8-1-1967

A Survey of the Commercial Fisheries on the Mainstrem Reservoirs of the Upper Missouri River System

Dean C. Hildebrand

A SURVEY OF THE COMMERCIAL FISHERIES ON THE MAINSTEM RESERVOIRS OF THE UPPER MISSOURI RIVER SYSTEM

by

Dean C. Hildebrand
B. S. in Biology, Valley City State College 1959

A Thesis
Submitted to the Faculty
of the
University of North Dakota
in partial fulfillment of the requirements
for the degree of
Master of Science

Grand Forks, North Dakota

August
1967

This thesis submitted by Dean C. Hildebrand in partial fulfillment of the requirements for the Degree of Master of Science in the University of North Dakota, is hereby approved by the Committee under whom the work has been done

Chairman

Dean of the Graduate School

ACKNOWLEDGMENTS

I wish to express my sincere appreciation to Dr. John Owen, my advisor, for his encouragement, help, and guidance; and to Drs. Vera Facey and Paul Kannowski, who proofread the manuscript and offered criticisms and corrections.

My special thanks to Mr. Dale Henegar, Fisheries Division Chief of the North Dakota Game and Fish Department, for his advice during the course of the survey; and to the commercial fishermen who treated me so kindly and offered experience and data which enabled me to compile this study.

I wish to acknowledge Mr. John Parsons and his staff at the Missouri River Commercial Fisheries Investigations Station at Mobridge, South Dakota; Mr. James Sprague, Fisheries Division Chief of the South Dakota Department of Game, Fish and Parks; and Mr. Arthur Whitney, Fisheries Division Chief of the Montana Department of Fish and Game--all of whom helped to make this survey possible by their cooperation.

This study was aided under public Law 88-309, the Commercial Fisheries Research and Development Act of 1964, and by the North Dakota Game and Fish Department.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF ILLUSTRATIONS

ABSTRACT

A survey of the commercial fisheries on the mainstem reservoirs of the Missouri River in Montana, North Dakota, and South Dakota was made in 1966. The objective of the study was to obtain basic information of use in the management of commercial fisheries that are developing in these waters and to identify biological problems significant to these new fisheries.

Each commercial fishery is described as to types and specification of gear, species caught, seasons of fishing, catch per unit of effort, licensing by the states, habitat of species, indications of depletion, and special problems affecting the development of the commercial fisheries. The preparation of fish for market, holding facilities, prices and records kept are briefly discussed.

There is a paucity of basic scientific information in this region that can be immediately drawn upon and used in the management of the developing fisheries. There are no indications of depletion recognized. The exploitation of commercial fish populations can apparently be increased many-fold. Current problems in the expansion of the fisheries appear to be in the economics of operation and in marketing rather than in the absolute abundance of potentially eommercial species.

INTRODUCTION

The primary purpose of this survey is to bring together basic data that will be of direct assistance in further development of the commercial fishing on the mainstem reservoirs of the Upper Missouri System.

DESCRIPTION OF AREA

The Missouri River, along its 2,466-mile channel from Three Forks in western Montana to its confluence with the Mississippi River, has been transformed from an uncontrolled natural wild river to a chain of great impoundments connected by waterways with regulated flows and releases. The transformation of the mighty river into a series of large reservoirs has initiated a complex of profound changes in the basic aquatic biology of the river system.

The Missouri River, longest of the tributaries of the Mississippi, is formed by the confluence of the Jefferson, Madison, and Gallatin Rivers in the Rocky Mountain area of southwestern Montana, 8,000 feet above sea level. Flowing first north onto the high plains, the Missouri then turns east before assuming its winding, unstable course to the Mississippi (Figure 1). For most of the way the river flows through its two major physiographic sections--the high and the low Great Plains--finally joining the Mississippi over its own alluvial plain, 2,466 miles from its source (White, 1964).

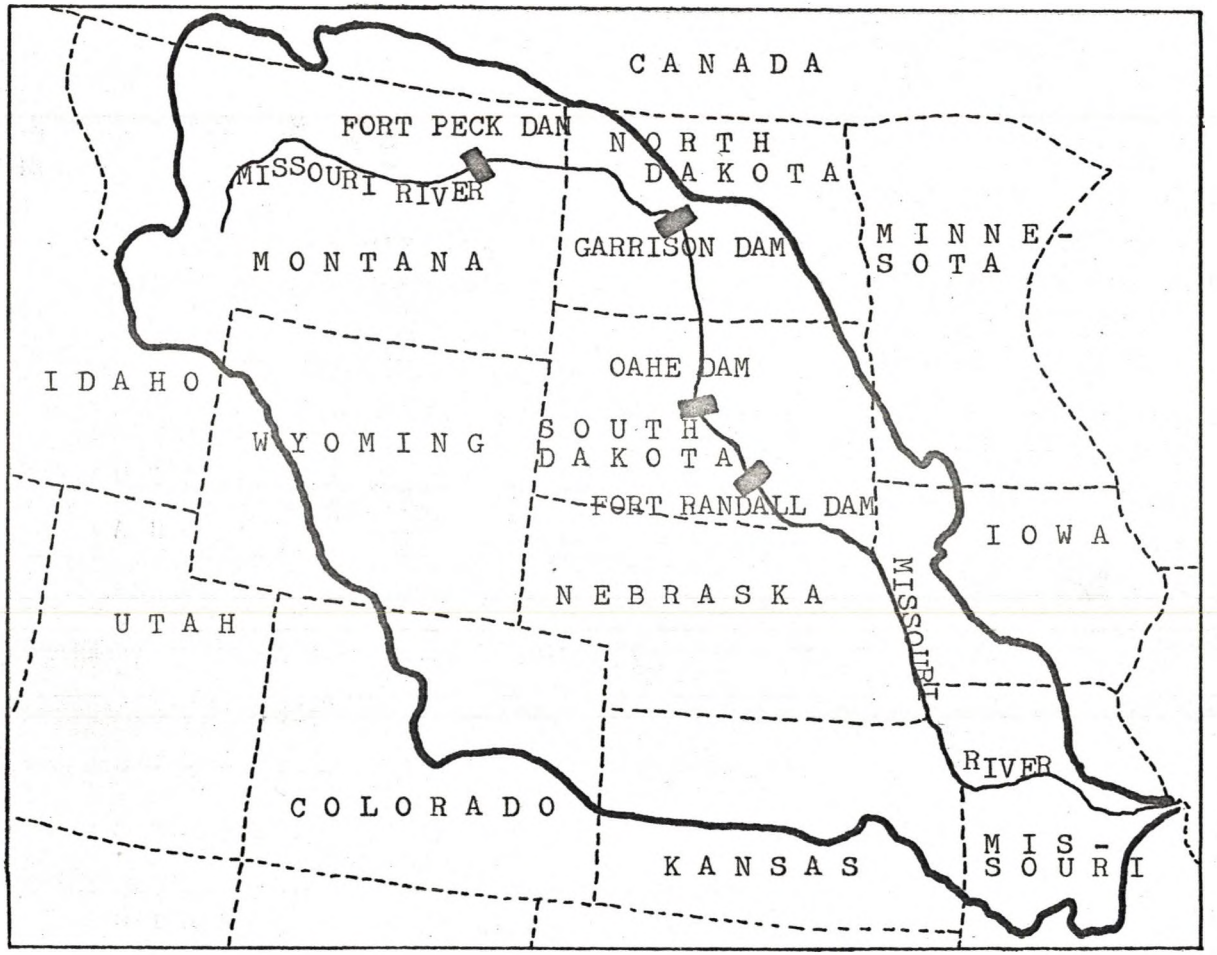


Fig. 1.--The Missouri Basin

The huge area drained by this great river system is about 529,400 square miles of which 2,550 square miles are in Canada. Elevations within the basin are extreme: from 14,000 feet above sea level in the Rockies near the continental divide to 400 feet where the Missouri joins the Mississippi (Figure 2).

The Rocky Mountains form the western boarder of the basin, but the entire basin where mainstem reservoirs were constructed is plains country with elevations ranging from 2,250 mean sea level (m.s.l.) at the upper end of Fort Peck Reservoir to 1,160 feet m.s.l. at Fort Randall Reservoir. This high plains country is a large, coalesced alluvial fan which was formed from streams draining eastward from the Rocky Mountains (Emerson, 1920). The present location of the Missouri River marks approximately the southern edge of Wisconsin glaciation during the Pleistocene (Fenneman, 1931). Thus extensive till and other glacial deposits overlay the north and east shores of the river; the drainage basin south and west of the river is overlain with extensive sedimentary deposits which are vividly exposed in the Badland regions of North and South Dakota. Except for a few trees in the river valleys and protected areas, the area was originally short grass plains country. Presently the upper part of the basin in Montana and North Dakota is used principally for the raising of row crops or for grazing cattle and sheep. In South Dakota the area west of the river is used principally for grazing and wheat

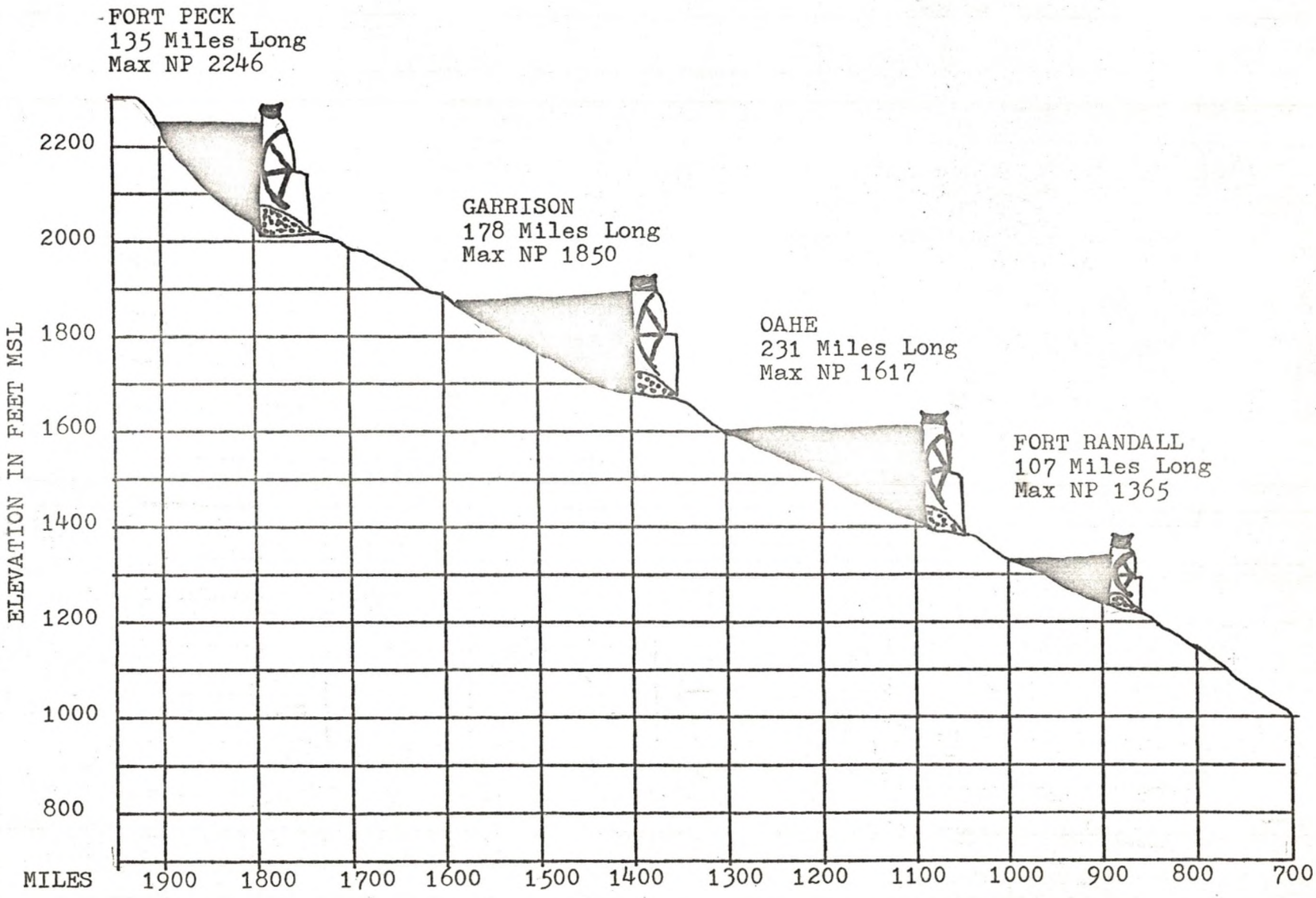


Fig. 2.--Elevation and Distance of Mainstem Reservoirs above the Mouth of the Missouri River

farming. The area east of the Missouri River is used for fairly intensive cultivation of row crops.

With the exception of the headwater areas, the soils in the entire basin are fine and erodable, and the unimpounded rivers are laden with silt. The principal surface sediments are shales or consolidated clay particles and chalk. The high turbidities in the basin are caused by flattened clay particles which are light in weight but which effectively shield out light (Benson, MS).

The climates prevailing over the basin are semi-arid with the extreme temperature ranges characteristic of a mid-latitude, continental interior. Hail, blizzards, torrential rains, heavy snows, sustained high temperatures (perhaps three weeks), and searing droughts have done their worst to discourage permanent settlement. In no other part of the interior United States are average wind velocities so high as on the Great Plains (White, 1964). The high rate of air movement increases evaporation and promotes dust blowing on fields which are--or have been--cultivated.

The population of the Missouri Basin is about 7,000,000. These states have shown a decline in population since 1939; whereas, that of the nation has increased significantly.

PICK-SLOAN PLAN

The blueprint for harnessing the Missouri was named for General Lewis A. Pick, then head of the Missouri River Division of the Corps of Army Engineers, and W. G. Sloan,

then a regional engineer for the Bureau of Reclamation.

The Pick-Sloan Plan called for seven large dams on the mainstem of the Missouri. All are now in place; however, the four involved in this study are Fort Peck, Garrison, Oahe, and Fort Randall (Figure 2).

The mainstem reservoirs differ greatly in size, depth, and water management requirements. Each of the upper three reservoirs--Fort Peck, Garrison, and Oahe--is larger in surface area and volume than the sum of the lower three reservoirs--Big Bend, Fort Randall, and Gavins Point. These upper reservoirs are used for long term water storage, and their annual water management is not as uniform as in the lower three reservoirs. The water levels of the upper reservoirs are being controlled by climatic conditions and available runoff. The lower reservoirs are being managed quite uniformly since their storage capacities are small and are dependent upon water stored in the upper reservoirs for operation during dry periods.

The Missouri River Reservoir System impounds 897 miles of river at full pool from Gavins Point Dam in South Dakota to the headwaters of the Fort Peck Dam in Montana. Only 317 miles of free flowing river exist within the impounded section of the river. All reservoirs are long and narrow with the Oahe reaching a maximum length of 231 miles at full pool. Trees and brush were not cleared from the reservoir's bottom except in a few areas where recreational use was expected to be heavy.

When filled, the "Great Lakes" of the Missouri will contain a capacity of 76,041,000 acre feet (93.8^{10} cubic meters) and a surface area of 1,261,000 acres (Benson, MS).

FISH SPECIES

As a consequence of impoundments, large populations or commercially valuable fishes are known to have been developed in the new reservoirs. These expanded populations are virtually unexploited by commercial fishermen, and little is known of their biology and numbers. It is speculated that the fish populations in the new reservoirs have not yet stabilized in the habitats developed because the impoundments are so recent.

There have been 59 species of fish identified from the Missouri River mainstem impoundments (Table 1). Many of these species are remnants of the original river or tributary fauna and have become rare or may have disappeared. Some new species have been introduced. The white bass, rainbow trout, kokanee, and lake trout are introductions. The common species of large fish in the system--not necessarily in each reservoir--are bigmouth buffalo, smallmouth buffalo, carp, river carpsucker, northern pike, channel catfish, shovelnose sturgeon, goldeye, sauger, black crappie, white crappie, walleye, yellow perch, shortnose gar, paddlefish, and freshwater drum. The collection and identification of small fish has not yet been carried out in the same detail on all reservoirs and the list is undoubtedly incomplete (Benson, MS).

TABLE 1.--Fish species collected in Missouri River mainstem reservoirs. Referred to as rare (R) or common (C). Common names from American Fisheries Society, Special Publication No. 2 (1960) (Benson, MS)

SCIENTIFIC NAME	COMMON NAME	RESERVOIRS			
		Fort Peck	Garrison	Oahe	Fort Randall
Scaphirhynchus albus (Forbes and Richardson)	pallid sturgeon	-	R	R	R
Scaphirhynchus platorynchus (Rafinesque)	shovelnose sturgeon	C	C	C	C
Polyodon spathula (Walbaum)	paddlefish	C	C	C	C
Lepisosteus platostomus Rafinesque	shortnose gar	-	C	C	C
Dorosoma cepedianum (LeSueur)	gizzard shad	-	-	-	C
Alosa chrysochloris (Rafinesque)	skipjack	-	-	-	R
Salmo gairdneri Richardson	rainbow trout	R	R	-	R
Salmo trutta Linnaeus	brown trout	R	R	-	-
Oncorhynchus nerka (Walbaum)	kokanee	R	-	-	-
Salvelinus namaycush (Walbaum)	lake trout	R	-	-	-

TABLE 1--(Continued)

SCIENTIFIC NAME	COMMON NAME	RESERVOIRS			
		Fort Peck	Garrison	Oahe	Fort Randall
Esox lucius Linnaeus	northern pike	C	C	C	C
Hiodon alosoides (Rafinesque)	goldeye	C	C	C	C
Cyprinus carpio Linnaeus	carp	C	C	C	C
Semotilus atromaculatus (Mitchill)	creek chub	-	R	R	-
Semotilus margarita (Cox)	pearl dace	-	R	-	-
Notemigonus crysoleucas (Mitchill)	golden shiner	-	R	R	R
Hybopsis gracilis (Richardson)	flathead chub	C	C	C	C
Hybopsis plumbea (Agassiz)	lake chub	R	R	-	-
Hybopsis gelida (Girard)	sturgeon chub	-	-	R	-
Rhinichthys atratulus (Hermann)	blacknose dace	-	-	R	-
Notropis stramineus (Cope)	sand shiner	-	R	-	R
Notropis blennius (Girard)	river shiner	-	-	R	-

TABLE 1--(Continued)

SCIENTIFIC NAME	COMMON NAME	RESERVOIRS			
		Fort Peck	Garrison	Oahe	Fort Randall
Notropis illecebrosus (Girard)	silverband minnow	-	-	R	-
Notropis atherinoides Rafinesque	emerald shiner	-	C	C	C
Notropis lutrensis (Baird and Girard)	red shiner	-	C	-	-
Hybognathus nuchalis Agassiz	silvery minnow	C	-	-	-
Pimephales promelas Rafinesque	flathead minnow	C	C	C	C
Cycleptus elongatus (LeSueur)	blue sucker	R	R	R	R
Ictiobus cyprinellus (Valenciennes)	bigmouth buffalo	C	C	C	C
Ictiobus bubalus (Rafinesque)	smallmouth buffalo	C	C	C	C
Carpiodes cyprinus (LeSueur)	quillback	-	R	-	-
Carpiodes c. carpio (Rafinesque)	river carpsucker	C	C	C	C
Moxostoma m. macrolepidotum (LeSueur)	northern redhorse	-	C	C	C

TABLE 1.--(Continued)

SCIENTIFIC NAME	COMMON NAME	RESERVOIRS			
		Fort Peck	Garrison	Oahe	Fort Randall
Catostomus commersoni (Lacépède)	white sucker	C	C	C-R	R
Catostomus catostomus (Forster)	longnose sucker	R	R	-	-
Pantosteus platyrhychus (Cope)	mountain sucker	R	-	-	-
Ictalurus melas (Rafinesque)	black bullhead	R	R	R	R
Ictalurus punctatus (Rafinesque)	channel catfish	C	C	C	C
Ictalurus furcatus (LeSueur)	blue catfish	-	-	R	-
Noturus flavus Rafinesque	stonecat	R	R	R	R
Pylodictus olivarus (Rafinesque)	flathead catfish	-	-	R	R
Noturus mollis (Hermann)	tadpole madtom	-	R	-	-
Roccus chrysops (Rafinesque)	white bass	-	-	C	C

TABLE 1--(Continued)

SCIENTIFIC NAME	COMMON NAME	RESERVOIRS			
		Fort Peck	Garrison	Oahe	Fort Randall
Micropterus s. salmoides (Lacépède)	largemouth bass	-	-	C	C
Lepomis cyanellus Rafinesque	green sunfish	-	-	R	R
Lepomis gibbosus (Linnaeus)	pumpkinseed	-	R	-	-
Lepomis humilis (Girard)	orange spotted sunfish	-	R	R	R
Lepomis macrochirus Rafinesque	bluegill	-	R	R	R
Pomoxis annularis Rafinesque	white crappie	-	C	C	C
Pomoxis nigromaculatus LeSueur	black crappie	C	C	C	C
Stizostedion canadense (Smith)	sauger	C	C	C	C
Stizostedion v. vitreum (Mitchill)	walleye	C	C	C	C
Perca flavescens (Mitchill)	yellow perch	C	C	C	C
Etheostoma exile (Girard)	Iowa darter	R	-	-	R

TABLE 1--(Continued)

SCIENTIFIC NAME	COMMON NAME	RESERVOIRS			
		Fort Peck	Garrison	Oahe	Fort Randall
Aplodinotus grunniens Rafinesque	freshwater drum	C	C	C	C
Eucalia inconstans (Kirtland)	brook stickleback	-	R	-	-

Commercial fishing of these reservoirs is just beginning. The catch in 1965 amounted to 1,297,000 pounds (Table 2), and the total commercial fishery resource is undoubtedly under exploited. Buffalo made up over 90 per cent of the catch, but it is known that other species are present in quantity.

TABLE 2.--Commercial catch of fish in thousands of pounds from Missouri River Mainstem Reservoirs in 1965 as reported by the Bureau of Commercial Fisheries, Statistics Branch, Ann Arbor, Michigan

SPECIES	RESERVOIRS				TOTAL
	Fort Peck	Garrison	Fort Randall	Oahe	
Buffalo	153.9	199.8	218.8	636.7	1,209.2
Carp	12.9	27.7	- - -	11.9	52.5
Catfish	12.3	- - -	3.6	9.2	25.1
Quillback	- - -	1.6	- - -	- - -	1.6
Sheepshead	.7	- - -	- - -	5.0	5.7
Suckers	- - -	- - -	- - -	2.9	2.9
TOTALS	179.8	229.1	222.4	665.7	1,297.0

METHODS

During the summer of 1966 each reservoir supporting a commercial fishery was visited at intervals to observe the activities of the commercial fishermen. At the time this survey was conducted, five commercial fisheries were in operation (Figure 3). One commercial fishery was located on Fort Peck Reservoir in Montana, two on the Garrison Reservoir in North Dakota, one on the Oahe Reservoir of North and South Dakota, and another on the Fort Randall Reservoir of South Dakota.

Information was obtained from each of these commercial fisheries. One to two weeks were spent at each location for the following reasons: (1) to become acquainted with the fishermen, (2) to obtain their cooperation, and (3) to learn in detail all phases of their operations.

The discussions with the fishermen were kept informal. No overt questionaire or set interview was followed; however, a basic outline of the information sought was planned in advance. A report was compiled on each fishery directly following the interview and/or observation. The following is the outline of the information sought:

1. Location of fishing
2. Methods of fishing
3. Specifications of gear
   a. Care

b. Methods of preservation

c. Durability or replacement rate

d. Cost per unit

4. Species caught

5. Boats

a. Size

b. Weight

c. Power

d. Special qualifications and/or apparatus

6. Fishing seasons

a. Closed

b. Open

c. Best or peak season

7. Catch per unit of effort

a. Maximum

b. Minimum

c. Average

8. License cost and requirements

9. Habitat where fish are pursued

a. Depths

b. Currents

c. Other information

10. Frequency of gear tending

11. Crews

a. Titles

b. Duties

c. Wages

12. Operation costs
13. Storage and holding facilities
14. Preparation of fish for market
15. Marketing of fish
    a. Local sales
    b. Out-of-state sales
16. Prices
    a. Landing
    b. Shipping
17. Records
    a. Keeping and storage
        (1) Private
        (2) State
        (3) Federal
        (4) Other
    b. Publication
18. Difficulties encountered
19. Indications of depletion

The data from the survey report forms were compiled for each individual fishery. A comprehensive description of commercial fishing as it now exists on the mainstem reservoirs of the upper Missouri River Basin has been developed. From this information suggestions for further avenues of expansion or continued research may be formulated.

SURVEYS

FORT PECK RESERVOIR

Fort Peck Dam was closed in 1938. The reservoir is 135 miles long, has a surface area of 247,000 acres and a shoreline of 1,520 miles. The maximum depth is 251 feet. It has a capacity of 19,100,000 acre feet at maximum pool (Figure 4).

BRUSETT FISHERY

There is one commercial fishery in operation on Fort Peck Reservoir of Montana. It is located approximately 35 miles west of Brusett at the mouth of the Musselshell River. The fishing is primarily for large and smallmouth buffalo. Fishing operations extend in the reservoir some 35 miles up stream and 20 miles down from the processing plant; however, fishing is concentrated in the Musselshell and Devils Creek area in the spring (Figure 4).

Gill nets (Figure 9) and trammel nets (Figure 10) are used throughout the year and form the backbone of the fishery. The gill and trammel nets are fished near shore on the bottom in 5 to 20 feet of water during the spring. Toward summer the gill and trammel nets are moved to water 30 to 50 feet in depth and fished on the bottom. These nets are moved toward shore in the fall and fished in water 5 to 20 feet in depth. Trap nets (Figure 8) are fished close to shore and near the mouth

of the Musselshell River in early spring.

The trap nets have a 10-foot square frame with a 100-foot leader and 150-foot wing guides. One large trap net has a 20 X 40 foot frame with a lifting crib. This net is also fished with leader and wings. The frames are covered with 3-inch square mesh. The trammel nets are 300 feet in length, 10 feet in depth, and have a 3½-inch square mesh. The outside panels of the trammel nets are made of nylon. The gill nets are 300 feet long, 10 feet deep, and have 3½-inch to 4-inch square mesh.

During normal operations, all damage done to the nets while fishing is repaired between sets. Gill and trammel nets are rehung and may be treated with a commercial net preservative during the winter months. Trap nets may last from 3 to 5 years, depending on usage.

The cost of nets varies with quality and type of net purchased. Good quality gill nets cost $60 to $75 each. Trammel nets cost from $75 to $135. The trap nets used by this fishery are built by the fishermen; the netting for these traps costs about $75 per trap.

The species of fish taken are big and smallmouth buffalo, catfish, drum, carp, and carp sucker. No distinction is made between large and smallmouth buffalo for marketing. Table 3 gives the catch in 1966.

TABLE 3.--Species and pounds of fish removed from Fort Peck Reservoir in 1966 as reported by Montana Department of Fish and Game

Species	Pounds
Big and smallmouth buffalo	157,092
Catfish	10,965
Drum	1,325
Carp	3,100
Carpsucker	12,800

A small number of game fish--sauger, trout, and northern pike--are taken; about 75 per cent of these are returned to the reservoir alive and in good condition. All game fish found dead are taken to shore and buried.

All boats used in this fishery were built by the fishermen. Five boats are used to set nets and return the catch. One large pickup boat is used to collect the catch from the smaller boats and bring it to a pickup point on shore when fishing a considerable distance from the processing point.

The fishing boats are 16 feet long, 4 feet wide with a depth of 2 feet and weigh about 200 pounds. These flat-bottomed boats have a capacity of about 1200 pounds and are powered by 18 horsepower outboard motors.

The pickup boat was constructed by the fishermen at a cost of $150 to $200 for material. This boat is 28 feet long, 8 feet wide with a 3½ foot depth. It is powered by a 100 horsepower outboard motor and has a load capacity of 6,000 pounds. Also used for the transportation of fish are five

pickup trucks, one 2-ton truck and one 2½-ton truck.

The season of fishing is limited only by weather as the current contract (Appendix I) permits fishing from January 1 to December 31. The best or peak season is during the early spring when fish are spawning--usually the later part of April and the first part of May.

An accurate estimate of the catch per unit of effort is difficult to obtain because the fishermen do not keep suitable records. The information had to be obtained from the memory of the fishermen and by observation during the survey. During August the catch per unit of effort of the 300-foot trammel net averaged about 50 pounds per lift once a day. According to the fishermen on the reservoir, an overall average would be about 50 to 60 pounds per unit of effort during the entire season. The maximum catch per unit of effort during the peak season may run in excess of 1,000 pounds, and the minimum catch per unit of effort could be as low as 15 pounds.

The license or contract requirements are listed in the contract. A bond of $1,000 must be posted by the contractor with the Montana Fish and Game Department for the privilege of fishing the Fort Peck Reservoir. The contractor must also pay the state of Montana for fish sold: $2.00 per ton for carp white carp, and sucker; $5.00 per ton for buffalo; and 5 per cent on the total sales on catfish, goldeye, perch, and other fish. The state tax on all fish sold from January 1 to December 31, 1966, was $641.39.

The habitat in which the fish are pursued depends upon the season of the year. In the spring fish are found in the mouths of streams and rivers. Later in the spring they move quite close to shore in water ranging in depths from 15 to 20 feet. During summer and fall the fish are found near the bottom in depths of 30 to 60 feet. The currents and movements of water increase or decrease as depth is controlled by the Army Corps of Engineers at the dam site. The fluctuation in currents and depths is gradual and does not have a marked effect on the fishing operations.

Nets are tended daily--weather permitting. During the fishing season, wind is a prime factor and often determines whether the fishermen will be able to raise their nets.

The Brusett Fishery is a family operation. The father is the contractor and manager; the sons do the fishing and trucking of fish to market. Five sons are fishermen, and each has his own boat and gear. The father pays the fishermen $.30 per salable fish--regardless of species. One son trucks the fish to market and receives a salary comparable to that of the fishermen. The salaries are based on the number of fish taken but average $250 to $300 per month. According to the fishery manager, the overall operational cost is $30,000 per year. This includes wages, equipment, electricity, gas, insurance, and other costs.

The preparation of fish for market is done at the fishery processing plant by the fishermen. The buffalo fish are fleeced--that is, the scales are removed by hand with a large knife--then the viscera and heads are removed. Catfish have

heads and viscera removed. Drum and carpsucker (white carp) have only viscera removed. All yellow carp are sold in the round. After processing, fish are packed in boxes with ice and stored. The storage facility is one insulated room approximately 10 X 14 feet. One large ice machine makes enough ice to store and transport the fish.

The primary market for this fishery is in the Oakland Bay area of California. No fish are sold locally. The fishery owns a 2½-ton insulated van that trucks the fish to California. The prices received for the fish delivered to California are shown in Table 4.

TABLE 4.--Species of fish sold and price per pound delivered to California from Fort Peck Fishery in 1966 (Brusett Fishery Manager, Personal Interview)

Species	Price
Large and smallmouth buffalo	$.30
Yellow carp	.10
Carpsucker (White carp)	.10
Catfish	.50
Drum	.35

The records of fish taken and sold from the waters of Fort Peck Reservoir are kept by the contractor. The contractor sends a report to the Montana Fish and Game Department of his activities. The Montana Fish and Game Department keeps a record of the species removed and the number of pounds of each species for which payment is due to the state.

The current difficulties encountered by the Brusett Fishery are: Very poor access roads make travel impossible during inclement weather; the tremendous amount of debris on the reservoir bottom makes seining for fish impossible; and the contractor feels that the Interstate Commerce Commission puts an extreme amount of regulations on the transportation of fish.

There has been no noticeable indication in the depletion of fish in the Fort Peck Reservoir; however, the fishermen feel that at present the fish are more difficult to catch than at the beginning of the fishery in 1962.

GARRISON RESERVOIR

The Garrison Reservoir, largest of the Missouri Basin Reservoirs, impounds the runoff from 180,940 square miles of the Missouri River Basin creating a huge man-made lake 178 miles long. The reservoir will store 24,500,000 acre feet (7,985 billion gallons) of water when full to capacity. It is more than 14 miles across at some points and 180 feet deep along the former river channel upstream from the dam (Figure 5).

NEWTOWN FISHERY

The Newtown Fishery operates in the central portion of the reservoir near Newtown, North Dakota (Figure 5). The fishing is primarily for carp, which are later smoked and distributed for sale.

The method of fishing used by this fishery is seining. The seine is loaded on a barge with one end of the seine anchored to the shore. The barge then distributes the net to enclose the area to be fished--bringing the loose end of the net back to shore (Figure 12). After the area to be seined has been enclosed by the net, the net is pulled to shore using a truck-mounted winch. As the net is pulled to shore, it is stretched for drying in such a manner that it is ready for reloading on the barge. As the net is pulled, the fish work their way to the center of the net and into

the pocket. When the fish have entered the pocket, the net is pulled to shore as rapidly as possible. The fish are then taken from the net, loaded into a truck containing ice, and transported to the plant for processing.

This fishery has two seines. One seine has a length of 4,000 feet and a depth of 27 feet with a center pocket. The net mesh is one inch square. This net is used in wide open areas with a minimum amount of bottom debris to interfere with the dragging procedure.

The second net is smaller having a length of 900 feet and a depth of 15 feet with one inch square mesh and a center pocket. This net is used for small bays and inlets not accessable to the large seine. Both nets are fished with float lines and a leadline from deeper to shallow water. The seine normally requires some mending after each haul because of the debris on the reservoir bottom. A commercial net set treatment is used at least once a year--usually during the winter when the gear is prepared for the coming season.

The durability of a good seine depends primarily on the area being fished but should last for five to ten years with normal maintenance. The cost of a good quality seine ready to fish is approximately a dollar per running foot--depending upon the depth of the net. The 4,000-foot net this fishery used cost $4,000 and the 900-foot seine about $700.

The commercial species caught by this fishery were carp and buffalo (Table 5).

TABLE 5.--Species and pounds of fish removed from Garrison Reservoir by the Newtown Fishery in 1966 as reported by the North Dakota Game and Fish Department

Species	Pounds
Carp	35,200
Buffalo	26,00

Game fish caught are walleye, sauger, and northern pike. Five to ten game fish are taken on the average with each pull of the large net. Nearly all of the game fish are returned to the water (approximately 80 per cent) in good condition. The game fish that die are processed and turned over to a needy institution for use. The home for the aged in Newtown is the recipient of most of these fish.

Only one boat is used by this fishery. It is 16 feet long and is powered by a 50 horsepower outboard motor. The barge used for transporting and distributing the net is 15 X 20 feet and is powered by a 35 horsepower outboard motor; however, at the time of this survey, an order had been placed with a manufacturing firm in Wisconsin for two large pontoon boats especially designed for the fishery operation.

The contract between the Newtown Fishery operator and the North Dakota Game and Fish Department (Appendix II) specifies no closed season; however, the severe winter weather makes fishing impractical from December through March. The best fishing is in the spring and fall when fish are near shore.

The catch per unit of effort is highly variable. Five tons per haul is considered a large catch. At times hardly

any fish are caught in the net due to tearing or lifting of the net by the reservoir debris or because the fish are not accessible at the time. The average catch is 1 to 2 tons per pull of the 4,000 by 27-foot seine.

Much of the fishing is done in bays and inlets that can be fished with the 4,000-foot seine. The bottoms of these bays are quite smooth and consist of sand or mud. There can be very little debris or obstruction in the seining areas. The fishing depth varies from the maximum seine depth of 27 feet to the shore. When the reservoir is low enough the fishermen are able to locate suitable fishing sites that are clear of debris or can be cleared for future fishing.

Fishing is a daily operation, but usually only one pull of the net is made within a 24 hour period. However, an average of one day per week of fishing time is lost because of the need for major repairs on a badly torn net.

The fishery is divided into three separate operations: fishing, processing, and selling. The fishing crew consists of the head fisherman and five fishing crew members. The processing operation is controlled by the plant operator and three processing and packaging people. The sale of products is the responsibility of two salesmen who travel and sell the fish to various markets. The general manager oversees the complete operation. Salaries of the general manager, chief fisherman, plant operator and salesmen--all of whom share in the ownership--are determined by fish sales. The employees are paid $1.25 to $1.50 per hour, depending on experience.

The Fort Berthold Indian Reservation, located near Newtown, provides much of the labor.

The carp are prepared for market by cutting the heads and tails from the fish, splitting the fish lengthwise through the backbone, removing the viscera, and cutting each fish into 1 to 1½ pound pieces. These pieces are placed in a saltwater brine for 8 to 10 hours. Then the fish are taken from the brine, put on racks, and allowed to drain. After the draining period, the fish are put into the smoke house and smoked at a high enough temperature to thoroughly cook the fish. The fish are then removed and cooled; each piece is weighed, packaged, and marked according to weight and price for delivery.

Storage facilities consist of a small cooler for holding fish ready to be shipped. One ice machine produces all the ice needed in transportation of the fish from the reservoir to the plant.

The average cost of operation is $.31 per pound of smoked fish processed. All smoked carp processed in this fishery is marketed in North Dakota and sells for about $.49 per pound in the local stores. Plans are being made to sell smoked carp in neighboring states and Canada in the near future. Some buffalo and unsmoked carp are sold to commercial fish buyers who truck them to Chicago where they are sold at the market price (Table 6).

TABLE 6.--Species of fish sold and price per pound for the Newtown Fishery in 1966 as reported by the North Dakota Game and Fish Department

Species	Price
Carp	$.03½
Buffalo	.10

The Newtown Fishery keeps a record of the fish sold and sends a report of sale to the North Dakota Game and Fish Department. The Fisheries Division of the North Dakota Game and Fish Department compile a consolidated list of all fish removed from the Garrison Reservoir and the amount of money the state receives for the removal of these fish under contract agreement (Table 7).

TABLE 7.--Summary of the commercial fish sales during the calendar year of 1966 from the Garrison Reservoir as reported by the North Dakota Game and Fish Department

Area	Species	Poundage	Sale Price	State Percentage
Garrison	Carp	75,475	$2,037.50	$101.87
	Buffalo	77,057	6,814.28	681.42
	Paddlefish	10,775	1,535.46	153.55
TOTALS		163,307	$10,387.24	$936.84

PARSHALL FISHERY

The Parshall Fishery is located at Parshall, North Dakota. The fishing area is that portion of the Garrison Reservoir west and southwest of Parshall--a distance of 5 to 20 miles (Figure 5).

This fishery seeks primarily big and smallmouth buffalo and uses a seine (Figure 12) set from a barge. Two portable winches powered by a small gasoline engine then pull the net toward shore. As the net is pulled, the fish are forced into the central pocket and rapidly drawn to shore. The fish are then transferred to a trailer tank partially filled with water for live transportation to the processing plant.

The seine used in this operation is 3,000 feet long, 27 feet deep, and has a 3-inch square mesh. The winches used to pull the seine to shore have a 5 to 1 ratio with a gasoline motor. A small pump with a gasoline engine is used to pump water into a wooden tank trailer 10 feet long, 4 feet high, and 5 feet wide. A 3/4-ton pickup truck is used to haul gear and pull the tank trailer.

All gear is maintained during normal operations. During the winter the seine is treated with a commercial net preservative; all equipment is serviced and repaired or replaced during the winter.

The durability or replacement rate of all equipment depends on the use and conditions of fishing. This fishery plans to use their seine 3 to 5 years before complete replacement will be necessary. The replacement of a good

seine of the quality now in use would cost approximately $3,500. The winches cost $75 each, and the tank trailer was built at a cost of about $125.

The species of fish caught for commercial use in this fishery are carp, buffalo, and paddlefish (Table 8).

TABLE 8.--Species and pounds of fish removed from the Garrison Reservoir by the Parshall Fishery in 1966 as reported by the North Dakota Game and Fish Department

Species	Pounds
Carp	34,480
Buffalo	51,057
Paddlefish	10,775

Approximately 8 to 12 walleye, northern pike, and sauger were taken per haul. About 75 per cent of these game fish were alive and returned to the water in good condition. The game fish that were not returned to the water were given to the home for the aged in Parshall with the permission of the Game and Fish Department.

A barge 45 X 40 feet powered by two 35 horsepower outboard engines is used to move and distribute the net. This is the only craft used by this fishery.

There is no closed fishing season required by law (Appendix II). The weather during the winter, however, is too severe to make fishing through the ice practical. The fishing generally comes to a halt when the ice forms on the reservoir in December, and it resumes in the early spring,

usually in April. The peak season of fishing is during the spring when fish move near the shore to spawn and again in the fall when fish seem to be active near the shore.

The catch per unit of effort is highly variable: ranging from 0 to as much as 22 tons per pull. The average catch is 1,000 to 2,000 pounds per pull of the 3,000-foot seine.

The fish are pursued in the small bays and inlets of the Garrison Reservoir. The fishing depth ranges from 27 feet, the depth of the seine, to the shore. In an area chosen for fishing, the fish can be observed and the bottom should be free of debris.

Gear is fished daily if the weather is favorable. The wind sometimes prohibits going out to fish. Usually only one pull of the seine is made per day.

The fishing crew is made up of six men. One man is the head fisherman and responsible for all fishing operations. There are a processing plant manager and two helpers. The chief fisherman receives $75 per week; the salary for the fishermen helpers is $50 per week; the plant manager is paid $65 a week; the plant helpers receive $1.25 per hour.

The operational cost of the fishery is about $20,000 per year. This includes labor, equipment, electricity, gasoline, insurance, and incidentals.

The preparation of fish for market includes sorting the fish according to species and removing the viscera from buffalo, drum, and paddlefish. The paddlefish also have the head, tail, and fins removed. The buffalo are graded accord-

ing to weight. The buffalo weighing over 8 pounds are called jumbo buffalo on the market; those under 8 pounds are called number ones. All buffalo are washed in a commercial preservative to prevent deterioration of the gills during storage and shipping.

The storage facilities consist of one cooler 20 X 30 feet. Fish are put into boxes and packed with ice to await shipment.

All fish are purchased by a commercial buyer from Memphis, Tennessee. The prices paid to the fishery are listed in Table 9. These buyers sell the fish on the commercial markets in St. Louis, Missouri; Chicago, Illinois; Memphis, Tennessee; and Spirit Lake, Iowa.

TABLE 9.--Species sold and price per pound received by the Parshall Fishery in 1966 (Fishery Manager, Personal Interview)

Species	Price
Buffalo (Jumbo)	$.10
Buffalo (Number one)	.08
Carp	.02
Paddlefish	.15

The records kept by the fishery include only receipts for the fish shipped. A fish sales report form is used by the North Dakota Game and Fish Department and must be filled out and checked by a state fishing supervisor. One copy is sent to the Game and Fish Department, one copy goes with the fish, and one copy is retained by the contractor.

The North Dakota Game and Fish Department keeps an accurate record of all fish sold from the waters of North Dakota.

The primary difficulties encountered by this fishery are labor problems. The fishery cannot afford to pay a high enough wage to get good reliable help. There is a large change-over of personnel (Most of which, with the exception of the head fisherman, are from the Fort Berthold Indian Reservation near Parshall). The wind causes loss of fishing time. Debris on the reservoir bottom makes fishing impossible in many areas and causes considerable damage to the nets.

There has been no indication of depletion of fish. The supply of fish is plentiful, but not many areas are free from debris; therefore, they cannot be fished without damage to the seine.

OAHE RESERVOIR

The Oahe Reservoir provides benefits in flood control, power, and recreation. Work on the project began in 1948 and 10 years later on August 3, 1958, the river was diverted through the outlet works. The dam reached full height on October 30, 1959.

The reservoir now contains approximately 14,700,000 acre feet of water, and on January 1, 1966, its water surface elevation was 1591.00 Mean Sea Level--about 29 feet below the maximum operating level. The maximum pool elevation achieved at Oahe to date occurred on December 26, 1965, when an elevation of 1591.58 was reached. The maximum storage is about 24 million acre feet. Normal operation is expected between 1607.00 and 1617.00 elevation (Figure 6).

MOBRIDGE FISHERY

Commercial fishing on Oahe Reservoir was initiated on July 7, 1964, following the completion of the Bluff City Fish Company's plant at Mobridge, South Dakota. The contract for removal of commercial fish species issued by the South Dakota Game, Fish, and Parks Department is similar to the one under which the same company has fished Fort Randall Reservoir since 1959 (Appendix III). A contract was also issued by the North Dakota Game and Fish Department for the portion of

Oahe Reservoir located in North Dakota (Appendix II). The fishery built a 50 X 75 foot building which includes storage as well as processing facilities.

The area fished is that portion of Oahe Reservoir from Mobridge north to the vicinity of Fort Yates, North Dakota--a distance of some 40 miles (Figure 6).

Gill nets and hoop nets (Figure 11) are the principal methods of fishing. The gill nets are 300 feet long, 10 feet deep and are hobbled to about 7 feet in depth. Most of the gill nets used have a mesh size of 4 square inches. Hoop nets with diameters from 5 to 7 feet, a 3-inch square mesh, and leads 100 feet long are used. All gear is usually fished near shore in waters less than 20 feet deep. Other equipment used include trucks with four-wheel-drive to get into and out of remote fishing areas.

All gear is maintained during operation. Gill nets are tarred once a year. During the winter months all gear is checked, repaired, and readied for fishing in the spring. Most gill nets last only one season, then are thrown away and replaced. Sometimes the gill nets are rehung with new netting--depending on the condition of the net. The cost of a good gill net (300 feet long and 10 feet deep) is about $100. The hoop nets last from 3 to 5 years. These may be repaired by putting in new hoops or replacing netting that cannot be mended. The cost of a good hoop net with 7-foot hoops, nylon net, and a 100-foot lead is about $150.00.

The Mobridge Fishery seeks buffalo primarily; the catch of other species is incidental (Table 10). The game fish caught

are northern pike, paddlefish, and sauger. These are caught in small numbers and at least 75 per cent are returned to the water unharmed. Game fish that are accidently killed are processed and sold as directed in the contract (Appendixes II and III).

TABLE 10.--Species and number of pounds taken by the Mobridge Fishery in 1966 as reported by the South Dakota Department of Game, Fish, & Parks and the North Dakota Game & Fish Department

Species	Pounds
Buffalo (Big and smallmouth)	371,581
Catfish	4,761
Drum (Sheepshead)	6,276
Carpsucker	26,572
Goldeye	42,893
Carp	60,699

The boats used by this fishery are of the square front, John boat type. The boats are alluminum, 16 feet long, 5 feet wide with a carrying capacity of about 1,200 pounds. They are powered by 40 horsepower outboard motors.

The contract permits fishing during the entire year; however, for the most part, commercial fishing usually stops in December and begins in April because of the severe winter weather. Winter fishing has been tried but without much success. Peak catches are in the spring and fall.

The catch per unit of effort averages about 60 pounds per lift of 300 yards of gill net and about 55 pounds per lift of one trap net.

The fish are pursued in shallow water from 5 to 20 feet in depth near the shore. Fishing operations are hazardous because of the many trees and great amount of debris still remaining in this relatively new impoundment.

The frequency of tending nets is once a day; however, there are times during the fishing season when the wind keeps the fishermen from running their nets.

The fishery personnel consists of one contractor, three fishermen and three fishermen's helpers. The contractor manages the fishery and buys the fish from the fishermen. He provides the fishermen with ice and processing facilities. The fishermen take their salaries according to the amount of fish they sell. The fishermen's helpers are paid a flat rate of $1.25 per hour or they may share in a percentage of the catch. The helpers wages are paid by the fishermen.

The operation of the processing plant costs about $3,000 per year. This includes electricity, water, insurance, maintenance, and other incidentals. The cost of operation is paid by the contractor. The plant is the property of the company that buys the fish and is managed by the contractor.

Preparation of the fish for market is done at the processing plant by the fishermen and their helpers. The fish are brought to the plant at Mobridge from the fishing areas by truck where they are sorted according to species. The viscera is removed, and the fish are washed and rinsed in a preservative solution to prevent deterioration of the gills during storage and shipment. The buffalo are graded by weight. According to reports from this fishery, jumbo buffalo are 6

pounds and over; buffalo under 6 pounds are called number ones. Medium buffalo are under 3 pounds. Carp are not dressed and are sold in the round. The fish are packed in boxes with ice and placed in a cold storage room in the plant.

Fish are picked up at the plant by wholesalers and moved by truck to markets in Chicago, Illinois; Memphis, Tennessee; and Spirit Lake, Iowa. Less than 1 per cent of the fish is sold locally. The species that are marketed locally are sold for $.20 per pound.

The fishermen sell their fish to the contractor upon landing. The contractor sells his fish to a wholesaler before shipping (Table 11).

TABLE 11.--Fish sold and prices per pound for the Mobridge Fishery in 1966 (Mobridge Fishery Manager, Personal Interview)

Species	Landing Price	Shipping Price
Buffalo (Jumbo)	$.07	$.11
Buffalo (Number one)	.05	.08
Buffalo (Medium)	.03	.05
Drum	.02	.05
Catfish	.14	.23
Carp	.02	.03

Records of fish caught within the boundaries of each state are kept by the fishery operator, and a report of the fish sold is filed respectively with the South Dakota Department of Game, Fish, and Parks and with the North Dakota Game and Fish Department (Tables 12 and 13). In addition, personnel

of the United States Bureau of Commercial Fisheries Reservoir Research Station at Mobridge closely monitor the catches in the course of their investigations.

TABLE 12.--Fish sold and payment to the state of South Dakota by the Mobridge Fishery in 1966 as reported by South Dakota Department of Game, Fish, and Parks

Species	Pounds	Payment to State
Buffalo	231,919	$1,159.60
Catfish	4,761	142.83
Carp	28,712	- - -
Drum (Sheepshead)	5,451	- - -
Carpsucker	26,572	- - -
Goldeye	42,893	- - -
TOTALS	340,308	$1,302.43

TABLE 13.--Fish sold and payment to the state of North Dakota by the Mobridge Fishery in 1966 as reported by the North Dakota Game and Fish Department

Species	Pounds	Payment to State
Buffalo	139,662	$1,316.49
Carp	31,897	39.38
Drum (Sheepshead)	825	2.48
TOTALS	162,474	$1,358.35

The Mobridge Fishery operates in the water of both North Dakota and South Dakota. The manager of the fishery

considers that his main problem stems from the differences in the regulations governing commercial fishing between the two states. Each state has different regulations concerning the type of gear used, the species which can be marketed, the bonds which must be posted, the duration of the contracts, and even the method of disposal of the game fish inadvertently captured.

The fishermen report no indication of the depletion of fish from the waters of Oahe Reservoir.

FORT RANDALL RESERVOIR

While not as large as the huge upstream reservoirs at Fort Peck, Garrison, and Oahe, Fort Randall's 6,100,000 acre feet of storage capacity definitely qualifies it as a large reservoir. The drainage area of the reservoir is 263,480 square miles. Its surface at maximum pool level is 102,000 acres, and it has a length of 107 miles. The maximum depth is 140 feet with 540 miles of shoreline at 1,350 elevation (Figure 7).

CHAMBERLAIN FISHERY

The fishery based at Chamberlain, South Dakota, fishes an area of the reservoir some 15 to 20 miles upstream from the town (Figure 7).

The methods of fishing are primarily the use of gill nets, trammel nets, and hoop nets. The gill nets and trammel nets are fished on the bottom near the shore in waters from 5 to 20 feet in depth. The hoop nets are fished in 4 to 8 feet of water with a 100-foot lead net toward shore.

The gill and trammel nets are hobbled; that is, the height of the net is reduced from 10 feet to 7 feet by tying the float line and the lead line. This increases the slack in the net making it more effective for catching fish. These nets are 300 feet long with a depth of 10 feet before hobbling. They are made of nylon with a 3½-inch square mesh.

The hoop nets have a 3½ to 4½-foot diameter mouth with 7 hoops and 2 throats. These nets are 12 to 14 feet in length and also have a 3½-inch square mesh.

Normal care and maintenance is required in keeping the nets in good fishing condition. All equipment is reconditioned during the winter, and the worn out gear is replaced. The netting is treated once per year with a preservative. Gill and trammel nets last one season. Hoop nets last 3 to 5 years. The cost of replacements is approximately $40 for hoop nets, $60 for gill nets, and $75 for trammel nets.

The Chamberlain Fishery seeks primarily buffalo. The catch in 1966 is given in Table 14.

TABLE 14.--Species and pounds of fish taken from Fort Randall Reservoir by the Chamberlain Fishery in 1966 as reported by the South Dakota Department of Game, Fish, and Parks

Species	Pounds
Buffalo	315,543
Catfish	4,527
TOTAL	320,070

Few game fish are taken by the Chamberlain commercial fishermen. These are, for the most part, northern pike, walleye, sauger, crappie, and paddlefish. About 95 per cent of these fish are returned to the reservoir unharmed. The game fish that die are processed and sold with all proceeds going to the Fish and Game Department as required in the fishing contract (Appendix III).

The boats used by the fishermen are conventional aluminum fishing boats (16 feet long, 5 feet wide, and 34 inches deep with a pointed bow). These are powered by 18-horsepower outboard motors. One wooden square fronted John boat was in use at the time of this survey. This boat (16 feet long, 5 feet wide) had a 28-horsepower outboard motor.

Commercial fishing is permitted the year around under the contract (Appendix III); however, the severe winter weather and dangerous ice conditions limit the fishing to the months between April and December. The peak seasons for fishing are the early spring while the fish are spawning (the last of April and the first of May) and in the fall.

The catch per unit of effort fluctuates continually; however, the catch for hoop nets may be a maximum of 250 pounds during the peak season to a minimum of 5 to 20 pounds during the slow portion of the season. The average catch per unit of effort for the hoop nets used in this fishery is 55 pounds. The gill nets have a maximum catch of 200 to 300 pounds and a minimum catch of 5 to 15 pounds. The average catch per unit of effort during the fishing season is 60 pounds per lift of a 300-foot gill net, 10 feet in depth with a $3\frac{1}{2}$-inch square mesh.

The contract cost and requirements are regulated by the South Dakota Department of Game, Fish, and Parks. A sample contract is contained in Appendix III.

The Chamberlain Fishery operates in an area of the reservoir which was not cleared of trees and debris before the land was flooded. The trees are dead and standing in

water up to a depth of 20 feet or more. Nets are set among the trees and in open areas of water from 3 to 10 feet in depth. The original river channel is free of the trees, but it is not often fished because of the depth. Fish seem to prefer the more shallow waters near shore during most of the summer.

All gear is fished daily, weather permitting. The fish are usually removed from the nets early in the morning. The nets are then reset and often moved from time to time to keep up the rate of catch.

The personnel operating this fishery consists of the plant manager or contractor, three fishermen, and three fishermen's helpers. The contractor is also engaged in fishing.

The contract holder is the only person authorized to sell fish taken from the Fort Randall Reservoir. All fishermen must sell their fish to the contractor, and he in turn sells them to the wholesaler who puts them on the retail market.

The wages of the contractor and fishermen are determined by the amount of fish taken and sold. The wages the fishermen's helpers receive is $1.25 per hour.

The contractor provides ice for transportation, plant facilities for processing the fish, and storage facilities for holding the fish until transported to market. The cost for electricity, water, insurance, general repair, and upkeep is approximately $2,500 per year. This does not include replacement of major items such as ice machines and cooler systems.

The preparation of fish for shipment consists of remov-

ing the viscera, washing the fish in a preservative solution, and packing 90 pounds of gutted fish in each box of ice. The buffalo fish are sorted according to size prior to packing. Dressed buffalo weighing 6 pounds or over are called jumbo buffalo; the smaller ones are called number ones.

The packaged fish are stored in an insulated cooler and kept at 32° F. prior to shipment. The processing plant has a large ice machine which makes all the ice required.

All fish are sold to the Bluff City Fish Company, owner of the plant. These fish are then shipped to markets in Chicago, Illinois; Memphis, Tennessee; and Spirit Lake, Iowa.

The price the fishermen receive from the contractor is the landing price. The price the wholesaler pays to the contractor is the shipping price (Table 15). The contractor pays the state of South Dakota a percentage on the pounds of fish sold (Table 16).

TABLE 15.--Species sold and price per pound at landing and shipping for the Chamberlain Fishery in 1966 (Fort Randall Fishery Manager, Personal Interview)

Species	Landing Price	Shipping Price
Buffalo (Jumbo)	$.07	$.12
Buffalo (Number one)	.04	.07
Catfish	.12	.23

TABLE 16.---Species sold, poundage, and payment to state by the Chamberlain Fishery in 1966 as reported by the South Dakota Department of Game, Fish, and Parks

Species	Pounds	Payment to State
Buffalo	315,543	$2,366.57
Catfish	4,527	135.81
TOTAL	320,070	$2,502.38

A record of all fish sold commercially is kept by the fishery in the form of shipping receipts. The report of sale of all fish is sent to the South Dakota Commission of Game, Fish, and Parks. A commercial fishery supervisor for the state of South Dakota is present to check all fish landed and shipped. The state keeps a record of fish taken and the revenue returned to the state.

The current difficulties encountered by the commercial fishermen on the Fort Randall Reservoir include navigational and fishing hazards due to the inundated trees in the fishing area and the paddlefish which are especially destructive to gill nets, yet may not be sold legally.

The fishermen on this reservoir have not noticed any depletion of the commercial species. The catches have been consistant since fishing began in 1959.

DISCUSSION

Exploitation of the populations of the commercial fishes from the mainstem reservoirs of the Upper Missouri River System is just beginning. The five small fisheries now in operation seek large and smallmouth buffalo primarily, but other species such as carp, catfish, carpsucker, and drum are taken in significant numbers.

The commercial harvests are infinitesimal considering the total standing crops that are probably present (Table 17). The standing crops of commercial species in the Missouri reservoirs are unknown, but they could range from as low as 100 pounds per acre to over 300 pounds per acre. It is difficult to see how this current low level of commercial fishing by itself could have much effect on the populations of commercial fishes in the reservoirs under stabilized conditions. Some effects on local fish populations are, of course, possible if the fishing is concentrated in a limited area or if there are special problems in reproduction.

TABLE 17.--Pounds per surface acre of commercial fish removed from the mainstem reservoirs in 1966

Reservoir	Pounds Per Acre	Surface Acres at Maximum Pool
Fort Peck	0.7	247,000
Garrison	0.5	324,000
Oahe	1.3	376,000
Fort Randall	3.0	102,000

At the present level of exploitation, it would seem that any effects on commercial fish populations by the commercial fishery would be vastly out-weighed by the far reaching effects of recent impoundment on the ecology of the fish populations. Some of the reservoirs are just now in the process of filling for the first time, and the unstable ecological conditions involved may presently be causing shifts in the balance of fish populations. For example, impoundment of a river favors pelagic spawners over stream spawners. Shifts in population balances, whatever the cause, might affect the future development of commercial fishes and should be anticipated. It would seem especially important to study and evaluate the shifts in population balances as the reservoir habitats stabilize and the commercial fisheries develop.

The states regulate commercial fishing within their respective boundaries by contracts with the fishermen. The contractual agreements between the states and fishermen are each separate and individual; however, they all tend to include the following general provisions:

(1) A bond is required.

(2) Upper and lower limits on the harvest may be specified.

(3) Type of gear is specified.

(4) Fishing operations are supervised by state personnel.

(5) Game fish taken must be handled according to state requirements.

(6) States receive a percentage fee for fish marketed.

Although the regulations of the states are generally similar, they often differ in detail. The operator who fishes Oahe in both North Dakota and South Dakota reports that differences in regulations between the two states are a restriction to him.

No attempt to evaluate the differences in the regulations can be made here. In view of the apparent low level of commercial exploitation, standardization of regulations might be considered in order to assist the expansion of the new industry.

The Brusett Fishery in Montana is a successful, small family operation that began on Fort Peck Reservoir in 1962. By building its own processing plant, storage facilities, and boats and by trucking their own fish to markets in California, the fishery has been able to keep its overhead expenses at a minimum. The method of fishing is primarily by gill and trammel nets. The Brusett Fishery is relatively self-sufficient in that it is home owned, does its own fishing, processing, and delivering to the retail markets.

The Newtown Fishery in North Dakota is a new fishery that obtained a contract to fish the Garrison Reservoir. The fish sought is primarily carp. A building was remodeled into a processing, smoking, packaging, and storage facility. A market for smoked carp is being developed throughout the state of North Dakota, and plans are to distribute the product in neighboring states and Canada. The method of fishing is by seine. A general lack of experience in fishing, a shortage of good seining areas, and the large overhead costs put this fishery at a disadvantage. However, if the harvest of fish

could be increased, the efficiency improved, and a dependable market for smoked carp developed, this fishery could be a success.

The Parshall Fishery at Parshall, North Dakota, has a contract for fish removal on the Garrison Reservoir also. All fishing is by seine, and the catch is sold to a commercial fish buyer. A general lack of experienced personnel and the debris on the reservoir bottom prevented the taking of large numbers of fish. The cost of operation was greater than the value of fish sold.

The Bluff City Fishing Company built a plant at Mobridge, South Dakota in 1964. The plant manager has a contract for the removal of fish from the Oahe Reservoir in North and South Dakota; he provides ice, processing, and storage facilities for the independent fishermen. All fish caught by the independent fishermen are sold to the contractor who, in turn, sells them to the Bluff City Fishing Company. This fishery seeks primarily buffalo and uses gill and hoop nets. The highly qualified contractor has a great deal of experience and operates this fishery effeciently and successfully.

The fishery at Chamberlain, South Dakota, began operation in 1959. This fishery operates similar to the fishery at Mobridge since the Bluff City Fishing Company owns both plants. The plant manager has a contract to fish the Fort Randall Reservoir. Independent fishermen fish the reservoir under the contract provisions and use the facilities of the processing plant. The fish are sold to the contractor who, in turn,

sells them to the Bluff City Fish Company. The fishery seeks primarily buffalo through the use of hoop and gill nets. This fishery is quite successful.

The gill, trammel, and hoop nets used by the commercial fishermen in the reservoirs appear to be economical, convenient, effective, and versatile. Even when as many as 10 to 15 pieces of gear are fished, the initial capital investment is low. The individual fisherman can equip himself with a truck, trailer, boat and motor, safety devices, and an adequate supply of gill nets, hoop nets, rope, and anchors for about $6,000. Fishermen equipped as above are highly mobile and can move the fishing operation for relatively long distances if necessary. Another advantage of gill and hoop nets is that they can be fished at any depth. The small boats used with this gear, however, can not operate during strong winds, nor can they travel long distances over the water.

The use of seines is extremely difficult because the trees and brush are not cleared from the reservoir bottom except in a few areas where recreational use was expected to be heavy. Much of the inundated bottom lands and prairie is dotted with fence posts, barbed wire, brush, and large cottonwood trees. Seines also require large crews and are vulnerable to bad weather.

New methods of fishing would be of particular help in 2 of the 5 fisheries visited. A definite need for further research in catching fish in greater numbers is needed. This would require experimental use of known gear and the development of new gear especially designed for these reser-

voirs. The tremendous distance that fish have to be moved results in a low price paid for the fish at the reservoirs. The Department of Interior is now in the process of accelerating its fish protein concentrate program (FPC). Through research, the development of an FPC plant near the Missouri River Reservoirs could assure a sound stable market. This would encourage the growth of profitable commercial fishing.

At the present time it appears that the costs involved in getting the fish to market and, to a lesser extent, the costs and difficulties involved in catching the fish restrict the development of commercial fishing in the Missouri Reservoirs rather than any limit of abundance of the commercial species or any other biological factor.

Additional research is needed on reproduction, growth, year classes, strength, and relative abundance of fish populations. This is especially needed on the Fort Peck, Garrison, and Fort Randall Reservoirs. The Bureau of Commercial Fisheries has a research investigation station at Mobridge that is currently working on the Oahe Reservoir.

I would strongly recommend a survey every three years of the commercial fisheries on the upper mainstem reservoirs of the Missouri River Basin. Comprehensive surveys of the commercial fisheries would serve as convenient references in monitoring changes in the overall biology and abundance of the fish populations in relation to the development of the commercial fisheries. Such surveys would assist in discovering problems as they arise and serve as guides for more detailed and specific research that might be required.

CONCLUSIONS AND RECOMMENDATIONS

(1) The commercial fisheries on the mainstem reservoirs of the Missouri are in their infancy. No evidence of depletion was found, and the rate of exploitation is but a small fraction of what might be sustained by the commercial fish population.

(2) The commercial fishing could be greatly expanded without any adverse effect on commercial fish populations.

(3) The population of sport fishes might be benefited by increased harvest of commercial fishes.

(4) There is a need for development of new fishery products and an expansion of the market for existing products.

(5) The introduction of new methods and improvement of commercial fishing gear might accelerate the expansion of commercial fishing in the reservoirs.

(6) A study of the feasibility of standardization of the regulations and the relaxation of the restrictions on commercial fishing should be made.

(7) There is a general need for aquatic research of all kinds on the new reservoirs. The paucity of basic scientific information on the reservoirs is a handicap in the management of the developing aquatic resources.

(8) A comprehensive survey of the commercial fisheries on the reservoirs should be made periodically. Such surveys would assist in detecting changes in fish populations and would point out needs for specific detailed investigations.

APPENDIX I

MONTANA

COMMERCIAL FISHING CONTRACT

STATE OF MONTANA
FISH AND GAME COMMISSION
Helena, Montana

C O N T R A C T

FOR THE COMMERCIAL REMOVAL OF NON-GAME FISH
FROM THE WATERS OF MONTANA

_____
Location

This agreement, made this _____ day of _____,19____, by and between the State of Montana Fish and Game Commission, by and through its State Fish and Game Director, herein designated as the Director, and_____of _____ herein designated as the contractor, witnesseth:

1. The contractor shall be permitted to remove fish of the following species:_____

_____

from the following waters:_____

During the period from _____,19___, to_____, 19___, inclusive, under the terms hereinafter provided.

2. The contractor shall, in the taking and removal of the fish listed in Paragraph 1, use the following equipment:_____

_____.

Said equipment shall be maintained in serviceable condition and shall be used in accordance with all state laws and the rules and regulations of the Montana Fish and Game Commission.

3. The Director may direct or permit the Contractor to

discontinue or curtail his fishing operations temporarily or permanently whenever the Director shall find that the continuance thereof is inexpedient or inadvisable in view of the purposes of the laws and regulations applicable thereto.

4. All species of fish not listed in Paragraph 1 of this agreement shall be returned alive and unharmed to the waters from which they came. The Contractor shall use all possible care and diligence in complying with this provision and evidence of negligence, such as the finding of dead and injured game fish resulting from the Contractor's operations, shall be considered a violation of this agreement. The Director may, in his discretion, relieve the Contractor from the consequence of such violation if such violation was unavoidable and was not caused by fault or negligence on the part of the Contractor. Unmarketable fish of the species of fish listed in Paragraph 1, shall not be returned to the water alive, but shall be buried or shall be so cut as to sink to the depths when disposed of in deeper waters.

5. All fishing operations of the contractor shall be subject to supervision by the Director or his authorized representatives. The Contractor shall keep written records in the English language of all his operations and transactions relating to taking, keeping, sale of, or other disposal of fish; and of the receipts, disbursements, and expenses incurred in connection therewith, which records shall be open at all times for inspection by the Director or by his authorized representatives. The Contractor shall make his reports to the Director

on such forms as the Director shall prescribe and require.

(6) In the event of any default by the Contractor in the performance of this agreement, the Director may, in his discretion, declare this agreement cancelled and terminated without prejudice to any right of the state to damages caused by such default; or the Director may do, or cause to be done, anything which the Contractor has failed to do as required by the provisions of this agreement.

(7) The Contractor understands and agrees that the Montana Fish and Game Commission, acting for the Montana Fish and Game Department, shall not be subject to the payment of damages, nor will it assume any liability arising from commercial fishing operations under the terms of this agreement.

(8) Under the terms of this agreement the Contractor shall be allowed to take and to sell the species of fish listed in Paragraph 1. Payment to the Montana Fish and Game Department shall be $2.00 per ton for carp, white carp, and sucker; $5.00 per ton for buffalo, and 5% on catfish, goldeye, perch, and others, less transportation costs to market. Remittance shall be made to the Montana Fish and Game Department within thirty (30) days after receipt of payment by the contractor for any fish taken under this agreement.

9. The Contractor shall give a bond to the Montana Fish and Game Department in favor of the State of Montana in the sum of one thousand dollars ($1,000) with coporate surety, conditioned on the faithful carrying out of the provision of this agreement to be by him performed. Upon any default or nonperformance of the terms of this agreement by said Contractor,

except wherein the Director has waived in writing such default or breach of agreement, the amount for which said bond is given shall become due and payable to the Montana Fish and Game Department.

In witness whereof, the parties hereto have executed this agreement this _____day of _____, 19____.

Witness_____ Montana Fish and Game Commission

Witness_____ by_____
State Fish and Game Director

_____ _____
Chief of Fisheries Management Contractor

_____ _____
Chief Fisheries Biologist Contractor

APPENDIX II

NORTH DAKOTA

COMMERCIAL FISHING CONTRACT

NORTH DAKOTA STATE GAME AND FISH DEPARTMENT
Bismarck, North Dakota

PROPOSAL FOR REMOVAL OF ROUGH FISH

This proposal made pursuant to request for bids, to the State of North Dakota, acting by and through the Commissioner of the State Game and Fish Department, herein called "Commissioner" by

_____

whose address is_____
herein called "contractor", as follows but subject to acceptance hereof by the Commissioner:

(1) Contractor agrees to conduct in a good workmanlike manner, rough fish removal operations from waters identified as_____in_____County, North Dakota during the period from_____to_____by the use of the following equipment, unless hereafter changed by written agreement between the Commissioner and Contractor, to-wit:

_____

(2) Contractor agrees to comply with all laws and all lawful rules and regulations applicable to his operations.

(3) Contractor agrees to return alive and unharmed to waters from which they were taken immediately after each haul all game fish and the following species:

_____

(4) Contractor agrees that all rough fish taken shall be disposed of either by sale at the highest market prices available, or as may be otherwise required by the commissioner and the costs incurred in taking or disposing of fish shall be borne solely by the contractor.

(5) Contractor agrees to keep accurate written daily records of all rough fish taken and the disposition thereof, in such form and detail as may be required by the commissioner and copies of all such records shall be furnished daily to the commissioner and all original records shall be kept available for examination at any time by the commissioner or his agent.

(6) Contractor agrees that all fish taken shall be deemed to be the property of the State of North Dakota until sold and all proceeds of sale of any fish hereunder shall be deemed the property of the State of North Dakota subject to the right of the contractor to compensation as hereinafter provided.

(7) Contractor agrees that all operations by the contractor hereunder shall be subject to supervision by the Commissioner or his agent to such extent as the commissioner deems

necessary.

(8) Contractor agrees to perform all acts required hereunder for _____percent of the gross receipts from sale of fish taken pursuant hereto, and such shall constitute contractor's sole compensation.

(9) Contractor agrees that he and his employees shall be considered for no purposes whatever, as employees of the State of North Dakota or the Commissioner.

(10) Contractor agrees that the Commissioner may cancel agreement upon any default on the part of the contractor, without prejudicing the right of the Commissioner to recover for all damage caused by such default.

(11) Contractor agrees that if the Commissioner accepts this proposal within five days after the date set for opening and reading bids, he will within 10 days of notice thereof, furnish a good and sufficient corporate surety bond to the State of North Dakota, conditioned upon the faithful performance of all terms and convenants hereof and compliance with all laws, rules or regulations relating to the performance of this public contract.

Executed by the Contractor at_____on this

_____day of_____, 196_____.

_____
Contractor

Witness as to Contractor's Signature:

By_____

_____

Title_____

_____

ACCEPTED BY THE NORTH DAKOTA GAME AND FISH DEPARTMENT THIS

_____day of_____, 196___.

_____
Commissioner

Bond furnished and approved this_____day of _____, 196___

_____
Special Assistant Attorney General

APPENDIX III

SOUTH DAKOTA

COMMERCIAL FISHING CONTRACT

STATE OF SOUTH DAKOTA
DEPARTMENT OF GAME, FISH AND PARKS
CONTRACT FOR REMOVAL OF ROUGH FISH AND BULLHEADS
As provided under SDC 25.0423 and 25.0607

This agreement made this _____day of_____, 19___, by and between the State of South Dakota, acting by and through the Game, Fish and Parks Commission, hereinafter referred to as the Department, party of the first part, and _____ hereinafter referred to as the Contractor, party of the second part.

WITNESSETH: That the Department, for and in consideration of the monies paid and the covenants and agreements to be performed by the Contract, at the time and in the manner hereinafter set forth, does hereby lease, let and hire unto the Contractor, and the Contractor agrees to conduct rough fish removal operations for a period of about five years commencing

on the _____day of_____,19___, and terminating on the

_____day of _____, 19___, under the direction of the Department as follows:

(1) Species and quantity to be removed: An unlimited quantity of rough fish: Catfish over 18 " total length during such periods and in amounts as specified by the Department: Other species as specified by the Department in order to effect a working relationship with other agencies involved.

(2) Equipment and man power to be used: Manpower shall be sufficient to properly carry out the intents and purposes of this contract. The contractor shall conduct his operation in such a manner as to provide proper supervision of his employees. Equipment shall include gill nets of not less than 3½" square mesh, and such entrapment devices as the Department shall deem permissible.

(3) Waters and periods to be fished: Oahe Reservoir excluding those areas where conflict with the activities of sport fishermen and other recreationists is probable, and such additional waters as may be mutually agreed upon between the parties hereto, but only after the obligation of the Contractor hereunder has been fulfilled and discharged. Agreement for additional waters and any extension of time shall be in writing, signed by the parties hereto, and attached to and become a part of this contract, and be subject to all the terms and conditions hereof with the same force and effect as though originally a part thereof.

IN CONSIDERATION OF THE FOREGOING, THE CONTRACTOR AGREES TO AND WITH THE DEPARTMENT AS FOLLOWS:

FIRST: To conduct the fish removal operations as specified herein.

SECOND: That the Contractor shall pay the Department ½¢ per pound for buffalofish; 0¢ per pound for other rough fish; 3¢ per pound for catfish and the entire proceeds from the sale of all other than rough fish and catfish. All fish are to be weighed (live or in the round) and payment made to the Department immediately following capture or as soon thereafter as deemed practical by the Department, but under no circumstances may the fish be shipped prior to the time payment is made to the Department.

THIRD: The Contractor shall commence the work of taking and removing said fish at the period above stated unless otherwise directed by written notice by the Department and shall thereafter continue said work during said term as above prescribed with all reasonable diligence, in a good and workmanlike manner, until all fish of the kinds hereinbefore specified have been removed from said waters, unless and until the said Contractor may be authorized by the Department to discontinue or curtail said work as hereinafter provided. The Department may, in the exercise of its discretion and best judgment, direct or permit the Contractor to discontinue or curtail said work temporarily or permanently whenever the Department shall find that the removal of said fish is inexpedient or inadvisable.

FOURTH: All game fish and all other fish of any kind not hereinbefore specified shall be returned alive and unharmed to the waters from which they were taken immediately after the same appear during the progress of each haul unless the Department elects to otherwise dispose of such game fish. The Contractor shall use all possible care and diligence in complying strictly with this provision and the finding of any such fish dead or injured in connection with the operation of the Contractor hereunder shall be prima facie evidence of a violation of this provision. All rough fish of the kinds hereinabove specified, if not marketable, shall be disposed of as the Department directs, but none thereof shall be returned to the water unconfined except in cases of emergency the Department may, in its discretion, give the Contractor authority to confine, crib, or impound such fish until they can be marketed. Such authority shall specify the place, size and details of the construction of such crib or pound, together with the length of time for which such fish may be so confined.

FIFTH: The Contractor shall keep a written record of all his operations hereunder and shall make written reports thereof to the Department in such form as the Department shall prescribe.

SIXTH: All fish taken by the Contractor hereunder shall be deemed to be the property of the State until the specified payment is made to the State. The Contractor shall provide at his own expense for keeping and feeding all fish which are kept alive and for handling and caring for all fish prior to and

following the prescribed payment to the State. The fish shall become the property of the Contractor following proper payment to the State, or immediately following capture in cases where no payment to the State is prescribed. All fish not marketed or properly transferred to other persons must be buried by the Contractor at a location and in a manner approved by the Department and the State Board of Health.

SEVENTH: The Contractor further agrees and warrants hereby that no other person whatever has any interest in this contract or the proceeds to be derived hereunder, except the parties named as contracting parties and that no payment or consideration of any kind or nature has been given to any person to secure or assist in the securing of this contract. Any violation hereof or attempted assignment of any interest in this contract shall constitute a material breach hereof, except as such assignment of interest may be approved in writing by the Department.

EIGHTH: In case of any default on the part of the Contractor the Department may at its option declare this agreement cancelled and terminated without prejudice to any right of the State to damages caused by such default, or the Department may do or cause to be done anything which the contractor failed to do as required by the provisions of this agreement and charge the cost thereof against the Contractor. Any monies due the Contractor for compensation or otherwise may be held by the Department and applied in payment of any damages sustained by the State or of the cost of remedying any fault of the Contractor as hereinbefore provided.

NINTH: The Contractor shall give bond to the State of South Dakota in the amount of 5 thousand dollars ($5,000.00), with corporate surety, conditioned upon the faithful performance of all terms and covenants of this agreement and subject to approval as provided by law for the bonds of contractors for the doing of public work.

TENTH: None of the conditions as set forth herein can be varied or modified nor this contract transferred or assigned except with the written consent of the Department.

ELEVENTH: Either party to this contract may cancel the contract by serving notice by registered mail and by personal service of the cancellation, and upon service of such notice all rights and obligations shall cease and terminate thirty days following the service of such notice. Should the Contractor cancel this contract the Department shall reserve the right to disqualify the Contractor for consideration on any subsequent contracts.

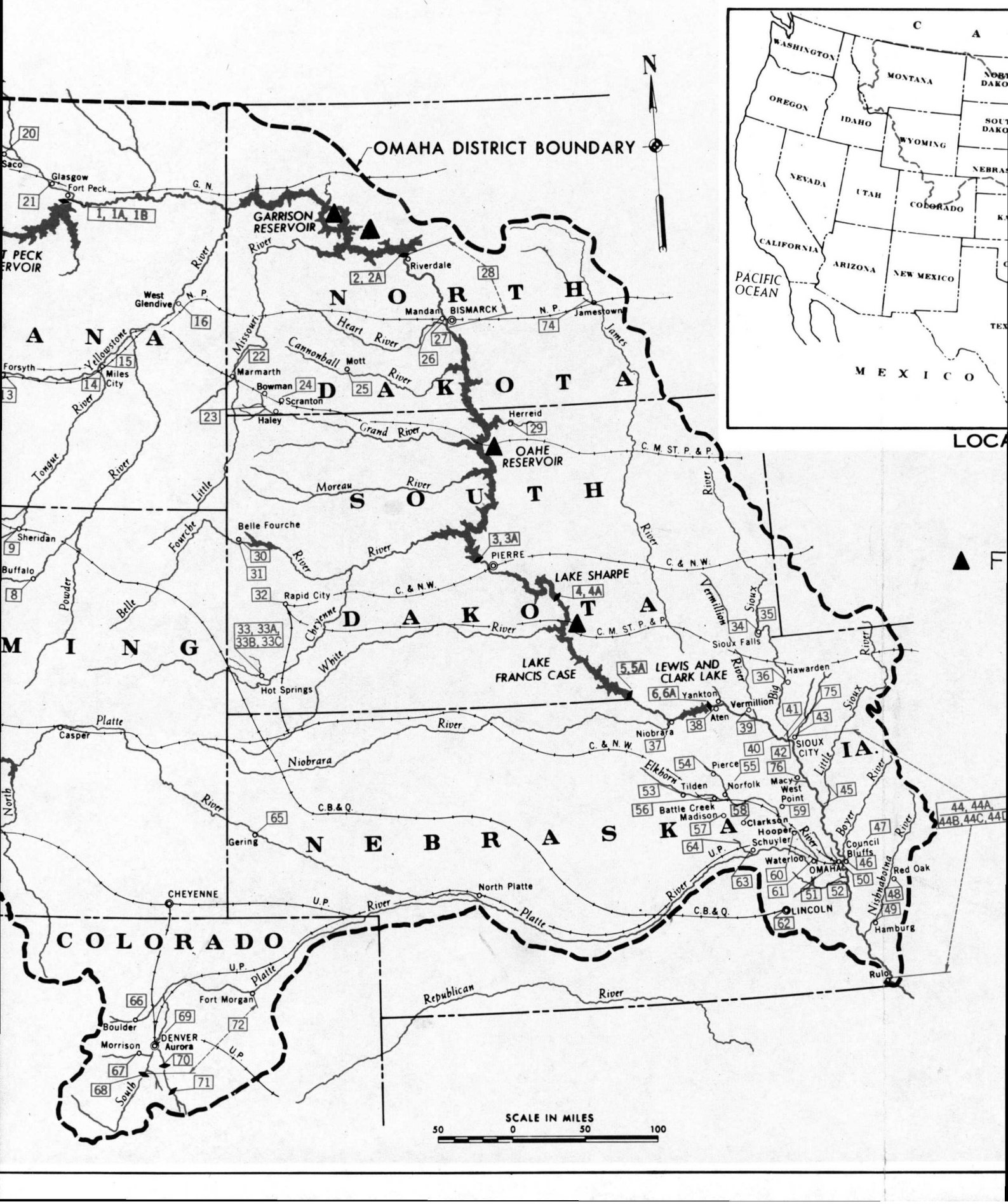
IT IS FURTHER UNDERSTOOD AND AGREED, That the Department shall be represented in all matters pertaining to the administration of this contract by the Director of the Department of Game, Fish and Parks.

IT IS FURTHER UNDERSTOOD AND AGREED, That no fishing shall be done under this contract except under the personal supervision of a person designated by the Department, which person shall carry out such duties in connection with the contract as the Director may require.

APPENDIX IV

LOCATION MAPS

Fig. 3.--Location map of the commercial fisheries on the mainstem reservoirs of the Upper Missouri River System.


OMAHA DISTRICT BOUNDARY
N
GARRISON RESERVOIR
OAHE RESERVOIR
LAKE SHARPE
LAKE FRANCIS CASE
LEWIS AND CLARK LAKE
NORTH DAKOTA
SOUTH DAKOTA
NEBRASKA
COLORADO
MONTANA
WYOMING
IOWA
Glasgow
Fort Peck
Riverdale
Mandan
BISMARCK
Jamestown
West Glendive
Forsyth
Miles City
Marmarth
Bowman
Scranton
Haley
Herreid
PIERRE
Belle Fourche
Sheridan
Buffalo
Rapid City
Hot Springs
Sioux Falls
Hawarden
Yankton
Vermillion
Aten
Niobrara
Casper
Gering
CHEYENNE
North Platte
Pierce
Norfolk
Tilden
Madison
Battle Creek
Macy
West Point
Clarkson
Hooper
Schuyler
Waterloo
OMAHA
Council Bluffs
Red Oak
LINCOLN
Hamburg
Fort Morgan
Boulder
DENVER
Aurora
Morrison
Missouri River
Heart River
Cannonball River
Grand River
Moreau River
Cheyenne River
White River
Belle Fourche River
Little Missouri River
Yellowstone River
Tongue River
Powder River
Platte River
Niobrara River
Elkhorn River
Big Sioux River
Little Sioux River
Vermillion River
James River
Boyer River
Nishnabotna River
Republican River
South Platte River
North Platte River
G. N.
N. P.
C. M. ST. P. & P.
C. & N.W.
C.B.& Q.
U.P.
SCALE IN MILES
50 0 50 100

WASHINGTON
OREGON
IDAHO
MONTANA
WYOMING
NEVADA
UTAH
COLORADO
CALIFORNIA
ARIZONA
NEW MEXICO
PACIFIC OCEAN
MEXICO

Fig. 4.--Location map of Fort Peck Reservoir, Brusset Fishery and fishing area.

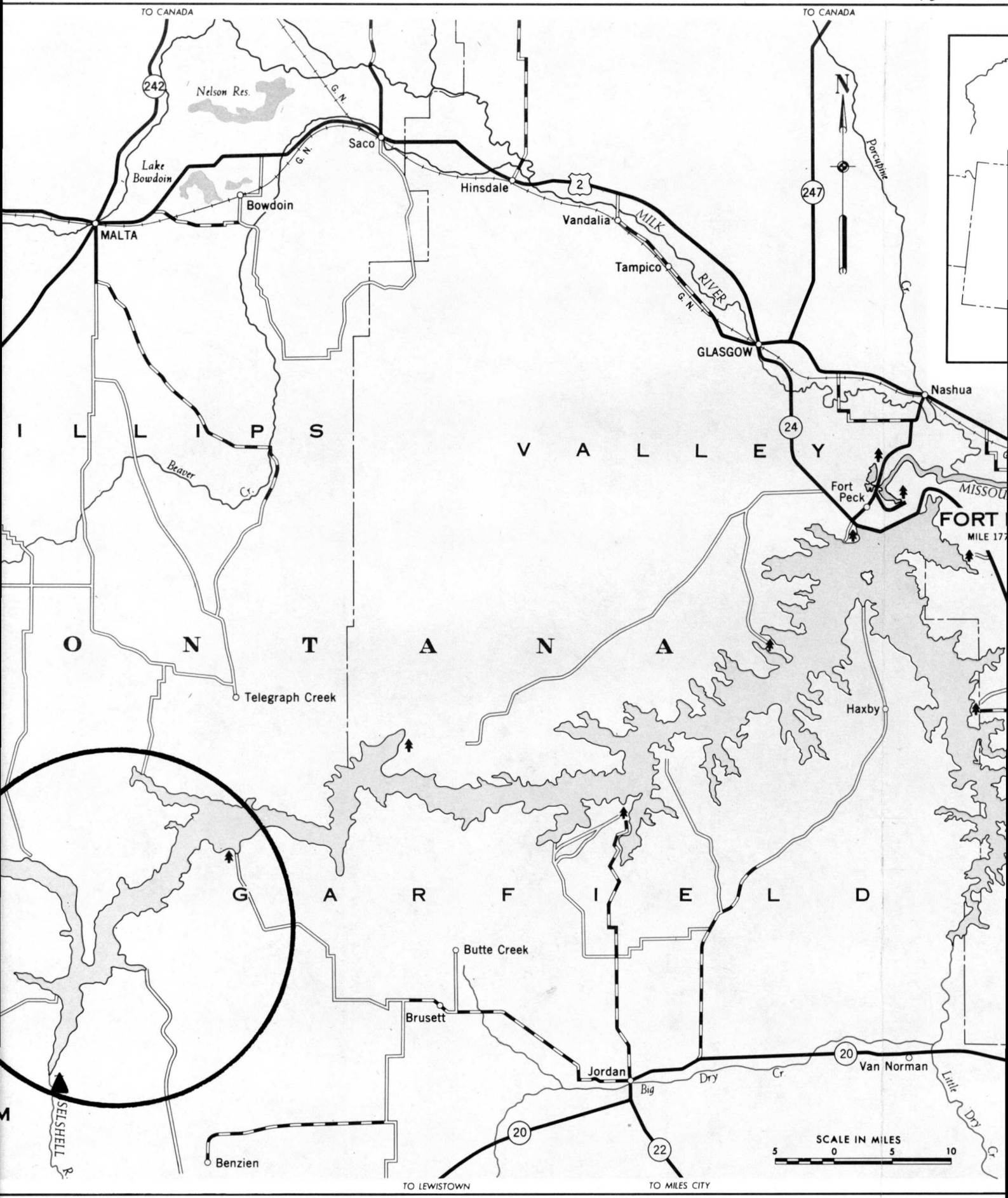

TO CANADA
TO CANADA
242
Nelson Res.
G.N.
Saco
Lake Bowdoin
G.N.
Bowdoin
MALTA
Hinsdale
2
Vandalia
MILK RIVER
Tampico
G.N.
GLASGOW
247
Porcupine Cr.
N
Nashua
24
I L L I P S
V A L L E Y
Beaver Cr.
Fort Peck
MISSOU
FORT
MILE 177
O N T A N A
Telegraph Creek
Haxby
G A R F I E L D
Butte Creek
Brusett
Jordan
Big Dry Cr.
20
Van Norman
Little Dry Cr.
SELSHELL R.
20
22
Benzien
SCALE IN MILES
5 0 5 10
TO LEWISTOWN
TO MILES CITY

Fig. 5.--Location map of Garrison Reservoir, Newtown Fishery, Parshall Fishery and fishing area.

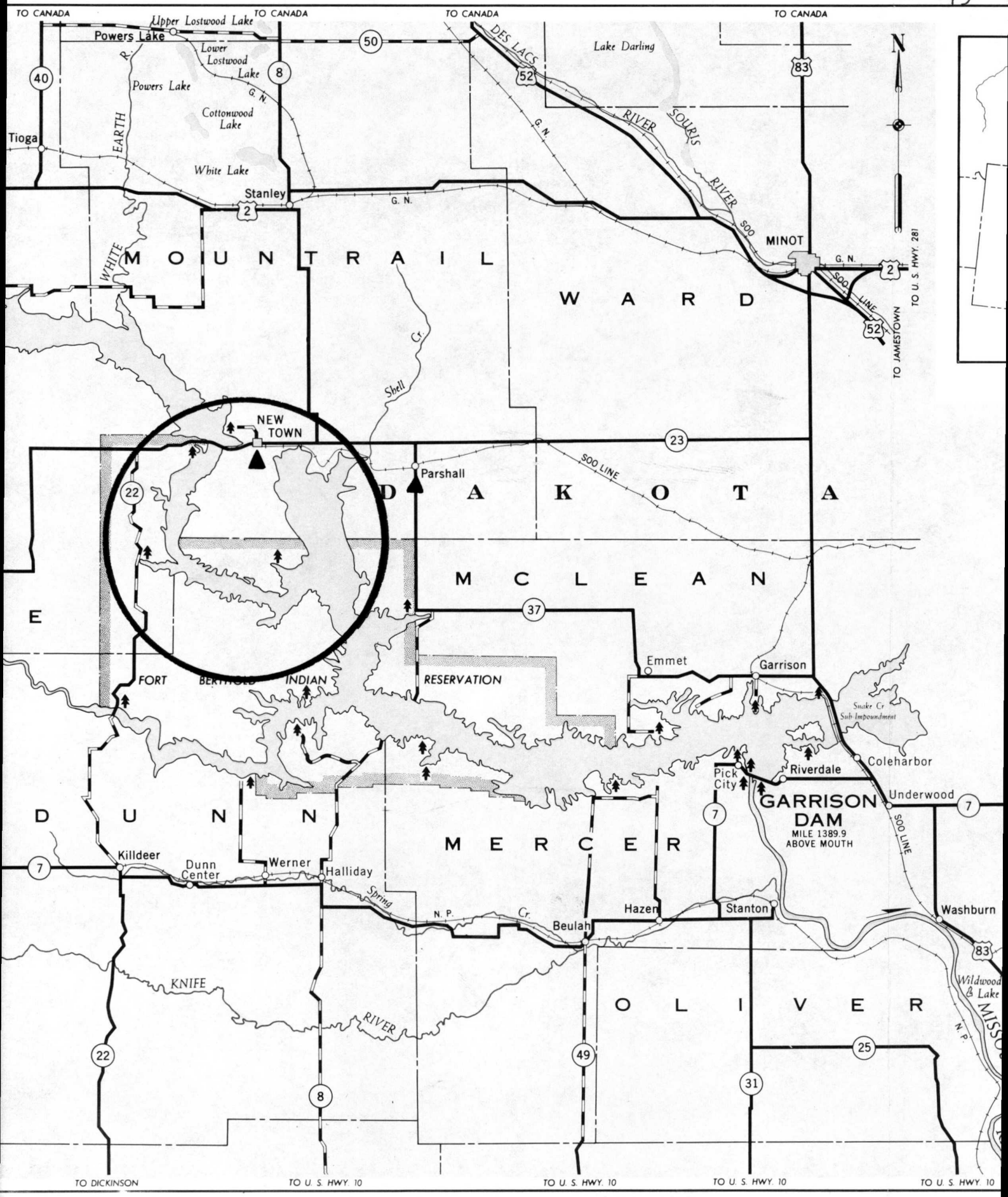

TO CANADA
TO CANADA
TO CANADA
TO CANADA
Upper Lostwood Lake
Powers Lake
Lower Lostwood Lake
Powers Lake
Cottonwood Lake
White Lake
Tioga
Stanley
EARTH R.
WHITE
DES LACS
Lake Darling
SOURIS RIVER
SOURIS RIVER
G. N.
SOO
MINOT
TO U. S. HWY. 281
TO JAMESTOWN
MOUNTRAIL
WARD
Shell Cr.
NEW TOWN
Parshall
SOO LINE
DAKOTA
MCLEAN
FORT BERTHOLD INDIAN RESERVATION
Emmet
Garrison
Snake Cr Sub-Impoundment
Coleharbor
Riverdale
Pick City
Underwood
GARRISON DAM
MILE 1389.9
ABOVE MOUNTAIN
SOO LINE
DUNN
MERCER
Killdeer
Dunn Center
Werner
Halliday
Spring
N. P.
Cr.
Beulah
Hazen
Stanton
Washburn
KNIFE RIVER
OLIVER
Wildwood & Lake
MISSO
N. P.
TO DICKINSON
TO U. S. HWY. 10
TO U. S. HWY. 10
TO U. S. HWY. 10
TO U. S. HWY. 10

Fig. 6.--Location map of Oahe Reservoir, Mobridge Fishery and fishing area.

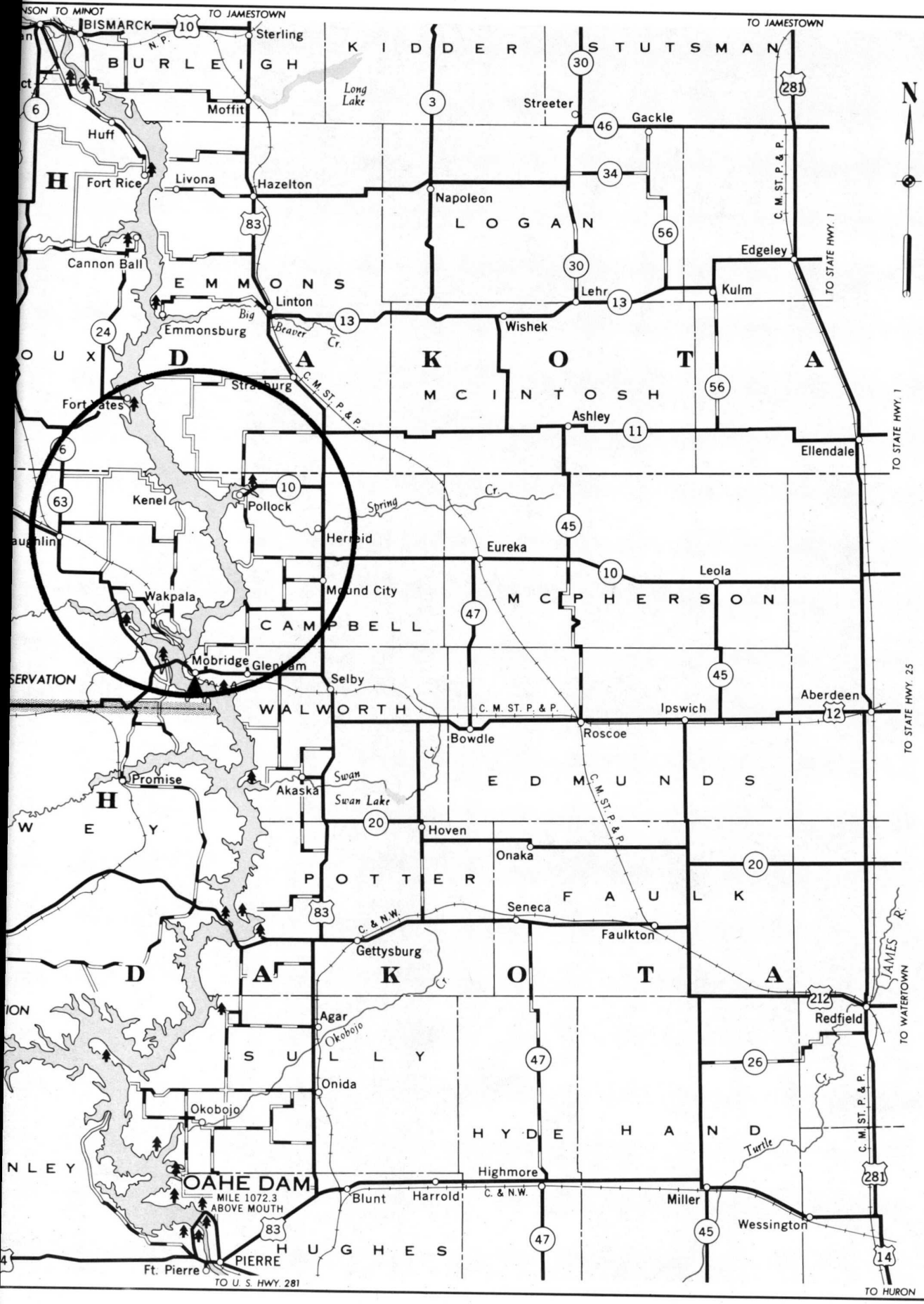
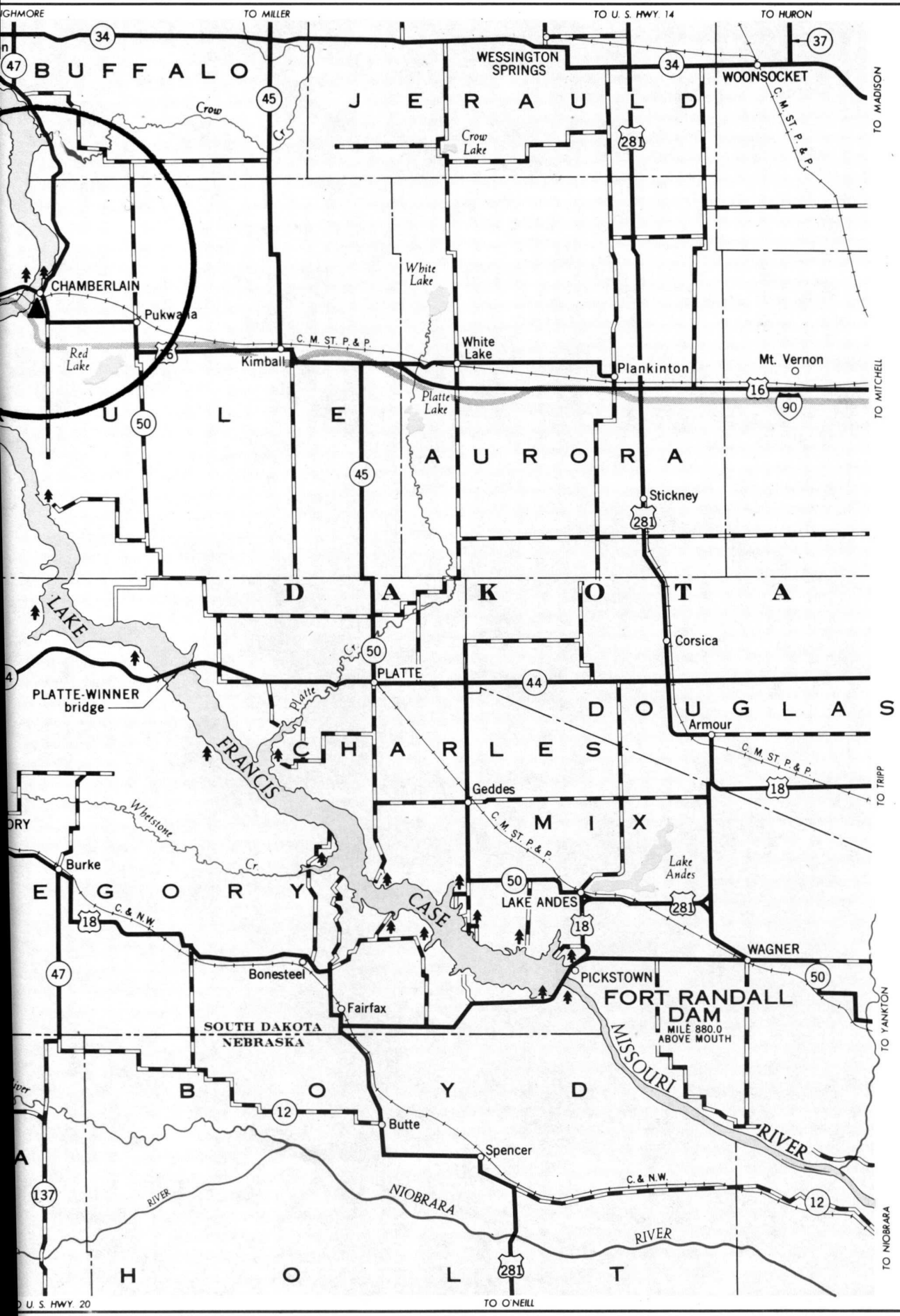

TO MINOT
BISMARCK
TO JAMESTOWN
Sterling
N.P.
BURLEIGH
KIDDER
STUTSMAN
TO JAMESTOWN
Long Lake
Moffit
Streeter
Gackle
Huff
Fort Rice
Livona
Hazelton
Napoleon
LOGAN
C. M. ST. P. & P.
TO STATE HWY. 1
Cannon Ball
EMMONS
Linton
Edgeley
Lehr
Kulm
Big Beaver Cr.
Emmonsburg
Wishek
DAKOTA
MCINTOSH
Strasburg
C. M. ST. P. & P.
Fort Yates
Ashley
Ellendale
TO STATE HWY. 1
Kenel
Pollock
Spring Cr.
Herreid
Eureka
Leola
Wakpala
Mound City
MCPHERSON
CAMPBELL
Mobridge
Glenham
Selby
WALWORTH
C. M. ST. P. & P.
Ipswich
Aberdeen
TO STATE HWY. 25
Bowdle
Roscoe
Promise
Akaska
Swan Lake Cr.
EDMUNDS
C. M. ST. P. & P.
Hoven
Onaka
POTTER
FAULK
Seneca
C. & N.W.
Faulkton
Gettysburg
DAKOTA
JAMES R.
Agar
Okobojo Cr.
Redfield
TO WATERTOWN
SULLY
Onida
Okobojo
HYDE
HAND
Turtle Cr.
C. M. ST. P. & P.
OAHE DAM
MILE 1072.3
ABOVE MOUTH
Highmore
Blunt
Harrold
C. & N.W.
Miller
Wessington
HUGHES
PIERRE
Ft. Pierre
TO U. S. HWY. 281
TO HURON

Fig. 7.--Location map of Fort Randall Reservoir, Chamberlain Fishery and fishing area.


TO MILLER
TO U. S. HWY. 14
TO HURON
BUFFALO
JERAULD
WESSINGTON SPRINGS
WOONSOCKET
Crow Cr.
Crow Lake
C. M. ST. P. & P.
TO MADISON
N
White Lake
CHAMBERLAIN
Pukwana
Red Lake
Kimball
White Lake
Plankinton
Mt. Vernon
TO MITCHELL
Platte Lake
BUFFALO
AURORA
Stickney
DAKOTA
LAKE
Corsica
PLATTE
PLATTE-WINNER bridge
Platte Cr.
DOUGLAS
Armour
FRANCIS CASE
CHARLES MIX
Geddes
TO TRIPP
Whetstone Cr.
Burke
EGORY
Lake Andes
LAKE ANDES
WAGNER
Bonesteel
PICKSTOWN
FORT RANDALL DAM
MILE 880.0 ABOVE MOUTH
Fairfax
SOUTH DAKOTA
NEBRASKA
MISSOURI RIVER
TO YANKTON
BOYD
Butte
Spencer
NIOBRARA RIVER
TO NIOBRARA
HOLT
TO O'NEILL
U. S. HWY. 20

APPENDIX V

FISHING GEAR

Fig. 8.---The trap net is a very effective form of gear for migratory species that tend to follow the shoreline. There are scores of designs and variations, but the basic principle is the same for all. Fish moving along the shore encounter a lead of netting. They follow this lead in an attempt to get past it and are led into one or more enclosures from which they find it difficult to escape.

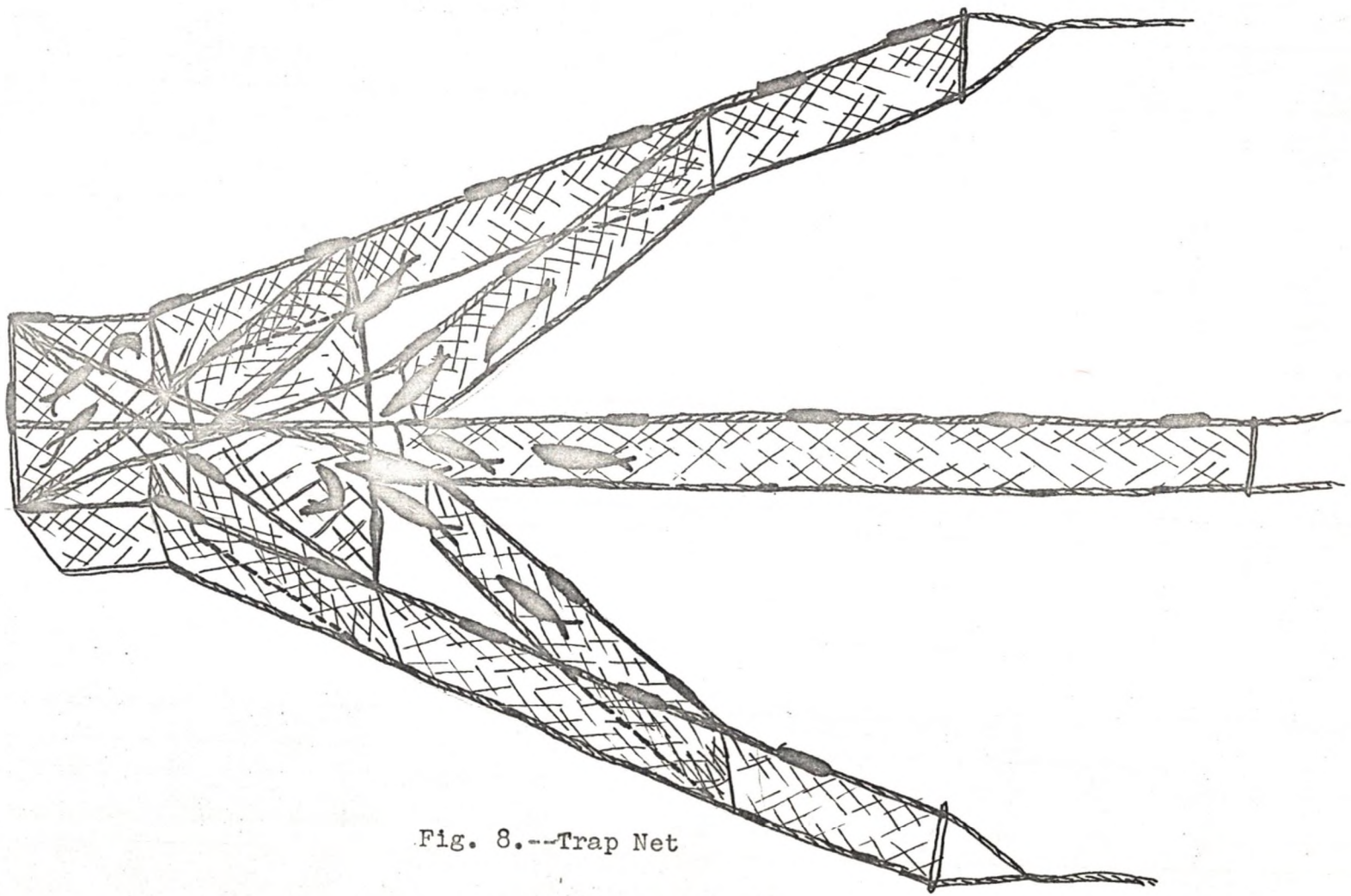


Fig. 8.--Trap Net

Fig. 9.--Gill nets normally capture fish by "gilling" them; that is, by having the fish pass its head through a mesh too small to permit either passage of the rest of its body or withdrawal of the head once the posterior margin of the gill covers has been passed by the mesh.

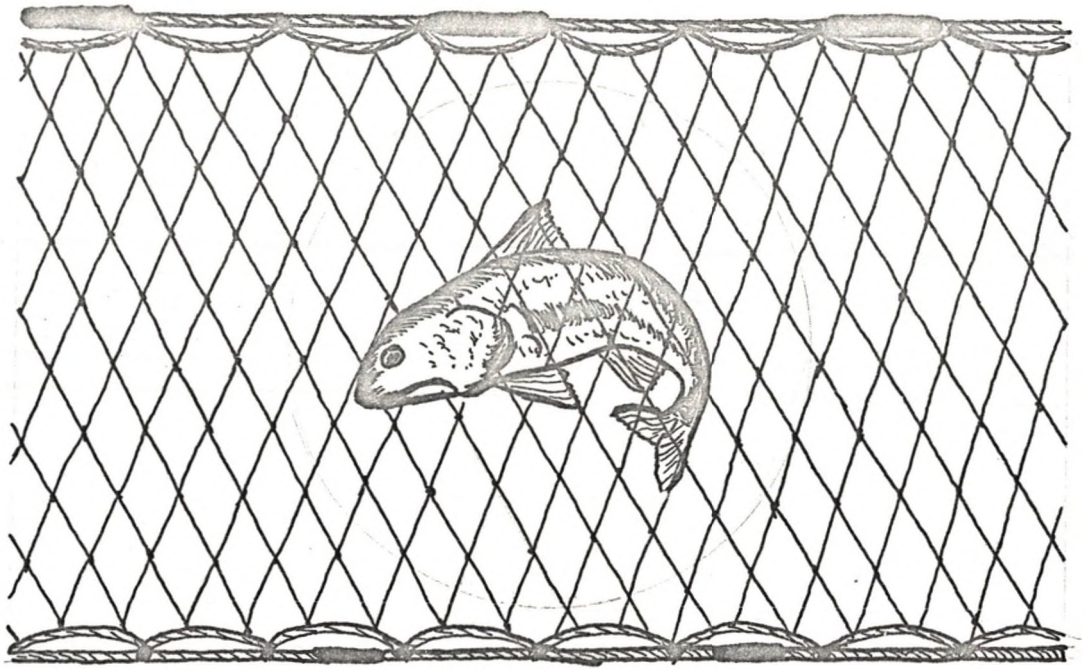


Fig. 9.--Gill Net

Fig. 10.--A trammel net consists of two or often three vertical walls of netting united at the top to a cork or float line and at the bottom to a lead line. One wall (or walls) of netting, of large mesh and heavy twine, is hung quite tight. The other wall, of fine mesh and light twine, is hung very loosely. Fish push a bag of the fine net through one of the large meshes of the coarse net and find it impossible to extricate themselves.

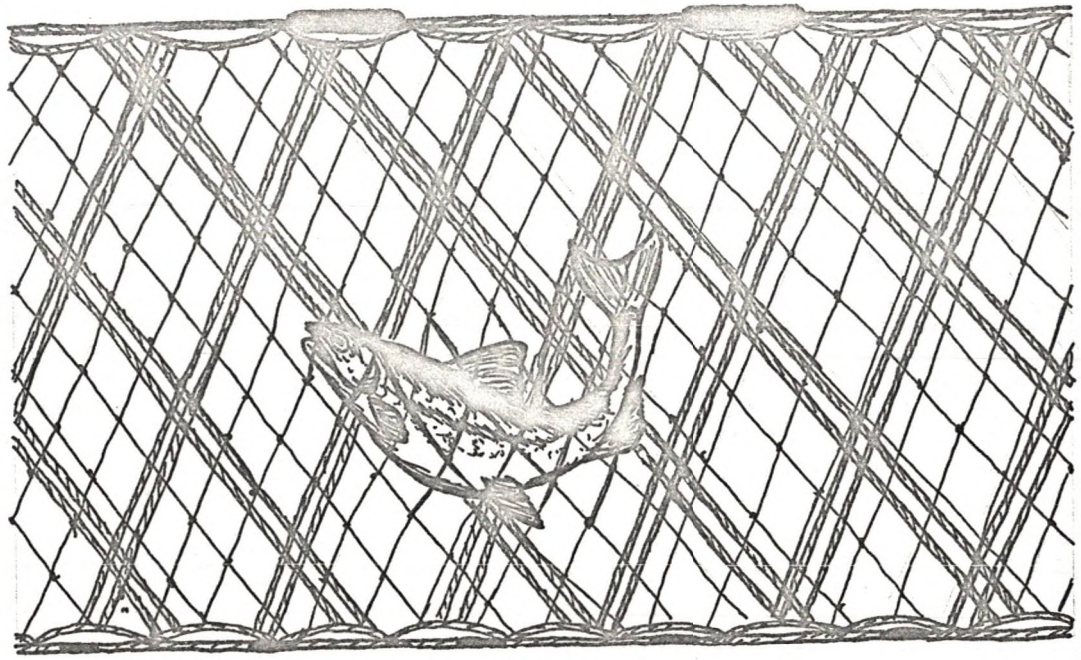


Fig. 10.--Trammel Net

Fig. 11.--The typical hoop net is a long bag mounted on one to several hoops. The hoops serve a double purpose; they keep the net from collapsing, and they form the attachment for the base of net funnels which prevent the fish from escaping readily. The catch is removed from the last pocket. The trap usually has long vertical, net leaders stretched from the center of the mouth to shore. As fish moving with the current strike the leader, they are deflected toward the mouth of the net.

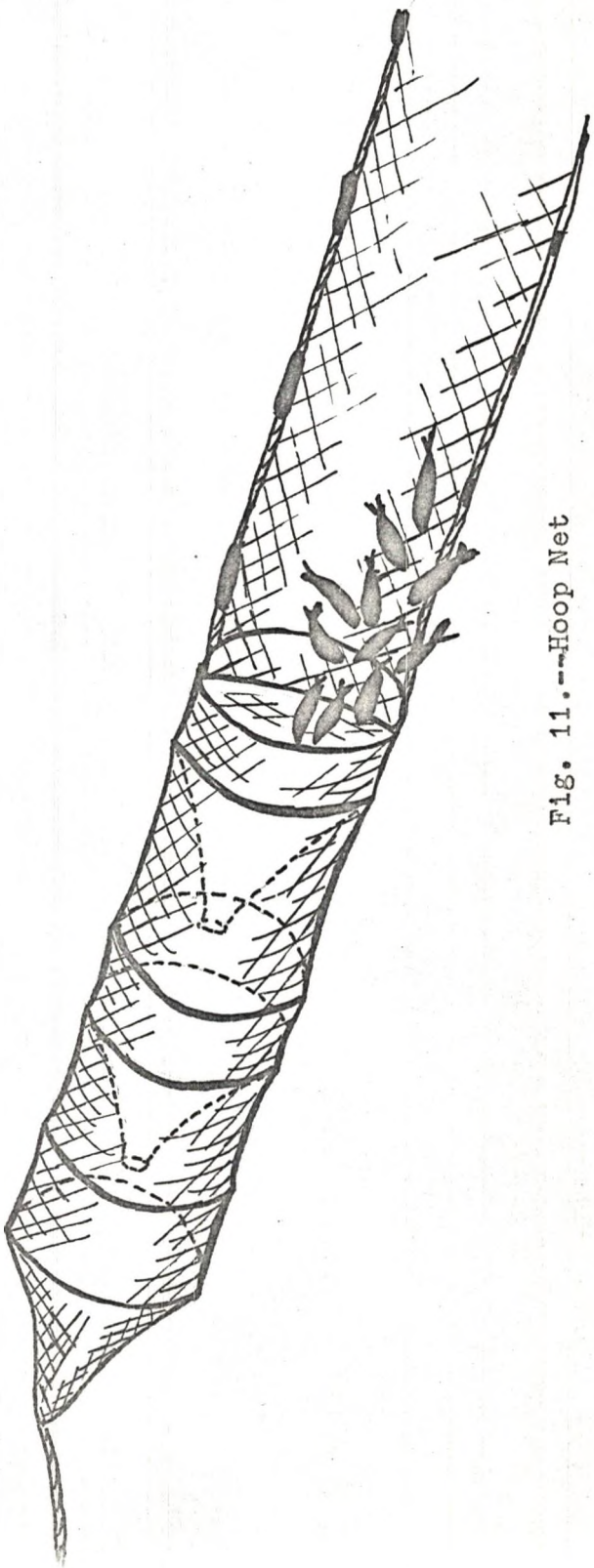


Fig. 11.--Hoop Net

Fig. 12.--Essentially a seine is a strip of strong netting hung to a stout cork line at the top and a strong, very heavily weighted lead line on the bottom. The wings may taper so that they are shallower on the ends. The bunt sometimes has the center portion of the netting formed into a bag to aid in confining the fish. At the ends of the wings the cork and lead lines are often fastened on each end of a short stout pole or brail. The hauling lines are then attached to the top and bottom of the brail by a short bridle.

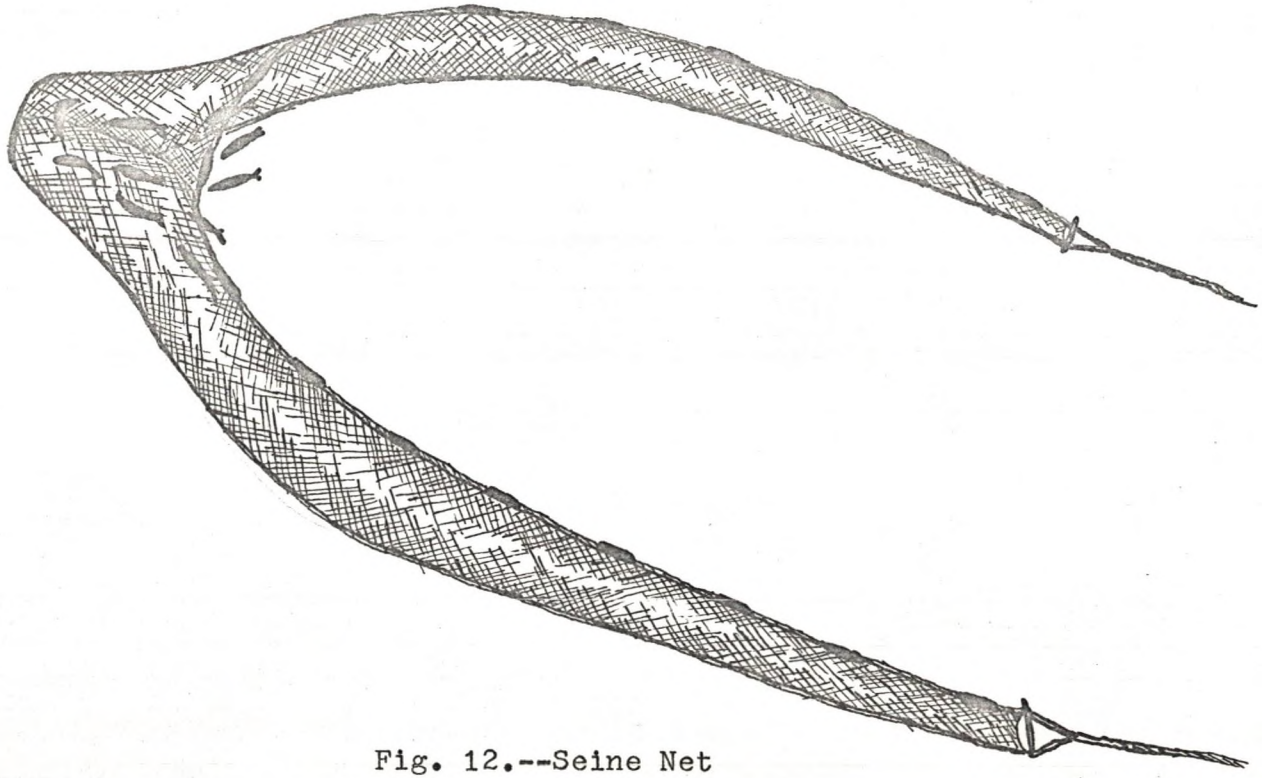


Fig. 12.--Seine Net

LIST OF REFERENCES

Benson, Norman G.; Chief, North Central Reservoir Investigations. Yankton, S. Dak. Personal letter. Dec. 28, 1966.

Benson, Norman G. 1964. A review of biological and fishery studies of Missouri River Mainstem Reservoirs. Unpublished manuscript. U.S. Department of Interior, Bureau of Sport Fisheries and Wildlife. Yankton, S. Dak.

Bingham, L. J., Fort Randall Reservoir Manager. Corps of Engineers, U. S. Army. Pickstown, S. Dak. Personal letter. Dec. 14, 1966.

Brusset Fishery. Personal interview with the fishery manager. July, 1966; August, 1966.

Chamberlain Fishery. Personal interview with the fishery manager. July, 1966; August, 1966.

Craft, George P. Area Engineer. Riverdale, N. Dak. Personal letter. December 14, 1966.

Eddy Samual. 1957. How to Know the Freshwater Fishes. Dubuque, Iowa: Wm. C. Brown Co. 253p.

Emerson, Frederick V. 1920. Agriculture Geology. New York: John Wiley & Sons. 319p.

Fenneman, Nevin M. 1931. Physiography of Western U. S. New York: McGraw-Hill Book Co. Inc. 510p.

Fort, R. S. and J. D. Brayshaw. 1961. Fishery Management. London: Faber and Faber Ltd. 398p.

Hohn, John H., Acting Area Engineer. Chief, Hydro Power Branch Fort Peck, Mont. Personal letter. Dec. 14, 1966.

Hubbs, Carl L. and Karl F. Lagler. 1958. Fishes of the Great Lakes Region. Rev. ed. Bloomfield Hills, Michigan: Cranbrook Institute of Science. 213p.

Jenkins, Robert M. 1965. Bibliography on Reservoir Fishery Biology in North America. Research report #68. Washington, D. C.: U. S. Government Printing Office. 57p.

Lagler, Karl F. 1966. Freshwater Fishery Biology. Dubuque, Iowa: Wm. C. Brown Co. 421p.

Lagler, Karl F., John E. Bardach, Robert R. Miller. 1962. Ichthyology. New York: Wiley & Sons. 545p.

McArthur, Raymond C., Area Engineer. Pierre, S. Dak. Personal letter. Dec. 14, 1966.

The Mighty Missouri: River That Was Finally Tamed. U.S. News & World Report. Sept. 13, 1965. p. 70-72.

Missouri River Reservoir Commercial Fishing Investigations. 1965. A Documentation of 1963-64 Activities and Findings. Mobridge, S. Dak. 74p. (Mimeographed).

Missouri River Reservoir Commercial Fishing Investigations. Personal interview with fishery biologist. June, 1966.

Missouri River Reservoir Commercial Fishing Investigations. Personal interview with the supervisory fishery biologist. June, 1966.

Mobridge Fishery. Personal interview with the fishery manager. July, 1966; August, 1966.

Montana Department of Fish and Game. Personal interview with the District Fisheries Manager. August, 1966.

Newtown Fishery. Personal interview with the fishery manager. July, 1966; August, 1966.

North Dakota Game and Fish Department. Personal interview with the Chief of Fisheries. June, 1966.

Parshall Fishery. Personal interview with the fishery manager. July, 1966; August, 1966.

Rounsefell, George A. and W. Harry Everhart. 1953. Fishery Science, Its Methods and Applications. New York: John Wiley & Sons. 444p.

South Dakota Department of Game, Fish, and Parks. Personal interview with the chief of fisheries. June, 1966.

Walburg, Charles H. and William R. Nelson. 1966. Carp, River Carpsucker, Smallmouth and Bigmouth Buffalo in Lewis and Clark Missouri River. Research report #69. Washington, D. C.: U. S. Government Printing Office. 30p.

White, A. J. "Missouri River", Encyclopaedia Britannica. 1964. Vol. XV.

Whitney, Arthur N., Fisheries Division Chief. Montana Department of Fish and Game. Helena, Montana. Personal letter. July 6, 1966