South Dakota

Department of Game, Fish and Parks

Missouri River Strategic Plans

2017-2021

Fisheries Management Plan for Lewis and Clark Lake and the Missouri River Upstream and Downstream of the Reservoir (Lewis and Clark Study Area)

Chris Longhenry, Gary Knecht, Kyle Bales and Jason Sorensen

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Vision statement for management of Lewis and Clark Lake

The state of South Dakota manages the aquatic resources of Lewis and Clark Lake and the Missouri River upstream and downstream of the reservoir for the continued use and enjoyment of South Dakota Residents and visitors.

Introduction

The Missouri River and its reservoirs provide considerable economic and recreational value for South Dakota. The Missouri River reservoirs and their fisheries support 40% of the total angler use in South Dakota. Strategic planning is required to provide recreational opportunities that meet user expectations, while protecting resources for future use. Plans to manage these resources are fundamental to their sustained and equitable use. This plan identifies current issues with fisheries management of Lewis and Clark Study Area and provides objectives and strategies to address these issues.

The Missouri River system represents one of the most economically and recreationally important aquatic resources in the state of South Dakota. Anglers spent over 2.4 million hours fishing the Missouri River system in South Dakota in 2008. In 2010, approximately 37% of all angler days in South Dakota were spent on the Missouri River system including the 4 reservoirs and 2 river reaches, and about 50% of all South Dakota resident licensed anglers fished the Missouri River system. The South Dakota Department of Game, Fish, and Parks developed the Missouri River fisheries management area plan to effectively guide management of the resource and direct future research.

Lewis and Clark Lake and the Missouri River Upstream and downstream from the reservoir (hereafter termed the Lewis and Clark Study Area) supported approximately 37,500 to 103,000 angler days with an estimated annual economic impact of $2.9-$8.14 million from 2001-2009. The Lewis and Clark Study Area is an important resource in South Dakota. The system's habitat and fish assemblage must be managed to enhance its value to various user groups. The importance of the Lewis and Clark Study Area to South Dakota fisheries is documented in the issues, objectives, and strategies provided herein.

Study 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. 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. Reservoir surface area is 12,707 ha at normal pool, with a storage capacity of 450,000 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.

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.

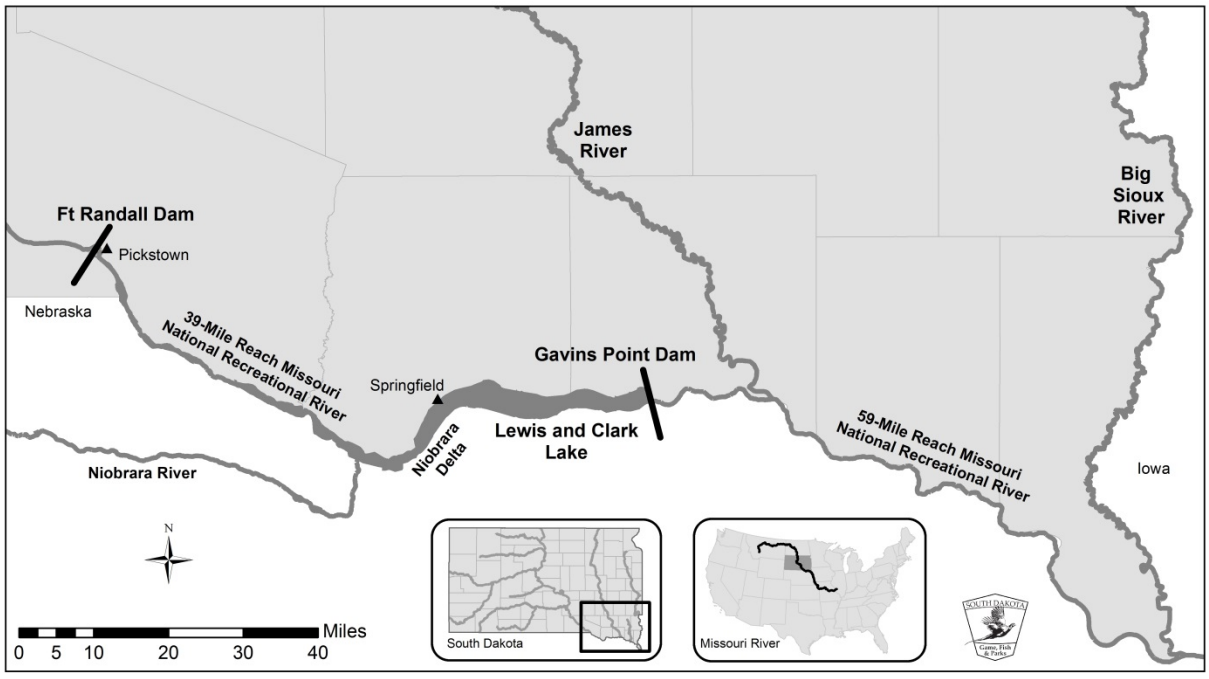

Figure 1. An illustration of the Missouri River from Fort Randall Dam to the South Dakota downstream border.

Management of Lewis and Clark Study Area

Water Management

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 mean sea level (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.

Stocking

The Lewis and Clark Study Area was stocked with 11 different species from 1979 through 2016. 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.

Table 1. Species, years stocked, maximum number of individuals stocked in a given year, and total number of individual species stocked in Lewis and Clark Study Area. Data includes all Lewis and Clark Study Area stockings since 1979.

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, 2010-2016	15,188	77,354
Walleye	1983-1988,1990,2014-2016*	27,676,520	45,298,080
White Crappie	1993-1997,1999-2000	173,234	424,603

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

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 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)

Annual surveys currently utilize experimental-mesh gillnets and nylon-mesh bag seines to survey fish populations in Lewis and Clark Lake. Twelve locations on Lewis and Clark Lake are sampled with 300-ft multifilament gill nets submerged overnight (about 20 h). Bar mesh dimensions include 0.5-, 0.75-, 1-, 1.25-, 1.5-, and 2-inch. All fish collected are identified, enumerated, measured (TL; mm) and weighed (g) at each sampling location. Otoliths are removed from all walleye and sauger for age-estimation. A 6.4-mm nylon-mesh bag seine, measuring 100-ft long by 6-ft deep with a 6 ft by 6 ft bag, is used to collect age-0 and small-bodied littoral fishes. Two seine hauls are made at each sampling station. All fish collected are 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 2015, walleye comprised 11% 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 7 were present with over half of the sample at age-2 and older. Approximately 32% of walleye in the gill-net sample were ≥ 15 inches and no fish were ≥ 20 inches. Proportional size distribution (PSD) decreased from 48 in 2014 to 44 in 2015 and is at the low end of the 9-year range.

Historically, walleye condition for Lewis and Clark Lake is generally between 80 and 90. Condition of walleye (stock length and greater) in 2015 was in the middle of this range (85). Walleye growth in Lewis and Clark Lake is considered good and walleye typically reach the 381-mm minimum length limit during their third or fourth growing season.

Two age-0 walleye were captured in gill nets in 2015 indicating low recruitment. That last time that recruitment was good was in 2007 and 2008. Low to moderate recruitment since 2009 has contributed to decreased walleye abundance.

Thirteen 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 52.2 fish/seine haul which is lower than the long-term mean. Age-0 white bass comprised the majority of the catch and no age-0 walleye were collected by seining in 2015.

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 (MICRA) 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 forty-six paddlefish were collected and tagged with monel jaw tags below Gavins Point Dam in 2015. Since 2007, a total of 2,323 paddlefish have been tagged with monel jaw tags, an average of 290 paddlefish 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. Recently the 2009 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 2015 summer archery season, archers spent an estimated 2,444 hours pursuing paddlefish. This estimate is right at the long term average of 2,447 hours. Archers harvested an estimated 30 paddlefish during 2015, shy of the long-term average of 45 paddlefish. The 2015 angler use (13,007 h) and harvest (772 fish) estimates for the paddlefish snag fishery were similar to the long term averages. Angler catch rate was 0.76 fish/h and anglers released an estimated 9,510 paddlefish in 2015, well above the long term average of 7,870.

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. Other detailed changes to walleye/sauger regulations are presented in Table 2.

Table 2. Walleye regulations on the Lewis and Clark Study Area from 1984 to 2016.

Year	Ft. Randall to SD-NE state line	SD-NE state line to Gavins Point Dam	Gavins Point Dam to Big Sioux Confluence
1984-1990	Daily Limit 6; Possession 12	Daily Limit 6; Possession 12	Daily Limit 6; Possession 12
1990-1999	Daily Limit 4; Possession 8	Daily Limit 4; Possession 8	Daily Limit 4; Possession 8
2000-2005	15” minimum except July and August No more than one over 18”	15” minimum Daily Limit 4; Possession 8	Daily Limit 4; Possession 8

	Daily limit 4; Possession 8		
2006-2015	15” minimum except July and August No more than one over 20” Daily limit 4; Possession 8	15” minimum Daily Limit 4; Possession 8	Daily Limit 4; Possession 8
2016	15” minimum and no more than one over 20” Daily Limit 4; Possession 8	15” minimum Daily Limit 4; Possession 8	Daily Limit 4; Possession 8

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 (Table 3). Most access areas will 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.

Table 3. Shore only access points from Fort Randall Dam to the Confluence of the Big Sioux River near the Iowa-Nebraska border.

Reach	Access Area Name	Ownership	River Mile
Randall Reach	Fort Randall spillway	SDGFP	881
Lewis and Clark Lake	Twin Bridges	SDGFP	828
	Charley Creek	USACE	826
	Horse Trail Campground	SDGFP	815
	Emanual Creek	SDGFP	834
Lower Missouri River	Bolton	SDGFP	757

SDGFP- South Dakota Game, Fish, and Parks
USACE- United States Army Corps of Engineers

The Lewis and Clark Study Area currently has 31 boat ramps, 11 of which are on the Nebraska side (Table 4). Many of the boat ramps are concrete with most of them having loading

docks. They are owned by multiple agencies including tribal, state, and federal organizations and some may require use fees.

Table 4. Boat Ramps from Fort Randall Dam to the Confluence of the Bix Sioux River near the Iowa-Nebraska border.

Reach	Boat Ramp Name	Ownership	Boat Ramp	Dock	River Mile
Randall Reach	Sunshine Bottoms	NGPC	1	N	866
	Spillway Ramp	USACE	1	Y	879
	Randall Creek	SDGFP	1	Y	879
	Verdel	NGPC	2	Y	852
	Ferry Landing	NGPC	1	N	841
	Running Water	SDGFP	1	Y	840
	Springfield 1	SDGFP	2	Y	832
	Springfield 2	SDGFP	1	Y	832
	Niobrara	NGPC	1	Y	844
	Santee	Santee Sioux	2	Y	829
	Sand Creek	SDGFP	1	Y	831
Lewis and Clark Lake	Tabor	SDGFP	1	Y	822
	Bazille Creek	NGPC	1	N	839
	Miller Creek	NGPC	1	Y	820
	Bloomfield	NGPC	1	Y	819
	Weigand	NGPC	4	Y	816
	Gavins Point	SDGFP	2	Y	814
	Midway East	SDGFP	4	Y	813
	Midway West	SDGFP	1	Y	813
	Navratil Cove	SDGFP	1	N	826
	Lewis and Clark Marina	SDGFP	3	Y	811
	South Shore	NGPC	1	Y	812
Lower Missouri River	Tailwaters North	USACE	2	Y	810
	Tailwaters South	USACE	1	Y	810
	St Helena	Cedar County	1	N	799
	Brooky Bottom Park	NGPC	2	Y	785
	Mulberry Bend	NGPC	1	N	775
	Ponca	NGPC	2	Y	753
	Riverside Park	City of Yankton	4	Y	805
	Clay County LU	Clay County	2	Y	780
	Myron Grove	SDGFP	1	Y	787
	Rosenbaum	SDGFP	1	N	749

NGPC- Nebraska Game and Parks Commission
SDGFP- South Dakota Game, Fish, and Parks
USACE- United States Army Corps of Engineers

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.

Issues and Opportunities

Lewis & Clark Lake (including the 39 mile Ft. Randall Reach)

1) *Issue* – <u>Shoreline and boat access can be limited due to a variety of factors.</u>

Lake access is limited for much of Lewis & Clark Lake. Shore and ice fishing access is limited as most of the lake shoreline is inaccessible to motor vehicles. During periods of low water, access on the 39 mile Fort Randall reach can become even more limited as water elevation limits boat ramp operation. Designated roads do not extend to low water elevations to allow shore fishing access. Additionally, there is no South Dakota access to the 39 mile Fort Randall reach between Randall Creek and the Running Water access sites. Problems with crowding at Lewis & Clark Lake boat ramps, as well as on the water, have also been mentioned by lake users as an issue.

Opportunities

Opportunities exist to increase boat and shore access on Lewis & Clark Lake. Some of these can be done at a relatively low cost to the State. Maintenance access roads and trails over state land could facilitate shoreline access. Shoreline access could be improved through agreements with landowners to develop access roads or trails on private land. A more costly option is to renovate existing boat ramps in order to ease crowding at high use locations. These ramps could also be coupled with the habitat initiatives outlined in the following *Issue 2*.

2) *Issue* – <u>Habitat quantity and quality negatively fish populations and anglers.</u>

Habitat diversity in Lewis & Clark Lake and the 39-mile reach up to Fort. Randall Dam has decreased since early impoundment. Hydroelectric peaking combined with channel degradation has reduced the amount of functional side-channel and backwater habitats in the 39-mile reach. Additionally, embayment siltation, and overall effects of reservoir aging, have filled lake embayments and negatively affect some boat ramps and popular shore angling locations. Wave action and water flow has had noticeable impacts on shoreline habitat through erosion of points and movement of fine sediments away from shoreline areas. Shoreline habitat, that concentrates fish near access areas used by shore anglers, has been degraded or eliminated on most of Lewis & Clark Lake.

Opportunities

Many opportunities exist to improve the remaining habitat or construct new habitat on Lewis & Clark Lake. Because of the size of the lake, some of these projects are costly. However, small-scale renovations can be completed over time to defray large one-time expenses. An example of a small-scale habitat modification would be focusing habitat efforts in small, back water bays. These efforts would not only increase fish production, but attract fish to shore fishing locations. Many shallow backwater areas have lost connectivity with the main channel and could be renovated to create a functional backwater ecosystem. Habitat modifications would be evaluated so that renovation could be continued, modified or discontinued dependent on specific outcome criteria.

3) ***Issue*** **– <u>Many knowledge gaps exist for fish population dynamics in Lewis & Clark Lake and the Fort Randall reach.</u>**

Knowledge gaps exist for Lewis & Clark Lake and the Fort Randall reach sport and prey fish. Recruitment, growth, mortality, and movement patterns are unknown for many species, making management recommendations difficult. Specifically, walleye movement and seasonal distribution in the lake and river system are unknown. Additionally, walleye abundance is highly related to water flow through the system, however the specific mechanism driving this relationship is unknown. Walleye abundance could be affected by entrainment, productivity, temperature, age-0 fish survival that in turn is affected by water flow. Additionally, information is lacking on some Lewis & Clark Lake non-game species. Information regarding stocking dynamics on Lewis & Clark Lake is limited and needed to guide ongoing or future stocking efforts. Uncertainty exists as to how water flow and fish distribution affects standard survey results for evaluating fish populations. The effects of aquatic invasive species on native fish are not well understood.

Opportunities

There are opportunities to fill knowledge gaps with fish population dynamics in Lewis & Clark Lake. Advancements in fish telemetry have produced cost effective systems that we could use to could increase our understanding of fish movement. An evaluation is currently being done to determine stocking success with walleye fry and fingerlings in order to determine the best hatchery product to use to optimize stocking success. Standard survey methodology is being evaluated to assess the reliability and predictive value of current surveys and to determine what modification can be made to improve them. Evaluation of current fisheries regulations and potential regulation changes can be done through collection of long-term data and modeling.

4) ***Issue*** **– <u>New and established aquatic invasive species could potentially impact the fishery and recreation on Lewis & Clark Lake.</u>**

Aquatic Invasive Species (AIS) are non-native species of fish, invertebrates and plants that negatively impact the ecosystem or the human use of the ecosystem. Several AIS are established in Lewis & Clark Lake including common carp, Asian clams and zebra mussels, and a large, reproducing population of Asian carp located immediately below Gavins Point Dam.

The primary vector for the movement of AIS invertebrates and plants is the overland transport of boats. The risk of AIS introductions into Lewis & Clark Lake is high since it attracts many anglers and recreational boaters from across the State and country. The establishment of Dreissenid mussels in Lewis & Clark Lake will likely impact the operation of Gavins Point Dam. The lake will be a potential source of AIS for other waters in South Dakota and for the Missouri River below Gavins Point Dam

Opportunities

Many opportunities exist to slow the spread of AIS with regard to Lewis & Clark Lake including education, control and regulation. Prevention through education and compliance through enforcement of regulations are likely the most reasonable and effective means to slow the spread of AIS.

The zebra mussel infestation at Lewis & Clark Lake presents many challenges to managing the resource. Although there is little that can be done to control the mussel population in the lake, many unique opportunities for research on the impact of the mussels on lake ecology and on effective management techniques with AIS in place can benefit all aquatic resources in South Dakota.

5) ***Issue*** **– <u>Challenges of public and government interactions</u>**

Lewis & Clark Lake is frequented by anglers from across South Dakota and the United States. As such, disseminating information and obtaining feedback from anglers across a wide geographic area is challenging. Lewis & Clark Lake also has multiple government jurisdictions including federal entities, border states, and tribes. Communication between these entities can also be challenging though warranted.

Opportunities

Opportunities exist to increase communication among agencies. A state tribal liaison was recently hired demonstrating the commitment the state has to increasing interaction with South Dakota's tribes. Collaboration with border states and various federal entities could benefit research and management of fishes in Lewis & Clark Lake. Inter-agency and border water meetings are currently held to alleviate agency disconnect. Public meetings present opportunities to interact with various publics.

Missouri River below Gavins Point Dam Issues and Opportunities

1) ***Issue*** **– <u>Shoreline and boat access on the Missouri River below Gavins Point Dam can be limited due to a variety of factors.</u>**

Boat and shore access is limited for much of the Missouri River below Gavins Point Dam. Boat ramps are interspersed throughout the river reach, but there are vast areas lacking adequate access. Siltation at access areas can impact access for both boat and shore anglers. Shore access is limited as most of the river shoreline is privately owned, and therefore, inaccessible. During times of low water elevation, river access can become even more limited as water elevation limits boat ramp operation. Tailrace boating closures during paddlefish season further compound the issue.

Opportunities

Many opportunities exist to increase boat and shore access on the Missouri River below Gavins Point Dam. Some of these can be done at a relatively low cost to the state. For instance, developing low maintenance gravel roads (with driving restrictions) over state land can increase shoreline access and potentially be developed along much of the Missouri River below Gavins Point Dam. Agreements with landowners could also be pursued for those projects. Periodic maintenance at access areas would help maintain both boat and shore access to the river.

2) ***Issue*** **– <u>Habitat quantity and quality may negatively impact anglers and fish populations.</u>**

Siltation on the Missouri River below Gavins Point Dam has had pronounced effects. Sediment transfer and localized siltation at access areas has impacted functionality. Water flow has had noticeable impacts on shoreline habitat and channel degradation, most of which has not been formally documented. Channel degradation could have pronounced effects on productivity. Habitat requirements for fish reproduction and recruitment may be lacking during some years depending on river elevation. Shoreline habitat targeted by shore anglers is reduced or non-existent for most of the Missouri River below Gavins Point Dam.

Opportunities

Cooperation with the USACE concerning water management can provide opportunities to improve or create habitat. Large scale habitat changes could contribute to fish reproduction, recruitment, retention, ultimately benefiting anglers. Reconnecting or creating new backwater areas may not only increase fish production, but also attract fish to accessible shore fishing locations. Shallow water areas could warm quicker, have higher productivity, and serve as potential nursery areas for young fish. Habitat modifications would be evaluated so that renovation could be continued, modified or discontinued dependent on specific outcome criteria.

3) ***Issue*** **– <u>Many knowledge gaps exist for fish population dynamics in the Missouri River below Gavins Point Dam.</u>**

Many knowledge gaps exist for fish species in the Missouri River below Gavins Point Dam. Recruitment, growth, mortality, and movement patterns are unknown for many species, making management recommendations difficult. Habitat use by specific species is unknown but greatly warranted. Effects of Aquatic Invasive Species on other species are unidentified.

Opportunities

Opportunities exist to fill knowledge gaps regarding fish population dynamics in the Missouri River below Gavins Point Dam. Advancements in fish telemetry have produced cost effective systems that we could use to could increase our understanding of fish movement. Standard survey methodology is being evaluated to assess the reliability and predictive value of current surveys and to determine what modification can be made to improve them. Evaluation of current fisheries regulations and potential regulation changes can be done through collection of long-term data and modeling.

4) ***Issue*** **– <u>Missouri River below Gavins Point Dam specific aquatic invasive species issues.</u>**

Many aquatic invasive species are established in the Missouri River below Gavins Point Dam. Reproducing populations of Asian carp, zebra mussels, Asian clams have all been documented in the river. Additionally, invasive plant species are likely present in select habitats because Eurasian water milfoil and curlyleaf pondweed have established in many areas of Lewis and Clark Lake directly upstream. Undoubtedly, fragments of both invasive plant species drift

through Gavins Point Dam providing a source for infestation in micro habitats suitable for plant growth.

Opportunities

Many opportunities exist to slow the spread of AIS with regard to the Missouri River below Gavins Point Dam including education, control and regulation. Prevention through education and compliance through enforcement of regulations are likely the most reasonable and effective means to slow the spread of AIS.

5) *Issue* – <u>Challenges of public and government interactions</u>

The Missouri River below Gavins Point Dam is frequented by anglers from across South Dakota and the United States. As such, disseminating information and obtaining feedback from anglers across a wide geographic area is challenging. Lewis & Clark Lake also has multiple government jurisdictions including federal entities, border states, and tribes. Communication between these entities can also be challenging though warranted.

Opportunities

Opportunities exist to increase communication among agencies. A state tribal liaison was recently hired demonstrating the commitment the state has to increasing interaction with South Dakota's tribes. Collaboration with border states and various federal entities could benefit research and management of fishes in the Missouri River below Gavins Point Dam. Inter-agency and border water meetings are currently held to alleviate agency disconnect. Public meetings present opportunities to interact with various publics.

Authorized water uses for Lewis and Clark Lake, as listed in the USACE Master Plan, include flood control, navigation, hydropower, fish and wildlife, recreation, irrigation, and municipal and industrial water supply.

Lewis and Clark Lake and the 39 mile Ft. Randall reach

Goal: Manage fisheries and aquatic resources of the Randall reach and Lewis and Clark Lake for long-term sustainable use and enjoyment.

Objectives and strategies presented here to address the Randall reach and Lewis and Clark Lake management issues not already addressed in objectives contained in the Missouri River strategic plan.

Objective 1. Identify factors that influence walleye/sauger recruitment and abundance in Lewis and Clark Lake by July 2021.

Strategy 1.1 Compile walleye/sauger population, productivity, and Fort Randall and Gavins Point Dams water release data for walleye/sauger recruitment and abundance analysis.

Strategy 1.2 Annually monitor productivity including plankton abundance, nitrogen, phosphorus, and chlorophyll levels.

Strategy 1.3 Collect temperature data to better understand temperature impacts on the food web in Lewis and Clark Lake and the Randall reach.

Strategy 1.4 Continue annual fall gill net surveys to monitor population size and response to biotic and abiotic variables.

Strategy 1.5 Estimate the relative contribution of fry and fingerlings stocked in 2016 to the walleye population and evaluate against contributions previous stockings.

Strategy 1.6. Summarize study findings in a report and disseminate information to potentially affected individuals (PAIs).

Strategy 1.7. Develop management recommendations based on findings.

Objective 2. Determine the effects of Fort Randall Dam hydroelectric peaking on fish reproduction and recruitment in the Randall reach By December 2021.

Strategy 2.1 Obtain and analyze species abundance and length data for the Randall reach from the USFWS pallid sturgeon assessment crew for this section of river, to determine trends and relationships between fishery trends and environmental and water management variables (stage, flow, etc.)

Strategy 2.2 Obtain and compile larval fish abundance data collected by Larry Hesse under contract for the states of South Dakota and Nebraska to look for relations between fish production and water management variables.

Strategy 2.3 Analyze the relationship between water releases and walleye abundance.

Strategy 2.4 Make water management recommendations to USACE and the Missouri River Natural Resources Council (MRNRC).

Objective 3. Evaluate efficacy of fish community surveys conducted on Lewis and Clark Lake by December 2021.

Strategy 3.1 Develop the survey design recommended by American Fisheries Society standard gillnet survey guidelines by July 2017.

Strategy 3.2 Evaluate hydroacoustics as a method of indexing prey fish abundance and compare results with the existing shoreline seine survey.

Strategy 3.3 Continue to evaluate various survey methodologies and then select the best methodology to monitor walleye and sauger recruitment.

Strategy 3.4 Evaluate findings (size structure, abundance, recruitment and growth) from black bass surveys with information collected from tournament/club events.

Strategy 3.5 Calculate correction factors for old survey data to accommodate changes in survey design and facilitate comparison with more recent data.

Strategy 3.6 Adopt and implement and improved design for annual surveys.

Objective 4: Determine potential threats from AIS in Lewis and Clark Lake by December 2021.

Strategy 4.1 Deploy samplers or conduct veliger trawls to monitor the spread of zebra mussels throughout the Randall each and Lewis and Clark Lake.

Strategy 4.2 Implement SCUBA based density sampling to estimate the relative growth of the zebra mussel population in established areas.

Strategy 4.3 Use historic water productivity data and data acquired for Strategy 1.2 to determine possible impacts of zebra mussels on water quality that cannot be attributed to other causes.

Strategy 4.4 Document changes in fish community and water quality that can be attributed to AIS populations.

Strategy 4.4 Work with state AIS biologists to investigate and evaluate AIS outreach programs and initiate programs for Lewis and Clark Lake boaters

Objective 5: Investigate walleye distribution and movement in Lewis and Clark Lake and the Randall reach by April 2021.

Strategy 5.1 Surgically implant transmitters to track movements in adult walleye.

Strategy 5.2 Compile and analyze movement and distribution data and use results satisfying Strategy 3.1 on population survey efficacy to evaluate effects on index of abundance variability.

Strategy 5.3 Estimate rates of adult entrainment through Gavins Point Dam.

Strategy 5.4 Write report/manuscript and disseminate findings to PAIs..

Strategy 5.5 Identify future research needs.

Objective 6: Evaluate entrainment of walleye and sauger through Gavins Point Dam by April 2021

Strategy 6.1 Develop a survey design to quantify walleye and sauger entrainment

Strategy 6.2 Compile/analyze entrainment data, prepare report/manuscript and disseminate findings to PAIs.

Strategy 6.3 Make water management recommendations to USACE based on findings.

Objective 7: Annually collaborate with all agencies involved in the management of Lewis and Clark Lake and the Randall reach.

Strategy 7.1 Coordinate data collection and management with Nebraska Game and Parks Commission.

Strategy 7.2 Participate in a biannual border water meeting with Nebraska Game and Parks Commission.

Strategy 7.3 Utilize U.S. Fish and Wildlife Service fisheries data on the Randall Reach for population analysis.

Strategy 7.4 Attend the Gavins Point Dam interagency meetings held by the USACE and provide input for the Annual Operating Plan.

Strategy 7.5 Collaborate with USACE and the National Parks Service (NPS) on aquatic invasive species issues

Lower Missouri River

Goal: Manage fisheries and aquatic resources of the lower Missouri River for long-term sustainable use and enjoyment.

Objectives and strategies presented here to address the Randall reach and Lewis and Clark Lake management issues not already addressed in objectives contained in the Missouri River strategic plan.

Objective 1: Develop or improve three access areas in the lower portion of the Missouri River by April 2021.

Strategy 1.1 Work with NPS, SDGFP Parks Division and USACE to determine the feasibility of creating shoreline access along the lower Missouri River.

Strategy 1.2 Hold public meetings to gather ideas on access needs.

Strategy 1.3 Work with SDGFP engineers to determine feasibility of creating access at identified sites.

Strategy 1.4 Identify potential locations for developing new boat launching access.

Strategy 1.5 Submit project proposals.

Objective 2: Develop an annual sportfish monitoring survey by April 2020.

Strategy 2.1 Analyze data from completed surveys, including those from the pallid sturgeon population assessment project, to determine the best sampling methods.

Strategy 2.2 Coordinate with Nebraska to develop sampling design that covers all desired species and avoids duplication of effort.

Strategy 2.2 Use American Fisheries Society Standard Methods guidelines to develop survey design.

Strategy 2.4 Calculate correction factors for data from old survey designs to maintain data utility.

Strategy 2.3 Implement new survey design.

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