YELLOWSTONE BASIN RESERVATION

10 - YEAR REVIEW REPORT

Submitted to

MONTANA BOARD OF NATURAL RESOURCES
AND CONSERVATION

August 19, 1988

Montana Department of
Fish, Wildlife & Parks
1420 East Sixth Avenue • Helena, Montana 59620

YELLOWSTONE RESERVATION
10-YEAR REVIEW REPORT

Reservant Name: Montana Department of Fish, Wildlife and Parks

Contact Person Name: Liter Spence

Address: 1420 East Sixth Avenue
Helena, MT 59620

Phone No.: 444-3888

Reservation Number: 1781-r

I. Objectives

(A) Purpose

1. The purpose of the department's instream flow reservation, as stated in the Board's Findings of Fact, is: 1) to ensure that waters are available for existing uses and to maintain a minimum flow, level, and quality of water; 2) to maintain the abundant and viable fishery and aquatic ecosystem existent in the Yellowstone River Basin; 3) to provide fish and wildlife habitat sufficient to perpetuate the diverse species comprising the various natural habitats; 4) to help maintain water quality; and 5) to contribute to a clean and healthful environment.

(B) Need

1. The need for the instream flow reservation, as stated in the Board's Findings of Fact, is as follows:

a) necessary for channel flushing and the maintenance of channels;

b) to control aquatic plant growth;

c) to maintain aquatic and wildlife species and the fishery of the basin;

d) to provide fish and wildlife habitat sufficient to perpetuate the diverse species comprising the natural resource at levels comparable to currently existing levels;

e) to provide for continued preservation of fish and wildlife habitat sufficient to perpetuate the several and many species found in each stream reach at currently existing levels;

f) to provide water-based and water-related recreation for residents of this State and tourists and other transients to this State;

g) to provide Fish, Wildlife and Parks standing to represent the public's interest in fish, wildlife and recreation when future applications for water use permits in the stream reaches are being considered.

All portions of the granted instream reservation for the various waters and stream reaches are presently being used for their intended purpose. The need for the instream reservation remains the same as originally stated in the application and at the time granted by the Board.

(C) Amount

1. The instream reservation granted for at least one waterway in the Yellowstone basin, the Tongue River, has proven insufficient for maintaining the fishery resource (see the second and fifth annual Yellowstone Reservation reports to the Board of Natural Resources and Conservation for further discussion). The Tongue River is important to Yellowstone River fish populations which spawn and rear their young in the lower river. Sauger and shovelnose sturgeon enter the Tongue River in spring when flows are high, spawn, then return to the Yellowstone.

The flow reservation granted on the Tongue River at its mouth totaled 54,289 A.F./year or 75 cfs for each month. While 75 cfs could be considered an acceptable flow during the summer when the river has historically gone dry, it cannot be considered adequate during other periods.

In recent years, flows in the lower Tongue in April and May have been unseasonably low and insufficient to attract sauger and shovelnose sturgeon spawners from the Yellowstone, causing the failure of reproduction in those years. Flows were, however, in the range of those granted by

the Board for instream purposes (75 cfs).

To maintain these migratory sauger and shovelnose spawning runs, the DFWP, in its original application, requested the following flows to be delivered between the T & Y Diversion Dam and the mouth of the Tongue River. These flows would trigger spawning migrations and maintain adequate spawning and rearing habitats for these species.

Period	Flow (cfs)
September 1 - February 28	190
March 1 - April 30	525
May 1 - July 15	600
July 16 - August 31	225

One of the apparent reasons the Board reduced the requested flows to 75 cfs was the availability of water to meet the needs of an enlarged Tongue River Dam, proposed by DNRC. However, the reservoir has never been built. DNRC was granted a water reservation of 383,000 AF/yr to increase the storage capacity of the existing Tongue River Reservoir and provide additional irrigation and other beneficial water uses, utilizing a total of 450,000 AF/yr. This 450,000 acre feet of storage could provide 72,000 acre-feet of firm annual yield for new use in addition to the 40,000 acre-feet yield now obligated in the existing reservoir (a total of 112,000 AF/yr), while releasing an average of 75 cfs below the reservoir (Order of the Board, Pg 260, Finding Nos. 36 and 37).

(D) Public Interest

The public interest value of the instream flow reservation remains high and has likely increased over the 1978 level. This increase stems partly from the fact that the slow down in Montana's agricultural industry has elevated the role of tourism in the State's economy. (Next to agriculture, the tourist industry is Montana's second largest employer). Montana's scenic and fish-filled rivers and streams greatly contribute to the influx of tourists and to the health and continued growth of the expanding tourist industry. A national survey showed fishing to be the second-most reported vacation activity, following going

to the beach - an experience not readily available in Montana (Montana Department of Commerce, 1988). Without adequate instream flows to protect recreational and fishery values, tourism in Montana would undoubtedly suffer.

According to the 1987 national survey of fishing and hunting by the U.S. Fish and Wildlife Service, Montana ranked fourth in the number of non-resident fishing license holders. Only Colorado, Michigan and Wisconsin, states located closer to more populous areas, sold more of these licenses. This reflects the popularity and, therefore, the importance of Montana's fishing resource and the need to maintain adequate flows to meet this public interest need.

Economic studies conducted by the MDFWP show that anglers alone expended $52.4 million in 1985 while recreating on the State's trout streams. (This figure excludes monies expended while fishing lakes, reservoirs and warm-water streams). Of the $10.2 million expended by anglers on the trout streams of the Yellowstone basin in 1985, non-residents of Montana contributed 60%, yet accounted for only 22% of the estimated 235,000 angler-days of pressure. As these data indicate, non-resident anglers provide a significant boost to the basin's economy and will continue to do so, provided our stream trout fisheries continue to be maintained at levels comparable to existing levels - an intended goal of the instream flow reservation. A further discussion of economic values is contained in Appendix A.

II. Ten-year Review Criteria

(A) Failure of anticipated demand for water for the purpose of the reservation to materialize.

1. (Not required for instream flow reservations).

(B) Inadequacy of the reservation facilities needed to put reserved water to use.

1. The DFWP reservation does not require any facilities in order to put the reserved water to use. Stream channels do change over time. However, only in the case of man-caused channel alterations is there a detrimental effect on the purpose of the reservation. Channel alterations eliminate or reduce the physical habitat of fish and aquatic organisms, thus reducing the places where these organisms live. In many such

instances, more flow is needed to fill the altered channel, which has become wider and more flat in configuration. These conditions only accentuate the need for adequate streamflow, which is at least partially provided by the amount of the granted flow reservation.

(C) Non-compliance with Montana or federal statutes for environmental standards.

1. No statute, rule or permit violations are known or anticipated in regard to the instream reservation.

(D) Incompatibility with local or regional planning efforts.

1. No conflicts with water resource, land resource or other planning ordinances are known or anticipated.

(E) Use of reserved water for other than beneficial use as defined in Montana law.

1. Beneficial uses of water, as defined by 85-2-102, MCA, include fish, wildlife and recreational uses. All of the instream reservations are being used for their intended beneficial uses and for the purposes stated under I.(A) of this report.

2. No misuse of reserved water by DFWP has occurred.

(F) Non-compliance with any conditions of the 1978 Order Establishing Reservations

1. The Order of the Board Establishing Reservations, paragraph 117 (page 49), requires DFWP to submit to the Board an annual progress report by December 15 of each year until all work required under paragraph 116 is completed. All of the work has now been completed with the exception of acquiring 10 years' gaging data on the Shields River near the mouth in order to quantify the 90th percentile flows granted by the Board. This gaging will be completed in 1988 and the quantified flows will be presented in the 10th annual report, thus completing the compliance requirements.

The following are compliance and related documents submitted to the Board since the reservation was granted.

The Yellowstone River Instream Reservation, Dec. 15, 1978-Dec. 15, 1979, First Annual Report. 29 pp.

The Yellowstone River Instream Reservation, Dec. 15, 1979-Dec. 15, 1980, Second Annual Report. 31 pp.

The Yellowstone River Instream Reservation, Dec. 16, 1980-Dec. 15, 1981, Third Annual Report. 33 pp

The Yellowstone River Instream Reservation, Dec. 16, 1981-Dec. 15, 1982, Fourth Annual Report. 58 pp.

The Yellowstone River Instream Reservation, Dec. 16, 1982-Dec. 15, 1983, Fifth Annual Report and Five Year Summary. 51 pp

The Yellowstone River Instream Reservation, Dec. 16, 1983-Dec. 15, 1984, Sixth Annual Report. 18 pp.

The Yellowstone River Instream Reservation, Dec. 16, 1984-Dec. 15, 1985, Seventh Annual Report. 55 pp.

The Yellowstone River Instream Reservation, Dec. 16, 1985-Dec. 15, 1986, Eighth Annual Report. 57 pp.

The Yellowstone River Instream Reservation, Dec. 16, 1986-Dec. 15, 1987, Ninth Annual Report. 77 pp.

Estimated Monthly Percentile Discharges at Ungaged Sites in the Upper Yellowstone River Basin in Montana. U.S. Geological Survey Water Resources Investigations Report 86-4009. April, 1986. 34 pp.

2(a) Studies and Assessments

Since the granting of the instream reservation in 1978, the MDFWP has continued to collect fish, wildlife and related biological information on those streams in the Yellowstone basin where a reservation was granted. These studies were

conducted to provide information needed to manage these fish and wildlife resources, to mitigate potential environmental impacts resulting from various proposed developments, and to support the granted instream reservation. About 65 documents and reports published since 1977 discuss the information that has been gathered from those waters. These documents and a brief summary of their contents are given in Appendix B.

Several past and ongoing studies are examining the responses of fish and other wildlife to flow variations in selected Yellowstone waterways. The following summarizes the findings to date for some of these flow-related studies.

A. White-tailed deer

The relationship between river flow and the riparian habitat in which white-tailed deer are associated on the lower Yellowstone River was evaluated (see Appendix B (Wildlife) for a list of references). A project conclusion is that fluctuations in annual river flow, which includes some flooding of islands and other low-lying areas of floodplain during May-July, are essential for maintaining riparian habitat favored by white-tailed deer along the Yellowstone River. A direct relationship exists between the relative amount of riparian forest communities and the distribution and numbers of deer.

B. Paddlefish

The magnitude and duration of the Yellowstone's spring flows appear to play a key role in enabling the annual spawning run of paddlefish to migrate up the Yellowstone River to the better spawning areas above the Intake Diversion Dam, as well as influencing reproductive success. In past years, anglers have harvested paddlefish upstream from Intake at the mouths of the Powder and Tongue Rivers and below the Cartersville Diversion Dam at Forsyth. In 1987 and 1988, portions of this stretch of river were electrofished to monitor paddlefish movement. Results of this monitoring are summarized below.

1987

Yellowstone River flows were low in May and exceptionally low in June. The annual peak flow at Sidney was 22,100 cfs on May 31.

Normally the river peaks in excess of 42,000 cfs. Between June 4 and June 19, 83 river miles were electrofished from the mouth of the Powder river to Intake. Only three paddlefish were observed. Flow peaks and duration were apparently insufficient to allow access for significant numbers of paddlefish to the better spawning gravels upstream of Intake Diversion Dam.

Distribution of paddlefish in May and June between Intake Diversion Dam and North Dakota was not highly "clumped", as occurred in normal flow years. Low flows in June may have prevented paddlefish spawning.

1988

Yellowstone River flows were higher in June 1988 than in June 1987, but still below average. Flow peaked at 32,000 cfs on June 9. High flows were also of shorter than average duration. Several days in June were spent electrofishing between the Cartersville Diversion Dam at Forsyth and Intake, but no paddlefish were observed. It was again concluded that river flows were not sufficient to move paddlefish upstream of Intake. Flows may also have been too low for paddlefish spawning downstream of Intake because large concentrations of paddlefish were not found.

C. Yellowstone Cutthroat Trout

The Yellowstone cutthroat trout of the upper Yellowstone River reproduce in June and July in the river's tributaries, many of which are severely dewatered during the summer irrigation season. Consequently, reproductive success can be limited in some years, particularly during dry years when irrigation demand exceeds the water supply. Ongoing work by DFWP has shown that tributary flow levels during the cutthroat spawning and rearing periods influenced year-class strengths of adult cutthroat in the main Yellowstone River, with dry years producing far fewer cutthroat than wet years. Densities of adult cutthroat were also highest in Yellowstone River sections having the better quality (and least dewatered) spawning tributaries. Sections having degraded tributaries supported fewer

cutthroat.

The findings to date support DFWP's contention that all the remaining unappropriated water in the upper Yellowstone's tributaries are needed to sustain the cutthroat fishery of the Yellowstone mainstem. This remaining water was applied for in the original reservation application, but the requests were substantially reduced in the Board's 1978 Order.

Further study of the relationship between tributary flow levels and cutthroat recruitment is presently being conducted by the Cooperative Fisheries Research Unit at Montana State University, with the financial support of the MDFWP.

These studies illustrate the major role played by streamflow levels in the life histories and success of fish and wildlife in the Yellowstone basin. The importance of the reserved water granted by the Board in helping to maintain these populations in the face of continued appropriations of water for diversionary purposes is also apparent.

2(b) Public Interest Considerations

Since the granting of the reservation, DFWP has monitored the flow levels in the basin during low water years using established U.S. Geological Survey gaging stations. DFWP also obtains from DNRC a current listing of water permit holders who are junior to the December 15, 1978 reservation priority date established by the Board.

During expected low flow or drought periods, DFWP has notified these junior users of the existence of the senior instream reservation and the possibility that they would have to cease their junior diversions if streamflows fell below the reservation amounts. This process was initiated in 1985 and repeated in 1987 and 1988. The purpose of this program is to protect the granted instream flow reservations in the public interest.

In 1985, junior users on the Stillwater, Bighorn and Tongue Rivers were notified on August 20 to

cease their diversions due to streamflows falling below the instream reservations. However, above normal rainfall in late August and September precluded similar activity on other streams since streamflows rose to normal or above normal levels.

Similarly, in 1987, below normal runoff was predicted. DFWP began monitoring streamflows on June 16 at 10 USGS gage sites in the basin. Letters were sent to 126 junior water users informing them of the anticipated drought and that they might be asked to cease their diversions at a later date. However, the second notification was not sent because several general and local rains occurred during July and August which caused streamflows to temporarily rise above the reservation on at least three occasions. Not until late September and October did streamflows stabilize below the reservation, but by this time most irrigation had ended and there was no purpose in notifying the junior users.

1988 has so far been a much different year than 1985 and 1987. A low winter snowpack following two previous drought years took its toll on available streamflow in the Yellowstone Basin. DFWP began monitoring streamflows on June 20 and on June 28 sent the first notification letter to all junior water users in the basin informing them of drought conditions and that they may have to cease their diversions. To date, streamflows in the main river and many of its tributaries are at record low levels for this time of year. Flows fell below the reservations in late July and continued to recede into mid-August. By July 29, junior water users in all reserved streams except the Yellowstone River above Livingston were notified to cease their diversions. In contrast to 1985 and 1987, there has been little or no precipitation and little likelihood of such events are currently forecast. It will require a major storm event to have a pronounced effect on streamflow. DFWP was continuing to monitor streamflows and compliance by the junior water users on the date of this report.

REFERENCES

Duffield, J., Loomis, J. and R. Brooks. 1987. The net economic value of fishing in Montana. Montana Department of Fish, Wildlife and Parks, Helena.

Duffield, J. and S. Allen. 1987. Contingent valuation of Montana trout fishing by river and angler subgroups. Montana Department of Fish, Wildlife and Parks, Helena.

U.S. Water Resources Council. 1979. Procedures for evaluation of national economic development (NED) benefits and costs in water resources planning. Final Rule. Federal Register, Vol 44, No. 242. December 14, 1979.

U.S. Water Resources Council. 1983. Economic and environmental principles and guidelines for water and related land resources. March 10, 1983.

Montana Dept. Commerce. 1988. Personal communication to Fred Nelson. MDFWP.

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APPENDIX A

In 1985, the Montana Department of Fish, Wildlife and Parks gained approval from the legislature to initiate a study to determine the value of fishing in Montana and to conduct a preference and attitude survey (Duffield, et al. 1987 and Duffield and Allen 1987). The primary objectives were to: 1) provide accurate and current net economic values of sport fishing in Montana to federal and state land and water management agencies; 2) provide current expenditures and net economic values to sportsmens groups, local governments and others interested in the economic impacts of fish-and-wildlife based recreation; and, 3) develop a base of fishery resource value and attitude information for use in making internal management decisions.

The study had three main components. The first was a series of surveys to determine the expenditure and net economic values associated with sport fishing in streams and lakes. The second component was a set of surveys to determine attitudes and preferences of trout stream anglers. The third was an economic analysis of several subgroups of trout stream anglers.

A regional Travel Cost Model was used to statistically derive a demand equation from the survey data collected from fishermen. This methodology is recommended by the Water Resources Council (1979 and 1983) as one of two preferred methods for estimating recreational benefits. The resulting demand equation is then used to calculate the net economic value for fishing at the site in question. Net economic value is the amount sportsmen said the fishing activity was actually worth <u>over and above their actual expenditures.</u>

The net economic value for only the <u>trout streams</u> in the Yellowstone River basin is $27 million per year (Tables 1 and 2). In addition, expenditure information by trip for residents and non-residents is shown (Table 3). Total expenditures based on the 1985/86 fishing use figures amounted to $10.2 million in 1985. (This $10.2 million is money expended only while fishing the Yellowstone basin's trout streams. Lakes, reservoirs and warm-water streams are excluded from the analysis).

A similar economic analysis is planned for the non-trout waters in Montana, at which time additional economic values will be derived for the Yellowstone basin's cool/warm water fisheries in the lower Yellowstone River and it's major tributaries.

Table 1. Net Economic Values Associated with the Yellowstone River Basin-1985.

River Section	Value Per Trip	Net Economic Value Per Day
Upper Yellowstone	$ 230.00	$ 210.00
Middle Yellowstone	63.00	62.00
Lower Yellowstone	111.00	111.00
Upper Yellowstone Tributaries	210.00	190.00
Middle Yellowstone Tributaries	58.00	54.00
Bighorn River	121.00	94.00
Stillwater River	82.00	68.00
Stillwater Tributaries	82.00	71.00
Boulder River	180.00	135.00

Table 2. Total Annual Net Economic Value.

River Section	Value Per Day	1985/86 Fishing Pressure	Site Value
Upper Yellowstone	$ 210.00	52,016	$ 10,905,000
Middle Yellowstone	62.00	31,156	1,948,000
Lower Yellowstone	111.00	995	110,000
Upper Yellowstone Tributaries	190.00	12,424	2,356,000
Middle Yellowstone Tributaries	54.00	30,132	1,640,000
Bighorn River	94.00	44,814	4,210,000
Stillwater River	68.00	32,857	2,227,000
Stillwater Tributaries	71.00	13,002	923,000
Boulder River	135.00	17,429	2,351,000
TOTAL		234,825	$ 26,670,000

Table 3. Expenditures by Resident and Nonresident Stream Fishermen - 1985.

Item	Resident	Nonresident
Transportation	$ 13.00	$ 166.00
Lodging	1.13	113.00
Food	16.00	175.00
Tackle	2.72	48.00
Guide	2.20	13.00
Misc.	1.00	21.00
TOTAL (Per Trip)	$ 36.00	$ 536.00
TOTAL (Per Day)	$ 22.00	$ 116.00

Total Resident Expenditures
Yellowstone Trout Streams, 1985 . . . . . .$ 4,066,628.00

Total Nonresident Expenditures
Yellowstone Trout Streams, 1985 . . . . . .$ 6,125,716.00

Total $10,192,344.00

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APPENDIX B

Annotated bibliography of fisheries and wildlife studies published since 1977 in the Yellowstone River Basin.

Fisheries

Belford, D.A. 1986. Abilities of trout to swim through highway culverts. M.S. Thesis, Montana State Univ., Bozeman, Montana. 67pp.

Data assessing the success of fish passage modifications to highway culverts on Cottonwood and Cedar Creeks are discussed.

Clancey, T.P. 1983. Effects of renovation on the Sacajawea Park lagoon system in Livingston, Montana. M.S. Thesis, Montana State Univ., Bozeman, Montana. 54pp.

Data on water quality, channel morphology and trout populations are discussed for Fleshman Creek.

Clancy, C.G. 1982. Southwestern Montana fisheries investigations; inventory and survey of waters of the upper Yellowstone drainage. Job Progress Rept., Fed. Aid Project No. F-9-R-29, Job No. I-C. Montana Dept. of Fish, Wildlife and Parks, Helena. 27pp.

Fish population estimates made for two study sections of the upper Yellowstone River and one section of the Shields River in 1980 are presented. Water quality, temperature and flow data are discussed for these two waterways. Instream flow requirements for trout in the Yellowstone River near Corwin Springs, as measured by the wetted perimeter method, are presented.

Clancy, C.G. 1983. Southwest Montana fisheries investigations; inventory and survey of waters of the project area. Job Progress Rept., Fed. Aid Project No. F-9-R-30, Job No. I-C. Montana Dept. of Fish, Wildlife and Parks, Helena. 25pp.

Trout population estimates for two sections of the upper Yellowstone River since the early 1970's indicate that wild trout numbers have increased since stocking of hatchery rainbow trout ceased. Numbers of Yellowstone cutthroat trout appear limited by fishing pressure. Trout populations in the Shields River appear suppressed by low summer flows. Water quality data for four sites on the Shields River are presented.

Clancy, C.G. 1984. Southwest Montana fisheries investigations; inventory and survey of waters of the project area. Job

Progress Rept., Fed. Aid Project No. F-9-R-32, Job No. I-C. Montana Dept. of Fish, Wildlife and Parks, Helena. 41pp.

Populations of trout in four sections of the Upper Yellowstone River are discussed, with emphasis given to Yellowstone cutthroat trout and factors that may be limiting their numbers. Tributaries to the upper Yellowstone River, including Mol Heron, Cedar, Tom Miner, Big, Mill, McDonald Spring, Emigrant Spring and Mission creeks and the Shields River were electrofished to assess cutthroat spawning runs. Results are presented.

Results of trout population estimates conducted in two sections of the Shields River in 1982-83 are presented. Low summer flow appears to be one factor limiting trout populations near Wilsall. Selected water quality parameters of the Shields River are discussed.
Water temperature data for two sites on the upper Yellowstone River are discussed.

Clancy, C.G. In press. Effects of dewatered spawning tributaries and special regulations on Yellowstone cutthroat trout in the upper Yellowstone River, Montana. Paper presented at Western Div. meeting, American Fisheries Soc., at Portland, Oregon in July, 1986. Paper to be published in proceedings.

Discusses effects of tributary dewatering and angling on the recruitment of adult cutthroat in the upper Yellowstone River.

Clancy, C.G. 1985. Southwest Montana fisheries investigations; inventory and survey of waters of the project area. Job Progress Rept., Fed. Aid Project No. F-9-R-33, Job No. I-C. Montana Dept. of Fish, Wildlife and Parks, Helena. 44pp.

Populations of brown, rainbow and Yellowstone cutthroat trout in the upper Yellowstone River are discussed, with special emphasis on spawning areas and spawning migrations.

The status of resident trout populations in a number of upper Yellowstone Basin tributaries, including Mol Heron, McDonald, Fleshman, North Fork of Brackett, Big, and Brackett creeks are assessed.

Population estimates on two sections of the Shields River from 1980-84 are discussed.

Clancy, C.G. 1980. Vital statistics and instream flow requirements of fish in the Montco mine area of the Tongue River, Montana. Montana Dept. of Fish, Wildlife and Parks, Helena. 55pp.

Results of fish population surveys and instream flow determinations conducted for the Tongue River in 1978-79 are discussed.

Decker-Hess, J. 1986. An inventory of the spring creeks in Montana. The American Fisheries Society, Bethesda, Maryland. 123pp.

Inventory data is presented for the following spring-fed streams; Bluewater Creek, Emigrant Spring Creek, Armstrong Spring Creek and Nelson Spring Creek.

Elser, A.A. 1980. Southeast Montana fisheries investigations; paddlefish investigations. Job Progress Rept., Fed. Aid Project No. F-30-R-16, Job No. IIa. Montana Dept. of Fish, Wildlife and Parks, Helena. 15pp.

Sampling results for the paddlefish run at Intake on the lower Yellowstone River in 1979 are presented.

Elser, A.A. 1984. Southeastern Montana fisheries investigations; fish management surveys. Job Progress, Rept., Fed. Aid Project No. F-30-R-19, Job No. I-b. Montana Dept. of Fish, Wildlife and Parks, Helena. 11pp.

Results of migrant fish sampling in the lower Tongue River for 1982 are presented.

Elser, A.A. 1983. Southeastern Montana fisheries investigations; fish management surveys. Job Progress Rept., Fed. Aid Project No. F-30-R-18, Job No. Ib. Montana Dept. of Fish, Wildlife and Parks, Helena. 23pp.

Results of migrant fish sampling in the lower Tongue River for 1981 are presented. Fish population surveys conducted in the Hanging Woman - Otter Creek drainages are discussed.

Elser, A.A. 1981. Southeastern Montana fisheries investigations; fish management surveys. Job Progress Rept., Fed. Aid Project No. F-30-R-17, Job No. Ib. Montana Dept. of Fish, Wildlife and Parks, Helena. 20pp.

Results of migrant fish sampling in the lower Tongue River for 1980 are presented. Fish sampling results are discussed for the Hanging Woman-Otter Creek drainages and other Yellowstone tributaries.

Fredenberg, W. 1985. Bighorn River creel census, March, 1982-October, 1983. Montana Dept. of Fish, Wildlife and Parks, Helena. 56pp.

Results of a 1982-83 creel census on the Bighorn River are discussed and compared to the findings of a census conducted in 1973.

Fredenberg, W.A., M.D. Poore and S.L. McMullin. 1986. Southcentral Montana fisheries study; inventory of waters of the project area. Job Progress Rept., Fed. Aid Project F-20-R-30, Job No. I-a. Montana Dept. of Fish, Wildlife and Parks, Helena. 27 pp.

Fish population data are presented for a number of Yellowstone reservation streams, including Sage Creek, Rock Creek (Clarks Fork drainage), Bridger Creek, and Upper and Lower Deer creeks.

Fredenberg, W.A., S.E. Swedberg and S.L. McMullin. 1985. Southcentral Montana fisheries study; inventory of waters of the project area. Job Progress Rept., Fed. Aid Project F-20-R-29, Job No. I-a. Montana Dept. of Fish, Wildlife and Parks, Helena. 19 pp.

Electrofishing data are presented for a number of Yellowstone reservation streams, including Sage, East Rosebud, West Rosebud, Willow, Red Lodge and Sweetgrass creeks and the Boulder and Stillwater rivers. A transplant of fluvial arctic grayling - a species of "special concern" in Montana - to Picket Pin Creek, a Yellowstone reservation stream, appeared successful.

Graham, P.J. and R.F. Penkel. 1978. Aquatic environmental analysis in the lower Yellowstone River. Montana Dept. of Fish, Wildlife and Parks, Helena. 102pp.

This study attempts to quantify effects of stream flow alterations on selected sport fish in the lower Yellowstone River.

Graham, P.J., R.F. Penkal and L. Peterman. 1979. Aquatic studies of the Yellowstone River. Prepared and submitted to the Bureau of Reclamation, Upper Missouri Region, Billings, Montana. 80pp.

Effects of streamflow alterations on selected sport fish in the lower Yellowstone River are discussed.

Hadley, K. 1984. Status report on the Yellowstone cutthroat trout (Salmo clarki bouvieri) in Montana. Montana Dept. of Fish, Wildlife and Parks, Helena. 74 pp.

This report discusses the present distribution of Yellowstone cutthroat trout - a species of "special concern" in Montana - in the Yellowstone River basin outside of

Yellowstone National Park.

Javorsky, L.D. 1984. The trout fishery on a reach of the upper Yellowstone River, Montana, during 1982. M.S. Thesis, Montana State Univ., Bozeman, Montana. 45pp.

Results of a creel survey to determine fishermen use and harvest on the fishery in a 9.2 km reach of the upper Yellowstone River in 1982 are discussed. Additional work documents cutthroat trout spawning runs in Big, McDonald Spring, Mill, Mol Heron, Cedar and Tom Miner Creeks, with the largest runs occurring in the latter two streams.

Marcuson, P.E. 1979. Summary of aquatic studies on Bluewater Creek, Montana. Montana Dept. of Fish, Wildlife and Parks, Helena. 27pp.

Summarizes aquatic information collected for Bluewater Creek up to 1979, including chemical, temperature, fish and invertebrate data.

Marcuson, P., P. Toennis and M. Schollenberger. 1982. Southcentral Montana fisheries study; inventory of waters of project area. Job Progress Rept., Fed. Aid Project F-20-R-26, Job No. I-a (Supplement). Montana Dept. of Fish, Wildlife and Parks, Helena. 47 pp.

Fish population estimates for 9 study sections and trout spawning data collected for the Stillwater River in 1981-82 are presented.

Marcuson, P.E. and S.E. Swedberg. 1979. Southcentral Montana fisheries investigations; inventory of waters of the project area. Job Progress Rept., Fed. Aid Project F-20-R-23, Job No. I-a. Montana Dept. of Fish, Wildlife and Parks, Helena. 6 pp.

Electrofishing data for the mid-Yellowstone River are discussed.

Marcuson, P.E. and S.E. Swedberg. 1979. Southcentral Montana fisheries investigations; inventory of waters of the project area. Job Progress Rept., Fed. Aid Project F-20-R-22, Job No. I-a. Montana Dept. of Fish, Wildlife and Parks, Helena. 5 pp.

Fish population and temperature data collected for the mid-Yellowstone River are discussed.

MDFWP. 1986. Draft upper Bighorn River fisheries management plan. Montana Dept. of Fish, Wildlife and Parks, Helena. 31pp.

Presents the Department's management plan for the upper Bighorn River for the period 1987-92. Includes fish population estimates since 1981, minimum flow targets and solutions to the present gas supersaturation problem.

MDFWP. 1986. Preliminary environmental review, smallmouth bass introduction - Bighorn River. Montana Dept. of Fish, Wildlife and Parks, Helena. 17pp.

Discusses the potential impacts of the Department's plan to introduce smallmouth bass to the lower Bighorn River.

MDFWP. 1981. Instream flow evaluation for selected waterways in Western Montana. MDFWP, Helena, Montana. 340pp.

Game fish population estimates are presented for Big Creek, Big Timber Creek, Brackett Creek, East Boulder River, Rock Creek (Shields River tributary), and Rock Creek (upper Yellowstone River tributary).

Oswald, R.A. 1982. A fisheries inventory of Bear Creek prior to proposed mineral mining at Jardine, Montana. MDFWP, Helena, Montana. 24pp..

Baseline fisheries data collected prior to proposed mineral mining are presented for Bear Creek. Bear Creek was found to support a relatively substantial spawning run of Yellowstone River cutthroat trout.

Parrett, C. and J. Hull. 1986. Estimated monthly percentile discharges at ungaged sites in the upper Yellowstone River basin in Montana. Water-Resources Investigations Report 86-4009, U.S. Geological Survey, Helena, Montana. 34 pp.

This report quantifies the amount (in cfs) of the percentile flows granted by the Board for the instream flow reservation on ungaged streams in the upper Yellowstone drainage.

Penkal, R.F. 1981. Life history and flow requirements of paddlefish, shovelnose sturgeon, channel catfish and other fish in the lower Yellowstone River system. Montana Dept. of Fish, Wildlife and Parks, Helena. 53pp.

This report is an extension of previous studies to quantify flow requirements and assess the impacts of energy development on the aquatic resource of the lower Yellowstone River and its tributaries. Waters discussed include the lower Yellowstone River, Little Powder River, Mizpah Creek, Powder River, Pumpkin Creek, Rosebud Creek, and Tongue River.

Poore, M. 1986. Southcentral Montana fisheries investigations; mid-Yellowstone River study. Job Progress Rept., Fed. Aid Project F-20-R-30, Job No. II-a. Montana Dept. of Fish, Wildlife and Parks, Helena. 11 pp.

Electrofishing data and fish population estimates collected for study sections in the mid-Yellowstone, Boulder and Stillwater rivers and East Rosebud Creek in 1981-85 are discussed.

Rehwinkel, B.J. 1978. Powder River aquatic ecology project, final report. Montana Dept. of Fish, Wildlife and Parks, Helena. 119pp.

Assesses the aquatic resource of the Powder River and its major tributaries. Includes discussions of fish populations, aquatic invertebrates and physical stream characteristics.

Rehwinkel, B. 1978. The fishery for paddlefish at Intake, Montana during 1973 and 1974. Trans. Am. Fish. Soc. 107:263-268.

Harvest and fishing pressure data are presented for the paddlefish fishery on the lower Yellowstone River at Intake, Montana.

Roberts, B.C. and R.G. White. 1986. Potential influence of recreational use on Nelson Spring Creek. Montana Cooperative Fisheries Research Unit, Montana State Univ., Bozeman, Montana. 69pp.

Impacts of wading by anglers on incubating trout eggs in sections of Nelson Spring Creek were studied. Mortality of trout eggs can be significant, depending on wading frequency and stage of embryonic development. Use of the creek by spawning trout from the Yellowstone River was also evaluated and angler use data presented.

Schollenberger, M. 1983. Study of Boulder River fishery, supplementary observations - Fall 1982. Montana Dept. of Fish, Wildlife and Parks, Helena. 12 pp.

Additional fish population data are presented for the Boulder River and its tributaries.

Schollenberger, M. 1983. Southcentral Montana fisheries investigations; inventory of waters of project area-(Boulder River). Job Progress Rept., Fed. Aid Project F-20-R-27, Job No. I-a (Supplement). Montana Dept. of Fish, Wildlife and Parks, Helena. 11 pp.

Fish data collected for the Boulder and East Boulder rivers in 1981 are discussed.

Stevenson, H.R. 1980. Southwestern Montana fisheries investigations; inventory and survey of waters of the upper Yellowstone drainage. Job Progress Rept., Fed. Aid Project No. F-9-R-28, Job No. I-C. Montana Dept. of Fish, Wildlife and Parks, Helena. 35pp.

Fish population estimates for one study section of the Yellowstone River in 1978 and for two study sections of the Shields River in 1978 and 1979 are presented. Water temperature and flow data for both waters are discussed. A population estimate made on Armstrong Spring Creek in 1978 is compared to estimates made in 1971 and 1972, prior to the establishment of a commercial trout hatchery on the creek.

Stevenson, H.R. 1979. Southwestern Montana fisheries investigations; inventory and survey of waters of the project area. Job Progress Rept., Fed. Aid Project No. F-9-R-26, Job No. I-C. Montana Dept. of Fish, Wildlife and Parks, Helena. 31 pp.

Water temperature, flow and fish population and growth data are discussed for the upper Yellowstone River. These data suggest that a positive relationship exists between flows in the upper river and changes in the brown trout population.

Stewart, P. A. 1985. Southeastern Montana fisheries investigations; fish management surveys. Job Progress Rept., Fed. Aid Project No. F-30-R-21, Job No. I-B. Montana Dept. of Fish, Wildlife and Parks, Helena. 10pp.

Migrant sauger and shovelnose sturgeon entering the lower Tongue River in 1984 were monitored. Use of the Tongue River by these spawners appears to be regulated by spring flow levels.

Results of the 1984 walleye egg taking operation on the Yellowstone River at Intake are discussed.

Swedberg, S. 1985. Southcentral Montana fisheries investigations; mid-Yellowstone River study. Job Progress Rept., Fed. Aid Project F-20-R-29, Job No. II-a. Montana Dept. of Fish, Wildlife and Parks, Helena. 19 pp.

Electrofishing data collected for sections of the mid-Yellowstone, Stillwater and Clarks Fork Yellowstone rivers in 1983-84 are presented.

Swedberg, S. 1984. Southcentral Montana fisheries investigations; mid-Yellowstone River study. Job Progress

Rept., Fed. Aid Project F-20-R-27&28, Job No. II-a. Montana Dept. of Fish, Wildlife and Parks, Helena. 37 pp.

Electrofishing and fish population data collected in 1982-83 for the Boulder and Stillwater rivers and two sections of the East Boulder and mid-Yellowstone rivers are discussed. Significant trout movements, probably related to spawning, occur between the mid-Yellowstone River and its major tributaries, the Stillwater and Boulder rivers.

Swedberg, S. 1982. Southcentral Montana fisheries investigations; mid-Yellowstone River study. Job Progress Rept., Fed. Aid Project F-20-R-26, Job No. II-a. Montana Dept. of Fish, Wildlife and Parks, Helena. 9 pp.

Population estimates for two sections of the mid-Yellowstone River are presented for 1980 and 1981. Tag return data indicate that mid-Yellowstone River trout utilize the major tributaries.

Swedberg, S. 1981. Southcentral Montana fisheries investigations; mid-Yellowstone River study. Job Progress Rept., Fed. Aid Project F-20-R-25, Job No. II-a. Montana Dept. of Fish, Wildlife and Parks, Helena. 12 pp.

Results of electrofishing and tagging studies conducted on 5 sections of the mid-Yellowstone River in 1980 are presented.

Swedberg, S. 1980. Southcentral Montana fisheries investigations; mid-Yellowstone River study. Job Progress Rept., Fed. Aid Project F-20-R-24, Job No. II-a. Montana Dept. of Fish, Wildlife and Parks, Helena. 8 pp.

Results of electrofishing and tagging studies conducted on two sections of the mid-Yellowstone River in 1979 are presented.

Various authors. 1978-1986. Southcentral Montana fisheries investigations, Bighorn Lake and Bighorn River post-impoundment study. Job Progress Rept., Fed. Aid Project No. F-20-R-22 through 30, Job No. IV-a. Montana Dept. of Fish, Wildlife and Parks, Helena.

These nine annual reports discuss the results of fishery, aquatic invertebrate and angler use studies conducted by the MDFWP on the Bighorn River between 1978 and 1986.

Vincent, E.R. and C. Clancey. 1980. Southwest Montana fisheries investigations; fishing regulation evaluation on major rivers. Job Progress Rept., Fed. Aid Project No. F-9-R-28, Job No. IIC. Montana Dept. of Fish, Wildlife and Parks, Helena. 21pp.

The results of a creel census/fish population study conducted on the Corwin Springs section of the Upper Yellowstone River are discussed.

White, R.G. and eight coauthors. 1987. The effects of supersaturation of dissolved gasses on the fishery of the Bighorn River downstream of the Yellowtail Afterbay Dam, 1986 annual report. Montana Coop. Fish. Research Unit, Montana State Univ., Bozeman and Montana Dept. of Fish, Wildlife and Parks, Helena. 181pp.

Results to date of a long-term study assessing the impacts of gas bubble disease on the fishery of the Bighorn River.

Wiedenheft, W. 1982. Study of Boulder River fishery. Montana Dept. of Fish, Wildlife and Parks, Helena. 22pp.

Fish population estimates are presented for 13 study sections in the Boulder River and its tributaries, including the East and West Boulder rivers.

Wiedenheft, W. 1982. Southcentral Montana fisheries investigations; inventory of waters of project area-(Boulder River). Job Progress Rept., Fed. Aid Project F-20-R-26, Job No. I-a (supplement). Montana Dept. of Fish, Wildlife and Parks, Helena. 29 pp.

Fish population and other fisheries data are discussed for the Boulder River, including the East and West Boulder rivers.

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Wildlife

Boggs, K.W. 1984. Succession in riparian communities of the lower Yellowstone River, Montana. M.S. Thesis, Montana State Univ., Bozeman. 54 pp.

Compton, B.B. 1986. Distribution of white-tailed deer along the lower Yellowstone River. M.S. Thesis, Montana State Univ., Bozeman. 74 pp.

Compton, B.B. 1986. Use of agricultural crop types by white-tailed deer. Proc. Mont. Acad. Sci. 46: In Press.

Compton, B.B., R.J. Mackie, and G.L. Dusek. In Review. Factors influencing density distribution of white-tailed deer in riparian habitats. J. Wildl. Manage. 00:00-00.

Dusek, G.L. 1984. Some relationships between white-tailed deer and agriculture on the lower Yellowstone River. Pp. 27-33 in Agriculture and Wildlife (A. Dood, ed.). Proc. Montana Chapt., The Wildl. Soc., Butte.

Dusek, G.L., R.J. Mackie, J.D. Herriges, and B.B. Compton. In Review. Population ecology of white-tailed deer in the lower Yellowstone River. Draft final project document, Montana Dept. of Fish, Wildlife and Parks, Helena.

Dusek, G.L., R.J. Mackie and B.B. Compton. 1986. Relationships between white-tailed deer and a free-flowing river in eastern Montana. Presentation given at the annual meeting of the Central Mountains and Plains States Section, T.W.S., in Custer, SD in August, 1986.

Herriges, J.D. 1986. Movement, activity, and habitat use of white-tailed deer along the lower Yellowstone River. M.S. Thesis, Montana State Univ., Bozeman. 131 pp.

These 8 documents address aspects of the relationship between streamflow and the riparian habitat in which white-tailed deer are associated on the lower Yellowstone River. A project conclusion is that fluctuations in annual streamflow, which includes some flooding of islands and other low-lying areas of floodplain during May-July, are essential for maintaining riparian habitat favored by white-tailed deer along the Yellowstone River. A direct relationship exists between the relative amount of riparian forest communities and the distribution and numbers of deer.

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