you gave us permission to multilith a few copies of your monograph on native trout. These were distributed to personnel in our department and I also gave one to Ron Jones of Fish and Wildlife Service in Yellowstone Park. In your note you mentioned your paper in last July's Progressive Fish Culturist and asked if your discussion of the principles of genetic differentiation and their interpretation for classification in identification is understandable - it certainly is, in fact, it is excellent.

At the West Yellowstone meeting last September I detected that you were somewhat disappointed that more interest had not been shown in the conservation of native strains. I am enclosing the January-February issue of Montana Outdoors in which I have an article on Montana's Fishes of Special Concern, and also a copy of our procedure for classifying the streams as to their fishery value. I discussed these briefly with you at West Yellowstone, but anyway, I wanted you to know we are interested in our native strains and feel we have taken a positive step toward protecting them.

Kindest regards,

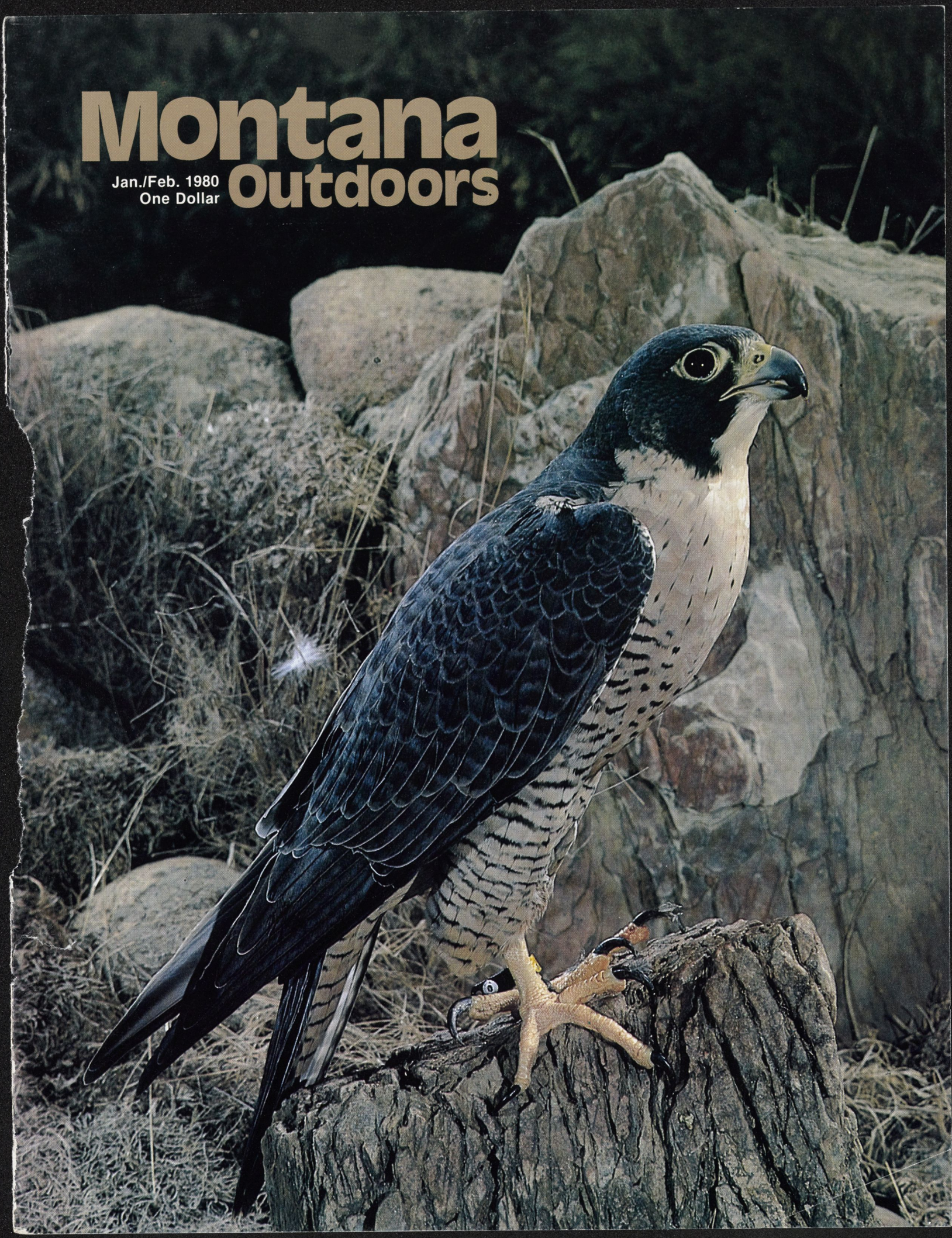
George

George D. Holton
Assistant Administrator
Fisheries Division

GDH/asw
Enc. 2

Montana Outdoors

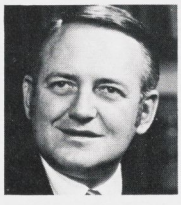
Jan./Feb. 1980
One Dollar

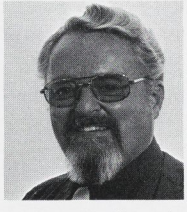


Montana Outdoors

Jan./Feb. 1980, Vol. 11, No. 1
(USPS 360 280)

THE COVER: A free-flying peregrine, such as the one in the front cover photograph by Alan G. Nelson, is truly a "shark of the air." At the moment of hitting its prey, a peregrine may be traveling at 200 miles per hour. For the story of a peregrine stricken with botulism and its "Return to the Sky," turn to Bill Pryor's article on page 7. For an update on the status of this endangered species in Montana, turn to Dennis Flath's article on page 31. The panoply of colors displayed by rainbow trout is aptly illustrated in Glenn West's back cover watercolor. One of Montana's native species, the rainbow is also one of 14 fishes of "special concern." To find out why, turn to George Holton's article on page 2.





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Fishes of "Special Concern"
continued

might be asked, "If these are 'fishes of special concern,' why is any harvest allowed?" For relatively fast-maturing species such as trout and grayling, the answer lies in reproductive potential. A single female cutthroat trout will produce, depending on her size, between 250 and 4,000 eggs in a spawning season. A female grayling will produce many more. Where spawning sites are not limited, the reproductive potential of such fish is so high that many more eggs and fry will be produced than the stream can support to adulthood. In most streams, including those never visited by a fisherman, less than 1% of the hatched fish live to spawn. Properly regulated fishing does not reduce the number of fish surviving to maturity.

Where long-lived game fish (sturgeon and paddlefish) are involved, more care is required to prevent overharvest. As mentioned, state regulations presently allow no harvest of white sturgeon and the paddlefish limit has been reduced. Although only a few pallid sturgeon are taken each year, we recommend even this limited harvest be curtailed.

The above listing of fishes comprises an "early warning system" or "watch list" to help ensure that the diversity of Montana fishes is maintained. For example, the shortnose gar would appear, by practical standards, to be a worthless fish. Yet it is a part of Montana's heritage and, perhaps more important, a segment of the heritage of Montana's children. They deserve the assurance that this prehistoric relict will not be heedlessly eliminated from state waters where it is native.

This "fishes of special concern" list played a significant role in a just completed evaluation of the fisheries resource value of Montana streams. Earlier evaluations in 1959 and 1965 (from which the blue ribbon trout stream concept arose) were heavily weighted toward trout fishing. This time, sport fishing for nontrout as well as trout received its full due; in addition, habitats for "fishes of special concern" were recognized even if no sport fishery was involved.

Montana's fish and wildlife managers have from the beginning had the philosophy that every species has a right to exist where it is native. With the mandate of the 1973 legislature, nongame as well as game animals can receive official recognition. ■

Thwaites, *op. cit.*

7. July 24, 1806. At "Camp Disappointment," 10 miles north of the Blackfoot River. Lewis: ". . . a few pigeons that we were fortunate enough to kill. . . ." Reference: Thwaites, *op. cit.*
8. July 25, 1806. At "Camp Disappointment." Lewis: "R. Fields and myself killed nine pige(ons) which lit in the trees near our camp on these we dined." Reference: Thwaites, *op. cit.*
9. July 10, 1833. Near Poplar, on the Missouri River. Prince Maximilian: ". . . many wild pigeons." Reference: Maximilian, Prince von Wied, "Travels in the Interior of North America, 1832-34" (Vols. 22-25 of "Early Western Travels," edited by R. G. Thwaites), Arthur H. Clark Co., Cleveland, 1906.
10. Aug. 30, 1853. Near Havre. Suckley: "A bird in immature plummage, which I took to belong to this species, I saw in a clump of choke cherry bushes on a branch of Milk River, near Bears Paw mountains, Nebraska." The date is approximate, but it was between Aug. 18 and Sept. 6. Reference: Cooper, James G. and Suckley, G., "The Natural History of Washington Territory . . ." (in "Reports of Explorations and Surveys . . . 1853-55," Washington, 1860).

where I [illegible] shot two. . . . In the mountains they fed, in August, chiefly on the service-berry (*Amelanchier alnifolia*), which along the Hell Gate, attains a size and flavor unequalled by any I have seen elsewhere." Reference: Cooper, James G., "The Fauna of Montana Territory," *American Naturalist*, 3:73-84, 1869. Cooper later (Cooper, James G., "Notes on Pacific Coast Birds," *Auk*, 7:214-216, 1890) retracted his reference to the species west of Montana.

14. Aug. 23, 1874. Chief Mountain (Waterton) Lake. A "young" bird collected by Coues (Coues, E., "Field Notes on Birds Observed in Dakota and Montana," Bulletin of the U.S. Geological Geographic Survey of the Territories, 4:628, 1878). According to Banks (personal communication), the specimen is still in the rare bird display at the U.S. National Museum.

? July 9-July 27, 1875. Between the mouth of the Yellowstone River and Carrol (an early-day settlement near the mouth of the Musselshell River) on the Missouri River. Grinnell: "Seen in small companies in July along the Missouri River bottom, where it was doubtless breeding." Reference: Grinnell, G. B., "Report of a Reconnaissance on the Upper Missouri," Washington, 1876.

The Director's Column

The early 19th century was a period of great zoological field trips. In spring of 1805, Lewis and Clark crossed into Montana and recorded the first scientific observations of such animals as the prairie rattlesnake and the grizzly bear. In 1833, a German naturalist named Prince Maximilian of Wied came up the Missouri River to study wildlife, while his artist-companion, Karl Bodmer, made drawings of the animals and the terrain. Ten years later, John James Audubon ascended the Missouri and the Yellowstone to the eastern edge of Montana, collecting specimens from which to do his paintings. And at about the same time, in 1831, a 22-year-old Englishman (whose father felt he should settle down into a serious job) left London on a voyage around the world that would take five years of his life. This explorer never reached the Missouri headwaters, but his trip added more to our understanding of Montana's wildlife than all of the fine early work by Lewis and Clark, Maximilian and Bodmer, and Audubon. The Englishman's name was Charles Darwin.

Darwin spent 20 years thinking carefully about what he had seen on his journey and then, because another man was about to scoop him, rather quickly he wrote a book. In it he tried to answer the central zoological question, over which scientists and churchmen had argued for hundreds of years. The question has two parts: (1) what is the source of variety among living creatures, and (2) what determines that some species will survive while some die, some will prosper while some only muddle through, some will dominate the earth for a time and others who formerly dominated will disappear totally? This is the riddle of death and change, the riddle of evolution, the riddle of existence. Darwin supplied one half of an answer. Because more creatures are constantly being born than can ever find food or habitat, he explained, the process of *natural selection* determines that the most fit species will survive while the ill-equipped perish. He titled his book "On the Origin of Species," but this was false advertising, since Darwin never did explain the *origin* of variety among creatures. That half of the riddle was left to a quiet Austrian monk named Gregor Mendel.

In 1866, Mendel published a paper, based on his experimental crossbreeding of garden peas, that described what is now known as "the particulate system of heredity." Mendel had discovered *genes*—the fundamental units of code by which physical attributes are passed down through living generations. Unfortunately, no other scientists discovered Mendel, and for 35 years his scholarly paper remained overlooked on a few dusty library shelves. Then in 1900 it was rediscovered and, joined with Darwin's ideas, provided a more complete answer to the great riddle.

Survival and adaptation by living creatures—evolution itself—is the result of natural selection operating on an unimaginable variety of possible characteristics: long necks and thick hair and sharp teeth, speed and good eyesight and protective coloration, feathers and fins and shells that can be pulled shut from inside, upright posture and enlarged brains and hands with opposable thumbs. That vast but finite variety, in turn, is the result of genetic diversity—the total number of living combinations into which the world's total number of differing genes can be arranged. The crucial importance of this diversity has led scientists to invent a special name for the roster of genetic possibilities. They call it the *gene pool*.

The gene pool is nothing less than a reservoir of potential answers to the continually changing problem of survival on earth. Each time a species disappears, the gene pool is irretrievably reduced, and all living creatures suffer a loss of options. If the *Penicillium* fungus had gone extinct when the dodo bird did, for instance, many thousands of additional humans by now would have died of pneumonia and diphtheria. With varying success, the problem of species survival has been faced by giant reptiles and woolly mammoths, by Audubon sheep and passenger pigeons, by peregrine falcons and snail darters. It is faced no less by *Homo sapiens*.

Two hundred years before Darwin's voyage, another Englishman wrote:

> No man is an island, entire of itself;
> every man is a piece of the continent,
> a part of the main; if a clod be washed
> away by the sea, Europe is the less . . .
> and therefore never send to know for whom
> the bell tolls; it tolls for thee.

John Donne, himself no believer in evolution, might as well have been speaking about the gene pool. Variety, as he understood, is not just the spice of life. It is the key to all survival.

graphics: Jeff Oens

Robert F. Wambach

The Riddle of Existence:

Fishes of "Special Concern"

by George Holton

illustrations by Glenn West

GAME species have long been protected in Montana, but official efforts have lately begun on behalf of nongame wildlife as well. In 1973, the Montana Legislature passed the Nongame and Endangered Species Conservation Act, declaring a state policy to perpetuate nongame as well as game species of wildlife. In pursuit of this double goal, the Department of Fish, Wildlife and Parks (DFWP) has identified species of "special interest or concern."

Montana has 14 fishes (13 species) of "special concern." Each is native (indigenous), restricted in range and, in most cases, limited in numbers in Montana. With further adverse impacts on its numbers or habitat, each is especially vulnerable to elimination from the state.

Some are of more concern than others. For example, the pallid sturgeon which is in trouble throughout its range in North America is of more concern than the trout-perch which, although found only in one place in Montana, has a widespread range across the northern United States and Canada.

Species will be added to or dropped from the "special concern" category as their status changes or new information is obtained. No Montana fishes are currently on the U.S. Department of the Interior's official list of threatened and endangered species. The "special concern" category has been established with the hope that no Montana fishes ever will be.

The 14 designated fishes can be grouped in three classes, reflecting levels of concern:

Class A—limited numbers and/or limited habitats both in Montana and elsewhere in North America; elimination from Montana would be a significant loss to the gene pool of the species or subspecies.

White sturgeon (*Acipenser transmontanus*)

Pallid sturgeon (*Scaphirhynchus albus*)

Paddlefish (*Polyodon spathula*)

Yellowstone cutthroat trout (*Salmo clarki bouvieri*)

Arctic grayling (*Thymallus arcticus*)

Class B—intermediate between classes A and C. Limited numbers and/or limited habitats in Montana; fairly widespread and fair numbers in North America as a whole; elimination from Montana would be at least a moderate loss to the gene pool of the species or subspecies.

Westslope cutthroat trout (*Salmo clarki lewisi*)—includes upper Missouri cutthroat trout

Native rainbow trout (*Salmo gairdneri*)

Sturgeon chub (*Hybopsis gelida*)

Sicklefin chub (*Hybopsis meeki*)

Shorthead sculpin (*Cottus confusus*)

Class C—limited numbers and/or limited habitat in Montana; widespread and numerous in North America as a whole; elimination from Montana would be only a minor loss to the gene pool of the species or subspecies.

Shortnose gar (*Lepisosteus platostomus*)

Finescale dace (*Phoxinus neogaeus*)

Trout-perch (*Percopsis omiscomaycus*)

Spoonhead sculpin (*Cottus ricei*)

All 14 fishes belong within seven larger families: sturgeon, paddlefish, gar, minnow, trout-perch, sculpin and trout.

PRIMITIVE FISHES

Three families—sturgeon, paddlefish and gar—are primitive fishes with fossil evidence from past geological ages. They have retained primitive features and can be considered remnants of ancient life.

STURGEON FAMILY

The **white sturgeon** is found mostly in Pacific Coast streams, where it is anadromous (spending part of its life at sea and ascending rivers to spawn). In the upper Columbia

River drainage, including Montana, the white sturgeon is landlocked. In Montana, it is found only in the Kootenai River below the falls. But according to a 1978 study, apparently even here its numbers have declined. Downstream from Montana, landlocked sturgeon are more numerous. Yet recent information from Idaho, Washington and British Columbia indicates concern about the physical and ecological effects of dams, water withdrawal and possible pesticide poisoning. The decline of white sturgeon in Montana seems linked to changes in the Kootenai's flow pattern resulting from Libby Dam (completed in 1972).

The 1971 Montana Legislature designated the white sturgeon a game fish. From July 1, 1971 until 1979, the limit was two fish per person per year, with restrictions on maximum and minimum length. New fishing regulations prohibit taking or possessing a white sturgeon and, until more is known about their status in Montana, this protection should continue.

The **pallid sturgeon**, another game fish, has been found in the Missouri River, including Fort Peck Reservoir, as far upstream as Fort Benton, and in the Yellowstone River downstream from the mouth of the Tongue River. Today it is seldom seen, but we do not know whether its numbers have diminished or whether it was always scarce in Montana. It is also rare in downstream states. The Endangered Species Committee of the American Fisheries Society in 1979 designated the pallid sturgeon a threatened species. This means the committee believes it "is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range."

Maintaining Montana's pallid sturgeon depends on protecting its habitat, particularly from barriers and dewatering. Care must also be taken to prevent overharvest, which is unlikely since so few are taken.

PADDLEFISH FAMILY

The **paddlefish**, once abundant in the Mississippi-Missouri River system, has declined to only six major reproducing populations, two in Montana. Of these two, one is an interstate population: Paddlefish from Garrison Reservoir in North Dakota migrate each spring up the Missouri into Montana. Part of this population branches off and ascends the Yellowstone to spawn, while the rest continues up the Missouri to Fort Peck Dam. The only known spawning here occurs in the lower reach of the Milk River. Just below Fort Peck Dam are water-filled dredge cuts (the dredge cuts were sources of earth for Fort Peck Dam) and, during the summer, as many as 4,000 paddlefish congregate in the cuts. Some of the fish also winter here, but apparently none use the dredge cuts for spawning.

The other reproducing population lives entirely within Montana. It inhabits the reservoir above Fort Peck Dam and makes spawning runs up the Missouri River.

As with every species, the cornerstone in maintaining Montana's paddlefish is habitat preservation, and *all possible efforts will be made.* Yet these fish are long-lived (20-year-old paddlefish are common) and relatively slow to mature sexually (males spawn at 7-8 years, females at 12-14 years), so a depleted population would take many years to rebuild. Therefore care must be exercised to prevent overharvest. In 1979, the American Fisheries Society's Endangered Species Committee listed the paddlefish as meriting "special concern" throughout its U.S. range. Our studies indicate the Montana populations are stable. However, to be on the safe side, statewide fishing limits, formerly two per day and in possession, were reduced in 1978 to one per day and two in possession. The department will continue to monitor population numbers and age structure and will be prepared to further reduce harvest if the future of paddlefish in Montana seems jeopardized.

GAR FAMILY

Although the **shortnose gar** is common in the Mississippi-Missouri system, in Montana—at the upper limit of its range—it is quite rare. Each year, just two or three are reported from the dredge cuts below Fort Peck Dam, and only one has ever been recorded from the Missouri River proper. This single

Montana has 14 fishes . . . of "special concern." Each is native . . . and with further adverse impacts on its numbers or habitat, each is especially vulnerable to elimination from the state.

fish was caught in August 1979 by department biologist Phil Stewart, 32 miles below the dam, at the mouth of Little Porcupine Creek. A nongame fish, the shortnose gar has never, to our knowledge, been more numerous in Montana.

SMALL FISHES

Five fishes of special concern are inconspicuous and not used for food or sport. They are members of the minnow, trout-perch and sculpin families.

MINNOW FAMILY

Although the **finescale dace** appears at scattered locations in Canada and the northeastern United States and as an ice age relict in Nebraska, Wyoming and South Dakota, it has never been recorded in Montana. Evidence of its existence here comes only from hybrids—crosses between finescale and northern redbelly dace—taken over the years from nine streams in the Missouri River basin.

The **sturgeon chub** lives in the currents of turbid streams, over bottoms ranging from rocks to coarse sand. It has a spotty distribution in the Mississippi drainage, from southern Illinois upstream to Montana. Dr. C. J. D. Brown reported in "Fishes of Montana" (1971) that the first Montana specimens were taken from the Milk River, during the Pacific Railroad surveys of 1853-55. It has apparently not been found in that drainage since. More recently, sturgeon chub have been collected from the Teton River, the lower Yellowstone River and three Yellowstone tributaries. According to Dr. George T. Baxter, an ichthyologist at the University of Wyoming, the sturgeon chub is more widely distributed in the upper Missouri drainage than formerly thought; however, it is a sensitive fish with exacting requirements and could be lost if care is not taken to maintain the habitat needed for viable populations.

The first discovery of **sicklefin chub** in Montana occurred during the summer of 1979, when department biologists Rod Berg and Bill Gardner found specimens in the 43-mile stretch of the Missouri River between Cow Island and Fort Peck Reservoir. This discovery apparently marks the upstream limit of the sicklefin's range, which extends down the Missouri-Mississippi system to southern Illinois. Dr. Frank B. Cross writes in "Handbook of Fishes of Kansas" (1967): ". . . the species seems so specialized for life in the large, silt-laden Missouri-Mississippi River that its survival may be threatened by impoundments and other modifications of habitat throughout its limited range."

TROUT-PERCH FAMILY

The **trout-perch** ranges from Alaska, across Canada, to the eastern United States. Yet within Montana it is found in only one place: Lower St. Mary Lake, on the Blackfeet Indian Reservation.

SCULPIN FAMILY

Because little is known of their life history and habits and because available information suggests their Montana ranges are limited, two species of sculpin are cited for special concern. The **shorthead sculpin** is confined to the Columbia River and Puget Sound basins. Montana specimens recorded to date are from the upper Flathead drainage and the St. Regis and Little Blackfoot rivers. The **spoonhead sculpin** is distributed from northwestern Canada to the Great Lakes region. In Montana, it has been found only in Glacier National Park.

SALMONIDS

The trout family includes Montana's most important food and sport fishes: trouts, chars, kokanee (salmon), Arctic grayling and whitefishes. Three trouts and Arctic grayling are of "special concern."

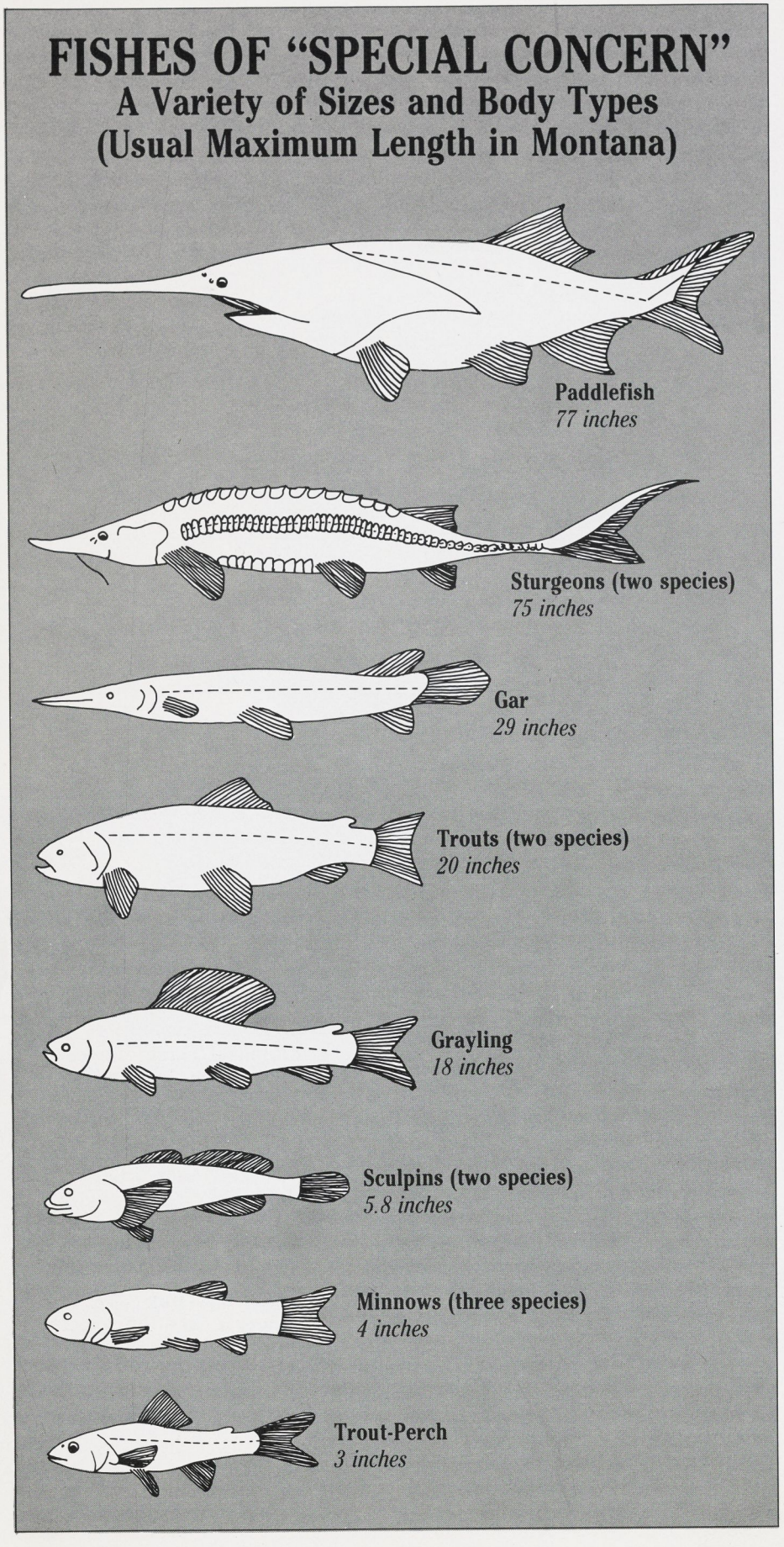
TROUT FAMILY

Montana's official state fish is the "blackspotted cutthroat trout," *Salmo clarki*. This designation encompasses both subspecies of native cutthroat, since both have black spots and belong to the same species. The choice is appropriate, because cutthroat were once abundant in nearly all of Montana's mountain and foothill streams, on both sides of the Continental Divide. Members of the Lewis and Clark Expedition took cutthroat in the Great Falls of the Missouri on June 13, 1805, leading Captain Meriwether Lewis to note in his journal that "the specks on these [trout] are of a deep black instead of the red or goald colour of those common to the U'. States." (Captain Lewis had in mind the brook trout native to eastern North America.)

Two subspecies of cutthroat are native to Montana: the **Yellowstone cutthroat trout**, in the Yellowstone River drainage, and the **westslope cutthroat trout**, in drainages west of the Continental Divide. The westslope cutthroat also appears in a number of streams *east* of the divide, where it is known, for management purposes, as the "upper Missouri cutthroat trout."

Both subspecies are found in many Montana locations, and this gives a sense of security. But are Montana cutthroat really secure? In fact, they have been partly or totally displaced from much of their former range by introduced fishes, including other trout species, kokanee, bass, sunfish and perch. They have been modified by hybridization with rainbow trout or other cutthroat species, where these close relatives were introduced or invaded naturally. And they have lost habitat through stream bank destruction, dewatering, sedimentation and other factors affecting water quality. The westslope cutthroat does have a stronghold in the upper Flathead drainage. But a dam or pollution barrier just above Flathead Lake could eliminate the migratory population that runs up from the lake to spawn in distant tributaries of the Middle and North forks. They are now reasonably safe in the Bob Marshall Wilderness above Hungry Horse Dam; yet even here they are threatened by enclaves of rainbow trout and Yellowstone cutthroat established by stocking years ago. They face additional threats from gas and oil exploration and development.

The typical cutthroat population—and this is especially true east of the Continental Divide—consists of a few hundred to a few thousand fish in a headwater stream: mere rem-



nants of former abundance. Unprotected by barriers, such a population will continue to suffer encroachment by rainbow and brook trout. Unless given consideration, it may also be destroyed by mining, logging, road building, grazing or other resource development.

Genetic differences between populations, even within the same subspecies, make efforts to perpetuate cutthroat more difficult. Such diversity is sometimes reflected in behavioral variations, as when two cutthroat populations differ greatly in the length of their spawning runs. The westslope cutthroat of Flathead Lake migrate as much as 120 miles to spawn in tributary streams; other westslope cutthroat spend their lives in headwater streams and make spawning journeys of a mile or less. Undoubtedly, there are further subtle differences, still undetected by man, between cutthroat populations. Each population has evolved and adapted itself to the particular stream system it inhabits. That isn't to say that some—various headwaters populations, for instance—might not be equally well suited to each other's habitats. Many probably are; but we do not know which are and which are not. In fact, we do not even know how many of the populations we have counted are pure cutthroat and how many are hybrids.

Dr. Robert Behnke, an expert on western trouts, has described the reasoning behind a concern—which we share—for maintaining individual races and subspecies:

> "The rationale of perpetuating native races and subspecies centers on the values of perpetuating genetic diversity; and for this we can draw analogies from the history of plant and animal husbandry. The source of genetic diversity necessary for developing new strains ultimately is derived from wild ancestral species. Fishes such as our native trouts are widely propagated but are in danger of losing the broad base of genetic diversity originally found in the species. Indeed, much of the cutthroat species, *Salmo clarki*, has already been destroyed. *A conservative estimate would be that 99% of the original population of S.*

clarki *in the interior regions of the U.S.A. have been lost in the last 100 years . . .*" (emphasis added).*

Perpetuation of cutthroat trout will be aided by: (1) recognizing them as being of special concern, (2) preserving their habitat, (3) preventing the planting of fish in cutthroat waters (except in rare situations where planting native strains may bolster or restore a population), (4) preventing overfishing and (5) where feasible, building barriers to prevent encroachment by competing species from downstream.

As late as 1972, the **rainbow trout** was not considered in fisheries literature to be native to Montana. Although the rainbow was the most common trout in the state, it was generally believed that all populations could be traced to hatchery stock. Yet Elmer Phillips, foreman of the Libby State Fish Hatchery during the 1930s and State Superintendent of Fisheries from 1940-44, persisted in believing that rainbow were native in the lower Kootenai River drainage. In 1977, Darryl Espeland and Dean Scow, students at Carroll College in Helena, undertook a thesis project to determine whether rainbow were, in fact, native to Montana. They were assisted by Dr. Fred Allendorf and Steve Phelps, geneticists at the University of Montana, and by fisheries biologists from the DFWP. Results from the Espeland/Scow study established that Elmer Phillips was right.

Using a biochemical technique, two forms of rainbow trout can be distinguished: coastal form and inland form (the differences between these forms are comparable to the differences among human races). The inland form is native; the coastal form has been the basis for all hatchery stocks used in the state. Espeland and Scow found fairly pure inland form rainbow in Callahan and South Callahan creeks and a mixed population (part native and part coastal) in the Yaak River, thereby showing that rainbow trout are native to Montana. In 1979, a mixed population was also identified in O'Brien Creek, another Kootenai River tributary.

Although North American distribution of remnant inland rainbow populations is not precisely known, experts generally believe it is being overwhelmed and replaced by hatchery rainbow throughout its range. Since rainbow of hatchery ancestry are numerous and widespread in Montana, why try to perpetuate the native form? There are good reasons: The native form is genetically distinct and probably differs in some attributes, such as habitat preference, time and place of spawning, food choice, growth rate or longevity. Such diversity enables a species to survive gradual changes in habitat and adapt to new situations.

The first step in preserving native rainbow stocks must be to identify additional streams where they are present, and then avoid planting hatchery fish which would hybridize with them or replace them. Their habitat should be protected. And, where feasible, they should be transplanted into additional waters as insurance against natural or man-caused elimination.

Although abundant throughout Alaska and northwestern Canada, the **Arctic grayling** is native in the lower 48 states only to Michigan (where it is now extinct) and to the upper Missouri drainage of Wyoming and Montana. During the ice age, these southernmost populations became separated from the main body of grayling hundreds of miles farther north.

When Lewis and Clark explored Montana, the grayling was widespread and numerous in the Missouri drainage above the Great Falls, particularly in streams. Remnant populations are found today in only about 30 streams of this drainage and in perhaps 10 other Montana streams. The American Fisheries Society's Endangered Species Committee in 1979 designated the stream form of Montana Arctic grayling a fish of "special concern." The Montana "special concern" list includes lake-dwelling grayling as well, for only an estimated 35 Montana lakes now have reproducing populations. Three-fourths of the grayling streams and a number of the lakes have competing fish species and many grayling waters sustain only sparse populations.

Competition from introduced fishes and habitat deterioration have been chiefly responsible for the decline. Perpetuation will require preserving its habitat, preventing planting of competing species in grayling waters, guarding against overharvest and introducing grayling into hospitable new waters.

CONCLUSION

Of the 14 fishes discussed above, seven are classified as game fish under Montana law. The question

continued on page 26

** From a paper given at the 1972 Conference of the Western Association of State Game and Fish Commissioners.*

Department of Fishery and Wildlife Biology

Colorado State University
Fort Collins, Colorado
80523

4 March 1980

Mr. Ron Marcoux
Montana Department of Fish and Game
8695 Huffine Lane
Bozeman, MT 59715

Dear Ron:

I read the proposal that the Foundation for Montana Trout presented to the Atlantic Richfield Corporation to fund trout genetic research with the objective of designing the genetic structure of trout to have more older, larger trout in your waters. I certainly wouldn't want to discourage a grant of $50,000 or so for trout research in Montana, but it would be important to aim it in the right direction and not invest in a fiasco to produce "super" trout from domesticated stocks.

This type of thinking is prevalent among many sincere and enthusiastic anglers. I might suggest that your department prepare a position paper on the subject as an educational tool, useful both to biologist and angler. I believe all of the background information can be found in various sections of my monograph.

The common error that is made concerns applying analogies between trout breeding and plant and animal selection for agriculture in relation to genetic "improvement" of stocks. Where the analogy breaks down is when domesticated "improved" trout are turned out in the wild to coexist with other fishes, get their share of the food, and avoid predation. All selected "improved" strains of plants and animals are only improved (according to standards of yield) when continually maintained by man. Consider what would happen to "super" strains of corn and wheat when sown in the wild, without cultivation, fertilization, irrigation, herbicides, insecticides, etc. What would be the survival of "super", "improved" strains of domestic sheep turned out in an environment with wolves and coyotes to fend for themselves without a sheepherder and dogs? These same principles govern the survival of hatchery trout turned into natural waters with predators and competitors. The guiding force of natural selection is survival in a natural environment. There is no possible way man can improve on natural selection for survival in the wild by hatchery selection. Hatchery selection for rapid growth selects for gluttony (above average caloric intake), deep body contours (pot belly), and good assimilation of hatchery diets. All of these traits have negative selection values under natural conditions of competitors, predators, and unstable (fluctuating) environments. All tests I have seen results from show the highly selected fast growth strains actually grow more slowly than other hatchery strains after stocking.

The attributes sought by the Montana Trout Foundation can be found in wild stocks. However, their use would be mainly limited to stocking lakes

where you are looking for a form of rainbow trout that can compete with and be an effective predator on kokanee and/or various cyprinids. The desert basin redband trout, now being propagated in Oregon (the trout I caught on dry flies in 83° water), does offer a genetic potential to expand your wild trout waters, particularly in eastern Montana, to establish trout in waters now considered marginal or submarginal trout habitat.

If you can direct the good intentions and funding of the Foundation along these lines, real benefits should result.

I would suggest priority could be given to the native Kootenai rainbow trout to expand its range and learn what it can do in new environments. Another fruitful approach to improve trout fishing is to learn more about the potential of stocking two or more species or strains of trout in the same lake to utilize ecological segregation. Such a program can emphasize use of your native cutthroat subspecies.

There are many opportunities to channel the energies and funding of individuals and groups who are enthusiastic to do something meaningful for trout so that antagonisms can be avoided and something useful results from their efforts. I think we must admit however, that the fisheries profession has too long been hooked on hatchery trout as the answer to all problems and thus we lack creative and innovative examples of fish management and research to offer as viable alternatives.

George Holton sent me a copy of the Jan.-Feb. issue of Montana Outdoors with the article on fishes of special concern. A very fine article. I would like to see an article in a future issue revealing how both of the native subspecies are being used to improve cutthroat fishing in certain mountain lakes by the practical application of the principles of segregation.

We were most happy to have Dick Vincent participate in our Colorado-Wyoming special regulation symposium. As usual, the presentation was excellent. I had not heard about the data on density independent mortality before and it was precisely what I've been looking for in my attempts to put the whole picture together on the effects of reducing angler induced mortality on a trout population. Can you urge Dick to send in a manuscript, even if only an expanded abstract, to publish in our proceedings?

Sincerely,

Robert Behnke

RJB:kle

cc: Richard May
Tom Pero
George Holton

Mr. Ron Marcoux
Montana Department of Fish and Game
8695 Huffine Lane
Bozeman, MT 59715

cc 1 Richard May
3 copies 2 Tom Pero
3 George Holton

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↓

I(b)

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The attributes sought by the Montana Trout Foundation ~~are~~ can be found in wild stocks. However, their use would be mainly limited to stocking lakes where you are looking for a form of rainbow trout that can compete with and ~~be~~ an effective predator on kokanee and/or various cyprinids. The desert basin redband trout, now being propagated in Oregon (the trout I caught on dry flies in 83° water), does offer a genetic potential to expand ~~your~~ wild trout waters, particularly in eastern Montana, to establish trout in waters now considered marginal or submarginal trout habitat.

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To be updated.

MONTANA DEPARTMENT OF FISH AND GAME

PROCEDURE FOR RATING MONTANA STREAMS

~~May~~ Fall 1979

GENERAL

Six value classes were established:

VALUE CLASS	CLASS DEFINITION
1	Highest-valued fishery resource
2	High priority fishery resource
3	Substantial fishery resource
4	Moderate fishery resource
5	Limited fishery resource
6	Not Classified

Each stream reach was placed in a value class for each of the two criteria below. The final classification, the fish resource value, was the higher class given for criterion 1 or 2.

Criterion 1 - Habitat and Species Value of Stream Reach

The class of each reach was determined by a point system in which most points were awarded for important habitats of fish species of special concern (native species found in limited numbers and/or limited waters). Fewer points were awarded to less important habitats of species of special concern and for the occurrence of widespread species found in substantial numbers. Least points were awarded for occurrence of non-indigenous species considered of minimal value. Additional consideration was given to tributaries that are important sources of trout recruitment. Points were also given for spring streams; outstanding esthetics; and for local community value where the stream, being one of few or the only one in the immediate area, is important to a community for scientific study, nature study, and/or recreation.

Criterion 2 - Sport Fishery Potential of Stream Reach

The class of each reach was based on a point system in which points were awarded for (1) productivity as indicated by biomass or numbers and sizes of game or sport fish, (2) ingress (legal rights of the public to fish the reach or willingness of landowner to permit fishing), (3) esthetics and (4) use by fishermen (fishing pressure).

DETAILED PROCEDURE FOR ASSIGNING VALUE CLASSES

A. Procedure for Criterion 1 - Habitat and Species Value of Stream Reach

I. Standards and Associated Points

Points[1]	Standard	
15	I	Highest-valued habitat[2] for class A species of special concern[3].
10	II	High priority habitat for class A species of special concern. or Highest-valued habitat for class B species of special concern.
5	III	Substantial habitat for class A species of special concern. or High priority habitat for class B species of special concern. or Highest-valued habitat for class C species of special concern.
3	IVA	Substantial habitat for class B species of special concern. or High priority habitat for class C species of special concern.
1.5	IVB	Substantial habitat for class C special of special concern.
.4	V	Limited habitat for any species of special concern. or Abundant[4] population of: (1) native not species of special concern[5] or (2) non-native game or sport species[5].
.3	VIA	Common abundance of: (1) native not species of special concern or (2) non-native game or sport species.
.2	VIB	Same as VIA only abundance rating is uncommon or unknown.
.1	VII	Same as VIA only abundance is rated as rare, M (species absent but might be present if habitat problem corrected) or E (species expected but not verified). or Presence of any non-native non-sport species.
3	VIII	Esthetics is 3 or higher (on a scale of 1 lowest to 5 highest).
3	IX	Stream is one of few streams or only one in the immediate area and is important to community for scientific study, nature study and/or recreation.
3	X	Stream is a spring stream or spring creek.

1/ Points are awarded for each species meeting a standard.
2/ Habitat designations: highest-valued, high priority, substantial, and limited are based on judgement decisions of fisheries managers.
3/ See list of species of special concern in Appendix.
5/ See list of Montana fish species in Appendix.

II. Assignment of class

Points	Habitat and Species Value Class
15 or more	1
10 to less than 15	2
5 to less than 10	3
.3 to less than 5	4
Greater than zero to less than .3	5
0	6

Important tributaries for trout recruitment are advanced one class but not higher than class 3.

NOTE: If no fish are present stream reach is automatically in class 6; exception, if no fish present but stream has local community importance (standard IX above) class 5 is assigned.

B. Procedure for Criterion 2 - Sport Fishery Potential of Stream Reach

I. Productivity - Award of Points and Assignment of Grade

a. Points for productivity of all trout species combined[1/]

Biomass (Kg) per 300 m	Points
70 and over	9
12 to less than 70	6.5
5 to less than 12	4
3.5 to less than 5	2
Greater than 0 to less than 3.5	1
If trout present but biomass is unknown:	
Each species with abundance A,B,C or D[2/] is assigned	1
Each species with abundance U,V, or Z is assigned	.5

b. Points for productivity of class A non-trout game and sport fish[1/]

Abundance Rating[2/]	Points
A	2
B	3
C	1
D	2
U, V and Z	.5

Note: Maximum for mountain whitefish is 2 points.

c. Assignment of productivity grade

Points (sum of points from a and b above)	Grade
9 and over	4
6 to less than 9	3
3 to less than 6	2
Greater than 1 to less than 3	1
1 or less	0

II. Assignment of Ingress Grade

Ingress rating [2/]	Grade
1	4
2	3
3	3
4	2
5	1
6 and 7	0

1/ For species designations see list of Montana fishes in Appendix.
2/ See explanation of ratings in Appendix.

III. Assignment of Esthetics Grade

Esthetics rating[1/]	Grade
5	4
4	3
3	2
2	1
1	0

IV. Assignment of Use (Fishing Pressure) Grade

Fisherman days/10 km	Grade
1250 and over	4
310 to less than 1250	3
65 to less than 310	2
Greater than 0 to less than 65	1
0 (none or unknown)	0

V. Computation of Sport Fishery Potential Score and Assignment of Class.

A. Score = Sum of (grade for each component x multiplier[2/]).

B. Assignment of Class

	Score	Conditions	Sport fishery potential class
1.	17 and over	Fish production based on natural reproduction. Trout with abundance B or D (bragging size)[3/] or paddlefish and ingress rating of 1, 2 or 3 and esthetics rating of 3, 4 or 5 and overall use of 5000 or more[4/]	1
2.	17 and over	Ingress rating of 1, 2 or 3 and at least one condition in 1 above not met.	2
3.	17 and 18	Ingress rating of 4 to 7	3
4.	15 to less than 17	Ingress rating of 1, 2 or 3	2
5.	15 to less than 17	Ingress rating of 4 to 7	3
6.	Greater than 11 to less than 15		3
7.	Greater than 4 to 11		4
8.	Greater than 0 to 4		5
9.	0		6

Note: If no fish are present stream reach is automatically in class 6.

1/ See explanation of ratings in Appendix
2/ Multiplier for productivity is 2; for other components (ingress, esthetic and use) the multiplier is 1.
3/ See explanation of abundance ratings in Appendix.
4/ For this purpose the stream segment may be a composite of adjoining reaches that meet all other conditions for Class 1, provided the original reach (that does not have sufficient fisherman-days) is less than 6 km.

C. Assignment of Fish Resource Value Class

The fish resource value class is simply the higher class given for criterion 1 or 2 above.

APPENDIX

INGRESS RATING. As used here ingress means the legal right to enter.

Code

1 - Stream section bordered almost entirely by public lands which insure ingress by anglers (exclude state school sections).

2 - A stream section bordered by a mix of private and public land where the public land is distributed in such a way that no significant portion of the stream is unavailable by vehicle and/or walking. Floating may also be a major means of access.

3 - A stream section bordered by mostly private land where ingress is uncontrolled or readily available by permission. This portion may be available by floating or through navigability laws. Also includes corporate lands - these are currently open but could go to individual ownership in the future or company policy regarding ingress could change.

4 - A stream section bordered mostly by private land where ingress is limited but some fishing is allowed. May include minor portions where public land or road crossing may provide limited ingress. The portion through private land may be available by floating or through navigability laws.

5 - A stream section bordered entirely by private land where public fishing is available for a fee or where a small group has leased exclusive rights. Legality may be in question on some streams but this category identifies the current "fee" or "lease" fishing areas.

6 - A stream section bordered mostly by private land where little or no ingress by permission is allowed. Floating precluded by stream size or other physical limitation (no road or public land to reach stream).

7 - A stream or stream segment bordered by public land that is unavailable because of posting on private land or locked gates on private roads.

FISH ABUNDANCE RATINGS. Abundance of fish refers only to adult fish, or in case game and sport fish to keeper size (7" minimum for trout; exception 6" minimum for trout populations which spawn when shorter than 7"). By nature abundance ratings are subjective. Since trout command the most interest of Montana fishes, the abundance ratings for all fishes were geared to trout. The abundance graph (Figure 1) is a guide to numbers associated with abundant, common, uncommon and rare. The ratings reflect the peak abundance during the year, e.g., when migratory spawners are present.

A = Abundant
B = Abundant with proportional number of bragging size (see appendix)
C = Common
D = Common with proportional number of bragging size (see appendix)
U = Uncommon
V = Uncommon with proportional number of bragging size (see appendix)
R = Rare
E = Presence not verified but expected
M = Species absent but could be present if habitat problems corrected
N = Not present
P = Species absent, but might be present if introduced (e.g., potential habitat in a barren stream)
Z = Abundance unknown

Special codes entered in abundance column to indicate habitat value of reach for species of special concern.

G = Highest-valued

H = High priority

S = Substantial value

L = Limited value

CODES FOR FISHES' USE OF REACH

Codes indicating single use or dominant use:

L = Resident throughout life cycle

A = Spawning elsewhere (includes hatchery fish) -- spends part or most of life in reach

H = Spawning and hatching -- young promptly move downstream

J = Spawning and nursery to subadult

C = Passing through -- species uses reach as a corridor to migrate upstream and return downstream

F = Feeding run

N = No use (in connection with abundance codes M, N and P)

Z = Use undetermined

Codes that are combinations of the above codes to indicate more than one population of a species.

R = L plus H or J

P = C plus L, A, H or J

S = H and J combined

Any other combination: Code entered for dominant use

ESTHETICS RATINGS. Esthetics were rated 1 (low) through 5 (high). Features that detract from esthetics include: pollution, dewatering, channelization, riprap (particularly car bodies and discarded building materials), mine tailings, a busy highway along stream and severe land abuse. As a guide:

1 - A stream with low esthetic qualities.

2 - A stream and area with fair esthetics qualities.

3 - A water with natural beauty but of a more common type that listed under 4 and 5. A clean stream in an attractive setting.

4 - A water comparable to 5 except that it may lack pristine characteristics. Presence of human development such as roads, farms, etc., usually comprise the difference between 4 and 5.

5 - A water of outstanding natural beauty in a pristine setting.

MONTANA FISHES IN FAMILY SEQUENCE
(Also see species of special concern list)

MT F&G Code	
¤ 27 –	Sturgeon*
¤ 90 –	White sturgeon
¤ 91 –	Pallid sturgeon
¤ 92 –	Shovelnose sturgeon
¤ 28 –	Paddlefish
38 –	Shortnose gar
34 –	Goldeye
> 01 ‡	Rainbow trout* (See 122)
> 02 –	Cutthroat trout*
> 03 ‡	Brook trout
> 04 ‡	Brown trout
> 05 –	Dolly Varden
> 06 –	Lake trout
> 07 ‡	Golden trout
¤ 08 ‡	Kokanee
09 ‡	Coho salmon
¤ 10 –	Arctic grayling
> 11 ‡	Rainbow x cutthroat trout hybrid
> 12 –	Westslope cutthroat trout (pure)
> 13 –	Yellowstone cutthroat trout (pure)
14 –	Whitefish*
15 ‡	Lake whitefish (May be native in St Mary's Lake)
¤ 85 –	Mountain whitefish
86 –	Pygmy whitefish
87 ‡	Chinook salmon
88 ‡	Splake
¤ 89 ‡	Salmon*
>118	Trout*
119	Trout/Salmon*
>120 ‡	Rainbow trout x golden trout hybrid
>121 –	Upper Missouri cutthroat trout (pure)
>122 –	Native rainbow trout
23 ‡	Northern pike (Native only in Saskatchewan River Drainage)
29 –	Peamouth
30 .	Goldfish
32 .	Carp
33 –	Northern squawfish
35 .	Utah chub
37 –	Minnow*
39 –	Longnose dace
41 –	Northern redbelly/Finescale dace*
42 –	Brassy minnow
43 –	Silvery/Plains minnow*
44 –	Flathead chub
45 –	Lake chub
46 –	Sturgeon chub
47 –	Emerald shiner
48 –	Sand shiner
49 –	Redside shiner
50 –	Creek chub
51 –	Pearl dace
52 –	Fathead minnow
53.	Golden shiner (May be native in eastern Montana)
140 –	Silvery minnow
141 –	Plains minnow
142 –	Finescale dace
143 –	Northern redbelly dace

MT F&G Code	
31 –	Sucker*
40 –	Buffalo*
55 –	River carpsucker
56 –	Longnose sucker
57 –	White sucker
58 –	Largescale sucker
59 –	Blue sucker
60 –	Bigmouth buffalo
61 –	Smallmouth buffalo
62 –	Shorthead redhorse
63 –	Mountain sucker
¤ 24 –	Channel catfish
25 ‡	Bullhead*
64 –	Stonecat
65 ‡	Black bullhead
66 ‡	Yellow bullhead
100 –	Trout-perch
¤ 26 –	Burbot
103 –	Plains killifish (Probably native)
106 .	Mosquitofish
109 .	Shortfin molly
112 .	Variable platyfish
115 .	Green swordtail
71 –	Brock stickleback
17 ‡	Largemouth bass
18 ‡	Bass*
19 ‡	Sunfish*
21 ‡	Crappie*
¤ 73 ‡	Smallmouth bass
74 ‡	Bluegill
75 ‡	Pumpkinseed
76 ‡	Green sunfish
77 ‡	Black crappie
78 ‡	White crappie
79 ‡	Rock bass
20 ‡	Yellow perch
¤ 22	Sauger/Walleye*
¤ 81 –	Sauger
¤ 82 ‡	Walleye
83 –	Iowa darter
36 –	Freshwater drum
16 –	Sculpin*
130 –	Mottled sculpin
131 –	Slimy sculpin
132 –	Torrent sculpin
133 –	Shorthead sculpin
134 –	Spoonhead sculpin

CODES:
- > Trout species
- – Native fish, i.e., indigenous
- ‡ Non-native game or sport fish
- . Non-native non-game or sport fish
- ¤ Stream class A non-trout game or sport fish
- * Undesignated as to native or exotic

MONTANA FISH SPECIES OF SPECIAL CONCERN* As of November 1978.

CLASS A - Gene pool insecure and/or limited habitats in Montana and elsewhere in North America.

White sturgeon
Pallid sturgeon
Paddlefish
Yellowstone cutthroat trout
Arctic grayling

CLASS B - Intermediate between class A and class C

Westslope cutthroat trout
Upper Missouri cutthroat trout
Sturgeon chub
Shorthead sculpin

CLASS C - Limited number and/or limited distribution in Montana, at least fairly widespread and abundant elsewhere in North America, gene pool not in jeopardy if extirpated from Montana

Shortnose gar
Native rainbow trout
Creek chub
Finescale dace
Trout-perch
Plains killifish
Spoonhead sculpin

BRAGGING-SIZE FISH

Species	Kg	Lbs.	Species	Kg	Lbs
Shovelnose sturgeon	2.7	6	Northern Pike	6.8	15
Paddlefish	34.0	75	Bullhead - black & yellow	.3	.7
Mountain whitefish	.9	2	Channel catfish	3.6	8
Kokanee	.9	2	Burbot	2.7	6
Cutthroat trout	.7	1.5	Smallmouth bass	.9	2
Rainbow trout	1.4	3	Largemouth bass	1.8	4
Brown trout	1.4	3	Crappie, black & White	.5	1
Brook trout	.5	1	Yellow perch	.5	1
Dolly Varden	3.6	8	Sauger	.9	2
Lake trout	6.8	15	Walleye	1.8	4
Arctic Grayling	.9	2			
Golden trout	.5	1			

*All are native with possible exceptions of plains killifish and finescale dace which are assumed to be.

FIGURE 1. FISH ABUNDANCE – FISH PER 300 METERS (APPROX. 1,000 FEET)