FINAL REPORT

Determination of river otter (*Lontra canadensis*) distribution and evaluation of potential sites for population expansion in South Dakota

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INTRODUCTION

The river otter (*Lontra canadensis*) is a state threatened species in South Dakota and is afforded protection through South Dakota Administrative Rule 41:10:02:04 (SDGFP 2012). In accordance with this classification, South Dakota law requires that "The Department of Game, Fish and Parks and the Department of Agriculture shall perform those acts necessary for the conservation, management, protection, restoration, and propagation of endangered, threatened, and nongame species of wildlife" (SDCL 34A-8-6). The river otter is also classified as an Appendix II species under the Convention on International Trade in Endangered Species of Wild Fauna and Flora, restricting international trade (Melquist et al. 2003).

Historical abundance is not well documented, although otters were one of the most widely distributed mammals of North America prior to European settlement (Higgins et al. 2000), inhabiting much of the North American continent, including South Dakota (Melquist et al. 2003). Boyle (2006) indicated that the river otter was historically common in major waterways of South Dakota, while Turner (1974) indicated they were absent from and of uncertain historical occurrence in the Black Hills region. Unregulated trapping, habitat degradation, and habitat loss decimated otter populations in South Dakota, and they were nearly or completely extirpated by the early 1900's (Boyle (2006). A 1977 distribution map for North America showed the otter absent from South Dakota (Melquist et al. 2003).

The Flandreau Santee Sioux Tribe released 35 river otters (17 in May 1998 and 18 in May 1999) in the Big Sioux River near Flandreau, SD; the animals were purchased from a private source in Louisiana (Hansen 1998, Moody County Enterprise 1999, Raesly 2001). In keeping with Tribal traditions and cultural values, the released otters were not marked or tagged, making it difficult to monitor the success of the release. However, recent genetic analyses indicate that North Dakota otters originated from Minnesota and there has been some gene flow between the North Dakota/Minnesota population and South Dakota otters (Brandt 2010, Stearns et al. 2010).

Concerned for the status of the otter, in early 2001, South Dakota Game, Fish and Parks (SDGFP) initiated funding and collaboration with South Dakota State University on a graduate project to determine the current distribution of river otters in South Dakota and assess the feasibility of a river otter reintroduction program (Kiesow 2003). Kiesow and Dieter (2003) described the current distribution of river otters in South Dakota while Kiesow and Dieter (2005) focused on the feasibility of a reintroduction in parts of the state.

To assess the distribution of otters in South Dakota and determine if remnant populations existed, Kiesow and Dieter (2003) selected 17 linear waterways for analysis based upon 3 criteria: 1) water permanence, 2) gradient, and, 3) stream order 3 to 7. Study streams included the Bad River, Belle Fourche River, Big Sioux River, Cheyenne River, Grand River, James River, Jorgenson River, Little Minnesota River, Little White River, Missouri River, Moreau River, North Fork of the Whetstone River, Vermillion River, White River, Medicine Creek, Rapid Creek, and Virgin Creek (Figure 1). For each stream they collected a variety of data pertinent to the suitability of the habitat for otters. The authors also searched for otter sign and collected information on sightings from a variety of sources, including the South Dakota Natural Heritage Program (SDNHP), tribes, landowners, trappers, and SDGFP personnel. Kiesow and Dieter (2003) concluded that no remnant population of river otters existed in South Dakota, but there was a small population of reintroduced otters.

During 3 winters spanning 2005 and 2008, SDGFP contracted with Jacquie Ermer, currently a Regional Wildlife Manager with SDGFP, to collect additional distribution data, evaluate survey methods suitable for long-term monitoring, and collect biological data from incidentally caught and killed river otters (Ermer 2006, 2007, 2008). SDGFP has continued to collect biological data from dead otters, including tooth samples for aging, tissue samples for DNA analysis, and reproductive information. This ongoing database will be useful in evaluating population characteristics and dynamics.

The SDNHP maintains a database of rare animal and plant species and plant communities in the state. Because the river otter is a monitored species, the SDNHP maintains records of reported river otter observations. Beck (1993) cautioned that public sightings reported in Colorado often prove unreliable for determining otter distribution, with misidentification of animals the biggest problem. The author also indicated that deliberate misreporting may also occur. Not all South Dakota otter observations are verified by SDGFP, but when they can be, the information is useful in understanding trends and changes in distribution. An analysis of the SDNHP otter database and incidental trapping records can be found in the South Dakota River Otter Management Plan (2012).

Objectives

1. Update river otter occupancy status of drainages with evidence more than 5 years old.
2. Determine river otter occupancy status of agreed-upon drainages.
3. Evaluate agreed-upon sites for reintroduction suitability.
4. Provide training to interested and available Game, Fish and Parks staff in appropriate river otter life history characteristics and survey methodologies.

5. Coordinate with GFP staff to instrument and release ≤5, live-trapped South Dakota river otters into previously selected, unoccupied streams predicted to be suitable river otter habitat.
6. Monitor any instrumented otters to determine home range, identify habitat characteristics of habitats used, foraging behavior, and other features associated with the newly established home ranges.
7. Use collected telemetry data to help evaluate whether to proceed with reintroductions.
8. Summarize results into a final report for the South Dakota Game, Fish and Parks Department (SDGFP).

METHODS

Stream Surveys for Occupancy

Survey streams were selected from the 17 waterways evaluated by Kiesow and Dieter (2003). Surveys focused primarily on streams where otters had not been confirmed present during the 5-year period between 2007 and 2011, including the Bad River, Belle Fourche River, Cheyenne River, Grand River, Little White River, Moreau River, Rapid Creek, Vermillion River, and White River (Figure 2). The remaining 8 waterways identified by Kiesow and Dieter (2003) were excluded from the occupancy analysis, although many bridge crossings on all but Virgin Creek were checked during the survey. A variety of information on drainages in South Dakota, including the distribution of tributaries for streams surveyed and discussed in this report, can be found at the following website: http://viewer.nationalmap.gov/viewer/nhd.html?p=nhd

In addition to searching for otter sign, the purpose of my visit to each of these streams was to gain familiarity with their characteristics, which would be used primarily to evaluate regional sites for moving "conflict otters" and to gain an overall perspective of the inter-relationship of South Dakota streams and otter distribution. For the purpose of this report, conflict otters are those otters that are in conflict with people or causing damage to personal property. The most typical conflict would likely be otters eating unacceptable amounts of stocked fish in private ponds or at private and public fish hatcheries. Other examples of conflicts include instances when otters pose a threat to people (swimmers) or their pets or whenever interactions occur with landowners or individuals in a manner that is perceived as a conflict.

Features I looked for in evaluating suitability of the different streams for otters included:

- Stream characteristics: Varying water depths and stream velocity, stream meanders, suitable bank cover (trees, shrubs), and presence of bank and in-stream structures.
- Watershed features: Presence of adjacent wetlands and suitable tributaries, presence of beaver or beaver activity, and the level of human impacts.
- Prey availability: A diverse prey base (e.g., multiple fish species, crayfish, and frogs) is always preferable to enhance otter habitat. While I always looked for the presence of potential prey at each survey site, prey suitability was based on existing data.
- Other factors: Not a high traffic area and few or no human establishments.

Sign surveys were conducted at bridge crossings for each of the survey streams. For stream survey routes, an effort was made to select stream segments based on a combination of accessibility, suitability of banks to detect otter sign, and stretches that appeared to have suitable otter habitat, although access was probably the over-riding factor. Broad coverage of the waterway was also an important consideration. However, access (road bridges) typically

dictated survey locations when conducting both foot and float surveys. Navigability from the put-in site to the pull-out site was also a prerequisite when selecting float surveys. I used a figure of 500 m (1-way) as the minimum length for walking routes, and attempted to check both banks for sign. Float routes were always much longer.

I attempted to conduct sign surveys during autumn when water levels are typically low and exposed banks facilitate sign detection. Additionally, otter family groups (a female otter and her young) are typically more mobile at this time, increasing the possibility of detection. And while low water levels made floating more difficult during autumn, I felt the benefits out-weighed the inconveniences of having to pull the watercraft over shallow spots. Float surveys were conducted using a canoe, kayak, or inflatable 1-person pontoon boat. Kayaks proved to be the most practical, even though sitting low in the water often made inspecting the shoreline for sign more difficult.

At bridge sign survey locations, I typically checked for sign under the bridge, if accessible. I used binoculars to scan the stream and banks both upstream and downstream from the bridge, took photographs in both directions from the bridge, and recorded elevation. Photos and GPS coordinates taken at bridge sign survey sites were submitted to SDGFP GIS staff for mapping and inclusion in their spatial database.

The following information was collected at bridge sites and survey routes:

- Name of the waterway, survey length (where appropriate), descriptive location, elevation, and coordinates (latitude and longitude).
- Visual observations of animals and tracks, scats, prey remains, or other sign of otter, beaver, and other wildlife.
- Visual observations of potential otter prey species or remains.
- Stream characteristics, water conditions, and human activity.

We initially intended to conduct aerial snow track (AST) surveys for otters. Logistics, timing, and unsuitable weather conditions prevented the effective use of this survey method. An AST survey protocol to try and determine population trends was drafted for use in South Dakota (Appendix 1). However, the only aerial surveys we conducted were to determine presence/absence.

Evaluation of Sites for Reintroduction

The 17 waterways evaluated by Kiesow and Dieter (2005) for possible reintroduction were rated based upon stream characteristics, watershed features, water quality, prey availability,

and other factors. Riparian habitat, prey base, and water quality were the 3 main factors considered most important in providing suitable river otter habitat. Based on their analyses, the authors concluded it was feasible to reintroduce river otters to South Dakota and recommended reintroduction into the top 5 rated waterways, including the Bad River, Big Sioux River, James River, Little White River, and North Fork of the Whetstone River (Figure 3).
With these conclusions in mind, I not only assessed the top 5 rated waterways, but 11 of the 12 remaining streams originally evaluated by Kiesow and Dieter (2005) to identify suitable otter release sites in each of the 4 SDGFP Wildlife Division Administrative Regions. During the evaluation, I considered such stream characteristics as varying water depths and stream velocity, stream meanders, availability of suitable bank cover (trees, shrubs, forbs, and tall grasses), the presence of bank and in-stream structures (e.g., trees that have toppled into the water), and the presence of current and past beaver activity. I also considered the presence of tributaries with suitable habitat and proximity to marshes, ponds, and lakes.

Radio Telemetry

Radio telemetry has been a useful tool to assist in studying river otters since intraperitoneal implants were first used in the 1970's (Melquist and Hornocker 1983). I coordinated with SDGFP staff in an effort to capture, instrument and release ≤5, live-trapped South Dakota river otters into 1 or more streams I considered currently unoccupied, but with suitable river otter habitat. An acceptable release site should have suitable riparian habitat, sufficient (permanent) water, available prey species, evidence of past and/or current beaver activity, and suitable banks where old and active beaver bank dens can provide adequate resting sites for otters, especially where the waterways are ice-covered in winter.

I used guidelines previously drafted and submitted to SDGFP for moving otters associated with depredation complaints (Appendix 2) to determine suitable candidates for translocation. We used Hancock live-traps and foot-hold traps designed to minimize damage to the animal's foot in our trapping effort. Because private trappers are required to release, if possible, any live-trapped otter, SDGFP personnel coordinated with trappers in the event an otter was captured while trapping for other furbearers. Live-trapped otters were delivered in transport cages/tubes to the Great Plains Zoo in Sioux Falls for holding prior to surgery to implant transmitters. Implant transmitters were purchased from Advanced Telemetry Systems, Isanti, MN, and the surgical procedures were similar to those described by Hernandez-Divers et al. (2001). Following surgery, the otters had Passive Integrated Transponder (PIT) tags inserted under the skin at the base of their tail, and received numbered metal ear and web tags.
After a recovery and holding period, instrumented animals were transported to the designated release location for release. Efforts were made to maintain daily contact with each animal at

least until they settled on a home area, and to identify habitats used, foraging behavior and prey selection, and other features associated with otters released in an unfamiliar environment.

Evaluation of the Need to Reintroduce Otters

The River Otter Management Plan (SDGFP 2012) outlines a variety of information that will be used in a final determination of whether or not to proceed with future river otter restoration efforts in South Dakota. I used the following information in developing recommendations regarding future otter restoration:

1. Current distribution of otters in South Dakota and how it has changed over time.
2. Changes in the number and distribution of otters incidentally captured each year and the sex and age distribution of these animals.
3. Distribution of suitable habitat in South Dakota and whether or not vacant habitat can be populated naturally or will require a reintroduction.
4. Data collected from instrumented otters, including habitat use, movements, and rest-site selection.
5. Current harvest regulations for semi-aquatic furbearers, especially beaver.
6. Land-use practices as they relate to riparian habitat, water quality, and suitability for river otters.

RESULTS

Ground Surveys

Between 2011 and 2013, I visited >300 bridge crossings along 16 of the 17 waterways identified by Kiesow and Dieter (2003) in their initial assessment of river otters in South Dakota (Table 1, Figure 4). The only stream of the 17 waterways I did not visit was Virgin Creek, a short drainage entering into the Moreau River where it is influenced by Lake Oahe. In 2012 and 2013, I focused bridge sign surveys primarily on the 9 streams where no otters had been reported during 2007-2011. However, many of the same bridge crossings were visited multiple times between 2011 and 2013.

During September and October 2012 and 2013, I completed 13 walking survey routes on 17.7 km of stream and 3 float surveys over 117.5 km for a total of 135.2 km (Table 2, Figure 5). SDGFP biologist Silka Kempema accompanied me on 2 of the 3 floats. Neither bridge sign surveys nor survey routes walked or floated revealed the presence of otters on the 9 rivers that were surveyed for occupancy. I also walked the banks at numerous locations on the Little White River while monitoring the 2 instrumented river otters.

Aerial Surveys

Aerial surveys of multiple streams were conducted on 6-8 March 2013. All flights originated at the airport in Pierre, South Dakota. A State of South Dakota single-engine Cessna 172 Skyhawk, piloted by State Pilot Doug Jones, was used on all flights. Details of the aerial surveys are described below.

Flight date: 6 March 2013
Flight time: Approximately 4 hours and 15 minutes.
Conditions: Mostly cloudy with no snow cover throughout the survey route.
Observers: Wayne Melquist and Nathan Baker (Region 2 Wildlife Manager, SDGFP).
Streams surveyed: Little White River from its headwaters, the White River (downstream from the confluence with the Little White River), the entire length of the Bad River, Medicine Creek from Presho to Lake Sharpe, and Lake Sharpe to near Pierre.
Flight route: From Pierre, we flew up the Bad River to southwest of Philip, then headed south to the headwaters of the Little White River, continuing down the river to the confluence with the White River. From there we flew down the White River to the confluence with the Missouri River, then headed northwest to Presho and followed Medicine Creek to where it enters Lake Sharpe. Finally, we followed Lake Sharpe upstream and back to the airport in Pierre.

Observations: We did not detect any sign of otters.

Flight date: 7 March 2013
Flight time: Approximately 5 hours and 46 minutes.
Conditions: Cloudy and partly cloudy with no snow cover.
Observers: Wayne Melquist and Heather Berg (GIS Analyst, SDGFP).
Streams surveyed: Cheyenne River, Belle Fourche River, Redwater River, and Spearfish Creek.
Flight route: Our route took us up Lake Oahe to the mouth of the Cheyenne River. We then flew up the Cheyenne River to Angostura Reservoir. From there we flew over the Black Hills, landing and refueling at the Black Hills Airport, east of Spearfish. We flew over Spearfish Creek from Spearfish to the confluence with the Redwater River. From there we flew up the Redwater River to the foothills near the South Dakota/Wyoming border. We returned down the Redwater River to the confluence with the Belle Fourche River and continued up the Belle Fourche River into Wyoming before turning around. We then followed the Belle Fourche River downstream to the Cheyenne River, continuing down the Cheyenne River and back to Pierre.
Observations: We did not detect any sign of otters.

Flight date: 8 March 2013
Flight time: Approximately 3 hours and 32 minutes; does not include taxi time between the Pierre and Tea airports (approximately 1 hour and 45 minutes each way).
Conditions: Cloudy and partly cloudy; dense ground fog early between Pierre and Tea. The East and West Forks of the Vermillion River were mostly covered with ice and snow. Ice and snow cover rapidly disappeared downstream from the confluence of the East and West Forks. The West Fork did not appear to have any standing or moving water. The Missouri River was free of ice and snow with extensive sandbars resulting from past flooding. The Big Sioux River had patchy ice and snow cover, primarily where there was little water movement.
Observers: Wayne Melquist and Ron Schauer (Region 3 Wildlife Manager, SDGFP).
Streams surveyed: East and West Fork and main Vermillion River, the Missouri River between the mouth of the Vermillion River and the mouth of the Big Sioux River, and the Big Sioux River from its mouth to just south of Sioux Falls.
Flight route: We flew from Pierre to Tea, where we picked up Schauer. From there we flew up the West Fork of the Vermillion River. By the time we got to Howard, the stream bed was barely evident. From the West Fork, we flew northeast to Lake Thompson, the headwaters of the East Fork Vermillion River, and proceeded down the East Fork past the confluence of the East and West Forks to the mouth of the Vermillion River. We then flew down the Missouri River to the mouth of the Big Sioux River, followed the river upstream to the Lake Alvin Recreation Area east of Harrisburg, and headed west to Tea.

Observations: The lower section of the West Fork had water/ice mostly contiguous up to near Salem, although there was no evidence of moving water. Lake Thompson was frozen over, except for a small open area where water flows under a bridge on 218 Street, which spans the lower portion of the reservoir. Approximately 4 miles north of Winfred (Lake County), we spotted otter tracks (N44.0612°, W97.3575°) on the frozen surface of the East Fork. Being familiar with this area, Schauer suggested we fly just east and south of the tracks to some privately owned ponds created by damming a tributary of the river. We spotted an otter on the ice at the west pond (N44.048°, W97.3337°) at 0951 h. The animal entered the water as we flew over. Both ponds have areas free of ice because they are being aerated. After receiving authorization from the owner to visit the site, I returned to the area the following day and observed 2 otters at the same location on the west pond. There was an abundance of sign (tracks and scats) at both ponds, which were stocked with fish, suggesting the animals had been there for an extended period of time. In all likelihood, the otters remained there because there was abundant prey and open water for access. I visited this site again on 17 March 2014, and discovered fresh sign (scats) of otter use. In August 2014, SDGFP received complaints from the landowner of the ponds that otters were cleaning out his stocked fish. Trail cameras documented 3 otters at the ponds (Julie DeJong, SDGFP, pers. commun.). The otters subsequently left, but soon returned. A decision was made to live trap and move the otters. In November, 2 adult-sized otters were live-trapped and released in the James River at a site previously identified as suitable for releasing conflict otters. Unfortunately, as long as otters occupy this stretch of the East Fork Vermillion River, they will likely continue to exploit stocked fish in these ponds.

On our flight north up the Big Sioux River, we observed tracks of a single otter on the ice approximately 3 km southwest of Akron, IA, and just east of Lake Nixon, Union County (N42.8112°, W96.5952°). Farther upstream on the Big Sioux River, we again observed tracks of a single otter on the snow-covered ice approximately 3 km west of Fairview in Lincoln County and east of Newton Hills State Park (N42.226°, W96.5319°); there was an adjacent feedlot on the Iowa side of the river.

Assessment of Individual Streams

The following comments on each of the 14 rivers and 3 creeks surveyed by Kiesow and Dieter (2003) are based on observations made while conducting aerial and ground surveys in 2011, 2012, and 2013. Suitable river otter habitat can vary widely, and the "best" habitat in one area may be far from the best habitat in another portion of the otter's range. While the best otter habitat is not found in South Dakota, suitable habitat clearly exists. Kiesow and Dieter (2005) believed that all 17 streams surveyed had sufficient prey for otters.

It is important to note that 2011 was a year of exceptional flooding and prolonged high water. Conversely, 2012 and 2013 were much drier years, resulting in lower flow rates for most waterways. Dramatic moisture differences between years are an example of how single-year surveys can be misleading. The flooding conditions that existed during 2011 on the James River seemed the most profound, largely because of the topography, which included numerous stretches of wide and flat floodplains.

Bad River

The North and South Forks of the Bad River join together on the west edge of Philip, SD, and the river continues northeast to the confluence with the Missouri River on the south edge of Ft. Pierre. It is a river typified by many meanders with generally good riparian habitat, where mature cottonwoods lining the steep banks are interspersed with agricultural fields and areas of cattle grazing. The stream is shallow for much of its length, except for where it is influenced by Lake Sharpe on the Missouri River.

Bridge surveys were conducted in 2011 and bridge and walking surveys were completed in 2012 between Philip and Fort Pierre (Tables 1 and 2). The river was dry upstream from Philip in 2011, but faintly flowing farther downstream. During the 2012 survey, the river was not flowing and only periodic pools of water existed. In 2011, several unidentified live fish (45-60 cm) were observed stranded in an old oxbow of the river. In 2012, dead and dying fish, primarily common carp (*Cyprinus carpio*) and catfish (*Ictalurus* spp.) were found at several isolated ponds in the drying up streambed. Local residents confirmed that the river typically stops flowing during autumn. Beaver (*Castor canadensis*) sign (small dams, cuttings, tracks) was observed in 2011 and 2012.

Suitability for otters:

The Bad River received the highest overall rating for otter suitability among the major river systems in South Dakota (Kiesow and Dieter 2005). However, during most years the streambed becomes a series of isolated pools by autumn, and during winter these ponds freeze shut, becoming inaccessible to otters. At that time, the only stretch of continuous water is a short section where the Bad River is influenced by Lake Sharpe. Therefore, the Bad River can only be considered seasonal habitat for otters. During autumn and winter, when fish have been extirpated from the pools farther upstream, otters would be confined to the lower stretch of the Bad River where there is permanent water and the Missouri River and Lake Sharpe. In

spring, when the river has sufficient flowing water, fish likely move upstream, once again making it suitable for otters.

Big Sioux River

The Big Sioux River begins as a network of intermittent streams south of Hwy 12 and west of Summit, SD, flows south through Sioux Falls, SD, and then becomes the border with Iowa before emptying into the Missouri River at the border with Iowa and Nebraska. Numerous tributaries link lakes and ponds to the Big Sioux River from the headwaters to the confluence with the Missouri River, thus expanding the amount of habitat available to otters.

I checked the Big Sioux River at 26 locations between Hwy 12 at Summit, SD, and Hwy 14 west of Brookings, SD. The River is slow and meandering throughout this section. Human impacts are readily evident in this stretch of the river, which flows through the metropolitan area of Watertown, SD. Intensive grazing has left many of the banks eroded and exposed, with little riparian habitat. Open grasslands appear to dominate the Big Sioux in this stretch.

Eleven bridge crossing were checked between Brookings, SD, and just south of Sioux Falls, SD, where the Big Sioux forms the border of Iowa and South Dakota. The River remains slow and meandering, and gets progressively wider. While there continues to be evidence of cattle grazing, the habitat for otters appears better in this stretch with more trees and shrubs along the banks.

I also checked several tributaries in this stretch that looked suitable to allow for expanded use and potential dispersal by otters. I checked Silver Creek (slow moving and looks stagnant) and Slip Up Creek (slow moving); both streams are just north of Sioux Falls. Pipestone Creek is an extensive drainage that originates north of Pipestone, MN. Pipestone Creek joins Split Rock Creek on the Minnesota side of the border and eventually empties into the Big Sioux a short distance east of Sioux Falls. I checked 7 crossings on these 2 creeks; the habitat at most locations looked reasonable for otters, but intensive grazing was also evident. Two sites I checked along West Pipestone Creek provided an example of this. On the downstream side of the road there was no grazing; the banks were more stable, and robust grasses and forbs grew to the water's edge. On the upstream side of the road, grazing was heavy, grasses were cropped, giving the banks the appearance of a manicured lawn, and the banks were eroding. Skunk Creek (3 locations checked) is a fairly extensive stream that originates at Brant Lake, southeast of Madison, SD, and flows through Sioux Falls, where it empties into the Big Sioux River. I also checked 1 location on Spring Creek, which drains into Skunk Creek prior to entering

Sioux Falls. These streams add to the overall potential available habitat for otters in the Big Sioux River drainage.

In April 2012, while following up on a reported otter sighting and den south of Elk Point, SD, I checked the Big Sioux River just north of Sioux City, IA, and Brule Creek near where it enters the Big Sioux. I had also visited several crossings along Brule Creek from east of Beresford, SD, to near Spink, SD, in 2011. There was evidence of beaver activity along this entire stretch of Brule Creek, and the stream, like numerous other tributaries of the Big Sioux, is potential or existing habitat for otters.

Suitability for otters:

The Big Sioux River was rated the second most suitable for river otters in South Dakota. There is no question that at least portions of the Big Sioux River are suitable for river otters, as there appears to be a stable, if not increasing population. Less understood is the role of tributaries in expanding the distribution, carrying capacity, and potential dispersal of otters from the core area on the Big Sioux River where otters were successfully released by the Flandreau Santee Sioux Tribe in 1998 and 2000 (Hansen 1998, Raesly 2001).

Missouri River

The Missouri River, with its 4 major dams in South Dakota, has a profound influence as it cuts through the State, dividing it into 2 regions commonly referred to as "East River" and "West River." Some other differences appear to exist. The East River region has generally better (finer) soils and more moisture than West River, a higher percentage of agricultural crops, and the finer soils result in less stream-bank erosion (Westin and Malo 1978).

The first of the 4 dams on the Missouri River created Lake Oahe, the largest reservoir in South Dakota, extending from near the middle of the State at Pierre, SD, to the North Dakota border. It is also the reservoir most likely to challenge the movements of otters. As is typical of reservoirs, drawdowns result in exposed banks with little or no cover for otters. In Idaho, otters tended to avoid reservoirs, used them sparingly, or used them under the cover of darkness (Melquist and Hornocker 1983). I suspect this is because there is generally no escape cover, especially if the shoreline of the reservoir is flat, giving them a sense of vulnerability to boaters or other threats. The ability of otters to negotiate Lake Oahe is further challenged once the reservoir freezes over. There are several small streams that drain into Lake Oahe. If these tributaries had enough suitable year-round habitat otters could possibly live in those parts of

the reservoir, provided they are able to tolerate heavy boating activity that occurs on Lake Oahe.

Lake Sharpe is the next reservoir downstream from Lake Oahe and is also the next largest. A stretch of 20-25 km from Oahe Dam, downstream to the Farm Island area appears to remain partially open during winter. This stretch, which includes the mouth of the Bad River, could provide winter habitat for otters. The remainder of Lake Sharpe looks less suitable for otters, especially when drawdown occurs and banks are exposed, and during winter. Medicine Creek, rated number 13 by Kiesow and Dieter (2005), drains into this section of Lake Sharpe. Provided there is sufficient water in the lower stretch of the creek during autumn and winter, it could be important to potential resident otters.

Lake Francis Case between the dams at Ft. Thompson and Pickstown, SD, looks progressively better than the upstream reservoirs for otters, although questionable as year-round habitat. The White River, rated last at number 17, drains into the Missouri downstream from Chamberlain. However, I don't believe it adds anything to the suitability of Lake Francis Case for otters. Several small creeks empty into the reservoir downstream from Hwy 44, but their value to otters is unknown. Lake Francis Case, like Lake Sharpe, is big water that becomes less suitable for otters when drawdown occurs and banks are exposed, and during winter when it is frozen over.

The Missouri River below the Fort Randall Dam at Pickstown, SD, downstream to the Springfield, SD, area has noticeably flowing water and riverine characteristics. This free-flowing stretch of the Missouri River appears suitable for otters. There are 2 creeks and most notably the Niobrara River that enter the Missouri River along this stretch. In April 2012, I visited an individual at his home overlooking the Missouri River at Springfield. On 31 December 2011, based on his description, he probably observed 4 otters, likely a family group, in the braided section of the river below his home. According to this individual, prior to the 2011 flood, this braided section of the river was full of cattails (*Typha latifolia*) . Today, these islands of cattails have disappeared, replaced by sand flushed downstream as a result of the flooding. His observation was approximately 15 km downstream from the mouth of the Niobrara River, and the Niobrara River was 1 of the streams where otters were released by the Nebraska Game and Parks Commission between 1986 and 1991 (Bischof 2003). On 9 November 2013, a Nebraska Game and Parks Commission Conservation Officer released an otter from a trap on the Nebraska side of the Missouri River across from Springfield, SD (Sam Wilson, Nebraska Game and Parks Commission, pers. commun.). The release location is approximately 1-2 km from where the reported 4 otters were observed.

Lewis and Clark Lake is the impoundment below Springfield down to the Gavins Point Dam. Similar to the upstream lakes/reservoirs, fluctuating water levels leave the banks exposed, and the lake itself would serve primarily as a travel corridor for otters.

The Missouri River below Gavins Point Dam near Yankton, SD is considerably different from much of the impounded waters upstream to the North Dakota border. There is in-stream structure, islands, and good riparian habitat that should make this stretch attractive and suitable for river otters.

Suitability for otters:

The Missouri River was rated the 3rd most suitable for river otters in South Dakota, but was excluded for consideration as a possible release site because of its extreme size, status as a major river drainage, and existing impoundments that make linear movements difficult (Kiesow 2003). However, the design and layout of the dams found on the Missouri River in South Dakota should not be a barrier to otter movement and dispersal. I visited each of the dam sites and the earthen nature of the dams would facilitate movement by otters over all of them. All of the major West River streams drain into the Missouri River, as do numerous small streams. Due to their intermittent nature, these small steams don't provide year-round habitat for otters, but collectively, they could be an important seasonal component, allowing otters to live in portions of the large reservoirs of the Missouri River. The Big Sioux, Vermillion, and James Rivers all drain into a stretch of good otter habitat on the Missouri River, creating an interconnected network for otters in these drainages. The Missouri River can also serve as a corridor, allowing otters to disperse from occupied habitat in adjoining States to unoccupied habitat in South Dakota.

James River

The James River and North Fork Whetstone River had the same overall rating for otter suitability, although they have very different stream characteristics. The James River extends the entire length of South Dakota from the North Dakota border near Hecla, SD, to the Nebraska border near Yankton, SD. Agricultural activities (cattle grazing and crop production) are prevalent throughout most of the James River, although the upper reaches that include Sand Lake National Wildlife Refuge (Sand Lake NWR) are far less impacted by such activities. The stretch from the North Dakota border downstream to near Stratford, SD, appeared to have the best habitat for otters. In this stretch, 2 reservoirs comprise much of the Sand Lake NWR, and Elm River (including Maple River) drains into the James River near Columbia, SD, with Moccasin Creek entering the river north of Stratford, SD. I checked several crossings of these

tributaries and the Elm and Maple Rivers looked better for otters than Moccasin Creek. Both beaver and their sign were observed at several locations on the James River. Mink (*Neovison vison*) sign was found on Elm River, including the head of a small bullhead (*Ameiurus* spp.), frog (Rana spp.) parts, and scats. Raccoon (*Procyon lotor*) sign was ubiquitous, with crayfish (*Cambarus* spp.) remains in several scats at latrine sites along the James River.

I checked 8 river crossings in the section of the James between Stratford, SD and Huron, SD, and multiple sites on several of its tributaries, including Mud Creek, Dry Run, and Turtle Creek. Tributaries that I did not check include Timber Creek, Foster Creek, and Shue Creek. This section of the James is wide, slow moving, and due to the persistent flooding in 2011, looked like a lake or reservoir in many places.

I visited 12 crossings on the stretch of the James from Huron, SD to its mouth at the Missouri River. The river in this stretch is much the same—wide, meandering through a wider bottomland (flood plain), open, and slow moving. Most of the bottomlands below Mitchell, SD, have been converted to crop production, leaving only small strips of mature deciduous trees along either side of the river at scattered locations. Some stretches are largely void of riparian vegetation.

<u>Suitability for otters</u>:

The James River was rated 4th among the 17 waterways evaluated. It was difficult to assess the suitability of most of the James River and tributaries in 2011 because so much of the area remained flooded during the time I was there. Conversely, conditions were dramatically different when I visited some of the same sites in 2012 and 2013, especially at upstream locations. In October 2011, the James River at the south end of Columbia, SD, was flooded beyond its banks. At the same location in October 2012, the riverbed had only standing pools of green-colored water. I can't be certain, but the lack of flowing water may have been due to water retention at Sand Lake NWR. Nonetheless, the impacts of drought conditions need to be taken into account when considering the distribution and carrying capacity of streams for river otters.

My general impression is that the upper portion of the James River, along with Elm River, a major tributary, is better otter habitat than the area downstream from Stratford, SD. In 2013, I found otter scats at 2 bridge crossings north of Stratford, and confirmed sightings of otters were made in 2014 southeast of Columbia and on Sand Lake NWR. Riparian habitat along the James River south of Stratford to the confluence with the Missouri River near Yankton, SD, has been widely impacted by agricultural activities. In spite of this, tributaries and adjacent

wetlands scattered along this stretch of the James River should collectively make the river suitable for otters to persist.

North Fork Whetstone River

The North Fork Whetstone River drains into the Minnesota River near Big Stone City, SD. The river was rated 4th along with the James River for otter suitability. However, unlike the James River, this river is small in size (generally <8 m wide) and has consistently clear, flowing water. Riparian habitat consisting of trees, shrubs, forbs, and grasses are protected and intact along the majority of the river. Trees provide a source of in-stream structure, enhancing the overall quality of the river for otters. Both forks of the Whetstone River originate in the Coteau des Prairies (prairie pothole) region, an elevated plateau that extends in a southeasterly direction that divides the Big Sioux River drainage from streams that are part of the Minnesota River drainage. Small lakes and ponds scattered throughout the prairie pothole region are used by otters from the North Fork Whetstone River and other streams on the east side, and may be used by otters from the Big Sioux River drainage.

The South Fork Whetstone River has good riparian habitat and in-stream structure at numerous locations. There was beaver activity, including dams, in at least 2 locations that I checked. Otter scats, visual observations, and trail camera pictures revealed the presence of otters, including a family group, at different locations on the South Fork Whetstone River drainage.

Suitability for otters:

In my view, the North Fork Whetstone River deserves a high suitability ranking for otters, and a resident population clearly exists there. However, the South Fork is probably just as important for otters, and they should be considered collectively in terms of sustaining an otter population.

Little White River

The Little White River originates from springs in the Nebraska Sand Hills near Batesland, SD, and the Nebraska border. From the headwaters down to Highway 73 south of Martin, SD, the river is narrow (<2 m wide), meanders through open agricultural land, and does not appear very suitable for otters. There are few stretches of suitable otter habitat between Highway 73 downstream to the Little White River Recreation Area (Recreation Area) and adjacent Lacreek National Wildlife Refuge (Lacreek Refuge). Unfortunately, heavy grazing throughout this section has greatly degraded or destroyed most of the riparian habitat. There are 2 exceptions to this, however. Cattle appear to have been totally restricted, for multiple years, in a short

stretch (approximately 0.8 km) upstream from 227 Avenue, and grazing pressure has been lighter in the stretch from 227 Avenue downstream to the Recreation Area than most areas where cattle are allowed to graze unrestricted. The resulting richness of the riparian area, especially in the stretch where cattle have been totally restricted, is testament to the potential for good otter habitat along many stretches of the river.

Lake Creek, which supplies the majority of the water to the Lacreek Refuge, Cedar Creek, and Spring Creek are all spring-fed tributaries of the Little White River, and along with other less prominent springs, contribute to the perennial flow. However, Lake Creek below the last small dam on the Refuge west of Tuthill, SD, was flowing in autumn 2011, but dry when I checked it on 28 September 2012. A small dam on the Little White River created a reservoir that is the dominant part the Recreation Area. The Recreation Area is adjacent to and immediately north of the Lacreek Refuge, is connected to the refuge by a canal with intermittent water flow, and is managed by the Lacreek Refuge staff. The Lacreek Refuge consists of a complex of channels, borrow canals, and pools created by a series of control dams. Marsh vegetation dominates with limited areas of trees and shrubs. With a diversity of potential prey, the Refuge should be potential otter habitat. Even though the Lacreek Refuge and Recreation Area looked suitable for otters, a Lacreek Refuge biologist stationed there for the past 19 years had never received reports of otters.

The Little White River from the Recreation Area downstream to where it begins dropping into a canyon is small (<4 m wide), slow-moving, and open with widespread cattle grazing throughout the riparian zone. The river starts dropping into a canyon southwest of Harrington where scattered juniper trees become evident. Cedar Creek enters the Little White River in a canyon at the western border of the Rosebud Reservation. Riparian habitat that includes large deciduous trees and shrubs with hillsides dominated by pine trees becomes more favorable as the river meanders down through Crazy Horse Canyon in the Rosebud Reservation. Cattle grazing is more restricted throughout most of Crazy Horse Canyon. Spring Creek empties into the Little White River southwest of St. Francis in the Rosebud Reservation. The headwaters of Spring Creek almost link with the headwaters of Minnechaduza Creek, a tributary of the Niobrara River, located in Nebraska. The area where these 2 creeks originate consists of small ponds, a small reservoir on Spring Creek, and intermittent wet meadows. Because the topography is so flat, it is difficult to distinguish the actual origin of each creek. I believe otters could potentially cross from the Niobrara River to the Little White River at this location. Otters were previously released in the Niobrara River by the Nebraska Game and Parks Commission between 1986 and 1991, as part of a statewide effort to restore the species in the state (Bischof 2003).

Large cottonwood trees dominate the riparian habitat as the river leaves Crazy Horse Canyon northwest of Rosebud down to the confluence with the White River near Westover, SD, south of Murdo, SD. However, cattle grazing is more widespread once again. By the time the river approaches the main White River, it is approximately 16-50 m wide, shallow, and with suspended particles more evident than farther upstream.

Flow rates through the canyon and water clarity were good when I surveyed the canyon in 2011 and 2012. However, in 2012, there seemed to be more silting, with sand covering the river bed and making the river shallow in many locations. How this could affect fish and other prey is unknown.

By the time the river reaches the main White River area it is up to 16 m wide and shallow, with increased turbidity. The river is 30-50 m wide and shallow near where it empties into the White River south of Murdo, SD. The "milky" appearance of the main White River, resulting from suspended clay particles, was not evident on the Little White River. While suspended particles reduced visibility near the mouth of the Little White River and were evident throughout the entire length of the stream, water clarity was better farther upstream.

Suitability for otters:

The Little White River was rated 5th and considered suitable for reintroducing otters. The Little White River has stretches with suitable riparian habitat interspersed with stretches where heavy grazing has resulted in bank erosion, silting, and generally poor riparian habitat. In my estimation, the best otter habitat includes the Lacreek Refuge, the Recreation Area upstream to just above 227 Avenue, and the stretch of river that flows through Crazy Horse Canyon in the Rosebud Reservation where there is good riparian habitat, islands, and in-stream structure (e.g., logjams). Riparian habitat and river characteristics in the stretch below Crazy Horse Canyon to the confluence with the White River do not appear as good, but I believe this stretch could sustain otters.

The White River may be a potential barrier to any possible natural colonization/recolonization of otters to the Little White River. Conversely, otters could potentially disperse from the Niobrara River via Minnechaduza Creek and Spring Creek into the Little White River. The most reasonable way to establish otters on the Little White River is through a continued translocation effort.

Vermillion River

The Vermillion River flows south between the Big Sioux and James Rivers, emptying into the Missouri River in southeast South Dakota. There is a mixture of lakes, reservoirs, marshes, and small tributaries associated with the Vermillion River drainage. Thompson Lake is at the headwaters of the East Fork Vermillion River. Downstream from the lake to Montrose, SD, the river flows through marsh habitat at several locations and is not well defined. Farther downstream is East Vermillion Lake, a reservoir created by damming the East Fork. Some stretches of the river have been adversely impacted by livestock grazing and agricultural crops, while other sections appear more suitable for otters with good riparian habitat and some in-stream structure.

I surveyed 26 bridge crossing on the main Vermillion River, 16 crossings on the East Fork, and 5 on the West Fork during autumn 2012 (Table 1). I also surveyed 0.5 km (combined) above and below the dam at East Vermillion Lake. Flow downstream from East Vermillion Lake was greatly reduced by the dam, resulting in the concentration of fish in pools below the dam. The flow and volume of water in the river upstream from Vermillion, SD, was lower than when I surveyed the river in November 2011. Nonetheless, there appears to be sufficient water for fish survival and, in spite of habitat loss due to livestock grazing and agricultural crops, the diversity of habitat associated with the river is sufficient and should make the drainage attractive to otters.

The West Fork was not flowing in September 2012, when the surveys were conducted, resulting in intermittent pools of standing water. Stranded fish would eventually be eaten or die. With little water in the stream bed, the West Fork probably freezes up during most winters, making it unattractive and inaccessible to otters. Under this scenario, the West Fork is, at best, seasonal habitat for otters.

There are few trees and shrubs along the East Fork upstream from the confluence with the West Fork. Trees, shrubs, and periodic in-stream structure become more evident along the Vermillion River in the Davis, SD, area south of where the East and West Forks join. There are progressively more trees and generally better riparian habitat downstream from Davis. Otter habitat appears increasingly better along the Vermillion River from the Davis area to the confluence with the Missouri River.

Suitability for otters:

The documentation of otters in the East Fork of the Vermillion River in 2013 and 2014 leaves little doubt that otters can live in this drainage. However, because winter conditions affect suitability and access on the East and West Forks, the year-round distribution and potential density of otters in this drainage remain questionable. For example, with little or no flowing water in winter, any otter movement would be primarily over the ice. Such movement would make otters vulnerable because they wouldn't be able to escape to water or under the ice. When we flew our aerial survey in March 2013, there were snowmobile tracks on the upper sections of both the East and West Forks. The frozen streams served as a "snowmobile highway" because most of the snow was gone from the adjacent fields. The river didn't begin to open up until we were below the confluence of the East and West Forks near Parker, SD.

Tributaries of the Vermillion River likely add to the overall distribution of habitat that could be exploited by otters. The proximity of lakes, ponds, and marshes add to the value of the drainage as otter habitat. The Vermillion River drains into the Missouri River between the Big Sioux and James Rivers. This stretch of the Missouri is as good as any stretch of the Missouri River in South Dakota for otter habitat, and would provide connectivity among the drainages.

Cheyenne River

The Cheyenne River originates in Wyoming and, along with its many tributaries, this extensive drainage system flows through a variety of habitats by the time it empties into the Missouri River in the central part of the State. The largest tributary of the Cheyenne River is the Belle Fourche River. There are numerous small tributaries that originate in the Black Hills, including Rapid Creek, Spring Creek, Battle Creek, Beaver Creek, French Creek, and Fall River; all are subjected to a variety of anthropogenic impacts. Few stretches of these streams appear adequately protected and are either exposed to agricultural activities (grazing or crop production) or urban and rural development. Several of these spring-fed streams only flow short distances and would likely have only limited use by otters. For these streams, their greatest contribution may be the reliable flow of water into the Cheyenne River, but they would also provide seasonal otter habitat.

I visited 7 bridge crossings, walked 4 stream segments for 6.6 km, and floated 17.7 km and 77.3 km stretches of the Cheyenne River during September and October 2012 and 2013 (Table 2, Figure 5). In autumn 2012, the Cheyenne River at Edgemont, SD, was not flowing and had little water in the stream bed. And while there appears to be suitable habitat from Angostura Reservoir upstream to the vicinity of Highway 71, if it wasn't for water coming from Cascade

Falls, a spring that originates in the Black Hills just upstream from Highway 71, there would not be sufficient water to sustain both fish and otters during periods of low water and drought.

The best otter habitat on the Cheyenne River is from Angostura Reservoir downstream to the mouth of Rapid Creek. This stretch includes most of the tributaries originating in the Black Hills, the first of which is Fall River, a clear, cold mountain stream that originates in the Hot Springs, SD, area. On 1-3 October 2013, Silka Kempema and I floated approximately 77.3 km of this stretch of the Cheyenne River from below Hwy 18/385 southeast of Hot Springs, to Hwy 40 at Redshirt, SD. The banks along this stretch were frequently lined with a combination of trees, shrubs, forbs, grasses, and even cattails (*Typha latifolia*) and bulrush (*Scirpus* spp.). Several hillsides were covered with large trees, shrubs, grasses, and forbs, and had seeps coming from them. These places would be ideal natal den sites. We periodically found evidence of beaver along the river and saw numerous fish, including what appeared to be common carp and smallmouth bass (*Micropterus dolomieu*). Smallmouth bass are 1 of 3 fish species found to be dominant in this section of the Cheyenne River (Hoagstrom et al. 2007a, 2007b). Stretches of good riparian habitat were interspersed with open grasslands that were often overgrazed by livestock, which appeared to have total access to the river throughout most of the stretch we floated. The water was reasonably clear, shallow, and there were many rocky riffles that required us to walk the kayaks over. Dwellings were sparse and there were none close to the river. We often floated long distances without seeing any buildings, and there were only 2 road bridges and a railroad bridge in this entire section of the river. Collectively, these features and conditions should provide the necessary life requirements of river otters and be attractive to the animals.

Spring Creek downstream from the dam at Sheridan Lake was dry during my visit in autumn 2012; in November 2011 it was flowing. Battle Creek had good flowing water and good riparian habitat at 3 locations visited in 2011 and 2012, in spite of the presence of cattle grazing.

The Cheyenne River at the Hwy 44 bridge, <1 km upstream from the mouth of Rapid Creek, was visited numerous times and was the starting point of a 17.7 km float completed on 8 October 2012 (Figure 5). The river from here to Wasta, SD., was wide, shallow, and clear. Riparian vegetation was sparse and consisted mostly of grasses and forbs with patches of willows (*Salix* spp.). The banks were generally low and unstable.

During our 7 March 2013 flight, the Cheyenne River was muddy and mostly ice-free, except for some ice jams. The water started clearing up in the area where Rapid Creek and Spring Creek entered the Cheyenne River. Water clarity and flow and riparian habitat, although somewhat patchy, appeared good. The water got progressively clearer as we continued upstream.

The stretch downstream from the mouth of Rapid Creek to Lake Oahe appears less suitable for otters. The river was muddy when we flew on 7 March, shallow, braided, and had little suitable riparian habitat adjacent to where water actually flowed. Cherry Creek and Little Cottonwood Creek, both in the Cheyenne River Reservation, do provide some suitable habitat in the lower reaches of the Cheyenne River. Cherry Creek is an extensive tributary that empties into the Cheyenne River approximately 40 km upstream from Hwy 63 near Cherry Creek, SD. I checked the creek at Hwy 73, south of Faith, SD. At this location, the stream was 5-7 m wide, the water was reasonably clear, and in spite of cattle grazing in the area, riparian habitat was fair. A heron rookery of approximately 12 nests in cottonwoods on the upstream side of the highway would be a good indicator that the stream has fish.

Suitability for otters:

The Cheyenne River was rated 8th among the 17 streams evaluated for otter suitability. It is an extensive drainage system with many tributaries, most of which originate in the Black Hills. These tributaries likely contribute substantially to the overall quality of the water in the Cheyenne River and to its diversity and suitability for otters. Sheridan Lake, located in the Black Hills, was created by damming Spring Creek, a stream with similar characteristics to Rapid Creek. The major difference is that Spring Creek stops flowing during dry years as water is held back by the dam creating Sheridan Lake. Sheridan Lake and Spring Creek both look like they should provide good habitat for otters, provided there is sufficient water in Spring Creek.

The best otter habitat includes a short stretch of the Cheyenne River upstream from Angostura Reservoir and the section of the river from the dam at Angostura Reservoir downstream to the vicinity of the mouth of Rapid Creek. Angostura Reservoir, like most reservoirs, has exposed banks with no riparian habitat during most of the year and boating activity would likely discourage its use by otters. The Cheyenne River downstream from the mouth of Rapid Creek to Lake Oahe provides marginal habitat for otters, but could certainly be used by resident and dispersing otters. A reintroduction would likely be necessary to establish a resident and breeding otter population on the Cheyenne River.

Jorgenson River

Big Coulee Creek originates in the prairie potholes and along with several other intermittent streams draining from the plateau forms the Jorgenson River. The river flows approximately 15 km (straight-line) north before entering the Little Minnesota River. Big Coulee Creek was flowing and had good riparian habitat at the bridge crossing I visited in September 2013. The 3

bridge crossings I visited on the Jorgenson River had protected sections with tall grasses, shrubs, and trees bordering the stream, creating good otter habitat; stretches dominated by grasses and agricultural fields coming within 3 m of the water; and areas where cattle moved freely in the stream and along the banks. One bridge crossing provided an example of some stark differences in habitat based on land-use practices. On 1 side of the road where cattle had grazed over a long period of time, the understory consisted of grasses groomed to the ground, no shrubs, and trees scattered throughout the bottomland. On the other side of the road, it appeared that cattle did not have access to the stream, resulting in robust grasses, shrubs, and trees lining the banks. Fortunately, because the sections heavily impacted by cattle and crops are interspersed with sections of the stream with intentional or de facto protection, this stream should still be attractive to otters, provided there are sufficient forage species available.

Suitability for otters:

The Jorgenson River was rated 9th for otter suitability and is similar to the other small streams draining into the Minnesota River drainage from the prairie potholes except for its short length. Alone, the Jorgenson River is probably not extensive enough to sustain otters. However, it does provide suitable otter habitat and adds to the network of streams likely being used by otters.

Belle Fourche River

The Belle Fourche River originates in Wyoming and is the largest tributary of the Cheyenne River. Spearfish Creek is a clear, cold mountain stream that flows out of the Black Hills through Spearfish Canyon and Spearfish, SD., joining the Redwater River between Spearfish and Belle Fourche, SD. The Redwater River, also a clear, cold mountain stream, flows out of the Black Hills in Wyoming, has extensive meanders, and finally joins the Belle Fourche River within the city limits of Belle Fourche, SD. Both tributaries are important in contributing to the year-round flow of the Belle Fourche River.

I checked multiple bridge crossings over the Belle Fourche and Redwater Rivers, and 1 crossing of Spearfish Creek (Table 1). Except for where it is channeled through the city, the Belle Fourche River in South Dakota is a slow, meandering river that exceeds 35 m in width in some places. In general, the landscape along the Belle Fourche River is open with trees typically scattered in the floodplain away from the banks and sparse riparian habitat consisting primarily of grasses and forbs. However, there are areas where shrubs and small trees line the river. Cattle grazing dominates the landscape, especially west of Belle Fourche and on the lower reaches of the Belle Fourche River, where unrestricted grazing and access to the riparian zone increases the sediment load. Beyond the borders of the Black Hills National Forest, riparian

vegetation along the Redwater River and Spearfish Creek is negatively impacted by private homes and "hobby" ranches scattered along their banks. Nonetheless, both streams continue to flow clear and cold throughout their entire lengths.

Just west of Belle Fourche Reservoir, the banks of the river are dominated by grasses and some forbs, but few shrubs; flow rates are good and the water is relatively clear. Silka Kempema, SDGFP Biologist, and I floated approximately 22.5 km of the Belle Fourche River near Hereford, SD., on 2 November 2012 (Figure 5). In this stretch, the river is typified by wide, slow-moving sections with occasional deep runs and pools interspersed with shallow, rocky rapids where the water is forced through narrow banks. Riparian vegetation tends to be sparse with banks either exposed, covered with grasses, forbs, and sedges, or small willows and indigo bushes. The banks along some stretches were covered with a dense, tall grass 2 m or more in height, possibly common reed (*Phragmites australis*). This tall, dense grass would provide excellent cover for otters and other wildlife. Beaver sign was evident throughout the 22.5 km stretch, the river remained relatively clear, and grazing intensity varied. From the bridge at New Underwood Road, downstream to the confluence with the Cheyenne River, the river bottom widens, vegetation is sparse, and the overall suitability for otters declines.

There are numerous other tributaries of the Belle Fourche River, and during wet years some have flowing water while others are intermittent, at best. Northeast of Vale, SD, Horse Creek contained water when I visited it in October 2012. I spoke with a hunter who, in November 2013, reported seeing at least 1 otter on Horse Creek just upstream from the confluence with the Belle Fourche River. East of Sturgis, SD, Cottle and Spring Creeks join to form Bear Butte Creek, which drains into the Belle Fourche near Volunteer, SD, on Hwy 34. Both Cottle and Spring Creeks were 1-3 m wide in November 2011 and had good riparian habitat, but in October 2012, they were dry. Others, such as Elm Creek, had water in the creek bed, but there was no flow. Several other streams drain into the Belle Fourche farther north, but their intermittent nature makes them unreliable for otters.

<u>Suitability for otters</u>:

The Belle Fourche River was rated 10th in otter suitability. In my estimation, in spite of heavy livestock grazing of the riparian habitat in numerous places, the Belle Fourche River has sufficient stretches with adequate habitat to sustain otters, assuming there are suitable prey species available (see Kiesow and Dieter 2005). Spearfish Creek and the Redwater River originate in the Black Hills, provide a reliable source of water, and contribute to the overall quality and suitability of the Belle Fourche River for otters and their prey. Otters using the

upper stretch of the Belle Fourche River would likely use the lower sections of both Spearfish Creek and Redwater River.

The Belle Fourche River has much clearer water and generally better riparian habitat than the lower Cheyenne River, in spite of stretches of heavy livestock grazing. The banks of the lower Cheyenne River are wide and as the volume of water in the streambed declines, the river winds its way through sandbars deposited during years of spring runoff. In my estimation, Lake Oahe, especially when it is frozen over, and the lower Cheyenne River are the greatest obstacles to natural movements of otters into the Belle Fourche River and upper Cheyenne River.

Moreau River

The headwaters of the North and South Forks of the Moreau River are in the arid southwest part of Harding County near the Montana border. The Moreau River is to the south of and parallels the Grand River and flows into Lake Oahe on the Missouri River. The 2 forks join to form the main Moreau River southeast of Zeona, SD. There are numerous tributaries of the Moreau that seasonally contribute water to the river system. Similar to the Grand River, the Moreau River drainage is dominated by open, sparse vegetation with extensive livestock grazing. In November 2011, September and October 2012, and September 2013, I checked 8 bridge crossings on the main stretch of the Moreau River, 3 crossing on the North Fork, and 4 crossings and 2 tributaries on the South Fork. There was no evidence of surface water flow on the South Fork, and only occasional evidence of surface flow on the North Fork and main section of the Moreau River. In 2012, when the most extensive surveys were conducted, pools of water were interspersed with stretches of dry and exposed river bed throughout the drainage except for the section from White Horse to the mouth of the river at Lake Oahe that appeared to have continuous water.

In September 2013, I spoke with a rancher who lives near Dupree, SD, on the Cheyenne River Reservation. His family has been ranching leased land along the Moreau River for about 20 years. This rancher said that the Moreau River frequently stops flowing, and in 2002, it was so dry it quit flowing by May and didn't resume flowing until the following spring.

Riparian habitat improved downstream from Hwy 63 and east of Green Grass, in spite of heavy grazing between there and White Horse. Trees, shrubs, and forbs periodically lined the banks close enough along this stretch to be beneficial to beaver and otter. Beaver sign was located at the Hwy 63 crossing in 2011 and the river was surprisingly clear. There are several locations on the lower Moreau River and the South Fork where riparian habitat could attract beaver and

where the river banks were steep enough for beaver to create bank dens. However, the limiting factor is probably an unreliable water supply.

Suitability for otters:

Kiesow and Dieter (2005) rated the Moreau 11th out of the 17 streams evaluated for otter suitability. Most of the river is situated in the drier part of South Dakota. Without sufficient snowpack and because it is not spring fed, moisture from snow and rain dictate water levels in the river and flow rates. The drainage has water during wet years (e.g., 2011), but during drier years there appears to be little or no flow, only intermittent pools remain until downstream from White Horse, east of Hwy 63. Grasses, along with some sedges and forbs dominate the riparian zone, especially in the upstream sections. Scattered trees and some shrubs occur in the floodplain, but they are generally too far from the river banks to add cover and provide in-stream structure. Sparse riparian habitat appears to be further limited by extensive livestock grazing, and overgrazing has degraded the banks along the river such that when the water is flowing, erosion results in an increase in suspended sediments, reduced visibility, and reduced water quality.

Fish distribution and biomass in the Moreau River drainage is probably limited by water conditions and availability. According to Dan Jost, Regional Fisheries Manager for SDGFP, Mobridge, SD, fish from Lake Oahe migrate up the Moreau River when there is adequate water, and many of these fish get stranded in pools when water levels drop.

Although there are occasional short stretches of suitable riparian habitat upstream from Green Grass, the limited nature of these stretches, combined with the lack of water in the river, make most of the Grand River seasonably usable by river otters, and generally poor in terms of overall otter habitat. The only possible exception might be the stretch of river downstream from Hwy 63 to Lake Oahe, where sufficient water would allow fish to survive year-round, and where otters may be able to also survive year-round. This stretch could be checked periodically during autumn and winter for otter sign.

Grand River

The Grand River flows east through arid lands of the Grand River National Grassland, paralleling the border with North Dakota before flowing into Lake Oahe on the Missouri River. The landscape is open with sparse vegetation; stream banks are dominated by grasses with scattered trees in the floodplain. The headwaters of the South Fork are in the Buffalo, SD, area in northwest South Dakota near the Montana border. The North Fork flows from North Dakota,

with its headwaters in the border area. They join at Shadehill Reservoir near the town of Shadehill, SD. Several smaller tributaries drain into both forks and the main Grand River.

During autumn of 2011 and 2012, I checked 7 bridge crossings and walked a 0.8 km stretch of the main Grand River. I also checked 3 bridge crossings on the North Fork of the Grand River and 4 crossings on the South Fork. Most of the bridge crossings checked in 2012 included those checked in 2011.

The North Fork at Hwy 75, south of the North Dakota border, was approximately 3 m wide, had a good flow, the water was clear, and the riparian habitat consisted entirely of grasses, although there were some trees/tall shrubs farther downstream that may have been near the river. The South Fork at Hwy 75 was 3-7 m wide, slow moving, had sparse riparian vegetation, and appeared to be frequently grazed. The North Fork farther downstream (south of White Butte, SD) was 3-5 m wide, had little flow, and poor riparian habitat. The lack of flow may have been influenced by Shadehill Reservoir, which was 5-7 km downstream. At Hwy 73 below Shadehill Reservoir, the Grand River was 7-10 m wide, silty, and flowing. In 2012, evidence of flowing water was difficult to detect, at crossings both above and below the reservoir. Water level in the reservoir was low with flat, exposed banks, providing no habitat or escape cover for otters. The Grand River at Hwy 65 south of McIntosh, SD, was approximately 15 m wide with banks dominated by grasses. Finally, the River at Hwy 63 south of Little Eagle, SD, which is only a few kilometers above Lake Oahe, was influenced by water levels in the lake.

I checked 3 tributaries on the Standing Rock Reservation between Hwy 65 and Bullhead, SD. Hump Creek at Hwy 65 is approximately 3 km from the Grand River. There was very little water in the stream bed, and it probably flows only intermittently at this site. White Shirt Creek, approximately 2 km upstream from the Grand River, looked stagnant, polluted, and in poor condition. Stink Creek/Iron Dog Creek, within 1-2 km of the Grand River, was ≤2 m wide and looked considerably better than either Hump Creek or White Shirt Creek. There did not appear to be any livestock grazing at this location as the grasses were robust and there were scattered shrubs along the banks. While there was little flow, the water was quite clear.

<u>Suitability for otters</u>:

The Grand River was rated 12th among the 17 streams evaluated for otter suitability. Most of the Grand River is situated in the drier part of South Dakota. Like the Moreau River, without sufficient snowpack and because it is not spring fed, moisture from snow and rain dictate water levels in the river and flow rates. The drainage has water during wet years (e.g., 2011), but during drier years it could stop flowing and become an intermittent stream. Grasses, along

with some sedges and forbs dominate the riparian zone, especially in the upstream sections. Scattered trees and some shrubs occur mostly in the floodplain, but they are generally too far from the river banks to add cover and provide in-stream structure. Sparse riparian habitat is further limited by extensive livestock grazing, and overgrazing has degraded the banks along the river. Degraded banks result in erosion, an increase in suspended sediments, reduced visibility, and a reduction in water quality.

Beaver sign was detected on both forks and the main stem of the river, but the amount of sign was limited. Poor bank conditions and a paucity of woody plants and other suitable food probably limit the distribution of beaver in the drainage.

Fish distribution and biomass in the Grand River drainage is probably limited by water conditions and availability. According to Dan Jost, Regional Fisheries Manager for SDGFP, Mobridge, SD, Shadehill Reservoir is stocked with a variety of game and forage fish. Some of these fish apparently disperse from the reservoir and would be a good source of food for otters. Fish from Lake Oahe also migrate up the Grand River when there is adequate water, and many of these fish get stranded in pools when water levels drop. While there may be sufficient prey available to otters at certain times of the year, I believe the Grand River provides poor otter habitat due to the lack of adequate riparian vegetation and in-stream structures, the impacts of grazing, and the unreliability of sufficient water and associated prey.

Medicine Creek

Medicine Creek originates near Draper, SD, flows east and parallel to Interstate 90, then turns north near Kennebec, SD, and enters Lake Sharpe after crossing BIA 10, west of Lower Brule, SD, on the Lower Brule Reservation. There is another Medicine Creek in this area that drains into Lake Sharpe farther upstream and from the north. Discussion of Medicine Creek in this report refers to the more southern creek of this name that originates near Draper, SD. On several occasions, I visited a bridge crossing at BIA 10 where Medicine Creek drains into a bay of Lake Sharpe. The banks leading to the bay and upstream for several hundred meters were lined with cattails and there was fresh beaver sign. Farther upstream, trees and shrubs bordered the creek.

I conducted a 2.5 km foot survey in a stretch of Medicine Creek near the southern boundary of the Lower Brule Reservation on 12 September 2012. The water was not flowing on this meandering stretch with only isolated pools of water remaining. Beaver sign, old and fresh, were evident at several locations. The riparian habitat was good for otters with a combination of trees of varying size, shrubs, grasses, and forbs along both banks. At the downstream end of

the survey route, a barbed wire fence crossed the creek and the area below was intensively grazed by cattle, reducing the quality of the riparian habitat.

Suitability for otters:

Medicine Creek was rated 13th in terms of suitability for river otters. Medicine Creek has good riparian habitat and numerous meanders, features that increase suitability for otters. Unfortunately, the intermittent nature of the stream makes it seasonably suitable. However, Medicine Creek could be an important part of an otter's home range when combined with the Missouri River.

Virgin Creek

Virgin Creek was rated 14th for river otter suitability. The South Dakota Atlas and Gazetteer (DeLorme 2009) shows Virgin Creek , which originates just southeast of Ridgeview, SD, on Hwy 212, as an intermittent stream. The creek empties into the Moreau River, just upstream from Lake Oahe on the Cheyenne River Reservation. I did not visit any stretch of Virgin Creek, and it was not recognizable when I crossed over it on Hwy 212 at La Plant, SD.

Suitability for otters:

The Virgin Creek drainage is located in an area that is open and dry. Considering that the Moreau River is marginal otter habitat and the value of Lake Oahe is questionable, it is hard to believe there is much value in Virgin Creek in terms of otter restoration. However, without actually seeing the creek, I can't be certain.

Little Minnesota River

The Little Minnesota River originates in the prairie potholes in the vicinity of Veblen, SD. The South Dakota Atlas and Gazetteer depicts the river as intermittent until just northeast of Sisseton, SD. At this point, it is probably not more than 24 km before it empties into Big Stone Lake and the Minnesota River southeast of Browns Valley, MN. The Jorgenson River drains into the Little Minnesota River approximately 27 km before it reaches Big Stone Lake. I checked 4 crossings on the Little Minnesota River in autumn 2012 and 2013; there was good riparian habitat, except the banks were mostly covered with grass at the Hwy 10 crossing east of Sisseton. Beaver sign was evident at 1 of the locations in 2012, but not in 2013.

Suitability for otters:

The Little Minnesota River, like the Jorgenson, Whetstone, and Yellow Bank Rivers, is a small meandering stream with stretches of good riparian habitat interrupted by agricultural crops and areas where cattle are allowed to graze in and adjacent to the streams. In spite of the impacts of cattle and, to a lesser extent, agricultural crops, these streams maintain sufficient riparian habitat to attract beaver along numerous stretches, and otters.

Rapid Creek

Rapid Creek is a prominent tributary of the Cheyenne River that originates in the Black Hills and flows through the metropolitan area of Rapid City, SD. It is a typical clear, cold mountain stream with a rock and gravel-dominated substrate as it enters and flows through the city from the Black Hills. Exiting the city limits, the river meanders southeast, bordered by periodic houses, agricultural fields, and livestock grazing before entering the Cheyenne River. Several kilometers before reaching the Cheyenne River, the stream becomes progressively more turbid from erosion associated with livestock grazing and other anthropogenic activities. I checked multiple bridge crossings both upstream and downstream from Rapid City, and walked 2 stream segments for a total of 2.7 km. Riparian habitat is good along most of Rapid Creek, in spite of flowing through a metropolitan area and having homes scattered along the drainage. Upstream from Rapid City, there was a beaver pond with a small lodge adjacent to Hwy 44 near the junction with Hwy 385. However, more extensive beaver activity was found in the 2.1 km stretch of river I walked starting at the confluence with the Cheyenne River.

Suitability for otters:

Rapid Creek was rated 16th of the 17 streams evaluated for otter suitability, and along with the White River, was rated lowest for water quality. However, I believe it does have habitat features that could attract and sustain river otters. The most desirable stretch of the river, in terms of otter habitat, is located downstream from Rapid City, although good habitat is patchy. In this section, the river slows down, deepens in many places, and meanders unencumbered through a wide, shallow basin. As to be expected, the diversity of potential otter prey would be much greater in this stretch than in the clear, cold, shallow waters of the river's upper reaches. Otters would likely explore the upper parts of the river, but I wouldn't expect them to stay there for long before returning to the more food-rich lower section.

White River

The White River is a large drainage that originates in Nebraska near southwest South Dakota. Flowing north into the Pine Ridge Reservation then turning east, it flows through the badlands, picking up suspended sediments along the way, and becomes the border with Buffalo Gap National Grasslands and the northern border of the Pine Ridge Reservation. From just southeast of Belvidere, SD, it no longer borders the Reservation and continues east to just south of Chamberlain, SD, where it empties in the Missouri River at Lake Francis Case. The White River has numerous tributaries, but the main tributary is the Little White River, which joins the White River south of Murdo, SD. Prior to the confluence with the Little White River, the water in the White River is creamy white, giving the river its name.

The White River has hydrologic features making it less suitable for otters. The wide, flat riverbed is the result of years of flooding, erosion, and silt deposition. These features, combined with poor soils and an arid climate, limit the establishment of good riparian vegetation along many sections of the stream. And in those sections where trees, shrubs, and grasses line the banks, often times the water is winding through the streambed far from the actual banks. Hoagstrom et al. (2006) describe the White River as perennial throughout South Dakota. However, I found that without sufficient winter snow and spring rain, the White River upstream from the confluence with the Little White River ceases to flow and becomes a series of isolated pools; this was the case in 2012. Downstream from the confluence, the flow of water originating from the Little White River is narrow, shallow, and occasionally braided while flowing through only a fraction of the broader riverbed. Because of this, a paucity of riparian vegetation is often separated by an exposed, sand-dominated riverbed. The absence of suitable escape and hiding cover creates conditions not conducive to either otter or the fish they depend upon. And with visibility greatly reduced from the high amount of suspended particles, otters would have to rely on their tactile senses to secure prey.

I visited 7 bridge crossings on the White River in autumn 2011, the most upstream being 2 sites just north of the Nebraska border. At these sites, the River was 5-7 m wide, silty, slow-moving, but had good riparian habitat. Where Highway 18 crossed the river in the Pine Ridge Reservation, there was a beaver dam. Nearby, White Clay Creek is a tributary that has excellent wetland habitat where a dam created Oglala Lake. In autumn 2012, I visited 8 bridge crossings along the White River, but spent little time conducting surveys as the river was not flowing. During my surveys of the river in November 2011, I described the White River below Interior, SD, as a wide, shallow, milky-colored river with generally poor riparian habitat. Therefore, even with sufficient flow, the White River upstream from the confluence with the Little White River probably has only marginal suitable otter habitat.

Suitability for otters:

The White River was rated last of the 17 streams evaluated for otter suitability. There are a few patches of suitable habitat on the White River, mostly in the upper reaches, but also some farther down. However, poor visibility due to the milky condition of the water and generally poor riparian habitat warrant the White River its low rating for suitability. At best, the river could be suitable as a travel route between the Missouri River and the Little White River. Conversely, it could be somewhat of a barrier.

Other Streams Visited

Several small streams within the Minnesota River drainage that originate in South Dakota were also visited. These streams include the North and South Forks of the Yellow Bank River, which flows into the Minnesota River at Big Stone Lake NWR, and multiple tributaries of the Lac qui Parle River and West Fork of the Lac qui Parle River, including Crow Creek, Florida Creek, Lazarus Creek, Lost Creek, and Monighan Creek. Except for intermittent stretches of cattle grazing in and adjacent to the streams and adjacent crops, these streams had what appears to be good otter habitat, with mature trees and shrubs lining the banks and in-stream structure. Otters are known to occur on the Yellow Bank River up to Punished Womans Lake near South Shore, SD, in the prairie potholes.

Jim Creek drains into Lake Traverse on the South Dakota and Minnesota border approximately 16 km east of Sisseton, SD. Lake Traverse is north of the Continental Divide and drains into the Bois de Sioux River. The Bois de Sioux River merges with the Ottertail River to become Red River on the North Dakota and Minnesota border, where there is a resident otter population. The Jim Creek drainage is a fairly short drainage originating from potholes and runoff just north of New Effington, SD, and in North Dakota, creating Big Slough (a stream), which drains into a marshy area and then forms Cottonwood Lake. From there, it drains through a series of ponds and marshes called Cottonwood Slough, eventually flowing into Lake Bdesaka and then Jim Creek. In 2005-06, Ermer (2006) conducted river otter surveys in this drainage, and also received reports of the presence of otters (Ermer 2007). I visited the Jim Creek drainage at 7 locations on 2 May 2012 from its mouth upstream to near its origin north of New Effington, SD. The best stream habitat was near the mouth of the creek. Approximately 3 km upstream, and below Lake Bdesaka, the creek was open and the land adjacent to the stream appeared heavily grazed. From Lake Bdesaka upstream to its origin, the steam flowed through mostly marsh habitat and stretches of open water. Collectively, the drainage appears to have suitable habitat for otters.

Otters occurring in the streams previously discussed that drain into Lake Traverse and the Minnesota River drainage may be part of the same metapopulation. There do not appear to be any obvious barriers to the movement of otters among these waterways.

Coteau Des Prairies

The Big Sioux River and streams that drain into the Minnesota River are separated by the Coteau Des Prairies (Prairie Pothole) region, an elevated plateau of poorer soils, but dotted with potholes. Most of these potholes do not have inlets or outlets, and are thus influenced by the level of precipitation that occurs in the area. If, during winter, they freeze shut, otters would have only seasonal access to the potholes. If, on the other hand, there was access during winter (e.g., springs or some kind of moving water kept the pothole, pond, or marsh area open), otters may be able to search out and exploit the site, provided suitable prey was available. This appears to be the case when Jacquie Ermer, SDGFP, documented the sign of 2 otters in a pond/marsh north of South Shore, SD, during a winter survey in 2010-11.

Movement of otters and other semi-aquatic furbearers between major drainages separated by the Prairie Potholes may be complicated by the lack of defined drainages in this plateau. Dispersing otters that choose to disperse upstream typically follow stream drainages to their headwater, then strike out overland looking for an adjacent drainage that they can follow downstream. East-west dispersal across the Prairie Potholes would be more random, requiring movement from pothole to pothole until a defined drainage is discovered. Recent sighting reports indicate that otters have clearly discovered the prairie potholes.

Current Distribution of Otters in South Dakota

The current known distribution of river otters in South Dakota includes, 1) the Big Sioux River drainage, 2) tributaries of the Minnesota River (Jorgenson River, Little Minnesota River, Whetstone River, and Yellow Bank River), 3) Jim Creek/Big Slough (a tributary of Bois de Sioux River), 4) the Vermillion River drainage, 5) the James River drainage, and, 6) the Missouri River downstream from Pierre (Figure 6). The Little White River should now be included as currently occupied by at least 1 otter, an animal born in 2014 on the Lacreek Refuge from 1 of the 2 otters released in 2013. It is important to note that otters are not evenly distributed in all of these drainages due to the patchiness of the habitat, as reflected in Figure 6. Reports of otters continue to increase in parts of South Dakota, and while visual sightings are a function of where people frequent, all indications suggest there is an increasing and slowly expanding otter population in South Dakota.

Otter observation reports submitted to SDGFP indicate that otters may be or may have been present in the Bad River, the Cheyenne River drainage, and Medicine Creek (Figure 6). However, some of these reports could not be confirmed and should be considered "possible" or "probable." Both the Bad River and Medicine Creek have good otter habitat, but they cease flowing during autumn and winter, making them only seasonally suitable for otters and reliant on the Missouri River/Lake Sharpe to provide year-round habitat. Otters may occupy portions of the Cheyenne River upstream from the confluence with Rapid Creek, but the lack of consistent sightings of animals or their sign, especially by trappers who trap these areas annually, would indicate the numbers are few and that they may be transients. There have been recent reports of otters on Horse Creek and Spearfish Creek, tributaries of the Belle Fourche River. With suitable otter habitat existing on these and other tributaries, including Redwater River, there may be a few otters on the Belle Fourche River drainage. Again, these sightings have not been or could not be confirmed. Even if they were otters, the rarity of these sightings would suggest these animals were dispersers or transients.

No otter sightings have been reported for either the Grand or Moreau Rivers. This is probably for good reason. Numerous sections of these rivers are heavily grazed, riparian habitat and other features typical of suitable otter habitat are either limited or nonexistent. During dry years, both rivers either cease flowing or have barely detectable flows, resulting in pools interspersed with sections of dry streambeds. Shadehill Reservoir, at the confluence of the North and South Forks of the Grand River, continues to contain water, even during drought years. And, while there is a suitable fishery in the reservoir, the banks are flat and exposed, lacking escape cover for otters. The only stretches with continuous water are where the rivers are influenced by Lake Oahe. Any otter attempting to occupy these rivers would likely be found in these lower stretches.

Some stretches of the Missouri River contain habitat and conditions that appear suitable for otters year-round. The best sections of the Missouri River in South Dakota are from Fort Randall Dam at Pickstown, SD, downstream to Lewis and Clark Lake east of Springfield, SD, and from Gavins Point Dam at Yankton, SD, downstream to the Iowa border. Both sections have major tributaries that are currently occupied by river otters. Another section that has features suitable to otters, including open water in winter, is from Oahe Dam downstream to below Farm Island in the Pierre, SD, area.

Less suitable for otters would include the larger open water of Lake Oahe, Lake Sharpe, Lake Francis Case, and Lewis and Clark Lake. These reservoirs tend to freeze over during winter, and because water levels tend to drop prior to them freezing over, the flat, exposed, gradual banks

provide little cover and no way of exiting water from under the ice. Under those conditions, otters would need to retreat to small tributaries, provided they contain water, during ice-over conditions. Winter ice and snow have been shown to affect otter behavior, including movements and dispersion in Idaho and Alberta, Canada (Melquist and Hornocker 1983, Reid et al. 1994). In summer when boat traffic is intense, otters would likely avoid large, open reservoirs void of escape cover, or they would probably travel only at night time.

Sites Suitable for Reintroduction or Translocation

Surveying the 16 South Dakota streams was useful in evaluating locations suitable for the release of conflict otters or for possible reintroductions. I previously provided a document identifying what I believe to be suitable locations in each of the 4 SDGFP Wildlife Division Administrative Regions where depredating river otters could be released (Appendix 3). In the streams where otters are not known to currently exist, these same sites would be suitable for reintroducing otters. These sites appear to have suitable riparian habitat, sufficient (permanent) water, available prey species, evidence of past and/or current beaver activity, and suitable banks where old and active beaver bank dens can provide adequate resting sites for otters, especially where the waterways are ice-covered in winter. Because river otters are highly mobile, an exact release location is not critical, as released animals will move to places that meet their life requirements.

Kiesow and Dieter (2005) identified 5 streams suitable for reintroducing otters, including the Bad River, Big Sioux River, James River, North Fork of the Whetstone River, and Little White River. The authors concluded that these streams with the highest overall rating have the greatest chance of sustaining otters and promoting future population growth. As a caveat, they also noted that these streams could be the best of a selection of unsuitable streams, rather than the best of a selection of suitable streams. The Missouri River ranked third (after the Bad and Big Sioux Rivers), but in her thesis, Kiesow (2003, page 29) indicated it was excluded as a river otter release site because of its extreme size and status as a major river drainage versus other selected rivers (tributaries). She also states that much of the Missouri River is impounded, making linear movements difficult for otters, although they may move to sections of the Missouri River upon release. My experience would suggest that if otters can cross over mountains (Melquist and Hornocker 1983), the earthen dams on the Missouri River would not restrict movements between reservoirs. Small streams emptying into the reservoirs of the Missouri River could be important as temporary refuge as otters travel these large bodies of water.

Training

A River Otter Field Identification document, consisting of a series of photographs with explanations, was produced for SDGFP staff. River otter literature was provided to pertinent individuals in each of the administrative regions. In-the-field training of appropriate SDGFP staff was limited to Wildlife Damage Specialists that were likely to deal with conflict otter issues. One-on-one meetings with Regional Wildlife Managers were held periodically throughout the project, primarily for the purpose of information sharing. Presentations were given to regional staff in Sioux Falls and at a wildlife staff retreat near Custer in September 2012. Also in September 2012, I attended the Fall Convention of the Western South Dakota Fur Harvesters Association in New Underwood, SD, and the South Dakota Trappers Association's Fall Rendezvous in Parker, SD, to share information about the otter project and to encourage cooperation in reporting sightings.

Evaluating Unoccupied Habitat Using Radio Telemetry

Suitable reintroduction sites for instrumented river otters were identified on the Belle Fourche, Cheyenne, and Little White River. No evidence of recent occurrence of otters had been recorded on any of these West River streams. The Little White River Game Production Area (GPA) on the west side of a reservoir that is part of the Little White River Recreation Area (Recreation Area) was selected as a release site for otters in an effort to evaluate currently unoccupied, but potentially suitable habitat for the species. The Recreation Area is administered by personnel from the Lacreek Refuge.

On 28 October 2013, a radio transmitter was surgically implanted in the peritoneal cavity (abdomen) of an adult female otter from the Big Sioux River (Moody County) by Dr. J. B. Minter, DVM, at the Great Plains Zoo in Sioux Falls, SD. Unfortunately, the otter died during recovery. On 6 November 2013, radio transmitters were successfully implanted in 2 otters from the Big Sioux River drainage, a male (M-301) from Brookings County and a female (F-302) from Moody County. Following surgery, both otters had Passive Integrated Transponder (PIT) tags inserted under the skin at the base of their tail, and received numbered metal ear and web tags. No additional otters were live-trapped and available for the translocation effort.

Monitoring Instrumented Otters

After a recovery and holding period, both animals were transported to the GPA east of Martin, SD, and released simultaneously on 14 November 2013 on the west side of the reservoir

created by damming the Little White River (Figure 7). I attempted to maintain daily contact with each animal, especially until they settled on a home area.

Upon release, both otters initially remained predominantly in the upper end of the reservoir where the Little White River enters. Within approximately 8 days after release, the reservoir and Little White River upstream from the dam at the Recreation Area became almost entirely frozen over and did not begin to open up until February 2014. Neither otter had ventured downstream below the dam prior to freeze-up. So once freeze-up occurred, the nearest reliable location where the otters could have exited the river through the ice and traveled over land to gain access to the river below the reservoir was approximately 6 km upstream. Consequently, they were, for the most part, now confined to the Little White River above the frozen reservoir.

Foraging behavior and prey selection was difficult to determine during winter 2013-2014, when all foraging and most feeding occurred under the ice. When the animals were able to exit the water through the ice, they often left prey remains, allowing us to determine, in part, what they were foraging on. The otters were never observed or documented together after their release. This is not unusual behavior for adult male and female otters, which only come together briefly during the spring breeding season.

I attempted to identify habitat features (e.g., characteristics of rest sites used), especially when there was an opportunity to make a close inspection of the animals' location. This was easier to accomplish when the otters occupied the Little White River. However, it was much more difficult to do once F-302 moved to the Lacreek Refuge in February 2014, where open, marsh habitat made it difficult to approach the otter without disturbing her.

Male Otter M-301

The male otter was monitored for 9,183 minutes during 58 different days from the release date on 14 November 2013 until contact was lost on 25 March 2014 (Table 3). Not included was the amount of time M-301 was monitored by Shilo Comeau, biologist with the Lacreek Refuge, and Tom Beck, Conservation Officer with SDGFP, as they did not record monitor times. Both individuals kindly assisted in checking on the otters during periods when I had to be gone. I recorded 54 active locations (Figure 8) and 52 inactive (resting) locations (Figure 9). I attempted to document the location coordinates as soon as an initial contact was made. I recorded 22 separate visual observations for a total of 113 minutes. These observations provided useful behavioral information about the male.

Activity and Movements

M-301 remained in the northwest corner of the reservoir and approximately 1 km of the Little White River above the Recreation Area from the time he was released on 14 November 2013 until approximately 6 January 2014, when he was discovered approximately 15 km (stream distance) upstream. Between 6 January and 11 March 2014, the male remained in a stretch of the Little White River, 15-35 km upstream from the Recreation Area reservoir.

A warm spell resulted in some patches of open water during late January 2014. However, these areas froze again when cold weather returned shortly after. During February, multiple days of above-freezing temperatures resulted in more open stretches of water, a situation that the female took advantage of to move to the Lacreek Refuge. By the second week in March, there were numerous open stretches in the river and reservoir, and it was at this time that the male began moving.

The male was located approximately 35 km upstream from the Recreation Area on 10 March 2014. This was the farthest upstream I recorded him from the release site (Figure 8). That same day, he started back downstream and by 0607 h on 13 March, I located him within 1 km of the reservoir. We did not locate him again until 16 March. I believe he continued downstream, passed through the reservoir and entered the Little White River below the dam for the first time. From there, he likely continued downstream to the confluence with Lake Creek, swam up Lake Creek to within 1 km (stream distance) of the eastern boundary of the Lacreek Refuge and approximately 4 km from where F-302 was currently located. From the reservoir to where he was located on Lake Creek east of the refuge boundary is a stream distance of approximately 25-30 km.

We will never know why M-301 did not continue upstream into the Lacreek Refuge. Instead, he went back downstream to the confluence and continued downstream on the Little White River. I located him on 23 March approximately 25 km downstream from his Lake Creek location. He remained there for 2 days, using a beaver bank den as a rest site, before continuing downstream. On 25 March 2014, he was another 18 km downstream, using another beaver bank den as a rest site. He emerged after dark and continued downstream, and I lost his signal about 2 km from the rest site as he moved out of range.

This was the last time we picked up his signal. Ground searches for the next 2 months failed to locate him. We conducted aerial searches on 4 and 12 April 2014 and 26 May 2014 that included the entire Little White River and White River drainages to the Missouri River, downstream for 40 km on the Missouri River and upstream on the Missouri River to Pierre, SD.

The movement patterns of M-301 during March 2014 suggest he may have left the upper Little White River and probably the entire Little White and White River drainages. Assuming his radio was transmitting during our searches, I believe we would have picked up his signal during either ground or aerial searches if he had remained in the area. I can only speculate as to why he left the area and the female didn't, although she never returned to the Little White River after moving to the Lacreek Refuge (Lake Creek drainage) in February 2014. Did the male remain on the Little White River during winter out of preference, or because winter conditions prevented him from leaving? Did he leave because favorable travel conditions were created when the river and reservoir became partially ice free? Or, did he leave because of the forthcoming breeding season (April-May), a time when males travel extensively looking for suitable females? Unless the male is discovered or recovered, these questions will likely go unanswered.

Foraging and Feeding

Scats from M-301 were collected opportunistically during the course of monitoring his activities and movements. However, the contents of the scats have not been analyzed and are not available for this report. Because all foraging and most feeding occurred under the ice on the Little White River during winter 2013-2014, little data are available on the kinds of prey consumed during that time period. I did manage to find prey remains and scats that indicated the male fed on carp and channel catfish (*Ictalurus punctatus*) during winter and spring. Based on much more evidence from prey remains, F-302 also fed primarily on these 2 species during the time she was in the same stretch of the Little White River. Once the scats are analyzed, we will have a better, although not complete, understanding of the feeding habits of M-301.

Rest Sites

I recorded M-301 using 20 different rest sites 52 times (Table 4). Beaver bank dens, with their underwater entrances, are critical to the use and survival of otters in waterways that freeze completely over, and M-301 was proficient at finding them. A single old beaver bank den on an island in the northwest corner of the Recreation Area was used 14 (27%) of the time. The male found this rest site shortly after he was released and used it almost exclusively until 8 December. He began moving upstream shortly after this, using other rest sites. Beaver bank dens accounted for 48 (92%) of the rest sites used by M-301; the majority of these sites did not appear to be actively used by beavers. Once a beaver bank den was discovered, the male often used it again while in the area. Visual observations allowed me to document M-301 using grass banks to rest for short periods of time, usually while traveling in unfamiliar locations.

Female Otter F-302

The female otter was monitored for 28,057 minutes on 229 different days from the release date on 14 November 2013 until she died on 19 January 2015 (Table 3). Not included was the amount of time F-302 was monitored by Shilo Comeau, biologist with the Lacreek Refuge, and Tom Beck, Conservation Officer with SDGFP, as they did not record monitor times. I recorded 23 active locations (Figure 10) and 44 inactive (resting) locations (Figure 11) for F-302 while she was on the Little White River. Once she moved to the Lacreek Refuge, I recorded 149 active locations (Figure 12) and 149 inactive (resting) locations (Figure 13). I attempted to document the active location coordinates as soon as an initial contact was made. I recorded 56 separate visual observations for a total of 208 minutes. These observations provided useful behavioral information about the female and interactions with her young. Trail camera pictures also provided valuable information about the female and her young (Figure 14).

Activity and Movements

F-302 only remained in the release area for 3 days before moving upstream approximately 8 km (stream distance) on 17-18 November 2013. She was back in the upper part of the reservoir by early morning on 20 November, but again moved back upstream that night. Prior to 21 November, ice began forming along the shores of both the reservoir and the slow-moving section of the river where it is influenced by the reservoir. By 22 November, the reservoir was completely frozen over and most of the river upstream was ice-covered. On 26 November she was approximately 24 km upstream. On 28 November, she had returned from her foray upstream to a location approximately 6-7 km upstream from the northwest corner of the Recreation Area and GPA. At this location, the river becomes restricted as it flows through a single culvert into a large pool, creating rapids and strong currents. Locals refer to this site as "the fishing hole." This was the only place above the reservoir dam that remained open during the entire winter. Numerous fish remains, primarily carp and a few channel catfish, were left by F-302 on the ice along the open water at this site. F-302 spent most of December on the Little White River within approximately 4-5 km of the reservoir. During most of January 2014 I located her either at the fishing hole area (she used an old beaver bank den approximately 300 m downstream from the fishing hole as a rest site), or a downstream stretch of river below 227 Avenue where she frequently used a high bank with a complex of holes as a rest site.

On 27 January 2014, F-302 moved downstream to approximately 2 km from the reservoir. On 31 January I located her along the northwest corner of the reservoir, where she had managed to exit the water through a hole in the ice along the shore. She had not been in the reservoir at the Recreation Area since 20 November, 6 days after her release. Prior to moving to the

Lacreek Refuge, F-302 used approximately 30 km of the Little White River upstream from the Recreation Area.

Contact with F-302 was lost after 31 January 2014, a period when I was gone, even though Tom Beck (SDGFP) made multiple efforts to find her. However, Beck confined his search to the Little White River and the general areas she had previously been found since her release in November 2013; he did not check for her on the Lacreek Refuge. The Lacreek Refuge consists of a series of regulated pools, semi-permanent, seasonal, and temporary wetlands controlled by a network of dikes and control dams, and provides a unique combination of grasslands and wetlands (Figure 15). After returning, I searched for 2 days before finally locating her on 28 February on the Lacreek Refuge at the south end of Pool 10 near the outlet dam for Pool 9, a straight-line distance of approximately 5 km from the reservoir. I believe she moved to the Lacreek Refuge shortly after I located her on 31 January 2014, as searches in the Recreation Area and other areas she had previously used failed to locate her.

During early February 2014, warm temperatures resulted in more open water, including channels, canals, and pools on the Lacreek Refuge. There is a canal at the south end of the Recreation Area reservoir that continues south under a county road and connects to Pool 10 on the Refuge. The canal connects with the west side of Pool 10, which is actually only approximately 0.7 km (straight-line) southeast of the reservoir (see Figure 15). However, the reservoir and Pool 10 are separated by the county road, high ground, and a hay field on the north side of the road. In spite of the canal being nearly dry during winter, in all likelihood, this is the route she took in order to access Pool 10 on the Refuge (Figure 16).

F-302 remained on the Lacreek Refuge in the channel area between the outlet dam at Pool 9 and Pool 10 until 17 March 2014. Because of the volume of water coming out of Pool 9, this channel generally remains open during winter. Between 17 and 29 March, she made excursions into various parts of the Lacreek Refuge upstream from Pool 9, the farthest being Pool 8. However, between 30 March and 5 May, she remained in a small area in the vicinity of Pool 9 and the channel linking Pool 9 with Pool 6. It is at this location F-302 gave birth to at least 1 young on about 1 April (Figure 17). However, I did not confirm that she had given birth until 9 June 2014.

Between 5 and 13 May 2014, she moved the young otter to a bank den in a dike road approximately 1 km (straight-line) southeast of the natal area (see Figure 17). An obvious question is why she moved the young. On 28-30 April 2014, Lacreek Refuge staff recorded 4.8 cm of rain. On 9 and 12 May, there was 4.8 cm and 4.3 cm of rain, respectively. As a result, water levels rose rapidly on Lake Creek and the Lacreek Refuge. Because there was no high

ground at the confluence of the channel and Pool 9 where F-302 had given birth, her natal "den", which was likely just dense vegetation, probably got inundated by the rising water, forcing her to move the young. While searching for the male on 26 May, we flew over Lacreek Refuge and confirmed that the area where she gave birth was flooded.

F-302 foraged primarily in Pool 9DU during the time her young was in the dike road bank den. Pool 9DU was approximately 2 km to the north and west, and to get there, she traveled up a borrow canal adjacent to the dike road, went through a culvert, and entered into the Pool 9DU complex. She continued to use Pool 9DU as a foraging area and periodically rested at multiple sites in and adjacent to this area until she moved the young otter to 1 of several waterfowl nesting mounds (see Figure 17) created during construction of the Pool 9DU complex. I witnessed her moving the young otter on 9 June 2014; it piggy-backed on the mother in the water and when she ran down the dike road she had the young by the scruff of its neck. Because of its size, running with the young appeared clumsy and difficult.

Food was abundant and easily obtained in Pool 9DU. During a 73-minute observation period on 17 June 2014, I observed F-302 catching and consuming a minimum of 46 different prey items, which appeared to be crayfish. The first day I observed the pup accompany the female was on 30 June in the open pond in Pool 9DU. On 1 July I observed F-302 and her pup foraging in the same pond. While I did not see the pup catch and consume any prey during the observation, it appeared quite skilled at swimming and diving.

F-302 and her pup remained in the Pool 9DU area until approximately 25 July 2014, although I recorded her using the south end of Pool 9 and the vicinity of where she gave birth on 26 June and 6 July. The last time she was documented in Pool 9DU was on 4 August. F-302 and her pup were now primarily using the channel between Pools 6 and 9 and the shallow, south end of Pool 9. This area and much of the Lacreek Refuge receives little human activity, allowing the otters to be active at different times during the day and at night without being disturbed. F-302 and her pup continued to use this area, although they occasionally ventured into Pools 6, 5, 8, and for the first time, Pool 7 on 12 September. These pools are all part of the complex of wetlands within the Lacreek Refuge and they provide an abundance of food, shelter, and seclusion for the otters.

F-302 and her pup spent the majority of their time in Pool 8 from 12 September to approximately 7 October 2014, although they periodically frequented Pool 7. They accessed Pool 7 primarily by a trail adjacent to the dam, affording numerous opportunities to obtain pictures with the use of a trail camera. The otters also use this crossover as a latrine site, providing a great source of scats that were collected for later analysis. During the time they

spent in Pool 8, the otters seemed to use a single rest site near a channel in the southwest part of the pool complex (see Figure 13). Because the entire area is low ground, I'm confident the rest site was in marsh grass, although I never ventured close enough to determine any characteristics of the site.

After 7 October 2014, F-302 and her pup spent the majority of the month in Pool 7, frequently using a single rest site out in the marsh. However, the otters made an interesting excursion the night of 13-14 October. On 13 October, F-302 and her pup were in Pool 7. The afternoon of 14 October I picked up her signal where she was resting at the south end of Pool 10, the general area where she was first located on the Refuge in February 2014. By early morning on 15 October she had moved back upstream through Pool 9 and was active in the channel between Pools 9 and 6. The following morning she was back in Pool 7, a round trip of approximately 22 km (Figure 18).

Because the trail camera logs the time when pictures are taken, I was able to document the frequency of visitation to a crossover site on the Tour Route Road, a gravel road open to the public. For example, on 19 September 2014, F-302 and her pup were photographed 4 different times at this crossover between 0349 h and 0444 h. And during 1 of those visits, raccoons (*Procyon lotor*) were on the crossover simultaneously, with the animals sometimes <1 m from each other (Figures 19 and 20). I don't believe this kind of inter-specific interaction has been previously recorded. On 9 October 2014, the 2 otters were photographed during 6 different time periods between midnight and 0632 h.

While F-302 and her pup spent the majority of their time in Pool 7 and 8 from 12 September through October 2014, she was located in the channel at the south end of Pool 10 again on 4 November. However, she didn't remain there long, returning to the channel area between Pools 9 and 6 on 6 November. Between 6 November and 9 December, F-302 and her pup occupied the channels between Pools 6 and 9, Pools 5 and 6, and especially the open water above and below the control dams that regulate water levels in these pools. These are areas of the Lacreek Refuge she is very familiar with. An extended cold spell during early and mid-November caused the pools and other open water with little movement to freeze over. Connecting channels and especially the areas below dam outlets remained open, however. I believe these conditions are partly responsible for F-302 vacating Pools 7 and 8. I found numerous scats at the 2 major outlets from Pool 6 in the latter part of November, indicating high use of these areas by the otters. Moderating temperatures at the end of November increased the availability of open water once again.

The presence of snow allowed me to confirm that the pup remained with F-302, which would be expected. We also captured her and the pup on the trail cameras at 0115 h on 16 December 2014 and in early morning on 27 December. In early morning on 10 December, F-302 was active in Pool 8 and eventually went inactive at a location she had previously used many times in September and October. However, on 11 December she was back in the channel below the Pool 6 north outlet. On 14 December, I located her in a beaver pond south of Pool 4W near the south boundary of the Refuge. This was the first time I recorded her in this active beaver pond. She was photographed by the trail camera at the Pool 7 outlet at 2001 h that evening before returning to the Pool 6 outlet area. At 0115 h on 16 December, both otters were photographed by the trail camera located at the Pool 6 south outlet west of Hazel Pond. For the remainder of the month F-302 and her pup remained in the Pools 5 and 6 area and the channels below Pool 6 downstream to near Pool 9. However, between 27 and 31 December, as more places became ice-covered, the otters remained near the open pool below the Pool 5 outlet, using 2 different rest sites. Ice conditions during winter and water levels during other seasons appear to dictate areas of use by the otters on the Lacreek Refuge.

Most of the open, slow-moving water on the Lacreek Refuge remained frozen over since the cold spell in November, while water remained open at the dike outlets where the water flows rapidly as it is channeled through the culverts. These pools typically hold high densities of fish and other prey, and the formation of ice shelves along the shores of pools created at the outlets from Pools 5 and 6 provided excellent places for the otters to feed on captured prey and to reveal what they had been foraging on.

The mild conditions that existed during most of December 2014 resulted in an increase in ice-free areas on the Lacreek Refuge. However, these conditions didn't last as temperatures dropped later in the month, with open pools continuing to shrink in size. Once Pools 5 and 6 froze over in late December, the otters spent most of their time near the open pools below the Pool 5, Pool 6 North, and Pool 6 South outlets, and the channel between the Pool 6 South outlet and a short distance north (downstream) from the Hazel Pond outlet.

On 2 January 2015, F-302 and her pup made an overland trek of approximately 1 km between the Pool 6 North outlet and the channel a short distance downstream from the Pool 6 South outlet (Figure 21). On 2 January, the trail camera photographed F-302 and her pup on the ice at the Pool 6 North outlet. I was fortunate enough to be sitting near the outlet on 2 January when F-302 and the pup emerged from the water at 0732 h and disappeared into the cattails, heading for the channel downstream from the Pool 6 South outlet. On 9 January, the otters made another overland trek between the Pool 6 outlets, but this time they came from the Pool 6 South outlet channel to the Pool 6 North outlet, foraged, then returned to the south channel.

By the time I checked on them at 1412 h that day, they were in the beaver bank/stick rest site downstream from the Pool 6 South outlet.

Temperatures began to moderate some in mid-January 2015. During the night of 13-14 January, F-302 and her pup travelled from the beaver bank/stick rest site in the channel downstream from the Pool 6 South outlet to the Pool 6 North outlet, on to the Pool 5 outlet, then to the Pool 8 outlet; at each outlet there were prey remains on the ice. At 0742 h, on 14 January 2015, she was active in the channel upstream from Pool 8. On 19 January, I located her in the morning in the Lake Creek channel upstream from Pool 7; she appeared to be active. At 1902 h I picked up a mortality signal from F-302's transmitter. The following morning I recovered her body in Lake Creek in the vicinity of where she was located the previous morning. I could not find any external injuries, so why she died remains unknown at this time. The carcass was shipped to the USGS National Wildlife Health Center in Madison, WI, where a necropsy has been performed; results are pending. I continued to keep cameras out and looked for sign of her pup, which should be fully capable of living on its own. During this time period, fresh scats were found near where F-302 was found dead, indicating the pup had remained in the area, at least temporarily.

Foraging and Feeding

Scats from F-302 were collected opportunistically during the course of monitoring her activities and movements. Scats from her pup were also collected, but no effort was made to differentiate between their scats. The contents of the scats have not been analyzed and are not available for this report. With perhaps 1 exception, a cursory examination of the scats conducted during collection did not reveal anything different than what was identified from prey remains. Very small scales in scats collected below the Lacreek Refuge Pool 7 outlet coincided with the presence of dense schools of what appeared to be brassy minnows (*Hybognathus hankinsoni*). The combination of scats, prey remains, and visual observations of foraging and feeding may not provide a complete picture of what was consumed (soft tissue prey may be missed), but the results should be a good representation of the feeding habits of F-302, and later of F-302 and her pup.

Because all foraging and most feeding occurred under the ice during the 2013-2014 winter, little data are available on the kinds of prey consumed during that time period. On occasion, when the otters were able to exit the water through the ice and feed on captured prey, remains revealed that common carp and channel catfish appeared to dominate on the Little White River, while in March only carp remains were found on the ice once F-302 moved to the Lacreek Refuge. The catfish were generally consumed from the tail at least to the dorsal spine, while

little, if any, of the carp were actually eaten. Most of the carp left on the ice were large (up to approximately 60 cm) and with their large scales, were probably hard to eat. This perhaps explains why only some fins or the tail were eaten, and few of the large scales found on large carp showed up in otter scats. In general, feeding behavior based on the presence of prey remains on the ice is probably misleading, as small prey items could be consumed easily and quickly under the ice.

Based on visual observations of F-302 foraging and feeding during summer and cursory examination of scats collected during summer and autumn on the Lacreek Refuge, crayfish dominated in the otter's diet during summer and early autumn, and likely in spring once they emerged from the substrate and became active. However, there seemed to be a shift to fish, including carp and brassy minnows, in October.

Judging by what the otters had left on the ice, black bullheads (*Ameiurus melas*) seemed to be the most common prey item during December. With bullheads, the otters typically consumed the section from the tail to the dorsal or pectoral spines, leaving the spines and bony head. On 24-25 December 2014, during 2 nights of foraging below the Pool 6 outlet, the otters left the remains of at least 87 different prey items on the ice, including 82 black bullheads, 4 carp, and 1 frog. F-302 and her pup also pulled 9 large carp up on the ice in 1 night at the Pool 5 outlet. In most cases, the otters didn't eat them or only consumed an occasional fin. That same night, the otters also pulled at least 7 frogs from the Pool 5 outlet, but appeared to only eat a leg from 2 of them. To my surprise, they also caught and consumed several crayfish from the pool below the Pool 5 outlet. The otters had to be probing in the bottom in order to capture crayfish and frogs at this time of year. It would be interesting to know why the otters would capture and drag so many prey items up on the ice, then not feed on them. It appears to be similar to "surplus killing," a behavior exhibited periodically by predators.

On 3 January, the otters had pulled 4 carp onto the ice below the Pool 6 south outlet. I also discovered the head and mandible of 2 northern pike (*Esox lucius*) on the ice. This was the first time I found evidence of the otters feeding on pike. While these observations provide some insight into the foraging and feeding behavior of the otters, a more thorough understanding will be available once the scats are analyzed.

<u>Rest Sites</u>

I documented F-302 using 58 different rest sites 193 times during the 229 days she was located (Table 5). While she was on the Little White River, 42 of the 44 rest sites she used appeared to be old beaver bank dens. While she could have used other types of rest sites, these were the

only ones I documented her using in a 30 km stretch of the river from the Recreation Area upstream (Figure 11). There was fresh beaver activity and at least 2 different beavers were observed in the northwest corner of the Recreation Area where the reservoir transitions into a defined stream. Judging from the sign, there has been a long history of beavers here. From the Recreation Area upstream for approximately 35 km, I found fresh beaver sign at 4 additional locations. Remnants of 1 dam were found a short distance upstream from the Recreation Area where there was a sufficient amount of shrubs and a few trees available to build a dam. Farther upstream, the paucity of woody plants due to heavy livestock grazing not only prohibited the construction of dams, but made it difficult for beaver to even persist. Furthermore, landowners have little tolerance for beavers that try to make a living here.

Rest sites used by F-302 on the Lacreek Refuge were widely distributed and reflected the particular area being used (Figure 13). Fewer beaver bank dens were available throughout the Lacreek Refuge, largely due to the flat topography. However, dikes and dams on the Lacreek Refuge did provide suitable banks for beavers and muskrats (*Ondatra zibethicus*) to dig dens that could eventually be used by otters and other animals. Bank dens were used as rest sites periodically by F-302 when she happened to be in the area where they were located. On 28 November 2014, F-302 and her pup were first discovered using a small, old bank/stick beaver lodge, located along the channel west of Hazel Pond, as a rest site. It had an underwater entrance and access hole through the sticks near the top. Even though this rest site was visited by mink and raccoon, F-302 and her pup frequently used it throughout December and part of January when they were in the area. Between 27-31 December, F-302 and her pup used what appeared to be an old beaver bank den dug into the dike road adjacent to the Pool 5 outlet where they foraged nightly. The rest site, which may have had multiple chambers that may or may not have been connected, had an entrance near the top of the dike. When checking this site, I frequently found raccoons peering out at me through this entrance. Nonetheless, the rest site was conveniently located at a rich foraging area.

The location of a secure rest site, like a bank den, did not dictate the areas she used or the time of year she used them. Winter conditions that limited access probably had the greatest influence on areas used. More often than not F-302 would simply use dense marsh vegetation near water for a rest site; the kind of habitat that dominates the Lacreek Refuge. And above-ground rest sites were used during all seasons. The most frequently used rest sites by F-302 on the Lacreek Refuge consisted of marsh vegetation (Table 5). Because I always tried to avoid disturbing the otters at rest sites, I'm unable to describe the characteristics of these above-ground sites. In those instances when she seemed to repeatedly use these rest sites, I believe she probably fashioned them into some kind of cubby and lined the ground with dry cattails, similar to what she did at the site I discovered on 11 March (Figure 22).

Snow cover provides excellent insulation and delays freezing on the edges of waterways. F-302 and her pup took advantage of this, allowing them to exit ice-covered water and use cattails covered by snow drifts as a rest site several times. During winter, it is not uncommon for otters to burrow into the snow and create snow caves that are then used as rest sites (Melquist and Hornocker 1983). In March 2014, F-302 also used the space between 2 ice shelves as rest sites.

River otters do not typically excavate their own natal dens, instead, they modify and use those created by other animals (Melquist et al. 2003). Johnson and Berkley (1999) documented the construction of a natal den by an introduced female river otter that consisted of a loose mound of cattail stalks and dried grasses on top of a hummock. F-302 appeared to give birth to at least 1 young otter on the Lacreek Refuge where there was not enough ground above water for a den. The highest spot was an old caved-in beaver lodge that was <1 m above water, and this was not where she had her young. I located her at this site 16 times, but never got close enough to the natal den for fear of disturbing her, so I can't describe its composition. I believe she probably fashioned a dense cluster of cattails into a cubby with 1 or more entrances, then lined the den with cattail leaves and grass, possibly similar to the day bed she constructed and used in March 2014 (Figure 22). Surface den construction is rare and Johnson and Berkley (1999) believe that such behavior may have been confounded by the fact that the animals introduced to southern Indiana were exposed to habitats different from where they originated (Louisiana). However, in our case F-302 came from eastern South Dakota. And while it would seem she had sufficient time to find a more secure natal den, this could have been the first time she gave birth and she lacked the experience to find a better site. We will know more about the role of experience once we have accurate age data for this female.

Similar to what Johnson and Berkley (1999) observed, F-302's natal den was flooded out and she was forced to move her young approximately 1 km away to a dike road bank den sometime between 5 and 13 May (Figure 17). I was unable to determine whether or not this den was made by beavers or muskrats. Prior to the pup being old enough to travel with F-302, she moved it to a third location, a waterfowl nesting mound, where I recorded her inactive 20 times (Table 5, Figure 17).

DISCUSSION

Factors Important in Evaluating Suitability

The basic needs for any wildlife species, including otters, must be met in order for them to survive and flourish. Adequate food, water, and shelter must be available for otters to persist in any given area, including South Dakota. And any seasonal changes in these basic requirements will affect otter distribution and density. Because otters are aquatic animals that feed on aquatic prey, food and water are inseparable.

Food

In terms of foraging and feeding behavior, river otters are specialists. Melquist et al. (2003) reviewed the frequency of occurrence of major food categories in the river otter's diet in 28 states and 1 Canadian province. In nearly all studies, fish were the dominant prey of otters, followed by crustaceans (primarily crayfish). Slow-swimming and bottom-dwelling fish species are particularly susceptible to otters and they were found in high frequencies in the diet. Faster-swimming species, such as trout and other members of the family Salmonidae, appeared to be taken by otters in fewer numbers than their apparent abundance. Therefore, in terms of potential prey species, abundance does not necessarily equate to availability.

During their evaluation of the 17 waterways for otter suitability, Kiesow and Dieter (2005) indicated that fish families, per river, ranged from 5 to 14, with the number of fish species ranging from 9 to 33. They found that the James River, Vermillion River, and Big Sioux River had the most diverse prey base, but concluded that all 17 waterways had a sufficient number of prey species for otters. Based on what limited data I was able to obtain from visual observations of the instrumented otters and the kinds of prey remains found, high prey species diversity is not a critical factor in determining suitability for otters. Once the otter scats are analyzed, we will have a better idea as to the importance of prey species diversity.

Water

Water quality was found sufficient to sustain fish, and therefore otters, in the waterways evaluated by Kiesow and Dieter (2005). Rapid Creek and the White River had the lowest water quality ratings. Turbidity can affect the hunting ability of otters, requiring greater use of tactile senses, but it doesn't preclude use by otters (Beck 1993). I found the White River very turbid upstream from the confluence with the Little White River.

As previously indicated food and water cannot be separated when evaluating the suitability of a waterway for otters. Fish require sufficient water and, with few exceptions, otter require fish if they are to remain in a particular waterway. West River streams, including the Belle Fourche River, Cheyenne River, Grand River, Moreau River, White River, and the Little White River near its confluence with the White River, contain segments where the streambeds are wide as a result of a history of erosion, siltation is extensive, and water often only flows through a fraction of the streambed. Where these conditions occur, there is often no riparian habitat, banks consist of previously deposited sand and silt, and water depths are often not more than 30 cm. Such conditions undoubtedly impact fish species composition and distribution and, in turn, suitability for otters.

The greatest impact on fish distribution and survival is simply the availability of water. For those streams that stop flowing or have greatly reduced flow in autumn and winter, including the Bad River, Grand River, Moreau River, and Medicine Creek, resident fish die when pools shrink or dry up. These streams rely on fish migrating upstream once flows return in spring. An unpredictable and unreliable prey base reduces the suitability of these streams to seasonal use, even though they may have good riparian denning habitat (e.g., Bad River and Medicine Creek).

Shelter

A riparian zone with trees, shrubs, grasses, and other ground cover provide suitable shelter and escape cover for otters. Where trees and shrubs are mostly absent (e.g., the Lacreek Refuge), tall grasses and aquatic plants do provide necessary cover and shelter. Riparian vegetation along South Dakota streams is dominated by grasses and tree species (Kiesow and Dieter 2005), although I found some stream segments where the banks were lined with shrubs. Often times, large trees were so far back from the banks that they did not contribute to the creation of in-stream structure and were not a factor in providing suitable otter habitat.

South Dakota stream banks range from gentle to steep and low to high. The Bad River and Medicine Creek provide examples of steep and moderately high banks, while many stretches of West River streams are gentle and low. Banks sufficiently high enough to allow animals such as beavers and muskrats to create bank dens are an important component of otter habitat. However, bank substrate is also important. Beaver dens dug into bank material that tends to bind together last much longer than those in material such as sand and gravel that don't bind together very well. Several places where beaver had dug into the banks along the Belle Fourche, Cheyenne, and Little White Rivers caved in due to unstable substrate.

Winter probably has the greatest influence on otter distribution in South Dakota. A lack of water restricts usable areas and ice-covered waterways may be difficult to navigate. During winter, especially when waterways are frozen over, access to rest sites from under the ice near foraging areas with suitable prey is critical. Otters must be able to exit water to groom and rest, but they also need access to food. The ability of otters to persist in an environment covered with ice is due largely to past and present beaver activity.

Based on a survey conducted by SDGFP personnel, beaver are widely distributed throughout South Dakota (Figure 23). Beavers are important to a functioning ecosystem, and some believe their removal or elimination can result in a cascade of negative impacts (Waters 1995). The importance of beaver bank dens to otters, especially because of their underwater entrances, has long been known (see reviews on this relationship by Melquist et al. 2003 and SDGFP 2012). When waterways are completely iced over, as described above, the presence of beaver bank dens allows otters to exit the water in order to groom and rest. In the current study, both otters used old and fresh beaver bank dens extensively, even when waterways were open.

Suitability of the Little White River Based on Telemetry Data from Released Otters

It is clear that suitable food and shelter are available on at least portions of the Little White River to sustain otters over winter, and there is no reason to believe otters couldn't persist during other seasons of the year. There appear to be at least 40 fish species (30 native, 10 introduced), including several state endangered and threatened species, currently present in the White River/ Little White River drainage (Hoagstrom et al. 2007c). This would suggest that suitable aquatic prey exists throughout the Little White River drainage and is not a limiting factor during any season. However, it is likely that fish species diversity and density vary in accordance with variations in habitat throughout the drainage.

The Lacreek Refuge obviously provides year-round suitable habitat for otters, as F-302 remained there from February 2014 until she died on 19 January 2015. The Refuge provides, as potential otter food, a diversity of as many as 25 different fish species (Zimmerman and Burgess 1972) and an abundance of crayfish. Food and shelter on the Lacreek Refuge were adequate enough for F-302 to give birth and raise a pup, although the availability of safe and secure natal dens may be questionable.

The presence of good riparian habitat and in-stream structure upstream from the Recreation Area appeared to be of little importance when the Little White River was frozen over. Habitat use at that time was a function of the distribution of suitable rest sites (primarily beaver bank dens), as available prey seemed widely distributed. Consequently, banks high enough to allow

for the creation of bank dens are important and these features were evident throughout the drainage. There did not appear to be any instances when ice depth restricted otter movement. However, neither otter used the reservoir once it froze over.

Very little telemetry data were available from M-301 to be useful in evaluating the Little White River below the Recreation Area. Stretches of open water appeared to persist during winter throughout the Little White River downstream from the reservoir at the Recreation Area. In some of these stretches, woody plants were largely absent from stream banks, primarily because of intensive livestock grazing, and the water was shallow with few deep pools. With a lack of woody plants, beaver sign in these areas was sparse, although M-301 managed to find and use 1 of the few active beaver bank dens along a stretch of the river that was heavily grazed by livestock. I do not know how fish presence and distribution in some of these stretches are affected by the overall shallowness of the water and lack of pools. However, I believe the lack of escape cover and shelter and the uncertainty of available prey make these stretches generally unsuitable for otters. These stretches would probably serve primarily as travel corridors between areas of good habitat.

Current Threats

Current threats to otter populations in South Dakota are not all that different from other parts of their North American range. These threats include incidental trapping, animals killed by vehicles (road-kills), seasonal variations in available water, riparian habitat loss, stream degradation, and perhaps others. An unknown but potential threat is the impact that agricultural chemicals might have on otters.

Accidental trapping

Otters are vulnerable to being accidentally trapped by trappers targeting primarily beaver, although they are also caught in traps set for other aquatic furbearers. Data for confirmed sources of mortality for 57 river otters killed in South Dakota from 1979 through 2011 revealed that 71% were from trapping (SDGFP 2012). In Nebraska, accidental trapping accounted for 86% of otter mortalities, with beaver trapping responsible for 75% (n=51) of those with known trap target species (Bischof 2003). These data are not surprising when we consider the benefits otters receive from their commensal relationship with beaver.

Beaver are widely distributed throughout South Dakota (Figure 23), which is beneficial to otters, but it can also be problematic. Currently, beaver trapping in South Dakota is divided into 3 different seasons geographically (SDGFP 2014). According to the 2014 Furbearer

Regulations, in West River (excluding portions of the Black Hills as described below), body grip traps may be used for beaver year-round, and a South Dakota resident "*may catch, trap or kill furbearing animals upon land owned or leased by him without obtaining a license to do so, during any period when hunting, catching, taking, trapping or killing such animals is permitted*." In the Black Hills, the beaver trapping season extends from 1 January through 31 March on "*U.S. Forest Service land within the Black Hills Fire Protection District south of I-90 and west of SD Hwy 79*." In East River, beaver can be trapped from 1 November through 30 April. Except for the existing season in the Black Hills Fire Protection District, the current trapping season structure for beaver in South Dakota is not conducive to otter recovery in West River, and any season extending beyond 31 March risks capturing and killing female otters with dependent young. Furthermore, because a swimming otter can be mistaken for a beaver, unrestricted shooting of beaver could result in an otter being accidentally shot, further jeopardizing otter recovery, especially in West River.

The Wisconsin Department of Natural Resources analyzed the time of year when otters are harvested in the state. They found that 40% of the annual otter harvest occurs prior to ice-up, 20% occurred during ice-over, and 40% of the harvest took place after ice-out (John Olson, Furbearer Ecologist, email dated 14 April 2015). And according to Olson, few trappers make sets specifically for otters, as "they know, over time any good beaver set will most likely pick up an otter." While conditions in South Dakota and Wisconsin are not entirely the same, any open season for either otter or beaver that includes April runs the risk of a high percentage of otters being captured, many of which could be females with dependent young.

Vehicle road-kills

Vehicles accounted for 11% of the 57 river otters with confirmed sources of mortality (SDGFP 2012). Road-kills will always be problematic where roads cross the streams, lakes, ponds, marshes, and thoroughfares frequented by otters and other furbearers. And the number of otters killed will likely increase as populations increase and expand.

Water as a limiting factor

The amount of suitable habitat available to otters in South Dakota varies by season. By late autumn or early winter during normal years of moisture, streams without a consistently reliable source of water are either reduced to a trickle or completely stop flowing. Four of the waterways evaluated by Kiesow and Dieter (2005), including the Bad River, Grand River, Moreau River, and Medicine Creek, fit into this category. And the Bad River was rated first for suitability as an otter reintroduction site by the authors. Both the Bad River and Medicine

Creek have good otter habitat, but lack a reliable year-round water supply. In effect, the lack of permanent water in these streams limits the potential year-round distribution and possibly the density of otters in South Dakota.

Riparian habitat loss and stream degradation

Erosion of stream banks is a natural process that results from the tendency of streams to meander, a process that is often exacerbated by human activities that accelerate erosion and generate excessive sediment (Waters (1995). The author identified 2 processes chiefly responsible for enhanced erosion, including the transport of bank material by high flows (e.g., flooding) and bank failures that cause slumping of material directly into a steam, which is then transported by normal currents. Sediments deposited over time can cause a riverbed to literally rise, channels to become more shallow, and direct erosive forces laterally to widen the channel and erode banks. Numerous examples of this can be found on West River streams.

A healthy riparian zone is not only important to otters and a diversity of wildlife species, it is important in filtering several types of nonpoint-source pollutants from agricultural areas, including sediment. Buffer strips of vegetation in the riparian zone intercept and retain sediment before it reaches the stream. Unfortunately, riparian habitat and the buffering capacity of the riparian zone in South Dakota has been widely degraded or destroyed by livestock or replaced with agricultural crops, thus reducing or losing the filtering effect. Riparian habitat in the more arid environment of West River streams appears more impacted by livestock, as cattle, with unrestricted access, are attracted to forage and water in riparian zones. In East River, the impacts on riparian habitat seem to be more shared by livestock and agricultural crops.

Among all sources of pollution afflicting streams and rivers, agriculture in its several forms is by far the most important, with over 3 times the amount of pollution contributed by the next leading source (USEPA 1990). Principal sources are row-crop cultivation on floodplains and livestock grazing in riparian zones, practices that are common throughout South Dakota.

Livestock affect streams by trampling and destabilizing stream banks. Destabilized and slumped banks result in widened channels, decreased water depths, elevated water temperatures, altered current velocity, and extensive sediment deposition. The consequences include loss of wildlife habitat in riparian zones and loss of stream bank cover for fish, situations that do not benefit otters. These conditions seem most apparent in West River streams. While conducting stream survey routes and float surveys, it was difficult to find places where water exceeded 1-1.5 m in depth because of sediment deposition.

Floodplain cultivation has been labeled one of the major anthropogenic sources of sediment, especially in warm-water streams (Waters 1995). Fall plowing that leaves tilled soil exposed to spring floods is an important sediment source should floodwaters inundate these fields, a situation that was particularly evident at numerous locations along the James River in 2011. And based on his review of current knowledge of sediment in streams, Waters (1995) found that a common source of sediment production in the agricultural Midwest was cultivation too close to a stream edge, resulting in the virtual loss of the riparian zone and crumbling stream banks. This practice is all too common in South Dakota.

Waters (1995) reviewed the impacts of sediments on fish populations and provided the following observations. The loss or reduction of fish populations has long been associated with turbidity and siltation of streams. One of the most important effects of deposited sediment upon the physical habitat of fish is reductions of water depth in pools, which decrease physical carrying capacity for juvenile and adult fish during summer growth periods. And sediment can threaten fish reproductive success and loss of rearing habitat. Heavy sediment deposition on streambeds can smother the physical habitat of macro-invertebrates, including crustaceans like crayfish and molluscs. And crayfish are certainly important prey for otters where they occur in South Dakota and throughout their range (Melquist et al. 2003).

Fortunately, riparian areas can quickly recover provided they are given adequate protection. The evidence is overwhelming that fencing in western areas has resulted in less sedimentation, better channel and stream bank conditions, improved habitat, and higher fish densities (many references cited by Waters 1995). Fencing not only prevents livestock from trampling stream banks, fencing also protects the rich vegetation of a riparian zone, which may act to filter sediment in runoff from grazed and cultivated uplands (Elmore 1992 as cited in Waters 1995).

Examples of robust riparian habitat can be found around South Dakota in protected areas such as state parks and federal refuges. Some private landowners are protecting riparian habitat, primarily to enhance hunted species, but many wildlife species benefit. Wildlife has benefitted from the Conservation Reserve Program (CRP), but more could be done. Agricultural buffer strips should be an integral part of the CRP.

Population Trend

A canine tooth from 52 South Dakota otter carcasses collected by SDGFP since at least 2006 were aged by Matson's Laboratory, Miltown, MT (Silka Kempema, pers. commun.). The oldest otter was 10 years old, 75% were ≤2 years old, and 1-year-old otters made up 44% of the total.

Based on the age structure of these otters and the high percentage of young animals, there is a reproducing and likely increasing population of otters on the Big Sioux River drainage and tributaries of the Minnesota River (e.g., Jorgenson River, Little Minnesota River, Whetstone River, and Yellow Bank River), the source of these samples.

If these populations are increasing in size, they are also likely expanding into new areas. The role these populations will play in affecting recovery in South Dakota is unknown. Streams of the Minnesota River drainage will likely contribute little to population recovery in the state. Conversely, otters in the Big Sioux River will continue to expand into tributaries, lakes, and ponds within the drainage, but should be a source for additional expansion into other waterways.

Need for Reintroductions

Role of past releases

In their analysis, Kiesow and Dieter (2005) recommended that otters be reintroduced in the 5 streams identified as the most suitable for sustaining a population. While these waterways may be perceived as the most suitable sites for releasing otters, other factors need to be considered in determining which drainages may offer the best opportunity to help restore otters to South Dakota. For example, it may be beneficial to release only conflict otters in drainages that appear to have a small, but existing population (e.g., James and Vermillion Rivers). And it would seem counterproductive to release otters in drainages/sections of drainages where released otters may contribute little to the restoration of populations in South Dakota (e.g., the NF Whetstone River and other streams that drain into the Minnesota River).

I believe it would be prudent to consider the effectiveness of past releases in South Dakota and surrounding states and the potential for movement by otters between drainages prior to reintroducing additional otters to South Dakota. Boyle (2006) believed that management to increase the distribution of river otters into suitable habitats is best accomplished through natural recolonization, with reintroductions employed as the last option. In South Dakota, having a greater understanding of the resident populations should be a prerequisite to further releases.

The release of the 34 otters near Flandreau in 1998 and 2000 was the source population for otters in the Big Sioux River drainage and likely the James and Vermillion River drainages. It is an example of how reintroducing otters can jumpstart population recovery and expansion. States adjacent to South Dakota, including Iowa, Nebraska, and Minnesota have either

reintroduced river otters or translocated them within the state (Minnesota) in an effort to restore or bolster populations. One of the 159 otters released in Nebraska between 1986 and 1991 was found dead in South Dakota (Bischof 2003). In all likelihood, this otter came from the release on the Niobrara River in northern Nebraska, as this river drains into the Missouri River near Springfield, SD. Researchers in Nebraska found that the average straight-line distance between the release site and where an animal died was 90.7 km (n=37). And at least 2 released otters from Nebraska were recovered in Missouri. One of these otters was accidentally captured in the Missouri River 120 km west of St. Louis, MO, a straight-line distance of 767 km (Bischof 2003).

The Nebraska examples reveal how otters can, and do, disperse beyond political boundaries. And in the past 20 years, otters have been reestablishing naturally in the Red River of the North drainage in the eastern portion of North Dakota. South Dakota has been a beneficiary of these releases and expanding populations, and the benefits should continue as these populations continue to expand. The question remains as to whether or not these past efforts are sufficient to result in the eventual restoration of otters in South Dakota?

Movements between major drainages

River otters are surprisingly mobile and capable of overland movements that include crossing mountain ranges (Melquist and Hornocker 1983). In South Dakota, otters have recently been reported in the prairie potholes and other locations not connected to a particular drainage. On 29 March 2015, a male otter was killed on Hwy 12 between 2 potholes, 5 km west of Webster, SD (Jacquie Ermer, pers. commun.) This location is between the James River and Big Sioux River drainages, and the animal could have originated from either drainage. On 14 April 2014, what appeared to be a male otter was photographed in the parking lot of the Minnehaha County Courthouse near Sioux Falls, SD. (Julie DeJong, pers. commun.). DeJong also reported the November 2014 locations of 2 accidentally trapped otters that were 19 km and 14 km west of the Big Sioux River. Finally, in March 2014, DeJong followed the tracks of an otter, and in her own words, described the movements: "We tracked the otter from one small ice-covered cattail slough to another. The path it took went from a small slough that was right next to the gravel road, into the ditch, along the ditch for about a hundred yards, over the gravel road, into the next ditch, along that ditch for about 50 yards, across the corner of a bare crop field, out into the other ditch, across the next gravel road, and down that ditch for another ¼ mile to another cattail slough." The Vermillion River was 15 km to the west, Lake Thompson 16+ km to the northwest, and Lake Badus 11 km to the southeast. These were the only likely places with open water when the observation was made.

While these seemingly unusual movements may be attributed to dispersal of yearling otters or the spring breeding season, they do provide examples of the potential for movements between the major East River drainages. Otters could conceivably move between the Minnesota River drainage and the Big Sioux River at Flandreau and Medary Creeks in South Dakota and the Yellow Medicine River in Minnesota via Lake Benton. Another movement corridor could be at Lake Hendricks, on the border, which connects the Lac qui Parle River in Minnesota and Medary and Deer Creeks in South Dakota. A third location could be between the NF Yellow Bank River (Minnesota River drainage), which looks like a good otter stream, and Mud Creek, which appears to be an intermittent stream, and drains into the Big Sioux northwest of Watertown, SD. The common area for these 2 streams is Punished Womans Lake and Round Lake, adjoining lakes where otters occur. The last of these potential movement corridors is associated with what appears to be the southern part of the prairie pothole region, where it is not as expansive as farther north.

Conceivably, otters could move between the Big Sioux and Vermillion Rivers by moving through Skunk Creek and a chain of lakes that include Brant Lake, Round Lake, Lake Madison, and Lake Herman. This would require animals to move through Madison, SD, by way of Park and Silver Creeks. However, I have not looked closely at this potential travel corridor, so it may not be practical. More realistic would be for otters to disperse from the Big Sioux to the Vermillion River via the Missouri River, where suitable habitat exists.

Collecting data from resident otters

Little is known about the ecology and population dynamics of resident otters. Therefore, it might be prudent to see what can be learned from those otters already occupying parts of the State. For more than 25 years, Passive Integrated Transponder (PIT) tags, also known as "microchips," have been used to permanently mark individual animals. Otters accidentally trapped, but not injured, could have a PIT tag inserted under the skin prior to being released. Recaptured animals could provide a variety of useful information. However, amount of data collected may not be sufficient to be meaningful.

Another option to consider is to instrument captured otters with intraperitoneal implant transmitters prior to their release. While these animals would require periodic monitoring, the knowledge gained would be useful in helping to determine the potential effectiveness and need for a reintroduction. The cost of purchasing, transporting, releasing, and monitoring otters from sources outside of South Dakota would be substantial. Through patience and focusing on collecting data from resident otters, the same recovery goal could be achieved, although it would likely take more time.

Benefits of a reintroduction

Reintroductions have successfully restored otters in states where they were extirpated and bolstered small or remnant populations (Melquist et al. 2003). By the year 2000, more than 4000 otters had been released in 21 states (Raesly 2001) and Alberta (Melquist and Dronkert 1987), and additional releases have occurred since then. Present-day distribution is beginning to look similar to when Europeans settled North America, requiring needed changes in distribution maps. I believe the evidence is overwhelming that reintroductions are effective in restoring otters, and there is no reason to believe that it wouldn't be successful in South Dakota. A 2012 survey of South Dakota residents found that 50% of those surveyed supported releasing river otters into suitable habitats in the State, while 11% disagreed (Gigliotti 2013). So it is clear there is strong support for otter recovery. And recovery goals in South Dakota could be reached much more quickly by releasing otters from a source outside the state. The question that needs to be answered is whether or not a reintroduction is absolutely necessary for recovery, or could recovery be achieved, admittedly more slowly, by either allowing natural expansion to occur, or by moving resident otters to locations within the state where the number of otters appears low?

RECOMMENDATIONS

Parameters for Delisting

Demographic parameters, including size, structure, and distribution of the South Dakota otter population will be necessary for delisting to go forward and for any consideration of a harvest. I recommend that biological data (e.g., sex, age, reproductive condition, presence of parasites) continue to be collected from dead otters recovered by SDGFP. Age structure of this "unintentional harvest" can be useful in gauging the reproductive health and dynamics of the otter population. Trend data and the expansion of otters into previously unoccupied areas can provide insight into the health of the existing population and the suitability of the habitat in previously unoccupied areas.

While biologists still haven't been able to develop a method to accurately estimate population density based on survey data, distribution and population trend data can be obtained through some variation of bridge sign surveys. I would recommend that standardized winter bridge sign surveys be established. Survey options could be similar to those used in Nebraska, where they don't leave the bridge (Wilson 2011), in Ohio, where they survey 300 m upstream and downstream from the bridge (Prange 2011), or the methods employed by Shardlow et al. (2009) in Kansas. I would also encourage exploring survey options used in other Midwestern states in an effort to find an appropriate survey method suitable for South Dakota.

Need for reintroductions to expand otter populations in South Dakota

I believe there are options available to SDGFP for increasing the density and expanding the distribution of otters in the state. The 2 options offered here are based on different assumptions for recovery goals.

Option 1 is based on the assumption that otter restoration in only East River streams is necessary to meet recovery goals.

This option would focus on using only resident otters to augment existing populations on the James River and Vermillion River drainages. The source of otters for this augmentation would be the Big Sioux River drainage and tributaries of the Minnesota River. Available otters could be those incidentally live-trapped, conflict otters that require moving, or otters intentionally captured for the purpose of moving them. This option makes sense if a determination is made that West River streams are neither part of the recovery effort nor necessary for achieving recovery goals.

Option 2 is based on the assumption that otter restoration in East River and West River streams is necessary to meet recovery goals.

There probably wouldn't be an adequate supply of otters available in South Dakota to augment small East River populations and establish viable breeding populations in West River streams. Therefore, this option would require purchasing otters from a source or sources outside of South Dakota for release at previously identified locations on the Cheyenne River, Belle Fourche River, and Little White River in order to expand the otter population west of the Missouri River. However, beaver harvest regulations, as described below, should be changed or the restoration effort may be fortuitous. Also under this option, I would recommend that East River streams continue to be augmented, but only by resident South Dakota otters. Kiesow (2003) outlined a reintroduction protocol and recommended a release of 120 otters in the state, with a minimum of 100. While the number may seem somewhat arbitrary and based on releasing otters in 5 streams, most parts of the protocol appear reasonable. I recommend a review of past successful restoration efforts in other states be combined with Kiesow's protocol and recommendations prior to establishing the number of otters for release in the West River streams.

Conflict otters and reintroduction sites

Recommended sites for future releases of otters have been identified for each of the SDGFP Wildlife Division Administrative Regions (see Appendix 3). Recommended age, sex, social status, and time of year when conflict otters should be trapped and moved are summarized in Appendix 2. Depending on ice conditions, winter may not be the best time to move otters, especially if the release site is frozen over.

Future surveys for occupancy

Aerial winter surveys, also recommended by Ermer (2006), and winter bridge sign surveys would, in my judgment, be the most practical means of determining otter occupancy. If possible, bridge sign surveys conducted on individual streams should be spaced no farther than approximately 16 km apart to reduce the possibility of missing the sign of otters residing between 2 adjoining survey sites. I recommend that future survey efforts focus on permanently flowing sections of the following West River streams:

- Bad River. Likely only the lower stretch that is influenced by Lake Sharpe.
- Belle Fourche River, upstream from the confluence with the Cheyenne River to, and including the Redwater River and Spearfish Creek.
- Cheyenne River, primarily between the confluence with Rapid Creek upstream to Angostura Reservoir, including the lower sections of Battle Creek, Spring Creek, and other tributaries of the Cheyenne River that contain sufficient flowing water (see Rapid Creek, below).

- Grand River. Likely only the lower stretch that is influenced by Lake Oahe.
- Little White River, including Lake Creek and Spring Creek.
- Moreau River. Likely only the lower stretch that is influenced by Lake Oahe.
- Rapid Creek, downstream from Hwy. 79/168 to the confluence with the Cheyenne River.
- White River (below the confluence with the Little White River).

Winter bridge sign surveys could be conducted on small tributaries that drain into the Missouri River between the mouth of Medicine Creek (Lake Sharpe), upstream to the North Dakota border, provided they contain sufficient water.

Long-term monitoring for population trends

For long-term monitoring purposes, I recommend that standardized winter bridge sign surveys be established at selected sites in the major drainages within each SDGFP Wildlife Division Administrative Regions as a method of collecting population trend data. Two survey methods to consider include those used in Nebraska, where the surveyor doesn't leave the bridge (Wilson 2011), or in Ohio, where they survey 300 m upstream and downstream from the bridge (Prange 2011, 2015). Survey routes where streams are completely frozen over probably wouldn't be productive; otters have to be able to exit the water in order to leave sign of their presence. The method used in Ohio doesn't require snow cover and would be less restrictive.

Beaver trapping season

I do not believe current regulations for harvesting and controlling beaver populations in South Dakota are conducive to the expansion of otters in West River and could hinder the rate of growth in East River. In South Dakota, female otters give birth on approximately 1 April. Any lactating female otter trapped and killed will result in the loss of her offspring. To reduce the possibility of trapping female otters with dependent young, beaver trapping seasons should not extend beyond 31 March. The unrestricted take of beaver that is currently allowed in West River should be replaced with a harvest season not to extend beyond 31 March if SDGFP plans to try and recover otters in that region of the State. Unregulated shooting of beaver should be discouraged or prohibited to avoid accidentally shooting an otter.

Habitat improvements

The prevention of sediment generation due to livestock overgrazing lies almost solely in one structural form—fencing of the riparian zones. Fencing has been proven to be an effective method of restoring riparian habitat, with many other associated benefits. While the land may belong to the landowner, the water belongs to the public. The many benefits of fencing should

be shared with landowners and they should be discouraged from allowing cattle total access to our waterways.

The many benefits to water quality and wildlife habitat from buffer strips are clear and have been discussed previously. Restricting cattle from streams and discouraging the planting of row crops up to the edge of streams and in flood plains would go a long way in restoring riparian habitat for otters and many other wildlife species. A Minnesota state statute requires a 50' (15.2 m) wide buffer strip on some streams to reduce soil erosion and improve water quality (Minneapolis Star Tribune, 1 February 2015). And at a Minnesota Pheasant Summit in December 2014, participants identified enforcement of existing buffer requirements as the top priority for boosting pheasant (*Phasianus colchicus*) habitat. Agricultural buffer strips, wide enough to dissipate the sediment load, should be an integral part of the Conservation Reserve Program (CRP). The establishment of buffer strips, initially through an incentive program, should be pursued in South Dakota.

Need for further research

I believe further research should be a prerequisite to both delisting and any consideration of a harvest season. The use of radio telemetry provides the greatest opportunity to collect meaningful biological data on otter ecology and how otters are impacted by human activity. A telemetry project should involve monitoring resident animals in the Big Sioux River drainage and tributaries of the Minnesota River drainage (e.g., Whetstone River and Yellow Bank River). I also recommend the use of telemetry to monitor otters translocated within South Dakota. For example, what was the fate of 2 otters captured at a private pond near the East Fork of the Vermillion River and released on the James River? Did they remain in the release area, or did they move? And, if they moved, how extensive was their movement? Is it possible that they moved back to the Vermillion River? These kinds of questions could be answered by employing telemetry to future translocated otters.

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Table 1. Streams surveyed to determine river otter distribution and suitability of sites for river otter reintroduction, 2011-2013. Distances are linear from the starting point, except for the floated segments, which are estimates of the actual stream length.

Stream Surveyed	Bridge Only	Stream Segments (km)	Floated (km)
Bad River	11	3 (2.8 km)	
Belle Fourche River	10		1 (22.5 km)
Redwater River	3		
Spearfish Creek	1		
Big Sioux River*	38		
Bois de Sioux River	1		
Jim Creek (& tributaries)	7		
Lake Traverse	1		
Cheyenne River	7	4 (6.6 km)	2 (17.7 km, 77.3 km)
Rapid Creek	8	2 (2.7 km)	
Grand River (main stretch)	7	1 (0.8 km)	
North Fork Grand River	3		
South Fork Grand River	4		
James River*	24		
Minnesota River (tributaries)			
Continental Divide (Bois de Sioux/Minn. R)	1		
Lac qui Parle River (& tributaries)	12		
Jorgenson River (& tributary)	4		
Little Minnesota River	4		
NF Whetstone River (& tributaries)	28		
SF Whetstone River (& tributaries)	8		
Yellow Bank River	2		
NF Yellow Bank R (& tributaries)	29		
SF Yellow Bank R (& tributaries)	17		
Missouri River (small tributaries)			
Oak Creek (Lake Oahe)	2		
Medicine Creek (Lake Sharpe)	1	1 (2.5 km)	
Cedar Creek (Lake Sharpe)	1		
Counselor Creek (Lake Sharpe)	1		
Campbell Creek (Lake Francis Case)	1		
Crow Creek (Lake Francis Case)	1		
Wolf Creek (Lake Francis Case)	1		
Moreau River (main stretch)	8		
North Fork Moreau River	3		
South Fork Moreau River	4		
Vermillion River (Main stretch)	26		
East Fork Vermillion River	16	1 (0.5 km)	
West Fork Vermillion River	5		
White River	8		
Little White River	21	1 (1.8 km)	
Lake Creek	1		
TOTALS	330	13 (17.7 km)	3 (117.5 km)

*The total does not include bridge surveys conducted on tributaries.

Table 2. Survey routes and float surveys conducted for river otters in South Dakota.

Date	Waterway	Survey #	Length of Surveys
9/7/2012	Cheyenne River	CR-1	1.7 km (0.5 upstream; 1.2 downstream)
9/8/2012	Cheyenne River	CR-2	1.0 km downstream
9/9/2012	Bad River	BR-1	1.1 km upstream
9/10/2012	Bad River	BR-2	0.8 km downstream from RR bridge
9/10/2012	Bad River	BR-3	0.9 km upstream
9/12/2012	Medicine Creek	MC-1	2.5 km (0.6 upstream; 1.9 downstream)
9/14/2012	E Fork Vermillion R	EFVR-1	0.5 km (0.2 upstream; 0.3 downstream)
9/23/2012	Grand River	GR-1	0.8 km downstream
9/25/2012	Cheyenne River	CR-3	1.5 km downstream
9/25/2012	Rapid Creek	RC-1	2.1 km (to confluence with Cheyenne R.)
9/26/2012	Rapid Creek	RC-3	0.6 km downstream
9/27/2012	Cheyenne River	CR-4	2.4 km downstream
9/29/2012	Little White River	LWR-1	1.8 km (1.0 upstream; 0.8 downstream)
10/2/2012	Belle Fourche River	BF-3	22.5 km float
10/8/2012	Cheyenne River	CR-3A	17.7 km float
10/1-3/2013	Cheyenne River	None	77.3 km float
TOTALS	13 survey routes/3 floats		135.2 km

Table 3. Summary of telemetry data for male river otter M-301 and female otter F-302.

Type of Telemetry Data	M-301	F-302
Monitoring period	11/14/2013 – 3/25/2014	11/14/2013 – 1/19/2015
Days located and monitored	58	229
Minutes active during monitoring	3,783	12,009
Minutes inactive during monitoring	5,400	16,048
Total minutes monitored	9,183*	28,057*
Visual observations:		
Number of observations	22	56
Total minutes observed	113	208
Different days observed	8	24
Active locations with data points	54	172
Inactive locations with data points	51	193

*Does not include time monitored by Shilo Comeau, Lacreek NWR, and Tom Beck, SDGFP, as they did not record the time.

Table 4. Rest sites used by male river otter M-301 between 11/15/2013 and 3/25/2014.

Rest Site Description (*)	General Location	Times Used (%)
Dense brush/willow trees (1)	Little White River Recreation Area	1 (02)
Old beaver bank den (1)	Little White River Recreation Area	14 (27)
Old beaver bank den (12)	Little White River	22 (42)
Active beaver bank den (3)	Little White River	12 (23)
Grass bank (3)	Little White River	3 (06)
TOTALS (20)		52 (100)

*Numbers in parentheses indicate the different locations used for that type of rest site.

Table 5. Rest sites used by female river otter F-302 between 11/15/2013 and 1/13/2015.

Rest Site Description (*)	General Location	Times Used (%)
Old beaver bank den (7)	Little White River (LWR)	38 (20)
Old beaver bank den (2)	Lacreek Natl. Wildlife Refuge (NWR)	17 (09)
Suspected old beaver bank den (1)	LWR Rec. Area/Game Production Area	4 (02)
Beaver bank feeding burrow/den (1)	Lacreek NWR	5 (03)
Dike road: old beaver/muskrat bank den (1)	Lacreek NWR	1 (<1)
Suspected muskrat bank den (1)	Lacreek NWR	1 (<1)
Above-ground sites:		
Marsh vegetation (primarily cattail) (33)	Lacreek NWR	61 (32)
Day bed in cattails (1)	Lacreek NWR	4 (02)
Dense brush (2)	Lacreek NWR	2 (01)
Ice shelf and beached vegetation (1)	LWR Rec. Area/GPA	1 (<1)
Snow-covered (drifted) cattails (1)	Lacreek NWR	3 (02)
Between ice shelves in cattails (2)	Lacreek NWR	7 (04)
Suspected beaver-cut trees in pond (1)	Lacreek NWR	1 (<1)
Unknown (1)	LWR	1 (<1)
Natal sites (in order of use):		
Marsh vegetation (cattails) (1)	Lacreek NWR	16 (08)
Dike road; old beaver or muskrat den (1)	Lacreek NWR	11 (06)
Waterfowl nesting mound/island (1)	Lacreek NWR	20 (10)
TOTALS (58)		193

*Numbers in parentheses indicate the different locations used for that type of rest site.

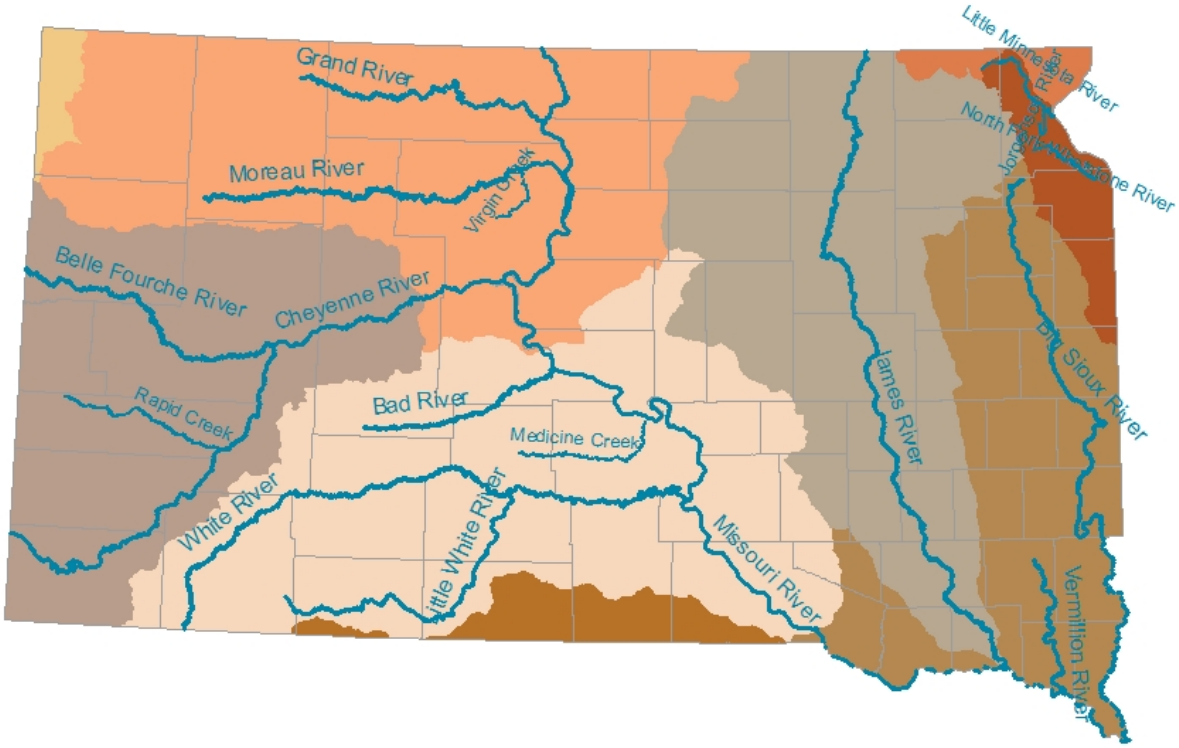

Figure 1. Seventeen waterways in South Dakota were selected by Kiesow and Dieter (2003) to determine river otter occupancy and evaluate their suitability for reintroduction.

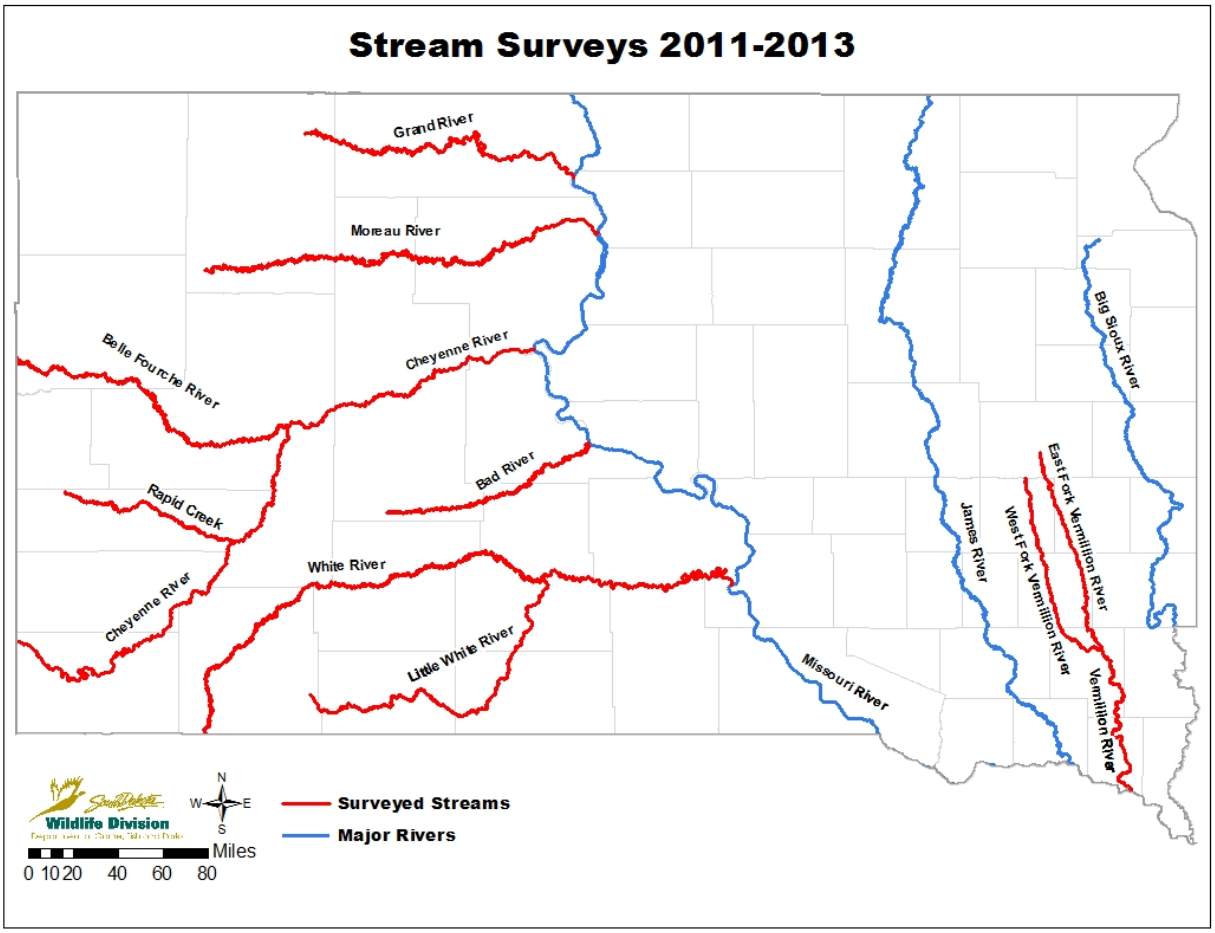

Figure 2. Nine South Dakota streams (red) were surveyed for river otters in 2011-2013. No confirmed otter observations had been reported for these streams during a 5-year period between 2007 and 2011.

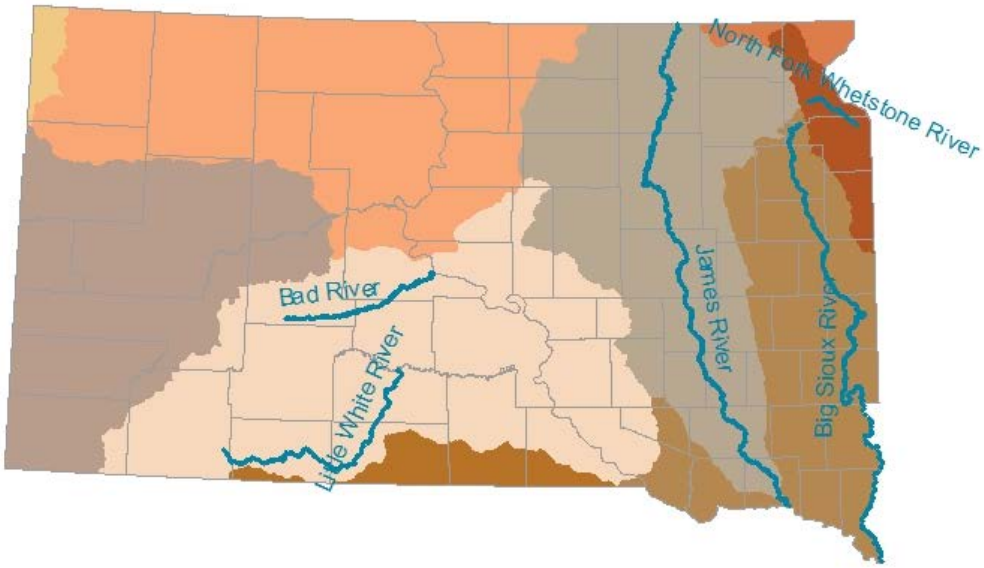

Figure 3. The 5 streams considered suitable for reintroducing river otters to South Dakota (Kiesow and Dieter 2005).

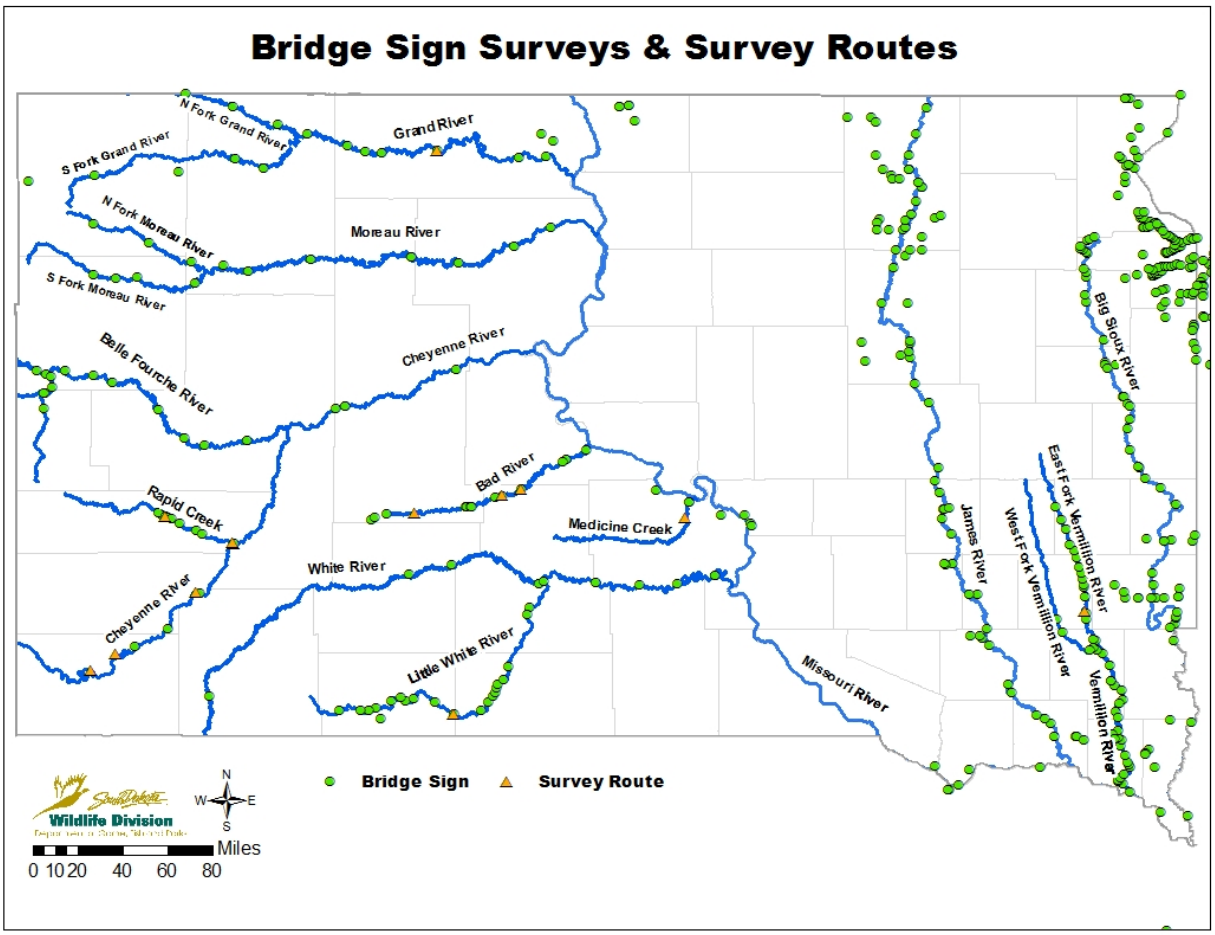

Figure 4. Distribution of bridge sign surveys (green dots) and survey routes (gold triangles) conducted in South Dakota streams, 2011-2013.

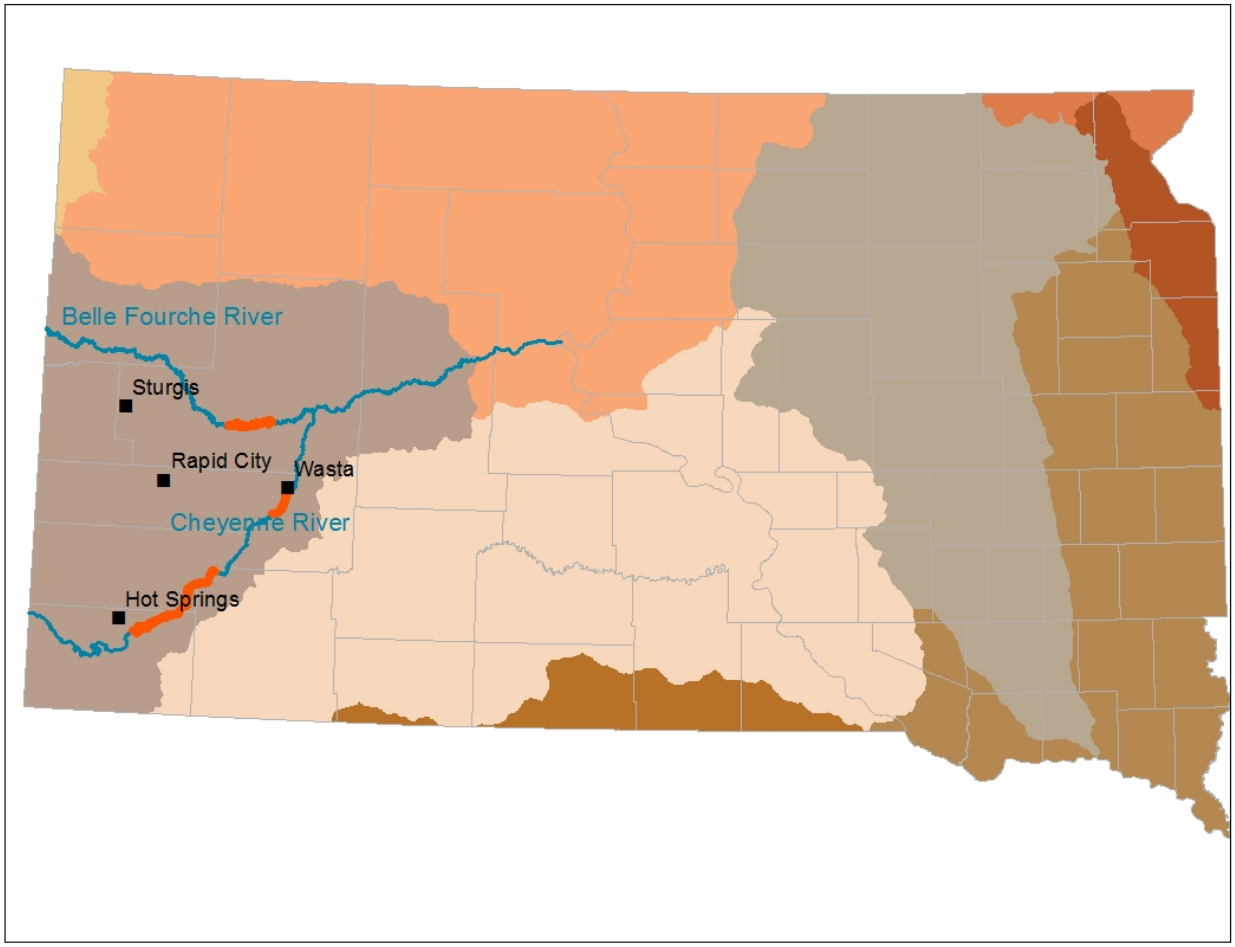

Figure 5. Locations of 3 float survey routes completed on the Belle Fourche and Cheyenne Rivers.

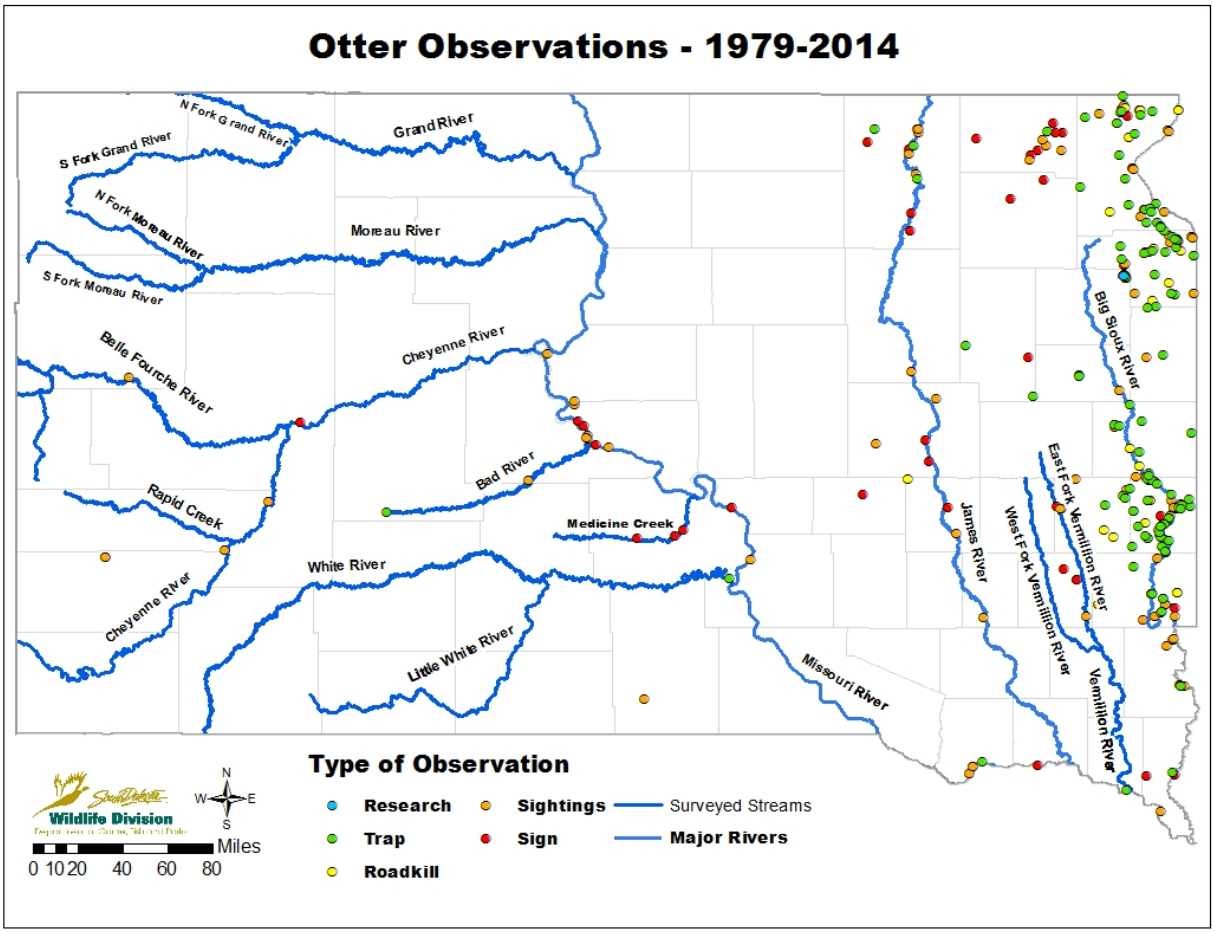

Figure 6. Distribution of otter observations received by SDGFP, 1979-2014. Not all of the reports documented on the map have been confirmed. Sighting and sign observations should be considered “possible” or “probable” unless accompanied by a photograph or other evidence that would allow confirmation as an otter.

Figure 7. Release site on the SDGFP Little White River Game Production Area and adjacent Little White River Recreation Area (administered by the Lacreek National Wildlife Refuge).

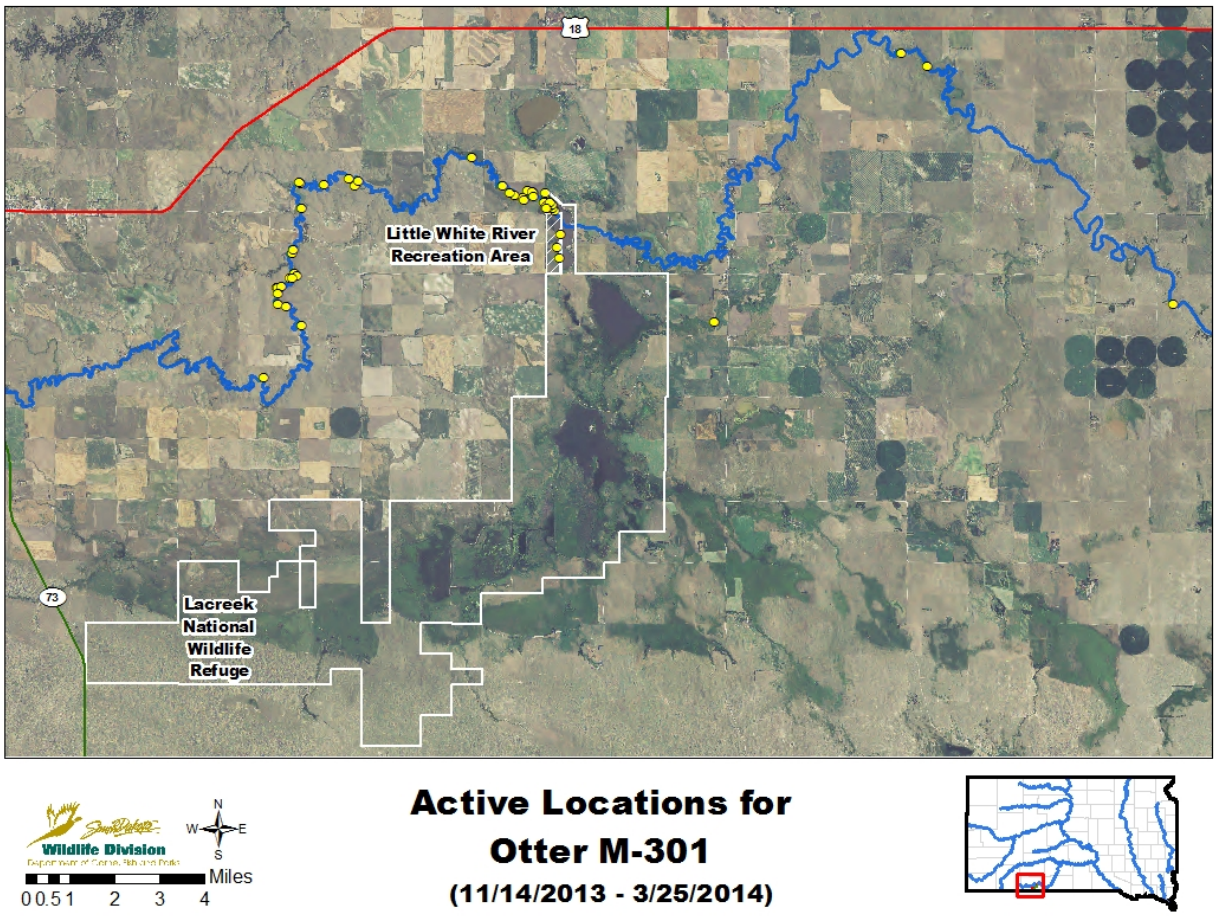

Figure 8. Distribution of active locations (yellow dots) for M-301 on the Little White River drainage (11/14/2013-3/25/2014).

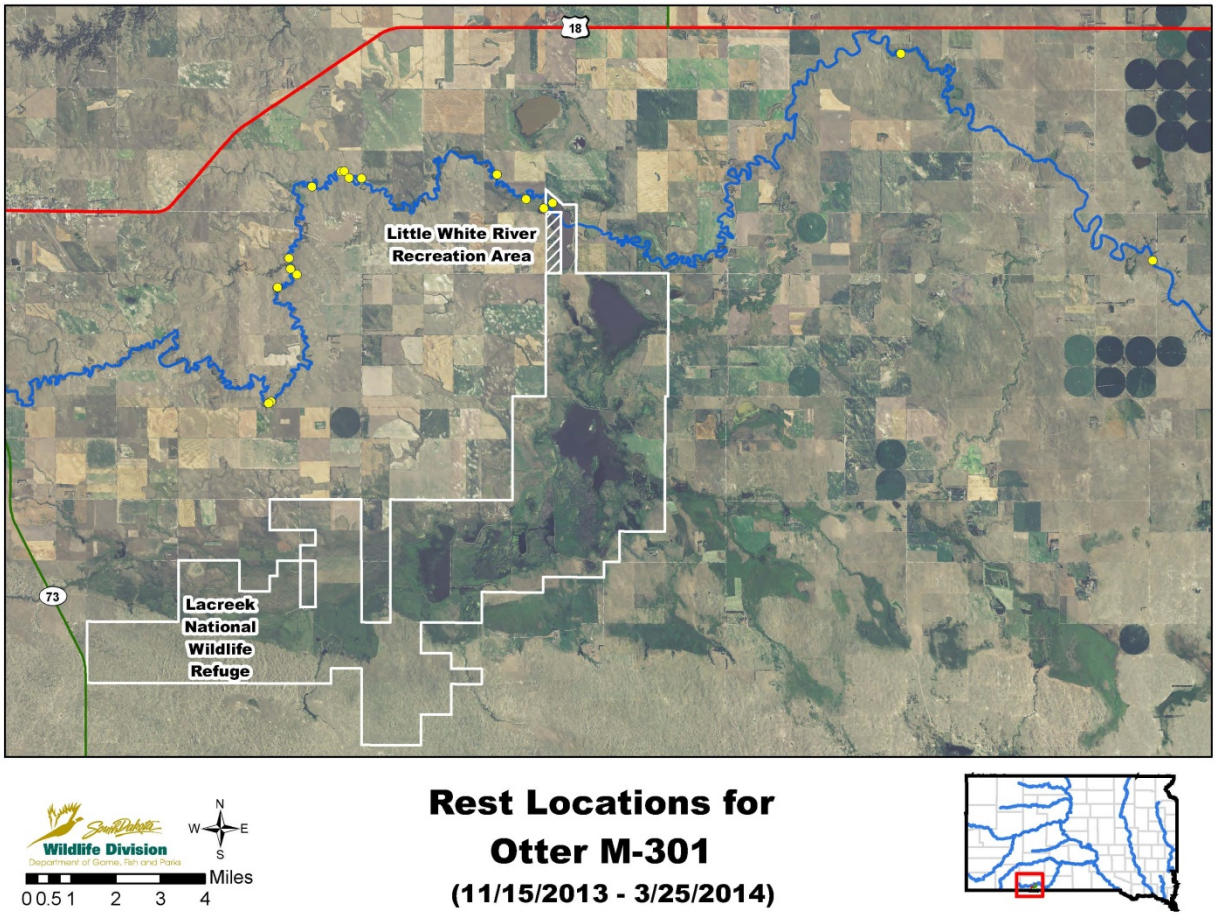

Figure 9. Distribution of rest sites (yellow dots) used by M-301 on the Little White River drainage (11/15/2013-3/25/2014).

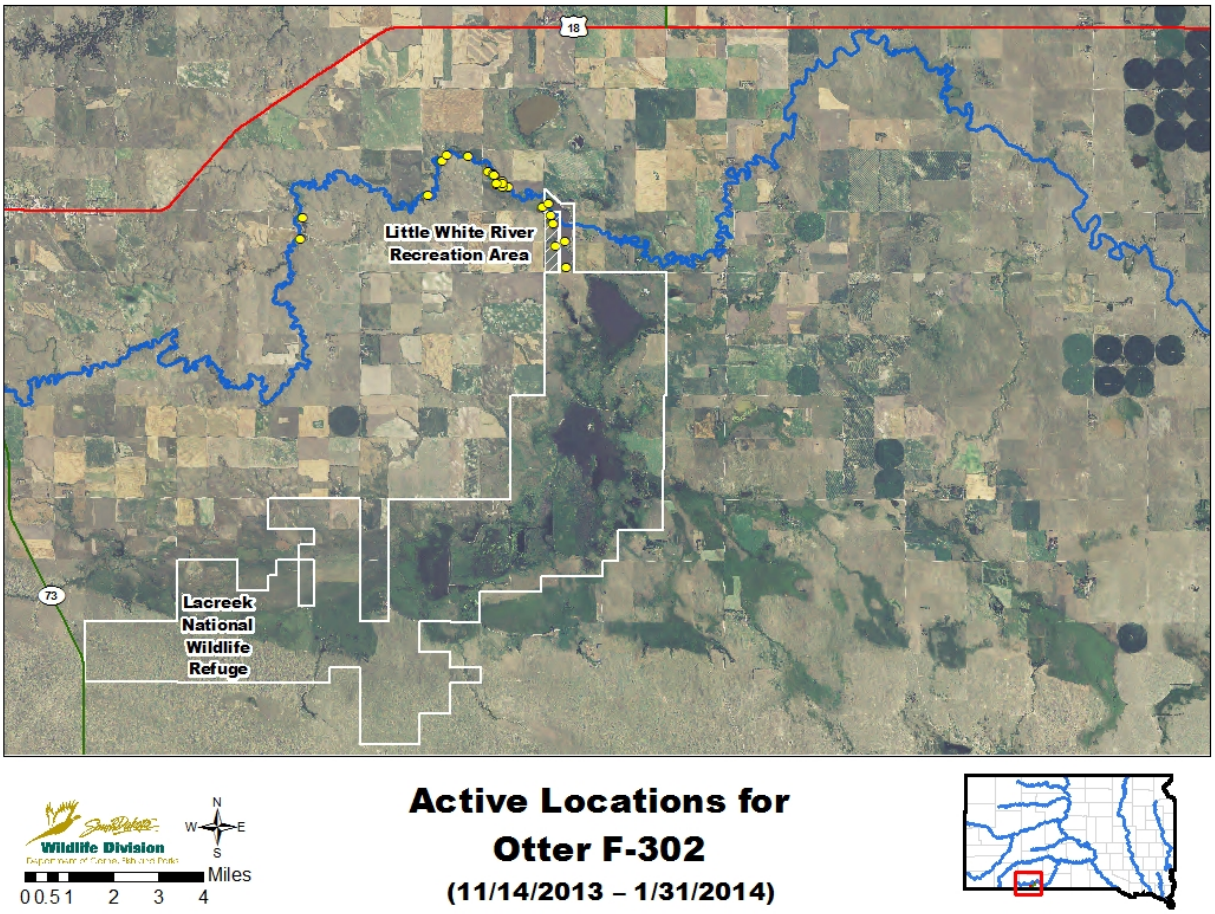

Figure 10. Distribution of active locations (yellow dots) for F-302 on the Little White River (11/14/2013-1/31/2014).

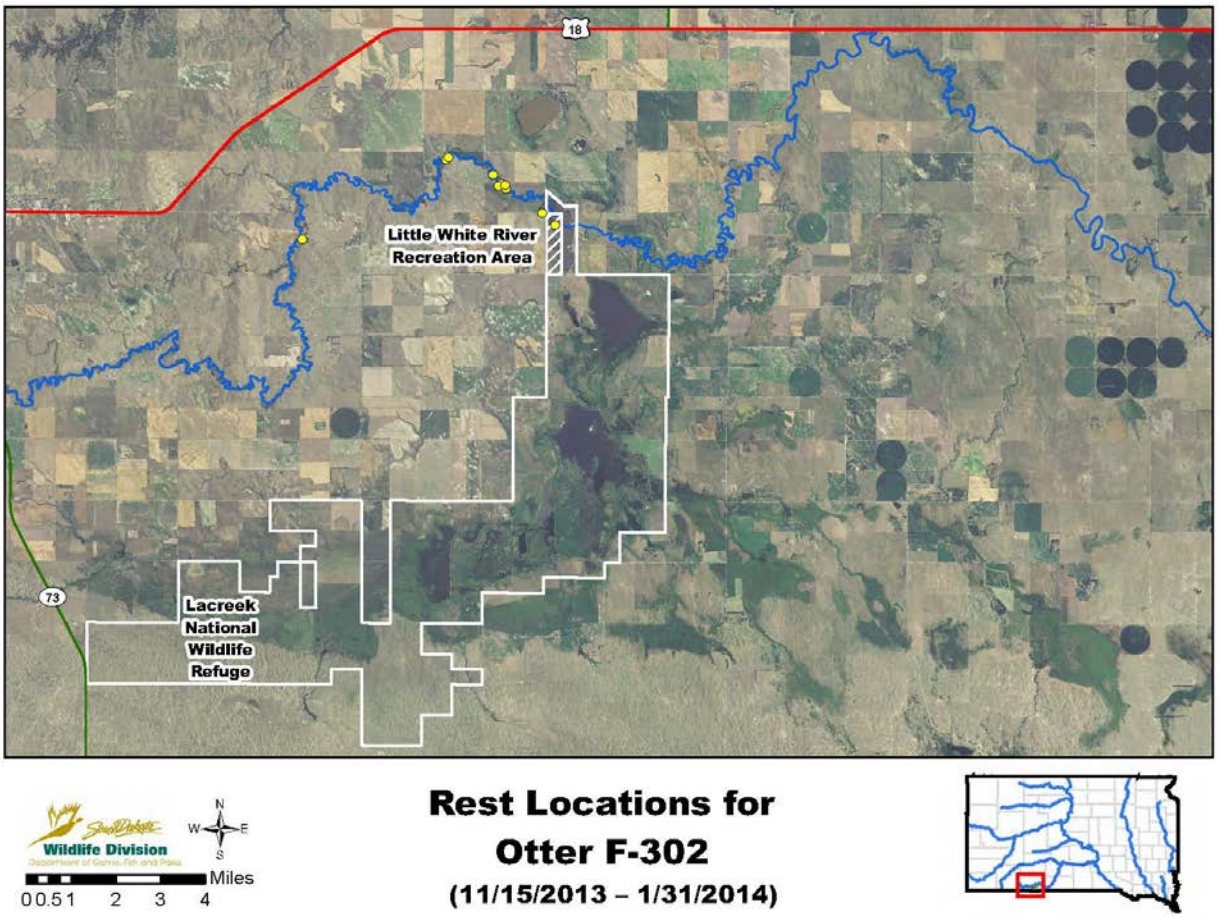

Figure 11. Distribution of rest sites (yellow dots) used by F-302 while on the Little White River (11/15/2013-1/31/2014).

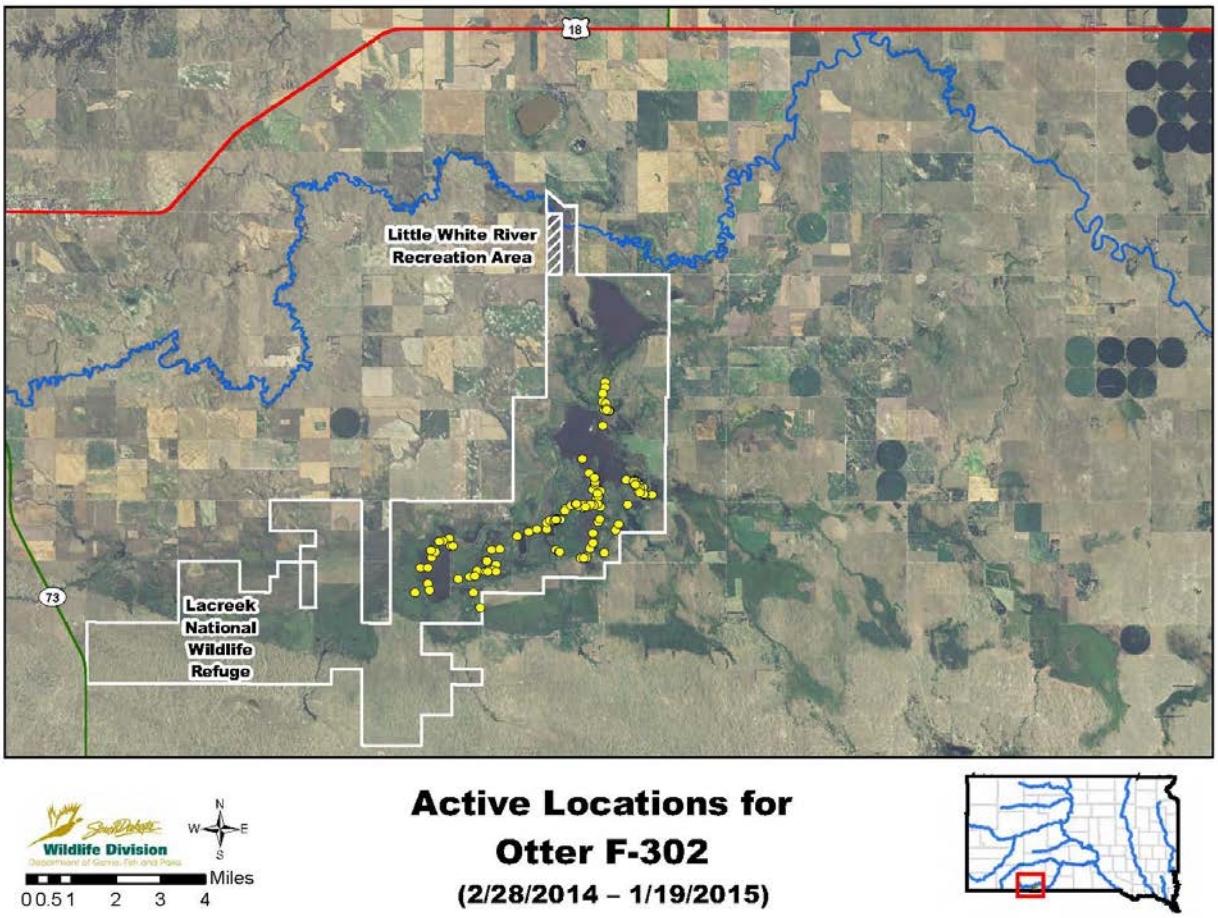

Figure 12. Distribution of active locations (yellow dots) for F-302 on the Lacreek Refuge (2/28/2014-1/19/2015).

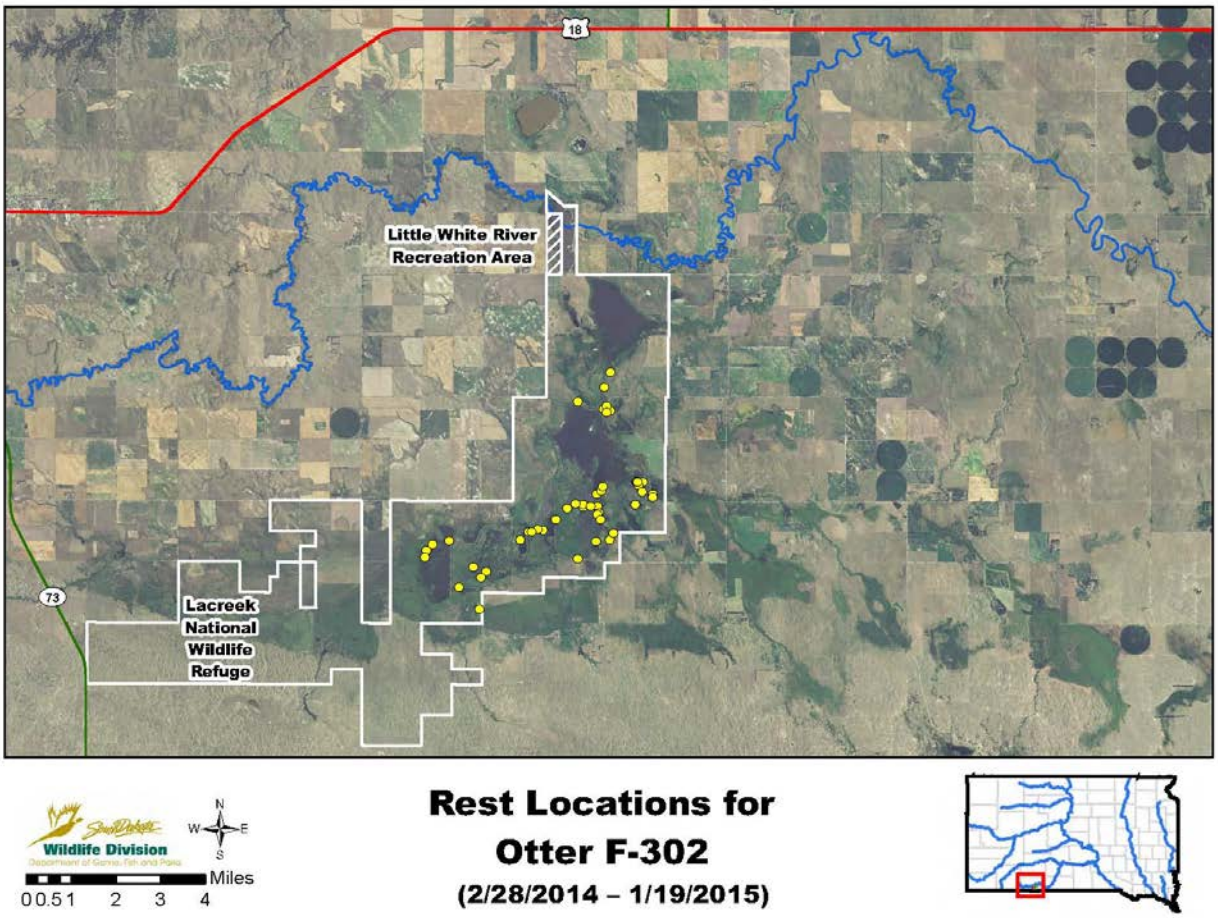

Figure 13. Distribution of rest sites (yellow dots) used by F-302 on the Lacreek Refuge (2/28/2014-1/13/2015).

Figure 14. Trail camera photograph of F-302 (left) and her pup at the Pool 7 dam crossover, 10/11/2014.

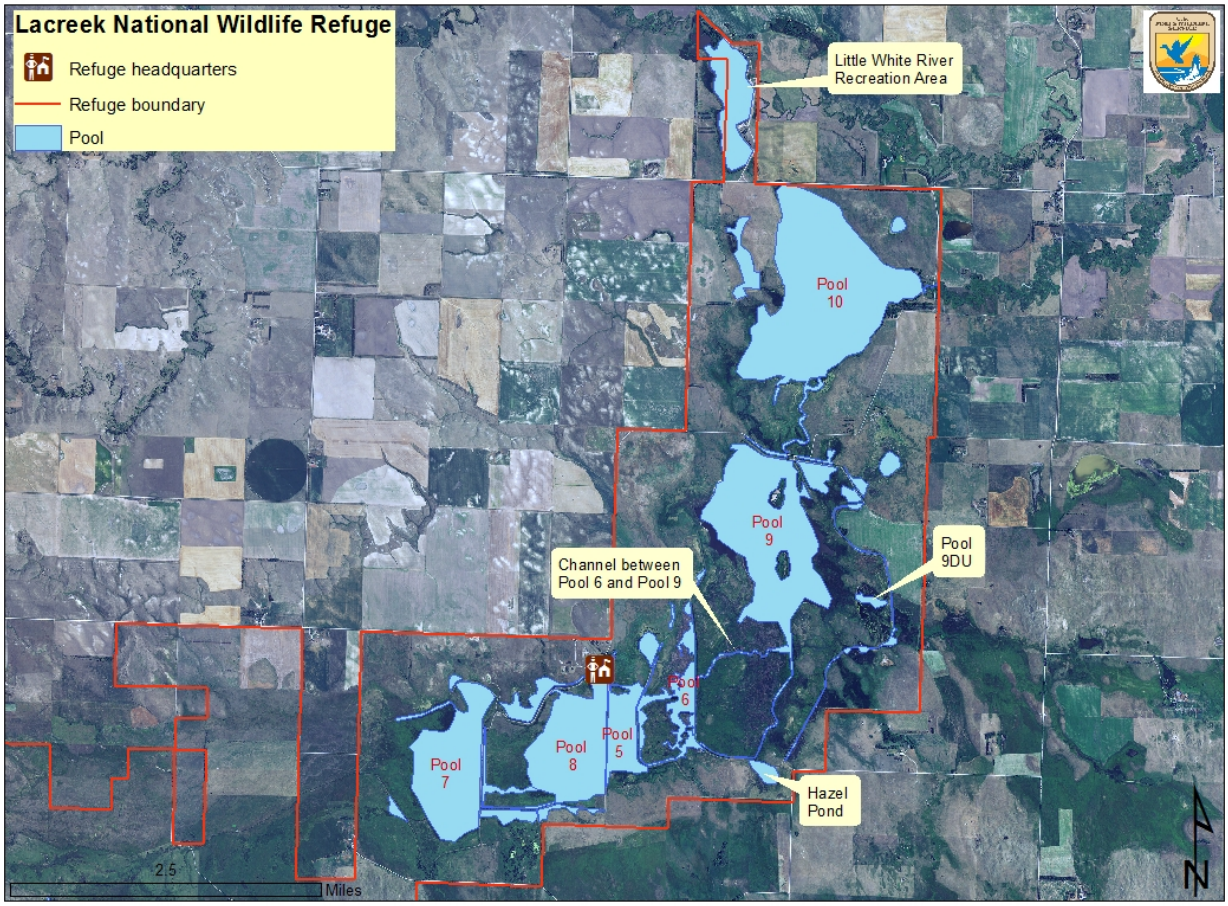

Figure 15. The Lacreek National Wildlife Refuge has a network of pools created by damming Lake Creek, a tributary of the Little White River. The Little White River Recreation Area (adjacent to the release site) is located at the top of the map.

Figure 16. Probable route of F-302 from the Recreation Area to Pool 10 on the Lacreek Refuge. The direction traveled is indicated by the arrow.

Figure 17. F-302 gave birth on the Lacreek Refuge during spring 2014 at Natal Site #1, then moved her young to Natal Site #2, and finally to Natal Site #3.

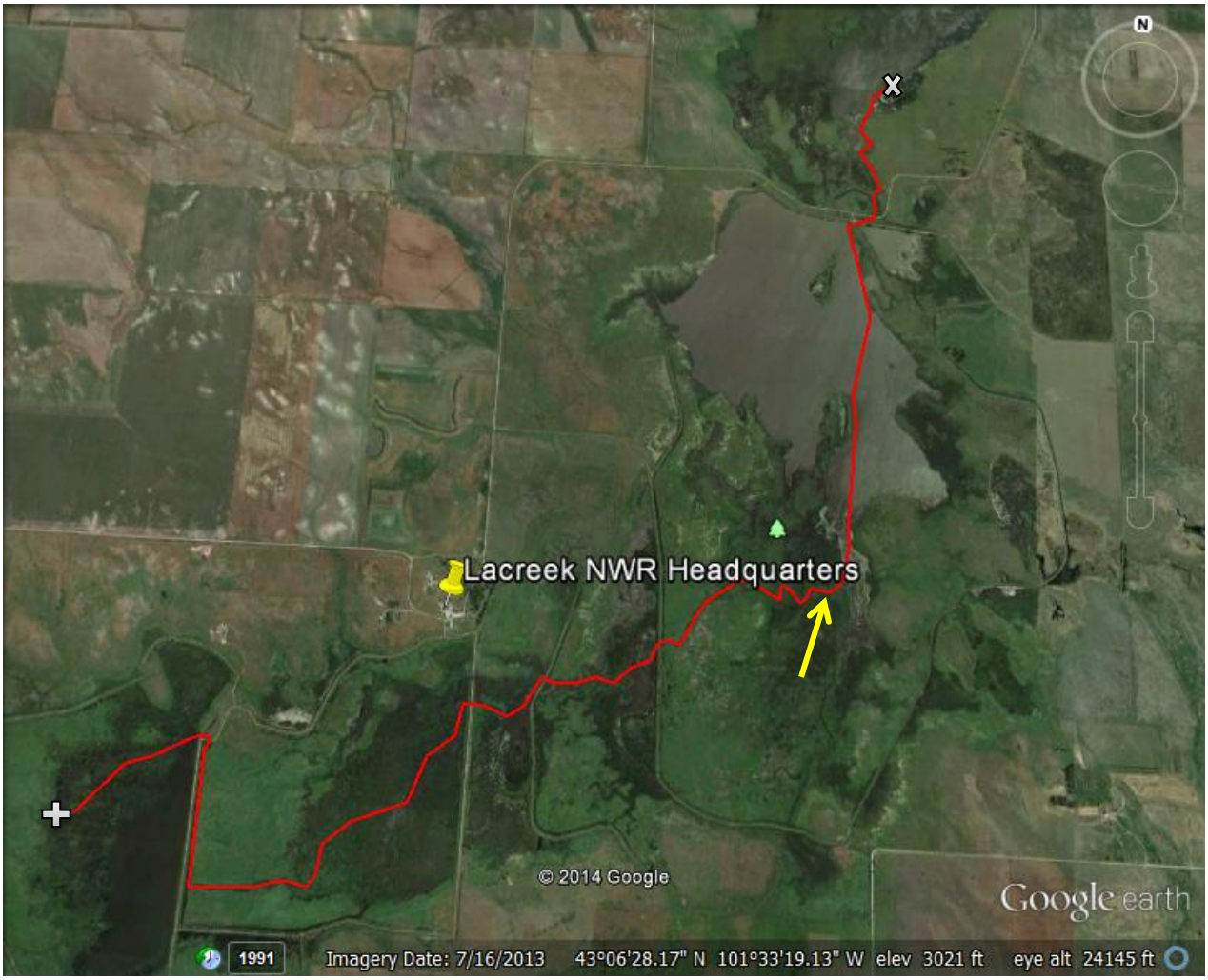

Figure 18. Likely route of F-302, and presumably her pup, from Pool 7 (+) to Pool 10 (x), Lacreek Refuge, on the night of 13-14 October 2014; a distance of approximately 11 km. On 15 October, F-302 was back upstream in the channel above Pool 9 (yellow arrow), and in Pool 7 (+) the following day.

Figure 19. A young raccoon and the otters on the Tour Route Road bridge near the outlet of Pool 7, Lacreek Refuge.

Figure 20. A young raccoon and 1 of the otters (yellow arrow pointing to the otter's tail) on the concrete wall that is part of the Tour Route Road bridge. An adult raccoon and the other otter can be seen nearby.

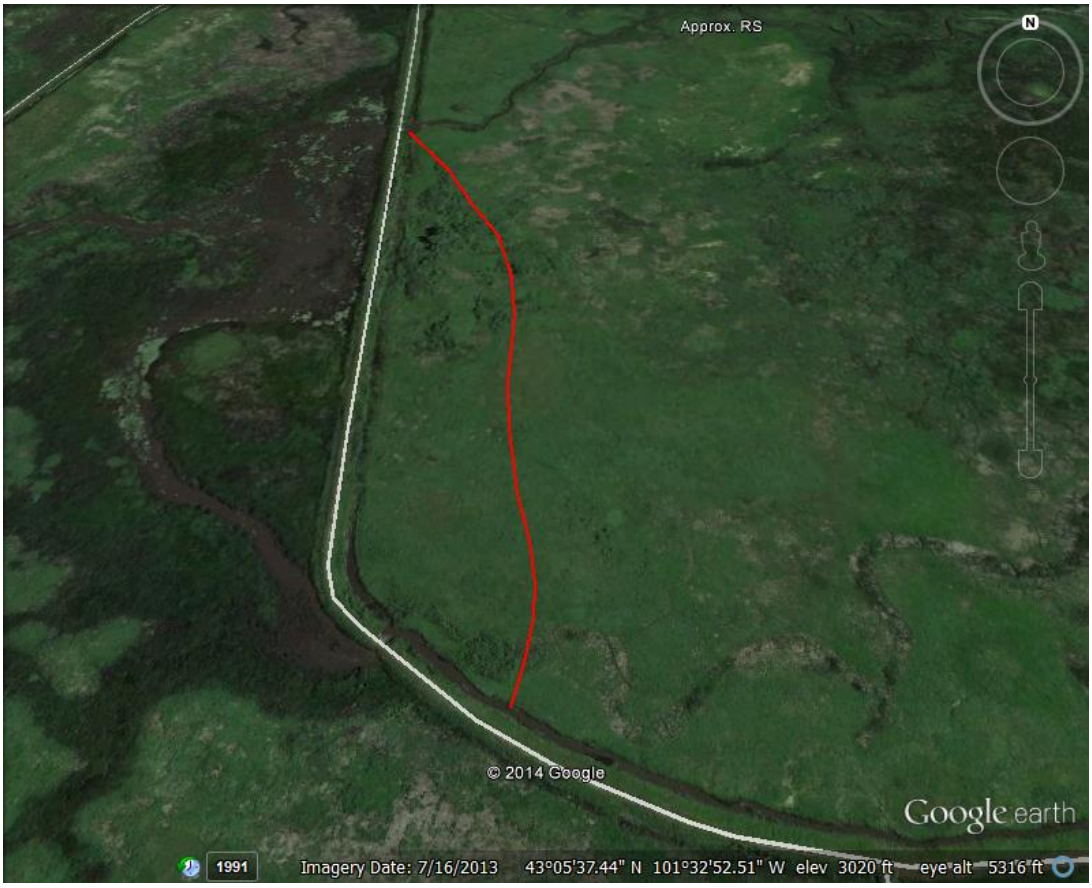

Figure 21. Overland route (red) of F-302 and her pup on 2 and 9 January 2015 between the Pool 6 north outlet and the channel downstream from the Pool 6 south outlet, Lacreek Refuge.

Figure 22. Day bed built and used extensively by female otter F-302 during March 2014 in a marsh near the Pool 9 outlet, Lacreek Refuge. The day bed, crafted out of cattail leaves, was approximately 40 cm in diameter; the pen placed in the center of the bed is 14 cm long. Based on the number of scats located within a meter of the site, this day bed was probably constructed in February.

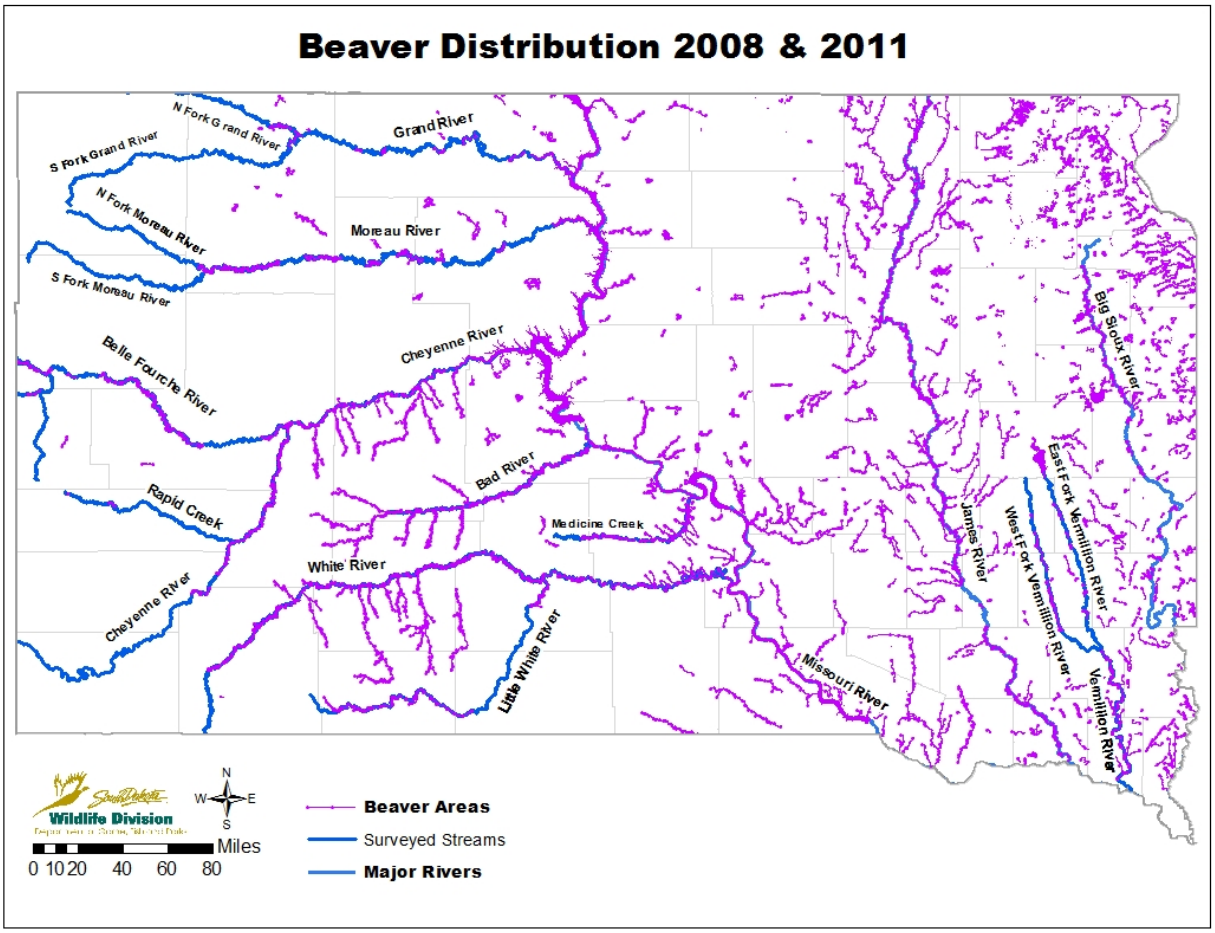

Figure 23. Distribution (shown in purple) of beaver in South Dakota based on questionnaire surveys conducted in 2008 and 2011 by SDGFP.

Appendix 1. Proposed aerial snow track (AST) survey protocol for river otters in South Dakota using a fixed-wing aircraft.

PROPOSED AERIAL SNOW TRACK (AST) SURVEY PROTOCOL FOR RIVER OTTERS IN SOUTH DAKOTA USING A FIXED-WING AIRCRAFT

Submitted by: Wayne E. Melquist

REVISED DRAFT (4-01-2015)

This information has been adapted from the protocol developed by the Wisconsin Department of Natural Resources (Kohn, B., and A. M. Roth 2004. Development of an aerial otter survey in Wisconsin. Unpublished 14 page Report. Wisconsin Department of Natural Resources, Madison). Preliminary analyses suggest that the survey had sufficient statistical power to detect trends of ≥5% per year if run 5 consecutive years, and to detect trends of ≥3% if run 10 consecutive years. The primary difference between surveys conducted in Wisconsin and those proposed for South Dakota is that the Wisconsin transects were 30-mile, straight-line, east-west/west-east, and randomly selected (originally to estimate duck breeding densities). Once established, a survey route becomes permanent and is flown once a year.

Otter sign in Wisconsin is typically documented where the straight-line transect route intersects a suitable waterway. The density of suitable waterways in Wisconsin is high enough to allow for the use of random, straight-line, east-west transects. Because waterways in South Dakota are not nearly as dense as in Wisconsin, establishing random, standardized transects would not be practical. And because otter distribution in South Dakota is largely dictated by a small number of major streams and their tributaries, survey routes that actually follow these waterways should provide the greatest opportunity to detect the presence and distribution of otters in the State.

Because survey routes in South Dakota would not be random, there shouldn't be a need to standardize route length. We found that it is possible to survey 1 or more entire drainage in South Dakota in a single day.

<u>Target dates</u>:

Survey routes should be flown between January and March; preferably as early as possible. However, for consistency, efforts should be made to conduct the surveys at approximately the same time each year. These dates can be flexible if the intent is only to determine presence/absence.

<u>Time of survey</u>:

Wait at least 24 hours after a significant snowfall (>2 inches) before starting AST surveys. If weather conditions prevent completion of multiple survey routes within 5 days of the snowfall, wait until the next snowfall before surveying remaining routes. To help standardize the surveys, try and keep the number of days since snowfall approximately the same when

conducting the surveys each year. Conduct surveys between 0900 hours and 1500 hours. The length of a survey route should be such that it can be flown within this 6-hour time period. For just presence/absence data, delaying the survey following a snowfall might increase the possibility of detecting sign. However, weather conditions would need to be monitored to avoid, for example, wind covering otter sign.

Weather conditions:

Detection of sign is best when it is sunny and the skies are mostly clear. If high winds cause snow to drift in open areas, wait at least 24 hours after the winds subside before conducting the surveys. Streams should be mostly frozen over prior to the snowfall.

Conducting a survey:

Plan to have a second observer (other than the pilot) in the plane to help conduct the survey. As a general guideline, flight altitude should be approximately 150-250 feet above ground level, with flight speed between 80-110 mph. However, safety is first and foremost, and it should go without saying to be vigilant for antennas, utility wires, and other airplanes. Pilots should notify area airports of low flight patterns, particularly in or near any controlled air space.

Data to record:

When establishing a new survey route, the start and end points of each route should be recorded on a detailed map using a GPS unit or other data-recording device. These coordinates should be supplemented with a physical description, if possible (e.g., a specific highway bridge, edge of a town, a dam, or other prominent landmark). By including this information on a route map and survey form/data sheet (or data storage/retrieval unit), it will help ensure the identical route is run each year.

When otter sign (tracks/sliding marks) is detected, record the location coordinates on the data sheet using a GPS unit, and on the accompanying map using the corresponding observation number. If appropriate, provide additional pertinent information about the sighting on the data sheet. Another option would be to use the Trimble Juno unit and CyberTracker program to collect these data and forego paper data sheets.

Count any otter sign seen within ¼ mile of either side of the waterway being surveyed (e.g., a tributary of the primary stream, a pond or marsh). Obviously, for presence/absence surveys, count any otter sign irrespective of the distance from the primary stream being surveyed.

You are encouraged to circle back to confirm uncertain otter sign observations. When snow depths exceed 15 inches, tracks and sign left by other large animals and people can be confused with otter track patterns, so it is important to double check and be certain of your

identification, if there is any question. In some instances, follow-up ground inspections may be useful to confirm an observation. Upon completion of the survey route, make sure all data are entered, and make note of any changes from the start conditions (especially cloud cover).

Appendix 2. Recommended age and sex of otters suitable for translocation in South Dakota based on the time of year.

Recommended age and sex of otters suitable for translocation in South Dakota based on the time of year

Submitted by Wayne E. Melquist

Revised 4-02-2014

RELEASE MONTH	DESIRED AGE, SEX, AND SOCIAL STATUS OF THE OTTERS
January	Any male except young-of-the- year [1] that are part of a family group; nonbreeding adult females, adult females without young, & yearling females
February	Any otter of any age or sex
March	Nonbreeding adult females[2] and yearling females; any male[3]
April	Nonbreeding adult females, adult females without young (no evidence of lactating), yearling females; any male[3]
May	Adult males & nonbreeding adult females; yearling males & females
June	Adult males & nonbreeding adult females; yearling males & females
July	Adult males & nonbreeding adult females; yearling males & females
August	Adult males & nonbreeding adult females; females with young ONLY IF ALL YOUNG CAN BE TRANSLOCATED WITH HER; yearling males & females
September	Adult males & nonbreeding adult females; females with young ONLY IF ALL YOUNG CAN BE TRANSLOCATED WITH HER; yearling males & females
October	Adult males & nonbreeding adult females; females with young ONLY IF ALL YOUNG CAN BE TRANSLOCATED WITH HER; yearling males & females
November	Adult males & nonbreeding adult females; females with young ONLY IF ALL YOUNG CAN BE TRANSLOCATED WITH HER; yearling males & females
December	Adult males & nonbreeding adult females; females with young ONLY IF ALL YOUNG CAN BE TRANSLOCATED WITH HER; yearling males & females

[1]Young-of-the-year otters are probably <14 pounds in January.

[2]Adult females need to be inspected closely to avoid moving a female that is close to giving birth.

[3]Adult males may move extensively during March or April because of the breeding season.

Appendix 3. Recommended sites for relocating conflict river otters in South Dakota.

RECOMMENDED SITES FOR RELOCATING CONFLICT RIVER OTTERS IN SOUTH DAKOTA

Submitted by: Wayne Melquist

Update 3-14-2015

The following sites allow South Dakota Game, Fish and Parks (SDGFP) regional staff the option of relocating conflict river otters either within or outside the administrative region the animal was captured. Most of these proposed release sites would be suitable in an effort to restore otters to South Dakota, and otters currently occupy some of these streams. River otters are capable of making long-distance movements over short periods of time. Because otters are highly mobile, staff can be flexible as to the exact location where otters are released.

At this time, relocating otters outside an administrative region should only apply to Regions 3 and 4, and should involve coordination with the recipient Region. Relocating a lactating female otter is not advised under any circumstances.

No release sites are recommended on any stretch of the Bad River, Grand River, Medicine Creek, Moreau River, or White River; all have insufficient year-round flow. Unlike the Grand River or Moreau River, however, riparian habitat along most of the Bad River and major stretches of Medicine Creek appears suitable for otters. No specific sites have been identified on the Missouri River, although the segments below Fort Randall Dam and Gavins Point Dam have suitable otter habitat and could be used for the release of conflict otters if other identified release sites were not available or desired.

I do not recommend releasing any conflict otters in the Big Sioux River drainage, those streams in South Dakota that are part of the Minnesota River drainage (e.g., Jorgenson River, Little Minnesota River, Whetstone River, Yellow Bank River), or streams that drain into the Bois de Sioux River (Jim Creek/Cottonwood Slough). These drainages are currently occupied by river otters.

SDGFP Region 1

Little White River

Release location: The Little White River Recreational Area, Lacreek National Wildlife Refuge, or Lake Creek upstream from the Lacreek Refuge.

Rationale: The Little White River Recreational Area consists of a small reservoir created by damming the Little White River. The Lacreek Refuge is adjacent to and south of the Recreational Area. The two areas are interconnected by a borrow channel that is periodically without water. Lacreek Refuge consists of a network of channels, marshes, and open water

habitat (pools) created by a series of dams and dikes on Lake Creek, a tributary of the Little White River. Lake Creek joins the Little White River downstream from the Recreational Area. These areas provide a diversity of habitat suitable for otters, and animals could eventually move downstream to other parts of the Little White River, including Crazy Horse Canyon, on their own.

Cheyenne River

Release location: Downstream from Angostura Reservoir, in the section between Highway 18/385 and the Riverside Road bridge east of Buffalo Gap.

Rationale: The habitat looks good in this area and otters would have the option of using Angostura Reservoir along with the Cheyenne River and tributaries downstream.

Bad River

Release location: None recommended.

Rationale: Because the Bad River does not flow year-round, it would likely only be used by otters seasonally. By autumn, the river consists of a series of isolated pools, except for the lower stretch of the river where it is influenced by Lake Sharpe.

Belle Fourche River

Release location: The Belle Fourche River between Elm Springs Road and the confluence with the Cheyenne River.

Rationale: This area has few roads and otters would have the option of moving upstream, taking advantage of the Redwater River and Spearfish Creek, or moving downstream and using the Cheyenne River.

Release location: The Belle Fourche River or Redwater River at or near the confluence of the two streams (the confluence of these streams is within the city limits of Belle Fourche).

Rationale: Animals released in this area have the option of using both rivers and tributaries such as Spearfish Creek.

Grand River

Release location: None recommended.

Rationale: The habitat for river otters is fair to poor in this drainage as it is open grassland and what little riparian habitat that exists, appears to be heavily grazed by livestock. In September 2012, throughout the drainage the river consisted of pools of water interconnected with faint

trickles of water apparent only where flow was restricted. These conditions likely relegate the Grand River to seasonal habitat for otters.

Moreau River

Release location: None recommended.

Rationale: The habitat for river otters is fair to poor in this drainage as it is open grassland and what little riparian habitat that exists, appears to be heavily grazed by livestock. In September 2012, flow was so faint that it was difficult to detect at most locations visited. These conditions likely relegate the Moreau River to seasonal habitat for otters.

SDGFP Region 2

Bad River

Release location: None recommended at this time.

Rationale: Because the Bad River does not flow year-round, it would likely only be used by otters seasonally. By autumn, the river consists of a series of isolated pools, except for the lower stretch of the river where it is influenced by Lake Sharpe. The area near the mouth of the Bad River could be considered in the future.

Grand River

Release location: None recommended.

Rationale: The habitat for river otters is fair to poor in this drainage as it is open grassland and what little riparian habitat that exists, appears to be heavily grazed by livestock. In September 2012, throughout the drainage the river consisted of pools of water interconnected with faint trickles of water apparent only where flow was restricted. These conditions likely relegate the Grand River to seasonal habitat for otters.

Little White River

Release location: Crazy Horse Canyon in the Rosebud Indian Reservation.

Rationale: The stretch of river that flows through Crazy Horse Canyon looks like the best habitat for otters, although little is known about the fisheries.

Medicine Creek

Release location: None recommended at this time.

Rationale: Medicine Creek contains suitable otter habitat along many stretches, including near its confluence with the Missouri River. However, because Medicine Creek flows and contains continuous water only seasonally, it would likely only be used by otters seasonally. Medicine Creek only contains sufficient water year round near its confluence with the Missouri River. The area near the mouth of Medicine Creek could be considered in the future.

Moreau River

Release location: None recommended.

Rationale: The habitat for river otters is fair to poor in this drainage as it is open grassland and what little riparian habitat that exists, appears to be heavily grazed by livestock. In September 2012, flow was so faint that it was difficult to detect at most locations visited. These conditions likely relegate the Moreau River to seasonal habitat for otters.

SDGFP Region 3

Vermillion River

Release location: The stretch of river east of Parker, SD, at the confluence of the East Fork and West Fork, downstream to the Clay County boundary.

Rationale: A released otter would have the option of remaining in the Vermillion River drainage, or moving downstream to the Missouri River. This stretch of the Missouri River, downstream from Gavins Point Dam, is suitable otter habitat.

Release location: East Vermillion Lake.

Rationale: Released otters would have the option of moving upstream on the Vermillion River to Lake Thompson, or downstream from the lake towards the Missouri River. East Vermillion Lake has a diversity of suitable prey species.

James River

Release location: The James River between Milltown, SD, and Mitchell, SD.

Rationale: There are several tributaries in this section of the James River that otters could use.

SDGFP Region 4

James River

Release location: Sand Lake NWR or the south edge of Columbia, SD, near the city park and where the road (396 Avenue) crosses the James River.

Rationale: This release site is close to the confluence of the Elm and James Rivers. While released otters could move upstream into the Sand Lake NWR and continue into North Dakota via the James River, the likelihood is that they would remain in the area of the Elm and James Rivers or move downstream and bolster the existing population on the James River. This site should only be used when there is sufficient flow in the James River.

Other Possible Release Sites

There are other possible release sites that could be considered, depending on the progress of otter population expansion in South Dakota. The Missouri River at the mouth of the Bad River, Cheyenne River, and Medicine Creek could also be used as release sites at certain times of the year and under the appropriate water conditions. The Missouri River below Fort Randall Dam at Pickstown, SD, downstream to Springfield contains suitable otter habitat and could be considered for future otter releases. Release sites in these areas could be identified based on land ownership and accessibility.