A CREEL CENSUS SURVEY OF THE MISSOURI RIVER SPORT FISHERY

by

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Mr. Larry Peterman
Fisheries Biologist
State of Montana
Dept. of Fish & Game
Box 430
Miles City, Montana 59301

Dear Mr. Peterman:

In response to your phone call of several weeks ago, I am enclosing the following items which either directly or indirectly contain information on the shovelnose sturgeon.

1) A copy of a thesis by Tim Modde on the electivity of food item by the shovelnose sturgeon
2) A copy of a final report to the Water Resources Institute containing short summaries of some of our Missouri River work. A few of these studies pertain to the shovelnose sturgeon.
3) Two papers published in the So. Dak. Acad. of Science on aufwuchs, benthos and drift organisms (appended to Water Resources final report).
4) A copy of a final report we did for the Corps of Engineers on fish distribution in 312 miles of the Missouri River.
5) A thesis copy of Cal Groen's Creel Census survey of the Missouri River sports fishery.

We have done additional work on the shovelnose including rather good data on fecundity and reproduction and an unsuccessful (or rather unreliable) attempt to age sturgeon. This information is contained in two theses, one of which is not yet completed.

I hope this information will be helpful to you and best of luck with your ambitious project.

Sincerely yours,

James C. Schmulbach

James C. Schmulbach
Professor

JCS/mb

ACKNOWLEDGEMENT

The author wishes to express special appreciation for the guidance and advice given by Dr. James C. Schmulbach throughout the investigation and during the preparation of this manuscript. Gratitude is expressed also to Dr. George Hoffman and Dr. Donald Dunlap for reviewing the manuscript. Assistance rendered by many contemporary graduate students was appreciated but special thanks are due to Bruce Moore and Don Lewis.

This project was administered through the Center for Environmental Studies at the University of South Dakota from financial assistance provided by the U. S. Army Corps of Engineers, Omaha District, Contract number DACW45-73-C-0002.

Lastly, I wish to express my gratitude to my wife, Becky, for her assistance and patience.

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INTRODUCTION

Surface water is a finite renewable resource on which man has placed many demands. In the U.S., priorital use of surface water has been extended primarily to agriculture, industry, municipalities, navigational interests, power producers, etc.. However, in recent years the recreational use of surface water has received considerable attention. An expanding population coupled with increased leisure time for many has placed a recreational burden on surface waters, particularly those near population centers. It has been predicted that outdoor recreational activity in the U. S. will become four times greater in the year 2000 than it was in 1960 (Bur. Outdoor Rec., 1968). Recreational users of surface waters will demand that their interests be given strong consideration in future plans for the management and operation of this resource.

In the U. S. the passage of the Multiple Use-Sustained Yield Act of 1960 instituted the multiple use concept on natural resources controlled and managed by federal agencies. Surface water is one of the resources considered under this concept. In some situations multiple water usage is possible. However, it is inevitable that conflicts will arise since the same resource cannot always be utilized in the same place at the same time in two or more different ways. Future use of surface water must take into account all possible uses of the water including those having intangible as well as tangible values (Canfield, 1967). However, in order to make

intelligent decisions we must have basic information about the existing and potential uses of the resource, including the recreational aspects. Since fishing is an important recreational use of surface waters, creel census surveys will help the planners to evaluate recreational potential.

In 1970, 36 million fishermen and hunters spent $7.1 billion to fish and hunt (Bur. Sport Fish. and Wildlife, 1970). Despite urbanization, pollution, and channelization of our water courses, about one third of the population participated in one or more of these sports. Approximately 29,363,000 fresh-water fishermen spent $3,734,178,000 ($6.30 per fisherman per day) on 592,494,000 recreational days.

The Missouri River, particularly the middle portion, affords some outstanding recreational opportunities for "quality" recreational experiences. The "Big Muddy", which is a colloquial name for the Missouri River, originates at Three Forks, Montana, at the confluence of the Jefferson, Madison and Gallatin Rivers. It flows southeasterly 2,464 miles (3,942 km) to its confluence with the Mississippi River above St. Louis, Missouri. It drains an area of 529,000 square miles (1,354,240 km^2) including 9,700 square miles (24,830 km^2) in Canada. The middle portion of the river contains six large main-stem reservoirs which exhibit a combined shoreline of almost 6,000 miles (9,600 km) which is more than the total continental shoreline of the Atlantic Gulf, and Pacific Oceans bordering on the contiguous 48 states (Bur. Outdoor Rec., 1968).

The six main-stem reservoirs at full capacity impound over 50% of the upper 1500 miles (2,400 km) of the river resulting in man-controlled water discharges. From Sioux City, Iowa, to its confluence with the Mississippi River, the Missouri has been channelized. Below the last main-stem impoundment (Lewis and Clark Reservoir) near Yankton, South Dakota, the river is unchannelized to Ponca, Nebraska, a distance of approximately 52 miles (83 km).

The unchannelized portion of the river is characterized by a meandering main channel, many subsidiary channels (chutes), sand bars, islands, changing shorelines, and variable current velocities. The bottom substrate consists predominately of fine sand (Volesky, 1969). Backwater marshes and shallow chutes are common in this portion of the river. The river width averages 2,363 feet (720.7 meters) and has a mean depth of 6 feet (2 meters) with the maximum depth rarely exceeding 20 feet (6.1 meters) (Morris et al., 1968).

The channelized portion of the river lacks the numerous chutes and backwater marshes. Channel improvement structures such as pile and rock wing dams, revetments, etc. utilize the force of the water to scour a narrow deep channel and to fill the backwater chutes with silt. The depth of the river near the pile dikes ranges from 10 to 28 feet (3-8.5 meters) while the average width of the channelized river is about 789 feet (240.3 meters). The surface area of a linear mile of the channelized river is approximately 67% less than the surface area of an equal distance of the unchannelized river

(Morris et al., 1968). The bottom substrate consists primarily of sand and silt and frequently contains much organic matter.

In the past the water in the river was managed principally to accomplish flood control, commercial navigation, and the production of hydro-electric power. Little consideration or research has been done on the recreational usage and in particular the sport fishery of this area.

Since little is known about the recreational usage and potential of the Missouri River a survey of the sport fishery in a 312 mile portion of the Missouri River was conducted from July 1, 1972 to June 30, 1973. The study area encompassed both unchannelized and channelized river.

The main objective of the overall study was to sample the recreational usage and value of this portion of the Missouri River. Specifically the creel census was designed to determine these parameters of the recreational usage:

1) Estimate the recreational angling pressure
2) Determine the characteristics of the fishery
3) Determine the characteristics of the angling public

METHODS AND MATERIALS

Description of Study Area

The study area encompassed 312 miles (499 km) of the Missouri River between Gavins Point Dam near Yankton, South Dakota, and Rulo, Nebraska (Figure 1). The river was divided into four sections for sampling purposes. Many criteria were used in establishing the boundaries of the sections but the most important were: 1) distance a boat could travel in a 6-8 hour sampling period, 2) access to the river including adequate boat launching facilities, and 3) easily recognized boundary markers such as bridges since many fishermen would be counted from the air. The four sections eventually established were as follows:

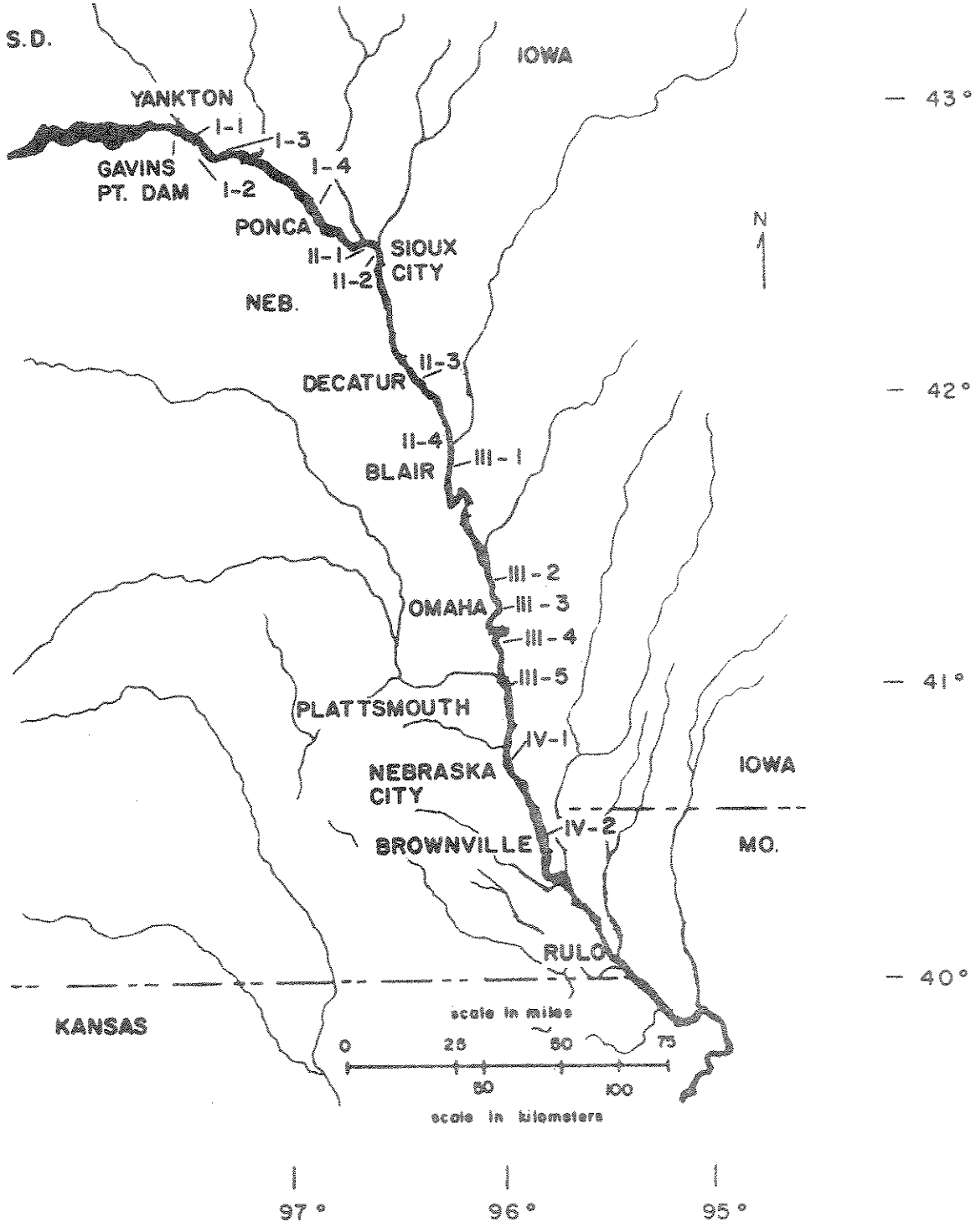
Section I	Gavins Point Dam to Sioux City, Iowa, river miles (r.m.) 810-733, a distance of 77 miles (123 km.)
Section II	Sioux City to Blair, Nebraska, (r.m.) 733-648, a distance of 85 miles (138 km.)
Section III	Blair to Nebraska City, Nebraska, (r.m.) 648-562, a distance of 86 miles (138 km.)
Section IV	Nebraska City to Rulo, Nebraska (r.m.) 562-498, a distance of 64 miles (102 km.)

Each section was then divided into subsections in order to obtain more precise statistics on fishing pressure and catch distribution. The divisions were:

Section I-1	Gavins Point Dam to the Yankton Bridge r.m. 810-806, a distance of 4 miles (6.4 km.)
Section I-2	Yankton Bridge to Clay County Park, S. D. r.m. 806-781, a distance of 25 miles (40 km.)

Section I-3	Clay County Park to Ponca, Nebr. r.m. 781-754, a distance of 27 miles (43 km.)
Section I-4	Ponca to Sioux City, Ia. (S. Sioux Bridge) r.m. 754-733, a distance of 21 miles (34 km.)
Section II-1	Sioux City to the Soo Terminal r.m. 733-728, a distance of 5 miles (8 km.)
Section II-2	Soo Terminal to Decatur, Nebr. r.m. 728-691, a distance of 37 miles (59 km.)
Section II-3	Decatur to the Little Sioux River r.m. 691-669, a distance of 22 miles (35 km.)
Section II-4	Little Sioux River to Blair, Nebr. r.m. 669-648, a distance of 21 miles (34 km.)
Section III-1	Blair to Dodge Park, Omaha, Nebr. r.m. 648-627, a distance of 21 miles (34 km.)
Section III-2	Dodge Park to I-490 Bridge, Omaha, Nebr. r.m. 627-616, a distance of 11 miles (18 km.)
Section III-3	I-490 Bridge to Bellevue, Nebr. r.m. 616-601, a distance of 15 miles (24 km.)
Section III-4	Bellevue to Plattsmouth, Nebr. r.m. 601-590, a distance of 11 miles (18 km.)
Section III-5	Plattsmouth to Nebraska City, Nebr. r.m. 590-562, a distance of 28 miles (45 km.)
Section IV-1	Nebraska City to Brownville, Nebr. r.m. 562-535, a distance of 27 miles (43 km.)
Section IV-2	Brownville to Rulo, Nebr. r.m. 535-498, a distance of 37 miles (59 km.)

Four different types of river habitats were contained within the study area. (1) Section I-1, the Gavins Point


S.D.
IOWA
YANKTON
I-1
I-3
I-4
GAVINS
PT. DAM
I-2
PONCA
II-1
SIOUX
CITY
II-2
NEB.
II-3
DECATUR
II-4
III-1
BLAIR
III-2
OMAHA
III-3
III-4
III-5
PLATTSMOUTH
IV-1
NEBRASKA
CITY
IOWA
IV-2
BROWNVILLE
MO.
RULO
KANSAS
N
scale in miles
0 25 50 75
50 100
scale in kilometers
43°
42°
41°
40°
97°
96°
95°

Dam tailwaters, provided a habitat which is not typical of natural riverine ecosystems. (2) Section I-2 and I-3 consisted of 52 miles (83 km.) of unchannelized river and represented the only natural river remaining in the Missouri River downstream from the main-stem impoundments. (3) Section I-4 consisted of 21 miles (34 km.) of stabilized river from Ponca State Park to Sioux City, Iowa. Stabilized river is characterized by having its banks stabilized with rocks and pile dikes but differs from channelized river in that no single deep channel has been developed. (4) Sections II, III, and IV consisted of 235 miles (376 km.) of channelized river. All channelized river sections are not alike because of the effects man-made structures have had upon the river. For example, section II had more oxbow lakes with functional connections to the river than the other sections and the main channel of Section IV was deeper.

Tributaries flowing into the Missouri River in the study area were the James River (r.m. 800), the Vermillion River (r.m. 772), the Big Sioux River (r.m. 734), the Floyd River (r.m. 731), the Little Sioux River (r.m. 669), the Soldier River (r.m. 664), the Boyer River (r.m. 635), the Platte River (r.m. 595), the Nishnabotna River (r.m. 542), the Nemaha River (r.m. 528), and the Tarkio River (r.m. 507).

Creel Census Survey Methods

Creel census surveys are frequently employed to evaluate a sports fishery so that a sound management plan can be promulgated for the fishery. Annual expenditures for creel studies

The complete census method in which all anglers are enumerated and interviewed is the most accurate. Generally this method is feasible only when access to the body of water is limited to a few points which are continuously monitored by trained personnel. Eschmeyer (1939), Fry (1949), and Cooper (1952) were among the first to conduct this type of census. Since considerable time, man-power, and cost are involved in a complete census, other approaches to the problem were needed. Voluntary reporting systems using postal card questionaires were tried but were found to be unsatisfactory and, in some cases, even resulted in biased data (Calhoun, 1950; Solman, 1951). Diaries and logbooks have also been used (Cleary, 1953) but the respondents usually were experienced and successful anglers (Carlander, 1958).

Most creel census studies use a sampling technique which provides a reasonable estimate of the fishery parameters with a minimum of effort and time. It is impractical to count and contact all anglers when there are a large number of access points and a limitation on the available time and man-power. Consequently, many investigators have devised sampling schemes whereby the fishermen are counted on a precise prearranged schedule while the angler interviews are completed at random. Anglers are usually interviewed while actively engaged in fishing or when the fishing trip is completed. The latter works effectively when the fishermen must check out through a station.

Stratified random sampling schemes where both the counts and interviews were taken from the fisherman

population on a prearranged schedule have been employed often (Best and Boles, 1956; DiCostanzo, 1956; Schmulbach, 1959; and others). A modification of a stratified random sampling technique known as the Latin-square design was used in part of this study. However, before explaining the details of the experimental design and the census taking procedures, the terms which are frequently used in the thesis will be defined. Many of these terms are unique to creel census surveys.

Creel Census Terminology

Sample creel survey - A sample creel survey is a partial census in which samples (counts and interviews) of fishermen are used to obtain estimates of angling data. Not all the fishermen are counted or contacted and only a representative sample is obtained.

Incompleted and completed fishing contacts - Incompleted contacts are those made while the angler is still actively engaged in fishing. Completed contacts are those obtained after the angler's trip is completed.

Man-hour of pressure - One man-hour of pressure is defined as one fisherman actively engaged in angling for one hour. This unit of effort is called a fisherman-hour or man-hour or angler-hour.

Catch rate (catch per unit of effort) - Catch rate is a measure of fishing success and is the ratio of catch (numbers of units or weight) to effort (hours). This ratio is obtained by dividing the total number or weight of fish

caught by the total number of hours fished and is referred to as the catch per fisherman-hour. The catch rate includes all fish caught per unit of time including those returned to the water.

Harvest rate (harvest rate per unit of effort) - Harvest rate is the number of fish which were caught and creeled (kept). This ratio is obtained by dividing the number or weight of fish creeled by the total number of fisherman-hours.

Fishing party - A fishing party is defined as one or more anglers who are fishing together and who have usually come to the river in the same vehicle. Only one member of the party was interviewed.

Method of fishing - This classification refers to the angling technique employed by the angler. In this study the anglers were divided into still fishermen, cast-and-retrieve fishermen, snaggers, throwline anglers and bow hunters. Still fishermen were those who fished with a heavily weighted line and the bait was not moved. These fishermen depend on the movement of the fish to locate the bait. Cast and retrieve anglers move their baits and lures continually.

Type of fishing - This classification refers to the location where the angling technique was employed. The two main types in this study were boat and shore fishermen.

Angler Counts - In the present sample creel survey, angler counts were made principally by an observer in a boat as he traversed the river. He was assisted by another census taker in an auto who took no part in making the counts but concentrated on interviewing anglers at major access

points. Communication between the two census takers was aided by two-way low-band FM radios. Binoculars (7X50) were also helpful in locating fishermen in remote locations. A routine was established whereby the auto census taker drove the boat census taker to an access point at one end of the four sections of the river previously described. The auto census taker would then interview fishermen at the main access points along the river and eventually meet the boat census taker at the other end of the section. The boat census taker made a progressive count of the anglers and interviewed fishermen in remote areas. Each of the four sections was sampled 20 times during the year for a total of 80 angler counts by boat.

In addition to the boat counts, 18 aerial counts were also conducted during the year. Each aerial count of fishermen was made on the entire 312 miles of the study area although on two occasions thunderstorms forces the pilot to abandon counting a portion of the river. Almost all aerial counts were on the same day the boat census taker was counting fishermen on one of the four sections of the river. This was done to establish the reliability of using aerial counts in the sample creel survey.

During the winter counting by boat was not possible so 25 angler counts were made by a census taker in an auto. The winter fishery is concentrated at Gavins Point Dam and several other access points in the unchannelized river. Therefore it was possible to get reasonably reliable winter angler counts by auto.

In all angler counts the recorder listed the approximate location of the anglers with reference to some physiographic feature and the type of fishermen, i.e. boat fishermen or shore fishermen. Recreational users such as boaters, swimmers, etc. were also counted but the counts were not used in estimating the characteristics of the fishery.

As previously mentioned the study area was divided into four sections which varied from 64 to 86 miles in length. Each section could be traversed by the census taker in a 16 foot creel census boat fitted with a 45 horsepower motor in 5 to 8 hours. The time necessary to travel each section influenced the type of sampling design which was employed. In addition, seasonal modifications of the sampling design were made because of differences in the length of the fishing day.

The design of the sample creel census was patterned after the Latin Square Design of other sample creel surveys. However, Schmulbach (1959) and Robson (1960) noted that the weekend days and holidays received much heavier fishing pressure than weekdays. Therefore, a modified latin square was used to insure that weekend days were sampled more heavily than weekdays. By doing this, I hoped to increase the accuracy of the fishing pressure estimates. The special characteristics of each season schedule are discussed in the following paragraphs (Table 1, text, and Tables 1-4, Appendix).

Summer 1972 (July 1, 1972 to August 31, 1972)

Angler counts were made on 40 dates within this period. The dates were selected to insure that counts and interviews

TABLE 1

Length and Dates of Each Seasonal Schedule, Length of Fishing Day, Percentage of the Total Number of Days Censused by Boat, Plane, and Combination of Boat and Plane of all Fishermen Which Were Interviewed on a 312 Mile Section of the Missouri River July 1, 1972 to June 30, 1973.

Season and dates	No. days in schedule	Length of fishing day censused	No. of days censused by boat and car			No. of days censused by plane		Total no. of days censused by boat and plane	
			no. days	no. days per sec	% of all days	no. days	% of all days	no. days	% of all days
Summer-1972 (July-Aug.)	62	6a.m.-8p.m.	40	10	16	14	23	24	39
Fall-1972 (Sept.-Oct.)	61	7a.m.-5p.m.	17	5	8	2	3	7	11
Winter 1972-73 (Nov.-Apr.)	181	8a.m.-6p.m.	25		14	2	1	27	15
Spring-1973 (May-June)	61	7a.m.-9p.m.	22	6	10	0	0	6	10
Total days			104			18		64	

were conducted on three weekdays and two weekend days per week. No section was sampled by boat more than twice or less than once per week. Each angler day of 14 hours was divided into two periods, a morning period from 0600 to 1300 hours and an afternoon period from 1300 to 2000 hours. Each period was sampled an equal number of times. Each weekday (Monday through Friday) was sampled five times with the exception of Tuesday which was sampled four times. Weekend days were sampled eight times each and the Fourth of July holiday was considered as a weekend day even though it occured during the week. Aerial counts were made of the fishermen in the entire study area on 14 (7 weekdays and 7 weekend days) of the 40 sampling dates. Angler counts by the boat census taker were made on 40 dates, with 10 counts being made in each of the four sections.

Fall 1972 (September 1, 1972 to October 31, 1972)

Angler counts were made on 18 dates including two aerial flights. Each fishing day was considered to be 10 hours long and no attempt was made to divide the day into morning and afternoon periods. Weekdays were sampled on Mondays, Wednesdays, and Fridays. Ten weekdays and eight weekend days were sampled in the fall. Weekend days sampled included four Saturdays and three Sundays. Each of the sections except section four were sampled five times. Section four was sampled three times because of its light fishing pressure. More sampling of this section was considered impractical because it was lightly fished and a considerable distance from the home of the census taker.

Winter 1972-73 (November 1, 1972 to April 30, 1973)

Angler counts were made on an irregular basis during the winter because of the vagaries of the weather. The majority of the sampling took place in Section I. However, some spot checks were made in Sections II and III. All of the 25 angler counts were made by auto except on two occasions when aerial counts were made of the entire river. Sample checks of the winter fishery occurred on 16 weekdays and 9 weekend days. During the winter an intensive sample creel survey was conducted by Nebraska and South Dakota fisheries biologists on the anglers and paddlefish snaggers at Gavins Point Dam. Some of these data are included with the winter results.

Spring 1973 (May 1, 1973 to June 30, 1973)

Angler counts were made on 22 dates. Section I, II, and III were sampled six times while Section IV was sampled four times. Each angler day was considered to be 14 hours long but no attempt was made to divide the day into sampling periods. Sample creel surveys during the other seasons demonstrated that anglers fished more often in the late afternoon and evening. Since the angling day was not divided into morning and afternoon-evening periods, an attempt was made to sample more frequently in the late afternoon and evening. To minimize hourly pressure variations of the fishermen counts, the progressive boat counts were initiated at different times in the day and different starting points were chosen. However, as previously stated, the late afternoon and evening hours were sampled more frequently. Weekdays were sampled on 14

dates and weekend days on eight dates. The Memorial Day angler count was included with the weekend day counts.

Low water levels and siltation of boat launching ramps made censusing by boat impractical until May. Angler counts by auto which were conducted during April 1973 indicated that there was little April angling pressure other than that at the major population centers and access points.

Angler Contacts

Angling statistics were secured through personal interviews with the anglers. Personal interviews were conducted while the count was progressing. Most of the fishermen interviewed (90%) were still actively engaged in fishing and hence the total catch and harvest, species composition of the catch, etc. were based primarily on incompleted trips. The average time fished was 4.7 hours. An attempt was made to contact as many anglers as possible during the sampling period. Due to the lack of public access to the river, locating and interviewing fishermen by auto was extremely difficult. On heavily fished days, however, the auto census taker was able to get interviews at the heavily utilized public access areas such as Gavins Point Dam and the Sioux City river front.

All anglers were asked to display their catches when interviewed. The catch was then recorded by species and the total length of each fish was measured to the nearest inch by the census taker. Other interview information included: (1) starting and estimated finishing time of the fishing trip; (2) species composition of the catch; (3) number and species of fish returned; (4) species sought;

the scientific and common names of fish angled from the Missouri River are listed in Table 2.

(5) type of bait used; (6) type and method of fishing employed; (7) number of anglers in the party; (8) distance traveled to the interview location and the residence of the anglers; (9) age, sex, and occupation of the anglers; (10) monetary value of gear and the cost per fishing trip; (11) general questions on recreational attitudes and desires; (12) number of fish hooked and lost, and; (13) number of fishing trips to the river per year. Copies of the questionaires used are included in Tables 5, 6 of the Appendix.

Reliability of Data from Incompleted-Fishing Contacts

Completed-fishing interviews have been successfully used to estimate fishery statistics on numerous occasions, and where conditions permit the use of this technique, it is usually considered desirable (Eschmeyer, 1942 and Rupp, 1955). Sample creel surveys relying upon completed fishing trips are impractical when the area fished has a large number of access points and the manpower is limited. Since the 312 mile-Missouri River study area was large and had many public and private access points, it was decided to base the estimates of the fishery and the fishermen parameters on incompleted fishing contacts. Many investigators have relied on data from incompleted trips to derive catch per unit of effort and other fishery statistics (Moyle and Franklin, 1953; DiCostanzo, 1956; Schmulbach, 1959; and others). However, DiCostanzo (1956) and Schmulbach (1959) tested the validity of using incomplete-fishing contacts to estimate catch per unit effort and found that incompleted trips gave

TABLE 2

The Species of Fish Caught by Anglers in the Missouri River Between Gavins Point Dam and Rulo, Nebraska From July 1, 1972 to June 30, 1973

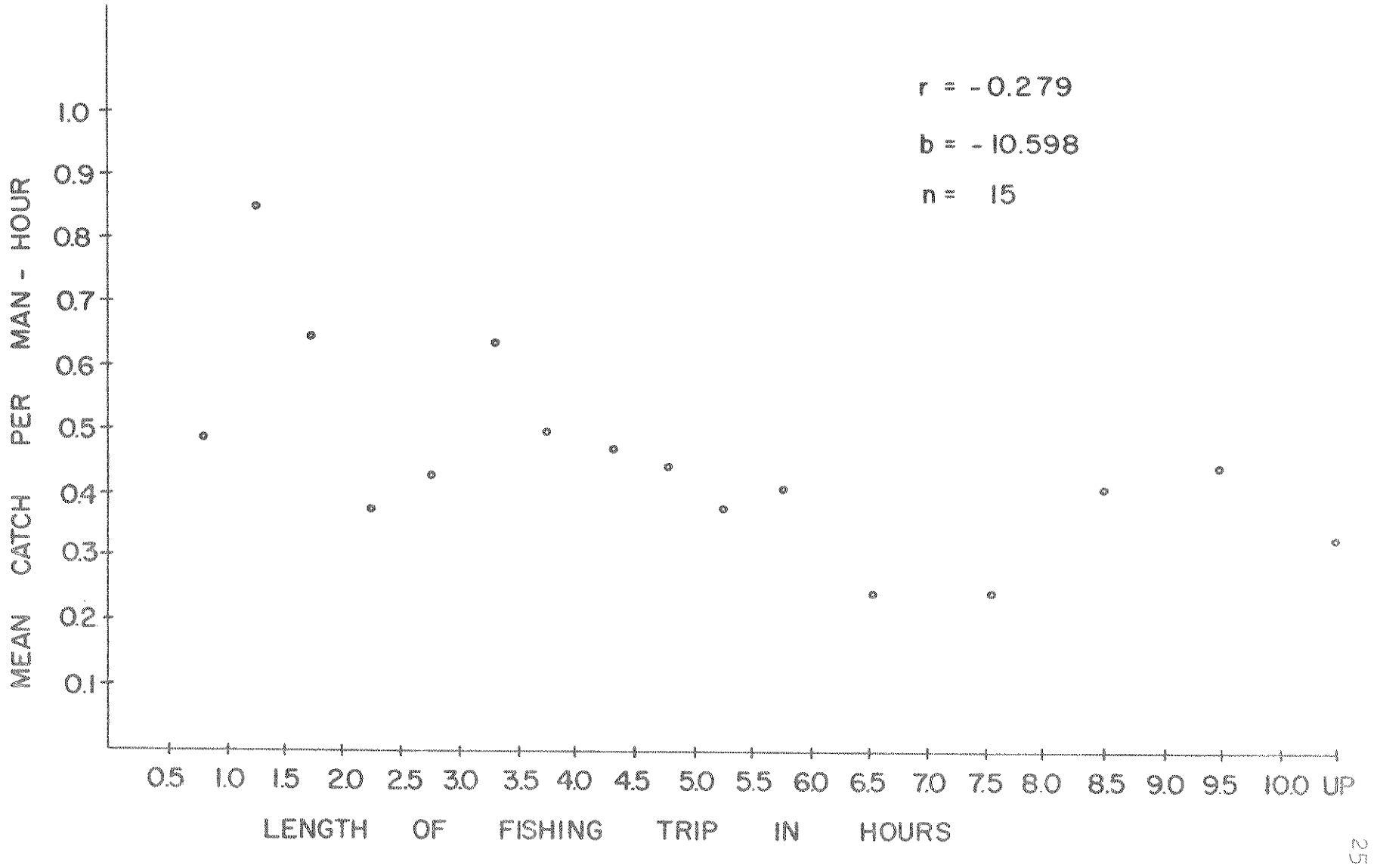
Family	Common name	Genus Species
Acipenseridae	shovelnose sturgeon	Scaphirhynchus platarynchus
Polyodontidae	paddlefish	Polyodon spathula (Walbaum)
Lepisosteidae	shortnose gar	Lepisosteus platostomus Rafinesque
Lepisosteidae	longnose gar	Lepisosteus osseus (Linnaeus)
Clupeidae	gizzard shad	Dorosoma cepedianum (Lesueur)
Clupeidae	skipjack herring	Alosa chrysochloris (Rafinesque)
Hiodontidae	goldeye	Hiodon alosoides (Rafinesque)
Esocidae	northern pike	Esox lucius Lennaeus
Cyprinidae	carp	Cyprinus carpio Linneaus
Catostomidae	blue sucker	Cycleptus elongatus (Lesuer)
Catostomidae	largemouth buffalo	Ictiobus cyprinellus (Valenciennes)
Catostomidae	smallmouth buffalo	Ictiobus bubalus (Rafinesque)
Catostomidae	river carpsucker	Carpiodes carpio (Rafinesque)
Catostomidae	shorthead red horse	Moxostoma macrolepidotum (Lesueur)
Ictaluridae	channel catfish	Ictalurus punctatus (Rafinesque)
Ictaluridae	flathead catfish	Pylodictis olivaris (Rafinesque)
Ictaluridae	black bullhead	Ictalurus melas (Rafinesque)
Ictaluridae	stonecat	Noturus flavus (Rafinesque)
Percich thyidae	white bass	Morone chrysops (Rafinesque)

TABLE 2 (Cont.)

Centrarchidae	largemouth bass	*Micropterus salmoides* (Lacepede)
Centrarchidae	white crappie	*Pomoxis annularis* Rafinesque
Centrarchidae	black crappie	*Pomoxis nigromaculatus* (Lesueur)
Centrarchidae	bluegill	*Lepomis macrochirus* Rafinesque
Centrarchidae	green sunfish	*Lepomis cyanellus* Rafinesque
Percidae	walleye	*Stizostedion vitreum* (Mitchill)
Percidae	sauger	*Stizostedion canadense* (Smith)
Percidae	yellow perch	*Perca flavescens* (Mitchill)
Sciaenidae	freshwater drum	*Aplodinotus grunniens* Rafinesque
Gadidae	burbot	*Lota lota* (Linnaeus)

reliable estimates of all fishery statistics.

There are three criteria which must be met before the data from incomplete fishing trips can be used to give an unbiased estimate of the catch per unit effort. These criteria are as follows; (1) the rate of catch should be approximately the same throughout all hours of the fishing trip; (2) the rate of catch should be the same for anglers who fish a short time as for those who fish a long time; and (3) the anglers' estimate of the time they have fished must be accurate. To ascertain whether the data from the present study met the first criteria, a plot of the rate of catch (the ordinate axis) versus the length of the fishing trip in hours (abscissas) was constructed (Figure 2). The lengths of the fishing trips were computed to the nearest 0.5 hour and the mean rate of catch for each 0.5 hour interval was used in the plot. Fishing trips longer than six hours were combined into one-hour intervals and the data from all fishing trips under 0.5 hours or over 10 hours were not used since the sample sizes in these categories were small. From the empirical data a linear regression and correlation coefficient was computed. The correlation coefficient ($r=0.2$) was not significant at the 05% probability level ($r=0.497$; d.f.=14) and indicated that there was no significant difference in the rate of catch as a result of the length of time a fisherman fished. There was a trend, however, for the fishermen who fished for longer periods of time to have a lower rate of catch, particularly those fishermen who fished for more than six hours. This


r = -0.279
b = -10.598
n = 15
MEAN CATCH PER MAN - HOUR
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0 6.5 7.0 7.5 8.0 8.5 9.0 9.5 10.0 UP
LENGTH OF FISHING TRIP IN HOURS

tendency probably is a result of the type of fishing and species of fish being sought by the anglers who fish long hours. For example, fishermen who seek flathead catfish often fish long hours with large bait fish which will catch few species other than flatheads. Also, fishermen snagging for paddlefish frequently fish long hours but because of the strenuous nature of the method of fishing, rest for long intervals between snagging attempts. Other contributing factors could be: (1) relaxed attentiveness by anglers as the hours passed; (2) anglers may have stopped fishing for a time in the middle of their fishing trip (i.e. lunch break) and failed to inform the census taker of this; and (3) many trips are begun at more desirable fishing times when the rate of catch is actually higher such as early morning. Considering all the data from this study and that of DiCostanzo (1956), Schmulbach (1959), and others, I concluded that the use of incompleted trips to estimate catch rates and other fishery statistics did not bias the estimates.

Additional support for the reliability of incompleted-fishing contacts in estimating the rate of catch was furnished by comparing the catch per hour of completed and incompleted fishing trips (Table 3). Although the observed mean catch per effort was higher in completed trips, a chi-square test (Snedecor, 1956; p. 226) indicated that the observed difference (x^2=1.905) was not statistically significant at the 05% probability level (x^2=4.60, d.f.=2).

TABLE 3

Mean Number of Fish Caught and Harvested Per Man Hour of Fishing for Compelted and Incompleted Fishing Trips in the Missouri River Between Gavins Point Dam and Rulo, Nebraska From July 1, 1972 to June 30, 1973
(Winter Excluded)

Section	Incompleted Trips		Completed Trips	
	catch	harvest	catch	harvest
Section I-1 (tail waters)	.42	.32	.54	.51
Section I-2&3 (unchannelized)	.75	.50	.67	.51
Section I-4 on (channelized)	.38	.27	.38	.19
Total	.45	.32	.54	.38

Although the data were not statistically tested to determine whether the rate of catch was the same for those who fished a short time as those who fished a long time (criterion 2) Schmulbach (1959) found no significant difference in the rate of catch of these two grouping of fishermen. I also assumed no difference in the catch rate of fishermen fishing long hours versus those fishing short hours.

Criterion number 3, regarding the accuracy of fishermen in estimating the time they fished, was not tested statistically with the data. Edwards (1971) found that anglers along the Colorado River over-estimated the time they would finish and actually stopped fishing sooner than they estimated. Conversely, Johnson and Wroblewski (1962) found that although angler finishing time estimates varied

greatly, the average estimate of 1,700 trips was very close to the actual time spent on Many Point Lake in northwestern Minnesota. Radford (1973) used t-tests to determine that there was no significant difference between actual and reported fishing times of Alberta anglers. Since this study had no observations on the accuracy of fishermen estimates of the time they would fish, it was assumed that their estimates were accurate.

RESULTS AND DISCUSSION

The Missouri River sport fishery was appraised using seasonal sampling schedules. The summer, fall, and spring schedules were each two months long while the winter schedule of six months lasted from November 1, 1972, through April 30, 1973 (Table 1). Intentions were to start the 1973 spring census in April but extremely low water levels prevented the census taker and most fishermen from traveling on the river. During April most fishermen were restricted to major access points.

With the exception of the tailwaters area, important factors determining the end of the fall angling season and the beginning of the spring season are the weather conditions and the river water levels which are controlled by the amount of water discharged from Gavins Point Dam. During an average year the ice breakup on Lewis and Clark Reservoir occurs in late March. More water is gradually released from the reservoir so that by the first or second week in April, the water has reached a level whereby the river can be navigated by commercial barge traffic in the channelized river. This event normally signals the start of the spring fishing season. However, in 1973, downstream flooding in late March and April and a small spring runoff in the upper Missouri River basin resulted in small water releases from Gavins Point Dam. Thus water levels were low in Sections I and II during April.

During the study (winter excluded) a total of 4,020 fishermen were counted by the boat census taker and approximately 50% of all the fishermen counted were interviewed (Tables 4 and 5). The largest percentage of anglers were interviewed in the fall (67%) and the smallest percentage in the summer (41%). An attempt was made to interview approximately the same percentage of anglers in each section (Table 4). Since a large number of interviews were recorded in all sections it was felt that no serious bias was introduced into the results by interviewing more anglers in a particular section than the actual pressure of that section justified. The greatest angling pressure and the most interviews (594) were observed at Gavins Point Dam (Section I). However, the smallest percentage of interviewed to counted fishermen was also recorded in this section. Angler counts at Gavins Point Dam amounted to 37% of the total number of anglers counted while 30% of the total number of interviews were recorded there. Section III (Blair to Nebraska City, Nebraska, including Omaha) received 22% of the total pressure compared to 29% of the total interviews. In the other four sections the total angler count percentage for each section was very close to the percentage of the total fishermen interviewed in that section.

TABLE 4

Numbers and Percentages of All Fishermen Counted and Interviewed
Between Gavins Point Dam and Rulo, Nebraska
July 1, 1972 to June 30, 1973 on the Missouri River

(Winter Excluded).

Section	Number fishermen counted	Percentage of total number fishermen counted	Number fishermen interviewed	Percentage of fishermen interviewed based on fishermen counts per section	Percentage of fishermen interviewed based on total number of interviews
I-1	1500	37	594	40	30
I-2+3	469	12	250	53	12
I-4	182	4	99	54	5
II	815	20	387	48	19
III	901	22	574	64	29
IV	153	4	103	67	5
Total	4020		2007	50	

TABLE 5

Numbers and Percentages of Shore and Boat Fishermen counted and interviewed on the Missouri River Between Gavins Point Dam and Rulo, Nebraska July 1, 1972 to June 30, 1973.

(Winter Excluded).

Section	Count of shore fishermen from boat		Count of boat fishermen from boat		Shore fishermen interviewed		Boat fishermen interviewed		Count of shore fishermen by plane	Count of boat fishermen by plane	Count of all fishermen
	no.	%	no.	%	no.	%	no.	%			
I-1	1194	80	306	20	190	97	5	3	781	92	2,373
I-2+3	239	51	230	49	85	54	71	46	197	137	803
I-4	110	60	72	40	37	69	17	31	94	68	344
II	631	77	184	23	146	82	30	18	703	346	1,864
III	807	90	94	10	237	92	19	8	475	269	1,645
IV	129	84	24	16	45	92	4	8	163	59	375
Total	3110	77	910	23	740	83	146	17	2413	971	7,404

the number of annual trips they made to the river (Table 26). I realized that this was a subjective question, but it was hoped that general usage patterns could be established from the responses. In Section I-1, 73% of the fishermen estimated that they made 10 or less trips to the Missouri River per year. Apparently the more ardent fishermen were concentrated in Section I-2&3, I-4 and IV. Over 65% of the anglers in these sections estimated that they made more than 10 trips per year to the river. In fact, 75% of the fishermen in Section IV estimated that they made 20 or more annual trips.

Residence and Distance Traveled to the Fishing Area

During the interviews, all fishermen were asked their place of residence and from these data the distance traveled to the fishing area was determined (Tables 27 & 28). Over 50% of all interviewed anglers lived within a 10-mile radius of the fishing location where they were interviewed. More than 75% of all the interviewed fishermen lived within a 20-mile radius in all sections except the Gavins Point Dam tailwaters. Anglers at this location traveled a considerable distace to fish. Approximately 17% of the tailwater anglers lived within a 20-mile radius and 66% traveled more than 50 miles to make the fishing trip. Interviewed fishermen in the tailwaters came from over 100 different cities and towns. Anglers from Omaha, Nebraska, made up 15.5% of all the interviewed anglers in the tailwaters while anglers from Norfolk, Nebraska, were the second most abundant with a 6% representation. In the other sections

TABLE 26

Estimated Number of Annual Trips to the River Made by Interviewed Fishermen on the Missouri River Between Gavins Point Dam and Rulo, Nebraska, July 1, 1972 to August 31, 1972. These Data Are Based on Estimates Made by the Fishermen at the Time of the Interview.

Estimated no. of trips	Sec I-1		Sec I-2+3		Sec I-4		Sec II		Sec III		Sec IV		Total		
	no.	cum %	no.	cum %	no.	cum %	no.	cum %	no.	cum %	no.	cum %	no.	cum %	%
1	17	23					4	7	9	8			32	10	10
2	9	35					4	15					13	15	4
3 - 5	18	59	3	15			2	18	4	12	1	4	28	24	9
6 - 10	10	73	1	20			5	27	18	27	3	14	37	36	12
11 - 20	8	84	3	35	5	42	15	55	21	45	3	25	54	53	18
21 - 50	4	89	10	85	5	83	16	84	34	73	11	64	80	79	26
51 - 100	6	97	2	95	1	92	4	91	22	92	4	79	39	92	13
101 - 200	2	100	1	100	1	100	5	100	9	99	6	100	24	100	8
201 and more									1	100			1		

of the study area, the anglers comprised a "local fishery" with the nearest communities being those best represented in the interviews.

Number of Fish Lost

During the summer of 1972 angler parties were asked to recall the number of fish hooked and lost. In order for answers to this question to be valid, the angler must accurately recall and report the fish he hooked but lost. It was interesting to note that 41% of the parties at the tailwaters responded that they had lost one or more fish while in the other sections, only about 20% responded that they hooked and lost fish (Table 29). The inexperience of many of the tailwater fishermen, especially those who were on a family outing and made less than 10 trips to the river per year, was probably a contributing factor to the higher number of anglers reporting that they lost fish.

Estimated Cost of Trip and Value of Gear

All interviewed summer fishing parties were asked to estimate the cost of their fishing trip (i.e. the cost of bait, food, travel expenses) and the value of their fishing gear (Tables 30 & 31). In Section I-1, most of the interviewed parties estimated that they spent more than $5 per trip while the majority of fishermen in the other sections estimated they spent less than $5 per trip. An estimated 98,252 man-days were spent fishing during the study year. The total annual recreational value of the fishery based on $6.30 per man-day for a freshwater sport fishery ("1970 National Survey of Fishing and Hunting") was approximately $619,000.00.

TABLE 27

Residence of Interviewed Fishermen on the Missouri River
July 1, 1972 to June 30, 1973.

Section I-1 (Gavins Point Dam Tailwaters)

Residence	no.	%	Residence	no.	%
Omaha, Nebr.	70	15.5	Weeping Water, Nebr.	4	0.9
Norfolk, Nebr.	27	6.0	Vermillion, S. D.	4	0.9
Yankton, S. D.	26	5.8	Council Bluffs, Ia.	3	0.7
Hartington, Nebr.	17	3.8	Nebraska City, Nebr.	3	0.7
Lincoln, Nebr.	17	3.8	Elkpoint, S. D.	2	0.4
S. Sioux City, Nebr.	9	2.0	Falls City, Nebr.	2	0.4
Sioux City, Ia.	9	2.0	Ponca, Nebr.	2	0.4
Ft. Calhoon, Nebr.	7	1.5	Decatur, Nebr.	1	0.2
Plattsmouth, Nebr.	6	1.3	Other	253	53.8
Bellevue, Nebr.	6	1.3			

Section I-2+3 (Unchannelized River)

Residence	no.	%	Residence	no.	%
Vermillion, S. D.	126	36.5	Newcastle, Nebr.	7	2.0
Yankton, S. D.	55	16.0	Hartington, Nebr.	7	2.0
Sioux City, Ia.	24	7.0	Omaha, Nebr.	4	1.2
Elkpoint, S. D.	21	6.1	Decatur, Nebr.	4	1.2
Lincoln, Nebr.	13	3.6	Onawa, Ia.	3	0.9
Gayville, S. D.	11	3.2	Oakland, Nebr.	2	0.6
Ponca, Nebr.	11	3.2	Burbank, S. D.	1	0.3
S. Sioux City, Nebr.	7	2.0	Other	62	17.2

TABLE 27 (Cont.)

Section I-4 (Stabilized)

Residence	no.	%	Residence	no.	%
Sioux City, Ia.	72	68.6	Jefferson, S. D.	2	1.9
Jackson, Nebr.	13	12.4	Ponca, Nebr.	2	1.9
S. Sioux City, Nebr.	8	7.6	Glenwood, Ia.	1	0.9
Homer, Nebr.	2	1.9	Other	5	4.8

Section II (Channelized)

Residence	no.	%	Residence	no.	%
Sioux City, Ia.	121	31.5	Nebraska City, Nebr.	5	1.3
Omaha, Nebr.	61	15.9	Carter Lake, Ia.	2	0.5
Blair, Nebr.	41	10.7	Sloan, Ia	1	0.3
S. Sioux City, Nebr.	37	9.6	Whiting, Ia.	1	0.3
Decatur, Nebr.	28	7.3	Walthill, Nebr.	1	0.3
Homer, Nebr.	8	2.1	Plattsmouth, Nebr.	1	0.3
Onawa, Ia.	6	1.6	Oakland, Nebr.	1	0.3
Mo. Valley, Ia.	6	1.6	Dakota City, Nebr.	1	0.3
Council Bluffs, Ia.	6	1.6	Other	57	14.8

TABLE 27 (Cont.)

Section III (Channelized)

Residence	no.	%	Residence	no.	%
Omaha, Nebr.	368	67.5	Bigelow, Mo.	3	0.5
Council Bluffs, Ia.	61	11.2	Ft. Calhoon, Nebr.	2	0.4
Bellevue, Nebr.	22	4.0	Mo. Valley, Ia.	2	0.4
Plattsmouth, Nebr.	18	3.3	Sioux City, Ia.	2	0.4
Nebraska City, Nebr.	14	2.6	Weeping Water, Nebr.	2	0.4
Papillion, Nebr.	5	0.9	S. Sioux City, Nebr.	2	0.4
Blair, Nebr.	5	0.9	Other	36	6.6
Pacific Junction, Ia.	3	0.5			

Section IV (Channelized)

Falls City, Nebr.	12	12.0	Mound City, Mo.	3	3.0
Rockport, Mo.	12	12.0	Shubert, Nebr.	3	3.0
Peru, Nebr.	11	11.0	Watson, Mo.	2	2.0
Nebraska City, Nebr.	11	11.0	Weeping Water, Nebr.	2	2.0
Hamburg, Ia.	8	8.0	Brownville, Nebr.	2	2.0
Auburn, Nebr.	7	7.0	Rulo, Nebr.	2	2.0
Council Bluffs, Ia.	6	6.0	Other	15	15.0
Craig, Mo.	4	4.0			

The estimated gear value was fairly constant for all sections with the majority of the fishermen estimating their gear was valued between $20 and $100.

Fishermen Comments

Fishermen were asked various questions pertaining to the use and potential use of the Missouri River (Tables 32 & 33). These responses were assumed to be spontaneous since the interviewer solicited no particular answer to any of the questions. The anglers freely expressed their opinions and the recorded responses were believed to be accurate estimates of the opinions of all Missouri River anglers. The most frequently mentioned concern of the anglers was lack of suitable access points.

Responses to specific questions about the river were as follows:

"How could your recreational enjoyment be enhanced on the river?"

1) 34% responded that they were satisfied (Approximately 63% were satisfied in the tailwaters, 37% in the unchannelized river, and 22% in the channelized river)

2) 18% wanted more access to the river

3) 9% responded that the trash and debris should be cleaned up

4) 6% responded that more courtesy should be shown from boaters and barge operators.

5) 5% wanted to keep the water level stabilized and stop all violent fluctuations

6) 4% wanted to stop pollution of the river

7) 4% responded that more recreational and convenience facilities were needed

8) 4% wanted to keep the river natural (10% in Section I-2&3)

9) 1% wanted the river stabilized (3% in Section I-2&3)

The remaining questions which call for a yes or no response were as follows:

"Are your fishing trips usually to the same area on the river?"

1) 59% responded yes

2) 41% responded no

"Is fishing the recreational activity you enjoy the most?"

1) 95% said yes

2) 5% said no

"Is your fishing enjoyment based on catch?"

1) 48% yes

2) 52% no

"Do you think the establishment of a "Wilderness" area in this area would be beneficial?"

1) 88% yes

2) 12% no

"Would you use it?"

1) 83% yes

2) 17% no

"Would you like to see a portion of the Missouri River established as a Wild Scenic or Recreational river as a part of our National System?"

1) 91% yes

2) 9% no

TABLE 28

Distances Traveled From Residence to Fishing Location by Interviewed Fishermen in the Missouri River Between Gavins Point Dam and Rulo, Nebraska, July 1, 1972 to June 30, 1973 (Winter Excluded).

Distance	Sec I-1		Sec 1-2+3		Sec I-4		Sec II		Sec III		Sec IV		Total	
	no.	%	no.	%	no.	%	no.	%	no.	%	no.	%	no.	%
0 - 5 miles	13	7	17	11	12	22	57	32	133	52	21	43	253	28
6 - 10 miles	8	4	50	32	33	61	56	32	58	23	8	16	213	24
11-20 miles	11	6	51	33	4	7	19	11	35	14	7	14	127	14
21-50 miles	32	16	22	14	1	2	24	14	12	5	3	6	94	11
51-100 miles	58	30	9	6	3	6	12	7	10	4	3	6	95	11
101-200 miles	67	34	7	4			4	2	6	2	5	10	89	10
201-400 miles	2	1											2	0
400 or more miles	2	1											2	0

TABLE 29

Number of Fish Hooked But Not Creeled (Lost) by Fishermen on the Missouri River Between Gavins Point Dam and Rulo, Nebraska, July 1, 1972 to August 31, 1972. These Data Are Based on Interviews With Fishermen When the Trip was Still in Progress.

No. fish lost	Sec. I-1		Sec I-2+3		Sec I-4		Sec II		Sec III		Sec IV		Total		
	no.	cum %	no.	cum %	no.	cum %	no.	cum %	no.	cum %	no.	cum %	no.	cum %	%
0	44	59	16	80	10	83	46	84	86	72	24	86	226	73	73
1	13	77	2	90	2	100	7	96	21	90	1	89	46	88	15
2	9	89	1	95					6	95	3	100	19	94	6
3	1	91							3	97			4	96	1
4	1	92	1	100			1	98	1	98			4	97	0
5	1	93											1	97	0
6	2	96					1	100					4	99	1
7 or more	3	100											4	100	1

TABLE 30

Estimated Trip Expenses Incurred by Fishing Parties on the Missouri River Between Gavins Point Dam and Rulo, Nebraska, July 1, 1972 to June 30, 1973 (Expense Estimates Were Made by Parties).

Estimated party cost per trip	Sec I-1		Sec I-2+3		Sec I-4		Sec II		Sec III		Sec IV		Total		
	no.	cum %	no.	cum %	no.	%	no.	%	no.	%	no.	%	no.	cum %	%
Under $1	5	8	2	10	7	58	17	31	43	36	11	39	85	28	27
$1 - 2	4	12	7	45	2	75	13	55	33	64	6	61	65	49	21
$2 - 5	14	31	6	75	3	100	13	78	31	90	8	89	75	73	24
$5 - 10	19	57	2	85			5	87	9	97	1	93	36	85	12
$10 - 20	18	81	2	95			4	95	1	98	1	96	26	93	8
$20 - 50	11	96	1	100			3	100	2	100	1	100	18	99	6
$50 - 100	1	97											1	99	0
$100 - 200	2	100											2	100	1

TABLE 31

Estimated Value of Fishing Gear Made by Fishing Parties on the Missouri River Between Gavins Point Dam and Rulo, Nebraska, July 1, 1972 to June 30, 1973

Estimated party value of gear	Sec I -1		Sec I-2+3		Sec I-4		Sec II		Sec III		Sec IV		Total		
	no.	cum %	no.	cum %	no.	cum %	no.	cum %	no.	cum %	no.	cum %	no.	cum %	%
Under $1					1	8			1	1	2	7	4	1	11
$2 - 5									1	2			1	2	0
$5 - 10	3	4	2	10			2	4	6	7	2	14	15	6	5
$10 - 20	5	11	1	15	1	17	5	13	7	13	4	29	23	14	7
$20 - 50	27	47	9	60	3	42	22	53	51	55	8	57	120	53	39
$50 - 100	24	80	3	75	2	58	10	71	32	82	5	75	76	78	25
$100 - 200	9	92	2	85	5	100	12	93	15	95	5	93	48	93	16
$200 - 500	6	100	3	100			4	100	6	100	2	100	21	100	7

TABLE 32

Comments From Fishermen Relating to Questions as to How Their Recreational Enjoyment Could Be Improved on the Missouri River from Gavins Point Dam to Rulo, Nebraska, July 1, 1972 to June 30, 1973.

Comment	Sec I-1		Sec I-2+3		Sec I-4		Sec II		Sec III		Sec IV		Total	
	no.	%	no.	%	no.	%	no.	%	no.	%	no.	%	no.	%
improved access	4	2	30	19	13	24	43	24	58	23	12	24	160	18
courtesy by boaters	2	1	7	4	4	7	11	6	26	10	1	2	51	6
pollution	4	2			2	4	12	7	14	5	3	6	35	4
clean up	13	7	12	8	4	7	17	10	33	13	2	4	81	9
water level	17	9	10	6	3	6	15	8	2	1	1	2	48	5
facilities	6	3	2	1			8	5	14	5	3	6	33	4
stabilize			4	3			1	1					5	1
natural	1	1	15	10	3	6	6	3	6	2	2	4	33	4
satisfied	123	63	57	37	16	30	36	20	54	21	15	31	301	34
other	25	13	19	12	9	17	28	16	50	19	10	20	142	16

Comments of fishing parties:

access - more public access to the river in the form of roads and boat ramps

courtesy - that barges and boaters would be more courteous to anglers and law enforcement would be used when necessary

TABLE 32 (Cont.)

pollution - polluting of the river stopped
clean up - trash and debris would be cleaned up and litter laws be enforced
water level - the water level would be stabilized and violent fluctuations of the water level stopped
facilities - more facilities along river such as camping areas, rest areas, and fishing areas
stabilize - stabilize the river
natural - keep the river natural
satisfied - no complaints
other - people with no comments or with other remarks

TABLE 33

Responses to Various Questions About the Use and Potential Recreational Use of the Missouri River by Interviewed Fishermen between Gavins Point Dam and Rulo, Nebraska, July 1, 1972 to August 31, 1972.

Question	Sec I-1		Sec I-2+3		Sec I-4		Sec II		Sec III		Sec IV		Total	
	no.	%	no.	%	no.	%	no.	%	no.	%	no.	%	no.	%
1 - same area														
yes	55	74	8	40	5	45	31	57	68	58	12	46	179	59
no	19	26	12	60	6	55	23	43	50	42	14	54	124	41
2 - enjoy best														
yes	71	96	19	95	10	91	51	94	113	96	25	96	289	95
no	3	4	1	5	1	9	3	6	5	4	1	4	14	5
3 - enjoy catch														
yes	33	45	7	35	6	54	23	42	62	52	15	55	146	48
no	41	55	13	65	5	46	32	58	56	48	12	45	159	52
4 - Wild area														
yes	51	73	18	90	9	82	48	89	110	95	25	93	261	88
no	19	27	2	10	2	18	6	11	6	5	2	7	37	12
5 - Use it														
yes	48	69	15	75	7	70	47	84	106	91	25	93	248	83
no	22	31	5	25	3	30	8	16	11	9	2	7	51	17
6 - Scenic river														
yes	60	84	16	89	11	100	49	92	112	96	24	89	272	91
no	11	16	2	11			4	8	5	4	3	11	25	9

Questions: (1) Are your fishing trips usually to the same area on the river? (2) Is fishing the recreational activity you enjoy the most? (3) Is your fishing enjoyment based on catch? (4) a. Do you think the establishment of a "Wilderness" area in this area would be beneficial? b. Would you use it? (5) Would you like to see a portion of the Missouri River established as a Wild, Scenic or Recreational River as a part of our National System?

The accuracy of the responses to the last three questions is doubted, however, because the interviewed anglers may have had different concepts of the terms "Wilderness Area" and "Scenic River".

THE WINTER FISHERY

During the winter (November 1, 1972 to April 30, 1973) 25 auto census trips and two aerial flights were completed in the study area. Fisherman counts of the entire river were made during the aerial flights while the auto censuses were conducted only in the tailwaters and at certain access points in Section I-2&3. Additional valuable census information was obtained from South Dakota and Nebraska fisheries biologists who carried on an intensive sample creel survey at the tailwaters of Gavins Point Dam.[1]

Two aerial surveys and seven auto trips to major access points in the channelized river indicated that the winter angling pressure was very small and for practical purposes non-existent. However, the unchannelized river (Section I-2&3) absorbed a small amount of winter fishing pressure, estimated at 2,720 man-hours (Table 7). This pressure estimate was derived at by taking the mean angler count/hour and multiplying it by the number of fishing hours during the winter season.

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[1]Corson, Allen and Donald Friberg, personal communications, Nebraska Game and Parks Commission (Corson) Lincoln, Nebraska and South Dakota Game, Fish and Parks Commission, Rapid City, South Dakota.

The main winter fishery was concentrated in the Gavins Point Dam tailwaters where an estimated 36,416 man-hours of pressure were expended. Therefore, much of the censusing effort was directed towards the tailwaters and the unchannelized river. Because of the unusual nature of the winter fishery the harvest estimates were divided into a snagging harvest and an angling harvest (Tables 34 & 35). The snagging fishery for paddlefish was treated separately since snagging is not considered angling by many, and since the only fish sought was a relatively large species, the paddlefish. The harvest rate in pounds per man-hour for the paddlefish fishery was not comparable to those of a traditional angling fishery.

The Paddlefish Snagging Fishery

Snaggers spent an estimated 13,202 man-hours fishing for paddlefish between October 1, 1972 and March 31, 1973 in the Gavins Point Dam tailwaters. The estimated harvest during this season was 4,192 paddlefish weighing 73,056 pounds. From these data, an average annual weight of 17.4 pounds was derived for the paddlefish. The harvest rate was estimated at 0.32 fish and 5.5 pounds per hour of snagging. These estimates are based upon the empirical data collected by Nebraska and South Dakota biologists. The harvest rates used in the preceeding estimates were larger than my estimate of 0.24 fish per snagging hour which was based on interviews of 70 shore-based snagging parties. The observed differences between the two catch rate estimates probably were not due to chance since the investigator's

TABLE 34

The Paddlefish Harvest on the Missouri River at Gavins Point Dam from October 1, 1972 to March 31, 1973.

Month	Number paddlefish	Man hours (snagging)	Number pounds	Average weight	Harvest rate
October	232	1,386	3,300	14.2	.17
November	464	1,152	7,484	16.1	.40
December	1,621	3,209	37,387	23.1	.50
January	988	2,634	15,613	15.8	.37
February	822	3,520	8,656	10.5	.23
March	65	1,301	616	9.5	.05
Total	4,192	13,202	73,056	17.4	.32

TABLE 35

The Winter Angler Harvest on the Missouri River at Gavins Point Dam from November 1, 1972 to April 30, 1973.

Month	Number fish	man hours (angling)	number pounds	harvest rate	number sauger/ walleye	number channel cat	number white bass	other
Nov.	1,592	1,486	985	1.07	1,019	67	490	16
Dec.	519	561	380	.92	504	5	10	
Jan.	1,666	1,561	1,233	1.07	1,666			
Feb.	906	1,004	670	.90	906			
Mar.	4,753	10,951	3,378	.43	4,170	13	20	550
Apr.	3,484	7,651	2,298	.45	2,102	243	72	1,067
Tot.	12,920	23,214	8,936	.56	10,367	328	592	1,633

estimates were based on interviews with shore snaggers only while the Nebraska-South Dakota estimates included both boat and shore snaggers. Boat snaggers exhibited a higher rate of catch than shore snaggers according to the Nebraska-South Dakota results. Moreover, the catch and harvest rates for snaggers were not comparable in both estimates since my interviews were based on incompleted fishing trips while the Nebraska-South Dakota estimates were based on completed trips. Nebraska law allows snaggers to continue fishing after they have taken their daily limit of two paddlefish. The snaggers then continue to snag, replacing their smaller fish with larger fish (high-grading). Catch and harvest rates computed from incompleted trips where "high-grading" is permitted will be smaller than the same rates computed from completed trips and the average size of the paddlefish will be smaller. This is exactly what was observed. The 49 paddlefish which were measured during interviews with fishermen who had not completed their trips had an 11 pound average weight compared to the 17.4 pound average recorded by the Nebraska and South Dakota census takers of completed fishermen trips. The main harvest of paddlefish occurred from December through February, 1973. The highest harvest rate occurred in December when 3,209 man-hours of snagging caught an estimated 1,621 paddlefish resulting in harvest rates of 0.50 fish per hour or 11.6 pounds per hour.

Another paddlefish creel census conducted in the Osage River and Lake of the Ozarks, Missouri, recorded that the average weight of harvested paddlefish was 32 pounds and the harvest rate of paddlefish over eight pounds was only 0.08 fish per hour (Purkett, 1963). In comparison, the winter tailwaters paddlefish harvest rates seem to be very good even though the average weight per fish was 17 pounds.

The paddlefish fishery in the unchannelized river was more difficult to sample since the pressure was not intense and not confined to one easily accessible area such as the tailwaters. However, paddlefish snagging was observed at the following three access points: (1) Ryken's Bend (r.m. 794), (2) Wildlife Landing (r.m. 789) and (3) the Highline Landing (r.m. 787). There probably were other areas where snagging occurred on the Nebraska side of the river but these areas were not easily accessible by auto. However, in the investigator's opinion the amount of snagging for paddlefish in areas other than those censused was small.

During the winter (November 1, 1972 to April 30, 1973), ten anglers and 31 snaggers were counted in the unchannelized river (Section I-2&3) on ten auto sampling dates and two aerial surveys. The majority of the snagging activity was located at Ryken's Bend. Interviews from six parties (19 snaggers) revealed that they snagged 12 paddlefish in approximately 20 hours for harvest rates of 0.61 fish/hour and 8.5 pounds/hour. A winter harvest estimate for the unchannelized portion of the river was not attempted because the sample size was too small for an accurate harvest projection.

Winter Angling

Between November 1, 1972 and April 30, 1973, angling pressure at Gavins Point Dam constituted 23,214 man-hours. The principal species harvested in late fall and early winter were sauger, walleye, and white bass (Table 35). Sauger and walleye were not differentiated by the South Dakota and Nebraska census takers so their numbers were combined in Table 35 and were designated as sauger/walleye. The white bass fishery declined in the winter but the sauger/walleye fishing remained good throughout the winter months. In fact, the highest catch rate for sauger/walleye (1.07 fish/hour) was recorded in January, 1973. The winter season had an estimated harvest at Gavins Point Dam of 10,367 sauger/walleye weighing an estimated 8,936 pounds, 328 channel catfish, 592 white bass, and 1,633 other species of fish (principally burbot, northern pike, carp, black bullheads, white and black crappie, etc.).

Although some angling was recorded in the unchannelized river, not enough information was available to make projected catch estimates. However, there was a significant sauger/walleye fishery in late winter and early spring (March through April) in the unchannelized river around the confluence of the tributary streams. Fishing success for sauger/walleye was good at the confluence of the James and Missouri Rivers (r.m. 800) with early spring fishing showing an estimated harvest rate of 0.88 fish/hour.

THE COMMERCIAL FISHERY

During the year, 32 commercial fishermen (19 parties) were interviewed. Fourteen of the 19 parties were fishing with hoop nets, two parties were using throwlines (trot-lines), 5 parties had trammel nets, and 5 parties had box traps. Approximately one half of the hoop nets were baited (6 parties employed cream cheese while one party used corn). The main species sought by the interviewed commercial fishermen were catfish, buffalo, and carp.

The commercial fishermen in the unchannelized river (Section I-1) averaged the most fish per fisherman (7.1 fish) while the fishermen from the stabilized and channelized portion of the river (Sections II, III, and IV), averaged only 2.1 fish at the time of the interview. Also the majority of the channel catfish harvested by commercial fishermen came from the unchannelized river (26 of the 33 catfish). The species harvested in the order of their occurence on the entire study portion of the Missouri River were: channel catfish (33); carp (33); small mouth buffalo (22); suckers (6); flathead catfish (5); drum (2); largemouth buffalo and a paddlefish (Table 36).

TABLE 36

Species Compositon of Fish Harvested by Thirty-two Commercial Fishermen in the Missouri River from Gavins Point Dam to Rulo, Nebraska, July 1, 1972 to June 30, 1973.

number of fishermen	Sect. I	Sect. II	Sect. III	Sect. IV
# fishermen	7	7	11	7
species harvested				
s.m. buffalo	17		3	2
l.m. buffalo			1	
carp	7	5	9	12
channel cat	26	5	2	
flathead cat		1	3	1
drum		2		
paddlefish			1	
suckers			6	
total	50	13	25	15

EFFECTS OF ENVIRONMENTAL PARAMETERS ON THE CATCH AND HARVEST RATES

Throughout this study several environmental parameters were observed to discern if changes in there parameters were correlated with sport fishery catch and harvest rates. Some parameters such as weather phenomenon may affect angler behavior more than fish vulnerability to angling. Other parameters such as water temperature, current velocity, water discharge rates, water level fluctuations, turbidity, etc. probably affect the vulnerability of fish populations to angling but their effects are interrelated and difficult to isolate and identify under uncontrolled field conditions. Obviously cause and effect relationships are difficult to identify when none of the many variables affecting the catch and harvest rates can be controlled. Therefore the following discussion should be considered as a cursory exploration into the complex problem of what environmental parameters affect catch and harvest rates in a sport fishery. The possible effects of only three environmental parameters will be discussed viz. 1) water temperature, 2) water level changes, 3) water discharge rates.

Water Temperature vs Rates of Catch and Harvest

Water temperatures were recorded at several locations along the 312 mile study area when each creel census count was taken. The highest catch (1.06-1.08 fish/hr) and harvest (0.78-0.83 fish/hr) rates were observed when the water temperature was between 46 - 55 F (Table 37). Sauger was

TABLE 37

Mean Number of Fish Caught and Harvested Per Man-Hour of Fishing Effort at Five Degree Temperature Ranges on the Missouri River from Gavins Point Dam to Rulo, Nebraska from July 1, 1972 to June 30, 1973 (Winter Excluded)

Temperature	Rate of Catch fish/hr.	Rate of Harvest fish/hr.
41-45 F	.57	.46
46-50 F	1.06	.78
51-55 F	1.08	.83
56-60 F	.46	.36
61-65 F	.52	.30
66-70 F	.45	.33
71-75 F	.38	.27
76-80 F	.35	.23

the principal species caught in this temperature range particularly in the spring (Table 38) One factor which may account for this observation is that sauger spawn at about 45 to 50 F (Harlan and Speaker, 1969). Thus the increased sauger vulnerability to angling in the spring may have been related to increased movement of this species during and following spawning activity.

The best fishing for channel catfish and carp occurred when the water temperature ranged from 66 - 75 F. The increased vulnerability of these species to angling may not be directly related to spawning activity, however, since channel catfish spawn after the water temperatures reach 75 F. while carp seem to spawn in an erratic fashion over a long period of time from late May throughout much of the early summer (Rehder, 1959). When the water temperatures exceeded 76 F. the catch (0.35) and harvest (0.23) rates were at an annual low. This period is often termed "the mid-summer slump." The reasons for this observation are not known.

Water Levels vs Rates of Catch and Harvest

The water levels (river stage or gauge heights) were recorded at Sioux City, Iowa, and Omaha, Nebraska (Table 39). No definite trend or relationship between gauge heights and catch and harvest rates was evident in the Missouri River data.

However, catch and harvest rates did vary predictably when both the direction and extent of the water level fluctuations were considered together (Table 40). Daily

TABLE 38

Number of each species Caught at Different Water Temperatures in the Missouri River Gavins Point Dam to Rulo, Nebraska, July 1, 1972 to June 30, 1973 (Winter Excluded).

Species	41-45°F	46-50°F	51-55°F	56-60°F	61-65°F	66-70°F	71-75°F	76-80°F
white bass		23		16		45	27	2
s.m. buffalo				2		10	12	
l.m. buffalo						6	4	
carp	1	1		13	24	111	145	36
channel cat		2		16	8	56	104	27
crappie*					2	29	2	
drum	2	2	2	17	16	62	57	10
s.h. redhorse			2	4		8	8	1
sauger	8	20	16	48	15	28	12	2
walleye	2			1		2	2	1
sturgeon	1			5		5	6	
goldeye				6	1	24	20	8
y. perch						3		
bullhead					7	15	14	2
flathead cat				1		5	4	6

* white and black crappie are combined.

TABLE 39

Mean Number of Fish Caught and Harvested Per Man-Hour of Fishing Effort at Different River Stages (Gauge Heights) at Sioux City, Iowa and Omaha, Nebraska on the Missouri River from July 1, 1972 to June 30, 1973 (winter excluded).

Sioux City reading	no. of fish caught	rate of catch	no. of fish harvested	rate of harvest
18-19 feet	106	.56	68	.36
19-20 feet	59	.60	38	.39
20-21 feet	38	.21	24	.13
21-22 feet	10	1.67	10	1.67
22-23 feet	18	.44	15	.37
23-24 feet	197	.51	134	.35
24-25 feet	19	.28	14	.20
Omaha gauge reading				
8-9 feet	143	.39	106	.29
9-10 feet	105	.32	65	.19
10-11 feet	70	.31	54	.24
11-12 feet	77	.31	56	.23
12-13 feet	14	.76	11	.60
13-14 feet	3	.11	3	.11

fluctuations of more than 3 inches (7.6 cm.) were recorded for each day sampled. The highest catch (0.45 fish/hr.) and harvest rates (0.31 fish/hr.) were observed when the water level fluctuated less than 3 inches per day (Table 40). When the water level rose more than 3 inches per day the catch and harvest rates were 0.33 fish/hr. and 0.25 fish/hr. respectively. The lowest catch (0.25 fish/hr.) and harvest (0.16 fish/hr.) rates occurred when the water level declined more than 3 inches per day. These observed differences were not tested to determine their statistical significance.

Water Discharge Rates vs Rates of Catch and Harvest

The daily discharge readings (cubic feet per second-c.f.s.) were recorded at Gavins Point Dam and Nebraska City, Nebraska. Catch and harvest rates were compared with the different discharge rates (Table 41). There was no apparent trend between water discharge rates and the harvest rates recorded by anglers.

TABLE 40

Mean Number of Fish Caught and Harvested Per Man-Hour of Fishing Effort During Daily Water Fluctuations of More Than Three Inches on the Missouri River From Gavins Point Dam to Rulo, Nebraska from July 1, 1972 to June 30, 1973 (winter excluded).

Fluctuation	Rate of Catch	Rate of Harvest
Up (3 in. or more)	.33	.25
Same	.45	.31
Down (3 in. or more)	.25	.16

TABLE 41

Rate of Catch, Rate of Harvest and Number of Fish Caught at Different River Discharge Rates (Cubic Feet Per Second) on the Missouri River at Gavins Point Dam and Nebraska City, Nebraska (Winter Excluded).

Discharge cubic feet/sec.	Gavins Point Dam			Nebraska City, Nebraska		
	rate of catch	rate of harvest	no. of fish in the sample	rate of catch	rate of harvest	no. of fish in the sample
18,000 - 20,000						
20,000 - 25,000	.51	.41	93			
25,000 - 30,000	.32	.23	99	2.00	2.00	2
30,000 - 35,000						
35,000 - 40,000	.27	.26	18			
40,000 - 45,000	.92	.48	23	.59	.47	15
45,000 - 46,000	.51	.39	208	.33	.33	15
46,000 - 47,000	.42	.30	177	.26	.09	40
47,000 - 48,000	.67	.50	8	1.16	.65	16
48,000 - 49,000	1.00	.63	55	.51	.39	36
49,000 - 50,000				.46	.15	6
50,000 - 52,000				.47	.33	23
52,000 - 54,000				.13	.13	3
54,000 - 56,000				.23	.23	1
56,000 - on						

SUMMARY AND CONCLUSIONS

1. The sport fishery of 312 miles of the Missouri River between Gavins Point Dam and Rulo, Nebraska, was sampled from July 1, 1972 to June 30, 1973 to secure estimates of the angling pressure, determine the characteristics of the Missouri River fishery, and those of the fishing public. The study area encompassed four different habitat types of the river viz. (1) the Gavins Point Dam tailwaters (4 miles), (2) unchannelized river (52 miles), (3) stabilized river (21 miles) and (4) channelized river (235 miles).

2. The creel census survey was divided into four seasonal periods and a modified Latin-square sampling design was used to estimate angling intensity. Angler counts were made by census takers in boats, in an airplane and in autos. The anglers were contacted while actively fishing (incompleted fishing trips) to estimate rates of catch and harvest, the species composition of the catch, and angler preferences. During the summer, fall, and spring sampling periods, 2007 boat and shore fishermen were interviewed. During the winter interviews with 70 angling parties were recorded.

3. The total annual angling pressure was estimated at 412,660 man-hours of which 135,545 man-hours (33%) were expended in the Gavins Point Dam tailwaters (5,270 man-hours per mile). The 52 miles of unchannelized river absorbed 63,357 man-hours of fishing and had the second highest pressure per mile (1,218 man-hours) while the 256 miles of stabilized and channelized river absorbed 213,758 man-hours

and averaged 910 man-hours per mile. Weekend days and holidays were fished more heavily than weekdays and fishing pressure was more intense near cities, towns, and accessible developed areas. The seasonal aspects of the angling pressure were as follows:

Summer 1972 (July-August) - 154,997 man-hours
Fall 1972 (Sept. - August) - 41,837 man-hours
Winter 1972-73 (Nov. - April) 39,137 " "
Spring 1973 (May - June) 176,689 " "

The spring season registered the greatest fishing pressure in all sections of the river except the tailwaters of Gavins Point Dam where more pressure was observed in the summer. The fall season had the smallest pressure.

4. The mean annual rate of catch (winter excluded) was 0.47 fish per man-hour while the harvest rate was 0.33 fish per man-hour. The unchannelized river had the highest annual harvest rate (0.50 fish/hour) while the tailwaters had a harvest rate of 0.33 fish/hour and the channelized river had the lowest harvest rate (0.26 fish/hour). The highest seasonal harvest rate was in the unchannelized river in the spring (0.60).

5. Twenty-nine species were represented in the catch with the 10 most abundant species in order of occurence being: sauger, carp, channel catfish, drum, white bass, goldeye, crappie, smallmouth buffalo, short-head redhorse, and the black bullhead. Approximately 81% of all sauger were harvested from the unchannelized river. Carp was the most abundant species in the tailwaters, stabilized, and

channelized river (winter excluded). Sauger, white bass, paddlefish, shovelnose sturgeon, and the larger channel catfish were more abundant in the unchannelized portion of the river than in the channelized.

6. An estimated 117,825 pounds of fish were harvested from the Missouri River during the study year (winter excluded). The tailwaters had the highest poundage of fish harvested per mile (31,683) followed by the unchannelized river (477.7) and the channelized river (205.3).

7. Shore fishermen accounted for 77% of the total number of anglers counted while boat fishermen comprised 23%. Overall, the boat fishermen had a higher annual harvest rate (0.36 fish/hour) than the shore anglers (0.32 fish/hour). The rate of catch during the weekdays (0.42 fish/hour) was slightly higher than that observed on weekend days (0.38 fish/hour).

8. Approximately 51% of the fishermen parties had no fish at the time they were interviewed. Moreover, 5% of the fishing parties had 36.7% of the catch.

9. Approximately 95% of all fishermen were observed still fishing with natural baits with the species most sought after being channel catfish (34% of the interviewed parties), anything which bites (33%), sauger/walleye (15%) and carp (11%).

10. The most popular bait was worms followed by minnows. Worms had a harvest rate of 0.41 fish/hour and minnows had a harvest rate of 0.49 fish/hour.

11. The average fishing party fished for 4.7 hours and consisted of 2.2 fishermen of which males constituted 82% and females 18%. The Missouri River fishery was basically a family oriented experience in which 45% of all interviewed parties were fishing with a family member. During the summer of 1972 students comprised the largest percentage of anglers (26.5%) followed by retired personnel (14.0%),housewifes (11.0%), laborers (8.2%), farmers (6.8%) etc. White collar workers constituted only a small percentage of the total fishermen.

12. Over 50% of all interviewed anglers contacted lived within a 10-mile radius from the fishing location where they were interviewed. The Missouri River fishery was basically a "local fishery" except for the Gavins Point Dam tailwaters where 66% of all interviewed parties traveled more than 50 miles to their fishing location.

13. An estimated 98,252 man-days were spent fishing during the study year. The total annual recreational value of the fishery based on $6.30 per man-day for a freshwater sport fishery ("1970 National Survey of Fishing and Hunting") was approximately $619,000.00.

14. Thirty four percent of the interviewed parties were satisfied with the river as a recreational site (63% were satisfied with the tailwaters, 37% in the unchannelized, and 22% in the channelized river). However, more than 18% of the anglers felt that their recreational enjoyment could be enhanced by more access to the river.

15. The winter fishery (November, 1972 to April, 1973), was mainly concentrated in the Gavins Point Dam tailwaters (36,416 man-hours of pressure) and to a lesser extent in the unchannelized river (2,720 man-hours). There was no significant winter fishing pressure in the channelized river. The principal species sought were the paddlefish and sauger/walleye. Snaggers spent an estimated 13,202 man-hours snagging in which 4,192 paddlefish were harvested (0.32 paddlefish per hour) weighing 73,056 pounds (average weight of 17.4 pounds per paddlefish). Approximately 23,214 man-hours were spent angling during the winter in the tailwaters in which 10,367 sauger/walleye (8,936 pounds), 328 channel catfish, 592 white bass, and 1,633 other species were harvested at a harvest rate of 0.56 fish per hour.

16. The highest rate of catch was observed when the water temperature was between 46 and 55 F. This higher catch coincided with excellent sauger/walleye fishing in the spring and late fall. There was no apparent correlation between water levels or discharge rates and the catch and harvest rates. However, the highest catch and harvest rates were observed when the water levels were stable (i.e. varied less than 3 inches per day).

17. The Missouri River sport fishery was compared with other rivers in the United States. The catch and harvest rates were lower than the Mississippi River sport fishery but better than or comparable with other rivers. The amount of fishing pressure per mile and surface acre was low except

for the Gavins Point Dam tailwaters which absorbed 33,886 man-hours per mile per year (236.6 man hours/per acre).

18. The importance of the unchannelized 52 miles of the river to the Missouri River fishery was underscored by the following fishery statistics. viz; The unchannelized river absorbed more fishing pressure per linear mile (1,218 man/hours) than any part of the stabilized or channelized river with the exception of the tailwaters. Moreover, this pressure was sustained in the absence of any major population centers near the unchannelized river. The annual rates of catch (0.72 fish/hour) and harvest (0.50 fish/hour) were higher in the unchannelized river than in any other portion of the river including the tailwaters. In fact, the annual harvest rate was about twice that observed in the channelized river. More desirable game fish were caught in the unchannelized river than in any other section. Approximately 81% of all the sauger creeled during the study were taken from the unchannelized river. The mean average total lengths of the fish species taken from the unchannelized river was greater than the average length of the same species from the channelized river. This size differential was greatest in the channel catfish.

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APPENDIX

TABLE 1

The Summer Creel Census Sampling Schedule of the Missouri River from Gavins Point Dam to Rulo, Nebraska, July 1 to August 31, 1972.

Dates	Mon.	Tues.	Wed.	Thur.	Fri.	Sat.	Sun.
July 3- 9	Sec I 13 flight	Sec II 13	Sec I 05		Sec III 05	Sec III 05 flight	Sec IV 13
July 10-16		Sec II 05	Sec III 13	Sec IV 05		Sec I 13 flight	Sec II 05
July 17-23	Sec I 05			Sec III 13	Sec IV 13 flight	Sec IV 05	Sec III 13 flight
July 24-30	Sec II 13		Sec IV 13	Sec III 05		Sec II 13	Sec I 05 flight
July 31- Aug 6		Sec I 13 flight		Sec II 05	Sec I 05 flight	Sec IV 13	Sec III 05
Aug 7-13	Sec III 13 flight	Sec IV 13	Sec IV 05			Sec I 05	
Aug 14-20			Sec II 13 flight	Sec I 13	Sec II 05	Sec III 13	Sec IV 05 flight
Aug 21-27	Sec IV 05 flight	Sec III 05			Sec II 13	Sec II 05 flight	Sec I 13

TABLE 2

The Fall Creel Census Sampling Schedule of the Missouri River from Gavins Point Dam to Rulo, Nebraska, September 1 to October 31, 1972.

Dates	Mon.	Wed.	Fri.	Sat.	Sun.
Sept. 4-10	Sec I Holiday	Sec II			
Sept. 11-17			Sec III	Sec IV	
Sept. 18-24					Sec III
Sept. 25- Oct. 1		Sec I		Sec II	
Oct. 2- 8			Sec II		flight
Oct. 9-15		Sec I			Sec IV
Oct. 16-22	Sec III Sec IV			Sec I	
Oct. 23-29		Sec I			Sec II
Oct. 30- Nov. 5			Sec III make-up	Sec III make-up	flight
Nov. 6-12		Sec II make-up			

TABLE 3

The Winter Creel Census Sampling Schedule of the Missouri River from Gavins Point Dam to Rulo, Nebraska, November 1, 1972 to April 30, 1973.

Dates	Mon.	Tues.	Wed.	Thur.	Fri.	Sat.	Sun.
Nov. 5-12							Sec I
Nov. 13-19					Sec I + II	Sec II	
Nov. 20-26							Sec II
Nov. 27-Dec. 3	flight Sec III		Sec I + II		Sec I	Sec I	
Dec. 4-10							
Dec. 11-17							
Dec. 18-24				Sec I			
Dec. 25-31							
Jan. 1- 7							
Jan. 8-14							
Jan. 15-21							
Jan. 22-28							
Jan. 28-Feb. 4						Sec I	
Feb. 5-11						flight	
Feb. 12-18							
Feb. 19-25					Sec I		
Feb. 26-Mar. 4							
Mar. 5-11		Sec I	Sec I	Sec I			Sec I
Mar. 12-18							Sec I
Mar. 19-25				Sec I			
Mar. 26-Apr. 1							
Apr. 2- 8							
Apr. 9-15							
Apr. 16-22			Sec I + II				
Apr. 23-29	Sec II						

TABLE 4

The Spring Creel Census Sampling Schedule of the Missouri River from Gavins Point Dam to Rulo, Nebraska, May 1 to June 30, 1973.

Dates	Mon.	Tues.	Wed.	Thur.	Fri.	Sat.	Sun.
May 1- 6							
May 7-13			Sec I		Sec II	Sec II	
May 14-20		Sec III	Sec IV			Sec III Sec IV	
May 21-27				Sec III			
June 1- 3	Sec I Holiday		Sec II				Sec III
June 4-10	Sec III			Sec I			Sec IV
June 11-17			Sec II			Sec I	
June 18-24		Sec I		Sec II	Sec III Sec IV		Sec II
June 25-30			Sec I				

TABLE 5

Creel Census Interview Sheet used by the Census Takers
During the Summer of 1972, July 1 to August 31, 1972

CREEL CENSUS
MISSOURI RIVER ENVIRONMENTAL INVENTORY

DATE_____ TIME_____

LOCATION/RIVER MILE_____

ANTIVITY ENGAGED IN? ___fishing ___camping ___general
___boating ___swimming/sunning ___other_____

TIME OF START TO ESTIMATED TIME OF FINISH?_____Total hrs._____
(does not include driving time)
If have engaged in more than one activity, (ex. boating, fishing & picnicing), state total time of each?

Activity	Time	Activity	Time
_____	_____	_____	_____
_____	_____	_____	_____

NO. IN PARTY? _____

No. of Males? _____ approx. ages_____occupations_____

No. of females_____ _____ _____

_____

RESIDENCE?_____

Distance traveled?_____
What does a trip like this cost you?_____(not equipment value)
Estimated no. of trips per year?_____
Are these trips usually to the same area on the river?_____
Are you doing the recreational activity you enjoy best?_____

TYPE OF FISHING (location)?___shore ____wader ___bridge ___other
___boat ____dock ___pier _____

TYPE OF FISHING? ____still fishing ____casting ___throwline
___other_____
____trolling ____snagging ___bow/spear

NO. OF FISH?_____
SPECIES COMPOSITION & APPROX. SIZE (total length in inches)?

_____ _____
_____ _____
_____ _____

TABLE 5 (Cont.)

No. of fish thrown back?_____ species?_____

Why were they thrown back?_____

No. struck (hooked) & not landed?_____

PREFERRED SPECIES? 1st choice_____2nd_____ 3rd_____

PREFERRED BAIT? 1st choice_____2nd_____

BAIT USED? ____artificial_____
____natural _____

Estimated monetary value of gear?_____

Estimated fishing time spent with members of the family?_____
(% or fraction)

If your enjoyment based on catch? _____

With respect to the river, what can the states' Game Fish & Parks do to enhance your recreational enjoyment?

Do you think the establishment of a 'Wilderness' area in this area would be beneficial? Would you use it?

Would you like to see a portion of the Missouri River established as a Wild-Scenic or recreational river as part of our National System?

TABLE 6

Creel Census Interview Sheet used by the Census Takers during the Fall, Winter and Spring of 1972 and 1973 September 1, 1972 to June 30, 1973

CREEL CENSUS
MISSOURI RIVER ENVIRONMENTAL INVENTORY

DATE_____ TIME_____

LOCATION or River Mile_____

TIME OF START TO EXTIMATED TIME OF FINISH?_____Total hrs._____

No. in Party _____ Residence_____

_____

Location of Fishing? ___shore ___wader ___bridge ___ice
___boat ___dock ___pier ___other_____

Type of Fishing? ___still fishing ___trolling ___throwline ___net
___cast/retrieve ___snagging ___bow/spear
___other_____
_____

No. of Fish?_____

Species Composition & Approx. Size? (total length in inches)

_____ _____

_____ _____

_____ _____

_____ _____

_____ _____

No. & fish species thrown back? _____

_____

What are you fishing for? _____

Kind of bait used? _____

With respect to the river, what can the states' Game Fish & Parks do to enhance your recreational enjoyment?