The Yellowstone River

AN INSTREAM FLOW
ALLOCATION FOR THE
WARM WATER PORTION

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ABSTRACT

The national energy situation requires serious energy conservation measures and the development of a high degree of national energy self-sufficiency. Suggested as part of the solution to the energy problem is the utilization of coal reserves in the western United States. These states, primarily rural in nature, with sparse human populations and little industrialization, are also habitat for some of the nation's finest fish and wildlife populations. Unrestrained energy development seriously threatens that wildlife abundance.

Flowing through and providing a key element to coal and energy development in the northern portions of the Fort Union coal deposit is the Yellowstone River and its tributaries. The Yellowstone River has survived as one of the last large, free-flowing rivers in the continental United States. Lack of mainstem impoundments allows spring peak flows and fall and winter low flows to influence a unique ecosystem and aesthetic resource. From the clear, cold water cutthroat trout fishery in Yellowstone National Park to the warmer water habitat at its mouth, the river supports a variety of aquatic environments that remain relatively undisturbed. The adjacent terrestrial environment, through most of the 550 Montana miles of river, is an impressive cottonwood-willow bottomland. The river has also been a major factor in the settlement of southeastern Montana, and retains much cultural and historical significance.

Montana has taken the legislative initiative in trying to protect its fish and wildlife resource and moderate the rate of development. Its legislation in many respects is model legislation and many of the new concepts now contained in Montana's laws may have application for other western states. Under the 1973 Water Use Act, state and federal agencies, as well as political subdivisions of the state, may apply to the Board of Natural Resources and Conservation to reserve water for existing or future beneficial uses, or to maintain a minimum flow, level, or quality of water. In March of 1974, the legislature imposed a 3-year moratorium on water developments over 20 cubic feet per second or 14,000 acre-feet storage in the Yellowstone Basin. The moratorium emphasized the need for reserving water in the Yellowstone Basin for the protection of existing and future beneficial uses of water. Particular attention was to be given to reserving waters for municipal and agricultural needs as well as guaranteeing minimum instream flows for the protection of aquatic life, water quality and existing rights.

The Department of Fish, Wildlife and Parks concentrated its efforts at determining instream flow needs on the lower Yellowstone where energy development and potential water demands were greatest. The department's request for the lower Yellowstone River at Sidney (Montana-North Dakota border) amounted to 8.2 million acre-feet (MAF). These flows were designed (1) to minimize nest predation on the Canada goose population, (2) to provide passage flows for the paddlefish spawning migration,

(3) to maintain the existing channel morphology, (4) to prevent excessive diurnal dissolved oxygen fluctuations, (5) to prevent dewatering of riffle areas, and (6) to minimize winter mortality.

After due consideration of all competing applications for reservation of Yellowstone Basin water, the Board of Natural Resources and Conservation granted the department 5.5 MAF of water at Sidney. The amount of water granted varies monthly and follows the shape of the natural hydrograph. The minimum instream flow granted on the lower Yellowstone can be expected to be equaled or exceeded on a frequency of approximately 85 years out of 100.

The establishment of minimum flows in the Yellowstone Basin by the Board of Natural Resources and Conservation should prevent furture depletions from further impacting the aquatic ecosystems during low water years. By tempering water demands in the lower basin, the threat of mainstem impoundment is minimized and the chances are enhanced for maintaining the Yellowstone River in a free-flowing condition.

Certain questions remain to be addressed. The division of tributary streams according to the Yellowstone Compact and the quantification of Indian rights may well affect the Yellowstone Basin. The resolution of these questions and the ultimate usage of that water will not affect the amount of the instream reservation granted per se; however, the priority of the above mentioned claims will affect the frequency with which the minimum instream flows will occur. This impact has not yet been addressed.

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INTRODUCTION

In the entire continental United States, few rivers remain unimpounded, essentially unaltered and in a natural free-flowing state. Most have been impounded for flood control, power generation or both. Many have had their physical stream channels altered and total channel length reduced. Others have become grossly polluted serving only as conduits for man's wastes; or dewatered to the point that the river simply ceases to exist. In the western states, a major threat to rivers and streams is dewatering.

Agriculture has traditionally been the major water user. The emerging energy industry, however, has shown significant potential as a major consumer of water. Our national thirst for petroleum and craving for energy of all kinds places new demands on the western coal fields as coal is looked upon as our energy ace-in-the-hole. Significant quantities of water are necessary in the production of energy as coal is burned for electricity, squeezed for oil and pulverized for transport.

Flowing through the Fort Union Coal Formation in eastern Montana is the Yellowstone River, expected to supply much of the water for the developing energy industry. The Yellowstone is free-flowing and essentially unaltered over its entire 650-mile length. The lower 300 miles are classified as a warm water river. To protect the Yellowstone from massive dewatering, instream flow protection was sought and secured. This is the chronicle of the efforts to secure an instream allocation for the warm water portion of the Yellowstone.

BACKGROUND

Montana is one of the few western states which has the legal framework necessary to allocate a portion of its surface waters to remain instream for fish and wildlife purposes. In a radical departure from common western water law, the enactment of the 1973 Water Use Act by the Montana legislature made the "Reservation Concept" an integral part of appropriation doctrine for allocation of water.

Prior to the 1973 Water Use Act, Montana functioned under the auspices of traditional western water law. The Doctrine of Prior Appropriation formed the foundation of earlier Montana water law, a doctrine best suited for promoting the maximum utilization of the state's water resources (Tarlock 1978). Under this law, the first use in time had the first use in right and water was dispensed on a first come, first served basis.

Montana operated under the "old" water law for over 100 years. During this time there was no legal means of securing instream flows for fish and wildlife and other uses and no recourse through the law when streams became severely dewatered. Two major obstacles in the old water law prevented securing instream flow protection for fish and wildlife. First, water could only be appropriated for a "beneficial" use and fish and wildlife simply were not specifically recognized as beneficial users of water. In addition, before water could be put to a "beneficial" use and appropriated, it had to be diverted from the streambed. Even if fish and wildlife had been considered "beneficial" users of water, the diversion requirement would have nullified an instream water appropriation effort.

The procedure for obtaining water rights did not contain a mechanism for denying anyone water based on environmental degradation per se. Even though all water rights are "subject to existing rights," the responsibility and burden of maintaining a senior water right rests with the senior right holders. As a result, several major rivers and many small streams and tributaries in Montana became severely dewatered through overappropriation and overuse. Under the old water use law, little could be done to protect instream values.

In 1973 Montana water law was completely revised. The resulting legislation was the Montana Water Use Act (Chapter 452, Laws of 1973 and codified as Sections 89-865 et seq.). This act contained several significant sections for the maintenance and preservation of instream flows for fish and wildlife benefits. The instream features of the act have assumed landmark significance in water planning and allocation efforts in Montana. No longer is water law strictly utilitarian; now it contains mechanisms for the recognition and maintenance of instream rights.

The 1973 Montana Water Use Act overcame two major problems which previously prevented fish and wildlife from securing protection for instream flows. First, Section 85-2-102, Montana Codes Annotated (MCA)[1] specifically defined fish and wildlife as a "beneficial use" of water. Second, a procedure was developed to secure water for instream purposes. No longer was it necessary to divert water before it could be put to a beneficial use. This procedure is contained in Section 85-2-316 MCA, commonly referred to as the Reservation Concept.

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[1] On January 12, 1979 the MCA replaced the RCM 1947 as the official codification of laws enacted by the Montana Legislature.

Basically, the reservation process allows for the allocation of the unappropriated waters of the state for future beneficial uses. The State or any political subdivision of the State or any agency of the Federal Government has the opportunity to reserve water. Waters may be reserved for existing or future beneficial uses or to maintain a minimum flow, level or quality of water.

The decision-making authority for approving, modifying or denying an application for reservation of water rests with the Board of Natural Resources and Conservation. An applicant desiring to reserve water must establish to the satisfaction of the Board four major items: (1) the purpose of the reservation, (2) the need for the reservation, (3) the amount of water necessary for the reservation, and (4) that the reservation is in the public interest. These items are debated and cross-examined at length through an adversary hearing process. The resulting record is then reviewed by the board and used as a basis for its decision.

The significance of the Reservation Concept to the fish and wildlife resources of Montana cannot be overemphasized. For the first time fish and wildlife as beneficial users of water may receive the protection and recognition of water law statutes. The agency responsible for and which receives the instream flow reservation has the opportunity to assume a protective role for fish and wildlife in the competition for unallocated surface waters of the state. No longer do the aquatic resources, recreational uses and other instream values have to accept merely what is left over after the diversionary uses have been satisfied; rather, the Department of Fish, Wildlife & Parks has the opportunity and, in fact, responsibility to actively seek protection and preservation for instream values.

Probably as significant as the Reservation Concept itself, at least from a practical standpoint, are the policy statements contained in the Montana Water Use Act. Policy considerations preface each chapter of the act and explain the intent of the law. The intent of the legislation is critical to the interpretation of the legislation itself. Section 85-1-101 MCA contains the policy considerations for the Water Use Act.[2]

Several of the policy considerations have a significant bearing on instream values. Subsection 2 promotes the conservation and development of the state's water resources to "... secure maximum economic and social prosperity for its citizens...." The inclusion of the word "social" adds a new dimension to the otherwise strictly utilitarian concept of water law and implies a social benefit to water.

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[2]At the time of this writing the Montana Legislature is considering amendments to this statute which will place maximum limits on instream flow reservations from a stream and prioritize reservations.

Subsection 5 specifically addresses the need for preservation of adequate supplies of water "... for public recreational purposes and for the conservation of wildlife and aquatic life...." This directly addresses the need for instream flows to maintain what can be termed "social values" as well as supporting the concept that wildlife in and of itself is to be protected and conserved.

An additional policy statement appears in Section 85-2-101 MCA. Significant in this policy statement is subsection 3 which encourages the utilization of the state's water resources "... with the least possible degradation of the natural aquatic ecosystem...." The intent of this statement is clear - streams and rivers of the state should not be depleted to the point where significant degradation to the natural ecosystem occurs. Again, this is a departure from the strictly utilitarian aspect of historic western water law. With this background, the Reservation Concept becomes an even more significant section of the Water Use Act.

While the 1973 legislature hammered out the specifics of the Montana Water Use Act, energy related events were about to occur in the Mideast which would profoundly influence the fate of the country itself. The Arab oil embargo emphasized our dependence on foreign crude oil, while at the same time, highlighted our reliance on all forms of energy. Energy self-sufficiency became a national goal and attention focused on domestic sources of fuel.

Suggested as a part of the solution to the energy problem was the utilization of the vast coal reserves of the western United States. The Fort Union coal formation underlies much of eastern Montana as well as portions of Wyoming and North Dakota. This formation contains an estimated 43 billion tons of economically recoverable coal in Montana (Matson 1974). The conversion of coal to more usable forms of energy requires significant quantities of water. The Yellowstone River and its tributaries are the primary source of surface water for coal conversion facilities in southeastern Montana. The development of the coal resources at the mine sites for electric power generation, synthetic gas, or liquid fuels will require diversion of water from the Yellowstone River and/or its tributaries and conveyance of aqueducts to the mine sites. Withdrawal of water from the Yellowstone River and its tributaries may require storage and diversion structures affecting the present flow regime and associated aquatic communities.

The early 1970's were a time of apprehension and concern in the lower Yellowstone basin. Energy-related reports such as the North Central Power Study (1971) and the Montana-Wyoming Aqueduct Study (1972) took a national "boiler room" approach to energy development in southeastern Montana. Coal leasing activities were proceeding at a feverish rate and competition for the region's limited water supply was intense. In addition to a number of industrial options for water from Yellowtail Reservoir, seven energy and water-marketing companies applied for over 1.1 million acre-feet of water annually from the main stem Yellowstone and its tributaries for industrial use.

Public sentiment ran heavily against the uncontrolled development of eastern Montana's coal resources and accompanying water depletions in the semi-arid plains. A legislature which had just struggled with instream concepts and water allocation procedures in the Montana Water Use Act reacted predictably and, in 1974, passed a law commonly referred to as the Yellowstone Moratorium. This law suspended all large applications (diversions of over 20 cubic feet per second (cfs) or storage over 14,000 acre-feet (AF)) for water use permits in the Yellowstone basin until March 10, 1977.[3]

The legislature noted that the widespread interest in Yellowstone basin water threatened the existing and future beneficial uses of that water, including recreation and wildlife and aquatic habitat. The language of the moratorium emphasized the need for reserving water in the Yellowstone basin for the protection of existing and future beneficial water uses; particular emphasis was given to the reservation of water for agricultural and municipal needs, as well as guaranteed minimum flows for the protection of existing rights and aquatic life.

The Yellowstone Moratorium held the line, at least temporarily, on gross depletions in the Yellowstone basin. At the same time, it specified a 3-year time period for the identification of future beneficial uses in the basin and the allocation of the water to satisfy those uses.

The series of events just described led to the urgent need for a quantification of instream flows for the entire basin as well as an assessment of the impacts associated with water withdrawals and associated diversion structures in the lower river. Since little biological work had been done in the Yellowstone basin, a major research effort was required to successfully capitalize on the new opportunities available for the protection of aquatic and wildlife habitats. The two major goals of aquatic research on the Yellowstone were: (1) to determine instream flow needs and support an appropriate application for reservation of flows, and (2) to assess the impacts of water withdrawals and associated diversion structures.

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[3]By amendment and court action, the moratorium was extended until December 31, 1978.

DESCRIPTION: THE YELLOWSTONE RIVER

The Yellowstone River is unique among the nation's major rivers. Two tributaries, the Tongue and Bighorn rivers, are regulated but the Yellowstone main stem is virtually unimpounded for its entire length. The Yellowstone originates in the northwestern corner of Wyoming, and flows northeasterly through Montana before joining the Missouri River near Cartwright, North Dakota. It has a total drainage area of approximately 70,400 square miles, 35,900 of which lie in Montana. Its length is approximately 678 miles, 550 of which are in Montana.

Major tributaries entering the Yellowstone in Yellowstone National Park include the Gardner and Lamar rivers. In Montana, the only major south-flowing tributary to the Yellowstone is the Shields River near Livingston. Major north-flowing tributaries to the Yellowstone in Montana include the Boulder, Stillwater, Clarks Fork of the Yellowstone, Bighorn, Tongue and Powder rivers (Figure 1).

Headwaters of the basin are in the high mountain areas of southcentral Montana and northwestern Wyoming. Approximately 70% of the annual flow of the Yellowstone comes from mountain snowpack. Winter accumulation and summer melting of this variable snowpack give the Yellowstone River its basic characteristics of high spring runoff and low flows through the fall and winter. The average annual runoff from the Yellowstone basin, adjusted to the 1970 level of depletion, is 8.8 million acre-feet (MAF). The maximum and minimum record annual basin outflows have been 15.4 and 4.3 MAF, respectively.

The Yellowstone is of great importance as a sport fishery and can be divided into three general zones as related to fish distribution. From its headwaters in Wyoming to its mouth in North Dakota, the river changes from an alpine, salmonid-type fishery to a diverse, warm-water aquatic ecosystem. A longitudinal profile of the Yellowstone is presented in Figure 2.

Montana's portion of the Yellowstone has 50 fish species, representing 13 families (Table 1). Although data are too limited to show distribution of 17 species, the probable distribution of the remaining 33 is illustrated in Figure 3 (Peterman and Haddix 1975).

The upper Yellowstone, from Gardiner to Big Timber (111 miles), supports cold-water salmonid populations of national significance and has been classified as a blue ribbon trout stream by the Montana Fish and Game Commission. This area is characterized by large populations of a relatively small number

Table 1. Fish species recorded for the Yellowstone River (family, scientific and common names).

ACIPENSERIDAE (Sturgeon Family)	
Scaphirhynchus albus	Pallid sturgeon
Scaphirhynchus platorynchus	Shovelnose sturgeon
POLYODONTIDAE (Paddlefish family)	
Polyodon spathula	Paddlefish
HIODONTIDAE (Mooneye family)	
Hiodon alosoides	Goldeye
SALMONIDAE (Trout family)	
Prosopium williamsoni	Mountain whitefish
Salmo clarki	Cutthroat trout
Salmo gairdneri	Rainbow trout
Salmo trutta	Brown trout
Salvelinus fontinalis	Brook trout
ESOCIDAE (Pike family)	
Esox lucius	Northern pike
CYPRINIDAE (Minnow family)	
Cyprinus carpio	Carp
Carassius auratus	Goldfish
Notemigonus crysoleucas	Golden shiner
Semotilus margarita	Pearl dace
Semolitus atromaculatus	Creek chub
Hybopsis gracilis	Flathead chub
Hybopsis gelida	Sturgeon chub
Couesius plumbeus	Lake chub
Notropis atherinoides	Emerald shiner
Notropis stramineus	Sand shiner
Hybognathus hankinsoni	Brassy minnow
Hybognathus placitus	Plains minnow
Hybognathus nuchalis	Silvery minnow
Pimephales promelas	Fathead minnow
Rhinichthys cataractae	Longnose dace
CATOSTOMIDAE (Sucker Family)	
Carpoides carpio	River carpsucker
Cycleptus elongatus	Blue sucker
Ictiobus bubalus	Smallmouth buffalo
Ictiobus cyprinellus	Bigmouth buffalo
Moxostoma macrolepidotum	Shorthead redhorse
Catostomus catostomus	Longnose sucker
Catostomus commersoni	White sucker
Catostomus platyrhynchus	Mountain sucker
ICTALURIDAE (Catfish family)	
Ictalurus melas	Black bullhead
Ictalurus punctatus	Channel catfish
Noturus flavus	Stonecat
GADIDAE (Codfish family)	
Lota lota	Burbot
CENTRARCHIDAE (Sunfish family)	
Lepomis cyanellus	Green sunfish
Lepomis gibbosus	Pumpkinseed
Lepomis macrochirus	Bluegill
Micropterus dolomieui	Smallmouth bass
Micropterus salmoides	Largemouth bass
Pomoxis annularis	White crappie
Pomoxis nigromaculatus	Black crappie
Ambloplites rupestris	Rock bass
PERCIDAE (Perch family)	
Perca flavescens	Yellow perch
Stizostedion canadense	Sauger
Stizostedion vitreum	Walleye
SCIAENIDAE (Drum family)	
Aplodinotus grunniens	Freshwater drum
COTTIDAE (Sculpin family)	
Cottus bairdi	Mottled sculpin

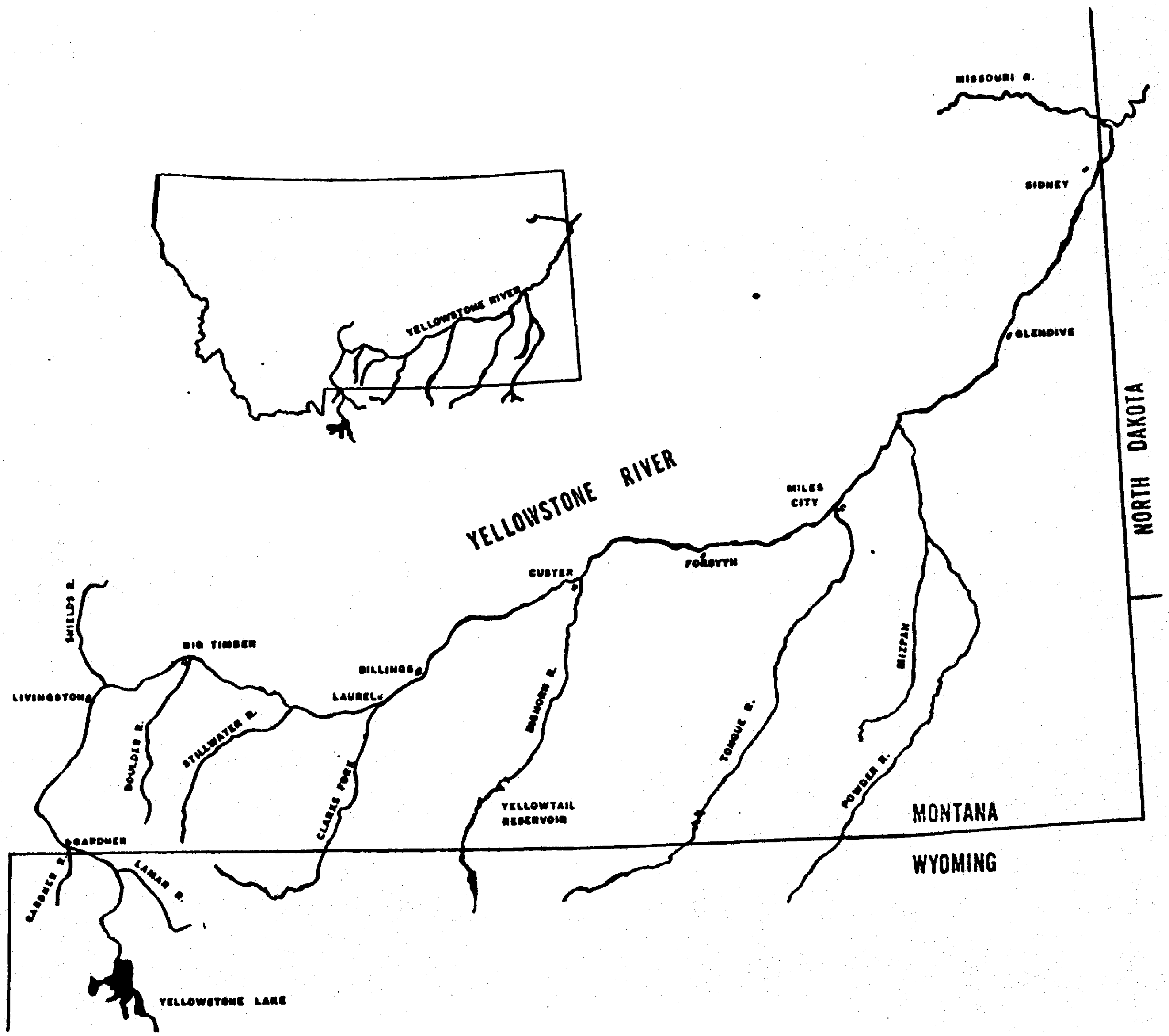

Figure 1. Yellowstone River drainage.

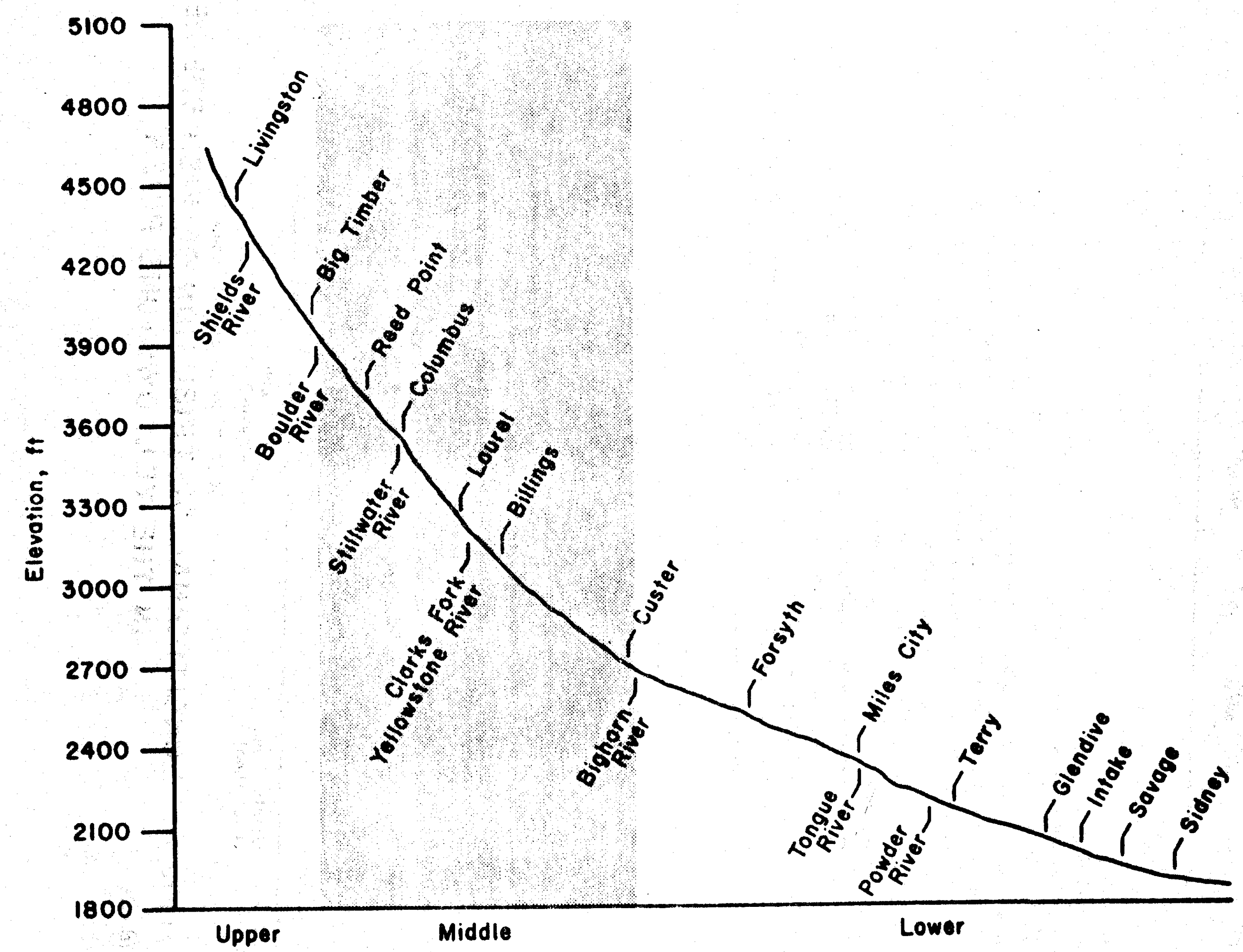

Figure 2.

LONGITUDINAL PROFILE OF THE YELLOWSTONE RIVER

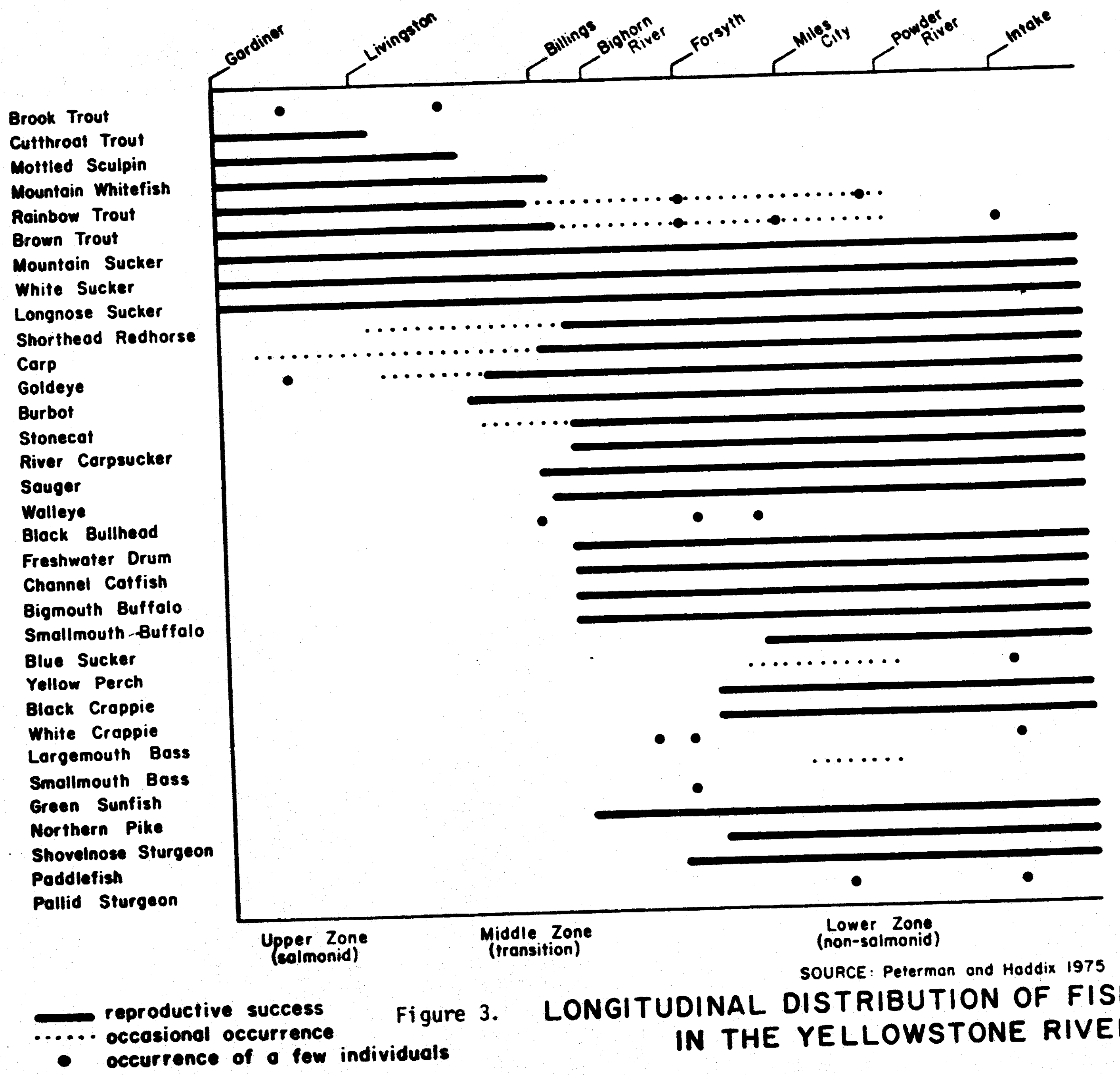

Figure 3. LONGITUDINAL DISTRIBUTION OF FISH SPECIES IN THE YELLOWSTONE RIVER

of fish species characteristic of clear, cold water rivers. The primary trout species are cutthroat, rainbow and brown trout. Large populations of mountain whitefish exist and longnose sucker are also abundant. The principal forage fish species is the mottled sculpin.

The Yellowstone cutthroat trout is a unique and highly prized species. Found only in the headwaters of the Yellowstone basin, its range appears to be quite restricted. Mountain whitefish are several times more abundant than trout and provide an important winter fishery (Berg 1975).

The transition zone between the primarily cold water environment of the upper river and the warm water environment of the lower river extends 160 miles from Big Timber to the mouth of the Bighorn River and is referred to as the middle Yellowstone. Although both cold and warm water species are present, their distribution and population dynamics are poorly understood.

The lower Yellowstone extends from the mouth of the Bighorn River to its confluence with the Missouri River, approximately 295 miles. This area supports a diverse aquatic ecosystem containing a wide variety of species commonly known as warm water fishes. Important sport species found in the lower Yellowstone include the paddlefish, shovelnose sturgeon, sauger, walleye, channel catfish, northern pike and burbot. In addition, large populations of nonsport species occur which represent a lightly utilized but potentially valuable resource.

There is an increase in species diversity as one progresses downstream on the Yellowstone. In Yellowstone National Park above Tower Junction, the cutthroat trout exist as the only trout species. Eleven species (five families) of fish have been recorded for the upper Yellowstone River in Montana; however, only six species (four families) are considered common or abundant. The middle river contains approximately 20 fish species representing eight families; however, sampling in this area has been very limited. The lower Yellowstone is the most diverse, with 46 species representing 12 families recorded.

METHODS

The method of obtaining instream flow protection had been determined legislatively. Section 85-2-316 MCA established the reservation process and the Yellowstone Moratorium selected the basin and determined the time period for the first effort.

The obligation of the Department of Fish, Wildlife & Parks in this process was to represent the fish, wildlife and recreational resources of the basin for the public interest. The responsibility was to produce an application for reservation of waters to cover the instream needs of 550 miles of main stem Yellowstone and 61 tributaries.

The approach adopted for reserving instream flows in the Yellowstone basin was developed specifically for that situation. While portions of the strategy may be transferable to other basins, the overall approach may well be unique to the Yellowstone situation.

In general, the strategy adopted and followed for reserving instream flows in the Yellowstone basin was as follows:

(1) The basic concept underlying the reservation application strategy was to, as much as possible, obtain site-specific biological data upon which to determine, support and defend recommended instream flows.

At the time when instream flow determinations were being made for the Yellowstone River basin, the science of instream flow methodology was in its infancy. Several methods utilized a percentage of the historical flow; however, these often lacked a specific reference to the biological attributes of a given stream. While some information was available on flow criteria for cold water fishes, very little could be found for warm water fishes or for large river habitats.

The Yellowstone basin contained too many different sizes, categories and types of streams to lend itself well to the application of a single instream flow methodology. The problem of applying the existing percentage methodologies was in their inability to respond to specific biological or physical attributes of individual streams or stream reaches.

As an example of specific biological attributes, certain tributaries were found to be vital for spawning and recruitment for main stem fish populations. The location, timing and duration of spawning as well as the flows required varies with the species involved. Some species required only enough flow to cover spawning areas while others depended on certain flows to trigger the spawning and migration response and allow passage to spawning areas. Certain rivers or river reaches were heavily used by Canada geese for nesting. Adequate flows were necessary to provide security from predation for the island-nesting geese.

Additional instream flow considerations are the functions associated with the high flow period. Basic channel habitat features and island and gravel bar structure result from the channel-forming flows which occur during high water.

Neither the channel-forming flows nor the specific biological attributes of certain streams could be addressed in the instream flow methodologies available at the time. It was considered fundamental to the department's effort to base the instream flows, as much as possible, on specific biological functions associated with the various streams.

(2) To rely on field personnel most familiar with a particular river or river reach for a site-specific determination of instream flows and to support and defend the flow recommendations.

Since the basic goal was to have the instream flows reflect site-specific biological conditions, the person most familiar with the area was assigned the task of determining instream flows for that area. In some cases, existing regional fisheries personnel were utilized for certain waters. In most cases, however, additional personnel were hired for specific areas.

The application for reservation of flows was submitted to the Department of Natural Resources and Conservation (the agency responsible for administration of the Water Use Act) and subjected to an adversary-type hearing before a hearings officer of the Board of Natural Resources and Conservation. During the course of the adversary hearing, the applications were subject to vigorous cross-examination by opposing parties. The advantage of having the person most knowledgeable about a particular river or stream testifying and available for cross-examination is obvious.

(3) The lower portion of the basin (below the mouth of the Bighorn River) would receive the greatest emphasis.

There are several reasons for concentrating on the lower portion of the basin. With the possibility of future irrigated agriculture expanding greatly and the prospect of considerable expansion of the energy industry in eastern Montana, the greatest potential for significant future depletions is in the lower basin. Since excessive downstream depletions invariably lead to upstream regulation through main stem impoundment, the best chance for maintaining the Yellowstone in a free-flowing condition lies in tempering water demands on the lower river.

In addition, the lower Yellowstone basin is a unique and valuable resource in its own right. Few, if any, large warm water riverine systems remain free-flowing. The channel form and aquatic biota reflect the free-flowing nature.

In addition, the lower river suffers from the sum of all upstream depletions. With insufficient funding and manpower to adequately cover the entire basin, it was believed best to develop a strong instream recommendation for the lower river and proceed upstream requesting water in areas of little biological data on the basis of supply alone.

(4) The development of a widespread and comprehensive public information program was essential for the success of the instream reservation request. There are a number of significant benefits, in addition to fish and wildlife, that accrue from adequate instream flows. To obtain a reasonable allocation for instream purposes, the instream benefits had to be identified and compared to the consumptive uses.

A public information program was developed to inform interested parties of the reasoning behind the instream reservations, their functions and probable impacts. In addition to regional programs, a special issue of the department magazine (MONTANA OUTDOORS, Vol. 8, No. 2) and a film ("Yellowstone Concerto") were produced for this effort.

RESULTS

Reservation Application

The Department of Fish, Wildlife & Park's application for reservation of Yellowstone River flows was submitted to the Department of Natural Resources and Conservation on November 1, 1976 (Mont. Dept. of Fish and Game 1976). This project was ultimately responsible for that part of the application pertaining to the lower 280 miles of the main stem Yellowstone plus the Bighorn River. Data and input were provided for the recommendation for the middle Yellowstone from Big Timber to the mouth of the Bighorn River. Introductory remarks concerning these areas were also prepared.

The lower Yellowstone, under predevelopment conditions, had an estimated mean annual flow of between 11 to 12 million acre-feet (MAF) (J. Dooley, personal communication). The average annual discharge at Sidney for a 62-year period of record (1912-1974) was 9.47 MAF (USGS Surface Water Records for Montana 1974). Adjusted to the 1970 level of water depletion, the mean annual discharge at Sidney was calculated to be 8.8 MAF (NGPRP 1974).

The department's instream flow recommendations at Sidney were for 8.2 MAF. The purpose of this amount of water is to provide fish and wildlife habitat sufficient to perpetuate the diverse species comprising this natural resource at levels comparable to current existing levels. In other words, the amount of water requested is designed to maintain the "status quo" as far as the aquatic and wildlife communities of the lower river are concerned. With approximately 3.5 MAF depleted annually from the basin, the status quo represents a less than optimum condition. A detailed discussion of the recommended instream flows is presented by Peterman (1979a).

The following is a summary of the instream flows requested for maintenance of the existing aquatic and wildlife resources found in the lower Yellowstone River and its immediate riparian areas. The flows are presented for the periods March-April, May-July, August-November, and December-February. The methodology used for each period is briefly described. Where possible, the latest biological and hydraulic data from current studies on the Yellowstone River were used. The literature is cited to substantiate current data and as a supplement where specific data are incomplete. Those methodologies selected were based on their suitability to the biological conditions found on the lower Yellowstone and reflect the existing data base at the time of the application.

March-April

The March and April flows are those required for successful Canada goose reproduction on the lower Yellowstone. An estimated 30 percent of the breeding population of Canada geese in the surveyed areas of the Central Flyway portion of Montana utilize the Yellowstone River main stem for nesting (T. Hinz, personal communication; Witt 1975). An additional 15 percent nest on the Powder, Tongue and Bighorn rivers. Maintaining conditions favorable for Canada goose production on these rivers is thus highly important.

The date of initiation of the first goose nest in the spring is to some degree dependent on spring weather conditions. In most years, however, the period from March 1 through April 30 will encompass the period of goose nest initiation on the lower river (T. Hinz, personal communication). Islands are the most preferred nesting areas for Canada geese on the Yellowstone (Hook 1975, Hinz 1975).

The security of a given island for nesting depends on its isolation from predators. The farther an island is from a large island or main bank where predators occur and the deeper the water is separating the island from this area, the more secure the nest will be. Island security as related to distance from a predator source and depth of the channel separating the island from that source has been demonstrated by a number of workers (Sherwood 1965, Hammond and Mann 1956, Hook 1973).

The security of islands utilized for nesting on the lower Yellowstone is directly related to river flows. Steady, high flows throughout the nesting period will produce greater depths of channels between islands and the mainland, and therefore greater security, than low flows. Canada goose nesting studies on the lower Yellowstone in 1975 and 1976 indicate that a flow of approximately 11,000 cfs during March and April would prevent excessive nest predation on islands (Hinz 1977). Lower flows (around 9,000 cfs) during the early part of the nesting period in the spring of 1976 resulted in an overall predation rate of 28 percent on 96 nests surveyed. Predation rates in individual study sections ranged from 7 percent to 57 percent. The period of low flows in the spring of 1976 (9,000 cfs) was the result of regulation fluctuations of the Bighorn River by Yellowtail Dam. In 1975, higher flows (11-12,000 cfs) during the early part of the nesting season were associated with an overall predation rate of 11 percent (range 0 percent to 20 percent) (Hinz 1977). Irregular flows with peaks higher than 12,000 cfs may produce substantial nest flooding. Using a similar methodology, Merrill and Bizeau (1972) determined that uniform releases of 16,000 cfs from Palisades Dam on the Snake River prevented goose nest predation yet did not produce nest flooding.

May-June-July

To maintain the integrity of the lower Yellowstone River and its associated aquatic and wildlife populations, it is necessary for the reservation to reflect the historic flow regime. The high water period of the Yellowstone occurs during May, June and July with June commonly having the highest flows. The portion of the reservation for these months is designed to preserve a portion of the spring flood flows for maintenance of the channel formation processes and for necessary biological functions.

Channel Maintenance Flows

The channel configuration of the lower Yellowstone is characterized by channel bars, islands, braided channel areas and an accompanying divided flow pattern in such areas. The diversity of channel, island and channel bar types found in the lower river leads to a diversity of habitat types for both aquatic and terrestrial populations.

The major process in establishing and maintaining the channel form in view of its geology and bed and bank material is the annual flood characteristics of the river (Leopold et al. 1964, Emmett 1975). The Yellowstone has a flow regime characterized by an annual spring flood which occurs during May, June and July with June commonly having the highest flows. The low water period normally occurs from late August through February with December, January and February having the lowest monthly flows.

It is the higher spring flood flows that determine the form of the channel rather than the average or low flows. Reducing these flows beyond the point where the major amount of bedload and sediment is transported would interrupt the ongoing channel processes and change the channel form. A significantly altered channel configuration would affect both the abundance and species composition of the present aquatic and terrestrial populations by altering the present habitat types.

It is generally accepted that the bank full flow during the spring flood is the most important determining factor in channel formation processes (Leopold et al. 1964, U.S. Bureau of Reclamation 1973). Actual field determination of the bank full stage is extremely difficult;

however, the flow of the 1½ year frequency flood is considered by many to approximate the bank full flow (Leopold et al. 1964, Emmett 1975). Bank full flow was estimated for the Yellowstone River at Miles City and Sidney by using the 1½ year frequency flood from flood frequency relationships.

The estimated bank full flow at Miles City and Sidney is 47,000 cfs and 52,000 cfs, respectively. It is not known how long the bank full flow must be maintained. Until studies further clarify the necessary duration of the bank full flow, a conservative duration period of 24 hours was chosen.

Paddlefish Passage Flows

In addition to maintaining the physical integrity of the channel and associated islands, the high water period also functions as a stimulus for spawning of certain important sport fish and provides passage flow necessary for successful migration to traditional spawning areas.

The two notable species which spawn during the high water period are the shovelnose sturgeon and the paddlefish. The paddlefish was selected as the key species for the high water period based on its importance as a sport fish (Elser 1973), its uniqueness as a species (Vasetskiy 1971), its migratory habits (Robinson 1966, Elser 1973, Rehwinkel 1975), and the importance of the lower Yellowstone as a spawning area for the species.

Bovee (1974) also suggests use of the paddlefish as an indicator species for large rivers of the Northern Great Plains. Since the paddlefish is the largest fish in the system, its passage requirements will be the greatest. It follows that if the paddlefish passage requirements are met, then the passage needs of other species will also be met.

The paddlefish is a seasonal inhabitant of the Yellowstone. Spending most of the year in Garrison Reservoir, they ascend the Missouri and Yellowstone rivers during the spring high water period to spawn. The most commonly reported upstream migration point in the Yellowstone is at Forsyth, Montana (river mile 238). To reach Forsyth, the paddlefish must first negotiate a low head irrigation diversion dam at Intake, Montana (river mile 71.1) which acts as a partial barrier to the upstream migration of the paddlefish (Robinson 1966, Rehwinkel 1975). A side channel bypasses the irrigation diversion; however, it only contains water during the high water period.

The importance of paddlefish reaching traditional upstream areas during their spawning migration is obvious. By negotiating the diversion dam at Intake, at least an additional 166 miles of mainstem Yellowstone and two major tributaries (Tongue and Powder rivers) are made available for spawning. Paddlefish have been documented in the Powder and Tongue rivers (Elser and McFarland 1975). In addition, a popular fishery exists for the paddlefish in areas upstream from the Intake diversion at the Forsyth diversion and at the mouths of the Tongue and Powder rivers.

The Intake diversion consists of a wood, stone and steel apron over which rocks are periodically dumped to maintain an adequate diversion head. Since the nature of the diversion may change with additional rock, the passage requirements of paddlefish over the diversion may also change. In addition, the possibility exists of a more efficient concrete diversion being installed at some future date. It is not presently known what flows would be required for paddlefish passage over a concrete structure.

A passage flow for paddlefish through the side channel which bypasses the Intake diversion appears to be the best measure of the necessary long-term passage flow for paddlefish. Recent studies indicate that the side channel is used for passage by the paddlefish and the required flows are unlikely to change with alterations in the diversion structure, provided the side channel itself is left unaltered.

For most of the year the Intake side channel is dry, flowing water only during the spring high water period. Water first enters the side channel at a flow of approximately 24,000 cfs (all flows related to the USGS gage at Sidney, approximately 40 miles downstream). Intensive sampling (electrofishing) of this side channel during the 1976 paddlefish spawning migration revealed that a flow of approximately 45,000 cfs in the mainstem allows sufficient flow in the side channel for adequate passage of the paddlefish. Observations by others (Purkett 1961, Elser 1973) suggest that the duration of the high flows, as well as the magnitude, is significant in determining the extent of upstream migration of the paddlefish during their spawning run. Therefore, a 45,000 cfs flow at Sidney was recommended from June 8 through 30.

Paddlefish migrations are believed to be triggered, at least in part, by rising water conditions (Purkett 1961). The May portion of the reservation is designed to preserve the period of rising flows prior to high water. The flows from May 1 through 20 are set at 11,000 cfs (Miles City and Sidney) and are an extension of the goose nesting flows for March and April. By May 20, the period of nest establishment is over and the bulk of the incubation is complete. Flows for May 21 to May 31 are 20,000 cfs at Sidney and 17,000 at Miles City and approximate the 70 percent exceedance level (a flow which is equaled or exceeded 70 percent of the time) for that period (Table 2).

Flows requested for June 1 through 7 are 26,000cfs at Sidney and 25,000 cfs at Miles City and, again, are designed to preserve a portion of the rising stage prior to the peak of high water. The flows for the remainder of June (8 through 30) should reflect those required for paddlefish passage plus the bank full flows for maintenance of the channel forming processes.

The bank full flow at Sidney is approximately 7,000 cfs higher than those required for paddlefish passage around Intake. After June 7, the flow should be allowed to peak at 52,000 for 24 hours. After peaking at bank full stage, the minimum flow becomes 45,000 cfs for the remainder of June.

The July flows requested represent a gradual dropping of water levels from the high water period of June to the lower water month

Table 2. Flow Reservation For the Lower Yellowstone River From the Mouth of the Bighorn River to the Montana-North Dakota State Line.

Time Period	Section 1-Mouth Bighorn River to Mouth Powder River 1/ CFS	Acre-Feet	Section 2-Mouth Powder River to Mont-N.Dakota state line 2/ CFS	Acre-Feet
January	4,800	295,200	4,900	301,350
February	5,500	309,745	5,900	332,271
March	11,000	676,500	11,000	676,500
April	11,000	654,500	11,000	654,500
May 1-20	11,000	436,260	11,000	436,260
May 21-31	17,000	337,110	20,000	396,600
June 1- 7	25,000	347,025	26,000	360,906
June 8-30	42,000	1,925,493 3/	45,000	2,066,286 4/
July 1-20	17,000	674,220	20,000	739,200
July21-31	9,200	182,436	10,000	198,300
August	7,000	430,500	7,000	430,500
September	7,000	416,500	7,000	416,500
October	7,000	430,500	7,000	430,500
November	7,000	416,500	7,000	416,500
December	5,600	344,400	5,700	350,550
Total		7,876,889		8,206,723

1/ All flows in section 1 relate to the USGS gage at Miles City.

2/ All flows in section 2 relate to the USGS gage at Sidney.

3/ Total acre-foot figure for June 8-30 includes 1 day of bankfull flow at 47,000 cfs.

4/ Total acre-foot figure for June 8-30 includes 1 day of bankfull flow at 52,000 cfs.

of August. A gradual drop in water levels is designed to allow downstream migration of both larval and adult paddlefish back to Garrison Reservoir. Using 70 percent exceedance flows and a two stage drop for July, flows requested at Sidney for July 1-20 are 20,000 cfs and for July 21-31 are 10,000 cfs.

August-September-October-November

Flows for the August through November period are based on those required for adequate rearing purposes. The successful rearing of stream fishes is dependent upon an adequate food supply, adequate habitat areas and suitable water quality (White 1975).

The principal food of most sub-adult fishes in river systems is aquatic invertebrates (Scott and Crossman 1973, Bjorn 1940, Miller 1970a and 1970b, Schwehr 1977). While some game species in the Yellowstone switch to a piscivorous diet as adults (sauger, walleye, burbot and northern pike), others remain almost exclusively aquatic invertebrate feeders throughout their entire life (shovelnose sturgeon). Some fish, such as the channel catfish, are omnivorous as adults, feeding on both fishes and aquatic insects (Schwehr 1977, Carlander 1969).

The necessity of maintaining suitable aquatic invertebrate production is apparent. Aquatic invertebrate production takes place primarily in riffle areas in most river systems (Hynes 1970). Riffles are also the areas which are most affected by reduced discharges (Bovee 1974). It is generally accepted that the maintainance of suitable riffle conditions (for food production) will also maintain suitable pool conditions (for habitat rearing). With the flows recommended for rearing, water quality deterioration will not be a factor.

The USGS - Washington Department of Fisheries method for recommending rearing flows in Washington is based on the assumption that rearing is proportional to food production, which in turn is proportional to the wetted perimeter in riffle areas (Collings 1974). This method has been recommended by White (1975) and is used here to determine rearing flows for the August through November period.

The primary consideration in assuring adequate rearing flows is to maximize the wetted perimeter of the streambed in the riffle (food production) areas, in view of the flow levels commonly occurring during August through November. In determining the rearing flows, representative riffle areas were located at three sites on the lower Yellowstone (Hysham - river mile 274.3, Kinsey - river mile 177.2, and Intake - river mile 71.1) and a minimum of four cross-sectional profiles surveyed at each site. Standard physical measurements were made and the hydraulic characteristics of the riffles at various flows were computed using the Water Surface Profile Program according to Spence (1975) and Dooley and Keys (1975).

In analyzing riffle areas in relation to flow, the wetted perimeter is commonly plotted against discharge. Wetted perimeter generally increases rapidly for small increases in discharge up to the point where the channel nears its maximum width (wetted perimeter extends from bank to bank). Beyond this point, wetted perimeter increases more slowly in relation to discharge. White (1975) suggests that the optimum quantity of water for rearing be selected near this inflection point.

Since the channel configuration of the Yellowstone varies from site to site, a given flow will not produce the same results at each riffle. In some riffle areas, the median flow for August through November will easily cover the riffle from bank to bank. At other riffles, an expanse of gravel separates the actual river channel from the high water bank, or an island gravel bar may be present. Under these circumstances, an unseasonably high flow would be required to extend the wetted perimeter from bank to bank. In this situation, a flow was considered which would cover only the main portion of the river channel.

At the Hysham and Kinsey sites, flows of between 6,000 and 8,000 cfs were sufficient to cover shallow riffle areas. The river immediately below the Intake diversion is believed to be a rearing area for shovelnose sturgeon and is the only location where sub-adult shovelnose can be consistently taken (Peterman and Haddix 1975). This reach commonly has large areas of exposed gravel during the August-November period and unseasonably high flows would be necessary to cover this area from bank to bank. A 7,000 cfs flow, however, would be adequate to cover the riffles in the active portion of the main channel.

In summary, a 7,000 cfs flow level appears adequate for rearing purposes (food production) at the surveyed riffles. This is only slightly less than the median flow level for August through November and would be expected to be equaled or exceeded approximately half of the time. A rearing flow of 7,000 cfs is recommended both at Miles City and Sidney since flows are very similar at the two gage sites from August through November and flow requirements from the surveyed riffles are also approximately equal.

An additional consideration in requesting adequate flows for August and September is the dissolved oxygen content of the river. If domestic, industrial, or agricultural water consumption were to expand in the Yellowstone River basin, increases in nutrients would occur through lowered river flows (loss of dilution) and by the return to the river of nutrient "wastes." Knudson (1976), using algal assays, demonstrated that increases in nutrients (particularly phosphorus) could lead to exponential increases in algal biomass. Diel measurements demonstrated that increases in dissolved oxygen fluctuations can be expected with increases in this algal accumulation. The flow at which near critical (growth limiting) dissolved oxygen fluctuations occurred at Custer was approximately 4,000 cfs (measured) and at Miles City near 6,000 cfs (calculated). Diel dissolved oxygen and algal accumulation data indicate that the lower river has a greater potential for reaching harmful dissolved oxygen fluctuations with decreased flows than does the middle river. Flows of 7,000 cfs for rearing purposes during this period should adequately cover the dissolved oxygen consideration.

December-January-February

The winter months (December, January and February) commonly have the lowest flows of the year. This is also the period when the aquatic populations are under the greatest stress. Growth for most species is slowed or halted, largely a result of near 0 C water and reduced production and availability of food organisms. Aquatic populations suffer their greatest natural mortality and biomass reduction during this period. The aquatic habitat available to fish and their food organisms is at its lowest point.

The riffles are commonly areas of greatest insect production in streams (Hynes 1970) and are most affected by reduced flow levels in the winter. Riffles are not only affected by reductions in wetted bottom areas, but also by anchor ice formations in winter months.

From a biological standpoint, the winter months have the least quantitative data available. While it is known that this period produces the greatest natural mortality, the exact causes of winter mortalities in a stream are poorly understood. Burbot spawn during the winter months, but the exact times, locations, and conditions are largely unknown. The habitat, movements and food habits of the important sport and forage fishes are poorly understood for the winter months. The biological effects of ice, both anchor ice and the massive ice jams which commonly occur on the lower river, remain a mystery.

In view of the critical nature of the winter period, it is felt that any significant depletion at this time could produce severe impacts on the fishes and related aquatic life and the furbearers (Martin 1977) of the lower Yellowstone.

The lack of quantitative data makes a determination of a minimum stream flow for the winter months very difficult. At present, it is felt the best protection to be provided the aquatic and wildlife resources of the lower river during this period would be to reserve the median flow for the winter months.

Median flow values for the Yellowstone River at Sidney and Miles City were computed by the U.S. Geological Survey for the period 1936-1974. Median flow values at Sidney for December, January and February are 5,680, 4,870, and 5,940, respectively. Corresponding median flows at Miles City are 5,600, 5,820, and 5,460.

The requested flows for the lower Yellowstone (mouth of Bighorn River to Montana-North Dakota state line) are summarized in Table 2. The lower river was divided into two sections (section 1 - mouth of Bighorn River to mouth of Powder, section 2 - mouth of Powder River to Montana-North Dakota state line) to accomodate those months where significant variations in flow between the two USGS gage sites (section 1 - Miles City, section 2 - Sidney) occur.

The Allocation of Yellowstone Basin Water

As a result of the Yellowstone Moratorium and the reservation provisions of the Water Use Act, 36 applications for reservation of Yellowstone basin water were filed with the Department of Natural Resources and Conservation (DNRC). Diversionary requests to reserve water to irrigate 443,712 acres totaled 1,186,582 AF and were submitted by 14 conservation districts, 2 irrigation districts and 3 governmental agencies. Eight municipalities applied for 391,517 AF with Billings alone asking for 317,456 AF. Four reservations were filed for multipurpose storage projects totaling 1,175,800 AF. These are total diversion figures; actual consumptive use would be less due to return flow.

Instream flow reservation applications were filed by the Department of Fish, Wildlife and Parks (8.2 MAF) and the Department of Health and Environmental Sciences (6.6 MAF). The North Custer County Conservation District requested a uniform flow of 4,000 cfs instream during the irrigation season at their Kinsey pumping plant and the Bureau of Land Management requested instream flows on several tributary streams for riparian habitat maintenance.

Since the allocation of water in the Yellowstone basin was considered a major action, an Environmental Impact Statement was required under Montana law. The DNRC had responsibility for preparation of the EIS and was aided by an ongoing Yellowstone Impact Study funded by the Old West Regional Commission. Various scenarios were constructed using the application requests as a data base and the hydrology modeling techniques and other information from the Yellowstone Impact Study. The draft EIS for water reservation applications was completed on December 13, 1976. After a comment period, the final EIS was released on January 31, 1977.

The applications for reservation of Yellowstone basin water were subjected to examination through contested case hearings as specified under the combined procedures of the Montana Administrative Procedures Act and the Montana Water Use Act. The adversary hearings began on August 8, 1977 and extended through September 27, 1978. Because of the large amount of testimony anticipated, prefiled testimony was required. The actual hearings were confined to the cross-examination and redirect examination. Even so, the hearings lasted for nearly two months.

In defense of the application for instream flows in the Yellowstone basin, the Department of Fish, Wildlife and Parks produced 22 witnesses expert in a variety of disciplines and offered exhibits for inclusion into the record. The application covered the entire mainstem Yellowstone in Montana (550 miles) and 62 of its tributaries.

Parties, other than applicants, appearing in support of the department's instream request included the Montana Wildlife Federation, Trout Unlimited, the Federation of Fly Fishermen, the Environmental Information Center, and members of the general public. Parties, other than the applicants, opposing the department's instream request included Intake Water Company, Utah International, Inc., the Montana Power Company, the Clark Fork Valley Water Users' Association, and the Montana Water Development Association.

A major area of controversy centered around the department's application on the Powder River. The Powder River lies in the eastern Montana coal fields. Both Intake Water Company and Utah International, Inc. are competing to build storage projects to utilize Powder River water for industrial water marketing. Both companies hold large industrial water filings on the Powder River. These filings were held in abeyance by the Yellowstone Moratorium.

The entire hearing proceedings were incorporated into 33 volumes of testimony. On August 17 and 18, 1978, the Board of Natural Resources and Conservation heard final arguments from each party. The reservation application requests, the numerous exhibits, the 33 volumes of testimony, and the final argument transcripts were combined to form the record. The record became available to the board members for their deliberation in mid-September 1978.

The court ordered further extensions of the moratorium to allow the board time to make reasonable deliberations. On December 15, 1978 the Order of the Board of Natural Resources and Conservation establishing water reservations in the Yellowstone Basin was signed. The monthly distribution of instream flows granted by the board for the Yellowstone River at Sidney is shown in Table 3.

Table 3. Instream reservation established for the Yellowstone River at Sidney, Montana by Order of the Board of Natural Resources and Conservation, December 15, 1978.

Month	CFS	AF/Y
January	3,738	229,831
February	4,327	240,281
March	6,778	416,711
April	6,808	405,031
May	11,964	735,528
June	25,140	1,495,644
July	10,526	647,090
August	2,670	164,166
September	3,276	194,917
October	6,008	369,377
November	5,848	347,920
December	3,998	245,814
Total Reservation		5,492,310

DISCUSSION

The concept of reserving waters for future beneficial uses and instream values represents a significant departure from traditional western water law. In the past, Montana's resources have been exploited in a rapid and often destructive manner, as in the quest for gold in the 1880's and early hard rock mining operations. Under the old water law, the water resources of the state faced the possibility of similar exploitation. When the water resources of the Yellowstone basin were threatened by large scale industrial depletions in the early 1970's, a moratorium on water filings over 20 cfs was imposed, and most of the unallocated waters in the basin were reserved for future beneficial uses under a revised water use act. The very fact that the reservation principle was introduced into the Montana Water Use Act and subsequently carried out in the

Yellowstone basin reflects a desire by the people that the water resources of Montana be developed in an orderly and environmentally sensitive fashion. The orderly development of a region's water resources carries with it a control on the degree and rate of exploitation of other resource developments dependent on water.

On December 15, 1978 the Order was signed by the Board of Natural Resources and Conservation reserving uncommitted waters of the Yellowstone basin for future uses. While the full significance of this allocation will not be known for many years, several implications of the reservation process itself and the instream reservations in particular are readily apparent.

The reservation process, as it applied to the Yellowstone basin, provided a means to obtain a secure water supply for those future consumptive water users who were least likely to be competitive for future high priced water. These users, principally agricultural and municipal in nature, were unable to satisfy their future needs through the water use permit system since water use permits generally address only immediate or present uses of water. These two entities typically do not have the financial resources necessary to undertake costly water development projects or to pay high prices for water. Their future well-being depends on securing a certain amount of water for reasonably defined growth and development.

The reservation process also provided a means for securing water for minimum instream flows. As a result of the Board's Order of December 15, 1978, a minimum instream flow for rivers and streams in the Yellowstone basin was established. This establishment of a minimum flow provides benefits to a broad segment of society.

Adequate minimum flow levels in a stream ensure existing water right holders of a secure future water supply. Without a secure minimum flow, existing water right holders during low water periods or under extremely depleted conditions may have difficulty exercising their existing rights.

Montana water Law prioritizes water rights on a first in time, first in right basis. The burden of proof and responsibility for obtaining that right, however, lies with the senior right holder. The practicality of the matter suggests that by the time the existing right user notifies junior users, takes the junior user to court if necessary, and obtains a court order to halt the junior user from obtaining water, either the critically low flow period has passed or the irrigation season is over. The guarantee of a minimum stream flow throughout the basin benefits holders of existing water rights by ensuring that the source of supply for their water is not severely depleted.

Each of the 13 applicant conservation districts applied for minimum flows to reasonably protect water levels at diversion sites of present irrigators. Minimum instream flows protect existing water rights by avoiding the necessity of expensive reconstruction of pumping facilities, ditches, canals, or other facilities which would result from depleted flow conditions.

Securing a minimum instream flow contributes to the maintenance of water quality in a river. The concentration of pollutants and consequently the degree of pollution in a river, is generally dependent on the flow of that river. In the Yellowstone, this is particularly true for the concentration of total dissolved solids (TDS). Generally, the lower the stream flow, the higher the concentration of total dissolved solids and other pollutants. High TDS levels not only affect water quality for domestic purposes, but high concentrations of salts in the water also adversely affect use for irrigation. The establishment of adequate instream flows will prevent certain pollution problems from becoming critical because of excessive depletions and dewatering.

The establishment of minimum instream flow levels affects water availability for appropriators junior to the reservations. When flow levels drop below the specified minimums, appropriators junior to the instream reservation will be required to cease withdrawals.

In the Yellowstone basin, the annual discharge and pattern of runoff is generally dependent on the mountain snowpack and its rate of thawing, although it is influenced to a certain extent by precipitation throughout the remainder of the year. In a free-flowing river system, a given flow will occur with a certain frequency that can be determined from historical flow records. The minimum instream flows granted for the lower Yellowstone can be expected to be equaled or exceeded approximately 85 percent of the time. In other words, appropriators junior to the instream flow reservation could expect to obtain a reliable water supply approximately 85 years out of 100.

For efficient, full service irrigation systems, a good water supply is usually considered to be necessary about 8 years out of 10 on the average (DNRC 1976). In addition to the irrigation reservations approved in the Yellowstone basin, the instream flow levels granted for the lower Yellowstone should allow for a certain degree of additional irrigated agricultural development.

For industrial energy development in the lower basin, the situation is different. Coal conversion facilities usually require a constant source of water. Industrial water applications junior to the established instream flow reservation cannot be guaranteed of a constant, uninterrupted supply of water. They would have to (1) provide offstream storage capabilities sufficient to maintain the operation of their plant through extended drought periods, or (2) modify the design of the plant cooling systems to require less water, or both.

With a minimum instream flow established, water availability may well become a limiting factor before the streams and rivers actually become severely depleted. The establishment of minimum instream flows, rather than a severely depleted stream situation, becomes the impetus for water conservation alternatives.

From a fish and wildlife perspective, the implications of the instream reservations and the allocation process on the Yellowstone are indeed significant. Under provisions of the Water Use Act in Montana, it is no longer necessary to abdicate water or critical riparian habitat areas dependent upon water to competing resource users due to a lack of legal standing. The unprecedented opportunity to defend aquatic and riparian habitat on the basis of water quantity ultimately leads to the preservation of population abundance as well as species diversity.

The results of the Yellowstone water allocation proceedings reveal that, at least in Montana, the aquatic and wildlife resources are recognized as serious competitors for the unallocated surface waters of the state. Successful competition in this arena by wildlife agencies can significantly aid in the effort to preserve the state's aquatic and riparian habitats.

The successful implementation of the instream flows granted in the Yellowstone basin may very well help ensure its continuance as on of the nation's last remaining free-flowing rivers. The major impetus for mainstem impoundment on the Yellowstone would come from severe annual depletions mainly affecting the lower river.

A depleted condition in the lower basin would impact municipalities depending on the Yellowstone for a water supply, irrigated agriculture, which is quite extensive in the lower basin, and also industrial development. By tempering water demands throughout the basin, the threat of mainstem impoundment on the upper Yellowstone can be minimized and the distinct possibility exists that the Yellowstone will remain in a free-flowing condition.

The Yellowstone basin currently enjoys a significant measure of protection for its aquatic and riparian wildlife communities as a result of the establishment of instream flow reservations. The protection, however, is neither absolute nor for all time. The Order is subject to legal appeal through the courts and litigation could extend for many years. In addition, the reservations must be reviewed at least once every 10 years, but this probably will occur every 5 years as presently ordered. The reservations granted may be modified by the Board during the review process.

To maintain the instream protection for the basin, the reservation must be supported and defended during the review process and a number of conditions required by the Board for obtaining additional data must be met. While the reservations on the Yellowstone are not the final word in instream flow protection for the basin, they set a significant precedent for future instream consideration and the development of a river ethic. Perhaps most significant is the fact that the instream reservations substantially strengthen the opportunity to preserve the Yellowstone River in a free-flowing condition and maintain its characteristic channel configuration with its associated aquatic, wildlife and riparian communities.

Acknowledgements

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Footnotes

[1]On January 12, 1979 the MCA replaced the RCM 1947 as the official codification of laws enacted by the Montana Legislature.

[2]By amendment and court action, the moratorium was extended until December 31, 1978.