Fisheries and Aquatic Resources Adaptive Management System

2019-2023

Missouri River Fisheries Management Area

South Dakota Game, Fish and Parks Wildlife Division

Formally adopted by GFP Commission: March 1, 2019

Department Mission

We provide sustainable outdoor recreational opportunities through responsible management of our state's parks, fisheries, and wildlife by fostering partnerships, cultivating stewardship and safely connecting people with the outdoors

Department Vision

We will conserve our state's outdoor heritage to enhance the quality of life for current and future generations

Division of Wildlife Mission

The Division of Wildlife will manage South Dakota's wildlife and fisheries resources and their associated habitats for their sustained and equitable use, and for the benefit, welfare and enjoyment of the citizens of this state and its visitors.

Our Motto ***"Serving People, Managing Wildlife"***

Introduction

The purpose of this strategic plan is to guide fisheries management based on the missions of the South Dakota Department of Game, Fish and Parks (GFP) and the Division of Wildlife. This plan is a dynamic tool addressing the issues, challenges, and opportunities in managing the Missouri River Fisheries Management Area (MRFMA), and the four Missouri River reservoirs (Lake Oahe, Lake Sharpe, Lake Francis Case and Lewis and Clark Lake). The components of this plan include an **Inventory** Section, which describes the resources present in the MRFMA, and reviews both historical and current management activities. This section is subdivided into three categories: **People**, **Fish**, and **Habitat**. Reservoir and river-reach strategic plans follow the general inventory section and include a brief inventory of each reservoir, specific management **Issues**, and measurable and time-bound **Objectives** and **Strategies**. Progress toward objectives will be determined at the end of 2023, prior to updating these plans. Management issues identified for the Missouri River system affect each reservoir differently; therefore system-wide issues were addressed along with objectives and strategies for each individual reservoir.

The MRFMA consists of the four mainstem Missouri River reservoirs in South Dakota (Lakes Oahe, Sharpe, Francis Case, and Lewis and Clark; Figure 1) and the two sections of un-impounded river below Ft. Randall and Gavins Point Dams. This management area contains over 475,420 surface acres of reservoirs and 129 miles of river, and sustains approximately 360,000 angler days each year. The annual direct economic impact of these fisheries is variable, but can exceed 50 million dollars. The reservoirs range in size from Lake Oahe at 311,000 surface acres to Lewis and Clark Lake at 23,000 surface acres. South Dakota's portion of the Missouri River receives inflows from the mainstem and local runoff that enters the system primarily through six western (Grand, Moreau, Cheyenne, Bad, White, and Niobrara Rivers) and three eastern (James, Vermillion, and Big Sioux Rivers) tributaries. The variety of aquatic habitats allows for a wide range of fisheries management activities. Permanent coldwater habitat only exists in Lake Oahe and in the Oahe tailwater section of Lake Sharpe.

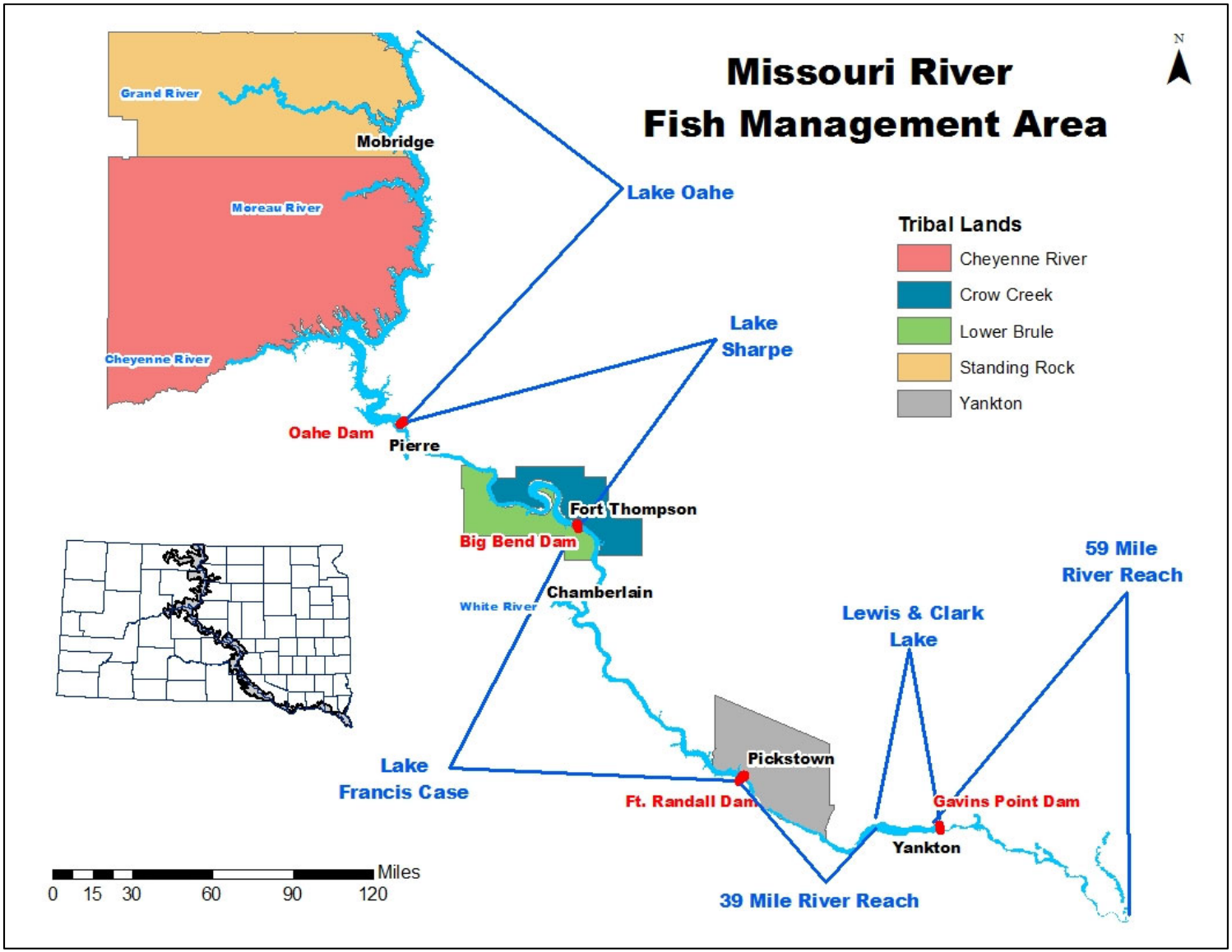

Figure 1. Map of Missouri River Fisheries Management Area.

Inventory

People

Demographics:

Eighteen counties border the Missouri River and its impoundments. The majority of anglers (70%) fishing the Missouri River are residents of South Dakota, and of these, most reside in the counties bordering the river. However, a number of resident and non-resident anglers travel over 100 miles each way to fish the Missouri River.

Regulations:

All game species in the MRFMA are managed with fishing regulations including daily creel, possession, and length limits. Fisheries within the boundary water areas are managed cooperatively with the Nebraska Game and Parks Commission and the North Dakota Game and Fish Department.

Angler preferences and satisfaction:

Over 360,000 angler days are typically spent each year fishing the MRFMA. Angler use and harvest surveys are used to monitor catch and harvest, as well as angler attitudes and preferences. Anglers have been surveyed annually on Lakes Oahe, Sharpe, and Francis Case since 1991, with anglers on Lewis and Clark and the river below Ft. Randall dam surveyed in 1984, 1994, 1995, 2000, 2001, 2005, and 2009. An angler use and harvest survey was conducted on the Lower Missouri River below Gavins Point Dam in 2009. The most commonly caught fish species in the reservoirs were walleye, white bass, channel catfish, and smallmouth bass. In recent years, over 800,000 walleyes have been harvested annually from the Missouri River system. In 2009, the last year all reservoirs were surveyed, 74% of anglers interviewed after fishing Lakes Oahe, Sharpe, or Francis Case expressed some level of satisfaction with their trip, while 18% expressed some level of dissatisfaction, and 8% expressed a neutral rating. (Don't we have more recent information than 2009?

Angler access:

Boat ramps provide access at 107 sites in the Missouri River Fisheries Management Area in South Dakota. Many ramps are located in state recreation areas, with some having fish cleaning and comfort stations. The GFP Parks Division manages all state operated recreation areas, boat ramps, and shoreline access along the Missouri River.

Other management entities:

Other government agencies involved in research or management efforts on the Missouri River system in South Dakota include the U.S. Army Corps of Engineers (USACE), South Dakota Department of Environment and Natural Resources, U.S. Fish and Wildlife Service, U.S. Geological Service, several state universities, and

several Native American Tribes. Water level management of the Missouri River system is controlled solely by the USACE. However, GFP participates on the Missouri River Natural Resources Committee to develop recommendations for the USACE. GFP also participates on the Missouri River Recovery Implementation Committee.

Fish

Species:

More than 50 fish species have been collected from the Missouri River system during fish population sampling (Appendix 1). Of these, 13 are classified as game species, with the remainder are classified as non-game, prey, threatened, endangered, or protected.

Fourteen aquatic species in the MRFMA are listed and tracked by the South Dakota Natural Heritage Program as threatened, endangered, or Species of Greatest Conservation Need (SGCN) within South Dakota's State Wildlife Action Plan (Appendix 2). Many of the 14 species listed as SGCN are found solely within the MRFMA. Declines in native large-river species are largely attributed to habitat alterations (e.g. construction of dams, impoundments, and channelization) which have blocked upstream migrations, modified the hydrograph, altered sediment transport and reduced floodplain connectivity.

Stocking:

In addition to surveys, other management activities in the MRFMA include the spawning and stocking of numerous fish species. Species routinely spawned include walleye, Chinook salmon and paddlefish. Lake Oahe walleye stocks have historically provided over 100 million eggs annually to both State and Federal hatcheries. Paddlefish from Lake Francis Case and Lewis and Clark Lake are spawned and the resulting fish are used to maintain and enhance the Lake Francis Case paddlefish population, and to develop a paddlefish population in Lake Sharpe. Coldwater sport fisheries for Chinook salmon, rainbow trout, and brown trout in Lake Oahe and the tailwaters below Oahe and Fort Randall dams are maintained entirely by stocking. Introductions, via stocking, of smallmouth bass, lake herring, and spottail shiners have also occurred. Pallid sturgeon spawning and stocking efforts have also been attempted in the flowing reaches below Ft. Randall and Gavins Point Dams.

Fisheries surveys:

Standardized gill net and seine surveys for monitoring fish populations have been conducted on all four reservoirs since the early 1980s. Other fisheries sampling includes gill netting, larval trawling, electrofishing, hydroacoustics, shoreline seining, and frame netting.

Fisheries research:

Research on Missouri River fisheries has focused on fish movement, harvest, fish passage through dams, habitat preference, stocking evaluation, predator-prey

relationships, and food habits. Past research has provided the basis for many of our current management strategies.

Aquatic Invasive Species (AIS):

Several Aquatic Invasive Species have been detected in the MRFMA, particularly in the river reach below Gavin's Point Dam (Appendix 3). Bigheaded carp species and zebra mussels are of particular concern.

Habitat

Historic Context:

Prior to dam construction, the Missouri River was a naturally-flowing river with diverse habitat, varying flows, a large, well-connected flood plain, and many native large-river fish species. After dam closures, the resulting alterations to habitat, flow, and flood plain connectivity led to large-scale changes in fish communities. This makes the MRFMA the most altered Fisheries Management Area in South Dakota.

Current Habitat Conditions:

Lakes Oahe, Sharpe, Francis Case and Lewis and Clark are operated by the USACE. The Flood Control Act of 1944 authorized the Missouri River system to operate for flood control, irrigation, navigation, power, recreation, water quality, water supply and fish and wildlife. The Missouri River reservoirs have large watersheds and large tributaries because they were designed to store water for flood control, water supply, and navigation (Miranda 2017). Water-level fluctuations interact with wave action to degrade shorelines that were once uplands and are unable to withstand continuous flooding, which promotes erosion and ultimately homogenization of once diverse littoral habitats (Miranda 2017). Sedimentation from erosion and run off, and subsequent reservoir ageing are a problem within the Missouri River system. Sedimentation reduces reservoir volume, affects productivity, alters water quality and can render boat ramps and fishing access areas unusable.

Habitat projects:

Few habitat enhancement projects have been completed on the Missouri River due to its large scale. However, Mossback fish habitat structures as well as Christmas trees have been placed in Hipple Lake, a backwater of Lake Sharpe.

Management Area

Lake Oahe is a mainstem Missouri River storage reservoir located in north-central South Dakota and south-central North Dakota. Lake Oahe is the fourth largest reservoir in North America with a surface area of 311,000 acres, 2,250 miles of shoreline and mean and maximum depths of 60 and 205 ft., respectively at normal operating pool. Because Lake Oahe is a storage reservoir, elevation, surface area, and volume frequently change over time. Consequently, standard survey sampling locations vary by year. Additionally, fluctuations in water level on Lake Oahe can have dramatic impacts on aquatic habitat, lake productivity, water temperatures, water residency time, and many other physical variables. Extreme changes in water elevation likely influence year-to-year variation of survey efficiency and precision and greatly influence angler access.

Lake Oahe's drainage area spans 62,000 sq. miles with three major tributaries: the Cheyenne, Moreau, and Grand Rivers. Lake Oahe storage capacity is 23.1 million acre-ft. of which 4.3 million acre-ft. is used for flood control. Record pool elevation was 1619.7 above mean sea level (msl) in 2011. Record flows out of Oahe Dam in June of 2011 were 160,300 cubic feet per second (cfs). Sedimentation in Lake Oahe from dam closure in 1958 to 1988 averaged about 19.8 acre-ft. /year and decreased storage capacity by 2.6%.

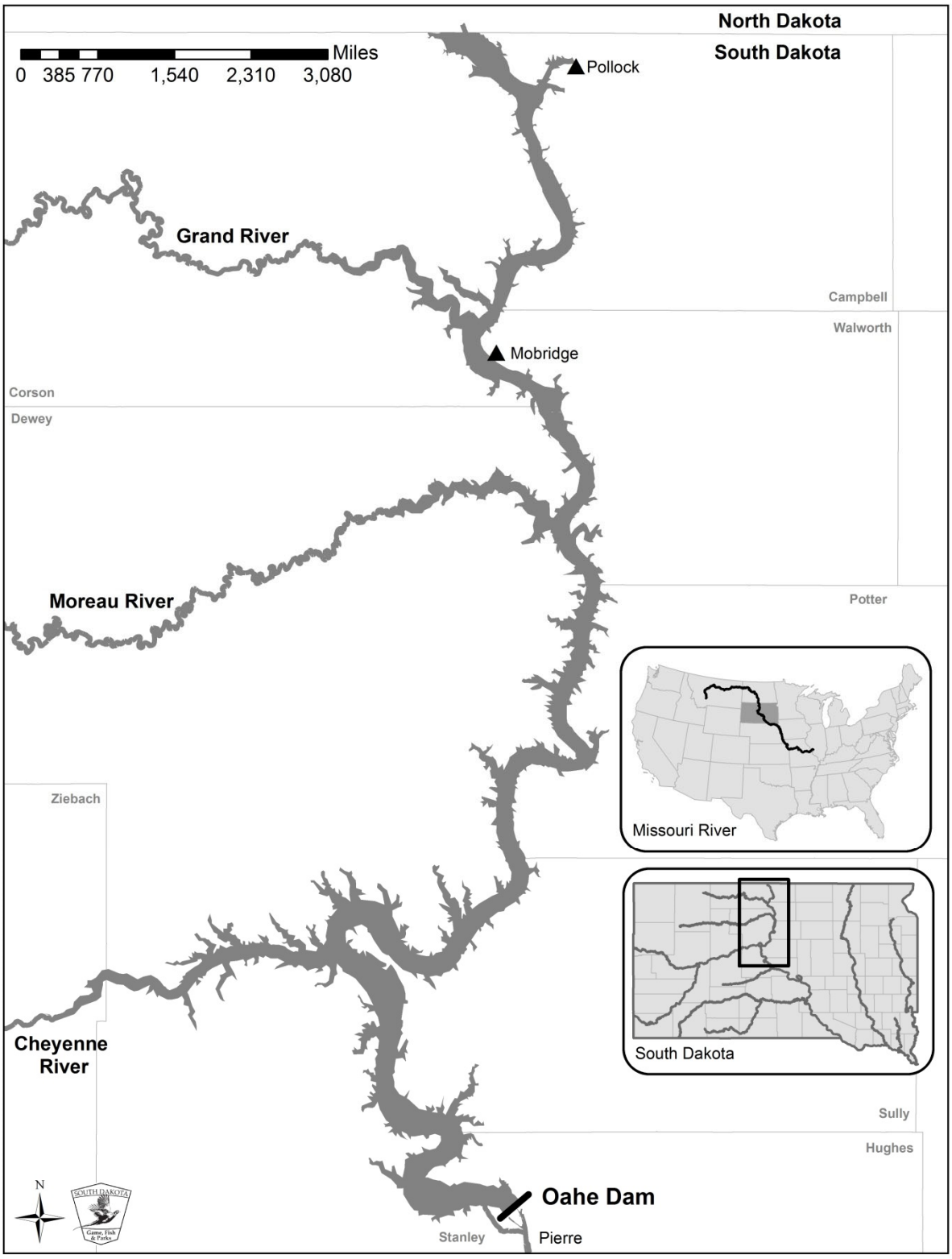

Figure 2. Map of Lake Oahe in central South Dakota.

Management of Lake Oahe

Stocking

In the early 1970's, attempts were made to develop a salmonid sport fishery in Lake Oahe that would use available cold-water habitat and diversify the fishery. Introductions of kokanee salmon, lake whitefish and opossum shrimp were made with the objective of establishing a cold-water prey base for a large predator species. These introductions were deemed unsuccessful; however, rainbow smelt stocked into Lake Sakakawea in 1971 had become abundant in Lake Oahe by 1977. Chinook salmon had also reached Lake Oahe as early as 1979 from Lake Sakakawea. As a result of the Chinook salmon and rainbow smelt introductions in North Dakota, GFP implemented its own Chinook salmon program in 1982. A popular Chinook salmon fishery developed and Chinook salmon have been stocked almost annually since that time.

Large numbers of rainbow, brown, and steelhead trout were also stocked in the 1980's and 1990's. The return to anglers of these stockings was low, but it is likely these stockings were responsible, at least in part, for the high walleye condition observed over the same time period (through walleye predation of stocked smolts). Because of the success of the coldwater sportfish program, Whitlock Bay Spawning Station construction began in 1982 and was completed in 1984. The Whitlock Bay Spawning Station was constructed to facilitate collection and spawning of Chinook salmon to meet annual egg needs.

From 1983 to 1998, small walleye fingerlings were stocked annually into the lower two-thirds of Lake Oahe in an effort to increase presumed poor recruitment. However, walleye stockings were considered unsuccessful. In 2017 and 2018, small walleye fingerlings were stocked in an effort to bolster low abundance of walleyes in the lower half of Lake Oahe. Introductory stockings of smallmouth bass fingerlings occurred from 1983 through 1989. Various life stages of lake herring were stocked in the 1980's and 1990's in attempts to diversify the prey base for predators and to provide large predators with prey items larger than rainbow smelt. Both smallmouth bass and Lake Herring introductions were successful at establishing self-sustaining populations. Currently, only Chinook salmon are stocked in Lake Oahe on an annual basis (see Appendix 4 for more details).

Fisheries Surveys

Standardized annual adult population gill-net surveys and shoreline baitfish surveys were initiated on Lake Oahe in 1982. In 1988, the deep water hydro-acoustic survey was initiated and in 2012, the deep water prey-fish gill-net survey was initiated. Other surveys have been developed and discontinued for various reasons (current surveys indicated with bold type). Current and historic surveys include:

1. Standardized gill net survey
2. Shoreline prey fish seining survey
3. Hydroacoustic survey

4. Deepwater prey fish gill-net survey
5. Larval trawling survey
6. Midwater prey fish trawl survey
7. Small mesh age-0 and age-1 walleye recruitment gill-net survey
8. Fall age-0 walleye electrofishing survey
9. Spring rainbow smelt trap-net survey

Various gears have been used to collect fish during the summer on Lake Oahe. From 1988-2016, the standard adult sportfish population survey consisted of setting three standard gill-nets overnight (approximately 20 h) in two depth zones (0- to 30-ft and 30- to 60-ft) at nine stations (total of 54 net sets). Gill-nets were placed on the bottom in each depth zone for a total of six nets at each station. Since 2017, experimental gill net design has followed the American Fisheries Society recommendation (Miranda and Boxrucker 2009). These experimental gill nets consist of eight 10 ft x 6 ft panels of monofilament mesh (0.75, 1.00, 1.25, 1.50, 1.75, 2.00, 2.25, 2.50 in) tied together in a random order. Additionally, each gill net is paired with a small mesh option described by Miranda and Boxrucker (2009) that consists of three, 10 ft x 6ft panels of monofilament (0.39, 0.51, and 0.63 in bar mesh). A total of 81 AFS standard nets were set at nine locations. Nets were randomly set within a 3.1 mile radius of selected boat ramps in water less than 80 ft deep.

A 0.25-in nylon mesh bag seine, measuring 100-ft long by 8.0-ft deep with a 6.0-ft by 6.0-ft bag, is used to collect age-0 and small-bodied littoral fishes during late July and August. Four seine hauls are made at each sampling location with all fish collected identified and counted.

Hydroacoustic surveys have been conducted since the late 1980's to monitor cold-water species that are less susceptible to the standardized gill net surveys. Since 2008, a Biosonics DT-X digital Echosounder and a split-beam transducer has been used. Roughly 34 transects are completed during the hydro-acoustic survey. Number of fish/m^3 of water sampled is extrapolated to the entire volume of cold-water habitat in Lake Oahe to derive population estimates of specific length classes of fish.

Beginning in 2012, a suspended deep water gill-net survey was introduced and paired with the hydro-acoustic survey. Suspended deep water gill-nets are 125 ft long and 24 ft deep. Nets are hung with sufficient flotation to allow for neutral buoyancy while in the water column. Netting effort has varied between years depending upon staffing, weather conditions, and net-placement locations; however, the goal is to sample 4-5 locations with two nets each.

These population surveys are designed to provide biological information regarding:

1. Species composition
2. Relative abundance

3. Age
4. Growth
5. Condition
6. Recruitment
7. Survival and mortality rates

Recent Fisheries Survey

In 2017, 21 species were captured in the adult gill-net survey. Walleye comprised 15% and channel catfish comprised 49% of all fish captured. Gizzard shad were the most abundant species captured during the seine survey. Also abundant were white bass and emerald shiners. About 28% of walleyes sampled in 2016 and 2017 were 15 inches or longer, lower than the most recent peak of 39% in 2015. Walleye condition (relative weight) tends to fluctuate as a function of prey abundance. Lakewide relative weight and growth varied little from 2015 to 2017, with growth of age-1 to age-3 walleyes similar to the 5-year average. during that period. In 2016, walleye age-4 and older were slightly smaller than the 5-year average.

The 2018 annual hydroacoustic survey estimated 16,715,569 age-0 rainbow smelt and 13,159,154 age-1+ rainbow smelt. The hydro-acoustic survey also documented a large number (8,391,148) of age-0 and age-1 (5,611,912) lake herring. In years when rainbow smelt abundance is low, high abundances of age-0 to age-2 Lake Herring may provide sufficient prey for sportfish in Lake Oahe. Age-0 and age-1 lake herring are similar to the size range of rainbow smelt and may provide a suitable alternative to rainbow smelt.

In 2017, lake herring and rainbow smelt comprised the majority of fish captured in the deep water gill-net survey. Lake Herring and rainbow smelt had the highest CPUE in 2015 (278 and 119 fish/net night, respectively). In 2017, lake herring CPUE was 187 fish/net night and rainbow smelt CPUE was 20 fish/net night. Lake herring ranged in size from 3.5 to 18 in. The size distribution of rainbow smelt ranged from 3.7 to 7 in, with approximately 77% in the 4.3 and 4.9 in length groups.

Angler-Use Surveys

Angler-use and harvest surveys were initiated on Lake Oahe in 1981. Sampling includes aerial counts of boat and shore anglers to estimate fishing pressure and angler interviews at lake access areas to estimate harvest, catch rates, release rates, mean party size, mean angler day length, target species and residency. Flight and interview dates are selected using a stratified random design based on the assumption of different levels of fishing pressure for weekdays and weekend days/holidays. Lake access areas for angler interviews were also assigned using a stratified random design with probabilities of assignment differing by access area and month.

Angler-use surveys are conducted from 1-May through 31-July for the sunrise to sunset period. Angler satisfaction and attitude questions are included in angler interviews. Anglers are also asked specific questions to help guide management

practices on Lake Oahe. For instance, in 2018, anglers were asked “Why did you decide to come here to fish today?”

Recent Angler-Use Survey

In 2017, anglers fished an estimated 130,018 angler-days during May-July on the South Dakota portion of Lake Oahe providing an estimated economic input of $9.2 million in local and regional revenues. However, fishing pressure was lower than the 10-year average of 165,876 angler-days. Resident anglers represented 77% of the parties interviewed on Lake Oahe, which was similar to previous years. Lake Oahe continues to be recognized as a destination walleye fishery with resident anglers coming from counties all across South Dakota. Walleye were the most sought after species for the last five years, with 83% of anglers targeting walleye.

Walleye comprised 88% (251,378 fish) of the total fish caught by anglers. smallmouth bass, channel catfish, northern pike, yellow perch and white bass were also harvested, to a lesser extent. Walleye also comprised the majority of fish released. Anglers generally begin to harvest walleye at about 12-inches in length. The average length of walleye harvested by anglers during 2017 was just under 15 inches. Walleye catch rates exceeded 0.30 fish/angler-h in each of the last 10 years which is considered an excellent fishery. The walleye catch rate in 2017 (0.98 fish/angler-h) was over three times that number.

Overall satisfaction on Lake Oahe during the 2017 May-July period was 82%. Trip satisfaction generally increased with the percent of daily limits attained by anglers. If an angler responded to trip satisfaction as anything less than “very satisfied”, creel clerks then asked the respondent what it would take to increase their ranking to “very satisfied.” Of the anglers that rated their satisfaction as “moderately satisfied” or below, 43% of parties indicated that catching more fish would increase their satisfaction rating, and 31% indicated catching larger fish would increase their satisfaction rating.

Fisheries Research

The amount of research on Lake Oahe fish populations and fisheries have varied over time. From right after impoundment through the mid- to late-990s, many research projects were undertaken focusing on a range of topics. Projects included examining Northern Pike abundance and atresia (June 1970), describing influences on sport fish, year-class strength (Hassler 1970), assessing mercury levels in fish (Walter et al. 1974), investigating population dynamics of percids (Nelson and Walburg 1977), describing patterns in reproduction with warm-water fish (June 1977), investigating sturgeon population dynamics (Kallemeyn 1983) movements and behavior of rainbow smelt (Burczynski et al. 1987), impacts of mining on water quality in the Cheyenne River drainage (Horowitz et al. 1988), evaluating Lake Oahe walleye stockings (Fielder 1992a, Fielder 1992b), determining age-0 walleye food habits (Jackson et al. 1992), adult walleye diets (Jackson et al. 1993; Bryan et al. 1995), impacts of walleye tournaments (Fielder and Johnson 1994), channel catfish food habits (Hill et al. 1995), rainbow trout food habits (Lynott et al. 1995),

caloric densities of Lake Oahe sport- and prey-fish (Bryan et al. 1996), factors influencing white bass abundance (Beck et al. 1997), walleye mercury levels (Mauk and Brown 2001), and walleye ageing techniques (Isermann et al. 2003).

Since the early 1990's, Lake Oahe has also been the impetus of many hatchery related research projects. These projects have primarily focused on salmonids (Barnes and Cordes 1992; Barnes et al. 1997; Barnes et al. 1999a,b,c; Barnes et al. 2000a,b; Barnes et al. 2001a,b; Barnes et al. 2003a,b,c; Barnes and Gaikowski 2004; Barnes et al. 2010; Barnes et al. 2013); however, some cool-water research has been conducted (Mauk and Brown 2001b; Barnes et al. 2005).

Over the past 15 years, Lake Oahe has again been the focus of a wide variety of fisheries research projects including using strobe lights to deter rainbow smelt from Oahe Dam intake structures (Hamel et al. 2008), determining the long term impacts of the 1997 flood (Graeb et al. 2008), applying the application of nonlethal isotope sampling on walleye (Fincel et al. 2012a), using prey fish stable isotopes to investigate sport fish food webs (Fincel et al. 2012b), quantifying sedimentation in the Missouri River reservoirs (Skalak et al. 2013), investigating gizzard shad reproduction characteristics (Fincel et al. 2013a), determining mercury and selenium concentrations in Lake Oahe walleye (Fincel et al. 2013b), quantifying Lake Oahe walleye diets and growth (Fincel et al. 2014a), using stable isotopes to determine Lake Oahe walleye trophic position (Fincel et al. 2014b), using otolith microchemistry to determine walleye natal origins in the Missouri River impoundments (Carlson et al. 2016a,b), determining potential walleye/sauger competition (Fincel et al. 2016a), quantifying rainbow smelt entrainment during the 2011 flood (Fincel et al. 2016b), and examining post-flood survival and exploitation of walleye (Felts 2018).

There are several ongoing research projects on Lake Oahe. Most notable is the rainbow smelt population dynamics study, a joint project with GFP and South Dakota State University. The goals of this project are to describe the dynamic rate functions, spawning sites and distribution patterns of Lake Oahe rainbow smelt. In addition, this project will review and revise the current hydroacoustics methods. Other ongoing research projects include 1) evaluating stocking adult pre-spawn gizzard shad in select bays of Lake Oahe, 2) determining Lake Oahe angler expenditures, 3) examining long-term impacts of the 2006 white bass die off (Radigan and Fincel. *in review*), and 4) examining the impacts of stocking location on angler returns of Chinook salmon.

Aquatic Invasive Species

Concern, knowledge and awareness of Aquatic Invasive Species (AIS) were largely non-existent until relatively recently on Lake Oahe. From impoundment through the mid 2000's there were no AIS specific surveys performed on the lake, and subsequently, there is very little information on AIS prior to this time. Monitoring surveys were initiated on Lake Oahe in 2008 and are currently incorporated into

standard fish management surveys. Dreissenid mussel veliger sampling is performed annually as an early detection method for zebra and quagga mussels. In 2018, plate samplers were deployed at a number of boat ramp docks along Lake Oahe to monitor for the presence of adult zebra mussels. Surveys have identified few AIS populations in Lake Oahe. Invasive plant species present in the reservoir include curly pondweed, and Eurasian water milfoil. Common carp and European rudd are the two AIS fish species in Lake Oahe.

Regulations

Walleye harvest regulations for Lake Oahe have differed from standard statewide regulations since 1990. Initially, a 14-inch minimum length limit was placed on Lakes Oahe, Sharpe, and Francis Case from April through June with a daily limit of four fish. In 1999, the harvest regulations were amended so only one fish in the daily limit could be 18-inches or longer, and the April through June minimum length limit was removed. Following high walleye recruitment in the early-1990s and a high release event through Oahe Dam shortly after, a predator-prey imbalance was recognized in Lake Oahe and the daily walleye limit was increased from four to 14 fish in 2001 of which, at most, four fish could be 15-inches or longer and only one of those could be 18-inches or longer. The objective of this regulation was two-fold: to reduce predation on rainbow smelt which saw rapid population declines in the late 1990's and to reduce the high abundance of walleye less than 15-inches. Following liberalization of the Lake Oahe walleye regulations, a decrease in angler satisfaction was associated with anglers unable to attain high daily limits. Thus, the daily limit was reduced to 10 fish in 2002 and six fish in 2004. In an effort to standardize regulations statewide, the daily limit was reduced to four walleye with only one fish allowed over 20-inches in 2006, and the possession limit of 12 fish was reduced to eight fish in 2007.

In 2011, the Missouri River experienced a massive flood that moved much of the Lake Oahe prey fish biomass through Oahe Dam. Following this high entrainment event, prey fish populations decreased greatly resulting in poor condition walleyes. Thus, the population was made up of fewer large fish of poor condition and many small fish (less than 15-inches) of below average condition. In reaction to the change in population size structure a change to the 2013 walleye regulations was made in an effort to take advantage of the exceptionally large 2009 year class. This regulation permitted the harvest of eight fish daily, of which, at most, four fish could be 381-mm and longer and only one of those could be 20 inches or longer. The regulation for four additional walleye on Lake Oahe was removed in 2014, and fishing limits returned to the statewide limit of four walleye of which one may be 20 inches or longer.

Reservoir Access and Habitat

The Lake Oahe shoreline has undergone dramatic changes since impoundment due to fluctuating water levels and shoreline erosion. Major sources of sediment are the Cheyenne, Moreau, and Grand Rivers and reservoir bank erosion. The western shore of Lake Oahe is primarily composed of deposits of Pierre shale, which is highly erodible and vulnerable to mass soil movement. The eastern shore is composed of less-erodible, glacial till. From 1964-1968, the average annual rate of sediment deposition in Lake Oahe was 28,375 acre-feet. The estimated time for Lake Oahe to completely fill with sediment is 700 years (US Army Corps of Engineers unpublished data). Lake Oahe contains a number of sub-embayments. These unique habitats provide excellent spring-time shore angling opportunities and can promote over-winter survival of warm water prey fish.

Lake Oahe has also experienced multiple high water evacuation periods. In the mid-1990's and in 2011, above average snow accumulation and heavy spring rains produced record flood conditions. Record releases of water were discharged through both the powerhouse and stilling basin release structures and high entrainment of fish through Oahe Dam was recorded.

Submerged macrophytes have been slow to develop in Lake Oahe due to fluctuating water levels, unsuitable substrate, windswept shorelines and shoreline turbidity. Small areas of pondweed are found along the lower east shore of the reservoir. Most submerged vegetation is terrestrial in nature.
Coldwater habitat (water less than 59^{o}F and >5mg/l of oxygen) is limited during summer stratification. The water outlets of Lake Oahe are 125 ft above the base of the dam and are within the cold-water zone during summer stratification during most years. Therefore, many cold- and cool-water species are susceptible to entrainment and loss from the reservoir during water discharges.

The Parks Division maintains 39 boat ramps along the Lake Oahe shoreline, including low water ramps that may be unusable except during periods of drought. These ramps vary the amount of angler-use with ramps like Bush's Landing having extremely high use with >100 boats serviced daily during peak times to ramps like Garrigan's Landing that might be used by 50 parties launching boats each year. Additionally, in the mid-2000s, the Title 6 land transfer added 2,250 miles of shoreline on Lake Oahe for GFP to manage.

Lake Oahe Management Issues

The following management issues are specific to Lake Oahe and are reflected in the objectives and strategies for Lake Oahe for the 2019-2023 period.

1. Shore fishing and ADA access opportunities are limited for most of Lake Oahe.

2. Water level fluctuations and high use necessitate regular improvements and maintenance at boat access locations..

3. Walleye reproduction, stocking success and recruitment in lower Lake Oahe may be negatively impacted by predation on juvenile walleye, lack of suitable nursery habitats, and other unknown factors.

4. The Lake Oahe smallmouth bass population is of high quality and attracting increased angling interest but little information exists on which to base management decisions.

5. Factors influencing stocking success and return to angler of Chinook salmon are unknown.

6. It is unclear if the current complement of fish sampling gears and angler survey methodologies are efficiently providing information on which to base management decisions.

7. The large number of governmental and non-governmental agencies with interest in the management of Lake Oahe's aquatic resources makes communication and coordination difficult.

Goals, Objectives, Strategies

Goal:

The state of South Dakota manages Lake Oahe's aquatic resources for the continued use and enjoyment of South Dakota residents and visitors.

Objectives and Strategies

Not all objectives will be met due to brushfires, unforeseen obstacles, and changes in needs or priorities as a part of the adaptive management process.

1. Objective:

Improve shore fishing opportunity at two locations along Lake Oahe by December 31, 2023.

Strategies:

a) Work with the Parks Division, GFP Land Managers, the USACE, local municipalities, and anglers to identify priority areas for access development and improvement based on potential use and feasibility.

b) Develop designs for ADA compliant shore fishing access improvements with access to deep water and fish habitat in Cow Creek/Spring Creek complex and at Sutton Bay.

c) Create specific structural habitat designs to concentrate fish in developed shore fishing areas.

d) Construct shore fishing access improvements in coordination with Parks, the USACE, and local partners.

2. ***Objective:***

Improve boat access at two locations along Lake Oahe by December 31, 2023.

Strategies:

a) Work with the Parks Division, the USACE, local municipalities, and anglers to identify priority areas for access development and improvement.

b) Develop designs to rebuild or renovate boat access sites at locations identified in strategy 2a, including areas such as Bush's Landing, Cow Creek and Little Bend.

c) Develop shoreline fishing opportunities in association with renovated boat access sites.

d) Construct boat access improvements in coordination with Parks, the USACE, and local partners.

3. ***Objective:***

Conduct six research studies addressing critical sport- and prey-fish on Lake Oahe by December 31, 2023.

Strategies:

a) Evaluate potential predation by smallmouth bass and adult Walleye on age-0 naturally reproduced and stocked juvenile walleye in Lake Oahe.

b) Evaluate hybridization and genetic variation of sauger and walleye in Lake Oahe to identify potential changes in

hybridization between species through time and among reservoirs.

c) Use a combination of acoustic telemetry and external tags to estimate bay specific smallmouth bass population sizes and movement.

d) Evaluate fish use and determine angler perceptions and satisfaction with artificial structures installed into Cow Creek.

e) Evaluate the effects of new rearing techniques (e.g. artificial structure, improved diets) on Chinook salmon survival and return to angler.

4. Objective:

Assess current survey methodologies to determine efficiency and effectiveness at indexing fish population characteristics and angler use patterns by December 2023.

Strategies:

a) Evaluate the use of vehicle counters to replace aerial angling pressure counts on Lake Oahe.

b) Determine if the current complement of sampling gears and analyses allow for identification of meaningful population trends (e.g. increases or declines) that may affect the fishery.

c) Evaluate the use and feasibility of new gears to target species that are under-represented in current survey methodology

d) Annually review appropriate sampling methods based on results of strategies 4a-4c.

5. Objective:

Annually improve the level of communication and coordination between agencies and organizations in the management of fisheries and aquatic resources on Lake Oahe.

Strategies:

a) Increase the number of opportunities for information exchange between GFP and USACE on water management and angler access issues and projects.

b) Increase the number of opportunities for information exchange between private entities, government agencies and non-governmental organizations on fisheries and aquatic resource management.

Lake Sharpe Strategic Plan

Management Area

Lake Sharpe is the 54th largest reservoir in the United States. It is a flow-through Missouri River reservoir located in central South Dakota and extends from Oahe Dam to Big Bend Dam. Lake Sharpe is 80 miles long and has a surface area of 57,000 acres. Hipple Lake and LaFramboise Bay are large backwaters located on upper Lake Sharpe. These embayments are generally warmer than the main lake, and recent research has shown their importance to the overall production of prey and sport fish in Lake Sharpe. Emergent vegetation, including curly leaf pondweed, Eurasian watermilfoil, fan-leafed crowfoot, American elodea, and sago pondweed is prevalent in embayments throughout Lake Sharpe. Cattail and round stem bulrush stands are more common in Hipple Lake, but can also be found in LaFramboise Bay.

The Lake Sharpe watershed spans 5,840 square miles (excluding the Missouri River) with the Bad River being the only major tributary. Lake Sharpe has a storage capacity of 1.9 million acre-ft. Record pool elevation reached in 1991 was 1,422 msl; however, record flows out of Big Bend Dam occurred in 2011 with a release of 166,300 cfs. Sedimentation is ongoing in Lake Sharpe with the majority of sediment input from the Bad River. From dam construction in 1964 to 1988, 6.1% of Lake Sharpe's water storage was lost due to sedimentation or about 4.3 acre-ft. /yr.

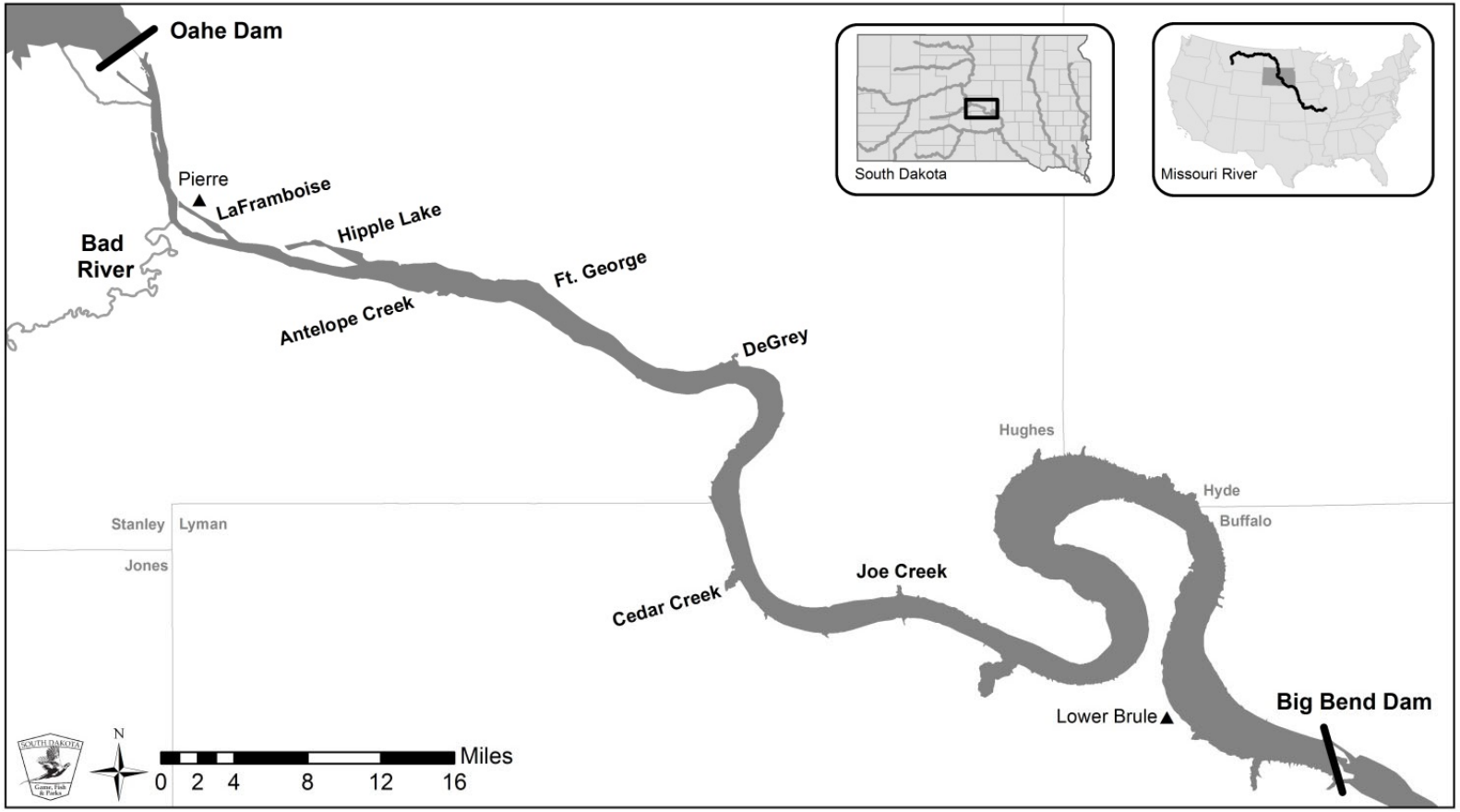

Figure 3. Map of Lake Sharpe in central South Dakota.

Management of Lake Sharpe

Stocking

Lake Sharpe was repeatedly stocked with approximately 20,000 tiger muskellunge fingerlings annually during the 1980's and 1990's. Stocking was discontinued in 1998, as few, if any, anglers were targeting muskellunge. Smallmouth bass were stocked between 1980 and 1991. Stocking was discontinued when natural reproduction was adequate to maintain the population. The majority of fish stockings into Lake Sharpe have been of cold-water species, primarily rainbow and brown trout. Brown trout stockings were discontinued in 1997 due to a low return to anglers when compared to rainbow trout. Chinook salmon and cutthroat trout were stocked briefly from 1984-1986 and in 1991. Catchable-size rainbow trout are stocked annually and are the only salmonid currently stocked into Lake Sharpe. Recently, efforts to restore a paddlefish population in Lake Sharpe have resulted in stocking of advanced fingerlings in 2015, 2017, and 2018 and advanced fry in 2016. Paddlefish stockings are planned through 2025 or until success of these stockings can be evaluated.

Fisheries Surveys

GFP started conducting standardized adult fish population surveys (gill-net surveys) on Lake Sharpe in 1986 and prey fish surveys (seining survey) in 1982. Since then, fish population surveys have been conducted annually (current surveys indicated with bold type). A variety of surveys have been conducted over time and include:

1. **Adult gill-net survey**
2. **Shoreline prey fish seining survey**
3. Larval trawling survey
4. Age-0 walleye fall electrofishing survey
5. Smallmouth bass gill-net survey
6. Panfish trap-net survey

AFS standard gill-nets and nylon mesh bag-seines are currently used in fish population surveys on Lake Sharpe. From 1986-2016, the standard protocol was to set six, 300-ft multifilament gill nets submerged overnight (about 20 h) at four locations on Lake Sharpe. Three nets were placed ≤ 30-ft depth and three were placed in > 30-ft where possible. Since 2017, experimental gill net design has followed the American Fisheries Society recommendation (Miranda and Boxrucker 2009). These experimental gill nets consist of eight 10 ft x 6 ft panels of monofilament mesh (0.75, 1.00, 1.25, 1.50, 1.75, 2.00, 2.25, 2.50 in) tied together in a random order . Additionally, each gill net is paired with a small mesh option described by Miranda and Boxrucker (2009) that consists of three, 10 ft x 6ft panels of monofilament (0.39, 0.51, and 0.63 in bar mesh). A total of 72 nets are set at random locations on Lake Sharpe (excluding the area immediately below Oahe dam

to Stoney Point). All fish collected are identified and counted. The first 50 individuals of each species are measured (TL; mm) and weighed (g) at each sampling location. All walleye and sauger are measured, weighed, and otoliths removed for age-estimation (10 per 2.5-cm length group per sampling location).

A 0.25-in nylon mesh bag seine, measuring 100-ft long by 8.0-ft deep with a 6.0-ft by 6.0-ft bag, is used to collect age-0 and small-bodied littoral fishes during late July and August. Four seine hauls are made at each sampling location with all fish collected identified and counted.

These surveys are designed to provide biological information regarding:

1. Species composition
2. Relative abundance
3. Age
4. Growth
5. Condition
6. Recruitment
7. Survival and mortality rates

Recent Fishery Survey

In 2017, walleye comprised 33% of the gill-net catch. In 2017, proportional size distribution of walleye was 26, lower than the 5 year average of 44. Approximately 30% of walleye in the gill-net sample were ≥ 15-in and 1% were ≥ 20-in. Historically, walleye condition (relative weight) for Lake Sharpe is generally between 80 and 90. Condition of walleye (10 in and greater) in Lake Sharpe was 77 in 2017, which is similar to the five-year average. Variability in walleye condition in Lake Sharpe likely occurs due to the seasonal availability of gizzard shad and entrainment of rainbow smelt through Oahe Dam. Walleye growth in Lake Sharpe is generally considered good and walleye typically reach the 15-in minimum length limit during their fourth growing season. However from 2013-2015, walleye surpassed 15-in at age-3.

Seventeen species of small-bodied littoral fishes were collected by shoreline seining. All species had previously been collected in Lake Sharpe. The overall catch rate for all species in combination was 839 fish/seine haul which is slightly above the long term mean of 697 fish/seine haul. As in previous years, gizzard shad were the most abundant species captured during the seine survey. Also abundant were Emerald Shiners, white crappie, white bass and smallmouth bass.

Angler-Use Surveys

The first angler-use and harvest survey on Lake Sharpe was conducted in 1974. Walleye have been harvested in Lake Sharpe since impoundment and contributed significantly to the sport fish harvest during the first angler-use survey in 1974. Soon after impoundment, paddlefish (a native species) provided a unique fishery below Oahe Dam and were frequently harvested. However, due to low catches and no recorded natural reproduction, paddlefish harvest was banned. Even without any

harvest, the population continued to decline. Sauger also were more common in angler harvest immediately after impoundment than today. Currently, walleye are the most commonly harvested species followed by smallmouth bass, white bass, and channel catfish.

Prior to 2003, angler use and harvest surveys consisted of aerial pressure counts to estimate fishing pressure and angler interviews to estimate catch, harvest and release rates as well as gather information on angler demographics, preferences and satisfaction. Since 2003, a bus route survey design has been used with angler use and harvest surveys to increase in order to improve the statistical reliability of pressure estimates. A bus route design is a modified access survey typically used for fisheries with numerous access sites spread over a broad geographical region. Current creel surveys are conducted from 1-May through 31-August for the sunrise-to-sunset (daytime) period. In 2018, wireless traffic counters were deployed at all access sites along Lake Sharpe, along with game cameras to record fishing pressure. Interviews were conducted during daylight hours to estimate angler catch, harvest and release rates. Wireless traffic counters are part of an on-going creel survey research project to make creel surveys more efficient and cost-effective.

Questions posed in standard interviews gather information on trip length, type of fishing (boat or shore), target species, zip code, party size, catch and harvest, size of fish caught, angler preferences and satisfaction. Anglers are also asked specific questions to help guide management practices on Lake Sharpe. For instance, in 2018, anglers were asked “Why did you choose to fish at this location?”

Recent Angler-Use Survey

In 2017, estimated fishing pressure for the May-August daylight period (339,835 h) was well above the 10-year average for Lake Sharpe (288,746 angler-h). Estimated angler trips in 2017 were the third highest recorded over the past 10 years. Walleye were the most commonly caught fish (305,774 fish) and smallmouth bass, white bass, and channel catfish were also commonly caught by anglers. Walleye harvest (142,370 fish) was slightly below the long term average (147,214 fish). In 2017, Lake Sharpe anglers contributed about $6.9 million to local economies. Residents made up 85% of the angler contacts which was similar to the previous 5 years. The majority of resident angling parties interviewed were locals from Hughes and Stanley counties. Travel is required for many anglers fishing Lake Sharpe as the reservoir is located a fair distance from large population centers. Many anglers drove over 100 miles each way to fish Lake Sharpe. The percent of anglers traveling in excess of 200 miles (one way) to fish the reservoir in 2017 was similar to past years. Walleye remain the primary species targeted (69%) by anglers on Lake Sharpe.

Angler perception of their fishing experience is important to evaluating the success of a fishery. In 2016, anglers were asked to consider all factors when evaluating their level of satisfaction with their fishing trip. Eighty-eight percent of angling parties interviewed in 2016 indicated some degree of satisfaction. In general, as the number of walleyes harvested per angler increased, so did the level of angler satisfaction,

and this was similar to past years. To better understand factors influencing satisfaction in 2016, anglers were asked the supplemental question: “What would help increase your satisfaction level to ‘very satisfied’?” The majority (57%) of anglers interviewed responded with “catch more fish”. When looking at the high levels of satisfaction on Lake Sharpe combined with the high catch and high release rates, it appears that management regulations and practices are currently working.

Fisheries Research

Fisheries research has been conducted on Lake Sharpe since impoundment. In the 1960’s and 1970’s, research focused on Northern Pike reproduction, recruitment and atresia (June 1970; Hassler 1970), channel catfish population characteristics (Elrod 1974), *Percid* population dynamics (Nelson and Walburg 1977), and the impacts of water discharge on age-0 fishes (Martin et al. 1981). A suite of sturgeon research was performed during the 1980’s and 1990’s (Kallemeyn 1983; Keenlyne et al. 1994). In the mid 1990’s, research focused on the influences of environmental variables on white bass recruitment, growth, and mortality (Beck et al. 1997) and entrainment of fishes through Big Bend Dam (Smith and Brown 2002).

More recently, the Lake Sharpe fishery has again become a research priority in South Dakota. Researchers evaluated potential competition between Lake Sharpe walleye and smallmouth bass (Wuellner et al. 2010), determined the impacts of drought on zooplankton communities and production (Beaver et al. 2013), examined gizzard shad population characteristics as they relate to other systems in South Dakota and throughout the US (Wuellner et al. 2008), and described hybridization of walleye and sauger (Graeb et al. 2010). Since 2010, GFP evaluated the effects of the smallmouth bass regulation, and based on the results of that research, the regulation was removed (Fincel et al. 2015). Research has also focused on diet overlap between walleye and sauger (Fincel et al. 2016a), the importance of specific habitats to Lake Sharpe walleye production (Carlson et al. 2016a), and the potential to use non-lethal tissues for isotope analysis (Fincel et al. 2011).

The flood of 2011 was a source of many research projects conducted to document the impacts of high discharge on the Missouri River system. Fincel et al. (2016b) examined the entrainment of rainbow smelt through Oahe Dam and into Lake Sharpe during the summer of 2011 and made recommendations for future releases. Additionally, walleye entrainment during the 2011 Missouri River Flood was assessed (Carlson et al. 2016b; Radigan et al. *In Review*) as was the impact of cold water releases on age-0 gizzard shad abundance, growth, and hatch timing (Greiner et al. 2016).

There are many current and ongoing research studies on Lake Sharpe including an evaluation of acoustic telemetry use with gizzard shad to determine the importance of Hipple Lake and other side channel habitat types to reproduction and survival and the use of otolith microchemistry to identify natal origins of gizzard shad and sport fish in Lake Sharpe. Other ongoing research projects include explaining current and ongoing trends with the Lake Sharpe white bass population, using acoustic telemetry

to evaluate current management practices with stocking rainbow trout in Oahe Marina, describing the dynamic rate functions, exploitation and movement of Lake Sharpe walleye, and evaluating population dynamics and movement patterns of shovelnose sturgeon in Lake Sharpe. GFP is also working with the USFWS to identify stocking protocols and document habitat use of stocked paddlefish in the reservoir. Current research is also evaluating economic expenditures and the financial impact of angling on Lake Sharpe to local communities.

Aquatic Invasive Species

Concern, knowledge and awareness of Aquatic Invasive Species (AIS) were largely non-existent until relatively recently on Lake Sharpe. From impoundment through the mid 2000's there were no AIS specific surveys performed on the lake, and very little information on species now considered AIS in South Dakota exist prior to this time. Monitoring surveys were instituted on Lake Sharpe in 2008 and currently have been incorporated into standard fish management surveys. Dreissenid mussel veliger sampling is performed annually as an early detection method for zebra and quagga mussels. Surveys have identified a few AIS invasions into Lake Sharpe including curlyleaf pondweed, Eurasian water milfoil, Purple loosestrife, common carp and European rudd.

Regulations

Walleye harvest regulations for Lake Sharpe have differed from standard statewide regulations since 1990 when an April through June 14-inch MLL was implemented. In 1999, the minimum length limit was increased to 15-inches during all months except July and August, and a stipulation that, at most, one fish in the daily limit could be 18-inches or longer was added. These changes were made to reduce harvest during a period of high angler use and increase the abundance of walleye longer than 18-inches in the population. The daily limit was reduced to three fish for 2004 and 2005 to reduce harvest during a period of low walleye abundance. In 2006, a daily limit of four fish was reinstated and the one walleye over 18 inch length regulation was increased to 20-inches. This regulation has been in place since 2006.

Experimental regulations for smallmouth bass were implemented in 2003. . Special regulations from 2003 through 2007 included a 12- to 18-inch protected slot length limit with only one fish 18-inches or longer in the daily bag. In 2008, the lower end of the 12-18 inch protected slot was increased to 14 inches to promote harvest of smaller bass in order to reduce their high abundance. An evaluation of that regulation was initiated in 2011, and based on the results of that evaluation, the regulation was removed in 2012.

Reservoir Access and Habitat

Shore fishing access is excellent on the upper third of the reservoir. Shore access within the cities of Ft. Pierre and Pierre and just downstream at Hipple Lake and Farm Island Recreation Area provide ample opportunity. There are a number of "pull-offs" approximately 12 miles downstream where anglers can access the reservoir. However, downstream from this location, shoreline access is limited to a few boat ramp access points and a couple of Game Production Areas. There are several fishing piers on Lake Sharpe and two ADA approved access areas. Following the flood of 2011, the fishing pier along LaFramboise causeway has become silted in and sits in less than ½ m of water. Although historically a popular angling location, this pier is rarely used for angling anymore.

Lake Sharpe currently has 25 boat ramps, four of which are maintained by the Lower Brule Sioux Tribe. Oahe Downstream, Farm Island Recreational Area, and West Bend are popular access points that offer camping and recreating opportunities to complement angling access. However, the number of usable boat accesses has decreased in recent years with ramps at DeGrey, Ft. George, North Bend, Cedar Creek, and Antelope Creek nearly unusable or unusable due to sedimentation. Additionally, anglers launching at Hipple Lake no longer can access the main lake rendering boat access to much of the middle zone of Lake Sharpe difficult.

Lake Sharpe contains some unique habitat types. Backwater areas unique to Lake Sharpe include Hipple Lake, the LaFramboise side channel, and the Ft. Pierre city developments all which provide complex habitats. However; no evaluation of the use of these areas by fish has been conducted. Since the late 2000's, Christmas trees have been placed in Hipple Lake as a way to boost lake productivity and to concentrate fish to areas easily accessible by shore anglers. These habitat modifications have been very popular and in 2016, Mossback® permanent habitat structures were placed in Hipple Lake. These habitat structures last far longer than the Christmas trees; however, no evaluations have been conducted in South Dakota to compare fish assemblages/sizes between the two habitat types.

Lake Sharpe Management Issues

The following management issues are specific to Lake Sharpe and are reflected in the objectives and strategies for Lake Sharpe for the 2019-2023 period.

1. Shore fishing and ADA access opportunities on the middle and lower portions of Lake Sharpe are lacking and improvements to existing opportunities in the upper portion are necessary.

2. Sedimentation and high use necessitate regular improvements and maintenance at boat access locations.

3. Factors that may be influencing the downward trend of the sauger population on Lake Sharpe have not been evaluated.

4. A better understanding of walleye population dynamics and movement in Lake Sharpe is necessary in order to effectively manage the fishery.

5. Fish population indices and data are not available for the Oahe Dam tailrace area due to high flow rates impeding the use of standard fish sampling gears.

6. Baseline data characterizing entrainment through Oahe and Big Bend Dams in non-flood years has not been obtained.

7. Flathead catfish population dynamics have not been described on Lake Sharpe; therefore there is little data on which to base management decisions.

8. It is unclear if the current complement of fish sampling gears and angler survey methodologies are efficiently providing information on which to base management decisions.

9. The large number of governmental and non-governmental agencies with interest in the management of Lake Sharpe's aquatic resources makes communication and coordination difficult.

Goals, Objectives, Strategies

Goal:

The state of South Dakota manages Lake Sharpe's aquatic resources for the continued use and enjoyment of South Dakota Residents and its visitors.

Objectives and Strategies

Not all objectives will be met due to brushfires, unforeseen obstacles, and changes in needs or priorities as a part of the adaptive management process.

1. ***Objective:***

   Increase shore fishing opportunities at two locations along Lake Sharpe by December 31, 2023.

   Strategies:

   a) Work with the Parks Division, GFP Land Managers, the USACE, local municipalities, and anglers to identify priority areas, with specific consideration for locations downstream of Ft. George, for access development and improvement based on potential use and feasibility.

   b) Develop designs for ADA compliant shore fishing access improvements in areas with access to deep water and fish habitat.

   c) Create specific structural habitat designs to concentrate fish in developed shore fishing areas

   d) Develop plans for sediment removal, and habitat improvements, in areas immediately downstream of the LaFramboise causeway shore fishing access sites.

e) Construct shore fishing access improvements in coordination with Parks, the USACE, and local partners.

2. Objective:

Improve boat access at two locations along Lake Sharpe by December 31, 2023

Strategies:

a) Work with the Parks Division, the USACE, local municipalities, and anglers to identify priority areas, with specific consideration for the stretch of Lake Sharpe extending from the Polo Field ramp to Joe Creek, for access development and improvement.

b) Investigate the feasibility of rebuilding or renovating boat access sites at Ft. George, DeGrey, Antelope Creek and/or Cedar Creek.

c) Develop shoreline fishing opportunities in association with renovated boat access.

d) Construct boat access improvements in coordination with Parks, the USACE, and local partners.

3. Objective:

Conduct six research studies on critical sport- and prey-fish on Lake Sharpe by December 31, 2023.

Strategies:

a) Evaluate hybridization and genetic variation of sauger and walleye in Lake Sharpe to detect potential changes in

hybridization rates between species through time and among reservoirs, and to evaluate potential population separation or mixing within and among Missouri River reservoirs

b) Estimate Lake Sharpe walleye population abundance, mortality (total and angling), exploitation and harvest patterns from mark-recapture data.

c) Investigate the potential use of underwater observations to index sport-fish populations in the Lake Oahe tailrace.

d) Determine daily, seasonal and yearly movement patterns of Lake Sharpe walleye using acoustic-telemetry.

e) Investigate factors that influence fish entrainment during non-flood years and quantify base-line entrainment levels.

f) Design a study to document Flathead Catfish population dynamics (recruitment, growth, mortality) in Lake Sharpe.

4. Objective:

Assess current survey methodologies to determine efficiency and effectiveness at indexing fish population characteristics and angler use and harvest patterns by December 2023.

Strategies:

a) Evaluate the use of vehicle counters to replace bus-route style creel surveys on Lake Sharpe.

b) Determine if the current complement of sampling gear and analyses allow for identification of meaningful population trends (e.g. increases or declines) that may affect the fishery.

c) Evaluate the use and feasibility of new gears to target species that are under-represented in current survey methodology.

d) Annually review appropriate sampling methods based on results of strategies 4a-4c.

5. Objective:

Annually pursue opportunities to cooperate with other organizations on fisheries and aquatic resource management within the Missouri River system.

Strategies:

a) Communicate and coordinate with the US Army Corps of Engineers on water management and angler access.

b) Increase the number of opportunities for information exchange between private entities, government agencies and non-governmental organizations on fisheries and aquatic resource management.

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Management Area

Lake Francis Case is a 107-mile long, 102,000-acre mainstem Missouri River reservoir, located in south-central South Dakota extending from Big Bend Dam to Fort Randall Dam (Figure 4). The White River, which enters Lake Francis Case from the west about 11 river miles south of Chamberlain, is the only sizable tributary on the reservoir. Due to its large sediment load, the White River has caused a large delta area to form in the reservoir. Other water inputs include localized runoff from many small creeks and groundwater from numerous artesian wells located throughout the reservoir. Lake Francis Case has a total drainage area of 14,150 square miles.

From 2007-2017, Lake Francis Case supported between 84,575 and 150,650 angler days annually and generated between $8.6 and 13.2 million in direct economic input to the local and regional economies (based on a value of $77 per angler trip). Lake Francis Case is an important resource in South Dakota and its habitat and fish community must be managed to enhance its value to various user groups. The importance of Lake Francis Case to South Dakota fisheries is documented in the issues, objectives and strategies provided herein.

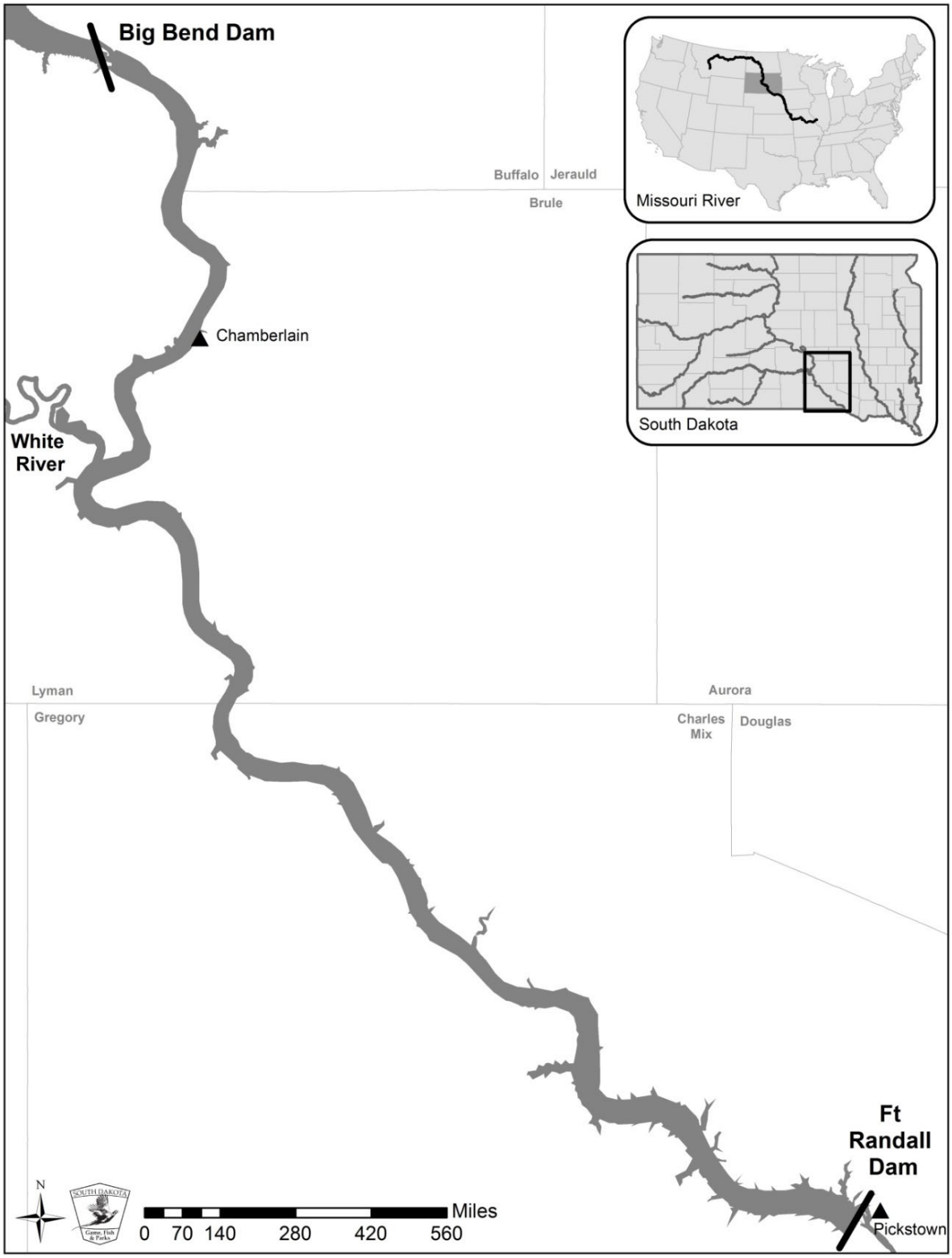

Figure 4. Map of Lake Francis Case in south central South Dakota.

Management of Lake Francis Case

Stocking

In an effort to diversify prey species in Lake Francis Case, adult Spottail Shiners were stocked in 1979. This one-time stocking proved successful as Spottail Shiners have been common in the reservoir since. Black crappies were stocked in the mid-1980s and Largemouth Bass were stocked from 1984 to 1990. Northern Pike were stocked sporadically from 1982 through 1993 while tiger muskellunge were stocked in the mid-1980s. Few anglers targeted these species and stocking efforts were discontinued. Smallmouth bass were stocked annually from 1985-1990 in an attempt to diversify the sport fishery. These stockings were discontinued when natural reproduction was adequate to maintain the population. In an attempt to utilize the coldwater habitat available in the reservoir, Chinook salmon were stocked annually from 1983-1986. Brown, cutthroat, and rainbow trout were also stocked sporadically from the mid-1980s until 2000. These stocking were discontinued after several years of poor return to the angler creel, and currently, no salmonid species are being stocked. Walleye fingerlings were stocked annually into Lake Francis Case from 1988-1992 and again in 2002, but were discontinued after it was determined that natural production was sufficient to maintain the population. Paddlefish have been stocked into Lake Francis Case since the late 1970s. Fry were stocked sporadically up to 1990, and fingerlings (8-10 inch) have been stocked annually since then. Initial paddlefish stockings were aimed at maintaining a brood source for paddlefish, while current stockings are made to support a put-grow-and-take snag fishery.

Fisheries Surveys

Standardized adult fish population surveys using gill nets were initiated on Lake Francis Case in 1982 and prey fish surveys using seines began in 1981. Since then, fish population surveys have been conducted annually on Lake Francis Case (current surveys indicated with bold type). Over the years these surveys have included:

1. **Adult gill-net survey**
2. **Shoreline seining survey**
3. Larval trawling survey
4. Age-0 walleye fall electrofishing survey
5. Spring adult walleye electrofishing survey
6. **Smallmouth bass electrofishing survey**

Since 2017, experimental gill net design has followed the American Fisheries Society recommendation (Miranda and Boxrucker 2009). These experimental gill nets consist of eight 10 ft x 6 ft panels of monofilament mesh (0.75, 1.00, 1.25, 1.50, 1.75, 2.00, 2.25, 2.50 in) tied together in a random order . Additionally, each gill net is paired with a small mesh option described by Miranda and Boxrucker (2009) that consists of three, 10 ft x 6ft panels of monofilament (0.39, 0.51, and 0.63 in bar mesh). A total of 72 nets are set at random locations on Lake Sharpe (excluding the area immediately below Oahe dam to Stoney Point). All fish collected are identified

and counted. The first 50 individuals of each species are measured (TL; mm) and weighed (g) at each sampling location. All walleye and sauger are measured, weighed, and otoliths removed for age-estimation (10 per 2.5-cm length group per sampling location).

A 0.25-in nylon mesh bag seine, measuring 100-ft long by 8.0-ft deep with a 6.0-ft by 6.0-ft bag, is used to collect age-0 and small-bodied littoral fishes during late July and August. Four seine hauls are made at each sampling location with all fish collected identified and counted.

These surveys are designed to provide biological information regarding:

1. Species composition
2. Relative abundance
3. Age
4. Growth
5. Condition
6. Recruitment
7. Survival and mortality rates
8. Population size structure

Fish Surveys

A fishery developed in Lake Francis Case shortly after impoundment. Black bullhead, largemouth bass, bluegill, and yellow perch were most abundant in the angler catch during the first couple of years after impoundment (Gasaway 1970). Ten to 15 years after impoundment, those fish populations declined while populations of emerald shiner, white bass, walleye, and channel catfish increased (Gasaway 1970). Over time, Lake Francis Case transitioned from a fishery dominated by northern pike, largemouth bass, and panfish into one dominated by walleye.

The Lake Francis Case walleye population is characterized by consistent recruitment and steady growth. One of the major factors affecting walleye recruitment in Lake Francis Case is run-off or more specifically nutrient in-flow into the reservoir. Lake Francis Case has the potential to produce huge year-classes of walleye when conditions are favorable, and during periods of high water, the reservoir can support higher walleye abundances. Relative abundance of walleyes has varied annually from 6 walleyes/net to nearly 30 walleye/net. Fluctuations in walleye abundance are strongly correlated with the amount of water flowing through the Missouri River basin each year.

In 2017, walleye comprised 23% of the gill-net catch. In 2017, proportional size distribution of walleye was 63, higher than the 5 year average of 44. Approximately 63% of walleye in the gill-net sample were ≥ 381-mm and 5% were ≥ 508-mm. Historically, walleye condition (relative weight) for Lake Francis Case is generally between 80 and 90. Condition of walleye (250 mm and greater) in Lake Francis Case was 81 in 2017, which is slightly lower than the five-year average of 83.

Variability in walleye condition in Lake Francis Case likely occurs due to the seasonal availability of gizzard shad and other prey items. Walleye growth in Lake Francis Case is generally considered good and walleye typically reach the 381-mm minimum length limit during their third growing season.

While age-0 gizzard shad typically provide a bulk of the forage for Lake Francis Case, many other species are available in the reservoir as prey. Age-0 yellow perch, white bass, freshwater drum, and crappie species provide alternative forage, as do many species of shiners, minnows, and darters. Catch per effort for shoreline seining on Lake Francis Case has historically averaged 550 fish/seine haul. Below average CPUE has been experienced in recent surveys. Eighteen species of small-bodied littoral fishes were collected by shoreline seining in 2015. All species had previously been collected in Lake Francis Case. The overall catch rate for all species in combination was 411 fish/seine haul. Age-0 gizzard shad comprised 54 percent of the catch. Emerald shiners and age-0 white bass comprised 22 and 12 percent of the catch respectively.

Angler-Use Surveys

The first angler-use and harvest survey on Lake Francis Case was conducted in 1954. This survey showed some harvest of walleye within a year after impoundment. Currently, walleye are the most harvested species followed by white bass, smallmouth bass, channel catfish, and sauger. Sauger were more prominent in angler harvest immediately after the reservoir was created than today.

Paddlefish (a native species) initially provided a unique fishery below Big Bend Dam and were frequently harvested. However, due to angler and commercial harvest coupled with low natural reproduction, paddlefish numbers declined and harvest was banned from 1988 through 2011. Paddlefish snagging reopened in 2012 with a limited-entry snag fishery that now occurs annually during the month of May.

Prior to 2000, angler-use and harvest survey techniques were designed using a template consisting of two independent parts. First, aerial pressure counts were used to estimate fishing pressure. Second, angler interviews were used to obtain estimates of individual angler harvest, catch, and release rates. Since 2000, a bus route survey has been used for the angler use and harvest survey to improve precision and accuracy of pressure estimates. A bus route design is commonly used to survey fisheries with numerous access sites spread over a broad geographical region. Current creel surveys are conducted from 1-April through 31-July for the sunrise-to-sunset (daytime) period.

Questions asked in standard interviews are designed to collect information on trip length, type of fishing (boat or shore), target species, zip code, number in party, number and species harvested and released, and size distribution of harvested walleyes. Questions to determine angler satisfaction and preferences as well as guide management activities are also included in the interview.

Information on angler use and harvest is also collected for the paddlefish season by including a postage-paid postcard with each permit issued. This card was designed

to be easily completed by anglers and serves to collect information needed to manage the fishery. To increase response, anglers that do not return their card are sent a reminder shortly after the season ends. The card includes questions on harvest, catch and release numbers, size harvested, hours snagged, area and days fished as well as general comments from anglers.

Recent Angler-Use Surveys

Estimated fishing pressure for the April-July daylight period in 2017 (563,531 angler-h) was similar to the long term average for Lake Francis Case (576,172 angler-h). Estimated angler trips spent on Lake Francis Case were the sixth highest on record since 1995. Walleye were the most caught species (383,945 fish), however, walleye harvest (148,138 fish) on Lake Francis Case was below the long-term average (163,235 fish). This may have been due to lower abundances of legal-sized walleye in the population. Walleye were also the most frequently released species with an estimated 235,807 fish released. Smallmouth bass, freshwater drum, white bass, and channel catfish were also commonly caught and released.

Lake Francis Case anglers contributed about $10.2 million to local economies in 2017. Non-residents made up 31% of the angler contacts which was similar to the percentage of non-residents for the past 4 years. Many (63%) anglers drove over 100 miles to fish the reservoir and most (96%) were primarily targeting walleye.

Angler perception of their fishing experience is important in evaluating satisfaction with a fishery and success of management practices. In 2017, anglers were asked to consider all factors when evaluating their level of satisfaction with their fishing trip. The median trip satisfaction rating for the April-July period was “slightly satisfied” with about 72% of angling parties interviewed indicating some degree of satisfaction. Over the previous five years, anglers had an average satisfaction rating of 75%. The level of satisfaction tended to increase with walleye catch rate which has historically been the case.

From 2012-2017, an average of over 1,800 residents have applied annually for 350 Lake Francis Case paddlefish snagging tags/permits. Paddlefish anglers have spent an average of 3,021 hours annually during this time pursuing paddlefish. Harvest has averaged 174 paddlefish and ranged from 123 fish in 2016 to 206 fish in 2017. An estimated 789 paddlefish are released annually by paddlefish anglers on Lake Francis Case and catch rates have averaged 0.3 paddlefish/hour of snagging.

Fisheries Research

Early fisheries research focused on changes in fish populations after impoundment (Gasaway 1970, Walburg 1977). Some studies evaluated the effects of discharge, water levels, and peaking on fish populations and productivity (Benson 1973, Martin and Novotny 1977). Martin et al. (1981) evaluated impacts of water discharge on age-0 fishes while Nelson and Walburg (1977) studied population dynamics of percids in Missouri River reservoirs.

As sport fisheries matured and the reservoir transformed into a walleye fishery, research focused on game fish and factors affecting them (Michaletz 1984, 1986).

Fielder (1989) assessed the success of stocking of coldwater fish in Lake Francis Case. Beck et al. (1997) researched the influences of environmental variables on white bass recruitment, growth and mortality. As angler use increased and sport-fish harvest became more of a concern, Game, Fish, and Parks research focused on survey methods and techniques (Miller, 1984, Stone and Lott 2002, Soupir et al. 2006). Wuellner et al. (2008) examined gizzard shad population characteristics as they relate to other systems in South Dakota and throughout the United States, and Graeb et al. (2010) described hybridization of walleye and sauger in Missouri River reservoirs.

Schreck (2010) examined seasonal use of Missouri River deltas by fishes. Walleye entrainment during the flood of 2011 was assessed by Carlson et al. (2016). Game, Fish, and Parks has worked with the USFWS to stock paddlefish into Lake Francis Case for more than 30 years. Pierce, et al. (2011) evaluated stocking success of paddlefish and investigated the potential for a sport fishery on Lake Francis Case. Their findings lead to the opening of the paddlefish snag fishery in 2012. Pierce, et al. (2015) also evaluated the effects of exploitation on mortality rates of paddlefish. Current research is evaluating economic expenditures and the financial impact of Lake Francis Case angling to local communities.

Aquatic Invasive Species

Lake Francis Case has curly leaf pond weed and Asian clams present, however curly leaf pond weed and Eurasian water milfoil are both likely present at undetectable levels. Both invasive plant species are present in Lake Sharpe directly upstream of Lake Francis Case and fragments of both species have been observed in the drift below Big Bend Dam. The fall drawdown likely inhibits heavy colonization of the two invasive plant species. Additionally, zebra mussels are present in Lewis and Clark Lake directly downstream from Lake Francis Case. The close proximity and shared recreational and fishing use between the reservoirs puts Lake Francis Case at a high risk of zebra mussel introduction. The fall drawdown would likely keep zebra mussels at lower densities due to dewatering of shallow areas and freezing during winter months. If zebra mussels do become established, Lake Francis Case would become a potential source for additional infestations around the state even if the drawdown keeps the population at low abundance.

Regulations

Lake Francis Case, Lake Sharpe and Lake Kampeska were the first South Dakota waters to have a length restriction placed on the walleye fishery. In 1990, an April-June, 15-inch minimum length limit was implemented on both Missouri River reservoirs. In 1999, the minimum length limit was increased to 15 inches during all months except July and August with a stipulation that, at most, one fish in the daily limit could be 18 inches or longer. These changes were made to reduce harvest during periods of high angler use and to attempt to equitably distribute the harvest of walleye longer than 18 inches. The daily limit was reduced to three fish in 2004 and 2005 as an additional measure to reduce harvest during a period of low abundance.

In 2006, the daily limit was returned to the statewide limit of four and the one walleye over 18-inch length regulation was increased to 20 inches. This regulation has been in place since 2006. Beginning in 1990, the “dredge-hole” area near Chamberlain has been closed to fishing from December-March to reduce catch and release mortality during the cold water period when walleye commonly inhabit this deep-water area. In 2003 the closed period was lengthened to December-April. A regulation implemented in 2001, and currently still in effect, requires anglers fishing through the ice from the northern Gregory-Charles Mix county line downstream to Ft. Randall Dam to keep the first four walleye they catch regardless of size. The purpose of this regulation is to reduce catch-and-release mortality during the cold water period when anglers are commonly fishing for walleye in deep water.

Reservoir Access and Habitat

Lake Francis Case provides many boat launching facilities, however, shore fishing access is limited. Boats can be launched at six recreation areas,10 lakeside use areas operated by GFP, and one recreation area and three lakeside use areas operated by the United States Army Corps of Engineers (hereafter Corps of Engineers; Appendix 5). These areas provide camping and recreation opportunities in addition to angling access and account for a majority of recreational access. Within these public access areas there are 24 Game, Fish and Parks, and four Corps of Engineers boat ramps. Abundant shore fishing access exists within the recreation and lakeside use areas, but shore fishing access is limited to a few “pull-off” areas outside of these areas, most of which are located in the upper third of the reservoir. Shoreline access is available within a few state Game Production Areas. Within the city of Chamberlain, there is a fishing pier at American Creek campground and an ADA approved fishing pier in American Creek marina. Standard operating elevation for Lake Francis Case is 1355 ft. above mean sea level (msl). Access to the reservoir is severely impacted by the annual drawdown during which water elevation drops nearly 20 feet, reaching approximately 1335-1339 ft. msl affecting many boat ramps (Appendix 1). The upper portion of Lake Francis Case consists of shallow, cottonwood-stump covered mudflats surrounding a deeper channel area. Below Chamberlain, the White River has created a shallow delta area in the mid-to-upper portion of the reservoir. This area typically warms faster in the spring and a large percentage of this area is exposed during the winter drawdown months. It is thought that the drawdown of the reservoir may hinder establishment of aquatic invasive plant species such as curly leaf pondweed and Eurasian watermilfoil. Unfortunately, the same action probably hinders survival of aquatic invertebrates. The mid and lower portions of the reservoir are relatively deep with a small percentage of shoreline habitat available to fish on the main lake. However, these sections of the reservoir do have large embayments which provide shallow water habitat for fish.

Lake Francis Case Management Issues

The following management issues are specific to Lake Francis Case and are reflected in the objectives and strategies for Lake Francis Case for the 2019-2023 period.

1. Effects of current walleye regulations on the population need to be investigated.

2. The annual fall draw-down of the reservoir exposes sediment in shallow water portions of the reservoir prohibiting aquatic vegetation growth and likely hinders aquatic invertebrate survival/production.

3. Maintenance of the paddlefish population relies on artificial propagation due to there not being any documented paddlefish reproduction/recruitment.

4. Evaluating paddlefish stocking success is challenging due to juvenile paddlefish being difficult to sample and factors influencing stocking survival/recruitment are not well understood.

5. Recent changes in gill net type and survey design has made comparison of historic and current data problematic.

6. It is unclear if American Fisheries Society small mesh gill nets will provide a useful index of walleye production/recruitment.

Goals, Objectives, Strategies

Goal:

The state of South Dakota manages the fisheries and aquatic resources of Lake Francis Case for long-term sustainable use and enjoyment.

Objectives and Strategies

Not all objectives will be met due to brushfires, unforeseen obstacles, and changes in needs or priorities as a part of the adaptive management process.

1. ***Objective:***

   Identify factors that influence walleye recruitment and abundance in Lake Francis Case by December 31, 2023.

   Strategies:

   a) Conduct a study to quantify angler exploitation and determine its effect on walleye recruitment.

   b) Assemble and analyze existing information to assess the relationship between walleye recruitment and various environment variables.

   c) Investigate impacts of winter water elevation draw-downs on reproduction and recruitment of Lake Francis Case prey and sport fish, with a focus on walleye.

2. ***Objective:***

   Evaluate the paddlefish sport fishery on Lake Francis Case and develop management recommendations by December 31, 2023.

Strategies:

a) Review and compile coded wire tag data to evaluate stocking success and determine conditions favorable to survival of fingerlings post-release.

b) Evaluate the paddlefish stocking program on Lake Francis Case to determine if stocking strategies are meeting management objectives.

c) Continue annual creel survey to collect data on harvested paddlefish and determine angler use, preferences and satisfaction.

d) Summarize information in a report and implement any identified changes in management.

3. Objective:

Maintain and enhance shore fishing and boat access along Lake Francis Case at two locations by December 31, 2023.

Strategies:

a) Work with GFP land managers, Parks Division, and Corps of Engineers to increase shoreline access at priority locations throughout Lake Francis Case.

b) Develop ADA fishing access at priority sites along Lake Francis Case.

c) Work with GFP land managers, Parks Division, and Corps of Engineers to develop recommendations that mitigate congestion

at popular access sites on Lake Francis Case during periods of high use.

d) Work with local county superintendents, Parks Division, and Corps of Engineers to ensure maintenance of public roads to access sites.

4. Objective:

Evaluate efficacy of fisheries surveys conducted on Lake Francis Case by December 31, 2023.

Strategies:

a) Evaluate the random sampling design with American Fisheries Society standard gillnet survey methodologies implemented in 2017.

b) Continue evaluation between fall electrofishing and American Fisheries Society standard small mesh gill nets to index walleye recruitment at fall age-0.

c) Evaluate and update creel survey design (e.g. time spent at each boat ramp by month and route selection probability) based on recent angler use trends at Lake Francis Case access sites.

d) Annually review appropriate sampling methods based on results of strategies 4a-4c.

5. Objective:

Increase public interaction by December 2023.

Strategies:

a) Provide online reports to the public.

b) Conduct informational meetings, open houses, and guide/resort owner meetings as requested to discuss Lake Francis Case issues.

c) Redesign and experiment with new report formats compatible with modern methods such as social media.

Strategic Plan for the Randall Reach, Lewis and Clark Lake and the Lower Missouri River below Gavin's Point Dam

Management Area

This plan addresses the area from Fort Randall Dam to the confluence of the Big Sioux River near the Iowa and Nebraska border and is split into three separate segments: the Randall reach, Lewis and Clark Lake, and the Lower Missouri River (Figure 5). The Randall reach extends from Fort Randall Dam downstream to the downstream edge of the Niobrara delta. The Randall reach contains the Fort Randall Dam tailrace, the 39-mile reach of the Missouri National Recreational River, and the delta above Lewis and Clark Lake. Lewis and Clark Lake starts below the Niobrara Delta and ends at Gavins Point Dam. The lower Missouri River reach is from the Gavins Point Dam tailwaters downstream to the confluence of the Big Sioux River. The lower Missouri River reach includes the Gavins Point Dam tailwaters and the 59-mile reach of the Missouri National Recreational River.

Lewis and Clark Lake was formed in 1955 by the completion of Gavins Point Dam. Full pool elevation for Lewis and Clark Lake is 1207.5 ft above mean sea level (msl). Reservoir surface area is 12,707 ha at normal pool, with a storage capacity of 4,913 acre-feet. Maximum depth is 45 ft with a mean depth of 16 ft. There is approximately 89.5 miles of shoreline surrounding the lake when elevation is at normal pool. The Lewis and Clark Lake watershed drains 16,000 square miles with the area above Gavins Point Dam draining 263,500 square miles. The small size of the Lewis and Clark Lake makes the area more sensitive to water releases by the United States Army Corps of Engineers (USACE). When releases from Gavins Point Dam reach maximum flow, all water in the reservoir can be replaced in just a few days. Timing, duration, and magnitude of releases impact primary and secondary production, fish recruitment, and other ecological variables within the reservoir, though these impacts are not completely understood.

Lewis and Clark Lake is primarily managed by the USACE as a flow through reservoir. Generally, water elevation is held at 1,207 to 1,209 msl with little variation throughout the year. The primary water management function is to act as a buffer reducing flow variation caused by hydroelectric peaking from Fort Randall dam upstream from Lewis and Clark Lake. Water levels vary daily from Fort Randall dam downstream to the head waters of Lewis and Clark Lake with the highest fluctuations in the upstream areas. The Missouri River below Gavins Point Dam is managed to provide water for all authorized purposes including flood control, hydroelectric power, irrigation, recreation, water supply, navigation, and fish and wildlife. There are three major tributaries for this study area. The Niobrara River, which originates in Wyoming, runs through Nebraska and enters the reservoir from the southwest, is the main tributary of Lewis and Clark Lake. Draining over 12,000 square miles of the Nebraska Sandhills, the Niobrara River contributes over half of

the 4 million tons of sediment deposited in the lake annually. The James River, approximately 710 miles (1,143 km) long, draining an area of 20,653 square miles (54,240 km2) in North Dakota and South Dakota, enters the lower Missouri River from the north. The headwater of the James River is located in Wells County, North Dakota. The James River is very slow flowing having a gradient of 5 inches per 1 mile which sometimes produces a reverse flow. Other than the Missouri River, the James is the only river to completely traverse the state. The James River is a major contributor of nutrients into the lower Missouri River in South Dakota. Originating in Roberts County, South Dakota, the Big Sioux River runs 419 miles (674 km) through eastern South Dakota and along the northwestern border of Iowa. It enters the Missouri River from the north near Sioux City, IA.

Sedimentation has decreased the lifespan of Lewis and Clark Lake to between 75 and 135 years as estimated by USACE. As of 2009, Lewis and Clark Lake had a storage loss of almost 30%. Based upon sediment data provided by USACE, Lewis and Clark Lake is projected to be at 50% of its design volume by the year 2045.

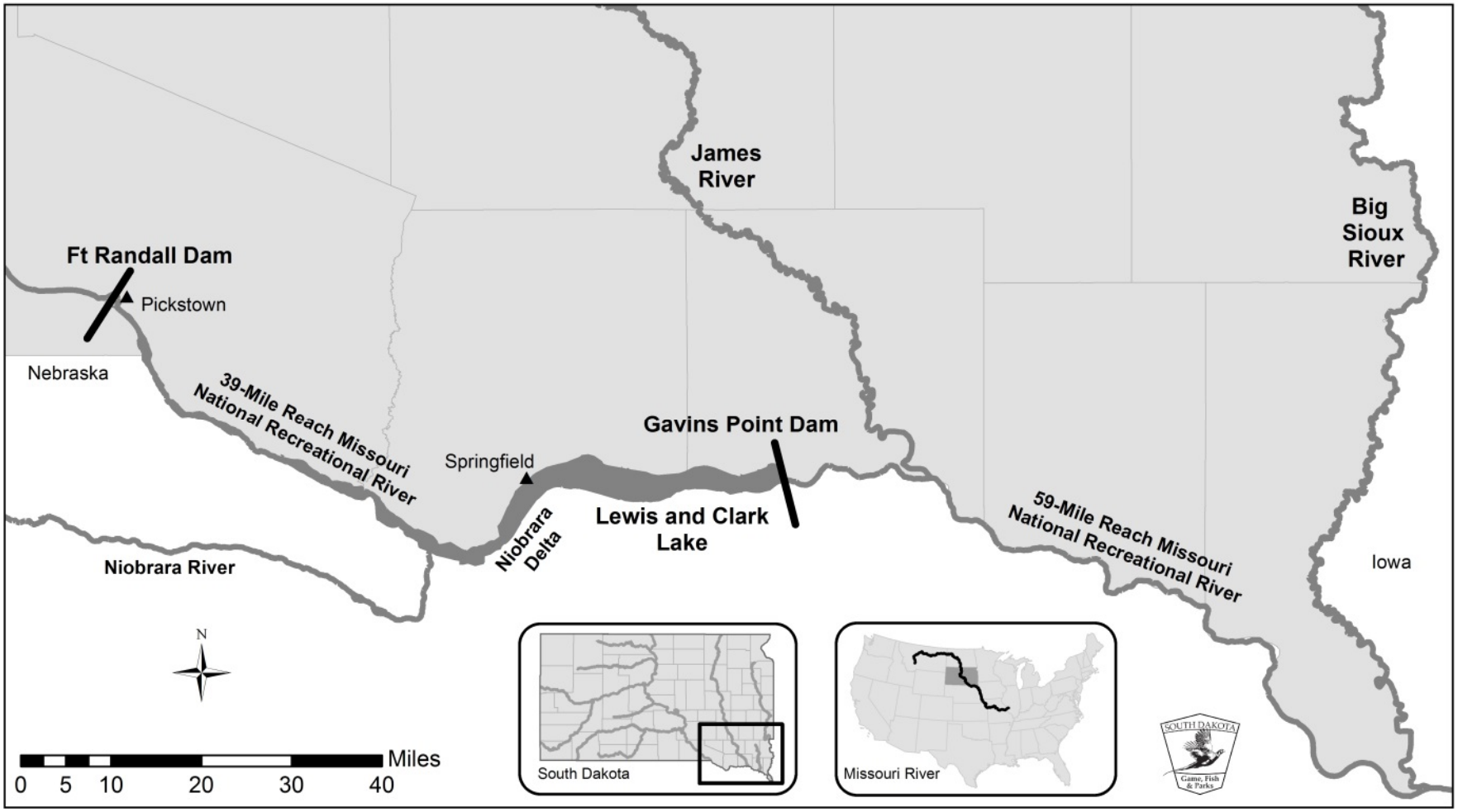

Figure 5. Map of the 39-Mile Reach of the Missouri National Recreation River, Lewis and Clark Lake, and the 59-Mile Reach of the Missouri National Recreation River in southeastern South Dakota.

Management of Lewis and Clark Lake

Stocking

The Lewis and Clark Study Area was stocked with 11 different species from 1979 through 2016 (Appendix 5). Approximately 100,000 to 250,000 walleye were stocked annually from 1983 through 1990. Walleye stocking resumed in 2014 and 2016, in cooperation with the Nebraska Game and Parks Commission when approximately 40 million fry and 1.5 million fingerlings were released into Lewis and Clark, respectively. In the early 1990s, Northern Pike fingerlings were stocked annually with a total number stocked of 2.5 million. Since 1993, more than 1.4 million black crappie fingerlings and more than 400,000 white crappie fingerlings have been stocked in Lewis and Clark. Trout have been stocked annually since 1984 as a put-and-take fishery in the Randall reach. Currently Lewis and Clark Lake is managed as a walleye/sauger fishery, although catfish species, bass species and crappies species contribute substantially to the sport fishery.

Fisheries Surveys

Standardized adult fish population gill-net surveys and shoreline seine surveys were initiated on the Lewis and Clark Study Area in 1981. Since then, fish population surveys have been conducted annually on the Lewis and Clark study area (current surveys indicated with bold type). Current and historic surveys include:

1. **Adult gill-net survey**
2. **Shoreline seining survey**
3. **Age-0 walleye fall electrofishing survey**
4. **Spring and fall black bass electrofishing**
5. **Productivity sampling**
6. Spring walleye electrofishing
7. Channel catfish hoop-netting
8. Flathead catfish low-frequency electrofishing
9. Native river species surveys (lower Missouri River)

Since 2017, experimental gill net design has followed the American Fisheries Society recommendation (Miranda and Boxrucker 2009). These experimental gill nets consist of eight 10 ft x 6 ft panels of monofilament mesh (0.75, 1.00, 1.25, 1.50, 1.75, 2.00, 2.25, 2.50 in) tied together in a random order . Additionally, each gill net is paired with a small mesh option described by Miranda and Boxrucker (2009) that consists of three, 10 ft x 6ft panels of monofilament (0.39, 0.51, and 0.63 in bar mesh). A total of 72 nets are set at random locations on Lake Sharpe (excluding the area immediately below Oahe dam to Stoney Point). All fish collected are identified and counted. The first 50 individuals of each species are measured (TL; mm) and weighed (g) at each sampling location. All walleye and sauger are measured,

weighed, and otoliths removed for age-estimation (10 per 2.5-cm length group per sampling location).

A 0.25-in nylon mesh bag seine, measuring 100-ft long by 8.0-ft deep with a 6.0-ft by 6.0-ft bag, is used to collect age-0 and small-bodied littoral fishes during late July and August. Two seine hauls are made at each sampling location with all fish collected identified and counted.
These surveys are designed to provide biological information regarding:

1. Species composition
2. Relative abundance
3. Fish age
4. Growth
5. Condition
6. Recruitment
7. Survival and mortality rates
8. Population size structure

Recent Fish Survey

In 2017, walleye comprised 6% of gill-net catch. Other species commonly caught included channel catfish, sauger, river carpsucker, and freshwater drum. walleye CPUE has decreased each year since 2008. All walleye year classes up to age 5 were present with 42% of sampled fish at age-2 and older. Approximately 56% of walleye in the gill-net sample were ≥ 381 mm minimum length limit and 30% of fish were ≥ 508 mm. Proportional size distribution decreased from 68 in 2016 to 57 in 2017, slightly higher than the 5 year mean of 55.

Historically, walleye condition for Lewis and Clark Lake is generally between 80 and 90. Condition of walleye (250 mm and greater) in 2017 was 84, slightly lower than the five year average of 88. Walleye growth in Lewis and Clark Lake is considered good and walleye typically reach the 381-mm minimum length limit during their second and third growing season.

Fifteen species of small-bodied littoral fishes or age-0 sportfish were collected by shoreline seining. All species had previously been collected in Lewis and Clark Lake. The overall catch rate for all species in combination was 90.9 fish/seine haul. Age-0 gizzard shad comprised the majority (93%) of the catch and no age-0 walleye were collected by seining in 2017.

Paddlefish have been tagged below Gavins Point Dam since the early 1990s. Coded wire tags were initially used during a Mississippi Interstate Cooperative Resource Association research project to monitor paddlefish movement throughout the basin. Beginning in 2007, monel jaw tags have been placed on paddlefish below Gavins Point Dam to monitor movement and estimate angler exploitation rates. Paddlefish were collected using a floating gill net 91.4-m long by 4.3-m deep with 88.9-mm mesh. Two hundred and fifty-two paddlefish were collected and tagged with monel

jaw tags below Gavins Point Dam in 2017. Since 2007, a total of 2,877 paddlefish have been tagged with monel jaw tags, an average of 288 annually.

Angler-Use Surveys

The first angler-use and harvest survey on the Lewis and Clark Study Area was conducted in 1984. The survey was conducted from the Fort Randall Dam tailwaters downstream to Gavins Point Dam tailwaters. Angler-use surveys have been implemented as needed, however, there has been little consistency in area or reach surveyed between angler use surveys. The most recent (2009) SD creel survey encompassed the Randall reach, Lewis and Clark Lake, and the lower Missouri River.

freshwater drum were the most harvested fish species during the 1984 angler-use and harvest survey. Also during this survey walleye were the most prominent sport fish harvested. Since then, there has been a transition in angler preference as walleye began to dominate all harvested species. Walleye were the most harvested fish species in the 2009 survey and the majority of freshwater drum were released. Currently, walleye are the most harvested species followed by white bass and channel catfish from Gavins point Dam upstream to Fort Randal dam. Freshwater Drum are the most harvested species below Gavins Point Dam.

Sample design for angler-use and harvest surveys on Lewis and Clark Study Area consisted of pressure counts and angler interviews. Pressure counts were used to estimate total fishing pressure and angler interviews were used to obtain estimates of individual angler harvest, catch and release rates, mean party size, mean trip length, and provide information on angler preference. The latest survey was conducted from April through October during daylight hours.

Questions posed in standard interviews gather information on trip length, type of fishing (boat or shore), target species, zip code, number in party, numbers and types of fish harvested and released, and lengths of walleye harvested by anglers. Angler satisfaction questions are included in each interview and anglers are also asked specific questions to help guide management practices on Lewis and Clark Study Area.

Recent Angler-Use Surveys

In 2009, an estimated 372,382 hours were expended fishing the Lewis and Clark Study Area from April 1 through October 31. This was greater than the long-term average for the Lewis and Clark Study Area (264,327 angler-h). Walleye were the most harvested species with an estimated 27,722 harvested.

In 2009, Lewis and Clark Study Area anglers contributed about $8.14 million to local economies and non-residents made up 47% of the angler contacts. The majority of this surveyed reach is Nebraska border water, so it is not surprising that approximately 36% of all anglers were Nebraska residents. Non-resident anglers

traveled from 17 different states to fish the surveyed reach. The majority of anglers came from southeastern South Dakota and northeastern Nebraska with about 24% of all anglers residing in Yankton County, South Dakota.

Walleye and/or sauger were the preferred species in 2009. Forty-eight percent of the anglers fishing the Lewis and Clark Study Area were primarily targeting walleye. Lewis and Clark Lake had the highest percentage (60.8%) of walleye anglers. The Randall reach was next with 45.3% of the anglers primarily targeting walleye, followed by the lower river at 22.2%. Channel catfish was the second most targeted species (9.5%) for the Lewis and Clark Study Area. Percent of anglers primarily targeting channel catfish was 10% for the Randall reach, 9.4% for Lewis and Clark Lake, and 9.5% for the lower Missouri River. Other species commonly targeted included smallmouth bass, largemouth bass, crappie, and freshwater drum.

Angler satisfaction with their fishing trip or experience is important to the success of a fishery. In 2009, anglers were asked to consider all factors when evaluating their level of satisfaction with their fishing trip. About 81.9% of angling parties interviewed in 2009 indicated some degree of satisfaction. Thirty-eight percent of all surveyed angling parties did not harvest any fish, and yet 78% of those angling parties expressed some degree of satisfaction with their trip. Over 70% of angling parties expressed some degree of satisfaction regardless of the number of fish caught. Questions relating to aquatic invasive species (AIS) were asked in the 2009 survey to determine angler knowledge about local issues with AIS. South Dakota anglers were slightly more aware of the presence of zebra mussels and Asian carp below Gavins Point Dam than non-resident anglers. However, a large number of anglers were unaware of the presence of either invasive species. Forty-one percent of the anglers were unaware of zebra mussels below Gavins Point Dam and 27% of the anglers were unaware of Asian carp in the lower Missouri River. Since this survey was completed, zebra mussels have become established in Lewis and Clark Lake.

Information was collected on archery and snagging fisheries for paddlefish via postage-paid postcards included in tag/permit packets. This information has been valuable in developing or modifying paddlefish regulations. During the 2017 summer archery season, archers spent an estimated 3,021 hours pursuing paddlefish. This estimate is above the long term average of 2,511 hours. Archers harvested an estimated 156 paddlefish during 2017, well above the long-term average of 54 paddlefish. The 2017 angler use during the snag fishery (12,647 h) was similar to the long term average, while the 2017 harvest estimate (585 fish) was below the long term average. Angler catch rate was 0.96 fish/h and anglers released an estimated 11,536 paddlefish in 2017, well above the long term average of 8,266.

Fisheries Research

Since impoundment, Lewis and Clark Lake has been the focus of much research. Shortly after impoundment, the primary focus was the observed changes in fish community structure (Benson 1968; Walburg 1969; Walburg 1976; Benson 1980;). Other early research included zooplankton studies in the reservoir (Hudson

and Cowell 1966; Tash et al 1966; Cowell 1967; Benson and Cowell 1968) and the Randall reach (Cowell 1970; Martin and Novotny 1977) and the lower Missouri River reach (Morris et al 1968; Novotny and Martin 1980). Researchers also studied invertebrate populations (Comwell and Hudson 1967; Claflin 1968; Hudson 1971) and the general limnology (Martin and Novotny 1975; Martin 1980; Martin et al 1980) of the newly formed reservoir. Individual fish species population characteristics, life history and feeding habits in Lewis and Clark Lake have been studied for sauger (Nelson 1968; Nelson 1969; Walburg 1972; VanZee et al 1996;), white bass (Ruelle 1971; Ruelle 1977; Beck et al 1997), freshwater drum (Swedberg 1965; Swedberg and Walburg 1970), yellow perch (Nelson and Walburg 1977), channel catfish (Walburg 1975), and emerald shiner (Fuchs 1967). Additionally, effects of reservoir operation on fish entrainment (Walburg 1971), fish populations in the reservoir (Benson; 1973) and river reaches (Walburg et al 1971; Kallemeyen and Novotny 1977) were also investigated.

Recent research on Lewis and Clark Lake has focused more on sportfish. Riis and Stone (1993) evaluated walleye, sauger, and smallmouth bass movements within Lewis and Clark Lake extending up to Fort Randall Dam. Graeb et al (2010) investigated age structure and hybridization between walleye and sauger in Lewis and Clark Lake. Graeb et al (2009) also described a shift in sauger spawning habitats since early impoundment years. Wickstrom (2006) studied distribution, movement and food habits of walleye and sauger in Lewis and Clark Lake.

Recent studies on the lower Missouri River and Randall reaches have been focused on native fish species and much of that directed at the endangered pallid sturgeon. Galat et al (2005) evaluated changes in spatiotemporal patterns of Missouri River fish populations. Kaemingk et al (2007) investigated fish diversity in the Niobrara delta while Schreck (2010) examined the seasonal aspect of fish diversity in the Niobrara Delta. Numerous studies on pallid sturgeon have been completed and some are still ongoing in both the Randall reach and lower Missouri River reach by the United States Fish and Wildlife Service (USFWS), United States Geological Survey (USGS), Nebraska Game and Parks Commission and several universities.

Current state-funded research is focused on improving the walleye population in Lewis and Clark Lake. Due to low recruitment in recent years, South Dakota biologists have been collecting productivity, temperature, zooplankton, dam release, and walleye recruitment data to help identify problems with walleye recruitment in the reservoir. Additionally, an experimental stocking was completed in 2016 in which 1.4 million OTC-marked, hatchery-reared walleye fingerlings were stocked in June. Marking will allow biologists to assess the relative contribution from fingerling stocking and natural reproduction. In addition, marked walleye fry were stocked by Nebraska Game and Parks Commission and their contribution will also be determined. Walleye will also be collected from the lower Missouri River reach to look at entrainment of both stockings. This information may help identify critical time periods limiting natural recruitment as well as evaluate the effectiveness of both stocking strategies as future management tools.

Regulations

Walleye regulations on the fishery in the Lewis and Clark Study Area differ from other Missouri River reservoirs mainly because the majority of the system is a border water with Nebraska. To accommodate this, the Study Area is divided into three separate regulation areas. Prior to 2000, walleye and sauger regulations consisted of a daily and possession limit. In 2000, a minimum length limit was established for the waters upstream from Gavins Point Dam.

Channel Catfish regulations recently changed on South Dakota-Nebraska border waters to more closely resemble regulations for Nebraska inland waters. Prior to 2016, anglers were allowed to keep five channel catfish per day and have 10 fish in possession. Current regulations allow 10 channel catfish per day and 20 in possession for the South Dakota-Nebraska border downstream to the Big Sioux confluence near river mile 734.

Reservoir Access and Habitat

Lewis and Clark Study Area has limited shore fishing access. Fishing piers throughout the system provide some shore fishing access. Most access areas have rock rip-rap that may be difficult for anglers to navigate. Lewis and Clark Lake has the most shoreline access in the Study Area. However, Gavins Point Dam tailwaters in the lower Missouri River reach has the most-used shore access site in the Lewis and Clark Study Area.

The Lewis and Clark Study Area currently has 31 boat ramps, 11 of which are on the Nebraska side. Many of the boat ramps are concrete with most of them having docks. They are owned by multiple agencies including tribal, state, and federal organizations and some may require use fees.

There are different habitat types throughout the Lewis and Clark Study Area. The Randall reach has many riverine attributes including braided channels, islands, and sandbars. There is limited sediment transport due to upstream reservoirs and substantial channel degradation in the upstream section of this reach. The Randall reach is also impacted by hydroelectric peaking operations from Fort Randall Dam which causes daily fluctuations in water level and flow. Water flows less than 9,000 cubic feet per second resulting in dewatered backwaters/ shallow areas which impacts invertebrate and fish production. The reach has larger, older islands, covered with willow and cottonwood trees as well as sand islands in the Niobrara Delta area. Many of the sand islands are covered with Phragmites and cattails. This section of the reach has a vast number of braided channels, islands, and backwater areas which create still water habitat for centrarchid species.

Lewis and Clark Lake has reduced habitat diversity due to major sedimentation processes including shoreline erosion, littoral drift, and delta encroachment. Many

embayments have been filled with sediment and cut off from the lake. Additionally, points have been eroded leaving a relatively straight, homogeneous shoreline consisting of gravel, cobble and bedrock. High flow-through rates combined with wind and wave action have removed fine sediments from much of the littoral areas. Shallow areas consisting of fine sediments are limited to the areas protected by the Weigand breakwaters and inside Miller creek.

The lower Missouri River is similar in many ways to the Randall reach with braided channels, sandbars, and channel degradation in upstream areas. The James and Vermillion rivers provide much needed sediment and nutrients to the lower Missouri River. The portion below the Big Sioux River becomes a navigable river with attributes such as channelization, side channels, levees, and dykes.

Management Issues for the Randall Reach, Lewis and Clark Lake and the Lower Missouri River below Gavin's Point Dam

The following management issues are specific to the Randall reach, Lewis and Clark Lake and the lower Missouri River below Gavin's Point dam and are reflected in the objectives and strategies for these waters for the 2019-2023 period.

1. The influence of Missouri River Basin run-off on factors that affect walleye recruitment, such as productivity, growth, temperature, and entrainment are not well understood.

2. Walleye seasonal/variable use of lake and riverine habitats and movement between habitats is unknown, making management difficult.

3. Entrainment levels related to flow are unknown and could complicate management actions such as stocking and regulation development.

4. Near shore habitat is not conducive for seining, making indexing prey abundance with the current gears difficult.

5. It is unclear if American Fisheries Society small mesh gill nets will provide a useful index of walleye production/recruitment which is important for evaluating stocking success.

6. There are currently few sport-fish surveys being conducted below Gavins Point Dam and population status is not well known for some species.

Goals, Objectives, Strategies

Goal:

Manage fisheries and aquatic resources of the Randall reach, Lewis and Clark Lake and the lower Missouri River below Gavin's Point dam for long-term sustainable use and enjoyment.

Objectives and Strategies

Not all objectives will be met due to brushfires, unforeseen obstacles, and changes in needs or priorities as a part of the adaptive management process.

1. Objective:

Identify factors that influence walleye/sauger recruitment and abundance in Lewis and Clark Lake by December 2023.Strategies:

a) Compile walleye/sauger population, productivity, and Fort Randall and Gavins Point Dams water release data to assess the effect of water releases on walleye/sauger recruitment and abundance.

b) Annually monitor productivity including plankton abundance, nitrogen, phosphorus, and chlorophyll levels to evaluate impact on recruitment.

c) Continue annual fall gill net surveys to monitor walleye population size and response to changes in biotic and abiotic factors.

d) Estimate the relative contribution of fry and fingerlings stockings to the walleye population to develop strategies to maximize stocking success.

e) Disseminate findings from walleye recruitment studies to potentially affected individuals and the public through presentations, reports, the GFP website and social media.

2. Objective:

Investigate walleye distribution, movement, and entrainment in Lewis and Clark Lake and the Randall reach by December 2023.

Strategies:

a) Surgically implant transmitters in adult walleyes to track movements.

b) Compile and analyze movement and distribution data and evaluate effects on index of abundance.

c) Develop a survey design and conduct a study to quantify walleye and sauger entrainment through Gavins Point Dam.

d) Analyze entrainment and movement data, write reports/manuscript and disseminate findings to potentially affected individuals.

3. Objective:

Determine the efficacy of fish community surveys conducted on Lewis and Clark Lake by December 2023.

Strategies:

a) Evaluate the survey design recommended by American Fisheries Society standard gillnet survey guidelines that was adopted in 2017.

b) Evaluate hydroacoustics as a method of indexing prey fish abundance and compare results with the existing shoreline seine survey.

c) Compare different survey methodologies and select the best one to monitor walleye and sauger recruitment.

d) Adopt and implement an improved design for annual surveys.

4. Objective:

Maintain annual collaboration with all agencies involved in the management of Lewis and Clark Lake and the Randall reach.

Strategies:

a) Coordinate data collection and management with Nebraska Game and Parks Commission.

b) Participate in a biannual border water meeting with Nebraska Game and Parks Commission.

c) Utilize U.S. Fish and Wildlife Service fisheries data on the Randall Reach for population analysis.

5. ***Objective:***

Submit a proposal for development a new boat access site between Running water and Ft Randal Dam by December 2023.

Strategies:

a) Work with USACE, National Park Service and the Yankton Sioux Tribe to identify possible locations for a new access project.

b) Work with engineering staff to select most feasible option and develop cost estimates.

c) Prepare project proposal and submit into access prioritization/selection process.

6. ***Objective:***

1. Develop or improve two access areas in Missouri River below Gavin's Point dam by December 2023.

Strategies:

a) Work with NPS, GFP Parks Division, GFP Engineering and USACE to identify existing access sites in need of improvement or new sites with shore fishing and boating access development potential.

b) Prioritize potential access site improvement locations based on a set of selected metrics.

c) Prepare improvement and/or development project proposals and submit them into the access prioritization/selection process.

7. ***Objective:***

Develop sportfish monitoring plan of action for the Missouri River below Gavin's Point dam by December 31, 2023.

Strategies:

a) Analyze data from completed surveys, including those from the pallid sturgeon population assessment project, to determine the best sampling methods.

b) Coordinate with Nebraska to develop sampling design that covers all desired species and avoids duplication of effort.

c) Develop a survey design under the guidelines of the American Fisheries Society Standard Methods.

d) Implement new survey design or modify the existing design to improve sampling precision and reliability.

Missouri River Fisheries Management Area
Initial Priorities for the 2019-2023 Period

Priorities for annual work plans related to accomplishment of Missouri River Fisheries Management Area objectives for the 2019-2023 period include:

- Evaluation of new creel survey methodology
- Evaluation of walleye stockings, specifically for Lakes Oahe and Lewis and Clark.
- Enhancement of access sites close to population centers
- Evaluation of walleye recruitment, especially for Lakes Oahe and Lewis and Clark
- Quantification of walleye movement and entrainment

Due to brushfires, unforeseen obstacles, and development of new management issues, plan priorities may change during the period of implementation.

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Appendices

Appendix 1. List of species present in standard surveys over the last 10 years (2009-2018) in each reservoir. X indicates presence.

Species	Oahe	Sharpe	Francis Case	Lewis and Clark	Below Gavins Point
Bigmouth Buffalo	X	X	X	X	X
Bigmouth Shiner					X
Black Bullhead	X	X	X		X
Black Crappie	X	X	X	X	X
Bluegill	X	X		X	X
Bluntnose Minnow		X		X	
Brassy Minnow	X				X
Central Stoneroller				X	
Channel Catfish	X	X	X	X	X
Chinook salmon	X				
Common Carp	X	X	X	X	X
Common Shiner			X	X	
Creek Chub				X	X
Emerald Shiner	X	X	X	X	X
Fathead Minnow	X		X	X	X
Flathead Catfish	X	X		X	
Freshwater	X	X	X	X	X

Species	Oahe	Sharpe	Francis Case	Lewis and Clark	Below Gavins Point
Drum					
Gizzard Shad	X	X	X	X	X
Goldeye	X	X	X	X	
Green Sunfish					X
Highfin Carpsucker					X
Johnny Darter	X	X	X	X	X
Largemouth Bass	X	X		X	X
Longnose Dace			X		
Longnose Gar					X
Mimic Shiner					X
Northern Pike	X	X	X	X	
Northern Redbelly Dace			X	X	
Orangespotted Sunfish					X
Paddlefish		X	X	X	X
Rainbow Trout		X			
Red Shiner			X	X	X
River Carpsucker	X	X	X	X	X
Rock Bass				X	
Sand Shiner		X			X

Species	Oahe	Sharpe	Francis Case	Lewis and Clark	Below Gavins Point
Sauger	X	X	X	X	X
Shorthead Redhorse	X	X	X	X	X
Shortnose Gar	X	X	X	X	X
Shovelnose Sturgeon		X	X	X	X
Silvery Minnow			X		
Smallmouth Bass	X	X	X	X	
Smallmouth Buffalo	X	X	X	X	X
Spotfin Shiner				X	X
Spottail Shiner	X	X	X	X	X
Stonecat		X			X
Tadpole Madtom					X
Walleye	X	X	X	X	X
White Bass	X	X	X	X	
White Crappie	X	X	X	X	X
White Sucker	X	X			
Yellow Perch	X	X	X	X	

Appendix 2. South Dakota Natural Heritage Program and Federally listed species in the Missouri River Fisheries Management Area. Status abbreviations: SE = state endangered; ST = state threatened; SGCN = Species of Greatest Conservation Need.

Common Name	Scientific Name	Federal Status	State Status
	Fish Species		
Blue Sucker	*Cycleptus elongates*		SGCN
Northern Redbelly Dace	*Chrosomus eos*		ST, SGCN
Pallid Sturgeon	*Scaphirhynchus albus*	Federally Endangered	SE, SGCN
Shovelnose Sturgeon	*Scaphirhynchus platorynchus*	Federally Threatened	SGCN
Sicklefin Chub	*Macrhybopsis meeki*		SE, SGCN
Sturgeon Chub	*Macrhybopsis gelida*		ST, SGCN
Trout-perch	*Percopsis omiscomaycus*		SGCN
	Turtle Species		
False Map	*Graptemys pseudogeographica*		ST, SGCN
Smooth Softshell	*Apalone mutica*		SGCN
	Mussels		
Hickorynut	*Obovaria olivaria*		SGCN
Higgins Eye	*Lampsilis higginsii*	Federally Endangered	SGCN
Mapleleaf	*Quadrula quadrula*		SGCN
Scaleshell	*Leptodea leptodon*	Federally Endangered	SGCN
Yellow Sandshell	*Lampsilis teres*		SGCN

Appendix 3.- Aquatic invasive species detected in the Missouri River Fisheries Management Area (X denotes presence).

Species	Oahe	Sharpe	Francis Case	Lewis and Clark	Below Gavins Point
Bighead Carp					X
Common Carp	X	X	X	X	X
Grass Carp					X
Silver Carp					X
European Rudd	X	X	X	X	X
Asian Clam			X	X	X
Zebra Mussels				X	X
Brittle Naiad				X	
Curlyleaf Pondweed	X	X	X	X	X
Eurasian Water-milfoil		X		X	

Appendix 4.- Species, years when stocked, maximum number of individuals stocked in a given year, and total number of individuals stocked in Lake Oahe in a given year. Data include all Lake Oahe stockings since 1979.

Species	Years Stocked	Max # stocked per year	Total # stocked
Brown trout	1981, 1984-1990	93,700	519,225
Burbot	2008	9,110	9,110
Chinook salmon	1982-2000, 2003-2018	884,542	9,744,033
Gizzard Shad	1982, 2012-2015	85,000	88,837
Lake Herring	1984, 1988, 1990-1992	4,460,000	32,208,700
Lake trout	1979-1985	198,392	1,398,557
Lake whitefish	1979	2,900,000	2,900,000
Northern Pike	1988-1992	594,150	1,193,861
Paddlefish	1985	88,000	88,000
Rainbow trout	1979-2000, 2012	257,370	2,983,776
Smallmouth Bass	1983-1989	227,500	1,088,000
Steelhead trout	1982, 1985-1989	50,000	228,559
Walleye	1983-1998, 2017-2018	2,079,540	77,157,943

Appendix 5. Species, years when stocked, maximum number of individuals stocked in a given year, and total number of individuals stocked in Lewis and Clark Lake in a given year. Data include all Lewis and Clark Lake stockings since 1982.

Species	Years Stocked	Max # stocked per year	Total # stocked
Black Crappie	1993-2000	291,632	1,491,122
Brown Trout	1987-1988,1990-2014	29,829	287,243
Cutthroat Trout	1984-1987	63,220	139,067
Largemouth Bass	1984,1987	100,000	175,000
Muskellunge	1984,1986,1988,1993	150,000	218,600
Northern Pike	1982,1990-1995,1997	1,600,000	2,512,077
Paddlefish	1986-1992, 2009	24,690	132,710
Pallid Sturgeon	2013-2014	1,064	1,467
Rainbow Trout	2001-2002, 2010-2018	15,188	77,354
Walleye	1983-1988,1990,2014-2016, 2018*	27,676,520	45,298,080
White Crappie	1993-1997,1999-2000	173,234	424,603

***** In cooperation with Nebraska Game and Parks Commission

Appendix 6. Management issues included in the 2014-2018 Missouri River Fisheries Management Area Plan.

1. The dynamic nature of recruitment, growth, competition, and mortality among fish populations complicates management.
2. Information obtained from current fish population surveys may be inadequate to document population status for some species, affecting the ability to effectively manage those species and the system as a whole.
3. Productivity changes, sedimentation, stream bed aggregation, habitat degradation, and the presence of Aquatic Invasive Species can impact fish populations.
4. Factors influencing angler satisfaction are not well understood.
5. Balancing biological and social needs during regulation development is challenging.
6. The Missouri River is highly susceptible to Aquatic Invasive Species infestation.
7. Collaboration with other governmental (federal, state, and tribal) entities on management issues is challenging and communication channels are not always adequate.
8. Many large river species native to the Missouri River are declining in abundance.
9. The current process of public involvement needs improvement.
10. Fisheries are impacted by the inter-reservoir transfer of organic (including fish, plankton, and plant matter) and inorganic (including phosphorus and nitrogen) material.
11. Ice fishing and shore fishing is limited due to travel restrictions on state and U.S. Army Corps of Engineer managed lands.
12. Sedimentation in reservoirs causes issues with boat ramps and delta areas.
13. Extreme water conditions limit access.
14. Bank stabilization limits shore access for shore angling.
15. Boat ramps and shore access are lacking in remote locations.
16. There are perceived crowding issues at access sites.
17. Different entities manage access locations leading to confusion among users.
18. Locations with handicapped and limited-mobility access are lacking.
19. Regulation compliance and effectiveness is difficult to estimate.
20. Border water regulations are inconsistent.
21. Anglers are challenged by fish species identification.
22. Regulation process timeframes can hinder regulation changes and limit opportunities for public input.
23. Current support of past and current regulations makes implementation of new regulations difficult to accept by some anglers.
24. Competing uses of aquatic resources causes conflicts.
25. Contaminant levels in fish flesh (primarily mercury) will continue to be a concern in large reservoirs that go through large annual elevation changes.
26. The biological needs of fish populations may conflict with economic development.
27. The Missouri River can serve as a source for dispersal of Aquatic Invasive Species.
28. Industrial development within the Missouri River Basin may impact aquatic resources.

Appendix 7. Objectives and completion status for the 2014-2018 Missourit River Fisheries Management Area Plan.

1. ***Objective:***

   Annually identify factors limiting game fish populations and angler satisfaction.

   Status: Completed and on-going

   Completed and on-going activities:

   Annual Creel Surveys (Oahe, Sharpe, Francis Case)

   Lake Oahe Walleye Tagging Research

   Lake Sharpe Walleye Tagging Research

   Chinook salmon Differential Stocking Location Research

   Standard Fish Population Surveys

   Lake Oahe Walleye Stocking Evaluation

   Lake Sharpe Paddlefish Stocking and Evaluation

   Hipple Lake and Mossback Structures

   Gamefish Stockings throughout FMA

   Rainbow Trout Telemetry

   Otolith Microchemistry Projects

2. ***Objective:***

   Assess current fish population survey methodologies to determine efficiency and effectiveness at indexing population characteristics by December 2018.

   Status: Completed and on-going

   Completed and on-going activities:

   MO River Standard and AFS standard gear comparison

   Tailrace sportfish surveys

   Electrofishing and small mesh comparison for juvenile WAE

3. ***Objective:***

Improve public involvement in fisheries management by December 2018.

Status: Completed and on-going

Completed and ongoing activities:

Annual Oahe/Sharpe Public Meeting (2014, 2015, 2016, 2017)

Statewide Lake Oahe Meetings (2018)

Development of Oahe and Sharpe Angler Access Plan

South Dakota Focus Television Show

Atlantic Salmon Outreach Video

Education and Outreach Events (Schools, BassMasters, etc.)

Volunteer assistance for research and management projects

Francis Case regulation change survey (2018)

4. ***Objective:***

Annually pursue opportunities to cooperate with other organizations on fisheries and aquatic resource management within the Missouri River system.

Status: Completed and on-Going

Completed and on-going activities:

Cooperative Paddlefish and Sturgeon Research (USFWS)

Mossback Structure Installation (Boy Scouts, Izaak Walton)

Lake Sharpe Remote Creel (USACE, Parks Division)

Whitlock Spawning Station Operation (Parks Division)

Mickelson Pond Improvements and Stocking (City of Pierre)

Cooperative Research Projects with SDSU, UNL & ISU

Annual Missouri River Clean-up (Izaak Walton, FWS, USACE)

Coordination meeting with USACE

Chinook salmon Work Group (NDGF, MTFWP)

Francis Case Paddlefish Season (CCST, LBST)

Gavins Point Paddlefish season (NEGPC)

Lewis and Clark WAE stocking program and evaluation (NEGPC)

5. ***Objective:***

   Incorporate aquatic non-game species information into survey and management strategies by December 2015.

   Status: Incomplete

6. ***Objective:***

   Assist with developing the section of the overall State Angler Access Plan which focuses on the Missouri River Fisheries Management Area by December 2015.

   Status: Partially Completed

   Partially completed activities:

   Oahe/Sharpe Angler Access Work Group/Plan

7. ***Objective:***

   Complete specific sub-plans for each reservoir and river reach in the Missouri River Fisheries Management Area by April 2014.

   Status: Completed

   Reservoir-specific sub-plans were completed and adopted by the GFP commission.

8. Objective:

Create a database management system for storing, analyzing, and reporting fisheries-related data by January 1, 2018.

Status: Completed and on-going

SDGFP Aquatics and GIS staff worked with a GIS consultant, ESRI, to develop a statewide database to store, analyze and report fisheries data (creel and fisheries survey, stocking, spawning and some research). Data is now stored in a Sequel Server database, fisheries and creel survey data are analyzed using programs coded in Sequel Server language, and reports are generated using Sequel Server Reporting Services (SSRS). Scripts were developed to auto-generate survey statistics which are placed into tables/reports located on our website.