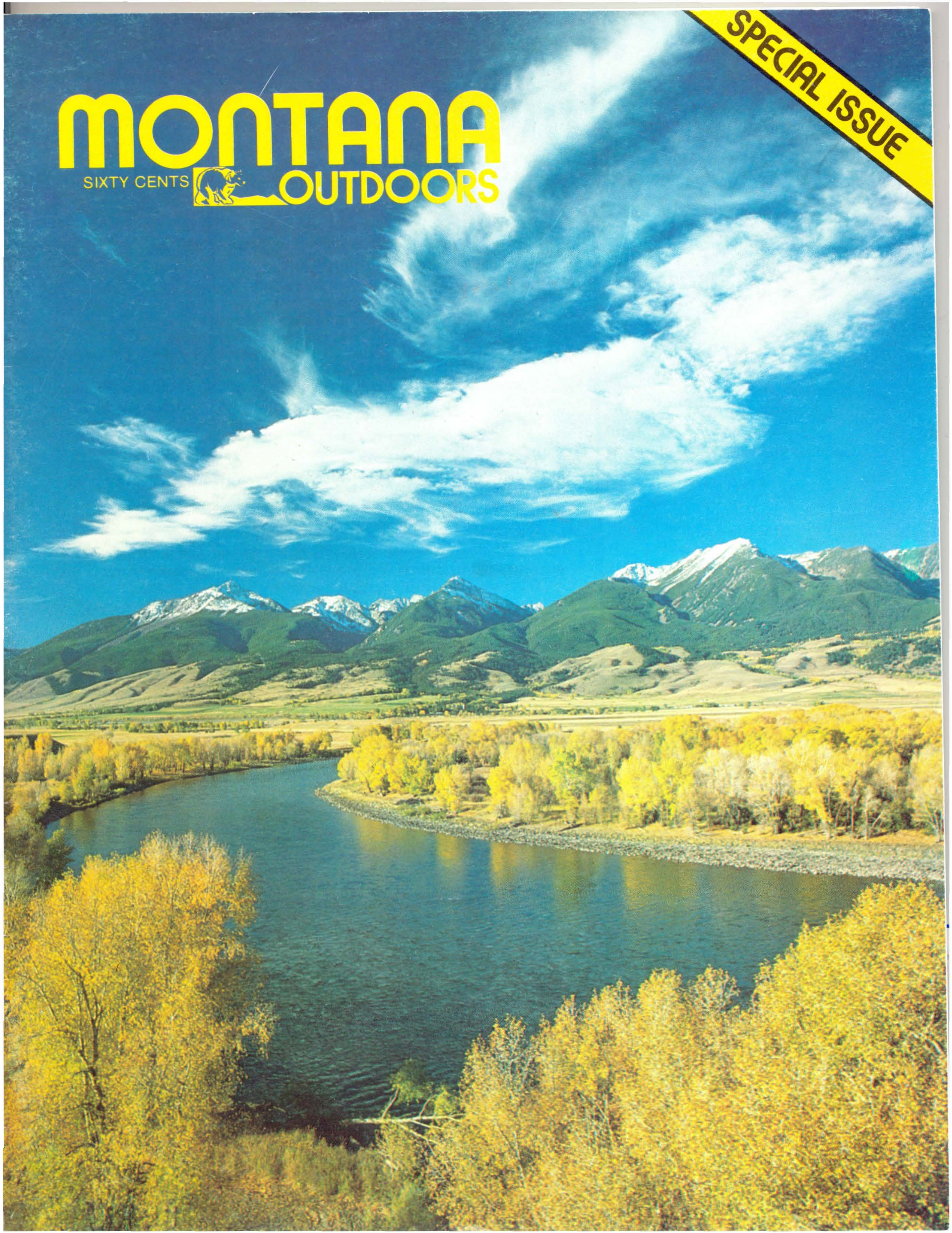
MONTANA
SIXTY CENTS
OUTDOORS
SPECIAL ISSUE

Thomas L. Judge/*governor,*
State of Montana

Willis B. Jones/*chairman,*
Fish and Game Commission

THE COVER: The Yellowstone is the largest free-flowing river left in the 48 adjacent states. It's a national treasure. It has shaped our history, influenced our agriculture, directed our movements, stimulated our thinking, contributed to our education and supported many of our families. Decisions are being made that will have an impact on the river second only to the basic geologic events that shaped this land. It is everyone's business to make sure these decisions are made in the best interest of the Yellowstone Basin and its natural ecosystem. Front and back cover photos: Mike Sample

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contents

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A Special Issue

a livable environment for WILDLIFE is a quality environment for MAN

This issue of *Montana Outdoors* is an extra. It's the first time we've devoted an entire magazine to one topic, in this case, the Yellowstone River. And it's the first time we've published an additional issue to the normal six-times-a-year schedule.

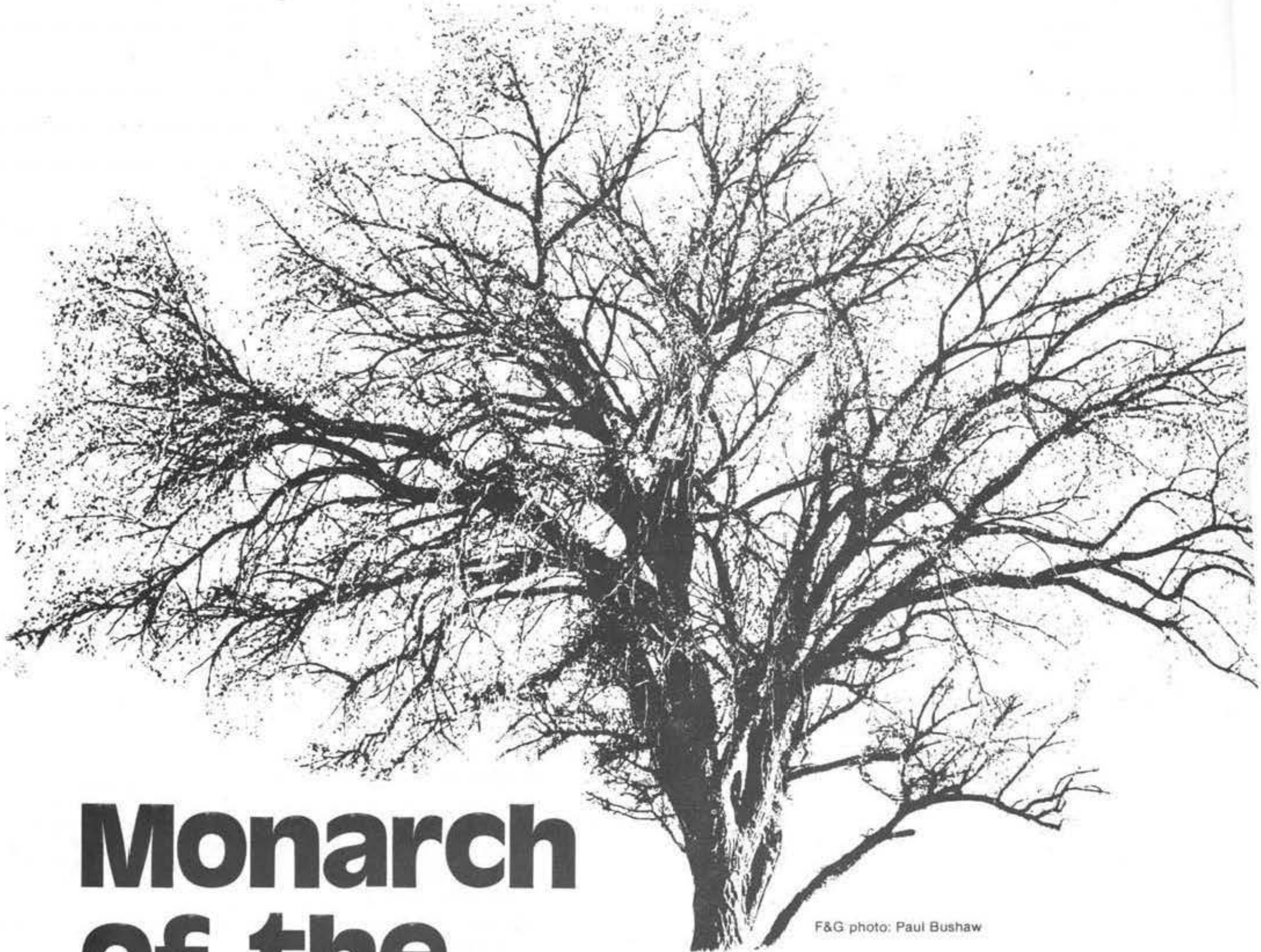
Why? We want to emphasize the incalculable value of the Yellowstone River, which begins in Wyoming and runs a mostly natural course for 600 and some miles to its confluence with the Missouri at the North Dakota border. Indeed, the Yellowstone, the longest free-flowing river in the continental United States, is the lifeblood of about one-third of Montana and much of northern Wyoming. Likewise, it's the main artery for a quality and relatively stable habitat for a large variety of fish and wildlife species. We want to do everything within our means to keep it so.

Since energy development became an issue in Montana about five years ago, researchers have done extensive study on the Yellowstone drainage. They have amassed a tremendous amount of sound information. Much of this documents the importance of the river to the region's recreational opportunity and fish and wildlife resource. With this data, researchers are able to predict the adverse outcome on wildlife and recreation should we lose the free-flowing Yellowstone to dams, diversions and/or dewatering.

Unfortunately, much of the valuable information generated by today's professionals isn't readily available to citizens. Since they don't have facts to back up their suggestions, it's difficult for people to prompt administrative and legislative actions to preserve threatened resources like the Yellowstone River. We decided to make this special effort, using research reports from studies in the Yellowstone Basin, to give Montanans some of the information they need to fight for a resource vital to their pleasure and livelihood. We hope our contribution will help win approval for keeping the Yellowstone in it's free-flowing, substantially unaltered condition. Doubtless this will benefit the fish and wildlife resource, and Montana in general.

In our agricultural-industrial society, it's next to impossible to protect a free river. Nearly all of our great rivers have been essentially undone. In striving for the Yellowstone's preservation, we are, in a sense, reaching for a star; but it's not unreachable.

Wes Woodgerd



F&G photo: Paul Bushaw

Monarch of the Yellowstone Basin

by Ken Walcheck

Near the junction of the Tongue and Yellowstone rivers stands an old cottonwood patriarch, firmly entrenched in the rich alluvial soil. It towers a notch higher and a shade wider than the surrounding cottonwood giants in the Yellowstone Basin. Its massive corrugated trunk, scarred by lightning and running prairie fires, riddled with insect borings, beaver gnawings and a score of other environmental maladies, testifies to its strength and endurance. Its deeply entrenched roots still draw life-sustaining minerals and water from the deep soil horizons and its ponderous, spade-like leaves still channel the sun's stream of energy through the tree's complicated circuits. The cottonwood stands as a living Montana historical monument similar to the Wisconsin oak that Aldo Leopold described so vividly in his classic, "A Sand County Almanac."

The cottonwood monarch has been standing for more than two centuries now. To the unperceptive eye, the cottonwood looks like nothing more than a gargantuan block of wood of questionable economic value. To the discerning eye, the giant cottonwood represents something else. It portrays a library impregnated with vivid historical happenings ingrained in its annual rings; recordings of a vast, wide-open country carved into an incredible array of topographic extremes; a land vascillating between flat and rugged, hot and cold, durable and fragile, beautiful and bizarre—drawing its medicine from the Big Sky; and a land dissected by a surging, bank-carving giant of a river called the Yellowstone, which stitches its way 670 miles from its source. It's a river with a complex ecosystem, constantly changing in nature's age-old rhythms.

The cottonwood pushed through the rich alluvium on a spring day in 1767—nine years before the signing of the Declaration of Independence. Just prior to its emergence, the Yellowstone and the surrounding rolling landscape were a cold maze of somber color and quiet. Soon they changed into a colorful vista, teeming with life and motion.

A sense of time lies thick and heavy on such a place. A coal seam on the far bank of the Yellowstone still exposes its storehouse of energy, which was stockpiled in the Paleozoic swamps more than 300 million years ago. During the water-logged days of this era, whole forests of dead trees filled the swamps. These areas were slowly buried and huge seams of coal were formed, covered with sediment and compressed into sedimentary rock. Geologists call this the Fort Union Formation, an area containing more than a trillion tons of coal. They would label it "the Persian Gulf" of strippable coal deposits, a basin containing approximately 40% of the U.S. reserves and 20% of the world's deposits.

The productive Yellowstone Basin absorbed generation after generation of wandering tribesmen who made no attempt to conquer the physical and biological elements of the prairie. They had no reason to alter the prairies. Their lives were seasoned by violence, climatic hazards and a score of other insecurities, but poverty was not one of them. The prairie supported a wealth of plants and animals readily available for conversion into life's necessities.

The northern Great Plains, at this early stage, had not experienced the exploitative and affluent tastes of the European culture lurking on the eastern seaboard. It still was unblemished and pristine, just as the young cottonwood was when it added its first growth ring. The only amphitheaters were the territorial fighting grounds of the bull elk, bighorn sheep and buffalo. The only theatrical performances were those given by the prairie grouse, which danced and strutted on traditional courtship grounds with their plumage thrust forth in all its splendor. The only cathedrals were the sedimentary formations carved and honed by wind and rain into a galleried maze of color and shape. The only music was the melodious tinkling of prairie birds, and beaver tails slapping quiet waters in deep, backwater channels. The only poetry was that of a brisk, prairie wind whispering through mixed prairie grasses. Ecologists, at a much later date, would write of the Yellowstone and the surrounding prairie as a complex, dynamic entity capable of supporting myriad plants and animals, all acting and interacting with one another under the pressure of nonliving forces—like weather, soil, minerals and geologic change—agents that have been active since time began.

The cottonwood's 39th year was a milestone in the history of a growing nation. During July 1806, Capt. William Clark probed the Yellowstone on the return leg of the Corps of Discovery's epic journey and became the first explorer to document existence of coal in the Yellowstone Basin. On July 28, Clark entered a notation in his diary describing a unique site somewhere between Armell's and Porcupine creeks in present Rosebud County: "The clifts on the South Side of the Rochejhone [Clark's spelling of "Roche Jaune," French for "yellow stone"] are Generally comp. of a yellowish Gritty soft rock... Straters of Coal in the banks on either Side those on the Star. Bluffs was about 30 feet above the water and in 2 vanes from 4 to 8 feet thick, in a horizontal position. The coal contained in the Lar Bluffs is in Several vaines of different hights and thickness. this coal or carbonated wood is like that of the Missouri of an inferior quality."

Students of Lewis and Clark, 170 years later, would find a taste of irony in Clark's entry—when an energy-hungry nation would be competing for this "inferior" coal. They would also find irony in knowing that this area would later be Nichols, site of the first pipeline to convey Yellowstone water to energy conversion plants—the Colstrip generating complex.

The wealth of data Lewis and Clark acquired about the vast and mysterious interior represented a challenge as well as a welcome invitation to a young and vibrant nation. The invitation rang out and the Yellowstone made its first boast to those who were within hailing distance. "Waughh! If you're man enough to muscle your way up my sinuous trail, I'll show you a country like you've never seen before—where the air is crystal clear and smells like nectar; where bottomlands teem with deer, elk and buffalo; where you can trap all the beaver you want and hunt game on land that lifts in great swells to the open horizon. My domain is laden with treasures like you've never seen, tasted or heard of. If you're willing to take me on, I'll give you your money's worth."

The Yellowstone's bragging fell on receptive ears. The first to come were the explorers, trappers and fur traders. For nearly four decades, scores of trappers floated past the cottonwood in their pirogues and keelboats laden with fortunes of fur. And following in their tracks came sodbusters, miners, cattlemen, homesteaders, shopkeepers and other opportunists—all eager to pluck a fortune or build a new life in a land of infinite wealth.

It was all there and waiting. And it went fast. The fur trade lasted a short 38 years (1806-1843). In 21 years (1860-1880) the Plains Indians were forced to give up many ancestral titles and claims after agonizing conflicts with settlers and the U.S. Army. In 22 years (1866-1887) the lucrative cattle industry, which based its enterprise on grass, weather and good luck, burned itself out. From 1880 to 1903, Montana succeeded from a frontier to a booming, profitable, industrial economy.

The cottonwood, then 132 years old, stood as a young giant when Montana achieved statehood in 1889. During this era, the mining industry was powerful enough to manipulate the state legislature and the press, elect a U.S. Senator and, in 1903, to lay off some 20,000 men—at that time, four-fifths of Montana's wage earners.

Then came the homesteaders. In 1909, the land office at Miles City was recording 1,200 claims a month. Between 1909 and 1918, an estimated 70,000 to 80,000 "honyockers" and "scissorbills" were homesteading in Montana. By 1922, about 60,000 of these people had been starved out or had given up—a human tide that left broken homesteads and rusted fences upon the land, poignant records of hope and failure.

Later, historians such as K. Ross Toole would write vividly of Montana's "boom-and-bust" eras and of how repetitive errors in using the land as a life-sustaining resource resulted in tragedy after tragedy.

Others, such as western artist Charles M. Russell, who witnessed a good share of Montana's tragedies, were more to the point on the subject of land abuse. "I have been called a pioneer," he told a group of Great Falls boosters (named the Forward Looking Citizens) in 1889. "In my book a pioneer is a man who comes to a virgin country, traps off all the fur, kills off all the wild meat, cuts down all the trees, grazes off all the grass, plows the roots up, and strings 10 million miles of bobwire. A pioneer destroys things and calls it civilization. I wish to God that this country was just like it was when I first saw it and none of you folk were here at all."

The cottonwood also has witnessed its share of tragedies: tragedies of when the early woodhawkers, who, with colorful epitaphs, cut cord after cord of cottonwoods to feed insatiable boilers of Yellowstone steamboats such as the Josephine and the Far West; of thundering herds of Texas Longhorns, which grazed and trampled the surrounding prairie grasses and the understory vegetation of the cottonwood grove; of oppressive clouds of impoverished soil lifted by searing winds from thousands of farms that blew away during the '20s and '30s—winds that sandblasted and impregnated grit in the cottonwood's trunk; of periods of drought in which blast-furnace temperatures and lowered water tables checked the monarch's growth, and that of thousands of homesteads.

In 1882, the cottonwood stood at 120 feet, tall enough to view the Northern Pacific's (NP) rails being laid through the Yellowstone Basin by seasoned gandy dancers. Although there was a miniscule need of coal for domestic use, it was the iron horse that became the first real consumer of Montana's fossil fuels.

Coal was first deep-mined by NP in the Red Lodge, Bozeman and Billings vicinities. By 1919, approximately three million tons of coal was mined in the state, mostly by NP. Labor problems at the deep mines prompted the opening of the Colstrip mine in Rosebud County in 1923. For the next 36 years (1923-1958), NP strip mined more than 42 million tons of sub-bituminous coal from approximately 1,000 acres of land to fire steam locomotives. With the company's switch to diesel power in 1959, the Montana Power Co. (MPC), through its totally-owned subsidiary, Western Energy, acquired the lethargic town of Colstrip and all its mining equipment. In 1968, MPC began mining and shipping coal to its new 180-megawatt Corette steam plant at Billings.

During the same year, a second mining firm, Peabody Coal Co., began a stripping operation in the Rosebud fields. NP shipped the first trainload of coal from the Peabody mine to a Minnesota utility in 1969. (NP merged with four other railroads to form the Burlington Northern on March 3, 1970.) For the first time in its life span, the monarch of the Yellowstone Basin felt a different kind of vibration in its massive root system—vibrations of a 100-car train carrying 10,000 tons of crushed, low sulfur coal. Montana had now entered the era of the coal rush.

Large-scale coal development never was seriously considered by most residents of the northern Great Plains until the findings of the North Central Power Study (NCPS) were made public in 1971. The two-volume tome was issued by the U.S. Bureau of Reclamation (Bu Rec) and 35 private and public electric suppliers in 14 states.

The scope of the proposal was huge, rivaling the sweeping dimensions of the region itself. The report proposed a planned development of the coal and water resources of some quarter-million square miles of Wyoming, eastern Montana and parts of North and South Dakota to generate a vast additional power supply for the United States. (That's nearly four times the area of the six New England states—Maine, Massachusetts, Connecticut, Rhode Island, New Hampshire, Vermont—and more than three times the area of North Dakota.)

The NCPS report asserted, among other things, that the demand for power in this country would double every 10 years. It called for construction of 42 mammoth coal-burning power plants—half of them situated in Montana's Powder River, Rosebud and Big Horn counties—a complex that would dwarf the Four Corners plants in New Mexico, the major stationary source of pollution in the world. The study also advocated creation of dams, reservoirs and aqueducts to store most of the available water in the area for the power plants, construction of thousands of miles of transmission lines and the consumption of massive amounts of coal.

Once the staggering dimensions of the proposal were fully dissected, analyzed and ruminated by concerned citizens, many found the scope of the plan almost unbelievable. They quickly pointed out that the proposal centered entirely on producing mind-boggling amounts of electricity, *not* with the horde of overwhelming problems that would accompany such a venture—air pollution, destruction of fish and wildlife habitat, reclamation difficulties, water depletions, social and economic strains, degradation of the human and natural environment and other insidious maladies.

A second shock wave reverberated through Montana in 1972 when the Bu Rec published its appraisal report on Montana-Wyoming aqueducts. The report proposed a grandiose network of off-stream storage reservoirs, pipelines and aqueducts and estimated that up to 2.6 million acre-feet per year, or one-third of the average annual flow of the Yellowstone, would be diverted to supply the water necessary for this massive industrial complex. And like the NCPS, it was oriented toward supplying a vital element—

water—which would be used to turn steam turbines, to cool thirsty power plants and gasifiers and to settle fly ash. It failed to mention that water diversion in the magnitude proposed, when paired with historical low flows or seasonal critical flow periods, could affect water quality in many ways, such as higher temperatures, increased salinity and increased concentrations of organic wastes. Any of these effects could have a resounding impact on the aquatic community.

The report failed to mention that the Yellowstone River and its four major north-flowing tributaries had been subjected to nature's experimentation and selection for millions of years and that these river systems have adapted to natural high and low flows, but not to the extremes that massive withdrawals could cause. It failed to mention the complicated phenomenon of drought and how it acts as an integral and necessary component of the age-old rhythms of the North American Steppe. And it failed to mention the predicament the proposed project would create for irrigators like Willie Day, a member of the Buffalo Rapids Irrigation District, during dry years like 1934 and 1961.

"The greatest demand on our project is from the last week of June until the middle of August," Day explains. "As you can see, average flow figures per season don't do us a bit of good. You can average the air you breathe per year, too, but have it shut off for five minutes during that time and the result would be the same as missing a month's water on our project."

Since the publication of the NCPS and the Aqueduct Study reports, private energy utilities and the government agencies involved with energy production have agreed that the two reports are "outdated" and "obsolete." Perhaps the framework of the two reports falls into these two categories, but certainly not the nucleus of the objective. The reasons are obvious. The promise of solar and nuclear power, breeder reactors and other space-age technologies has not materialized. At the same time our domestic production of oil and gas continues to decline. With the prediction of depleting fossil fuel reserves on the not-too-distant horizon, there has been no concerted nationwide effort at conservation to thwart the voracious appetite of an energy-hungry nation.

In Montana, as elsewhere in the Fort Union region, coal development started gathering momentum after the two major reports had been issued. The roster of the prospectors began to read like a who's who of the energy giants: Mobil Oil, Shell Oil, Sun Oil, Utah International, Getty Oil, Tenneco, Exxon, Chevron, Consolidation Coal, Peabody Coal, Gulf Mineral and others.

Not only were the big names there, but also the subsidiaries, the subsidiaries of subsidiaries, the fronts for speculators and the syndicates. All were competitively scrambling to secure permits and leases, and making high priority plans for further exploration and commitments for exploration. This all was being done with great secrecy. (For an in-depth look at prospecting and mining activities, see "What's Going On Out There?" in the March/April 1975 *Montana Outdoors*.)

In 1972, a group of retired eastern Montana ranchers selected the verdant cottonwood grove at the junction of the Tongue and Yellowstone rivers as a fitting place to celebrate the Fourth of July. As the afternoon festivities subsided, the men sauntered over to the old monarch, hunkered and rested their backs against its massive trunk.

The talk centered around the flurry of prospecting activities and how some landowners had willingly or unwillingly leased or sold their surface rights to coal companies.

As the sun dipped low on the western horizon, an old-timer with gnarled hands, and a weather-worn face laced with dendritic furrows of age-old wisdom, suddenly spoke up and told a tale of land swap to the group. He reminisced about a distant neighbor of his who traded 300 acres of prime cattle range for a shiny, new Model T Ford. The car salesman had offered him the same deal, but he turned it down. The grizzled old-timer went on to tell the group how he visited the same neighbor several years later and noticed the rusting, partly dismantled and useless Model T sitting in the back forty. His 300 acres, he told his friend, was still under *his* ownership, and in terms of natural beauty, breadth and productivity, he still owned a chunk of real estate that a hundred Model T's could never buy.

The old-timer then related to the group how a representative of one of the biggest coal companies recently had visited him and tried to buy his surface rights. "I told that man about the Model T incident, and even though I knew he was backed by one of the richest firms in the world, I told him no matter how much his company came up with, it would always be one antelope short of the price of my ranch. And you know, I don't think he ever could quite understand that money's not everything."

Perhaps the greatest confusion in the early 1970s stemmed from the developers' desire to conceal their activities from competing firms, the public and government officials. These and other interested parties were kept in the dark about plans and details for projects such as ownership rights to the coal and the land surface above it, strip mining operations, energy conversion plants, railroad spurs, transmission lines, water diversions, main-stream impoundments (such as Allenspur) and coal exports—all of which would have severe impacts on the people and the environments of large areas. Bitter conflicts arose over these developments and concerned groups, grappling desperately for facts, were left uninformed. While these citizens groped in confusion, the developers were proceeding with gigantic steps to "get it while you can."

And then there were the drifts of paper, geologists' field notes, bureaucratic memos, environmental skirmishes, legislative documents, exhortative brochures, press releases, statistical surveys and priority decisions. From that blend of paper, people and coal dust some grand theme should have emerg-

Yellowstone River Basin

CARTOGRAPHY BUREAU
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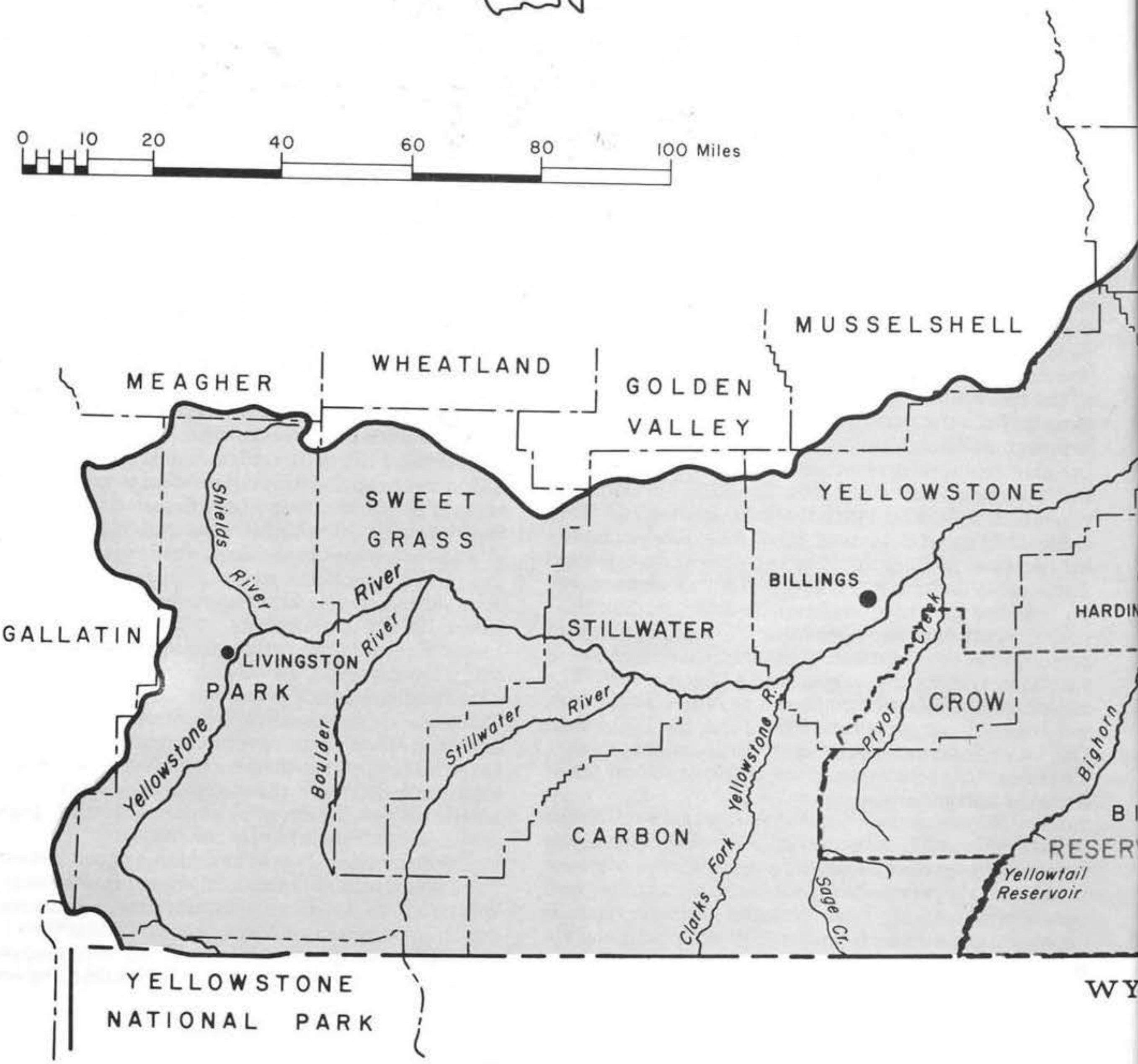

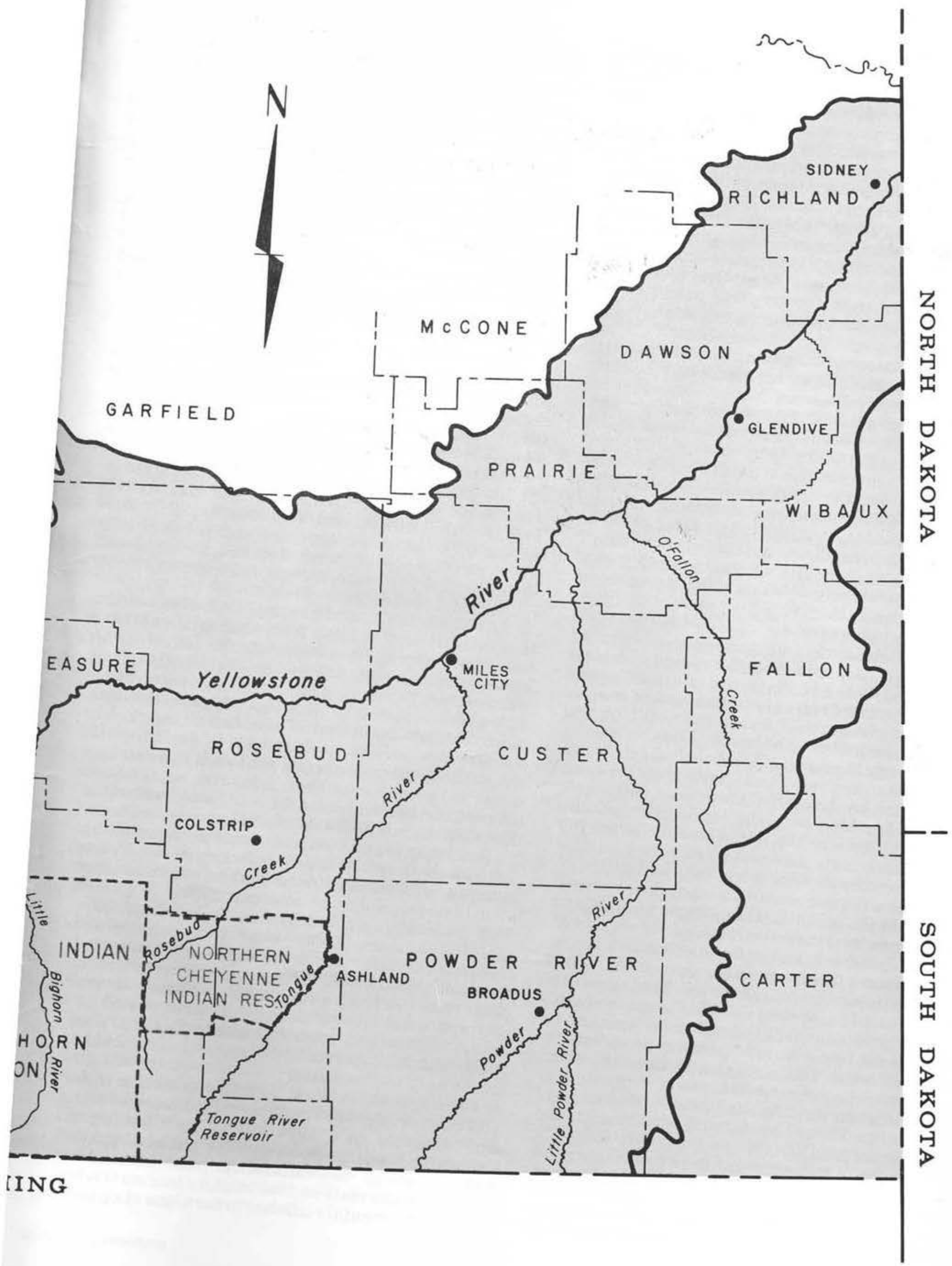
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ed, a crashing crescendo on the overall status of energy development on the northern Great Plains. However, it was not so. The conviction that developed was at best a negative one.

The first groups to actively oppose the strippers were eastern Montana farmers and ranchers who hurriedly banded together to form protective groups such as the Northern Plains Resource Council (NPRC), Tri-County Ranchers Assn. and later others such as the Rosebud Protective Assn., the McCone Agricultural Protection Organization and the Yellowstone Basin Water Users Assn. Groups such as these, as one coal company employe put it, would play an important part in "keeping us honest." In 1973, the federal government launched the Northern Great Plains Resource Program, an interagency, federal-state task force, to assess the social, economic and environmental impacts of coal development and to "coordinate on-going activities and build a policy framework which would help guide resource management decisions in the future." The study, according to some, was pretty much a case of locking the door after the fox was in the hen house. Despite the government's concern over what was going on in the western coal lands, the new study group would be severely criticized, first because it did not adequately provide for public participation and, second, in view of the rapid development taking place, it would be extremely difficult to activate the program designed by the regional planners.

The initial claim of some companies developing coal in eastern Montana was that the land lacked intrinsic value. Some boldly said eastern Montana was nothing but a "big ugly." Such assertions, as well as accelerating coal activities and deterring passage of environmental protection laws, raised the hackles of many Montanans, such as Carolyn Alderson of the Decker-Birney country in southeastern Montana. Her concern about the coal industry's threat to eastern Montana's air, land, water, wildlife and quality of life was heard in all corners of the Big Sky country.

"To those of you who would exploit us, do not underestimate the people of this area," she warned. "Do not make the mistake of lumping us and the land all together as 'overburden' and dispense with us as nuisances. Land is historically the central issue of any war. We are the descendants, spiritually, if not actually, of those who fought for this land once, and we are prepared to do it again. We intend to win."

The 1973 Montana Legislature was sparked to enact laws to bring about tighter controls and a modicum of order. The lawmakers passed the Montana Utility Siting Act, the Montana Strip Mining and Reclamation Act, the Strip Mined Coal Conservation Act, the Water Use Act and other resounding environmental bills.

One of the more important laws passed was the Utility Siting Act, which was amended and renamed the Major Facilities Act in 1975. The act provided for evaluations of environmental, social and economic impacts of coal conversion facilities using more than a half-million tons of coal a year, other energy facilities and large transmission lines. The public need for the development and environmental compatibility would need to be shown before construction would be approved by the Board of Natural Resources and Conservation. The new law provided the direction and means by which decision-making authority would be exercised by governments responsible and responsive to the people of Montana.

In March 1974, Bill Schneider, editor of *Montana Outdoors*, wrote a hard-hitting newspaper editorial entitled "Does King Coal Have an Achilles Heel?" Schneider pointed out that the key to the proposed energy conversion plants is water, and if Montana could regulate its water, it would be more likely to control King Coal.

Faced with the prospect of increasing competition for use of a limited water supply in the Yellowstone Basin, the 1974 Legislature passed one of the most critical bills, the "Yellowstone Moratorium." The moratorium postponed action on major water-use permits from the Yellowstone River Basin for three years (until March 11, 1977). It provided a breathing spell to begin to determine existing water rights in accordance with the Montana Water Use Act. It permitted the Dept. of Natural Resources and Conservation to assist other agencies and political subdivisions such as irrigation districts, counties and towns in reserving water for agricultural, municipal, recreational and wildlife uses.

The Montana Dept. of Fish and Game became the first state agency to apply for a reservation of flows in the Yellowstone River to provide recreation and to protect the fish and wildlife habitat on the lower Yellowstone. The department asked for a reservation of water sufficient to sustain the aquatic communities of the river and to establish a base flow to prevent new permit applicants from depleting the river. The department hoped that such reservations would take preference over industrial applications temporarily suspended by the bill. In no case would the reservation affect existing users.

The merits of maintaining a free-flowing Yellowstone have been debated extensively. In one instance, a fish and game official defended the river at a Livingston Jaycee meeting: "What is gained from maintaining a free-flowing Yellowstone? How can you measure it—by what slide rule do you calculate the river's numerous attributes? To say that we would retain a unique river system, incorporating plant and animal communities, historical and archaeological sites, geological features of extraordinary scenic and scientific merit, plus the river itself, with its opportunity for recreational pursuits, marks only the beginning."

Others, such as W. H. Hornby, executive editor and vice president of The Denver Post, warned of the scaremongers. At a 1974 Miles City Chamber of Commerce meeting, he said, "The national goal of seeking energy self-sufficiency puts tremendous pressure on our state and community leaders to relax their environmental vigilance in the name of a phony patriotism. We must beware of flag wavers who would drain us dry. The Yellowstone Basin's record of service to the nation is as good as any. And there are many Americans out there who believe that reasonable preservation of these last great open spaces comes closer to being a fulfillment of the American dream than heating one more office building in Portland, Seattle or Kansas City."

Numerous smoke signals simmered on the Yellowstone Basin horizon to warn of excessive water withdrawals. Nevertheless, few people realized that excessive water extraction, especially when paired with historical low flows or seasonal critical flow periods, could affect water quality. (Research has shown that the aquatic community can be endangered by the many complex reactions to significant withdrawals.) And few people, if any, understood how an excessive sediment build-up from reduced flows could cause physical changes in the stream channel. These changes could impair diversions for irrigation, domestic and industrial purposes and, through stream deposition, increase the flood hazard on both rural and urban land.

On June 25, 1976, a monumental decision was made in Helena. By a single vote, the State Board of Natural Resources gave approval to construct two giant coal-fired generating plants at Colstrip. (The Utility Siting Act gave the board the power to approve or reject such development.) The approval also called for the construction of a 430-mile, 500-kilovolt transmission line to carry power from the generating complex to Hot Springs in western Montana, where it would be fed into connecting distribution systems. The plants, known as Colstrip units #3 and #4, each would generate 700 megawatts and would be companions to units #1 and #2 (350 megawatts each), which went on line in 1975 and 1976. Construction on plants #1 and #2 began before the Utility Siting Act was passed; therefore, they were exempt from its regulations.

During the time-consuming and expensive hearings (March 1975-June 1976), the seven board members sifted through 17,000 pages of testimony and 9,000 pages of exhibits before making the decision they thought would be in the best long-term interest of Montanans.

Meanwhile, a polarization of opinions was developing and a distinct battle line soon was drawn. On one side of the line were MPC and the other utility applicants—Puget Sound Power and Light, Portland General Electric, Washington Water Power and Pacific Power & Light. They contended there was "substantial credible evidence" to show the units would fill a public need and also would be compatible with the environment.

On the other side were the opponents: the Dept. of Natural Resources and Conservation, the Northern Cheyenne Tribal Council, the NPRC (a coalition of ranchers and environmentalists) and numerous concerned citizens who saw serious problems and threats in coal extraction and electrical energy generation and transmission.

There was also that large pool of Montana citizens who were uninterested in Colstrip units #3 and #4. It soon became clear that many Montanans viewed the matter in extremely simplistic terms and felt the issue was of no particular concern to them. Furthermore, some felt the hearings boiled down to an exercise in futility since the energy giant—Montana Power—would still win as King of the Hill because of its power and political influence.

Convincing an uninformed citizenry of a public problem has always been a challenging task. Aldo Leopold, founder of the profession of wildlife management in America, was perhaps most perceptive in identifying with the difficulties of winning public understanding to a conservation problem. Here are Leopold's penciled remarks, made in the mid-1940s, as reported in "Thinking Like a Mountain," by Susan L. Flader: "If the public were told how much harm ensues from unwise land use—it would mend its ways. This was once my credo, and I think still is a fairly accurate definition of what is called 'conservation education.'

"Behind this deceptively simple logic lie three unspoken but important assumptions: (1) that the public is listening, or can be made to listen; (2) that the public responds, or can be made to respond, to fear of harm; (3) that ways can be mended without any important change in the public itself. *None of the three assumptions is, in my opinion, valid"* [*emphasis added*].

Leopold's conclusions are still valid today; yet, certain American beliefs and practices present in Leopold's time are changing. In the past, there seemed to be enough room or sufficient resources to compromise differences and console the defeated. Losers, it was assumed, could become winners elsewhere in America. We can no longer afford such comfortable assumptions. Even though too many people still have not faced up to the serious contradictions in their value system or paid much attention to the limits of abundance, a new breed of American with an ecological conscience is surely developing.

More than 200 years has passed since the cottonwood's life support system started to function. As a product of a prairie environment, the monarch of the Yellowstone Basin witnessed its share of Montana's growth, expansion, progress and change; its share of Americans impatient with traditions, ideologies, and the status quo and eager to explore the next wilderness, and its share of gross mechanical alterations of the environment.

And in the future, Montana and the rest of the states—among whom the spirit of understanding and generosity has not been wholly absent—will have to walk different and sometimes difficult paths to find solutions for the numerous challenges that will confront our society. We will have to relinquish a large measure of our individualism and enter a new stage of social development with each other and with the world, one based on mutual sacrifice and cooperation. It's unfortunate that our ox must be gored before a cohesion for decisive public action is achieved.

What People Think

by Bill Pryor

To paraphrase another author, opinion in decent people is knowledge in the making. It's that sort of reasoning that prompted three Montana State University graduate students to analyze public opinion in the state—particularly in the Yellowstone Valley—concerning development and the environment.

Ruth Frisina, a graduate student in education, concluded in her master's thesis that citizens who have lived in the state the longest are least willing to have their taxes increased or income reduced to live in an unpolluted area in the future. Those relatively new to Montana would pay the most for a clean environment. Frisina thinks this dedication to conservation among new residents could be the result of their experiences in less pristine areas.

In another survey, Lee Faulkner and Mike Howard, of the Water Resources Research Center at MSU, probed citizens' stances on future use of Yellowstone River water. Residents from the 69,000 square-mile river basin responded with numerous shades of opinion, such as:

- If the Yellowstone's water is liberally allocated to coal development, the river will be very low one year in four; one year in six it will be dry.
- The Yellowstone Basin is water poor and coal development will use water that is currently being used by agriculture.
- Coal slurry pipelines consume vast amounts of water. For long-distance coal transporting, railroads are a better alternative.

Frisina's data collection tool was a sheet of 57 questions about energy and the environment. From Montana telephone directories she chose every 312th private residence and mailed her questionnaire to 967 Montanans chosen in this manner. The poll was mailed July 23, 1974. Less than two months later, she received 248 replies, a 25% return. This response is comparable to similar surveys.

Respondents ranged from 18 to 60 years old; 80% were male, 20% female. Returns showed that 2% of the respondents' families have lived in Montana for five generations, 18% for four generations, 32% for three, 27% for two and 21% for less than one generation.

Those people polled considered themselves "somewhat conservative to middle-of-the-road."

Frisina found that people expect energy development to occur in Montana. They are hopeful it can be done with little or no damage to the environment. Of the respondents, 78% said they expect expansion of Montana's energy industry and related river water use. But most people said state officials should be more concerned about environmental quality than about economic growth.

Only 32% of the respondents considered Montana's reclamation laws capable of assuring protection of the mined land, while 68% said the laws are inadequate. Most people said the state must provide land use planning to deal with growth and development problems.

Montanans generally are uninformed and simply are not prepared to face the rapid pace at which vital and perhaps irreversible decisions are being made.

Wilderness and an associated western life style, according to 76% of the respondents, are valuable and scarce resources that should be preserved. Many of the people who have lived in Montana for more than five years said they would not have their taxes increased or submit to reduced income in order to live in an unpopulated area in ten years. Generally, people who would accept economic restrictions have moved here from other parts of the United States within the past five years.

Radio and television are the sources of information on energy and the environment for more than half of the people surveyed. Half of the respondents said that in a four-month period they saw four or more articles, broadcasts or programs that dealt with a Montana energy issue. The remaining respondents were less informed.

Montanans generally are uninformed, Frisina said, and "simply are not prepared to face the rapid pace at which vital and perhaps irreversible decisions are being made."

Frisina wrote that Montanans are an isolated electorate hoping for the best of both worlds. They expect environmental and energy trade-offs to end in an economy invigorated by grossly expanded industrialization and the sale of extractable resources. Yet, they expect to preserve the relatively pristine physical conditions of the state.

In their project entitled "Private Opinions and Public Decisions: The Future of Water Use in the Yellowstone River Drainage," Faulkner and Howard surveyed two groups: decision makers and Yellowstone Basin residents.

The decision makers are legislators, state and federal agency personnel and industry and citizen group representatives. Interviews were conducted with 58 of these people.

The second group was comprised of 4,000 Yellowstone Basin residents in Montana and Wyoming randomly selected from telephone directories. Each person chosen was mailed a questionnaire and 2,056 responded; 54% from Montana and 46% from Wyoming. The highest response was 58% from the Billings area; the lowest was 32% from Gillette, Wyo.

Those surveyed were asked if they thought the Yellowstone had enough water for coal development and agriculture and if new reservoirs might be necessary to provide water for industry. They also were asked how water purity, ground water and the existing life style would be affected by coal development and conversion plants situated near and using water from the Yellowstone.

Both groups tended to think water storage in off-channel reservoirs would be required for coal development. However, there was strong support to maintain the Yellowstone as a free-flowing river. Of those surveyed, 49% said no dams should be built on the Yellowstone, 26% disagreed and 24% had no opinion.

Billings residents generally agree there is enough water in the Yellowstone for both industry and agriculture. But agriculturists downstream contend there is *not* enough water and they fear that present flows might be used for coal development rather than for crops.

Montana law prohibits industry from taking water rights from agriculture. In Wyoming, industry has priority. However, residents in both states were overwhelmingly opposed to transferring water rights from agriculture to industry.

People living on the upper Yellowstone along the blue ribbon trout haven want plenty of water flowing and no dams. Alterations of the river could bode ill for fish and wildlife in the basin. If water flows are decreased, the river would run slower. The water would be warmer in summer and a higher percentage of it would freeze in winter. Both circumstances shut off oxygen to aquatic insects, fish and plants.

Flow reductions also would encourage more sediment to fall out of suspension and settle over what is now a clean gravel bed. Salinity—the most serious water quality problem in the eyes of the respondents—would increase if flows are reduced.

Coal development would cause an influx of people in the Yellowstone Basin. Ranchers and farmers said the area needs no more population growth, 52% to 24%, citing increased trespassing and animal harassment as potential problems.

Montanans are hoping for the best of both worlds. They expect an economy invigorated by grossly expanded industrialization, yet they expect to preserve the relatively pristine conditions of the state.

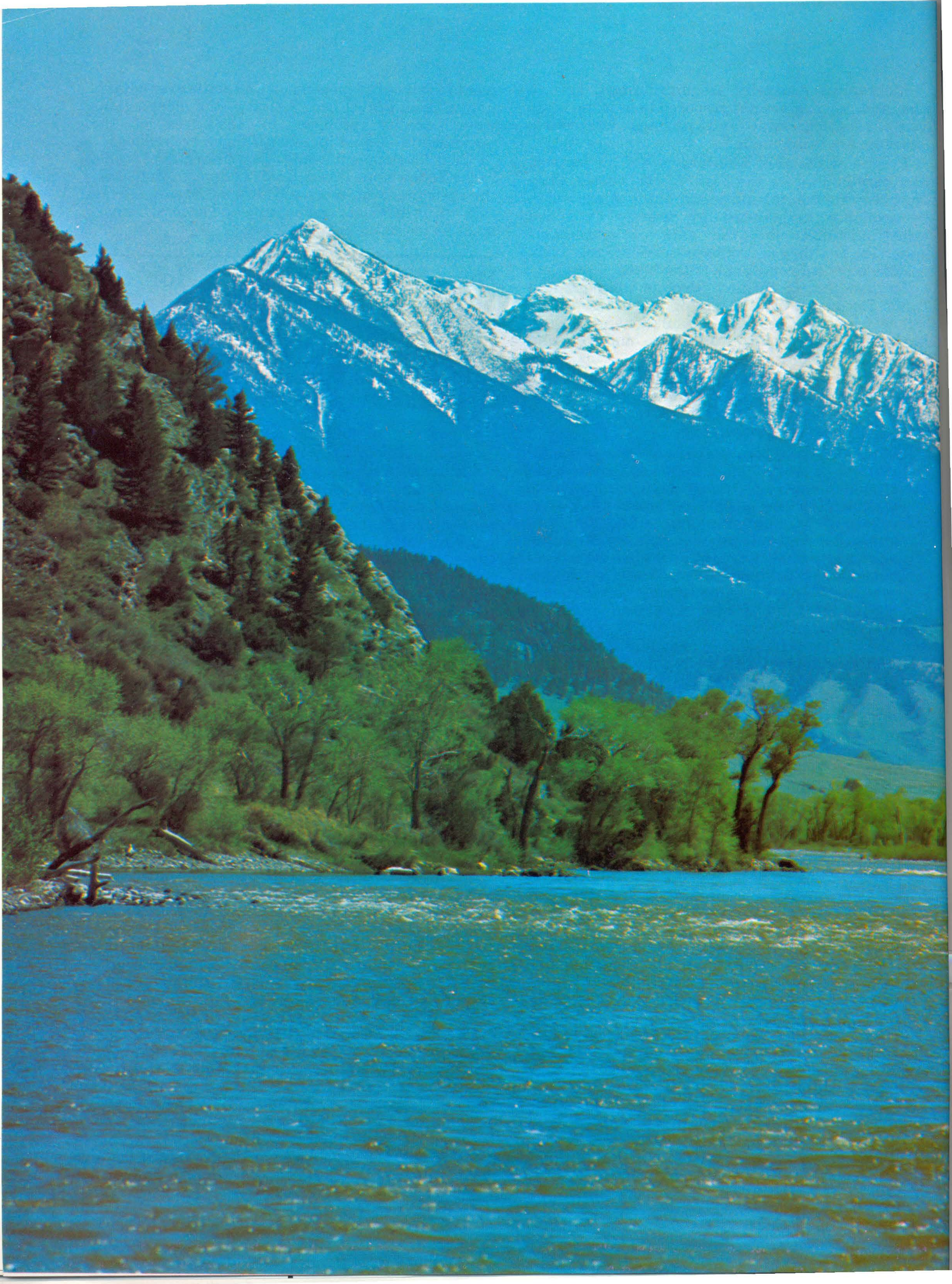
Billings residents agreed 56% to 21% that no population increases are necessary; however, 55% opposed to 35% of the city dwellers said that with proper planning, a large increase in population will not hurt the area. Ranchers and farmers disagreed 53% to 38%.

Proponents of coal development have touted increased tax revenues as an advantage of population increases. More schools and more jobs would result, they say. But even the Billings people believed 40% to 27% that community services such as health care would not improve. Apparently, these people think additional public services will be diluted by the increase of people requiring them, leaving no net gain.

Faulkner and Howard listed policy recommendations derived from their survey of public opinion. Among them are:

- Preserve the free-flowing nature of the Yellowstone.
- Recognize and preserve existing instream values for all water in the Yellowstone drainage.
- Discontinue transfer of water rights from agriculture to industry and reserve sufficient water to allow for expansion of area agriculture, or place agricultural use of water as a priority over industrial use.
- Limit deep ground water use until studies of the resource and impacts of large-scale use are complete.
- Require water users to construct offstream water storage capable of sustaining their water needs during periods of low flow.

Montanans appear to be cautious about coal development in the Yellowstone Basin, even though they generally are uninformed about its consequences. Most of them realize the value of a free-flowing Yellowstone with enough water to support agriculture and wildlife. That's good to know, because it's neither bricks nor money that run our government. It's long been held that our decision makers have nothing to support them but opinion.



Yellowstone Water:

There's Only So Much

by Mike Aderhold

The Montana Legislature enacted the Yellowstone Water Moratorium in March 1974. This measure prohibited large diversions or impoundments in Montana's portion of the Yellowstone River drainage for three years, reasonable time to study the river before responding to the many pressures for its water.

The three years have gone, and still there is

Colstrip (below) is just one of many existing and proposed industry sites that will demand massive amounts of water. photo: Carol Harlow. The proposed Allenspur Dam, which would be built at this site (left) just south of Livingston, threatens one of the last large, free-flowing rivers in America. photo: Mike Sample

considerable disagreement and misunderstanding among the various interests.

Water Committed

Existing Water Rights

Individuals cannot own Yellowstone River water, but they can obtain the "right" to use that water, and thousands have. The process for a long time was simple. You signed up at the county courthouse and agreed to put so much water to "beneficial use." This use traditionally meant that the water must be diverted or otherwise appropriated from the natural waterway. The date you signed up or the date the water was diverted established the "time" of the water right.

The 1973 Water Use Act requires all new water use applicants to file for a permit with the Water Resources Division of the Department of Natural Resources and Conservation (DNRC). The application must be advertised and reviewed before permits are granted. But as it was before the act, "first in time, first in right" determines the prevailing right if water is short and rights are legally contested.

Often water simply was diverted and the trip to the courthouse disregarded. In Montana, such a failure to file does not invalidate the right.

In many cases the right was traded, sold or otherwise transferred and the action never was legally documented. Some rights have been dropped. Others have been increased without record. Still other filed rights were never developed. The answers to how much Yellowstone water is committed and who holds the rights are buried in the vaults of the basin's courthouses, in the homes of landowners and in the memories of old-timers.

No one knows how much Yellowstone water is committed. The Water Use Act provided for the development of a uniform, statewide permit system for appropriation and use of water, a centralized record system for all water rights and a procedure to determine and adjudicate existing rights. The effort is tedious, and it will be years—maybe decades—before we know exactly how much of the Yellowstone River was already spoken for in 1977.

Water Promised

The Yellowstone Compact

Wyoming embodies 51% of the Yellowstone drainage, Montana about 48% and North Dakota nearly 1%. In 1950, long before western coal development became an issue, irrigation was the matter at hand and Montana and Wyoming agreed to apportion the water they shared.

The agreement, known as the Yellowstone Compact, was ratified by Congress in 1951. North Dakota is signatory to the compact, but does not share in the water. The allocation divides by percent the flow at the mouth of the Yellowstone's major tributaries originating in Wyoming—the Clarks Fork Yellowstone, Bighorn, Tongue and Powder rivers. While the compact recognizes all water rights prior to 1950, it prohibits other diversions of water out of the basin without the consent of the legislatures of the signatory states.

The current issue is industrial water use. Coal development in Wyoming which is proceeding at a faster rate than in Montana, is rapidly creating an industrial need for Wyoming's share of the water. Montana's position is to withhold approval of any diversions out of the basin until the two states can quantify the compact's percentages. Although Montana has not agreed, Wyoming has published an estimate claiming its share is in excess of 2.4 million acre-feet (maf), or roughly 27% of the Yellowstone River's average annual flow, which the Bureau of Reclamation (Bu Rec) has estimated at 8.8 maf. The lowest annual flow recorded by the U.S. Geological Survey is 4.2 maf.

Once the issue of Wyoming's share is settled, the next step is to decide where, when and how Wyoming will get its water. Current ideas include piping water from Bighorn Lake behind Yellowtail Dam, or storing water north of Miles City and piping it south or letting most of Wyoming's share go downstream so it can be tapped at Oahe Reservoir in South Dakota. The decision will have a major impact on how much water flows in the Yellowstone east of Miles City.

The compact gives Wyoming 60% of the Clarks Fork, 80% of the Bighorn, 40% of the Tongue and 42% of the Powder. If Wyoming takes its share before it hits the mainstem Yellowstone, it would add pressure for mainstem storage.

Water Claimed

Indian and Federal Rights

In the 1972 constitution, Montana asserts its jurisdiction over *all* water within the state. However, this assertion is subject to rights involving the Indians and the federal government.

In a 1908 legal argument involving the Milk River, the U.S. Supreme Court ruled that when the various tribes ceded their lands to the United States, they reserved not only tracts of land for their own use, but also sufficient water to fulfill their "needs" on these reservations. The Winters Doctrine, the collective title for rulings in a particular U.S. Supreme Court decision, is being interpreted by the Indians to mean that this "reserved" right may apply to all water arising on or flowing by or through a reservation.

Questions arise in quantifying this right. Some courts have ruled that this right does not depend on actual use or even apparent potential use, but may apply to any future or present need. The Indians' legal position is strong, but a number of questions must be answered before the state can determine how much of the Yellowstone River is committed to the Crow, Northern Cheyenne and Wind River reservations. Clearly, the Indians' reserved rights will affect other water uses.

Reserved rights also apply to federal government lands, where sufficient water is reserved to satisfy "federal purposes." These areas include most national forest land, national parks, federal recreation areas and wildlife refuges. (The U.S. Supreme Court in 1955 ruled in the Pelton Dam case that a power company did not need a state water right permit, since it had a license from the Federal Power Commission to construct a power project on land withdrawn from public domain for power purposes. This opinion was reinforced by the 1963 Arizona v. California decision.)

Determining federal and Indian rights are legal problems, but the federal rights can be decided in state courts, while probably it will take a federal court to adjudicate Indian rights.

Water Required

Wildlife and Recreation

In 1969, Montana legislators realized that if the state was going to maintain a tourist industry based in part on a trout fishery, it was going to have to do something to preserve trout. They recognized the need to maintain a minimum flow in certain reaches of high-quality trout streams and authorized the Montana Fish and Game Commission to appropriate available water in parts of 12 Montana streams. The Yellowstone down to a little below the Stillwater River was one of the waterways selected. The appropriations at the time were second class rights; judges were given the authority to appropriate water from these allocations at a later date.

The 1972 Montana Constitutional Convention's Natural Resources Committee unanimously adopted a water rights provision that protected Montana's water for agriculture, industry *and trout*. Later, the provision was struck down. Nevertheless, the new constitution confirmed existing water rights and, since the fish and game's 1969 Yellowstone appropriations were never challenged, it is assumed these rights are assured.

In addition to recognizing and correcting the state's archaic water rights system, the Water Use Act—without redefining "beneficial use" or endangering existing water rights—allows state and federal agencies to apply to reserve water "for existing or future beneficial uses or to maintain a minimum flow, level or quality of water."

To protect the aquatic environment, the fish and game commission, using the information and research techniques available in 1973, applied for an annual reservation of about 7 maf of the Yellowstone measured at Sidney. Figured in this was sufficient water to maintain the food chain, the stream bed and the water quality in a condition capable of supporting recreation based on a sport fishery. In November 1976, the fish and game dept. revised its application and asked for 8.2 maf based on intensive research performed in the last three years. The reservation is supported by sound biological evidence. (See pages 27-41 for reports on many of the Yellowstone studies.)

Water Appropriations

Irrigation and Industry

Montana is an agricultural state. Farming and ranching are its major industries. The economy of the state is to a large measure dependent on the conditions of agricultural markets. Progress in agriculture supposes an expanding productive base, and expanding much of our crop production requires irrigation. Political representatives from agricultural counties protect the potential to irrigate. The state advocates that water be preserved for future irrigation and has made it illegal to transfer irrigation rights to industrial use.

About 1¼ million acres is irrigated in the Yellowstone Basin. In Montana's portion of the drainage, there is roughly 650,000 irrigated acres, depleting about 1.9 maf of water. Soil surveys indicated that another 2.2 million acres in the Yellowstone drainage of this state is irrigable. In other words, this land is capable of producing crops if given water. Most of this land is bench country requiring expensive pumping equipment. With the more efficient irrigation technology used today, about 2 acre-feet of water is required for every acre irrigated. In the last two years, between 20 and 30 thousand additional acres has been irrigated along the Yellowstone River using sprinkler equipment. Future market projections made by federal agencies indicate a need to double agricultural production in the next 50 years.

At the 1975 Fort Union Coal Field Symposium, Bu Rec Regional Planning Engineer Phil Gibbs said large-scale expansion of irrigation in the Yellowstone Valley may be "wishful thinking." He said irrigation units are hard to justify. Not one unit investigated along the Yellowstone by the bureau in the last eight years has demonstrated economic feasibility using federal criteria for justification. He said there will probably be limited development by individuals or small groups using private financing, but he concluded there will be much less irrigation than many suppose. He saw little competition for water between irrigators and coal industries.

Generally, industrial use of water in the Yellowstone drainage means energy development. Other industries require water, but their demands are minor in comparison. Specific figures on water needed for planned development are hard to pin down; coal and energy companies are often obscure about their plans.

However, the Northern Plains Resource Council, a coalition generally of farmers and ranchers, estimated in 1974 that industry has shown interest in at least 3.36 maf a year of Yellowstone Basin water. Of that amount, the council shows that industry has filed appropriations on 1.17 maf a year, has been granted options on .71 maf a year and has requests pending for an additional 1.48 maf a year.

The DNRC in a 1975 publication listed industrial applications, filings and options for Yellowstone water in Montana at 1.3 maf a year. A Northern Great Plains Resource Program 1973 report shows optioned and applied requests for the whole basin total 2.25 maf a year. The Bu Rec's 1972 Montana-Wyoming Aqueduct Study suggested that up to 2.6

maf a year may be required in the two states. A 1972 U.S. Bureau of Mines publication estimated the maximum use at 2.2 maf a year in the Powder River Basin.

These figures are maximums and such uses probably would not be practical, tolerated or even possible. But if water use of this magnitude is not contemplated, why these estimates and applications?

Surface mining and reclamation are not the operations that require huge amounts of water, but rather (1) mine mouth generation plants, (2) coal gasification or liquefaction plants and (3) slurry pipelines.

The water consumption of power plants depends on water quality, size of the plant, local climatic conditions, the type of cooling system used and water conservation practices. Water consumption estimates vary from 1 acre-foot per year per megawatt to 20 acre-feet per year per megawatt. (The plants at Colstrip, if generating units #3 and #4 are built, will produce 2,100 megawatts.) Economics, particularly the cost of getting water to the plants, will affect consumption. Generally, the cost of producing electricity from coal increases as the quantity of water consumed in the cooling process decreases.

In *Chemical Engineering* magazine (March 1974), Nicholas Chopey listed 39 different systems for obtaining pipeline gas from coal. Most of these methods produce a low-BTU gas. Technology for producing high-BTU gas is still developing, and so far no commercial gasification plants are operating in the United States. Gasification plants are more efficient energy converters than power plants and will require less water and less coal per unit of energy produced.

Coal slurry pipelines can be used to move coal out of Montana for conversion near centers with high demands for electricity. About 600-800 acre-feet of water is required to move one million tons of coal. Under Montana law, however, the use of water for slurry to export coal from the state is not a "beneficial use."

One thing we know for sure: coal conversion is water extravagant.

Water Storage

Allenspur Dam Site

The time-honored response to water shortages in the intermountain west has been to dam and store. In Montana's portion of the Yellowstone drainage there are seven reservoirs with a total capacity of more than 5,000 acre-feet. By far the largest is Yellowtail Reservoir, which backs up the Bighorn River and stores almost 1.28 maf. The seven reservoirs provide 1.5 maf of water storage for agricultural, municipal, industrial and flood control purposes.

Montana has 24 potential dam sites on the

Agriculture and industry might have to compete for water. F&G photo: Craig Whitney

Yellowstone River system. The site with the largest storage capacity is on the Yellowstone mainstem at Allenspur, 2½ miles south of Livingston at the lower end of Paradise Valley. An issue for 75 years, construction of Allenspur threatens one of the last large, free-flowing rivers in America. The dam already would have been built were it not for widespread state opposition and, until now, a moderate demand for water. Coal demand has made water more valuable, but increasing environmental awareness seems to be countering this change.

Despite Montana's 1974 legislative decision (Senate Joint Resolution 42) that Allenspur Dam would be contrary to the state's goals and objectives, this issue is sure to continue.

A 1963 Bu Rec report envisions a 380-foot dam creating a pool that would flood about 32,000 acres. The reservoir would be about 31 miles long and have a maximum width of 4 miles. Maximum draw down would be about 72 feet. Such a structure could store about 4 maf and furnish for downstream use about 1.5 maf annually.

Proponents say the dam would prevent some flood damage in the lower valley, provide water for irrigation, yield water for coal development in eastern Montana, dilute pollutants and maintain minimum river flows.

Opponents point out the project would destroy more than 56 miles of top-quality free-flowing water in the mainstem Yellowstone and its tributaries, including 32% of the Yellowstone River's blue ribbon water. On site there would be a loss of farm land, displacement of people, an increase in evaporation, loss of wildlife habitat, changes in water temperature, creation of a mud flat and dust problems and a boom-and-bust social, economic and environmental impact on the surrounding area.

Downstream, the project would modify the Yellowstone's flow pattern and alter the aquatic ecosystem. Sediment movement would be modified. Downcutting of the river channel would lead to elimination of islands, bars and backwater areas. Dissolved gas concentrations would be altered.

Opponents also point out that the 4 maf of water behind a 380-foot dam would be perched above Montana's most populated valley and some of the state's best agricultural land. And there are three major geologic considerations: (1) the dam is bound to leak, since the area is made up of porous rock; (2) faults and seismic activity have been documented in the dam site area, and (3) the dam's regulatory operations could induce the unstable soils in the region to slide and increase water turbidity.

Water Controversy

Is There Enough Water?

A 1974 National Academy of Science's committee report concluded "not enough water exists [in the western states] for large-scale conversion of coal to other energy forms. . . ."

A Bu Rec representative stated at a public meeting in 1975, "There is not much possibility for competition between water for land and water for coal. Any conflict over water is between those proponents of development and those who prefer nondevelopment."

The DNRC reported in 1975 that the Yellowstone drainage "does not have enough water to satisfy all existing uses, reservation requests, and projected demands."

In a 1976 extension service publication, a Montana State University professor of agricultural economics said, "Water will probably not be a physically limiting factor in energy production. . . ."

A check if these apparently conflicting statements reveals that they are based on different assumptions and on different interpretations of limited facts. Everyone agrees that the primary source of Yellowstone water is the snowpack that accumulates in the mountains during winter. Runoff from this snow usually begins in April, peaks in May or June and is over by late July. Flows during the runoff period are 5 to 10 times the average during fall and winter. Water shortages, if they occur, will be between August and March. If massive industrial demands are met, winter depletion is a new possibility.

There are three major water uses: ecological, agricultural and industrial. The water requirements vary in time. Natural living systems must have year-round water movement approaching natural flows. Agriculture, or more specifically, irrigation, generally requires a dependable flow during the summer growing season. Industry needs a reliable year-round supply of water.

Is there enough water? Yes and no. The Yellowstone drainage *does* have enough water to satisfy predictable agricultural and industrial needs if Montanans are willing to pay the high environmental and financial costs of storage development. The Yellowstone River as it flows today *does not* have enough water to satisfy all future demands if they are developed anywhere near the maximum proposed.

Water Reserved

Free-Flowing or Dammed

What are the values of a free-flowing Yellowstone?

Advocates of maintaining the river free-flowing argue that the river in its natural state is a unique theater of living and non-living forces at work together. It is simultaneously a classroom and a playground capable of stimulating a mind and providing recreation indefinitely. With a little care, the Yellowstone can furnish water and sustenance for man and wildlife forever.

The Yellowstone is the largest free-flowing river left in the 48 adjacent states. It's a national treasure. It has shaped our history, influenced our agriculture, directed our movements, stimulated our thinking, contributed to our education and supported some of our families.

Opponents of maintaining the river free-flowing say the Yellowstone could be made more productive if controlled, its water stored and paid out during periods of low flow to benefit potential agricultural and industrial development. Many people contend that Montana water should be used by Montana residents for local benefit.

The counter argument is that with some tributary, off-stream and on-site storage coupled with water conservation practices and efficient industrial technology, it is possible to have a mixed, stable economy and keep the mainstem Yellowstone flowing free. Advocates argue that the value of a free-flowing Yellowstone will increase in time, contributing in ever greater amounts to the local economy.

The other side counters with the nation's energy need and the high cost of the proposed alternative.

But what will finally satisfy America's wanton energy demands after we've sacrificed all our wild lands and rivers in the name of prosperity?

This issue will be settled by value judgments based on our collective sensitivity to our environment.

Water Services

Social Development

Tied closely to industrial development are population increases. Permanent settlements will require permanent water supplies.

The Water Quality Bureau of the Montana Department of Health and Environmental Sciences has said that most of the communities in southeastern Montana using wells as a primary water source have little or no reserve during summer. Water treatment plants will have to be expanded and water will have to be brought in to some areas. The bureau also has said that most Montana sewage treatment plants are inadequate to meet sewage treatment requirements.

In our society, almost everything we do requires water. Rural domestic and municipal water requirements are relatively small compared to other demands, but they are significant when there is a water shortage.

Man's reliance on water should be remembered when considering development and nondevelopment in eastern Montana. Other factors are important, too.

In this state, the classic argument for development contends that it will provide jobs, higher wages and bring in outside money. This situation would give our children the option of remaining near home. The new money would stimulate all sectors of local economies. The tax base would expand, our public services would improve and our standard of living would increase.

Unfortunately, the predicted outcome of development does not always come true. The high environmental and social cost of some developments often produces few lasting benefits.

In Montana, we have seen that boom-and-bust development is often worse than no development at all. During the bust, the benefits are reversed, leaving depression. Rapid rural development often hurts those in the area outside the boom economy. Such problems have been documented along the Alaskan pipeline and associated with coal development in Gillette and Rock Springs, Wyo., and in Colstrip.

No development at all, while sometimes appealing, is hardly a viable alternative. But a reasonable choice would be a controlled, gradually increasing, stable economic expansion based on a mixed development of renewable and non-renewable resources and services promoting and protecting our natural endowment.

Water Control

Responsible Decisions Now

It is the opinion of the Montana Dept. of Fish and Game that the future of the Yellowstone River still can be decided at the state level by the residents of Montana and their representatives in 1977. The river must be protected now because, with time, decisions deferred will become decisions made. Unless Montana is in control, competing users will divert their small shares of water without coordination. The cumulative effect of these small shares eventually will create a critical withdrawal problem. One or two dry years and we will "suddenly" have another crisis. A regulated Yellowstone might then become the only popular alternative. And the fate of the river will have been decided because we didn't act in 1977.

It doesn't need to happen. Adequate information is available about water conservation methods, about coal conversion alternatives and technology, about possible national energy requirements and about the value of a free-flowing river system. Adequate information also has been gathered about water availability in the Yellowstone. We can have a natural Yellowstone and avoid a future water crisis by:

1. Encouraging a formal federal energy policy.
2. Formulating a formal state energy policy.
3. Specifically identifying state goals.
4. Adopting a conservative water use philosophy.
5. Defining the limit of acceptable energy development.
6. Researching alternatives to large-scale development of non-renewable resources.
7. Encouraging energy conservation.
8. Assuring that the cost of development be borne by the consumers of the resource.
9. Investigating alternative energy production technologies for Montanans.
10. Strictly enforcing laws granting fish and wildlife enough Yellowstone water to maintain high populations.
11. Adhering to strict and conscientious enforcement of statutes and policies relevant to energy and natural resource development.

Our mission is written into the Montana Constitution, which says, "The state and each person shall maintain and improve a clean and healthful environment in Montana for present and future generations."

Emigrant Peak, in the Absaroka Range between Gardiner and Livingston, looms above the Yellowstone. photo: Mike Sample

A River Is More Than Water

by William H. Hornby

Think of all the people who have come into the valley of this river to take strength from its freedom. For the Yellowstone does have a life and a spirit of its own—the Indians knew that. This river isn't just water. The Yellowstone has a giving life and a giving spirit.

It first gave to the Crows who called the valley home, and intermittently it gave to the hunting Blackfeet, Assiniboines, Gros Ventre, Flatheads, Shoshones, Nez Perces, to the Cheyennes and the Teton Sioux. It even gave to the Mandans and Arikara who came from the muddy Missouri, from which an early environmentalist, Chief Rotten Tail, said, "A Crow's dog would not drink."

Then it gave, oh how it gave, to the white fur trappers looking for the beaver's brown gold, and later to the miners scratching for the harder yellow of gold in the streams coming down from the snowy Absaroka. The lifewater rushed down from the great Yellowstone Lake amid the high, smoky mysteries of "Colter's Hell." Over the great falls, through canyons and peaceful moose meadows that became the world's greatest park. Down toward the Great Bend through the gates above Livingston came the lifestream, to give life to the farmers and floating boatmen. The basin carved by the river gave trails to the wagonmasters and bed to the railroaders and highwaymen. And what of the gift of irrigation to homesteaders and tapwater to city dwellers?

Think of the names of the counties that fringe the river—Park, Sweet Grass, Stillwater, Carbon—yes, the pioneers knew coal was there even then. Treasure, Yellowstone, near the gold-grey rimrocks that christened the river. Rosebud, where once was a valley of wild roses. Custer—there was death, too, along the river. Prairie, Richland. Turn these county names on your tongue for a moment—they all bespeak the different lives the river has given.

How long has human dependence on the river been going on? The Crows came into the buffalo's valley in the 1700s. La Verendrye, a Frenchman, presumably first saw the valley in

Cutthroat trout depend on the river's tributaries for spawning. photo: Mike Sample

the Miles country about 1743. So it's maybe three centuries that men of record have been using the shimmering artery. Before then it was the bountiful game. Elk, antelope, bears, ducks, beaver, otter—you count them.

Before man came there was empty beauty along the river; there was the wild, and the sound of that gurgling, grinding water

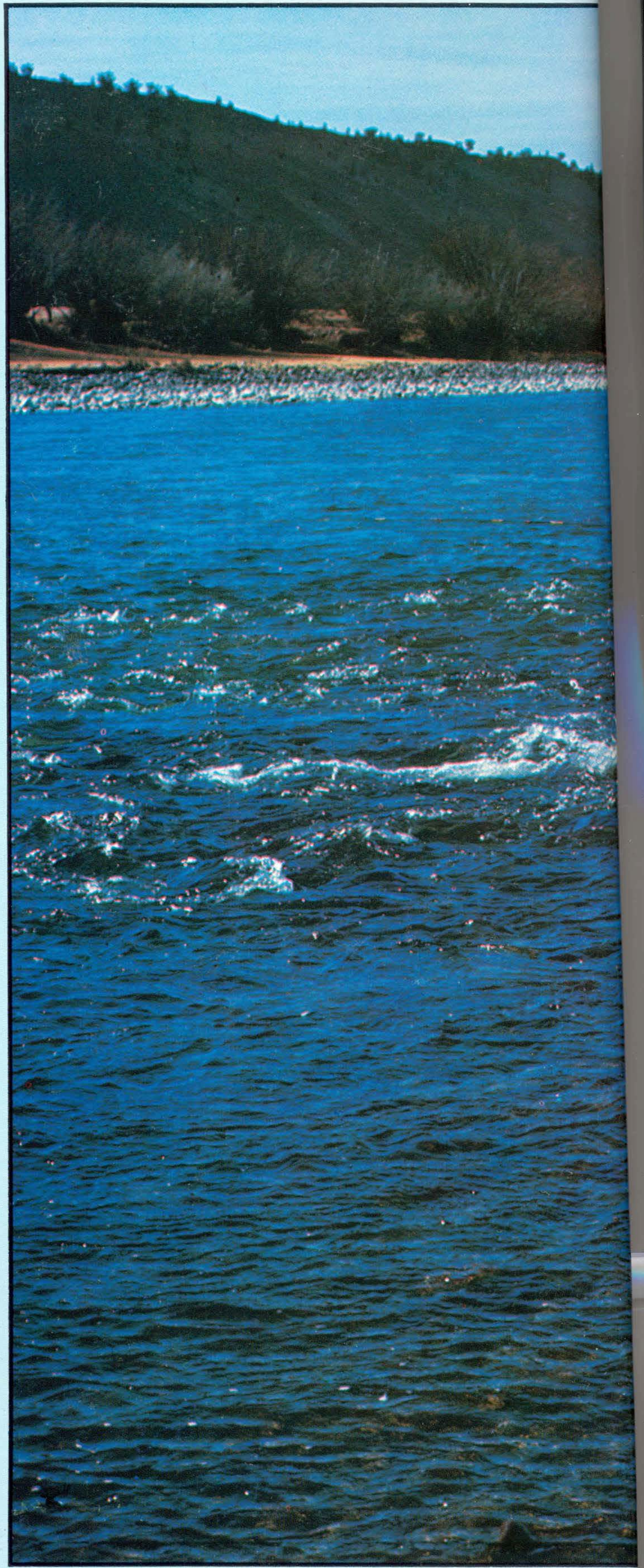
Floating is one of dozens of ways people enjoy the river. photo: Harry Engels

Canada geese inhabit the Yellowstone Valley all year long. photo: Harry Engels building gravel beaches and shifting bars. Cottonwoods, and hawks, the rustle of glinting green-yellow leaves against the far purple peaks, wild rich grasslands, the buttes catching the sunset, the ever, ever Big Sky. How quiet and free it must have been.

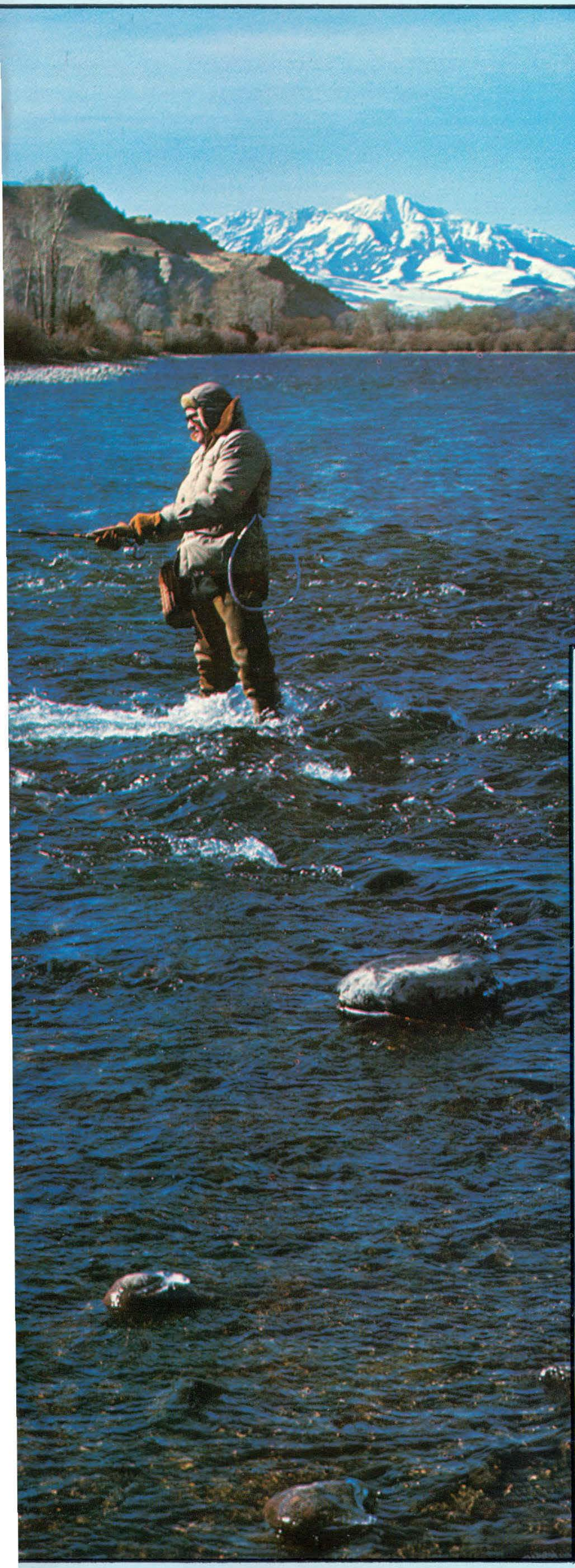
Today on the Yellowstone you often wake from that peace and quiet of a hundred years ago, although that word "peace" might seem amiss to a Custer, a muleskinner or a boom-town madam. The Yellowstone Valley had to grow. Towns and cities were brought by the railroad and named for its moguls—Billings, Livingston. Or brought in part by the army and named for its brass—Miles, Forsyth, Terry. In the Yellowstone Valley there live today nearly 200,000 people, a rough quarter of a huge state's population. But how many recognize their debt to the river? To how many is it more than just water?

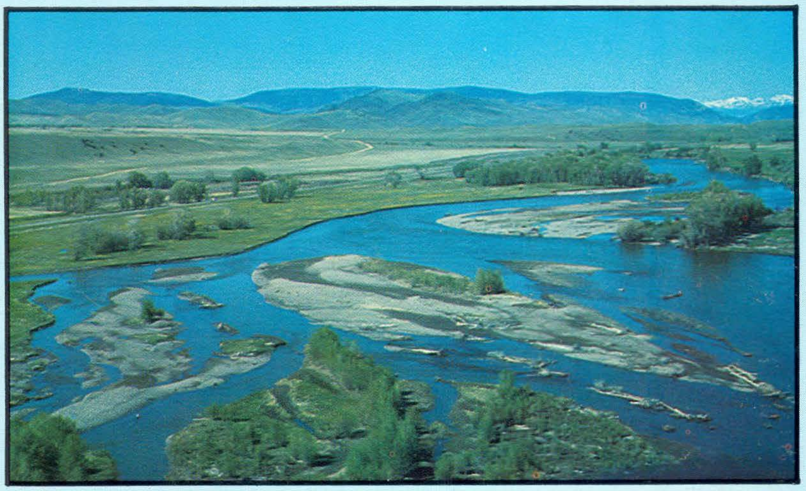
Out of state in the wider world, "Yellowstone" means only the park, the great magnet. Or possibly the blue ribbon trout water of Paradise Valley. Most of the rest of the country doesn't know this great river as one of the last lengthy rivers that doesn't have a dam anywhere. But inside Montana we know "Yellowstone" also for the fine hunting of the eastern plains, for the irrigated richness that surrounds thriving Sidney, for the oil fields around Glendive, for the ranching that clings to Miles City, for the badlands and for urban Billings.

Once a diehard fan of the Yellowstone, your mind goes back to it wherever you are. Several years ago in remote China at the source of that nation's Yellow River, I was struck by the similarities of the countryside to our sparse, dry, but everlastingly beautiful eastern Montana plains. And in China, the



The upper Yellowstone is known for trout, but whitefish are even mor





Islands provide security for nesting geese. F&G photo: Larry Peterman

se. photo: Harry Engels

Today, irrigation is becoming more efficient. F&G photo: Bob Martinka

The proposed Allenspur Dam would destroy 32% of the river's blue ribbon water. F&G photo: Bob Martinka

In spring, paddlefish migrate up the Yellowstone from North Dakota's Garrison Reservoir to spawn. F&G photo: Mike Haddix

lesson of human dependence on the part of the people toward their river was obvious.

The Chinese had even written a symphony for their river, detailing its thousands of years of history. Floods and Famines, Irrigation and Harvest, Wars and Revolutions. It suggested a symphony for our Yellowstone, with passages for explorers and mountain men, for Indians and cavalries. I heard the rumbles of the buffalo, the shout of the muleskinner, the dusty thunder of the longhorn herds in stampede and on the horizon the piercing whistle of the NP. The whir of the combine, the clank of the oil drill, the crunch of the coal shovel. And what music you could make of the great Mother Park with its fires and geysers, its wind-tossed lake.

I mused on the China river that had thousands, not just several hundred years of human use, and noted, "As you look at the hundred years or so of organized human living in the Yellowstone Basin, it is clear that our river has often been a line of battle or a link between hostile camps, and not often a particularly connecting pathway. The Yellowstone has never been looked upon as requiring the protection or the interdependence of those living along its shores, or elsewhere on its table. Whether it is the trout fisherman fighting the irrigator, the smalltown retailer fighting the bigger town discounter, the environmentalist fighting the miner or rancher—you name it. The attitude of the cavalryman toward the Sioux, of the cowman toward the shepherd still clings to our river dwellers in a legacy of watchful hostility."

Those were words that came in 1974. Three years later, what's to change? Still there are more petty quarrels than common attitudes among the river's dependents.

Yet the Yellowstone flows on—the great Free River, with its own life and spirit. What do we mean by free? Still undammed on its main stream. Still available on a relatively equal basis to all users; not yet totally reserved or reservoired for any special economic interest. Not yet run dry to serve particular greed.

Where will the Yellowstone be in another 300 years? Still free? Can the beautiful

Upland game birds thrive in the Yellowstone Valley's diverse ecosystem. photo: Jon Cates

White-tailed deer are bountiful in the willow thickets and aspen stands. photo: Vince Claerhout

pictures on these pages still then be taken? Will there be equal opportunity to stumble after a big trout or to pump water for a golden field as well as to mine needed fuel? Will the clearness of the water be such as was familiar to Lewis and Clark, or will a Crow's dog no longer drink in his own river?

Does a great river have a spirit of its own, or were the Indians wrong? Is there something that Montanans can give back to a river from which they have taken so much? Protection? Balance in usage?

In the old days the river was strong and men were weak. The river held its own. But now man is multiplying and competing along its banks in ever greater numbers, and these new men are not aware that a river has a great spirit, that it should run free, that it should "be" for everybody, and still have something left for itself. There are too many people to whom the Yellowstone is just "water," and they want to take theirs. Just taking, no giving. Where will that attitude leave our Free River in 2077?

Yellowstone Research

Research: Here's Why

by Bob Martinka

Many people think of a river as a simple system of flowing water. If you remove some water, it seems that nothing much will happen, except the water level will drop a little.

But that's not true. Rivers are complex, with living and nonliving components. The living creatures depend on the nonliving material and have been adapting to fluctuations in nonliving features for thousands or even millions of years.

The living components of a river include such things as algae, insects, fish, waterfowl and beaver. Some of the critical features of a river that affect aquatic life include temperature, velocity, sediment, bottom material, channel configuration and fertility. So far it is known that waterfowl and beaver, for example, are not as dependent on a particular river as algae, insects and fish; but all of the complex interrelationships of river features and wildlife are not understood.

The possibility of large additional agricultural and industrial water withdrawals from the Yellowstone makes it necessary to understand these relationships and what will happen to them if the system is altered. An extensive research program is needed, for if one river feature is changed, such as large reductions in the amount of flowing water, then all of the others will be affected.

A decrease in the number of insects might lead to fewer small fish. This would decrease the amount of food available for large sport fish, such as catfish and sauger. Also, large water withdrawals might increase late summer water temperatures in the lower Yellowstone, which could be detrimental to some insects and fish.

Studies of each river component and its interrelationships with the other components are necessary before all the effects of large-scale water withdrawals can be determined.

The Montana Dept. of Fish and Game is conducting a broad-based Yellowstone drainage research program, which is financed by many different sources. Since it isn't sportsmen who threaten the Yellowstone with water withdrawals, sportsmen shouldn't have to bear the burden of research costs. Therefore, the department has used only limited amounts of its funds to support the program.

The Old West Regional Commission, a federally funded organization guided by a six-member board comprised of a federal co-chairman and the governors of Montana, Wyoming, North Dakota, South Dakota and Nebraska, is a major funding source. Other sources include the Bureau of Reclamation, the U.S. Fish and Wildlife Service, Intake Water Co., Colorado Interstate Gas, Pan Handle Eastern, the Environmental Protection Agency and Utah International.

The department is required to participate in studying the effects of water withdrawals by such Montana laws as the 1973 Water Use Act, the 1974 Yellowstone River Water Use Moratorium and the 1975 Major Facility Siting Act. Moreover, the department is obliged to protect our state's wildlife resources.

Upper Yellowstone Fishery

by Rod Berg

Dan Bailey's Fly Shop in Livingston is testimony to the abundance of big fish in the Yellowstone. There on the "Wall of Fame" hang several hundred plaques with outlines of trout taken from the river. All of the fish weighed more than 4 pounds.

Joe Brooks, considered by many outdoor writers and fishermen as the outstanding fishing authority of our time, searched the continent for more than 30 years for the finest fishing areas. In his comprehensive "Guide to Fishing Across North America," Brooks concluded that "the Yellowstone offers probably the best trout fishing in America today."

Historical evidence suggests that the Yellowstone always has provided an important fishery. Indians, trappers, explorers and pioneers gathered along its banks to catch fish. But an increasing, and seemingly insatiable human demand for Montana's limited freshwater supplies threatens to change all of that.

This study, funded by the Federal Aid to Fish and Wildlife Restoration Act, was conducted by the fish and game dept. from July 1972 through September 1975 to help evaluate the effect of conflicting water demands on the Yellowstone fishery.

The river study area, from Gardiner to the mouth of the Boulder River at Big Timber, is characterized by its clean, cold, highly productive water. Streambed materials predominantly are round cobbles in riffle and run areas. Aquatic insects graze microscopic aquatic plants called algae, which cover the cobbles. The insects, in turn, are the staple food for resident fish populations. Crannies between the cobbles provide shelter for young trout and small forage fish, such as the mottled sculpin. Adult fish security is provided by deep water, large rocks, debris and water surface roughness.

Found in the upper Yellowstone and its tributaries are 17 species representing 7 families of fish, but only 10 species are considered abundant. Common game fish include rainbow, brown, Yellowstone cutthroat and brook trout and mountain whitefish. Longnose, white and mountain suckers, longnose dace and mottled sculpin are the prevalent nongame species.

Trout population estimates obtained through electrofishing surveys in five study areas of the Yellowstone River revealed standing crops ranging from about 100 to nearly 500 seven-inch and longer trout per 1,000 feet of stream. These catchable trout averaged just more than a pound and ranged to more than 8 pounds.

Mountain whitefish are several times more abundant than trout. Though highly regarded by some anglers and disdained by others, whitefish provide an important winter fishery. They can be taken readily during winter when trout fishing is often sluggish. Electrofishing estimates show standing crops ranging from about 160 to more than 1,200 catchable whitefish larger than 12 inches for every 1,000 feet of stream.

Trout and mountain whitefish are members of a broad family of fishes called *Salmonidae*. Research has shown that most members of this family migrate considerably during the spawning season searching for spawning sites. Characteristically they spawn on clean gravel in clear, shallow, moving water. Rainbow and cutthroat trout spawn during spring, while brown and brook trout and mountain whitefish are fall spawners.

Trout and mountain whitefish spawning runs were found in 13 of 18 Yellowstone tributaries sampled by researchers using electrofishing boats. These fish appear to be particularly dependent on the tributaries for spawning. Tag returns revealed that cutthroat exhibited a strong homing tendency to their natal streams. Some cutthroat residing in the mainstem of the Yellowstone River migrated at least 14 miles to spawn in their natal stream.

The tributary streams also supply the Yellowstone with much of its high-quality water and bedload material. In addition, they support self-sustaining resident populations of rainbow, cutthroat, brown and brook trout.

The 103 miles of river from Gardiner to Big Timber has been classified by the fish and game commission as a blue ribbon trout stream, having national significance in terms of productivity, degree of use, aesthetics and availability for fishing. This is the longest single reach of blue ribbon stream in Montana and represents 23% of the state's 452 miles of blue ribbon water.

In the 75 miles between Gardiner and Springdale, there are 19 public access points on the river, and most landowners allow access to fishermen if permission is asked.

The major threat to streams in the upper Yellowstone Basin is improper land and water use planning and management. Heavy silt loading and alteration of stream flow patterns resulting from excessive logging and associated roadbuilding have harmed fish populations in some streams in the study area.

Additional problems have been caused by mechanical alteration of stream banks and channels, severe water withdrawals in some streams for irrigation, and removal of mainland vegetation by livestock and crop clearing. A number of potential sites for non-fuel mineral and coal mining, oil drilling and geothermal power plants also are found in the upper Yellowstone Basin. Development of these sites could do even more damage to the aquatic resource.

The greatest single threat to the upper Yellowstone is posed by a huge potential water demand, part of which would be required to develop the Fort Union coal deposits in eastern Montana. Substantially increased irrigation is yet another major threat.

If these water demands become a reality, mainstem or off-stream storage would be required to insure availability of water during dry periods. The Allenspur Dam site, 2½ miles upstream from Livingston, was the only mainstem storage site on the Yellowstone River considered in the Bureau of Reclamation's Montana-Wyoming Aqueducts Report. Impacts of the proposed dam and reservoir on the aquatic resources of the Yellowstone would be massive. It is doubtful, if not impossible, that the blue ribbon trout fishery could be maintained in an impounded stream. Natural flow patterns and high water quality provided by free-flowing streams are essential in maintaining such an ecosystem.

The flood pool of the proposed reservoir would consume 33 miles of mainstem Yellowstone, 14 miles of mountain tributary streams and 9 miles of spring creeks—56 miles of top quality free-flowing trout water would be lost. This irreversible commitment would destroy 32% of the Yellowstone River's blue ribbon water, or 7.5% of the state's blue ribbon stretches. This loss would become particularly significant in light of increasing national demand for free-flowing wild trout water combined with an ever diminishing wild trout resource.

Those Pesty Insects

by Robert Newell and Dennis Schwehr

Most people pay little attention to the insects along a river, unless a swarm of bugs becomes bothersome. Insects may not be the stars of the cast of creatures thriving in a river, but their role is vital.

A careful study of the kinds and numbers of insects can provide valuable data on the biological condition of a stream or lake. Any change in this condition can signify that something is wrong.

With a grant from the Intake Water Co., the fish and game dept. initiated a two-year study in August 1974 as part of a series of studies to understand how all the animals living in the Yellowstone Basin interact with the river. The insect study has helped determine the kinds and numbers of insects living in the river and how much water they need to maintain healthy communities.

Twenty study areas were established along more than 550 miles of river from Corwin Springs near Gardiner to the Montana-North Dakota border.

Results of the first year's work showed that more than 170 kinds of aquatic organisms live in the river, most of them insects. A total of 37 species of mayflies, 39 species of caddisflies and 32 species of stoneflies were found. Generally, the animals living in the upper river are different from those living hundreds of miles away in the lower river.

Roughly one-third of all organisms captured during the study were mayfly nymphs. Fifteen species were caught at Corwin Springs; 17 species were found at Glendive. The two sampling stations had four species in common.

Caddisflies also are abundant in the river. Five species were found at Glendive, while 11 species were collected at Corwin Springs.

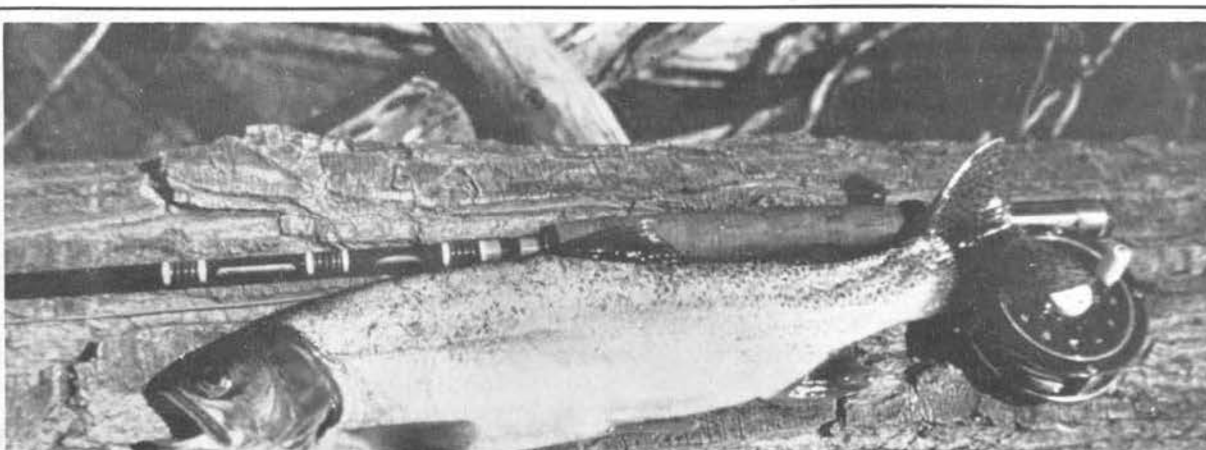
Stonefly larvae were caught throughout the river, but were most abundant in the upper third of the Yellowstone where the water is colder, cleaner and faster. At Corwin Springs, 21 species were collected and the numbers steadily decreased until only three species were found at Glendive.

Fishermen in the upper river anxiously await the hatch of the giant stoneflies *(Pteronarcys californica)* in June and July. These stoneflies, often called salmonflies, are about 2 inches long and their emergence on the river brings the largest trout up to feed on them.

Midges *(Chironomidae)* are also profuse in the river. The larvae are small, less than a half an inch long, and look like small worms. The adults also are small and usually are black. Although they resemble mosquitoes, they do not bite. Swarms of adults usually are observed in fall and winter when fishermen try to imitate them with small dry flies (snowflies).

Other organisms found in the river include sow bugs, aquatic moths, water boatmen, water scorpions, riffle beetles, dragonflies, damselflies, scuds, water mites, snails, clams, flatworms and worms.

In the second year of research we found a striking difference in insect populations between the upper and lower river. Several samples taken in fall disclosed a total of 619 organisms per square foot at Corwin



A free-flowing river is essential for Yellowstone cutthroat trout. F&G photo: Bill Schneider

Springs and 624 at Livingston. Numbers steadily decreased downstream: 92 per square foot were found at Glendive and 42 at Intake, 17 miles downstream.

Differences in numbers of species and types of organisms occur because of such things as temperature, food, current speed, bottom conditions, gradient and silt.

Researchers closely examined the preferred currents of bottom-living insects. Most insect larvae lived in currents in the 1.5 to 2.5 feet per second range. Using this information, we have determined that a reduction of 1,000 cubic feet per second in fall would cause about a 10% reduction in the number of insects in the lower river.

Insects would be endangered even more during winter. They would be more susceptible to freezing in the ice and to being mashed as the ice breaks and grinds along the bottom in the shallow water. Lower water levels allow ice to form on the river bottom. This is called anchor ice, and when it dislodges, it carries away the frozen bottom-dwelling insects.

A diverse group of organisms lives on the bottom of the river. Fewer insects and fewer kinds of insects are found downstream. Water withdrawals will decrease the number of insects further.

The invertebrates and subsequently the fish populations are destined to decrease as more people move into the Yellowstone Basin. Conditions such as siltation, poor grazing and farming practices, water withdrawals, irrigation return and sewage wastes will contribute to the decimation.

Water Invites Recreation

by Max Erickson

As the sun appeared one June morning, ardent paddlefishermen were busy trying to snag one of the monsters on the Yellowstone River near Glendive. Farther west at Forsyth, half a dozen youngsters were hustling to shove off for a float trip on the winding waterway. At Big Timber, along the same river, two elderly fellows were sitting down to a trout breakfast, compliments of their angling skill the evening before.

Recreation on the Yellowstone is as diverse as nature itself. Fish and game dept. personnel have been analyzing how water-related recreation might be affected by water withdrawals and development of the Yellowstone Basin. This project, which began late in 1974, is funded by the Old West Regional Commission.

Within the study area, which includes the Yellowstone River and its tributaries from Big Timber east to the North Dakota line, recreational activities vary from catfish to trout fishing, from rock hounding for semi-precious Montana moss agates to asparagus picking, from multi-day organized river floats with hundreds of people to scenic and peaceful afternoon outings. Hunting white-tailed deer along the river bottoms can be fruitful—even surprising, as pheasants and waterfowl seem to grow tame when you are equipped only with your rifle.

Through observations and 469 questionnaires compiled in 1975 and 1976, researchers found that fishing is the pet recreational activity for more than half the people using the Yellowstone. Relaxation, sightseeing and picnicking also were popular.

Favorite recreation areas are the developed and well-signed sites. Eight of these sites are owned by the fish and game dept. (See *Montana Outdoors*, July/August 1976.) Most of these areas include gravelled parking areas, garbage cans, water, barbeque stands and picnic tables, making the sites inviting for a family outing or fishing trip.

Many undeveloped areas also exist along the Yellowstone, but you must be familiar with the area to find them. The areas that offer an assortment of pleasures plus convenient access are the most popular along the river. If fishing is spotty or poor, or if no picnicking facilities exist, or if access roads are extremely rough, the chances are poor of finding a throng engaged in water-based recreation.

However, good fishing, facilities and access roads do not necessarily lead to crowds at Yellowstone River recreation sites. Approximately 77% of the people surveyed in 1975 and 1976 said the site they were enjoying at the time the poll was administered was not too crowded, but just right. In fact, more people said the site they were using was not used enough, compared to those who thought it was overcrowded (12.1% to 11.5%).

Boats are used commonly for rock hounding, sightseeing and fishing, but there is no conflict among boaters because of crowding. Less than 10% of the people surveyed said floating or boating was their favorite activity.

After it was determined where most recreation occurs and why people enjoy certain sites more than other areas, it was time for researchers to document how different flows affect recreational use.

Since daily flow records are kept at several points along the river, it was convenient to compare recreational use during high water run-off years with use in years of relatively low water run-off.

We concluded that access is the use factor affected most by flow rates. Here's what we found:

In 1975, the peak flow of the Yellowstone at Miles City was 69,800 cubic feet per second (cfs) on July 9. In 1976, the peak was 45,900 cfs on June 13. During 1976, a 24.3% increase in recreational use was observed in comparison with 1975. This increase in use is attributed to many factors, but it's notable that flooded and muddy access roads were present in 1975 at several sites until mid-July. This situation did not exist in 1976, allowing people in June and early July to enjoy sites that were inaccessible at that time the year before.

It's ironic that the high flows that trigger paddlefish reproductive instincts and permit them to migrate past the Intake diversion dam near Glendive are the same flows that limit even four-wheel-drive vehicles from getting to some of the prime paddlefishing areas. Almost every year a few fishermen, unwary of the Yellowstone's depth, venture in their four-wheel-drives to an east-bank side channel on the Yellowstone at Intake. The river crossing attempts often become what residents have dubbed the "General Motors float" and the Yellowstone sweeps the vehicles downstream. One year, three outfits were piled up at once on a sandbar.

Swimming and floating are other activities affected by flow conditions. However, unless water levels are drastically reduced, the limited swimming activity is influenced very little. Floating, which requires only a few inches of water for an average rubber raft or canoe, can be enjoyed with reasonably varying water levels. Since the floating vessels usually are light, they can be portaged at precarious places.

The story for motor boating and water skiing is more grim.

The Montana Department of Natural Resources and Conservation has said that with increased irrigational development, the Yellowstone River water demand within the study area in the year 2000 could be 25% to 50% of the total flow during August and September, assuming each month's flow is equivalent to the average for that month. If extremely low water years are considered (presumably the lowest 10 of 100 years), the demand figures increase to 40% to 70% for August and September.

Of four locations on the Yellowstone near Miles City, at least one site might not have the required 18 to 20 inches of water needed to operate a motorized craft by the year 2000.

Increased water demand would decrease the number of areas where it's possible to operate a motor boat. This would be dangerous, especially for boaters unfamiliar with the Yellowstone River.

Agate hunters in coming years also could be disappointed. High run-off is instrumental each year in exposing new agates for rock pickers. Any effect on this natural process could make the rocks increasingly difficult to find. Lower levels make rock hounding easy, but with the number of rock hunters combing the river bed, nature's annual spring flow patterns are necessary to keep turning up more agates.

Fishing is an experience that is enhanced by success. The fish population of the Yellowstone River is tremendous, but analyzing the influence of flow fluctuations on the fishery is incredibly complex. However, researchers know that any loss of vertebrate or invertebrate species because of increased water withdrawals could affect the whole biological food chain necessary for good fishing.

This study did not investigate the effects on recreation of the proposed Allenspur Dam, which would be built near Livingston. But a recent study on impounded and unimpounded sections of the lower Columbia and Snake rivers revealed that use of recreational boats per mile of river was greatest on unimpounded stretches. With the addition of each dam on the Columbia and Snake in the last several years, use by anglers has shifted and has intensified in the remaining unimpounded sections of the rivers. Distribution data showed that people prefer the unimpounded sections for recreation during all seasons.

Most of the people surveyed in the Yellowstone study said they were interested in the future of their favorite outdoor areas, but confessed that they were ignorant of the developing agricultural and industrial water demands in eastern Montana.

Increased water use from the Yellowstone might affect your recreational outing, depending on the activities you enjoy most. With this development, it could be easier for you to drive to a particular area in June, but without water, there probably would be little pleasure in your experience.

These studies emphasize that the recreational potential of the Yellowstone is awesome, but dependent on the river's natural ecosystem. If we're not cautious and aware of the impact of alterations on the river, we could squander our favorite recreational sites, and cheapen our hard-earned reward—leisure.

The River's Migratory Birds

by Tom Hinz

Canada geese are prized gamebirds. Waterfowlers and photographers alike lust after the large flocks that have begun sojourning on the Yellowstone River in the last 25 years or so.

Most people agree it's nice to have the wary birds around, if only just to see and hear them in the morning and evening passing to feed in the fields. The fall flocks provide prime hunting in some areas. In spring, the honkers seem unbothered by humans and can be approached easily by wildlifers and shutterbugs.

Clouds of mallards and other ducks crowd the river and nearby fields during migrations, too, drawn by the abundance of large acreages of irrigated grain crops in the Yellowstone Valley.

Bald eagles and other bird species also use the Yellowstone as a temporary home, each spending time along the river for a different reason; each requiring different foods, resting places and degrees of isolation and security.

The interrelationships of these birds with the Yellowstone may change soon. Energy exploration, water exploitation and pipeline and transmission line construction in southeastern Montana could spell trouble for the nesting geese and ducks, migrating flocks of all species and solitary bald eagles.

Canada geese inhabit the Yellowstone Valley all year long and at certain times are the most abundant waterfowl on the river. Since geese are believed to be the most common water bird breeding on the lower Yellowstone, they were the principal subjects of a two-year fish and game dept. study funded by the Old West Regional Commission. Ducks and other large water birds that live in the valley also were observed to determine the effects of potential water withdrawals on many of the migratory wild fowl.

About 450 pairs of Canada geese nest on the Yellowstone within the area from Billings to North Dakota. Pairs usually begin to build their nests between mid-March and late April.

In the Yellowstone, geese prefer to nest on islands; nests are uncommon where no islands exist. However, an abundance of islands is not always correlated with a profusion of geese. Many small, open islands exist in the Yellowstone above the mouth of the Bighorn River; yet there aren't as many geese there as in some stretches of the Yellowstone where islands are less common. Apparently, many of the small islands in this section are not sufficiently isolated from the main banks to afford geese the security they require for nest building.

Favorite goose nesting islands, where nests sometimes are only a few feet apart, offer easy meals for predators—*if* these hungry hunters can get to the islands. On an island downstream from Miles City, 13 pairs of geese hatched broods in 1975. In 1976, raccoons hunted the island early in the nesting season and destroyed most of the eggs that had been laid. Later, eggs were laid in three more nests; two clutches hatched.

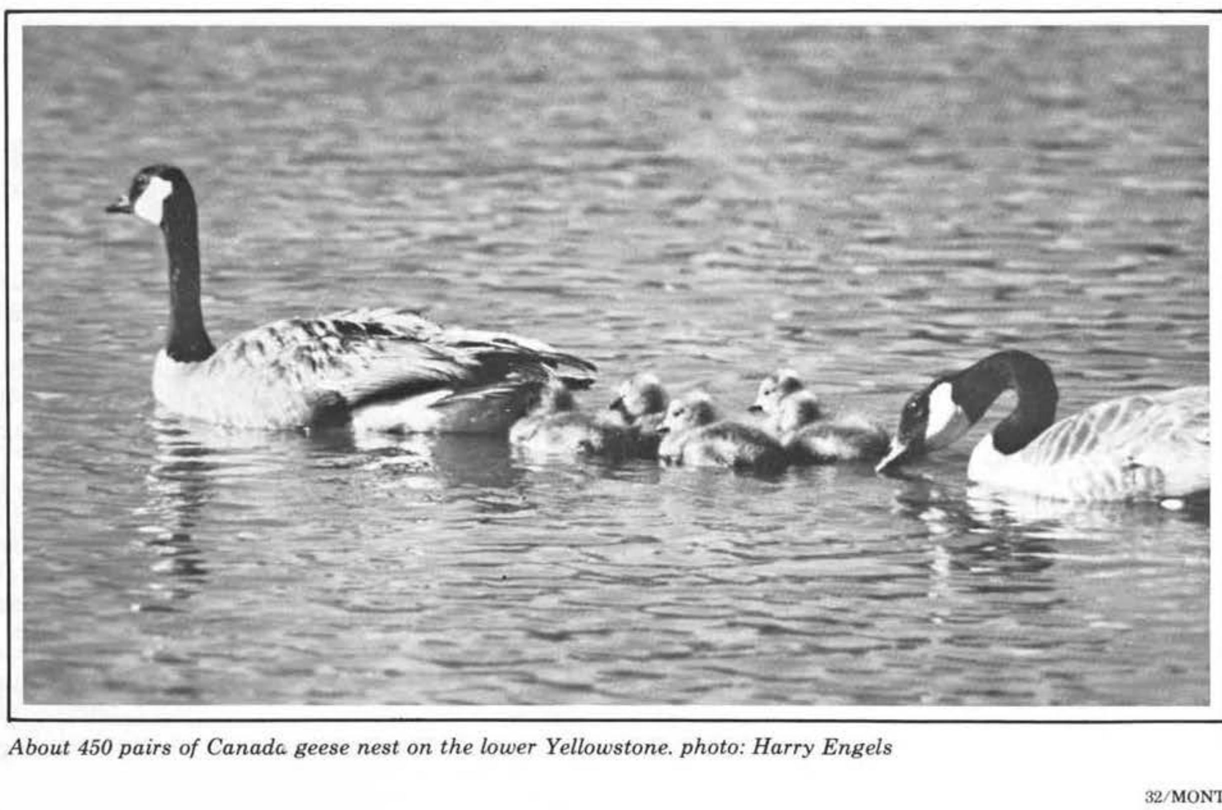
Lower flows in the Yellowstone in early spring 1976 apparently provided the raccoons with easier access to the island.

Large numbers of Canada geese, as many as 10,000 in fall and 16,000 in spring, stop on the lower Yellowstone during migrations. These geese rest on secure islands where corn, wheat and barley fields lay nearby. Pastures and hayfields also provide feeding and resting areas and flocks commonly are seen in these fields during migrations.

Mallards and other dabbling ducks are drawn to the Yellowstone by its islands and nearby agricultural lands. Field-feeding mallards seem to prefer picked cornfields. Most diving ducks loaf on the river for short periods on their way to northern breeding grounds in the spring and to southern wintering areas in the fall.

Fourteen great blue heron rookeries with more than 400 breeding birds were observed in the study area at the beginning of the nesting season in spring. Herons feeding along islands and banks near these nesting areas use fish, including goldeyes, river carpsuckers and minnows, as their principal food source.

White pelicans and double-crested cormorants



About 450 pairs of Canada geese nest on the lower Yellowstone. photo: Harry Engels so eat fish from the Yellowstone during summer. In '75 and 1976, no known successful nestings of these species occurred in the study area. Pelicans arriving spring live and fish along the Yellowstone primarily downstream from Miles City near the mouth of the owder River, and below the dam at Intake, 17 miles ortheast of Glendive. Numbers of pelicans and ormorants on the river decrease at the outset of older weather in fall.

Late fall, winter and early spring are the times to ee the most bald eagles in the valley. One pair efended a nesting territory near Hysham during oth years of the study, but apparently did not rear young either year. More than 100 adult and juvenile eagles were counted during peak migration periods and several individual birds were seen along open sections of the river throughout the winter.

Bald eagles along the Yellowstone primarily feed on carrion, including livestock and deer carcasses. Although bald eagles frequently were observed diving at flocks of ducks, no captures were witnessed.

Even though the exact impacts are uncertain, water withdrawals that alter the structure of the river channel and islands are likely to harm waterfowl that nest on the river's islands. Flow reductions would lower, narrow or eliminate channels that separate nesting islands from the large, vegetated islands and banks where predators, livestock and agricultural activities are present. This would increase stress on waterfowl.

Temporary lowering of the river's water levels could produce more successful fishing for the fish-eating birds, including bald eagles, but the consequence of long-term water reductions probably would be a permanent loss of fish habitat. This would lower the numbers of fish present and make fishing less productive for these birds.

Common goldeneyes and mergansers, which feed on aquatic plants and invertebrates, also probably would benefit from short-term flow reductions, but would suffer if loss of habitat for their food species should occur.

Lower Yellowstone Fishery

by Larry Peterman

You're about halfway through a float trip down the Yellowstone, pushing off again at Custer to navigate another day toward the confluence of the Yellowstone and Missouri rivers.

You began at Gardiner, had a few tense moments trying to stay upright through Yankee Jim Canyon, and later bobbed past Livingston and Big Timber. The trip through the blue ribbon reach was a fast float over crystal clear water alive with trout and whitefish.

You pushed on past Reed Point, Columbus, Laurel and Billings and noticed a subtle difference in the river's character. The water is murky, so you couldn't see the change in fish species from the upper river. In this part of the Yellowstone live ling, sauger, goldeye and, below the Huntley diversion, a few channel catfish. This is the transition zone where the aquatic ecosystem changes from a cold to a warm water environment.

As you pass the mouth of the Bighorn River, you enter the reach known as the lower Yellowstone, which is different from the upper river in size, shape and character.

As the river's physical character changes, so does the aquatic biota. Trout and whitefish, so common in the upper reaches, rarely exist in the lower river. Niches for whitefish are filled by goldeye; trout are replaced by ling, walleye, sauger and northern pike. Fish diversity increases to about 45 species compared to 17 species recorded for the upper river. There are fish as primitive as the paddlefish and shovelnose sturgeon, as rare as the pallid sturgeon, as unusual as the blue sucker and as popular as the walleye and sauger.

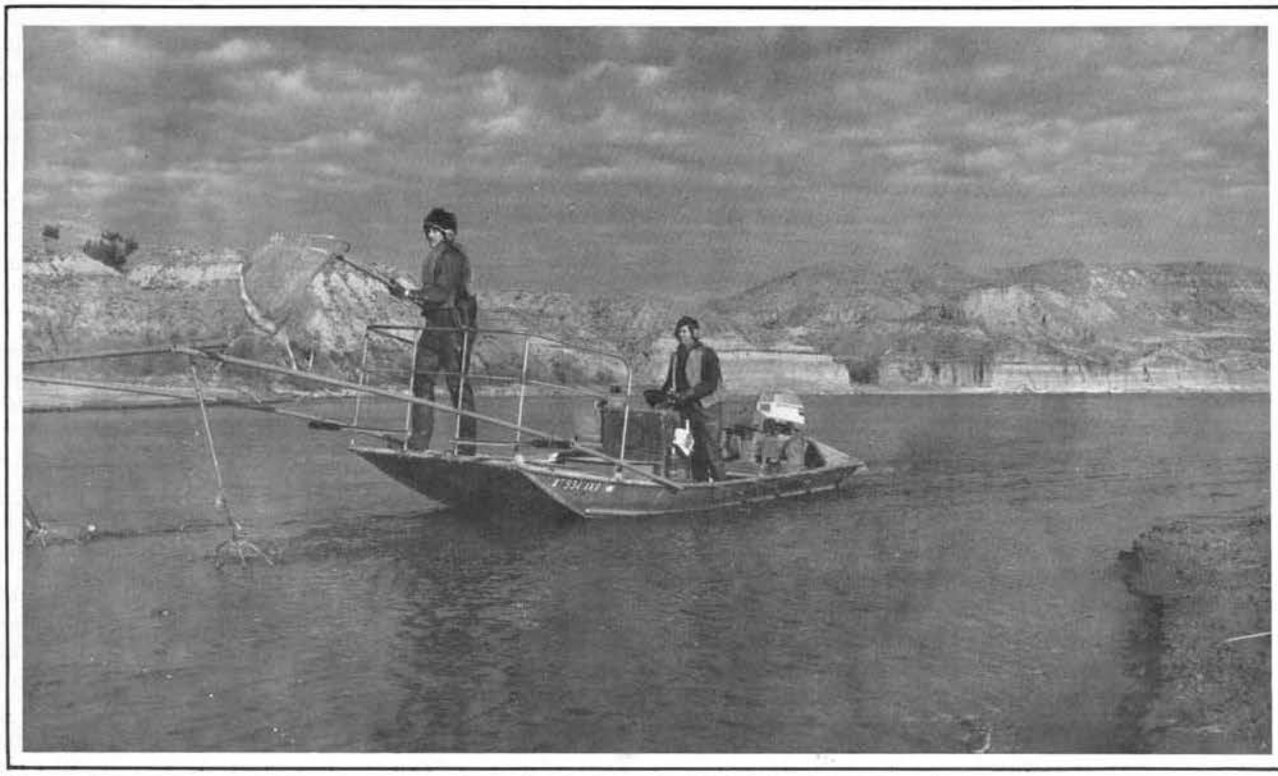
Primitive characteristics developed in eons express themselves well in some species. Sturgeon have bony plates instead of scales, suction-like mouths instead of jaws and teeth. Paddlefish have cartilagineous skeletons, shark-like tails and notochords—rod-shaped, elastic cell structures that develop into unsophisticated spinal chords.

Just above Miles City, you meet a strange flatbottom craft with a jet outboard motor. From booms sticking out of the bow, metal electrodes dangle in the water. Steel tentacles hang off each side and a generator putts away next to the driver. It's an electrofishing boat designed for a lower river fisheries study funded by the Bureau of Reclamation.

The study was initiated several years ago after the prospect of large industrial water demands posed a threat to the resources known collectively as the lower Yellowstone. This portion of the river is large and seasonally turbid. Its flows fluctuate greatly and portions of it have moderate to high current velocities. Because the diversity of the river makes capturing and studying fish difficult, the researchers had to devise methods and equipment to catch a wide variety of fish. The electrofishing boat is one tool they use in addition to an assortment of nets and traps.

These researchers have been answering questions about fish, including shovelnose sturgeon and sauger and have contributed to our basic information about where they live, what they eat, how far they travel and, in some cases, where they reproduce.

It happens to be lunchtime, so you join the



Researchers net fish for tagging from an electrofishing boat. F&G photo: Richard Landers

researchers with your sandwich and get the scoop on the lower Yellowstone.

The diversion dam at Forsyth, they tell you, is the upper limit in the river for the shovelnose sturgeon. The shovelnose sucks up aquatic insects—its main food—like a vacuum cleaner, while gills filter out the less palatable debris. These fish prefer main channel areas with strong currents. Spawning occurs during high water when they ascend the Tongue and Powder rivers in large numbers. The average size of shovelnose in the Tongue spawning run is 5 pounds, but there are records of fish up to 15 pounds. That's large compared to shovelnose in other sturgeon waters where they average 2 to 3 pounds and seldom grow larger than 6 pounds.

Sauger inhabit the lower Yellowstone, too, but their life requirements are different. They rely on aquatic insects for food only during the first year of life. As adults, they feed primarily on forage fish. Sauger live not only in main channel areas, but also in backwaters and sloughs. Apparently they are attracted by the large number of forage fish inhabiting backwater areas.

Sauger spawn before the high water period, sometime during April and May depending on weather conditions. They spawn below the irrigation diversions and in the Tongue and Powder rivers. They probably spawn in other areas, too.

Although a lot of work remains to be done, enough information has been gathered to begin predicting impacts of potential large-scale water withdrawals from the Yellowstone.

Soon you are drifting past the mouths of the Tongue and Powder rivers, two important tributaries of the Yellowstone. They are the rivers most likely to be affected by future water development projects, simply because they don't have much water. Lower reaches of both tributaries are spawning areas for a segment of the Yellowstone sauger and walleye populations. If too much water is taken from these rivers, reproduction for a portion of the Yellowstone fish populations will be affected.

Just as the Tongue and Powder rivers are tributaries to the Yellowstone, the Yellowstone itself is a tributary to the Missouri River and Garrison Reservoir. Recent studies indicate that in early spring walleyes from the upper portion of Garrison Reservoir migrate up the Yellowstone and congregate to spawn below the diversion dam northeast of Glendive at Intake. Following the walleye, the paddlefish make their annual spawning run. Significant flow reductions prior to and during the high water period could affect the migrations of both species.

All fish have certain habitat requirements. The two types of habitat most likely to be affected by flow reductions during late summer, fall and winter are riffle areas and backwater or slough areas. Riffle areas would be reduced in size; backwaters would shrink or be lost entirely.

If backwater areas are diminished, a portion of the sauger habitat would be eliminated. Shovelnose are main-channel fish, so they don't use backwaters; however, they feed almost exclusively on aquatic insects, which live primarily in riffles. Water withdrawals would reduce riffle areas and subsequently would reduce the food supply for the shovelnose.

The amount of water taken from the drainage is one consideration in preserving the lower Yellowstone fishery; the methods of removing that water pose still another. You can either pump water out or build a cross-stream dam and divert water into a canal. If future water withdrawal systems use diversion dams, impacts on fish movements must be considered. Movement studies show that under adequate flow conditions, sauger can negotiate the major irrigation dams on the lower Yellowstone. On the other hand, such dams restrict shovelnose movements.

Predicting impacts of water development projects on the aquatic resources is a major part of the fishery work in this area. Only a few impacts have been considered. Many more species and different effects are yet to be examined.

After you've pulled the canoe out of the water near the historic site of Fort Union, beaming with the pride of a newly accomplished river rat, all this studying and predicting might seem trivial. But the decisions to allocate water for future use in the Yellowstone Basin may well represent an irreversible commitment of resources.

An environmental statement is required by law to see that the effects of development are known before permanent damage is done to the fish populations of the lower Yellowstone. But it goes further than that.

We are living in an area faced with increasingly scarce supplies of non-renewable and renewable resources: natural gas, crude oil, non-fuel minerals, water, fish and wildlife. Before decisions can be made for the best use of our remaining resources, we must know all of the available facts and possible consequences.

In some cases, minor changes in plans can be made to avoid or minimize adverse impacts. If future impacts are deemed to be too great a sacrifice, the projects might be scaled down drastically or abandoned. If the projects are finally considered necessary at all costs, we can proceed. But at least we will be fully aware of the consequences of our actions, and fully responsible.

Tributaries Design The River

by Al Elser

The Yellowstone River is what its tributaries make it. So preserving the lower Yellowstone means protecting the integrity of its major contributors.

Rosebud Creek and the Tongue and Powder rivers have contributed nobly to the Yellowstone and the richness of Montana history. It was along the Rosebud that Custer marched his troops that fateful June in 1876. Indians fought whites near the Rosebud and in the Tongue River Basin, too.

In February 1877, Fort Keogh's log walls began to rise at the junction of the Tongue and Yellowstone rivers. The fort was a mission to avenge those who died on the Little Bighorn and bring peace to the frontier.

The cattle industry took hold in both basins about 1880 and, with the loss of the area's bison in 1882, the government was forced to purchase beef to feed the Indians on the reservations.

The Powder has been described as "too thick to drink and too thin to plow; a mile wide and an inch deep." Capt. William Clark named the river the "Red Stone" when he reached its mouth July 30, 1806. He wasn't impressed with its water quality and crossed to the banks of the Yellowstone to spend the night.

Today, these streams—the major branches of the Yellowstone from its confluence with the Missouri upstream to the Bighorn River—provide water for man, livestock and crop lands. The Rosebud, Tongue and Powder are becoming even more vital as coal and energy development proceeds in eastern Montana.

Rosebud Creek faces extensive development because it is underlain by coal. The stream is threatened by activity on the land and in the air:

- Colstrip mines 2-5 miles away are on an underground watershed that naturally flows into the Rosebud.
- The wind at Colstrip generally blows to the southeast; consequently, gases and particulates in the plume of Colstrip Units #1 and #2 usually will be dispersed toward the Rosebud.

In essence, the river likely will receive water that has been in contact with mine spoils and power plant ash, and will be affected by the smokestacks' plume.

In October 1975, researchers began to evaluate the aquatic communities of Rosebud Creek. Funded by the Water Quality Division of the Environmental Protection Agency (EPA) and administered by the Fisheries Bioassay Laboratory at Montana State University, the study was completed in November. It inventoried the aquatic populations of Rosebud Creek, determined species composition, distribution, diversity and abundance, and evaluated and predicted the potential impacts of proposed coal development.

Researchers found that while nonsport fish are most common, sport fish also exist in the Rosebud. Northern pike have been found throughout the drainage and brook trout have been taken upstream near Kirby. Sampling has shown that sport fish move out of the Yellowstone into the lower reaches of the Rosebud, which they apparently find suitable for spawning. Sauger, walleye, channel catfish and nonsport fish migrate into the Rosebud in spring.

Fish population data will help evaluate changes in the aquatic plant and animal life as coal mining and conversion is carried out in the drainage.

Strip mining began in Montana's Tongue River drainage in 1973 when Decker Coal Co. began operations on the banks of the Tongue River Reservoir. In 1975, Decker produced about 9.25 million tons of coal. Production will jump to more than 20 million tons annually if two proposed extensions are approved by the Board of Natural Resources and Conservation.

Additional development seems inevitable. The Decker-Birney Resource Study of April 1974 identified strippable coal reserves underlying 359,333 acres of the Tongue River Basin. Energy companies have also planned industrial uses for Tongue River water.

The Tongue River study has sought to identify what each fish species in the river needs for survival and to evaluate the effect of Decker mining on fish populations in the Tongue River Reservoir.

Data obtained from this study—primarily concerned with sauger, shovelnose sturgeon, paddlefish, blue suckers and channel catfish—will provide defendable minimum flow recommendations for the Tongue River and establish flow criteria for the warm-water fish species of the prairie streams.

Continued surveillance of Tongue River Reservoir fish populations is necessary so changes associated with coal mining can be detected. The Tongue River Reservoir cooperative studies are funded by the Old West Regional Commission and the EPA and conducted by the fish and game dept. and the Montana Cooperative Fisheries Research Unit at MSU.

Decker is cooperating, too. Its efforts range from a complete limnology study, which measures chemical, physical and biological properties of the reservoir, to development of a northern pike spawning marsh using effluent water. The proximity of Decker's mining to the reservoir is ideal for evaluating the impact of strip mines on the aquatic system.

The Powder River also is threatened by coal mining, but researchers there are analyzing the effects of water withdrawals for coal conversion complexes. In the late 1940s, the Bureau of Reclamation designated a reservoir site at Moorhead, 3 miles north of the Montana-Wyoming border. According to the plans, the dam would be used primarily for irrigation; industrial use would be minor.

In 1974, however, Powder River water was sought by two energy-related firms. Intake Water Co. filed with the Dept. of Natural Resources and Conservation for 318,700 acre-feet per year, and Utah International requested 72,400 acre-feet per year. Both companies plan storage facilities primarily for industrial use.

A three-year study to determine the effects on the Powder River of an impoundment and large-scale water withdrawals was begun in 1975 with funds from Utah International. Samples were taken throughout the drainage to determine, as in the Rosebud studies, the species composition, distribution and diversity of resident fish populations.

Migrant fish populations were monitored during spring to assess the importance of fish movements from the Yellowstone River to the Powder. Sauger, shovelnose sturgeon and channel catfish were found moving into the Powder in large numbers. Paddlefish were not taken during their spring migration, but anglers maintain that the fish move into the Powder at that time each year.

Movements of these migrant fish will be important in recommending discharges from an impoundment.

Water controls all activity in this semiarid region. The industrial future of the Fort Union coal fields is no exception. The nature and extent of development depends on the quantity of water available at the mine site. Withdrawal of large volumes of water from Great Plains rivers and streams will require storage facilities and diversion structures certain to affect the flow patterns and associated aquatic communities.

These studies on the branches of the Yellowstone are necessary to evaluate the influence of the energy industry on fish populations. To some degree, what happens to its tributaries also happens to the Yellowstone itself.

Furbearers On The Yellowstone

by Pete Martin

Beaver in the Yellowstone Basin are almost completely dependent on the river for their livelihood. This study, sponsored by the Old West Regional Commission, is assessing the impact of altered river flows on beaver and three other furbearers that exist in the prairie river system: mink, muskrat and river otter.

Of the beaver caches observed in the Yellowstone Valley, 88% were on the river. The other 12% were found in irrigation canals or sloughs. Mink and muskrat live in proximity to the river, but mink are able to move away from it and muskrats prefer to live in marshes. Few river otter inhabit the study area, which includes the Yellowstone from Big Timber to North Dakota, the Bighorn River from Yellowtail Dam to the river's mouth and the Tongue River from the Tongue River Reservoir to the river's mouth.

The Yellowstone supports a higher density beaver population than the Tongue and Bighorn rivers, which are regulated with dams. The braided sections of the Yellowstone, with many islands and abundant willow and young cottonwood stands, characterize the best beaver habitat. The poorest habitat has only one water channel with few or no deciduous trees or shrubs. The Bighorn and Tongue rivers appear to have fewer braided sections than the Yellowstone, which could account for their lower beaver population densities.

All three rivers seem to have beaver populations larger than at any time since records were begun in the early 1950s.

Trapping is important to the economy of the Yellowstone Basin. Nearly a quarter of a million dollars was paid to local trappers in the 1973-74 season. The average trapper earned more than $1,400. Beaver, mink and muskrat skins accounted for about 20% of this average income, but beaver was the most important water-related furbearer, accounting for 13.5%.

Yellowtail Dam has had a harsh effect on Bighorn River habitat. According to counts made from aerial photographs taken before and after the dam was built, the number of island gravel bars decreased by 51%, from 619 to 301. This amounts to 77% loss in island gravel bar area, or more than 1,400 acres. The most severe losses were in the river section closest to the dam, where 86% of the island gravel bar area was lost. Lateral gravel bars, all those situated next to the mainland bank, also were severely altered.

Vegetated islands provide prime beaver habitat in a prairie river system. The dam reduced the number of these islands by 31%, from 414 to 287, and 23% of the island area was lost, or 1,470 acres. With fewer islands, there are fewer intermediate waterways where beavers build caches, dams and lodges.

Water reductions also threaten beaver by eliminating waterways and joining islands with the mainland. Even though the riparian area (land along the river banks) remains fairly stable, when islands become part of the mainland, they become accessible to man and livestock and their value for protective cover is severely degraded.

Reduced flows during winter can directly influence furbearers by allowing beaver caches and muskrat beds to freeze, making them inaccessible. Entrances to lodges and bank dens could become exposed, making the furbearer vulnerable to predation. The entrances could be frozen shut and the animal could be trapped inside to starve.

Major flow reductions could encourage beavers to build more dams, which would trigger several other reactions:

- Beaver would reduce their food supply by making extensive additional cuttings of cottonwood trees and willow stands.
- The resistance of the banks to erosion during the spring high water period would be weakened.
- Habitat would be reduced for other wildlife species, including deer, game birds, song birds and raptors (birds of prey) which use cottonwoods and willows for nesting, perching and protective cover.

Increased winter flows might wash away beaver and muskrat food caches. These furbearers then

Beaver are dependent on the river for their livelihood. photo: Jon Cates would have to make a new stockpile, exposing themselves to the elements and to predators.

The indirect effects of flow alterations could be longer lasting and more dramatic than these direct effects. Regulated rivers are deprived of peak flows necessary to form new islands and gravel bars. The reservoirs collect sediments behind the dam and release clear water downstream. But the clear water regains its original sediment load, causing channel degradation. This degradation eliminates many of the existing islands and gravel bars.

Willow, the primary food for beaver, is usually the first plant to occupy areas of deposited sediment and gravel. If existing islands and gravel bars are eliminated and no new ones are being formed, the willow will be the first plant to disappear.

More than destroying potential cache, lodge and dam sites, alterations of the free-flowing Yellowstone would in time destroy much of the beaver's food supply. This would clearly spell the demise of beaver populations and a decrease in populations of other furbearers as well.

Ground Floor Information

by Loren Bahls

The Yellowstone is a three-story river. On the top floor are the carnivores, the fish and the fish-eating birds and mammals. On the middle level are the herbivores, the spineless little animals that graze vegetation and serve as fish feed. At ground level are the producers, aquatic plants that convert sunlight and raw materials into carbohydrates. And in the basement, without much need for light, work the decomposers, the microbes that recycle dead plants and animals.

The ground floor is a good place to start an analysis of a freshwater ecosystem like the Yellowstone. Aquatic plant samples were collected at 20 sites along the river by fish and game dept. employes engaged in fish and invertebrate research. Altogether, 240 samples were collected and inspected.

The significant producer in the river is algae, a simple, usually microscopic plant attached to the river's bed. The algal flora is dominated by two groups: green algae and diatoms. Diatoms, the most diverse group, are single-celled, golden-brown creatures enclosed in glass cases.

Collectively, algae are the end link on the chain of food leading to fish. They help aerate water and recycle nutrients, and because they use dissolved minerals in their nutrition, they are much more sensitive to chemical pollution than invertebrates or fish.

Blue-green algae, the ones that cause "blooms" in eutrophic (shallow and nutrient-rich) waters, are not a significant component of the Yellowstone's algal flora. A recent study near Billings by the Department of Health and Environmental Sciences confirms that the Yellowstone is not eutrophic. But the river is naturally fertile and, with human intervention, the potential for eutrophication is there.

Among the river's sources are naturally heated mineral springs in Yellowstone Park. These warm, clear, nutrient-rich waters are partly responsible for the productive blue ribbon trout fishery in the upper river. Cottonwood trees and other terrestrial plants along the river also contribute to its fertility. Leaves and twigs that fall into the water are either decomposed by bacteria into their basic mineral components, which are incorporated into the aquatic food web by algae, or they are recycled directly into the system by shredders, aquatic insects with nasty mouthparts.

But what would happen if a dam were constructed on the river, or if flows were decreased without stabilization? The algae provide a clue.

The principal non-diatom alga of the Yellowstone River is *Cladophora*, commonly cursed as "seaweed" by luckless fishermen. It is a conspicuous, long, stringy plant that often becomes a nuisance in response to nutrient enrichment and stabilized flows. But it also may provide food and cover for the invertebrates that serve as fish feed. *Cladophora* is found all over the world, making it, perhaps, the algae's counterpart to the dandelion.

In Montana, luxuriant growths of *Cladophora* are found in the East Gallatin River below the Bozeman sewage treatment plant and in the Bighorn River below Yellowtail Dam. Given this alga's ecological requirements and its performance in response to altered flow patterns on other rivers, it is expected that major water withdrawals without flow stabilization probably would lead to a decline in *Cladophora*, along with invertebrates and valuable sport and forage fishes.

On the other hand, an impoundment on the Yellowstone would enhance the production of *Cladophora* immediately downstream.

Yellowstone Reservoir (Bighorn Lake) is a good example of what probably would happen upstream from an impoundment on the Yellowstone. The flooding of rich alluvial soils and slower flows of warmer and clearer water triggered massive blooms of blue-green algae immediately after Yellowtail was filled, even though blue-greens were probably insignificant in the Bighorn River before the dam was built. Following impoundment, the Yellowstone's naturally fertile waters would assure a rerun of the Yellowtail episode.

The Yellowstone is also a three-legged river. The first leg, roughly from Yellowstone Park to Columbus, has cold, clear, relatively shallow water with a firm rocky bottom that is regularly bathed in sunlight. Conditions here favor luxuriant riffle communities of attached algae and invertebrates. These riffles serve as food factories for the upper Yellowstone's blue ribbon trout fishery.

The middle leg, from Columbus downstream to about the mouth of the Bighorn, is a transition zone for algae and other aquatic life. Here the river picks up larger amounts of silt and nutrients from both natural and cultural sources, the water becomes murkier, and the bottom less firm and less stable. The algae often encounter loose footing, hence they often become detached and free-floating. Downstream through this section the cold water salmonid fishery is gradually replaced by a warm water fishery typical of a plains river.

In the final leg down to the North Dakota border and the river's mouth, the water usually is so muddy and the bottom so dark and unstable that most algae are free-floating, although they were once attached to the bottom upstream. Analysis of both plankton (free-floating) and benthos (bottom) habitats confirms that there is little distinction between these two algal communities; most varieties are common to both habitats. The bulk of the free-floating algae are weakened benthic forms that have been detached from their moorings. Unlike lakes and larger, slower-moving rivers, the Yellowstone sports only a handful of truly planktonic algae, even at its lower end.

What do these findings mean in terms of overall river ecology and management?

Normal seasonal flow variations are necessary to maintain algae populations in a healthy balance. Flow regulation by impoundment could mean blue-green algae blooms above the dam and nuisance growths of *Cladophora* below. Unchecked water withdrawals and a greater divergence between maximum and minimum flows could cause a significant decline in algae populations and stream productivity.

Considering the Yellowstone as a system, the upper leg is the most critical segment in terms of production. Nutrients contained in plants and animals produced in upstream riffles may be recycled many times over before the river discharges into the Missouri. Therefore it is most important to maintain normal flows in the upper river. Of the Yellowstone's three legs, it would be the worst possible place to put a dam.

Leaves and stems of shoreline plants, particularly cottonwood trees, appear to supply a significant amount of energy and nutrients to the river. Therefore, anything that affects the streamside vegetation, including harvest of cottonwood trees, would likely affect the aquatic community as well.

But there is still much to learn about the ecology of the river. How important are the cottonwood trees to aquatic production? Does plant growth occur to any great extent in the lower river, or do animals there rely primarily on plants produced upstream and delivered by the currents? Are attached or free-floating algae more important in the middle and lower segments of the river? How efficiently and in what manner are algae used by invertebrates and ultimately converted into fish flesh?

Answers to these and other questions are essential for intelligent management of this unique and priceless natural resource.

Ample Flows For Fish And Wildlife

by Larry Peterman

In the steamboat era of the mid 1880s, when daring captains maneuvered boats up and down the Yellowstone, the flow conditions of the lower river were considered virgin; the water was neither regulated nor diverted. It was free-flowing and had an average annual flow of between 11 and 12 million acre-feet (maf) of water at its mouth.

More than a hundred years later, the average annual flow of the Yellowstone is 8.8 maf, a 20% to 27% reduction from average pre-development conditions. But even though a great deal of water is withdrawn each year and many of the river's tributaries are dammed, the Yellowstone remains free-flowing. It's one of the last large rivers in this country that has escaped the rash of dams, locks, reservoirs and channelization projects that have plagued and ultimately destroyed the free-flowing nature of other great rivers.

Aquatic and terrestrial creatures, over thousands of years, adapted to the variations of flow, and populations fluctuated within limits set by the extremes of their environment. Average flow figures are useful for comparisons, but they mean little to aquatic populations. To the fish swimming in a pool near Sidney, it's critical that only a scant 4.2 maf of water flowed down the Yellowstone in 1961. That is 4.6 maf less than the *average* flow of 8.8 maf.

The seasonal and yearly variations in flow can cause fish, wildlife, farmers and other water users much grief, regardless of what the *average* is.

Fish and wildlife need their share of water. Every paddlefish and Canada goose can tell you that. But the Montana Legislature didn't recognize these needs until 1973, when it passed the Montana Water Use Act. This bill designated fish and wildlife as a "beneficial use" of the the river and established a system for beneficial users to reserve water. So, for the first time, the fish and game dept. had grounds to ask for water reservations for instream use.

This is the first of two important steps needed to maintain fish and wildlife in the Yellowstone. Next, while water is being allocated for other uses, ample flows must be reserved to meet the needs of creatures whose livelihood is sustained by the river.

Analyzing instream use of water is more complicated than, say, determining the numbers of fish in a stretch of river. Instream use also involves such things as water quality, hydrology, waterfowl production, recreation and water levels high enough to provide water for existing irrigation. Instream flow needs are different for each of these aspects.

The fish and game dept. has applied for a reservation of flows necessary to maintain the habitat and needs of fish and wildlife species found in the lower river. The department determined these needs during a three-year study funded by the U.S. Fish and Wildlife Service and with information from other studies described in this magazine. Flows have been requested for four time periods critical for natural biological functions and habitat preservation. The requested flows follow as closely as possible the natural flow patterns (high and low periods).

March-April—Waterfowl. These months are vital for Canada geese using the lower river for breeding. For security, honkers almost always use islands for nest sites. With adequate flows, islands generally are isolated from the mainland, offering protection from predators.

Since islands are made secure by high water levels, it is clear that nesting geese are less secure during low flows, when water depths and velocities in side channels lessen, providing predators easier access to the islands. Recent goose nesting studies indicate approximately a 30% increase in nest predation under low flow conditions, about 9,000 cubic feet per second (cfs), as compared to higher flow conditions, about 11,000 to 12,000 cfs.

Waterfowl researchers feel that flows significantly less than 11,000 cfs during the goose nesting period would be detrimental to production.

May-July—Paddlefish. Paddlefish are seasonal inhabitants of the Yellowstone. Spending most of the year in Garrison Reservoir, they swim up the Yellowstone in large numbers each spring to spawn. Researchers studying paddlefish agree that the height and the duration of the spring rise are two important factors influencing the distance and success of the spring paddlefish migration.

May, June and July make up the high-water period of the lower Yellowstone. June commonly has the highest flows. Rising river flows during May, the prelude to the high flows in June, tell paddlefish it is time to begin their upstream migration. The flows in May usually are high enough to allow partial passage up the river.

To reach Forsyth, where paddlefish traditionally end their migration, they first must negotiate an irrigation diversion dam at Intake, northeast of Glendive. By passing this diversion, at least an additional 166 miles of mainstem Yellowstone and two major tributaries (Tongue and Powder rivers) are made available for spawning. The peak flows commonly occur in June and allow this passage. Recent studies have determined that about 45,000 cfs is required for paddlefish to maneuver through a side channel that bypasses the diversion dam. It is important that this flow be maintained for the last three weeks in June to permit them to get by.

July commonly is characterized by decreasing flows. By then, the paddlefish have migrated upstream and have spawned. During the gradually decreasing July flows, adult and larval paddlers are able to migrate back to Garrison Reservoir.

The spring high water surge also helps form and maintain the river channel. High flows are necessary to start the river gravels (collectively called bedload) moving to form islands, gravel bars and shoal areas. Without the annual surge of high water, the processes of river building and rebuilding would diminish and the diversity of aquatic and wildlife habitat types would be reduced.

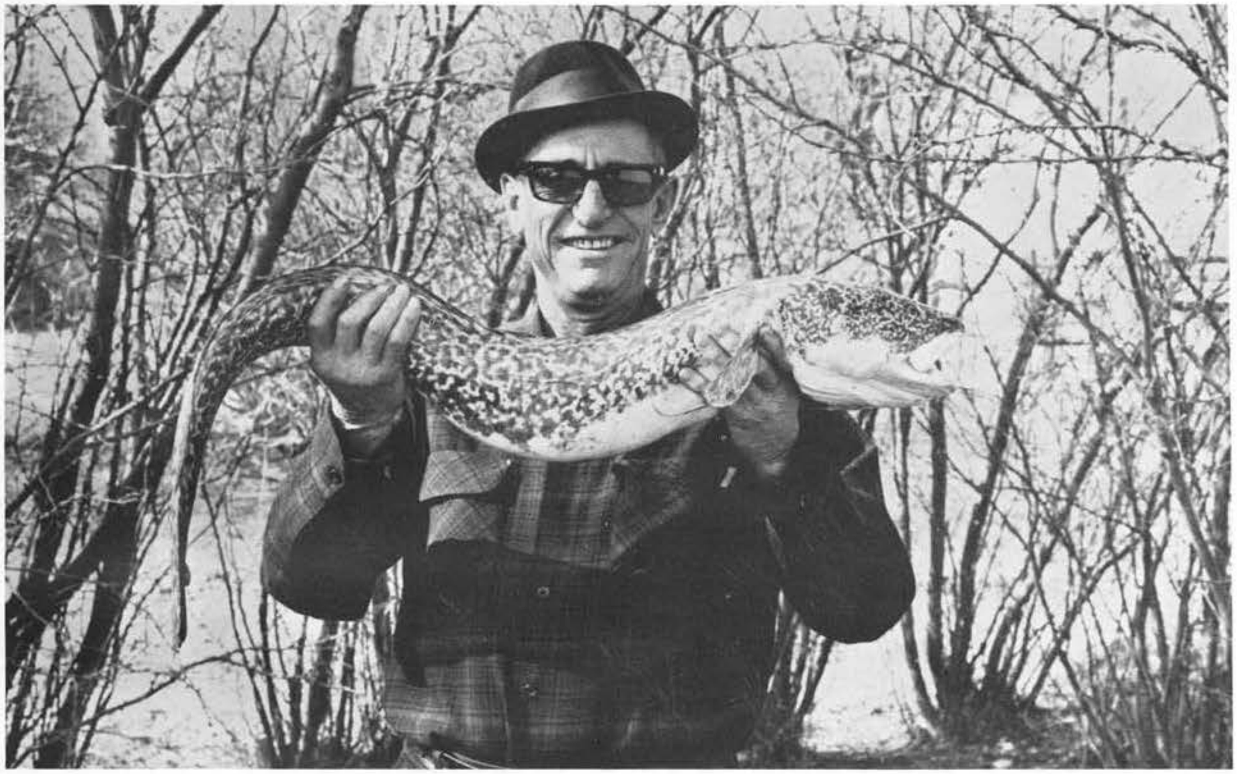
Leading hydrologists believe that the spring flood level reached on the average of two out of three years (called dominant discharge) is the flood flow required to maintain the existing river morphology (form and structure). The dominant discharge at Sidney is 52,000 cfs. The department reservation recommends that sometime during the last three weeks of June the river be allowed to peak at that flow and then revert for the rest of the month to the minimum flow required by paddlefish.

August-November—Rearing Flows. By August, the high flows of spring usually have subsided and the river enters the low-water period. Spawning for most fishes is completed, or nearly so, and the major activity for the next several months is simply growth. Adult fishes put on weight to withstand the rigors of winter. Recently hatched fishes and fingerlings merely try to survive and grow fast enough to avoid becoming someone else's supper.

The struggle of small fish to reach maturity is called "rearing" and is a primary consideration in requesting flows for late summer and fall. While many factors enter into the rearing of stream fishes, researchers consider an adequate food supply of aquatic insects to be of prime importance.

Aquatic insect production takes place primarily in riffle areas. Unfortunately, riffles also are the areas most drastically affected by low flows; impacts on pools are less severe. It follows that if the food-producing riffle areas are adequately covered with water, then the pools also will maintain suitable habitat and stream rearing will not be adversely affected. The department requested flows of 7,000 cfs for late summer and fall, enough to keep sufficient water flowing over the riffles.

December-February—Winter Survival. These months commonly have the lowest flows of the year. The habitat available to fish and their food organisms is at its lowest point. For aquatic populations, winter is the period of greatest stress and highest mortality. Many riffle areas (food produc-



The burbot is one of 45 fish species in the lower Yellowstone. F&G photo: Mike Aderhold

tion, remember) are affected not only by reductions in size, but also by the formation of anchor ice, which forms on the bottom in shallow water, kills aquatic insects when it freezes and scours the bottom when it breaks loose. Massive ice jams also occur, disrupting flow patterns and the river bed.

Oddly, when most fish populations are just trying to maintain themselves, the burbot (ling) chooses to "do its thing" during winter; it spawns sometime during January or February.

It appears that any significant depletion during the critical winter months could produce severe impacts on fishes and related aquatic life on the lower Yellowstone. The department believes that adequate protection can be provided by reserving the flows equalled or exceeded half of the time. In December, January and February, these flows are between 4,800 cfs and 6,000 cfs.

After going through the mathematical contortions of converting cubic feet per second to acre feet per year, the annual amount of water requested by the department comes out to 8.2 maf.

A substantial amount? Yes, but it's a substantial resource we are trying to maintain. The department is not asking for all of the Yellowstone's water. All existing water rights are guaranteed under the Water Use Act. The reservation in no way interferes with any existing, lawfully appropriated water right. Water reservations approved for irrigation districts and municipalities for future water use probably will not be affected. Those reservations most likely will depend on the date of approval.

Future water applications not covered under a reservation probably will be affected. We are at the point where significant additional water withdrawals during low-water years will profoundly affect not only aquatic resources, but all instream users. It is not a pleasant prospect, but certainly a possibility under the present piecemeal method of appropriating water.

To determine the future of the Yellowstone Basin water, we must realistically assess water availability, future water use and instream flow requirements. If consideration is given to instream water needs, future water users not covered under an approved reservation will be allowed to withdraw water only during those years or months when flows are greater than the specified instream needs.

Many different groups are interested in having adequate flows remain in the river. The fish and game dept. request is aimed at the needs of fish and wildlife. The Montana Department of Health and Environmental Sciences has submitted a reservation based on flows required to maintain the water quality of the river. Irrigation districts also are interested in having enough water remain instream to provide an adequate diversion for existing structures.

No flow reservation can guarantee that low water years, such as 1961, will not occur again. They probably will. Assuming climatic patterns do not change drastically, the department reservation, if approved, will insure that low flows will not occur more frequently or be significantly more severe than they have been in the past.

When you think about it, that's pretty important to just about everyone.

Time for a Decision

by James A. Posewitz

We still can seek an accommodation with nature and those forces that made the river what it is today, and in so doing, pass on to another generation at least one major river that still runs free.

The Yellowstone River can no more be described in terms of acre-feet discharge or cubic feet per second flow than can a virgin forest be described in board feet of lumber, a home in square feet of floor space, or the true measure of a man by his height and weight.

Statistics, numbers and data might seem to tell us something, but they really tell us little about a living and life-sustaining river. Numbers aren't apt to describe a ribbon of flowing water that changes with each season, yet continually performs essential tasks for an incredible array of living things—life forms necessary for our own survival.

The Yellowstone is best described by the living communities it sustains: the eagles that soar over its course in early winter searching for food, the cutthroat trout of Yankee Jim Canyon, the paddlefish spawning run at Intake, the nesting geese, the migrating ducks, the beaver and the deer. The river also is characterized by an angler floating a fly at the head of a riffle, a waterfowler waiting expectantly on a quiet backwater, a deer hunter stalking in a willow thicket, a nonhunter watching the systematic feeding of pelicans or enjoying the raucous confusion of a heron rookery. These things describe the river and what it means to Montana.

Preservation of a resource such as this free-flowing river is a complex undertaking. It requires understanding of the river and the needs of the many animal species that inhabit its water and its floodplain. It requires understanding Montana water laws and using them to secure protection for the water needed to sustain fish and wildlife. And it requires public understanding and sympathy for our cause.

What the Montana Dept. of Fish and Game is asking by applying for a reservation of Yellowstone River water is that we as a people make the sacrifices necessary to insure that this treasured resource is not depleted. If depletion can be prevented, the free-flowing character of the river can be sustained. On the other hand, if demands for consumptive use of Yellowstone water cannot be tempered, ultimate depletion is inevitable; the only question will be: When? At that point the mighty Yellowstone will be broken, just another dammed and regulated river.

Montanans still have one more chance to aspire to something greater. We still can seek an accommodation with nature and those forces which made the river what it is today, and in so doing, pass on to another generation at least one major river that still runs free.

To accomplish this, we have asked that a flow of water be reserved in the Yellowstone that resembles

the present natural flows of the river. Our reservation can do this, should it be granted by the Montana Board of Natural Resources and Conservation.

There are things this reservation can do and things it cannot do. For example, it has been calculated that the river is already 20% to 27% depleted by existing water users. A reservation of flows granted either today or in the future can in no way affect that present use or depletion. Existing rights cannot be altered; they are affirmed and protected by Montana's new constitution and by the 1973 Water Use Act. What it *can* do is affect new applicants for water use permits. They would have to respect the river water levels specified in our reservation, should it be granted.

Our reservation cannot restore flows or interfere with historic use. It *will*, however, help assure that the traditional users of Yellowstone River water will have less competition from future applicants for water and that the water flowing in the river will be of usable quality.

Unfortunately, even should the full amount of our request for water be granted, it would not guarantee protection for the river. Flow reservations by law must be periodically reviewed. Water could be appropriated from our reservation in the future if the Board of Natural Resources and Conservation found a future applicant's use consistent with the objective of our reservation.

A flow reservation cannot guarantee the river will not occasionally suffer from low flows. Low-water years have occurred in the past and, in natural order, will occur in the future. The impact of those low flows will be felt and endured by the fish and wildlife of the river. But our reservation can insure that this low flow condition does not become the common condition of the river.

By itself, a flow reservation cannot guarantee that no dams will be built on the Yellowstone mainstem, but it can help prevent depletion of the river. A case in point: If substantial water allocations are granted to developing industries, a permanent dependency on the flow of the river would be created. All would go well until the inevitable dry years come. The Yellowstone probably would be reduced to a trickle and the new residents and industry owners would be faced with two options, either close their thirsty operations or dam and regulate the river to assure their own future uninhibited by nature.

If severe depletions are prevented, the need for flow-regulating dams is certainly reduced, if not eliminated entirely.

Montanans have long shown a concern for the flowing waters of the state, and have acted when that resource needed protection. Montana passed the first stream preservation act of its kind in 1963, long before environmental protection became a popular cause. In 1975, this concept was broadly expanded and protection was provided for stream channels and banks. In 1971, the state's Water Quality Act was given the muscle it needed to insure that water pollution would be abated. In 1973, the Water Use Act was passed and we were one of the first states to provide a systematic procedure for allocating water for use by fish and wildlife.

In 1974, a three-year moratorium on permits for major water use in the Yellowstone was imposed to insure that time was available to assess flow requirements for the river. It provided an opportunity to protect those flows before major water use applicants removed that option.

The period of grace that moratorium provided ends in March; the moment of truth for the Yellowstone is at hand. While the work that went on during the moratorium was biological and the arguments offered are technical, the solution will be, to a great extent, political. It is a solution we all must share in developing. The solution concerns the future of the Yellowstone, which belongs to all of us.

Today, mid-winter 1977, the river is locked in ice, its surface frozen, its banks blanketed by snow, its fish and wildlife quietly enduring another winter in anticipation of spring—the time of rebirth and the beginning of a season of renewal. While the natural world lies frozen, the people determining its future are in debate as they sort through the mass of demands being made upon the river. Their technicians are feverishly working and reworking mounds of data.

Soon the Canada geese will return and their clarion call will announce spring 1977 as the river stirs once again, like it has a thousand times before. As the honkers nest, the sauger will return to selected gravel bars and spawn. Cutthroat will follow, seeking the right tributary so their kind can cling tenaciously to existence. In the dim waters 500 miles downstream, the ancient paddlefish will feel the surge of the rising river and respond to it as their ancestors might have responded 60 million years ago before being laid to rest on what are now the fossil beds of McCone County.

To the geese searching for the river island nesting site that will insure their species' future, and to the other living creatures of the Yellowstone, spring 1977 may appear to be just another spring. But to people engaged in this water allocation, nothing could be more misleading than to judge from the perspective of what can be seen on the river as fish and wildlife go about their traditional chores.

The decisions about to be made will have an impact second only to the basic geologic events that actually shaped this land. These decisions will direct the future of the Yellowstone. They will determine whether the Yellowstone will remain free or whether it will become just another dammed river. Don't let them be made without you.

CONTRIBUTORS

As you will read in "Monarch of the Yellowstone Basin," early Montana settlers didn't have the knowledge and foresight to treat the land sensitively, and today it's questionable that we are any better. **Ken Walcheck,** inspired by the history ingrained in the annual rings of a 200-year-old cottonwood, tells what man has done to the Yellowstone Basin and the stark truth of what is going on today. Walcheck is the department's information officer for the Miles City region. See page 2.

According to opinion polls conducted by Montana State University graduate students, Yellowstone Valley residents generally are cautious about development. Turn to page 10 to read "What People Think," by the department's regional information officer in Billings, **Bill Pryor.**

The Yellowstone River as it flows today does not have enough water to satisfy all future demands. On page 12, **Mike Aderhold** tells us about water: who has it, who wants it, who needs it—and what can be done to prevent fish, wildlife and existing water users from getting the thirsty end of upcoming decisions. Aderhold, the author of "Yellowstone Water: There's Only So Much," is the department information officer in Glasgow.

Man always has taken from the Yellowstone River, but rarely has he given anything back. As mighty as the Yellowstone is, only man can give what the river and its wildlife so desperately need: protection. **William H. Hornby,** a Montana native, has written "A River Is More than Water" to stimulate affection for the Yellowstone. Hornby has strayed from the Yellowstone River to Denver where he is the executive editor of The Denver Post. His column, "Yellowstone Notebook," appears regularly in the newspapers of Livingston, Miles City and Glendive. See page 19.

Using funds from various sources, the department has been conducting research projects in the Yellowstone drainage to determine the probable effects of increased water use and development on fish, wildlife and water-related recreation. It is primarily from research studies such as these that the department is able to justify its Yellowstone water reservation request to protect the river's wild ecosystem. In "Research: Here's Why" on page 27, **Bob Martinka,** an ecologist and project leader for the department's coal and energy studies, explains the researchers' role in protecting fish and wildlife. Martinka's article introduces nine reports on Yellowstone studies, written by the researchers.

"Upper Yellowstone Fishery," by **Rod Berg,** notes that an increasing demand for Montana's limited freshwater supplies could ruin much of the blue ribbon water in the upper river. Berg has an M.S. in fish and wildlife management and has been working on this project for two years.

"The River's Migratory Birds," by **Tom Hinz,** says increased water withdrawals would allow predators to maraud and livestock to trample goose nesting islands. Hinz has an M.S. in fish and wildlife management and has worked full time with these bird studies for two years.

"Furbearers On The Yellowstone," by **Pete Martin,** reports that alterations of the free-flowing Yellowstone would severely reduce beaver populations. Martin has an M.S. in fish and wildlife management and has been involved in three studies concerned with wildlife and development in the Yellowstone Valley.

"Water Invites Recreation," by **Max Erickson,** cites evidence to prove that if we're not cautious about development, we could squander favorite recreational areas. Erickson has been researching with the department for two years to fulfill the requirements for an M.A. in recreational area management from Montana State University.

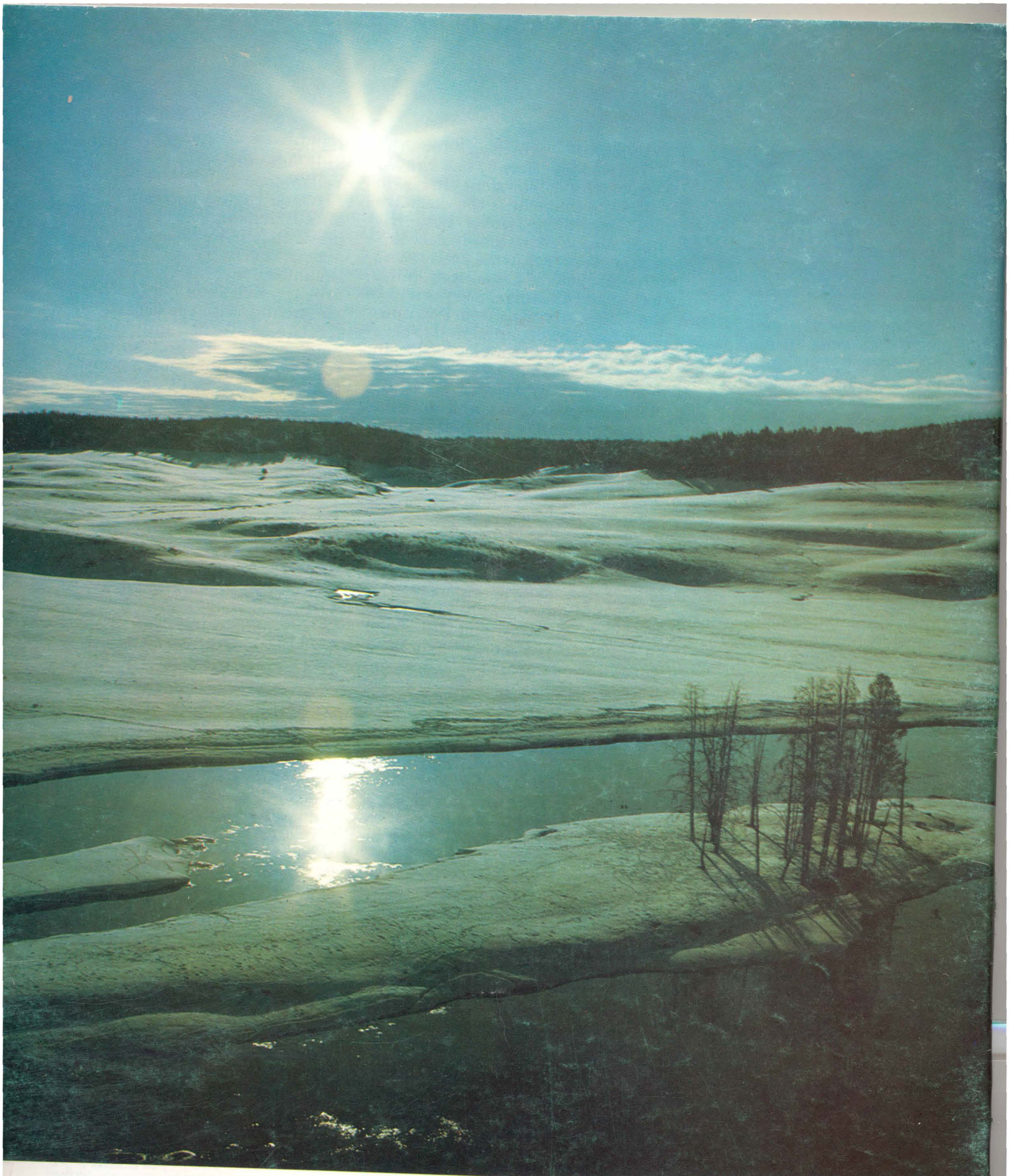
"Ground Floor Information," by **Loren Bahls,** tells us that algae are useful in predicting the effects of a dam on the Yellowstone. Bahls has a Ph.D. in botany and is the staff ecologist for the Montana Environmental Quality Council.

"Those Pesty Insects," by **Robert Newell** and **Dennis Schwehr,** explains that fish need aquatic insects, and aquatic insects require water. Newell has a Ph.D. in aquatic biology. Schwehr has an M.S. in biology. Both men worked on the insect study for two years.

"Lower Yellowstone Fishery," by **Larry Peterman,** points out the differences between the fish populations of the river's upper and lower stretches. Peterman, an aquatic planning ecologist, also explains in "Ample Flows For Fish And Wildlife," why it's important to just about everyone to protect the Yellowstone.

"Tributaries Design The River," by **Al Elser,** shows that what happens to its tributaries also happens to the Yellowstone itself. Elser is the regional fisheries manager in Miles City.

Montanans still have a chance to seek an accommodation with nature and those forces that made the river what it is today. **James A. Posewitz,** in "Time for a Decision," asks that we make the sacrifices necessary to prevent depletion of the Yellowstone. Posewitz is the department's environment and information division administrator. See page 42.



A RIVER IS MORE THAN WATER

—see page 19