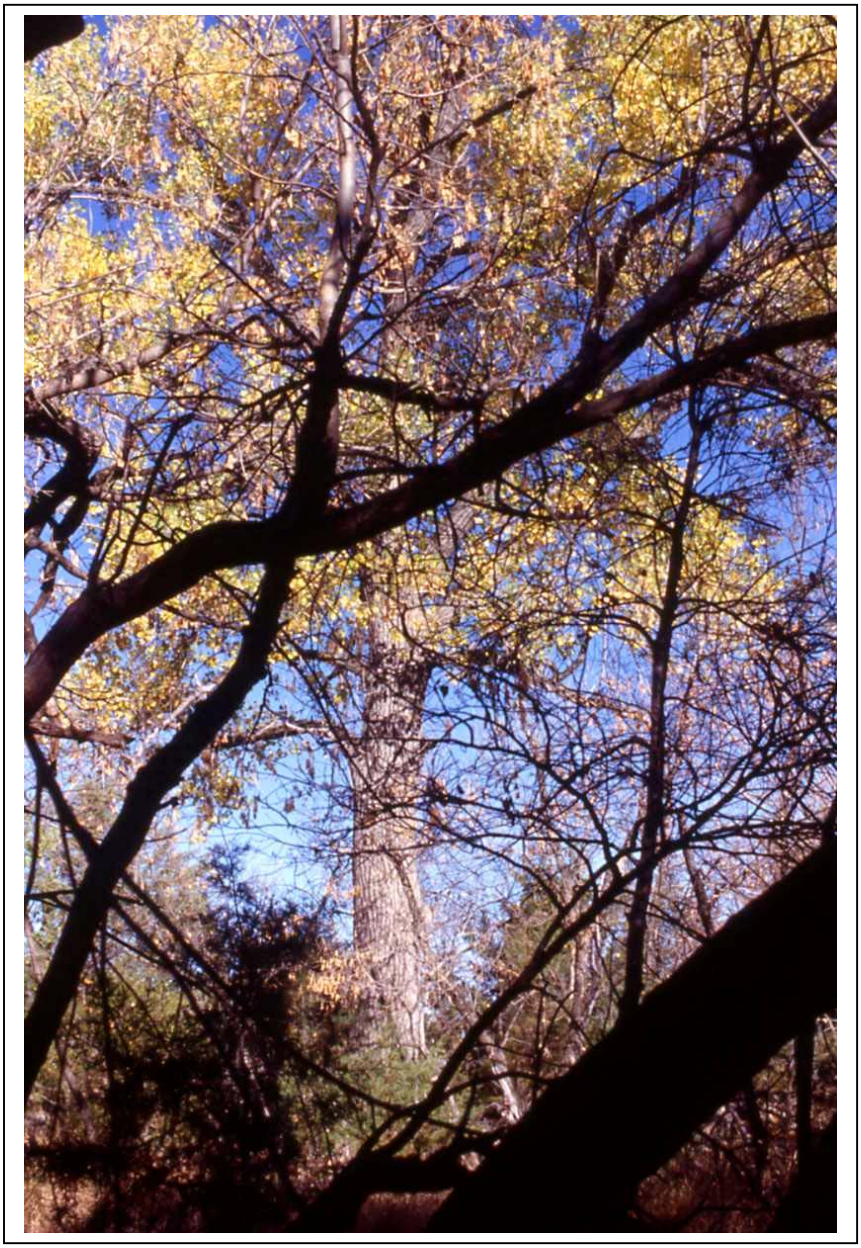
Wildlife Habitats of LaFramboise Island:
Vegetational change and management of a Missouri River Island



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I. Executive Summary

LaFramboise Island is a 580 acre forested island with an attached former sandbar of about 65 acres lying in the Missouri River between the towns of Pierre and Fort Pierre. The majority of the cottonwood trees on the island are more than 65 years old, are dying at an average rate of about 2 per acre per year, and in about 30 years most of them will be gone. Some Missouri River islands in central South Dakota historically became dominated by junipers such that they became know as “cedar islands.” Without intervention, this appears to be the fate of LaFramboise Island. This and other vegetation changes are leading to a loss of habitat diversity with associated loss of wildlife. The following actions are recommended: 1) Reforest the central grassland with cottonwood forest, 2) Retain “The Cedars” and allow junipers to expand where green ash are absent, 3) Promote a mixed deciduous forest where green ash or other deciduous trees are present, 4) Plant cottonwoods or other suitable eagle roost tree species along the periphery of the island where cottonwood are not reproducing, 5) Better define the relationship between river surface water elevations and island ground and surface waters, and use this information in vegetation management.

II. Introduction

LaFramboise Island is an important natural resource in the Pierre/Fort Pierre area. In 2004 alone, people made over 20,000 visits to LaFramboise Island (M. Adams pers. comm. 2004). They come to the island for hiking, biking, picnicking, wildlife watching, archery hunting, etc. Wells on the island provide a significant proportion of Pierre's drinking water. The remnant cottonwood forest on the island provides a day-roost for wintering bald eagles and provides habitat for a host of other resident and migratory wildlife. Historically there were dozens if not hundreds of forested islands in the South Dakota reach of the Missouri River. Today, LaFramboise Island is one of less than ten forested islands remaining in the state.

On January 1, 2002, LaFramboise Island was transferred in fee title from the U.S. Army Corps of Engineers (COE) to the State of South Dakota and placed under the management of the State Parks and Recreation Division. The intent of the state is to manage LaFramboise Island as a "nature area" with a minimum of development. Unfortunately, the habitats that made LaFramboise Island so important for wildlife are changing in ways that are less suitable for many wildlife species.

This report documents some of these vegetational changes and recommends management actions that will hopefully help to sustain some of the island's varied wildlife. The ecological environment of LaFramboise Island has been dramatically altered by the construction of Oahe Dam and subsequent alteration of the river flow regime. Managing for a "nature area" in such an altered, if not "unnatural" environment, might easily qualify as a "fools errand." Nevertheless, the importance of this island for wildlife and recreation necessitates management to deal with perceived problems that have developed. For example, most people recognize that the cottonwoods are dying in what appears to be an alarming rate. Vegetation on lower elevations of the island appears to be killed by high water events, allowing the noxious weed Canada thistle to invade. The island's deer population has dramatically declined in recent years. These and other problems demand a response. Hopefully, this report will provide both the Parks Division and the public with some of the factual details about the nature of LaFramboise Island, together with a better understanding of some of the opportunities and limitations for its future.

III. History of LaFramboise Island[1]

The first written reference to LaFramboise Island was made during the Lewis and Clark Expedition. William Clark's journal entry for Monday, September 24, 1804 includes the passage, "passed a Island about 1½ m. long on which we saw maney elk & Buffalow…" In a duplicate entry for this date (Clark often transcribed his notes in case one copy was inadvertently destroyed) Clark writes in reference to LaFramboise Island "passed a Island on the S.S. (starboard side) on which we saw several elk, about 1½ miles long called Good humered Islds," (Moulton 1987). While the first map depicting LaFramboise Island mistakenly names it "Bad humoured Island" and provides little detail, it does show its general location in the same vicinity as it occurs today (see Figure 1).

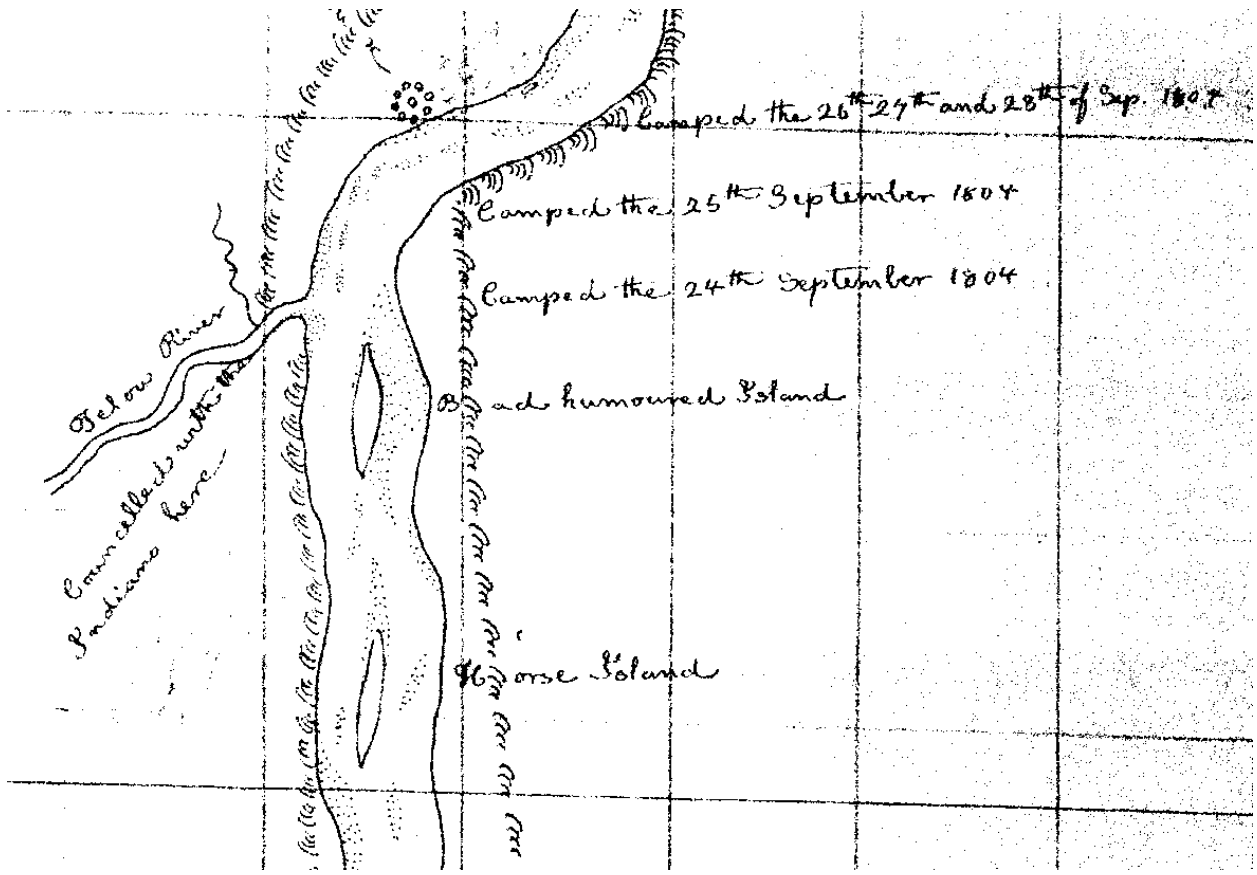

Figure 1: Depiction of LaFramboise "Bad humoured" Island in the early 1800's. "Horse Island" is today's Farm Island. (Taken from Clark-Maximilian Sheet 12 in Moulton 1983.).

Following the Lewis and Clark Expedition, written accounts regarding this reach of the Missouri River stem from the members of two fur trading companies who traveled up the river in 1811,

[1] LaFramboise Island is named after Joseph LaFramboise who set up a trading post at the mouth of the Bad River in 1817 (Sneve 1973). "Framboise" is the French word for red raspberry.

one lead by Wilson Price Hunt for John Jacob Astor's American Fur Company, and a second by Manuel Lisa for the Missouri Fur Company. These men were accompanied by naturalists John Bradbury, Thomas Nuttall, and Henry Brackenridge and were in the vicinity of Fort Pierre during the first week in June, 1811. None of them make any specific reference to what is now LaFramboise Island (Bradbury 1817, Brackenridge 1814, Nuttall 1818).

The next historical reference to LaFramboise Island occurs during an expedition lead by Prince Maximilian in 1833 and 1834. While the expedition spends the first week of June 1833 in the Fort Pierre area, and stops in Fort Pierre during their return trip down the river in 1834, there are no specific written comments regarding the island (Thomas and Ronnefeldt 1976). However, while in the Fort Pierre area, Karl Bodmer, an artist accompanying Prince Maximilian draws a sketch of Fort Pierre in which LaFramboise Island is clearly visible (see Figure 2).

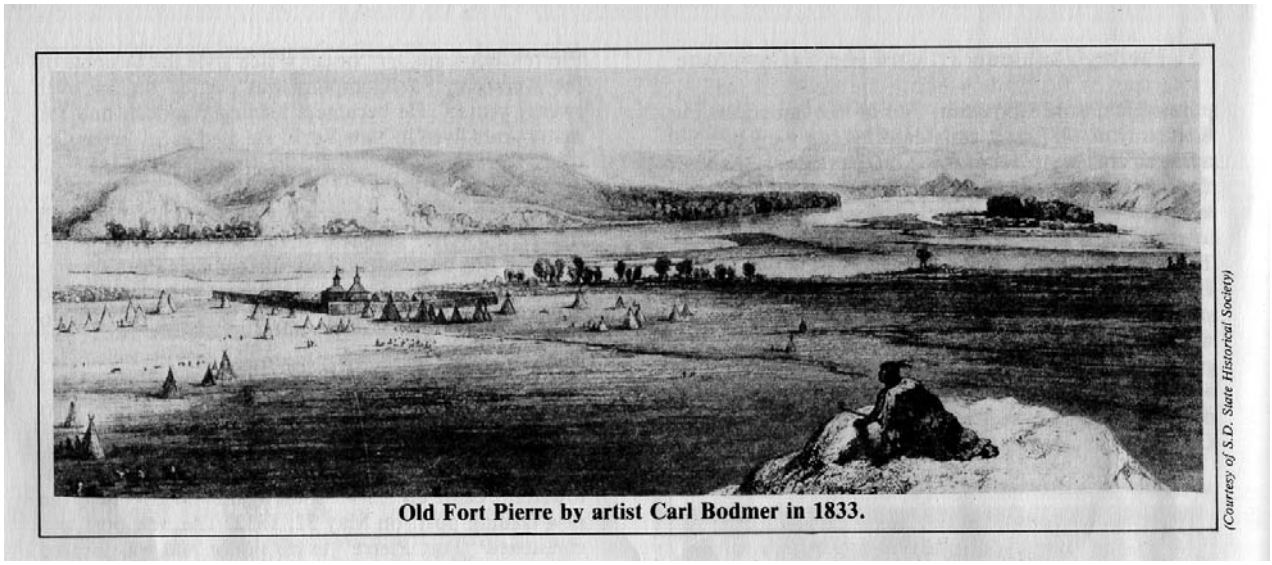

Figure 2: 1833 sketch by Karl Bodmer showing LaFramboise Island in upper right.

In 1843 John James Audubon and several companions ascend the Missouri River on board the steamboat "Omega." Audubon's journal from this expedition contains numerous natural history observations about this reach of the river, but makes no specific mention of LaFramboise Island (Audubon 1986).

The first detailed maps of the Island were produced in the 1890's including one by the U.S. Army Corps of Engineers (see Fig. 3), as well as the first plat of the island (see Fig. 4).

The original plat shows what appears to be the first documented resident of the island, a man by the name of "Rivers," for whom the Island was named by the original surveyor. Joseph Rivers apparently lived on the island for a few years while it was still part of the Great Sioux Reservation prior to 1890 (Sneve 1973). Based upon a land title search, Mr. Rivers apparently never filed a claim on any portion of the island. Instead, the island was essentially divided into

three parcels (sets of lots) the first parcel consisting of 163 acres on the upstream end of the island deeded to Robert and Stella Proudfoot starting in 1893; a second parcel consisting of about 131 acres on the downstream half of the island deeded to Paul R. Goddard in 1893, and finally a single lot of about 46 acres on the very downstream tip of the island deeded to Basile

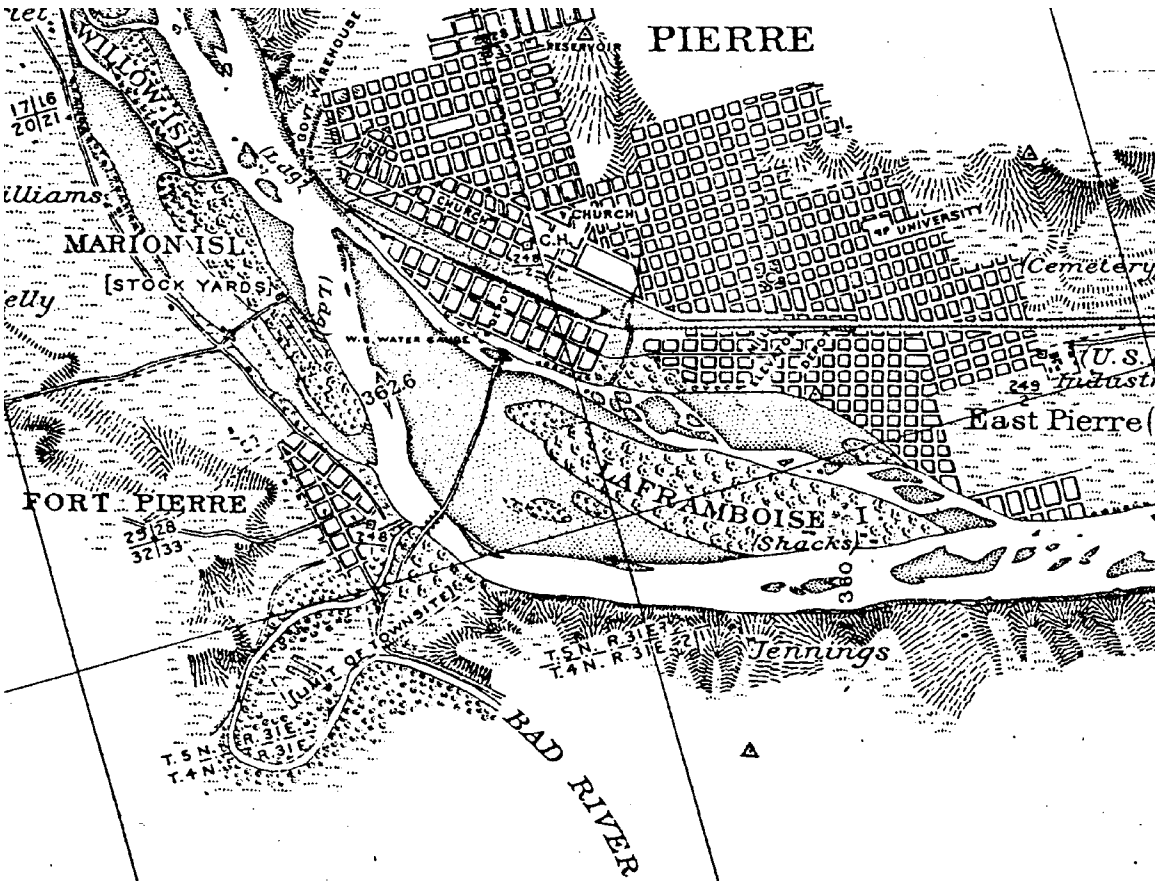

Figure 3: Portion of an 1891 map by the U.S. Corps of Engineers showing LaFramboise Island.

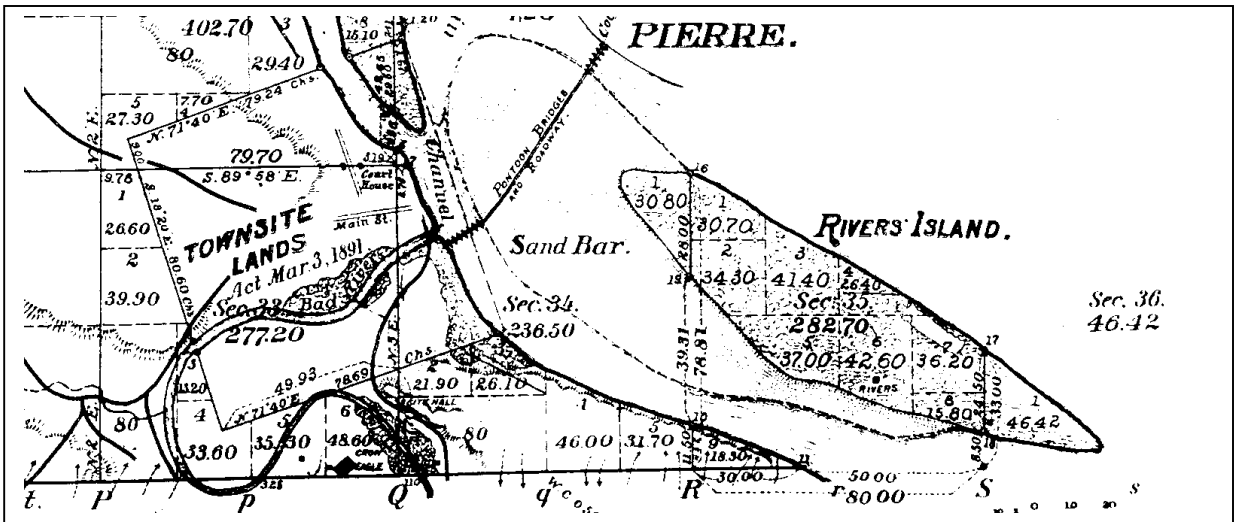

Figure 4: First plat of LaFramboise (Rivers' Island) in 1891.

De Rosie in 1894. The Proudfoot parcel remained in the family until it was sold to Charles Lee Hyde, Sr. in 1909. The Hyde family retained ownership until the land was condemned and purchased by the Corps of Engineers in 1962.

The Goodard parcel was bought and sold several times until it was finally purchased by Edwin and Florence Ashcroft who owned the parcel from 1898 until 1909 when they sold it to Edgar J. Perry. The Perry family, including their adopted daughter Etta Johnson retained the land from 1909 until 1952. The land was then bought and sold several times until 1957 when it was sold to Pat H. Feeney who held the property until condemnation by the Corps in 1962. The DeRosie tract also went through numerous owners until it was combined with the Goodard parcel in the 1950's and was owned by Pat Feeney at the time of condemnation.

The island was used for commercial production of agricultural and wood products from the time of settlement up until condemnation by the Corps. Little has been documented about this early occupancy and agricultural use. Charles (Lindy) Feeney remembers that Herb Badger and his family lived on the island in 1958 and that Badger had a small sawmill which was used to cut cottonwood logs into planks. Charles Feeney also recalls growing irrigated potatoes on the island in 1958 (C.Feeney pers. comm. 2004).

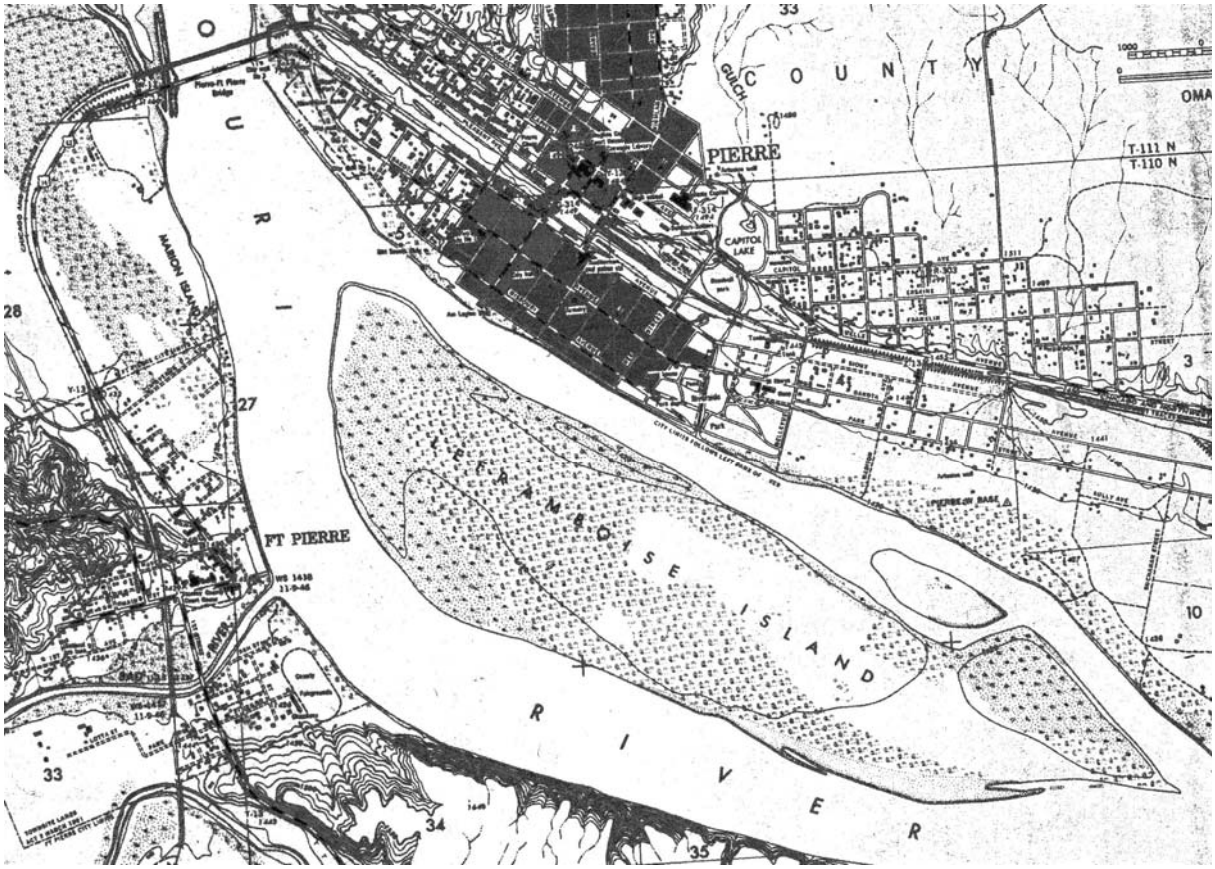

Figure 5: 1947 Map of LaFramboise Island by U.S. Army Corps of Engineers showing island prior to construction of Oahe Dam and island causeway.

During this time, there were several buildings on the island including a cabin, old house (used as a shop), small barn, shed, and associated corrals (Origer 1962a). In the early 1960's the island was leased by Everett and Miles Smalley of rural Stanley County (E.Smalley pers. comm. 2004). During that time they grew potatoes, alfalfa, corn, and other crops on the approximately 90 acres of cultivated land on the island (E.Smalley pers. comm. 2004). Some of this was irrigated with the aid of a large diesel pump and 3,600 feet of aluminum pipe. A berm/canal had been constructed along one of the fields to facilitate flood irrigation (Origer 1962a, C. Feeney pers. comm. 2004). After the Herb Badger family moved to Alaska (in ca. 1958), Bill Lewis lived on the island and did chores for the Smalleys (E.Smalley pers. comm. 2004, Origer 1962a, C. Feeney pers. comm. 2004).

With the anticipated construction of the Oahe and Big Bend Dams, the U.S. Army Corps of Engineers purchased all of LaFramboise Island in the early 1960s. Shortly after the completion of Oahe Dam in 1962, a causeway to the island was built across the north channel of the Missouri River connecting LaFramboise Island to Hughes County and providing vehicular access to the island from Poplar Street in Pierre. About this same time the upstream side of the island was armored against erosion with rock rip-rap. The north shore of the island was also rip-rapped in 1998.

Eventually, the Corps of Engineers designated and managed LaFramboise Island as a Natural Area (USACOE 1979). Most, if not all the farm buildings and equipment were removed. A parking lot was constructed on the northwest corner of the island along with a picnic shelter,

Figure 6: Aerial photo of LaFramboise Island taken in 1950's (Pierre Chamber of Commerce, from Schuler 1987, p. 150.)

fireplace, vault toilet, and approximately five miles of hiking trails. In 1978 and 1979 two wells for the city of Pierre were constructed on the island, followed by the construction of two additional wells in 2003. Combined output from these wells typically amounts to 25 to 32% of the Pierre water supply (J.Childs pers. comm. 2004).

On January 1, 2002, under the Title VI land transfer, mandated by Water Resources Development Act 106-53 passed by Congress in 1999, ownership of LaFramboise Island was transferred to the State of South Dakota. The state Parks & Recreation Division assumed management of the island at that time, and intends to continue its designation as a Nature Area (see Fig. 7).

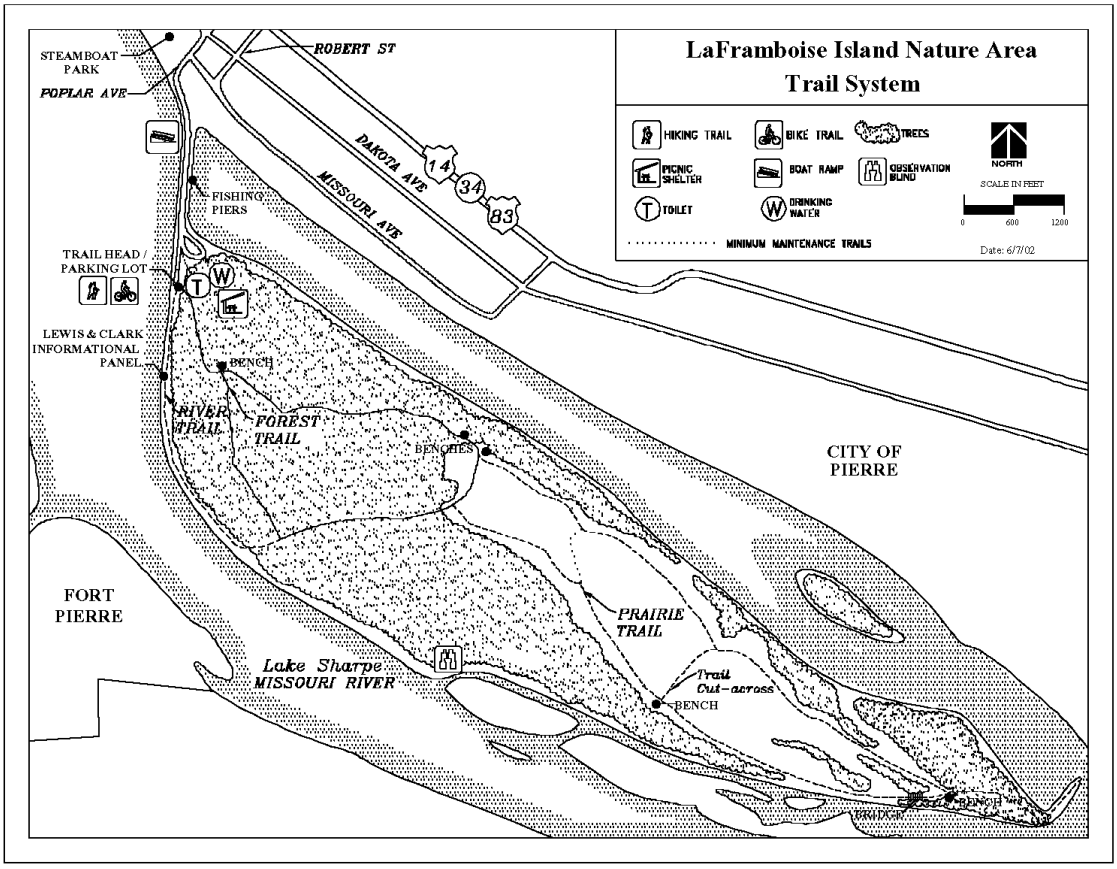

Figure 7: Current map of facilities and trails on LaFramboise Island.

IV. Vegetation of LaFramboise Island

Figure 8 shows a recent aerial photograph of LaFramboise Island and Figure 9 portrays a generalized vegetation map. Each mapping unit is briefly described below:

Cottonwood Forest: (ca. 370 acres). The map unit depicting cottonwood forest corresponds with the portion of the island having at least a partial cottonwood canopy. The canopy is about 50 feet tall with or without a tall shrub/small tree layer comprised predominately of juniper, green ash, and Russian olive (See Photo 1). The vegetational details of two plots in this cottonwood forest are presented in Appendix A, and characterize some of the variation within this vegetation type (see section on the island's future vegetation, p. 33 for a more detailed description). This map unit also includes small clearings in the cottonwood forest, patches of juniper thickets, and several developments at the upstream end of the island, e.g. parking lot, picnic shelter, city wells, etc.

Cedar[2] Forest: (ca. 50 acres). This map unit delineates a portion of the island (locally known as "The Cedars") where there is a young, dense juniper forest having a few, large, emergent cottonwoods, the only surviving remnants of a previous cottonwood forest. Two circular plots were sampled within the heart of this juniper forest (see Appendix B plots LT-12, LT-13), where densities ranged from 1380 to 2600 junipers per acre. These densely grown junipers ranged in size from 1" to 6" in diameter at breast height (dbh) with an average of about 3 inches. Their heights were roughly 10 to 30 feet tall. (Perhaps this vegetation should be more correctly termed a "juniper thicket" since virtually none of junipers exceed 10" dbh.). No additional tree or shrub species were found in these or adjacent transitional plots other than a single Russian olive (see Appendix B plots LT10, LT-11). Beaver had cut or girdled many of the remaining cottonwoods and beaver-cut cottonwood stumps were common. Very little sunlight penetrates these dense stands and there is virtually no herbaceous understory (see Photo 2). Even juniper seedlings are absent.

Cattail Marsh: (ca. 5 acres) Several relatively small cattail marshes occur in old river chutes and depressions on LaFramboise Island. The two depicted on the vegetation map were large enough to delineate on aerial photos. They are nearly pure stands of narrow-leaved cattail (*Typha angustifolia*) (see Photo 3). Because of river bed aggregation by sediment from the Bad River, peak water releases from Oahe Dam are now one to two feet higher in elevation than just after the dam was completed approximately forty years ago. Most of upper LaFramboise Island should not be affected by these increasing water levels because it lies upstream from the major area of riverbed aggregation (West Consultants 1999). However, it appears that the downstream portion of the island may be experiencing higher water levels because depressions (e.g. sand dune troughs) which formerly supported cottonwoods, green ash, and Russian Olive; now feature dead trees, stands of Canada thistle and colonizing cattails, (see Photo 4) a vegetational change that is also occurring on Farm Island.

[2] Several studies have demonstrated that many if not most of the "cedars" in South Dakota are hybrids between eastern red cedar (*Juniperus virginiana*) and Rocky Mountain juniper (*Juniperus scopulorum*). See: Van Haverbeke, 1968; Fassett, 1944. Most of the Junipers on the floodplain have a pyramidal growth form typical of eastern red cedar, while many of the junipers on the steep, dry river breaks typically have a more rounded, globe-shaped form typical of Rocky Mountain juniper. Individual trees are often intermediate in other taxonomic characteristics

Sandbar Meadow & Braided Stream: (ca. 65 acres) Along the southeastern edge of LaFramboise Island lies a former sandbar that has existed since before construction of Oahe Dam (see Figures 6 & 8). Much of it is separated from the island by a shallow chute that cuts across the sandbar (See.

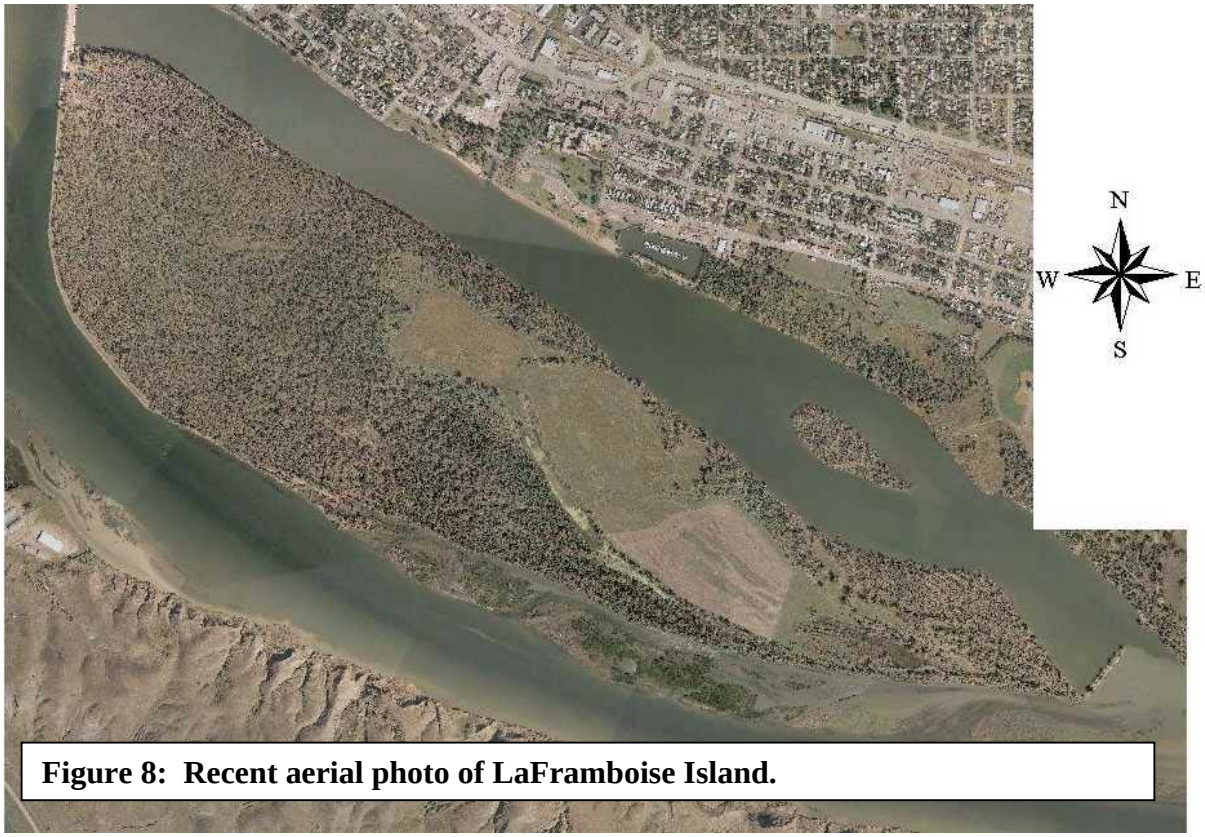

Figure 8: Recent aerial photo of LaFramboise Island.

Figure 9: Generalized Vegetation Map

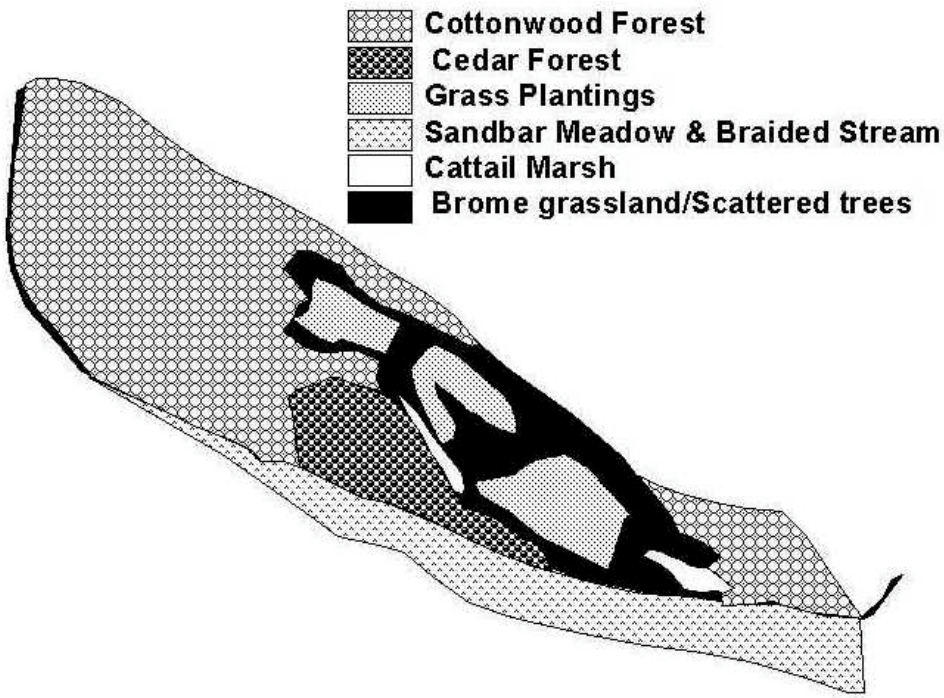

Photo 1: Photograph of cottonwood forest near Plot 2 (see Appendix A) with understory of predominately *Equisetum hyemale*.

Photo 2: Dense juniper forest in area known as the "Cedars." Note barren understory.

Photo 3: Most wetland environments on LaFramboise Island are dominated by monotypic stands of the invasive, narrow-leaved cattail.

Photo 4: Some low-lying portions of the island forest are converting to wetland habitats, evidenced by the dying trees and invading cattails and thistles, due to post-dam water levels.

Photo 5: The former sandbar off the southeastern side of the island has become vegetated by narrow-leaved cattail, wet-meadow vegetation and invading Russian olive, which are periodically killed by high water levels.

Photo 6: The old agricultural fields are now vegetated by smooth bromegrass or warm-season grassland plantings into which Russian olive are invading.

Photo 5). Water depth and flow rates fluctuate daily with the flows and water elevation of the main channel. The sandbar is only one to two feet above the pool elevation and is vegetated primarily by cattails. Where there are slight rises in elevation, the vegetation becomes dominated by three-square (*Scirpus pungens*), reed canary grass (*Phalaris arundinacea*), or Canada thistle (*Cirsium arvense*). Russian olives have also become established on the sandbar, however these small trees have virtually all died, apparently the result of prolonged root inundation. There is a notable absence of willows or young cottonwoods on this sandbar suggesting that the modified hydrograph of the river has converted what was a seasonally flooded sandbar to a continually saturated wet meadow because of daily water fluctuations.

Brome grassland/Scattered Trees: (ca. 95 acres). Much of the central portion of LaFramboise Island was cultivated up until the 1960's and is now is vegetated by smooth bromegrass (*Bromus inermis*) an invasive, exotic grass widely planted for livestock forage and erosion control. While smooth bromegrass has also invaded many other areas on the island (e.g. cottonwood forest clearings), the map unit depicted delineates much of the former cropland and adjacent areas where all that remains of the previous cottonwood forest are a few, old, isolated trees. Another invasive exotic, Russian olive (*Elaeagnus angustifolia*) appears to one of very few woody species capable of colonizing into open stands of smooth bromegrass (see Photo 6). In some locations these have formed woodland habitats similar to other adventive Russian olive woodlands elsewhere in South Dakota. In an effort to more precisely characterize this vegetation type, one stand was sampled and is described in Appendix A, Plot 3.

Grass Plantings: (58 acres). In recent years, portions of the smooth brome dominated old fields were planted to warm season native grasses, predominantly switchgrass (*Panicum virgatum*), big bluestem (*Andropogon gerardii*), and Indiangrass (*Sorghastrum nutans*). The western-most plot (14 acres) was seeded in 1986, the central plot (17 acres) was seeded in 1987 and the eastern-most plot (27 acres) was seeded in 1998. The seed mix for the third planting consisted of sand bluestem (*Andropogon hallii*), Indiangrass, and switchgrass together with the following native prairie forbs:

a. Maximillian sunflower (*Helianthus maximilianii*)--5 pounds
b. Upright prairie coneflower (*Ratibida columnifera*)--2 pounds
c. wild bergamont (*Monarda fistulosa*)--5 ounces
d. Butterfly milkweed (*Asclepias tuberosa*)--3 ounces
e. Leadplant (*Amorpha canescens*)--5 ounces
f. New England aster (*Aster novae-angliae*)--4 ounces
g. Dotted blazing star (*Liatris punctata*)--5 ounces
h. Shell-leaved penstemon (*Penstemon grandiflorus*)--5 ounces

Unfortunately, most if not all the forbs were killed by Canada thistle control efforts.

V. Wildlife of LaFramboise Island

A. Rare, Threatened or Endangered Species

Bald Eagles

At the time of this publication the bald eagle (*Haliaeetus leucocephalus*) is still listed as a federal and state threatened species. Bald eagles are now a consistent winter resident in the Pierre area where they have been documented in Audubon Christmas bird counts since at least 1971 (NAS 2004). There are three sources of wintering population estimates: 1) Audubon Christmas bird counts which are compiled by volunteers during a single 24 hour day which must occur between December 14 and January 5. The Pierre count occurs within a 176 square mile, circular area defined by a 7.5-mile radius extending out from the State Capitol Building. 2) The "midwinter bald eagle survey," which is conducted by staff of the S.D. Game, Fish and Parks Department (GFP) and staff from the U.S. Fish and Wildlife Service (FWS) who make aerial and ground level counts of all eagles in South Dakota with particular emphasis on the Missouri River. It is part of a nation-wide eagle and waterfowl survey made annually during the first week of January. 3) The Pierre office of the U.S. Fish and Wildlife Service monitored bald eagle numbers and night roost locations within the Pierre/Fort Pierre area from 1979 through 1989. The results of this monitoring effort were published in 1991 (USFWS 1991). None of these sources contain information specific to LaFramboise Island, with the exception of the third study which does indicate that in the winter of 1988/89 at least four bald eagles used the LaFramboise Island reach of the river (their "unit 5") as a day roost. Table 1 summarizes eagle numbers recorded in the Pierre area. In recent decades, bald eagles have preferred the cottonwood stands upstream, closer to Oahe Dam, for night roosting. LaFramboise Island has not yet been used as a winter roost site (USFWS 1991).

LaFramboise Island does provide day roosting habitat for bald eagles during the winter. In general, bald eagles are quite commonly observed during winter months perching in large cottonwoods along the periphery of the island where they can easily spot fish or waterfowl prey

In February and March, 2003 a pair of mature bald eagles constructed a nest on the downstream, river side of LaFramboise Island and were observed in the immediate vicinity of the nest for several weeks (see Photo 7 and Figure 10). Although the River Trail was closed to the public some people disregarded the baracade and hiked or biked near the nest. Whether it was due to that disturbance or not, the eagles abandoned the nest (D. Backlund pers. comm. 2004). Apparently the same eagle pair returned to this nest in February 2004. It is unknown whether they laid any eggs. They remained near the nest for several weeks but no fledglings were observed and the pair finally left (Daniel 2003, Daniel 2004, Askren 2004).

Photo 7: Bald eagle nest.

Table 1: Winter Bald Eagle Counts in the Pierre/Fort Pierre Area Compiled from Three Sources*

(* None of these three counts cover precisely the same areas, accounting for some of the differences in numbers. See explanations below)

Winter	Xmas Bird Count[3] (1979-2003)	Mid-Winter Bald Eagle Survey[4] (1986 – 2004)	USFWS Pierre Area Counts[5] (1979 – 1989)
1979-80	14	*	29
1980-81	13	*	34
1981-82	19	*	47
1982-83	*	*	42
1983-84	18	*	44
1984-85	18	*	31
1985-86	26	54	38
1986-87	26	88	68
1987-88	3	60	37
1988-89	30	104	58
1989-90	21	143	*
1990-91	18	50	*
1991-92	27	9	*
1992-93	25	49	*
1993-94	12	78	*
1994-95	41	98	*
1995-96	28	102	*
1996-97	58	40	*
1997-98	28	39	*
1998-99	14	47	*
1999-00	22	16	*
2000-01	21	2	*
2001-02	23	21	*
2002-03	29	21	*
2003-04	35	21	*

3 The Pierre Christmas Bird Count occurs each December and is conducted by volunteers who identify and enumerate all birds observed within a 7 mile radius of the State Capitol Building. It is part of a nation-wide survey effort. For tabulated results see: National Audubon Society (2004).

4 The Mid-winter Bald Eagle survey route in South Dakota is an aerial survey of the Missouri River corridor with a fixed-wing aircraft supplemented by selected ground surveys and conducted in January each year. Results presented above are for the Lake Sharpe segment of the survey, an area much larger than the Pierre/Ft. Pierre Area. Eileen Dowd Stukel is the South Dakota coordinator of this survey (Stukel 2004).

5 Staff from the state office of the U.S. Fish and Wildlife Service conducted biweekly surveys of bald eagles wintering on upper Lake Sharpe (primarily in the Pierre/Ft. Pierre area) from Novermber through March, 1979 to 1989. Results were compled in: U.S. Fish & Wildlife Service (1991).

Figure 10: Bald eagle nest location (white asterisk).

Pallid Sturgeon

On April 26, 1989 a pallid sturgeon (*Scaphirhynchus albus*) was caught a couple hundred yards upstream from LaFramboise Island by fisherman Rod Link. A sonic tag was implanted into this fish and its movements tracked by GFP fisheries staff. The pallid sturgeon is a federal and state listed endangered species. Unfortunately, they no longer reproduce in the impounded portions of the Missouri River and no pallid sturgeon have been reported in this immediate reach of the river since the 1989 capture (J. Riis, pers. comm. 2004).

Interior Least Tern

In 1984, interior least terns (*Sterna antillarum athalassos*), a state and federally endangered subspecies, built 4 nests on the sandbar that lies between LaFramboise Island and Fort Pierre. All the nests were subsequently flooded out by water releases from Oahe Dam (SDNHD 2004).

Piping Plover

Piping plovers (*Charadrius melodus*) are a federal and state listed threatened species. On June 21, 1980 Rich Hill observed two adult piping plovers with a young chick near the downstream tip of LaFramboise Island. Then in June and July, 1984 a pair of piping plovers nested on a patch of sand along the LaFramboise Island causeway. The nest was unsuccessful and no piping plovers have been observed on or near the island since (SDNHP 2004). None of Lake Sharpe has been identified as critical habitat for piping plovers (USFWS 2002).

False Map Turtle

The false map turtle (*Graptemys pseudographica*) is a state threatened species. On May 16, 1997 about 20 false map turtles were captured in a frame net by GFP fisheries staff near the mouth of Capitol Creek just across from LaFramboise Island (SDNHP 2004). False map turtles lay eggs in excavated nests dug into sandbars and sandy beaches near the water's edge. While no nests have been documented on LaFramboise Island or in the island's immediate vicinity, it is likely that some of the sandbar/sandy beach habitat on LaFramboise and Dump Islands serves as suitable nesting habitat. Since much of the shoreline in the LaFramboise Island vicinity has either been rip-rapped or is used as a swimming beach, what little remains could be quite important to nesting false map turtles, as well as to the other more common turtles in the Pierre area including western painted turtles (*Chrysemys picta*), snapping turtles (*Chelydra serpentina*), and smooth softshell turtles (*Trionyx muticus*).

Western Box Turtle

It's uncertain whether western box turtles (*Terrapene ornata*) naturally occurred in the Pierre area. In our part of its range, these small box turtles typically inhabit sandy places like the Nebraska sandhills in southcentral South Dakota and in very localized areas elsewhere in the southern half of the state. The species is monitored by the SD Natural Heritage Program because of its very localized occurrence and potential declines due to habitat destruction and the pet trade (it is a popular pet). In 1986 two adult females and one adult male were found in the woodlands along the Missouri River just east of the downstream end of LaFramboise Island. A single adult box turtle was also found on LaFramboise Island on September 15, 1992 (SDNHD 2004). Whether these were released pets or wild turtles is unknown, but if they continue to be observed over time and reproduction can be documented, they and their habitat should be protected.

Other rare species

In 1993 a least shrew (*Cryptotis parva*) was trapped on LaFramboise Island. This tiny shrew species has been poorly documented in South Dakota but is now believed to occur throughout much of the state based upon recent small mammal surveys (SDNHD 2004).

In June 1979, river otter tracks were observed along the Hughes county shoreline just across from the downstream end of LaFramboise Island by two former government trappers, Lou Huffman and Clarence Grant. Northern river otters (*Lutra canadensis*) are a state threatened species that was nearly eliminated from South Dakota. In recent years there have been reintroduction efforts in Nebraska, Iowa and by the Flandreau Santee Sioux Tribe in eastern South Dakota. Whether as a result of these reintroductions or from natural population increases, there have been an increased number of sightings in central South Dakota in recent years (SDNHD 2004). In a recent evaluation of potential river otter habitat in South Dakota, both the Missouri River and Bad River (whose mouth is opposite LaFramboise Island) received high ratings as potential reintroduction sites for river otters. Because most of the Missouri River is impounded (and its riparian forest inundated), much of the river would be unsuitable (Kiesow 2003). River otters also tend to inhabit areas with low human disturbance which suggests that

dispersing river otters may occasionally pass through this reach of the river, but that it is unlikely that this immediate area will support a permanent population.

American woodcock (*Scolopax minor*) are an uncommon and very localized breeding species in South Dakota. Displaying males have been observed on LaFramboise Island during the breeding season for the past several years, although no nest or young have been yet observed (D. Backlund pers. comm. 2004).

Cooper's hawk (*Accipiter cooperii*) is also an uncommon, localized breeding species in South Dakota. In May, 1983 a single Cooper's hawk was observed for at least one week during the breeding season, although no additional evidence of breeding has been documented since then (SDNHP 2004).

B. Resident and Migratory Birds

The South Dakota breeding bird atlas project documented nesting bird species throughout South Dakota and although LaFramboise Island was surveyed, the results were lumped into a larger sampling block that included all of the greater Pierre/Fort Pierre area (Peterson 1995, Peterson 2004). More recently, Kenny Miller, a Pierre birder, has compiled a list of 122 bird species which he has observed on LaFramboise Island (see Table 2). Of these 122 species observed on the island, 61 are documented as breeding in the Pierre area. Several of these like the black-capped chickadee, hairy woodpecker, wild turkey, and great horned owl are year-around residents. A few, like the red-breasted nuthatch, Townsend's solitaire and northern goshawk are winter residents, while many are non-breeding bird species that migrate through South Dakota and depend on LaFramboise Island for food and cover during their spring and fall migrations. A more definitive and quantitative list of these migrant species does exist for Farm Island (see Table 3) where banding efforts have been conducted during the spring and fall migrations for more than 11 years. Similar systematic banding efforts have not been conducted on LaFramboise Island, but migratory bird use should be quite similar.

Two nesting colonies on LaFramboise Island are also notable. In the southwestern portion of the island there are several dozen great blue heron nests. These have been occupied for several years although no quantitative information has been collected on number of nesting pairs, nest success, young produced, etc. In this same area turkey vultures also have what appears to be a night roost. It is assumed that these are non-breeding individuals because no nesting or recently fledged young have been observed. There also appears to be a double-crested cormorant nesting colony of a few nests on the northeastern margin of the island opposite the Legion Cabin on the Hughes County shore.

Table 2: Birds Sighted on LaFramboise Island 1985 – 2003

Compiled by Kenny Miller, Pierre, SD

[Species marked with asterisk * have been documented as breeding in the Pierre/Fort Pierre area based upon Peterson (1995), and more recent observations].

BirdName
American Crow
American Goldfinch*
American Kestrel*
American Redstart*
American Robin*
American Tree Sparrow
American Wigeon
American Woodcock*
Bald Eagle*
Baltimore Oriole*
Barn Swallow*
Bell's Vireo*
Belted Kingfisher*
Black-and-white Warbler
Black-billed Magpie*
Black-capped Chickadee*
Black-headed Grosbeak*
Blackpoll Warbler
Blue Jay*
Blue-winged Teal*
Bohemian Waxwing
Bonaparte's Gull
Broad-winged Hawk
Brown Creeper*
Brown Thrasher*
Brown-headed Cowbird*
Canada Goose*
Canada Warbler
Caspian Tern
Cedar Waxwing*
Chimney Swift*
Common Goldeneye
Common Grackle*
Common Merganser
Common Nighthawk*
Common Yellowthroat*
Cooper's Hawk*
Dark-eyed Junco
Downy Woodpecker*
Eastern Kingbird*
Eastern Phoebe
Eastern Screech-Owl*
European Starling*
Field Sparrow*
Franklin's Gull
Glaucous Gull
Golden-crowned Kinglet
Great Crested Flycatcher*
Great Horned Owl*
Gyrfalcon
Hairy Woodpecker*
Harris' Sparrow
Hermit Thrush
Herring Gull
Hooded Merganser
House Finch*
House Wren*
Least Flycatcher*
Lesser Scaup
Lincoln's Sparrow
Magnolia Warbler
Mallard*
Merlin
Mourning Dove*
Mourning Warbler
Northern Cardinal*
Northern Flicker*
Northern Goshawk
Northern Harrier
Northern Parula
Northern Pintail*
Northern Saw-whet Owl
Northern Shoveler*
Northern Shrike
Orange-crowned Warbler
Orchard Oriole*
Osprey
Ovenbird*
Peregrine Falcon
Pied-billed Grebe*
Pine Grosbeak
Pine Siskin
Purple Finch
Red-bellied Woodpecker*
Red-breasted Nuthatch
Red-eyed Vireo*
Red-headed Woodpecker*
Red-tailed Hawk*
Red-winged Blackbird*
Ring-billed Gull
Rose-breasted Grosbeak
Ruby-crowned Kinglet
Ruddy Duck
Rusty Blackbird
Sandhill Crane
Sharp-shinned Hawk
Snow Goose
Song Sparrow*
Spotted Sandpiper
Spotted Towhee*
Swainson's Thrush
Swamp Sparrow
Tennessee Warbler
Thayer's Gull
Townsend's Solitaire
Tree Swallow*
Turkey Vulture*
Varied Thrush
Warbling Vireo*
Western Grebe*
Western Kingbird*
Western Meadowlark*
White-breasted Nuthatch
White-crowned Sparrow
White-throated Sparrow
Wild Turkey*
Wilson's Phalarope
Wilson's Warbler
Wood Duck*
Yellow Warbler*
Yellow-headed Blackbird*
Yellow-rumped Warbler

Table 3: Birds Banded on Farm Island, Spring & Fall (1993- 2004)

Compiled by Doug Backlund, SD GFP

Birds banded Farm Island 1993-2004	**# banded**
Orange-crowned Warbler	865
Yellow Warbler	528
Least Flycatcher	473
Myrtle Warbler	407
Common Yellowthroat	403
Swainson's Thrush	345
Traill's Flycatcher	238
Ruby-crowned Kinglet	144
American Redstart	133
Blackpoll Warbler	114
Black-capped Chickadee	105
Tennessee Warbler	99
House Wren	91
Gray Catbird	83
Wilson's Warbler	82
White-throated Sparrow	78
Spotted Towhee	73
Warbling Vireo	71
Song Sparrow	62
Lincoln's Sparrow	56
Northern Waterthrush	50
Red-eyed Vireo	45
Black-and-White Warbler	45
Black-headed Grosbeak	43
Slate-colored Junco	41
Brown Thrasher	40
Clay-colored Sparrow	37
Ovenbird	37
White-crowned Sparrow	26
Mourning Warbler	25
Yellow-breasted Chat	24
Cedar Waxwing	22
Nashville Warbler	22
Magnolia Warbler	22
White-breasted Nuthatch	19
Yellow-shafted Flicker	17
Gray-cheeked Thrush	17
Baltimore Oriole	16
Field Sparrow	16
Harris's Sparrow	15
Swamp Sparrow	15
Downy Woodpecker	14
Rose-breasted Grosbeak	10
Red-breasted Nuthatch	10
American Tree Sparrow	9
American Goldfinch	8
Chipping Sparrow	7
Chestnut-sided Warbler	6
Western Palm Warbler	6
Eastern Kingbird	5
Blue Jay	5
Northern Cardinal	5
Lazuli Bunting	5
Hairy Woodpecker	4
Philadelphia Vireo	4
Bell's Vireo	4
Golden-crowned Kinglet	4
Unidentified Dark-eyed Junco	3
Black-throated Blue Warbler	3
Black-throated Green Warbler	3
Canada Warbler	3
Brown Creeper	3
Veery	3
Sharp-shinned Hawk	2
Orchard Oriole	2
Le Conte's Sparrow	2
Golden-winged Warbler	2
Northern Parula	2
Bay-breasted Warbler	2
MacGillivray's Warbler	2
Marsh Wren	2
Belted Kingfisher	1
Yellow-bellied Flycatcher	1
Brown-headed Cowbird	1
Pine Siskin	1
Savannah Sparrow	1
Fox Sparrow	1
Blue Grosbeak	1
Northern Rough-winged Swallow	1
Blue-headed Vireo	1
Solitary Vireo	1
Blue-winged Warbler	1
Townsend's Warbler	1
Hooded Warbler	1
Hermit Thrush	1
Eastern Bluebird	1
Total	5199

C. Mammals

(Mammal common names used follow Higgins, et. al (2000) where precise scientific names can be found.)

White-tailed Deer

Prior to construction of the mainstem dams, the Missouri River bottoms and adjacent river breaks provided some of the best deer habitat in South Dakota. In this pre-dam environment Bever (1956) estimated the carrying capacity to be approximately 40 deer per linear river mile. While there are no deer population estimates specifically for LaFramboise Island, since 1992 deer harvest estimates have been made for the combined harvest from Farm and LaFramboise Islands (see Table 4). As the third column of Table 4 illustrates, Farm and LaFramboise Islands provide a substantial proportion of the archery deer harvest in Hughes County, ranging from 30 to 91%, an indication of their popularity for archery deer hunting.

Photo 8: Grapevine on cottonwood with browseline.

Also evident in Table 4 is the substantial drop in deer harvest between 1996 and 1997. The winter of 1996/97 was extremely severe and resulted in increased mortality for many wildlife species. In addition to the recurring blizzards, much of Farm Island was flooded due to a combination of ice dams in the river and water releases from Oahe Dam to maintain an open channel. Multiple layers of ice formed over much of Farm Island creating additional hazards and ultimately higher deer mortality.

What these numbers also indicate is the extremely high number of deer that existed on the islands prior to 1997. As the deer population increased during the late 1980s and 1990s, it apparently exceeded the carrying capacity of LaFramboise Island. Deer, presumably together with cottontail rabbits, have overbrowsed their forage resource.

This overbrowsing is clearly evident today. Browselines are commonly encountered throughout the island as illustrated in photos 8 & 9.

Table 4: Deer Harvest Estimates on LaFramboise Island and Farm Island Recreation Area 1992-2002.

Compiled from annual big game harvest projection reports (see Sources listed on page 29) based on a statistical sample of hunters surveyed, (the number of hunters sampled is intended to achieve a 90% confidence level). Response rates during these years ranged from 87% to 93%). Harvested numbers represent a combined total from the general archery deer season plus the special antlerless archery season (they do not include deer killed in the firearm season on Farm Island. There is no firearm season on LaFramboise Island) .

YEAR	Estimated Deer Harvest from Farm & LaF. Islands *	Percent of Hughes County Total Archery Harvest
1992**	72	91%
1993	94	66%
1994	56	53%
1995	85	79%
1996	107	82%
1997	26	53%
1998	39	48%
1999	26	57%
2000	25	56%
2001**	13	30%
2002**	28	46%
2003**	29	51%

* Following the hunting season each year, Hughes County archery hunters are sent a survey to document whether they killed a deer and where it was killed. Archers were specifically asked whether the deer they killed was from the Farm Island /LaFramboise Island area or from elsewhere in Hughes County. The "Farm/LaFramboise Island Area" also does include the narrow strip of riparian forest that lies along the river from Downs Marina to Farm Island. Virtually all the deer reported have been whitetails.

** In 1992 there was no archery antlerless season in Hughes County, and in 2001, 2002, & 2003 LaFramboise Island and Farm Island Recreations Area were specifically excluded from the special archery antlerless hunting units.

While there is no quantitative vegetation data to compare current forage production on LaFramboise Island with past amounts, qualitatively speaking there has been a significant vegetational change in the last twenty years. Where young grapevines, woodbines, virgin's bower, wildrose, and other palatable browse species once occurred in abundance in the understory, now grow thousands of unpalatable juniper seedlings.

A basic tenet of wildlife management is that the health and abundance of a wildlife population is directly dependent on the quality of its habitat (Lenarz 1990). For a variety of reasons including an over-abundance of deer, the habitat quality of LaFramboise Island has declined.

Photo 9: Browse line on chokecherry of LaFramboise Island.

Beaver

Beaver have always been an important animal of the Missouri River and they continue to inhabit bank dens along the river and on LaFramboise Island. Unfortunately, the cottonwood and willow that beaver largely depend on for food are not reproducing, leading to a situation where beaver now threaten the remaining cottonwood trees (see Photo 10) along the shoreline of the island which also provide roost and nest sites for bald eagles, cavity nesting birds, bats, and other wildlife. Figure 11 shows a map of LaFramboise Island depicting areas where beaver damage is most severe. There are dozens of

Photo 10: Three cottonwoods gnawed off by beaver.

beaver-killed cottonwood trees located especially along the southeastern side of the island, so that there are now very few large cottonwoods for substantial reaches along the margin of the island. Because beaver also cause damage to ornamental trees near the shorelines in Pierre and Fort Pierre, several beaver (averaging about 16 per year) are trapped or killed each year in response to complaints in this reach of the river. In addition to natural reproduction, an influx of beaver is observed following flood events on the Bad River (D. Bernstein, pers. comm. 2002).

Figure 11: LaFramboise Island locations where beaver-cut stumps were observed. Open triangles indicate plots with or near beaver stumps. Black dots indicate locations of systematically located tree plots described in Appendix B.

Bats

In a recent study on bats of eastern South Dakota, Missouri River gallery forests were found to have higher catch rates and a larger number of species than any other habitat sampled (Swier 2003). In this same study, three bat species were documented on LaFramboise Island: little brown bat, big brown bat, and silver-haired bat. Several of these individual bats were radio tagged and their movements tracked to roost sites. The deeply furrowed bark of mature cottonwood trees is an important habitat feature for bats, especially the silver-haired bat, which prior to this study was not known to summer in South Dakota. An additional four species of bats could potentially also occur on LaFramboise Island since they were detected on Farm Island. The high tree canopy of LaFramboise Island makes capture of bats difficult, however a more intensive bat survey scheduled for 2005 should help document the full bat fauna of LaFramboise Island (A. Kiesow, pers. comm. 2004).

Other Mammals

Eastern fox squirrels inhabit LaFramboise Island but because of the limited food supply are not particularly abundant. On the other hand, eastern cottontails are relatively common. Predators like coyotes or fox occasionally den on the island, while mink and raccoon commonly frequent the island's shoreline. Three gray fox were trapped on the island in the late 1970's (C. Solberg pers. comm. 2004), and one was shot with an arrow in the early 1980's (T. Schaal pers. comm. 2004). Both long-tailed and least weasels have been observed in the Pierre area and are likely to occur on the island. Mammals like meadow vole, deer mouse, and thirteen-lined ground squirrel have not been documented on the island but likely occur there together with other small mammal species.

D. Reptiles

Snakes observed on LaFramboise Island include bullsnake (*Pituophis catenifer*), racer (*Coluber constrictor*), and prairie rattlesnake (*Crotalus viridis*). Additional snake species in the Pierre/Ft. Pierre area likely to occur on LaFramboise Island include the common and plains garter snakes (*Thamnophis sirtalis & T. radix*). plains hognose (*Heterodon nasicus*) and milk snake (*Lampropeltis triangulum*).

For turtles of LaFramboise Island see discussion under false map turtle above. No lizards have been observed on the island.

E. Amphibians

Western chorus frogs (*Pseudacris triseriata*) and northern leopard frogs (*Rana pipiens*) are the most common frogs on LaFramboise Island, although a small colony of Cope's gray treefrog (*Hyla chrysoscelis*) does occur in the forest below Oahe Dam and could potentially occur on the island (D. Backlund, pers. comm. 2004). LaFramboise Island has not been surveyed for toads, however Woodhouse's toad (*Bufo woodhousei*) has been detected on the Hughes County side of the river across from the island (J. Kiesow, pers. comm. 2004) and can be assumed to occur on the island. Neither plains spadefoot toads (*Scaphiopus bombifrons*) nor Great Plains toads (*Bufo cognatus*) were detected in the riverside forest on the Hughes County side (J. Kiesow, pers. comm. 2004) although it is possible that they occur on the island. Tiger salamanders (*Ambystoma tigrinum*) also have not been formerly documented on LaFramboise Island but because they occur statewide and throughout Hughes and Stanley counties, it is highly probable that they do occur on the island.

F. Fish

One feature of LaFramboise Island that does have significant fisheries benefits is the chute along the Island's southeastern shoreline. Inflows to this chute only occur during water releases from Oahe Dam, but this small, backwater habitat undoubtedly benefits a number of river fishes including channel catfish, sauger, various baitfish and young gamefish, and possibly shovelnose sturgeon which are declining in abundance in Lake Sharpe (B. Hanten, pers. comm.2004).

G. Invertebrates

Crustaceans

There's only been one systematic survey for clams in upper Lake Sharpe (Ecological Specialists 1998) and the closest they came to LaFramboise Island was the sampling they did near lower Farm Island. Of the four species documented, two, the pink papershell (*Potamilus ohiensis*) and fragile papershell (*Leptodea fragilis*) have been observed near LaFramboise Island (D.Backlund, pers. comm. 2004). The other two species, white heelsplitter (*Lasmigona complanata*) and giant floater (*Pyganodon gradis*) may also occur in waters adjacent to LaFramboise Island but just have not have been documented yet.

The riprapped banks on the west and north sides of LaFramboise Island also support a substantial population of crayfish. While the identity of the species has not been verified with positively identified specimens, it is highly likely to be the northern crayfish (*Orconectes virilis*).

Insects

While there has not been a comprehensive survey, there has been some incidental collecting of butterflies on LaFramboise Island. Table 5 lists 17 species of butterflies that have been identified on the island. Many of these (e.g., eastern tiger swallowtail, mourning cloak, etc.) have larvae that depend on forest plants for food. More comprehensive butterfly lists are available for adjacent Hughes County (58 species) and Stanley County (69 species), (Marrone 2002).

Table 5: Butterflies Collected on LaFramboise Island
(from personal collection of Gary Marrone)

Common Name	**Scientific Name**	Date	Collector
Juniper Hairstreak	*Callophrys gryneus siva*	06/09/90	G.M. Marrone
Common Wood-nymph	*Cercyonis pegala nephele*	08/11/90	Marrone & Kean Family
Gorgone Checkerspot	*Chlosyne gorgone carlota*	08/11/90	G.M. Marrone
Orange Sulphur	*Colias eurytheme*	06/09/90	G.M. Marrone
Clouded Sulphur	*Colias philodice*	08/11/90	Marrone & Kean Family
Monarch	*Danaus plexippus*	08/11/90	Marrone & Kean Family
Variegated Fritillary	*Euptoieta claudia*	08/11/90	G.M. Marrone
Viceroy	*Limenitis archippus*	08/11/90	Marrone & Kean Family
Melissa Blue	*Lycaeides melissa*	06/09/90	G.M. Marrone
Mourning Cloak	*Nymphalis antiopa*	03/12/92	Eileen Dowd Stukel
Eastern Tiger Swallowtail	*Papilio glaucus*	08/11/90	G.M. Marrone
Pearl Crescent	*Phyciodes tharos*	05/28/83	G.M. Marrone
Cabbage White	*Pieris rapae*	08/11/90	G.M. Marrone
Eastern Comma	*Polygonia comma*	03/25/00	G.M. Marrone
Edwards' Fritillary	*Speyeria edwardsii*	06/09/90	G.M. Marrone
Gray Hairstreak	*Strymon melinus franki*	08/11/90	Marrone & Kean Family
Red Admiral	*Vanessa atalanta rubria*	06/09/90	G..M. Marrone

Sources for Table 4

Huxoll, Corey. 2003. Big game harvest projections for 2002. South Dakota Game Report No. 2003-01, SD Game, Fish and Parks Department, Pierre, SD. 88 pp.

Huxoll, Corey. 2004. Big game harvest projections for 2003. South Dakota Game Report No. 2004-01, SD Game, Fish and Parks Departmetn, Pierre, SD.

McPhillips, Kelly and Chuck Schlueter. 1998. Big game harvest projections for 1997. South Dakota Game Report No. 98-03, SD Game, Fish and Parks Department, Pierre, SD. 80 pp.

McPhillips, Kelly. 1993. Big game harvest projections for 1992. South Dakota Game Report No. 96-03, SD Game, Fish and Parks Department, Pierre, SD. 82 pp.

McPhillips, Kelly. 1994. Big game harvest projections for 1993. South Dakota Game Report No. 94-01, SD Game, Fish and Parks Department, Pierre, SD. 82 pp.

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Schlueter, Chuck. 2000. Big game harvest projections for 1999. South Dakota Game Report No. 2000-07, SD Game, Fish and Parks Department, Pierre, SD. 77 pp.

Smith, Art. 2001. Big game harvest projections for 2000. South Dakota Game Report No. 2001-01, SD Game, Fish and Parks Department, Pierre, SD. 80 pp.

Smith, Art. 2002. Big game harvest projections for 2001. South Dakota Game Report No. 2002-01, SD Game, Fish and Parks Department, Pierre, SD. 120 pp.

IV. Future Vegetation and Management

A. Desired Future Condition

LaFramboise Island is managed as a "Nature Area" by the State Parks and Recreation Division. This designation indicates that the level of development is kept to a minimum, typically consisting of only hiking trails, parking lot, restrooms, and picnic tables. The objective is to provide park users with an opportunity to hike, bike, ski, birdwatch, photograph, fish, and, in some cases, hunt, in a relatively natural environment. Campgrounds, playgrounds, buildings, etc. are typically not constructed in Nature Areas. LaFramboise Island differs somewhat in that the City of Pierre has constructed several wells and well houses on the upstream end of the island, and there is a U.S.G.S. gauging station on the southwest corner of the island. The hiking trail system on LaFramboise Island has been designated as a "National Recreational Trail," by the U.S. Department of Interior.

Management of LaFramboise Island is somewhat prescribed by the terms of the Title VI land transfer, and the "Missouri River Endangered Species Memorandum of Agreement" between GFP, FWS, and COE. Under these agreements the state pledged to conserve threatened or endangered species along the Missouri River. Most relevant to LaFramboise Island are the specific commitments pertaining to bald eagles. Paraphrased from these agreements those commitments are:

1. Agreeing to not remove cottonwood trees important for bald eagle nesting or roosting, except for limited removal of single trees which pose a human safety hazard (if trees are removed they are to be replanted at a 4:1 ratio).

2. Protect nesting or roosting areas from recreational activities that might pose a threat or disturbance to the eagles.

3. Restrict construction activities so that they do not occur within ¼ mile from active eagle roosts or ½ mile from active eagle nests.

In terms of biological objectives, the Parks Division would like to sustain the diversity of native wildlife on the island while minimizing or at least optimizing the management costs. The island's wildlife diversity is directly related to the diversity and condition of the habitats available. Historically important habitats of the Missouri River bottom including LaFramboise Island included:

1. Mostly barren sandbars with a river hydrograph that allowed successful nesting by shorebirds like interior least tern, piping plovers and the various river turtles.
2. Early successional willow and young cottonwood thickets.
3. Mature cottonwood forest.
4. Mixed deciduous forest that developed on infrequently flooded portions of the floodplain as the maturing cottonwoods died out.
5. Juniper forests like those that occurred on Cedar Island and other locations in this reach of the Missouri River.

6. Riparian wetland habitats.
7. Chutes, holes, riffles, and other aquatic habitats typical of the undammed Missouri River.

Given the environmental changes that have occurred because of the impoundment of the Missouri River and the presence of invasive and exotic plant species; creating or sustaining these native habitats and their associated wildlife may or may not be possible, but at minimum will require substantial management efforts. The alternative is to allow the island to "naturally" succeed to a predominately cedar forest with smaller stands of exotic or invasive plants like Russian olive, smooth bromegrass, narrow-leaved cattail[6], and Canada thistle. How natural succession could lead to these primarily exotic habitats with very limited wildlife value is described below.

B. Floodplain Ecology of LaFramboise Island

The vegetation of LaFramboise Island and its future can only be understood in the context of the Missouri River floodplain environment; how this ecological system functioned prior to the impoundment of the Missouri River, and how it is functioning today.

Briefly summarized, the undammed Missouri River meandered over a broad floodplain, which in central South Dakota was one to two miles wide. Known as the "Big Muddy," the Missouri River transported large quantities of sediment which were deposited wherever the current slowed enough for these soil particles to settle out of suspension. This resulted in the creation of sandbars, islands, points, etc. Turbulent floods would erode banks and islands from some locations while creating them elsewhere, typically cutting banks from the outside of river bends and depositing sediment on the inside of bends (LaFramboise Island is on the inside of a river bend). Islands were created by sediment deposition or by the river cutting a chute between a piece of land and the mainland. (Hesse 1996). During high water of peak flood events, sediment deposition would "build" islands to an even higher elevation. This phenomenon was witnessed and recorded by Meriwether Lewis during the Lewis & Clark expedition in 1804 to 1806. In his description of sandbar willow, Lewis describes the island building process he observed during their journey:

> "This tree [sandbar willow, *Salix interior*] is invariably the first which makes it's appearance on the newly made Lands on the borders of the Mississippi and Missouri, and seems to contribute much towards facilitating the operation of raisin this ground still higher; they grow remarkably close and in some instances so much so that they form a thicket almost impenetrable the points of land which are forming always become eddies when overflown in high water these willows obstruct the force of the water and makes it more still which causes the mud and sand to be deposited in greater quantities … as the willow incrases in size and the land gets higher (and more dry) by the annul inundations of the river, the weeker plants decline dye and give place to the cotton-wood

[6] Apparently narrow-leaved cattail (*Typha angustifolia*) did not historically occur on the northern plains (Larson 1993). Whether it invaded North America from Europe or was native to coastal areas is still being determined (Smith 2000). Regardless of its origin, narrow-leaved cattail readily invades disturbed wetland habitats and crowds out other native wetland plant species. It also hybridizes with the native, wide-leaved cattail (*T. latifolia*), forming sterile but vegetatively aggressive hybrid swarms.

> which is it's ordinary successor, and these last in their turn also thin themselves as they become larger in a similar manner and leave the ground open for the admission of other forest trees and under brush…" (Moulton 1987, p. 455).

In describing cottonwood as the "ordinary successor" of sandbar willow, Meriwether Lewis is alluding to what ecologists now term "succession," whereby the vegetation on a given piece of land changes over time in a predictable pattern.

Modern ecological studies have, more quantitatively, documented some of the successional patterns on the Missouri River floodplain. At least four studies along the Missouri River in southeastern South Dakota have described aspects of a successional sequence that begins with colonization by cattails or sandbar willow, develops through transitional phases to a plains cottonwood dominated forest, and finally, in the absence of stand replacing floods, develops into a mixed deciduous forest that may contain the following tree species(in addition to aging cottonwoods): green ash, American elm, boxelder, bur oak, slippery elm, hackberry, American basswood, black walnut, and eastern red cedar (Johnson 1950, Heckel 1963, Wilson 1965 & 1970, Lawry 1973). Ecological studies along the Missouri River in central North Dakota have documented a similar successional pattern ultimately resulting in a forest dominated by green ash, boxelder, bur oak, and American elm (Johnson, et al. 1976).

Another successional sequence which resulted in a forest dominated by red cedar[7] appears to be a pattern typical in central South Dakota. Early explorers and map makers repeatedly referred to "cedar islands" in a reach of the Missouri River extending from near Fort Randall to near the mouth of the Bad River. The maps drawn by William Clark show four islands which are indicated as being "covered with cedar," (Moulton 1983), and the journals of Lewis and Clark cite at least seven islands or bottoms covered with red cedar (Moulton 1987). A typical citation is their entry on 16 September, 1803 describing American or Cedar Island, "this island is about 1 mile long with a great portion of cedar timber near the middle of it." (Moulton, 1987 p. 79). Louisell's Fort, a trading post located on Dorian/Cedar Island near the mouth of modern day Cedar Creek, is described as being built of cedar logs (Moulton 1987).

Dr. Willam Lass recently discovered a business ledger of the Latta – Johnson Woodyard located on the above-mentioned Dorian Island from the mid 1800's. During the spring and summer of 1867 this woodyard sold 817 cords of wood of which at least 75 cords were cedar along with 550 cedar posts and 200 cedar poles (108 cords sold were of cottonwood, the remaining 634 cords were not identified to species). All were apparently cut from upper and lower Dorian Islands which had a combined size of approximately 750 acres. Most of these sales were to the 41 steamboats that stopped at the woodyard during this period (Lass, In Press). Considering that steamboats had been ascending the Missouri River beyond this point since 1831 and that they, depending on their size, burned approximately 15 cords of wood per day (Lass, In Press), it is likely that many of the tree size cedar, (since it was hotter burning than cottonwood and because of its resin could have been burned green), would have already been cut even before the start of the Latta – Johnson Woodyard. Indeed, John James Audubon, while ascending the river on the steam boat "Omega" mentions cutting cedar in this same vicinity in 1843 (Audubon 1897). It seems evident that some of the islands in this reach of the Missouri River supported not just

[7] See footnote #2, page 10 for explanation of cedar v.s. juniper.

cottonwood forests with a few scattered juniper trees, but substantial stands of forest dominated or codominated by juniper.

Johnson (1992), in a study of Missouri River floodplain forests in central North Dakota, determined that the pre-settlement forest was, in fact, dominated by early successional stages. He reports that young pioneer stands (<40 yrs. old) comprised 47% of the forest, while older pioneer stands (40-80 yrs. old) comprised 25% of the forest; that transitional forest (80-150 yrs old) comprised 21% of the forested acreage and that equilibrium stands(dominated by green ash, elm, oak, etc.) (>150 yrs.old) comprised only 7% of the forested acreage. Johnson (1992) also demonstrated that with construction of Garrison Dam and subsequent cessation of flooding, there is a continuing shift to older forest stages and very little recruitment of new, early successional forest; the very types that once dominated the Missouri River floodplain and provided habitat for its varied native wildlife.

LaFramboise Island appears to reflect similar changes in vegetation. Historic maps and sketches of the island show a large, mostly unvegetated or shrub covered sandbar island with a forest located in the central downstream portion of the island (see. Figures 2, 3, 4). How much of this forest was cut during the steam-boating era is unknown, but with patenting of the land and settlement, the forest was cleared and converted to cropland or grassland which is clearly shown on photos and maps from the 1940's to the present (see Figures 5, 6, 7, 8). While the historic forest was cleared and is now mostly a grassland, the upstream sandbar portion of the island was colonized by cottonwoods which have developed into the present day cottonwood forest.

C. Future of LaFramboise Island's Natural Vegetation

In 1966 Dr. Dilwyn Rogers conducted a vegetational study of Farm Island. At the same time, he collected plot data from LaFramboise Island consisting of 5 circular 1/10th acre plots located in a single stand of cottonwood forest. Within each plot he measured and tabulated each tree larger than 4 inches dbh, and made additional observations on the woody vegetation. His analysis and results are summarized in an unpublished report to the SD Game, Fish and Parks Department (Rogers 1966).

While the exact location of Dr. Rogers study site is not known, comparable data was collected in 2003 in preparation for this report (see Appendices A & B). For the following comparison and analysis, 27 plots (see Appendix B) located within the area mapped as cottonwood forest in Figure 9 were pooled, together with the two cottonwood releve plots presented in Appendix A for a total of 29 1/10 acre plots. Table 6 presents a 37 year comparison of the cottonwood component of this forest.

Table 6: Characteristics of cottonwoods sampled on LaFramboise Island in 1966 and 2003.

	Median DBH	Ave. DBH	# Trees /Acre	Basal Area per Acre
Rogers 1966	10.5"	11.2"	138	10.7 sq.ft./A
Ode in 2003	16.9"	17.4"	75	9.1 sq.ft./A

As this table illustrates, the maturing cottonwood forest on LaFramboise Island demonstrates a pattern typical of these forest types, progressing toward fewer, larger trees per acre with a declining total basal area. The only other tree species found in Dr. Roger's plots was peach-leaved willow (*Salix amygdaloides*) at a density of 2 per acre and average dbh of ca. 4 inches. He also writes that the dominant shrubs in this stand were western snowberry (*Symphoricarpos occidentalis*) and wild grape (*Vitis* sp.). He found very few junipers or green ash (*Fraxinus pennsylvanica*) seedlings or saplings in this stand.

Over the past 37 years much has changed in the cottonwood forest of LaFramboise Island. As the density of cottonwoods has declined (at a rate of about 2 per acre per year), the number of junipers and, to some extent, green ash have dramatically increased. In cottonwood forests throughout much of the upper Missouri River Valley, green ash is one of the most important tree species to colonize cottonwood forests and, over time, becomes the dominant forest tree. A 1988 study of the cottonwood forest below Oahe Dam (just five miles north of LaFramboise Island) documented this very successional pattern where young green ash are developing beneath the cottonwood overstory and promise to become the dominant tree (McCormick & Sowers 1988). Table 7 compares the tree species density differences between the Oahe Downstream area and LaFramboise Island.

Table 7: Comparison of tree species densities between Oahe Downstream and LaFramboise Island forests (all age classes combined per acre)

	Oahe Downstream Area * (1988)	LaFramboise Island **(2003)
Green Ash	262	34
Cottonwood	67	62
Boxelder	14	9
Russian Olive	13	54
Cedar/Juniper	9	469

* Data taken from McCormick & Sowers (1988) based upon 106 plots in a 686 acre area just below Oahe Dam.
** Averages calculated from all 37 plots containing trees. See Appendices A & B.

While green ash appear be succeeding the cottonwood on Oahe Downstream, junipers are clearly the future forest of LaFramboise Island. Of the 44 systematically placed points around the periphery of the island where plots were located, only 19 plots contained any green ash and these tended to be on the north side of the island (see Figure 12).

The 124 green ash measured in sample plots had an average stem size of 3.4 inches (dbh) with a median size of 3.2 inches, and ranged from 1 inch to 8 inches in diameter. Densities within these green ash plots ranged from 10 per acre to 320 green ash per acre. While the periphery of the island may not be perfectly representative of the island's interior, this patchiness of green ash is characteristic of the island. Of the two subjectively placed releve plots in the islands interior (see Appendix A), one contained green ash and one did not. Given continued survival and growth of green ash, it will likely dominate the canopy in a portion of LaFramboise Island's future forest and will probably bear some resemblance to green ash/chokecherry woodlands that naturally

occur in river breaks and riparian zones elsewhere in central South Dakota (see Hansen & Hoffman 1988, Archer & Tieszen 1977, for descriptions of this woodland type). Whatever the dominance of green ash in the future forest, it will likely be over-whelmed if not over-shadowed by the massive number of junipers which are now developing in the LaFramboise Island forest understory.

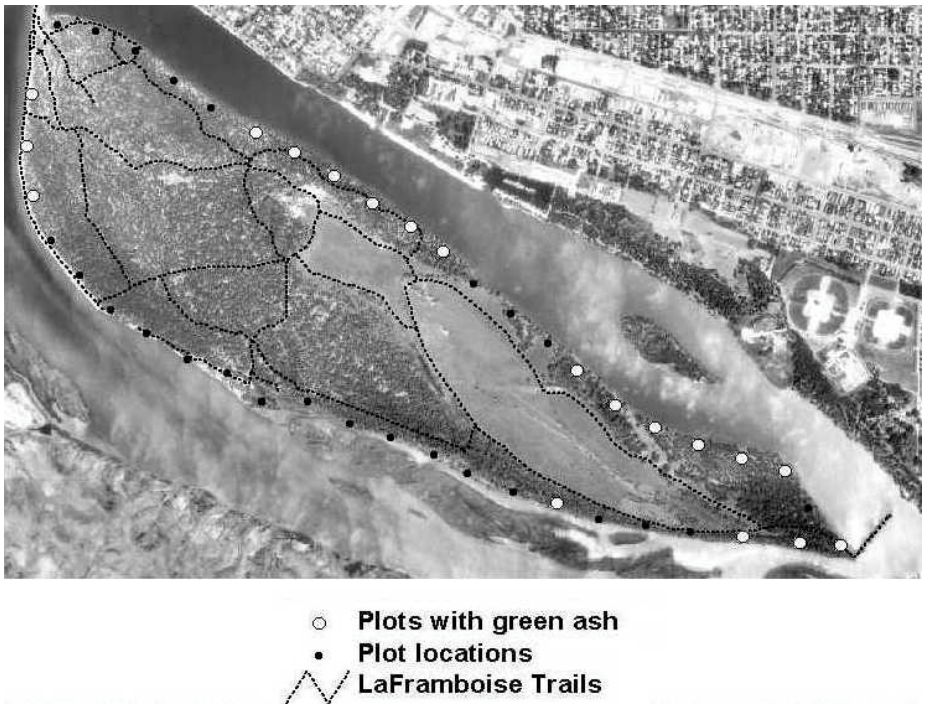

Figure 12: Aerial photo of LaFramboise Island showing locations of plots containing green ash.

As discussed above, several of the now inundated Missouri River islands historically supported substantial acreages of juniper forest. This appears to be the fate of much of LaFramboise Island. A total of 37 plots were sampled on LaFramboise Island (34 peripheral tree plots in Appendix B plus the 3 vegetation releve' plots in Appendix A). Every plot but one contained juniper seedlings, saplings, or trees. Excluding the two juniper forest plots (LT12 & LT13), the average density of junipers was 382 per acre of which 65% were seedlings or saplings less than 6 feet tall. Three plots had densities exceeding 1000 junipers per acre. As these juniper seedlings and saplings grow, more and more of the forested portion of the island will resemble the area locally known as "The Cedars," and mapped as Cedar Forest on Figure 9.

Junipers are notoriously vulnerable to fire. On the presettlement landscape of the northern plains, where prairie fires were frequent events, juniper woodlands were restricted to fire-protected environments like river breaks, badland escarpments, buttes, and islands. In South Dakota there are no "old growth" juniper forests on islands. All of the islands have either been inundated by reservoirs or, like LaFramboise, are vegetated by maturing cottonwood forest or other forest types. Perhaps this juniper forest will resemble juniper woodland types of the western Great Plains, most notably the Rocky Mountain Juniper/Indian ricegrass type *(Juniperus scopulorum/Oryzopsis micrantha* plant association) as described by Hansen, et.al. (1988) and

others. This type occurs in the Missouri River breaks in central South Dakota (Rumble and Gobeille 1995), although there are few old-age stands from which to extrapolate.

The old agricultural fields on LaFramboise Island, whether vegetated by smooth brome or by recently planted native grasses, are being invaded by Russian olives (*Elaeagnus angustifolia*), an exotic, invasive, small tree widely planted in windbreaks and wildlife cover plantings. To a lesser extent, junipers are also invading this grassland (see Photo 6). In some locations these Russian olives have formed a woodland vegetation, (see Plot 3 in Appendix A). Across all of the plots sampled as part of this report (excluding the plot specifically located within a Russian olive stand), Russian olives occurred in 28 of the 36 plots (78%) with an average density of 54 per acre, although the densities ran as high as 340 Russian olives per acre. Somewhat surprisingly, Russian olive seedlings occurred in only 2 of the 36 plots. While there is no incontrovertible evidence to support it, it seems likely that this scarcity of seedlings is not due to lack of reproduction but to the high herbivory by deer and rabbits.

In addition to Russian olives, smooth bromegrass has invaded virtually all the cottonwood forest in close proximity to the large central grassland on the island (See Figure 13).

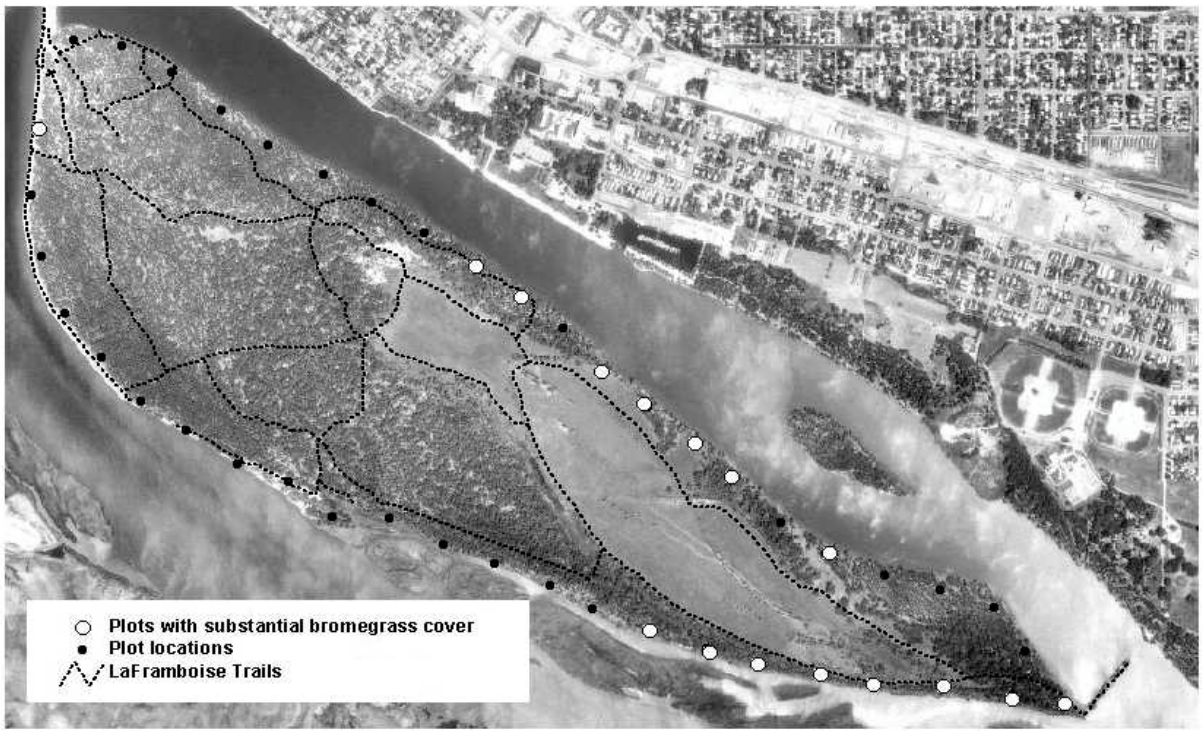

Figure 13: Plots dominated by smooth bromegrass with or without cottonwood canopy.

The few wetland habitats on LaFramboise Island are vegetated by virtually pure stands of the exotic narrow-leaved cattail. While such stands of cattails provide nesting habitat for species like red-winged blackbirds, they lack plant diversity, structural diversity, and open water zones

(i.e. interspersion) and undoubtably bear little resemblence to the much more diverse wetland habitats historically present on the Missouri River floodplain.

In summary, the vegetation of LaFramboise Island is changing in ways that will provide less diverse habitats for wildlife and plants; eactly the opposite direction from the stated management objectives. Most of the existing cottonwood forest is converting to a juniper forest. This new forest will lack suitable snags so necessary for cavity nesting birds, bats and tree squirrels. Juniper forests also typically lack both a diverse herbaceous understory and a shrub layer, both of which are important to deer, ground nesting forest birds, and migratory forest birds. The old agricultural fields are dominated by monotypic stands of smooth bromegrass or planted stands of warm season native grasses. With the decline of cottonwoods, smooth brome is invading the cottonwood forest understory and displacing understory forbs. In some areas that lack tree seedlings, it appears that that cottonwood forest is being completely replaced by stands of smooth bromegrass. These stands of smooth bromegrass are in turn being invaded by Russian olives, whose stands contain significant numbers of juniper seedlings suggesting that, over the long term, they too will succeed to juniper forest.

The only upland habitat that appears to be heading for at least a mixed forest type, are the stands of green ash and the very few stands of boxelder. These could lead to a deciduous forest type that would provide habitats for forest animals and plants not accomodated by the soon to be extensive juniper forest.

The limited areas of wetland habitats support monotypic stands of the invasive narrow-leaved cattail and the noxious weed Canada thistle. While sandbars still occur in the LaFramboise Island reach of the river, present water level fluctuations render them unsuitable for the many wildlife dependent on this type of habitat.

D. Future of Bald Eagle Roost Trees

While the loss of LaFramboise Island's cottonwood forest will negatively affect many wildlife species, day-roosting bald eagles don't need an entire cottonwood forest so long as there is a sufficient number of large trees (which in this part of the continent typically means cottonwoods) scattered along the periphery of the island which can be used for perching. With the lack of cottonwood reproduction, not only is the cottonwood forest doomed but virtually every cottonwood tree on the island is on a countdown to death.

Plains cottonwoods are not long-lived trees. According to Hightshoe (1987), plains cottonwood matures at 65 to 75 years with rapid decline thereafter, rarely surviving to 125 years. Twenty-one cottonwood trees on LaFramboise Island were cored with an increment borer and aged. The results are presented in Table 8.

Table 8: Ages of Cottonwoods sampled on LaFramboise Island

#	General Location	Diameter at Breast Height in Inches	Age*	Approximate Year Germinated
1	Within vegetation releve sample plot 1	29”	84±1	1920
2A	Within vegetation releve sample plot 1	23”	Rotten core	?
2B	Near vegetation releve sample plot 1	19”	73	1931
3	Near picnic shelter	26”	68	1936
4	Near picnic shelter	15”	68	1936
5	Near wellhouse #12	14”	46	1958
6	Near wellhouse #12	27”	73	1931
7	Near gaging station (sw corner of isl.)	23”	63	1941
8	Near gaging station (sw corner of isl.)	12”	63	1941
9	Near vegetation releve sample plot 2	36”	79	1925
10	Center of veg. releve sample plot 2	15”	79	1925
11	Within LT plot 38	19”	72±1	1932
12	Within LT plot 38	11”	72±1	1932
13	Near LT plot 38	14”	72±1	1932
14	Within LT plot 27	18”	68±1	1936
15	Within LT plot 27	11”	68±2	1936
16	Just outside LT plot 27	8”	68±2	1936
17	Eagle nest tree	45”	Rotten core	?
18	Tree 5’ east of eagle nest tree	32”	75	
19	Western edge of big meadow	46”	>57	Tree center not reached.
20	Within LT plot 9	18”	46	1958

** Based on increment cores taken at 4.5’ high, in October 2004. Ages are number of rings counted plus 3 (assuming it takes 3 years for a cottonwood seedling to grow 4.5’ tall).*

Table 8 illustrates a few important observations about the cottonwoods on LaFramboise Island. First, localized stands of cottonwood are typically all of the same age regardless of size. An effort was made to core at least one smaller tree and one larger tree in each location. In most cases (e.g. 3&4, 7&8, 9&10, 11&12, 14&15) the smaller diameter trees were the same age as the larger diameter trees. This is typical of cottonwood and other early successional trees where seedling establishment occurs in swarms resulting in all the trees of a stand being the same age. The largest disparity in size was between #9 (36” dbh) and #10 (15” dbh) with both trees being approximately 79 years old.

A second observation is the importance of rapid growth rate for producing large trees suitable for eagle roosting. The largest tree measured was a tall, open grown cottonwood on the western edge of the central meadow (#19) which was almost four feet in diameter at breast height. While the center of the tree was not quite reached with the increment borer being used, this tree had the widest growth rings of any tree measured. Extrapolating to the center of the tree, it appears to be

between 60 and 75 years old, considerably younger but larger than the oldest tree measured, the 84 year old tree #1 with a 29" dbh.

One of the assumptions has been that many of the cottonwoods on LaFramboise Island dated to the 1952 flood which inundated the entire island. Table 8 provides evidence to disprove this hypothesis. None of the trees sampled dated to this year nor should they be expected to. Record breaking floods on the Missouri River like the massive floods in 1881, 1943 and 1952, all occurred in early spring, i.e. April, well before any cottonwood seed would have been shed by female cottonwood trees. Cottonwood seedling establishment would more typically occur after the "June rise," when river levels would rise due to snow melt in the Rocky Mountain head-waters, and when cottonwood seeds are being actively shed.

Table 8 also illustrates that while the cottonwoods on LaFramboise are not all the exact same age, there appears to be a relatively narrow range of ages, with many of the trees 60 to 80 years old. A few younger trees do exist. The two youngest trees cored were about 46 years old. Along the south shoreline of the island a very few additional small, apparently 20 to 30 year old cottonwoods were seen, and at least a few seedlings were observed in the rip-rap armored portions of the island (see Photo 11).

Clearly, cottonwood mortality over the next 30 to 50 years will leave the island with very few remaining cottonwoods.

Of more immediate concern for roosting bald eagles are the rather large reaches of the island's periphery where there are no roost trees, as illustrated in Figure 14.

Photo 11: Cottonwood seedling on rip-rap of LaFramboise Island.

In a study of the bald eagle roosts below Fort Randall Dam in southern South Dakota, Steenhof (1976) found that roosting bald eagles showed a high preference for large cottonwoods located close to the riverbank. While these bald eagles also used cliffs and other tree species for roosts, during the two year study period, they never used any of the four artificial perches that had been constructed for them, and showed a distinct preference for large trees (ave. dbh = 16") with horizontal branches, located within 30 m (100') of the river, and having an open flight path on at least one side.

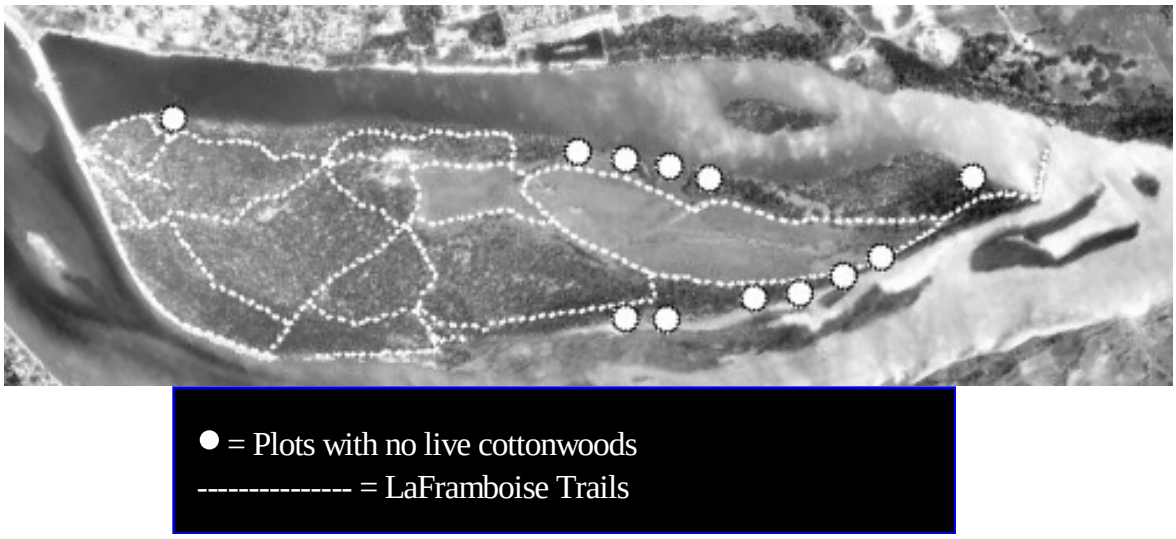

Figure 14: Sample plots on LaFramboise Island where no live cottonwoods were found.

Short of a major weather event (e.g. tornado, wind storm) that could knock down many of the large cottonwoods, most of the periphery of LaFramboise Island should support an adequate number of roost trees for approximately the next 30 years. This assumes that one large cottonwood tree or branched snag every 100 yards or so is enough for day perching/hunting bald eagles. However, the current level of cottonwood regeneration is far too low to even sustain this minimal number of cottonwood roost trees beyond the next few decades. Furthermore, reaches of the island's periphery having no suitable perches will continue to increase unless actions are taken to reestablish cottonwoods or other suitable roost trees and protect them until they reach suitable size for eagle perching.

VII. Recommendations

The following recommendations constitute an effort to reforest significant portions of LaFramboise Island through reforestation of non-forested areas, and through conversion of cottonwood forest to a more self-sustaining new forest type. However, given the altered environment of LaFramboise Island, it is not clear to what extent the island is even capable of sustaining a future deciduous forest, cottonwood or otherwise. In particular, water releases from Oahe Dam pose an especially difficult problem. In the early 1990's Oahe Reservoir filled to the point of overflowing. The Corps of Engineers responded by running high flows through Oahe Dam. This raised the surface water surrounding LaFramboise Island for exceptionally long periods of time during the growing season and apparently caused the death of many trees in low-lying areas. While there is no empirical data linking elevated surface water to ground water, it is likely that ground water levels also rose during these high release periods. Rising ground water for most of the growing season drowns tree roots. Conversely, in dry years, like the late 1980's and recent years, when Lake Oahe levels are low; the Corps of Engineers releases less water through the dam. These reduced flows, it is assumed, lowers the ground water levels on LaFramboise Island, which could encourage tree roots to grow deeper, only making them more vulnerable when prolonged high flows return.

Junipers and Russian olive are fairly shallow-rooted trees adapted to the relatively dry upland conditions in central South Dakota. Except where they occur in the lowest areas on the island, they are for the most part unaffected by these alternating high and low flow events.

Site specific evaluation including soil analysis, depth to water table and measurements on how this water table fluctuates would minimize the amount of guesswork involved in deciding whether a particular site would be suitable for trees and which tree species might be most likely to succeed. Unfortunately, documenting the maximum and minimum water table fluctuations will take time, perhaps years for these wet/drought cycles to repeat themselves. Given this likelihood, a more practical short-term approach is to proceed with tree planting and simply use knowledge of soils, elevations, and presence of live trees as a way to minimize the chance that planted trees will drown from high water events, at least until such time as ground water levels can be more precisely predicted.

1. Reforest the central grassland with cottonwood forest.

The central meadow or grassland on the island exists because the forest that once existed there (see Figures 2, 3, & 4) was cleared for agriculture. Since it is no longer needed for agricultural production, this meadow should now be managed to best serve future wildlife and recreational needs. While the open expanse on the interior of the island may be a nice visual feature, it provides poor habitat for forest wildlife. As grassland habitat it is too small and in the wrong landscape to benefit grassland wildlife. Many grassland birds are "area dependent," i.e. requiring a tree-free, grassland area of a certain minimum size. While the meadow on LaFramboise Island slightly exceeds the minimum size (ca. 75 acres) for several grassland birds including grasshopper sparrows, dickcissels, and bobolinks (Fitzgerald, et al. 1999) there are many, larger, more desirable grassland habitats in the Pierre/Fort Pierre area for grassland birds

to choose from, thus they rarely use LaFramboise Island (note the general absence of grassland birds on the bird checklist shown in Table X).

This area could be reforested in any of several ways. It could be mechanically planted using traditional bare-root stock. Or, it could be hand planted with containerized stock. Or, patches of bare soil could be irrigated allowing cottonwood seeds to germinate, grow into thickets, and over time thin themselves into stands of cottonwood trees.

Unfortunately, large-scale, bare-root tree planting on LaFramboise Island has not met with success. In 1993 about 1,850 bare-root cottonwood and native shrub seedlings were hand planted by volunteer organizations (L. Noeske pers. comm. 2003). Virtually none of the seedlings survived, owing primarily to dry conditions, competition from grass, and consumption by wildlife. In 1998, 6,200 tree and shrub seedlings were mechanically planted into a prepared site and provided with a fabric weed barrier (D. McCormick, pers. comm. 2003). By 2002 all of these woody plants had died. While many had been browsed by deer or rabbits, it's not clear why there was not greater survival. Hand planted containerized stock should have higher survival rates, particularly if protected from browsing, but is extremely expensive and labor intensive for large number of trees.

One of the most critical habitat features missing from LaFramboise Island, and almost the entire Missouri River valley in South Dakota are stands of early successional cottonwood forest. The meadow area seems to be the best location on LaFramboise Island to try and restore, at least temporarily, this missing habitat component. Due to the failure of past attempts at planting bare-root cottonwoods on LaFramboise, it is probably time to try a new method. Ideally some form of irrigation could be used to stimulate cottonwood seedling establishment. This has happened naturally on one particular low spot in the grassland meadow when abundant spring and summer rains in the early 1990's created the conditions for cottonwood seedlings to germinate and form a dense thicket of cottonwood saplings (see Photo 12).

Such conditions could be recreated artificially by pumping water from the Missouri River and irrigating patches of the meadow during and after cottonwood seed dispersal in late May and June. The herbaceous vegetation would have to be tilled or killed, and the young cottonwood seedlings/saplings might have to be watered for several years until their tap roots reach the water table, but they would thin themselves over time while providing suitable browse and cover for deer and other island wildlife. Ideally these seedling/sapling patches would be created over time to provide a diversity of future cottonwood age classes, i.e. create one 20 acre patch every 10 years, rather than small patches every year or a 100 acre patch all in one year. Twenty to thirty acre patches would be similar in size to natural stands that dominated the pre-dam floodplain, and 10 year intervals approximate the frequency of seedling establishment events (W.C. Johnson pers. comm. 2004).

2. Retain "The Cedars" and allow junipers to expand where green ash are absent.

Natural forest succession on LaFramboise Island is leading to a juniper dominated forest across virtually the entire island. Such a vegetation was a natural feature characteristic of several Missouri River islands in central South Dakota and should be represented on LaFramboise

Island. Female juniper trees provide a winter food source for several wintering bird species like cedar waxwings and robins. Juniper woodlands also provide nesting habitat for birds like black-capped chickadees, mourning doves, and long-eared owls. And they provide thermal cover for white-tailed deer, other mammals and birds (Sieg 1991). Unfortunately, juniper forests do not benefit the same species nor as many wildlife species as do cottonwood forests or mixed

Photo 12: Early successional cottonwood stand created by abundant rainfall in the early 1990's. Outer saplings killed by herbicide drift.

deciduous forests (Rumble and Gobeille 2004). The area called "The Cedars" should be retained and allowed to develop to maturity as well as selected other sites. However, to retain wildlife diversity and abundance, junipers should not be allowed to dominate the entire island.

The southern portion of the island appears to have fewer green ash and higher juniper densities than the northern portion of the island, although this varies greatly from site to site. It is recommended that in the absence of detailed site suitability information for tree survival, green ash or other deciduous trees be used as indicators of how suitable a particular site is for planting additional deciduous trees. Sites where juniper predominate and green ash are absent are probably the best locations to simply allow juniper forest to develop. And, where other forest management strategies fail, junipers will dominate.

3. **Promote a mixed deciduous forest where green ash or other deciduous trees are present.**

Successional studies elsewhere on the Missouri River floodplain suggest that cottonwood forests ultimately, when not destroyed and restored by flooding, convert to mixed deciduous forests of some combination of green ash, bur oak, American elm, slippery elm, hackberry, American basswood, black walnut and eastern red cedar (see earlier discussion on page 32). It seems likely that some sites (e.g. plots LT-34, LT-36) are capable of supporting a green ash dominated forest. It is recommended that various trees, shrubs and herbs typical of mixed deciduous forests in central South Dakota be planted on LaFramboise Island with the hope that at some time in the future they will naturally reproduce in a self-regenerating deciduous forest. Whether certain sites are capable of supporting such a self-sustaining deciduous forest is unknown, but if junipers are not eliminated and controlled they will, in all likelihood, usurp any future option for deciduous forest development. More specific steps for promoting this deciduous forest are listed below:

a. **Clear juniper seedlings and saplings**: While junipers have been reproducing on the island for many years, the vast preponderance of seedlings and small saplings suggest that the relatively moist 1990's resulted in explosive reproduction. Selectively cutting these seedlings and saplings now would be relatively easy compared to the much more labor intensive, more hazardous and more dramatic effort of logging tree size junipers sometime in the future. Junipers occur as male and female trees. The males produce pollen, the females produce berries/seeds. To prevent reestablishment on particular sites it would be prudent to also remove or kill at least the female juniper trees, which left alone, would simply continue to flood the site with seeds whose seedlings would compete with more desirable plants.

b. **Retain and encourage green ash:** Green ash clearly reproduces itself within the LaFramboise Island forest. However, very few green ash seedlings or small saplings were observed during this study. Given the moist conditions of the 1990's, seedlings and saplings should have been abundant. While there is no direct evidence to explain this paucity of young green ash, it's likely that they were eaten by deer and rabbits, along with most of the woodbine, grapevines, poison-ivy, and other browse which was once abundant on the island but is now virtually absent except where inaccessible to these animals. Past livestock use of the island has undoubtedly also reduced the overall abundance of deciduous forest species. Throughout the island there are examples of green ash trees that are in direct competition with junipers growing next to them. In areas to be managed for mixed forest, these competing junipers should also be removed.

c. **Plant and protect native plant species that may naturally reproduce.** Appendix C is an annotated list of plants that potentially could reproduce in a hypothetical deciduous forest on LaFramboise Island. Some of them naturally occur on the island and reproduce themselves given the opportunity. Others are native to deciduous woodlands in central South Dakota or grow and reproduce here after being introduced. These trees and shrubs should be planted into suitable sites where the cottonwoods are declining.

The intent is not to plant an entire stand of trees within the existing cottonwood forest, but to establish enough trees to serve as seed sources that could naturally reproduce within LaFramboise's future forest. Bur oaks, for example, were historically found on the Missouri River floodplain and along adjacent tributaries, and still occur at various sites in central South Dakota (e.g. Medicine Knoll Creek, DeGray, West Bend, etc.). However, there is no seed source for bur oaks on LaFramboise Island other than the rare acorn deposited by a visiting blue jay or crow. While bur oak are not likely to reproduce in a densely shaded forest understory, there should be many microsites like river banks, trail edges, bromegrass dominated clearings, etc. where bur oaks might succeed.

Regardless of their ability to reproduce, there are still two primary barriers to tree growth and survival (above and beyond water level fluctuations). First, smooth bromegrass has invaded much of the island and prevents the establishment of more desirable species other than Russian olive and juniper. Secondly, over-browsing by herbivores continues to suppress natural reproduction by various native shrubs and herbs that, just 20 years ago, were quite abundant.

d. Control deer and rabbit numbers to enable tree and shrub seedling development. It is clear that there has been overbrowsing on LaFramboise Island to the point of eliminating many deciduous tree and shrub seedlings. It is assumed that much of this occurred during and prior to 1996, when deer harvest numbers suggest a higher deer population than the present. It is not certain whether there are currently too many deer and rabbits on LaFramboise Island to allow vegetational recovery. However, it also seems apparent that because of this past overbrowsing, the carrying capacity of LaFramboise Island is now substantially lower than it was just a few years ago, enabling the habitat to sustain fewer deer than it did in the past. With vegetation recovery, the island could certainly support more deer than it does today.

Determining the deer carrying capacity of LaFramboise Island, establishing a population goal, and monitoring the deer population size is an intensive process involving a deer censusing technique, vegetation sampling, model development, and adjusting deer harvest. It is unlikely that GFP would allocate the substantial and ongoing financial and staff commitments that it would take to manage such a small deer population at such an intense level.

It would be more practical to simply erect fencing material to protect plantings and perhaps to create exclosures to monitor natural vegetation recovery. If natural vegetation recovery inside the exclosures is markedly improved over the unprotected natural vegetation, then measures should be taken to reduce the deer population even further. One measure that could be taken to stabilize or reduce the deer herd would be to reinstate the special antlerless archery season on the island. This season was curtailed on the island in 2001. LaFramboise Island is closed to all firearm hunting.

Cottontail rabbits have many predators on LaFramboise Island, including great horned owls, coyotes, bullsnakes, weasels, etc. The cottontail hunting season is also open to archery hunters.

e. Conduct plantings in forest-suitable soils. Little has been said in this report about soils of LaFramboise Island which are simply mapped in the county soil survey as "alluvial land" or as "Munjor fine sandy loam" (Smalley 1975). Floodplains are notorious for having complicated soils because floodwaters alternately deposit various sediments (sand, silt, clay) in layers, in ridges, in lenses, etc. And, these same floodwaters may scour other areas down to much older sediments. Mixed deciduous forests grow on and help create forest soils. It is possible that, in general, the soils of LaFraboise Island are simply too young to support a self-sustaining mixed deciduous forest. By the same token it seems apparent that some microsites on the island are suitable for green ash, elm, boxelder and presumably other deciduous trees. In lieu of a detailed soils map, the presense of deciduous trees or field inspection of soils should dictate where plantings should occur. Supplementing these soils with leaf litter, mulch, even fertilizer on a short-term basis should be considered if soil tests indicate the lack of nutrients for initial tree establishment and growth.

4. Plant cottonwoods or other suitable eagle roost tree species along the periphery of the island where cottonwood are not reproducing.

If the central grassland is successfully reforested with cottonwood, if may not be necessary to provide any additional roost trees for bald eagles. However, it would be prudent to also specifically plant trees along the island's periphery to insure future roost trees as these cottonwoods continue to fall. Containerized stock would be probably be best suited for this purpose. Unfortunately to reach roost tree size, these planted saplings would have to be protected from beaver (see section on beaver, p.). Alternatively, tree species less desirable to beaver could be planted to reduce the need for protection. Ponderosa pine, for example, when full grown provides large horizontal branches suitable for bald eagles, and may be less aggressively gnawed by beavers. Using Steenhof (1976) as a guide, these future roost trees should be planted within approximately 100 feet from the water's edge.

5. Better define the relationship between river surface water elevations and island ground and surface waters, and use this information in vegetation management.

There are two U.S.G.S. Missouri River gauging stations in the immediate vicinity of LaFramboise Island. One of them is located on the island itself, along the shoreline immediately across from the mouth of the Bad River (site name: "Missouri River at LaFramboise Island," #06441590). The second is located on the Hughes County shore just off the downstream end of the island (site name: "Missouri River below LaFramboise Island," #06441590). These two gauging stations transmit hourly measurements of the surface water elevation (in feet above a 1400' datum) in the Missouri River (Solberg, pers. comm. 2004).

Installation of ground water monitoring wells on the island would enable monitoring of ground water elevations as they fluctuate with river elevations. A similar system was established by the Game, Fish and Parks Department at Putney Slough to establish the relationship between surface and ground water (Dakota Environmental 2003) and could be employed on LaFramboise Island as well.

It would be also useful to know how surface waters on LaFramboise Island fluctuate with changes in river elevation. For example, there are two cattail filled wetland basins/chutes on the island (see Figure). By monitoring water depth in these two basins as they relate to river elevations, we might be able to predict the range and periodicity of water depths, which in turn, may suggest what other plant species might be adapted to these conditions. Or, what modifications might be made to create a wetland environment with more diverse vegetation and wildlife. Simply digging these basins deeper might create open water habitat free of cattails but likely would not result in a diverse and productive wetland environment because ground water and mineral substrates are typically nutrient poor, inhibiting the growth of algae, microinvertebrates and macroinvertebrates which form the base of the aquatic food web. Increasing surface water runoff into these basins or periodically killing patches of cattails with herbicides might be preferable methods of increasing diversity. On-the-other-hand, it might be possible that increasing the permanent water depth of these basins would allow muskrats to inhabit them providing some biological control of the cattails, and diversifying these wetland habitats.

VIII. Conclusion

This report provides a management direction which can hopefully be transformed into more precisely budgeted and scheduled management actions. Unfortunately there are some technical obstacles that must be overcome before such a detailed management plan can be formulated. For example, past attempts at tree planting on the island (which have been substantial) have largely failed. High water releases from the Oahe Dam have apparently had deleterious effects on the island's vegetation but it is not yet clear how future water releases will limit vegetation management. Using irrigation to stimulate cottonwood regeneration has been accomplished elsewhere but the methodology needs to be worked out locally before it can be reliably used with predictable success.

Actions that can begin include: 1) thinning junipers from areas to be managed for mixed deciduous forest. 2) planting containerized trees and shrubs for future eagle roost trees and seed trees within the mixed forest, 3) experimental irrigation of bare soil plots for establishment of cottonwoods, 4) installation of ground water elevation monitoring wells, 5) better mapping of soils to aid in planting site-specific tree species.

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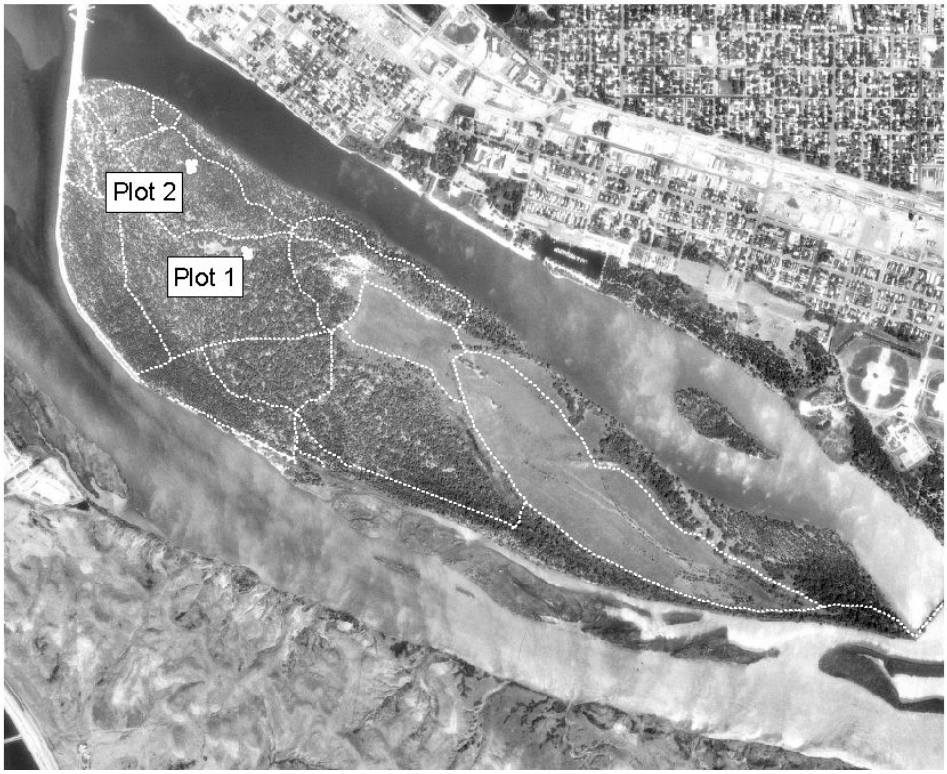
APPENDIX A

LaFramboise Island Vegetation Plots

In an attempt to characterize the vegetation of LaFramboise Island for comparison to vegetation types elsewhere in North America, two releve plots were subjectively positioned within relatively uniform stands of cottonwood forest (see locations shown below). A third releve plot was placed in a stand of Russian olive woodland (for location see map following plot 3 data). Ocular estimates of vegetative cover were made for each species present by strata within a 20 meter by 20 meter plot. The diameter at breast height (4.5 ′) was also recorded for each tree within the plot. Vegetation type names and codes are from the National Vegetation Classification System (Anderson , et al. 1998). Vascular plant names and codes follow the National List of Scientific Names (USDA 2004).

Additional vegetation types do occur on LaFramboise Island but these are virtually pure stands of cedar (*Juniperus virginiana*), narrow-leaved cattail (*Typha angustifolia*), and smooth bromegrass (*Bromus inermis*), or are planted stands of native warm season grasses; none of which warranted sampling for regional comparisons.

Cottonwood Forest Plot Locations



LaFramboise Island Plot 1

Nomenclature: Populus deltoides/Juniperus virginiana Floodplain Forest CEGL002094
Location: Hughes/Stanley County, SD. A forested island in the Missouri River between Pierre & Ft. Pierre.
Legal Description: Section 34, T5N R31E. **Lat:** 44° 21' 23" **Long:** 100° 21' 16"
Slope: 0 **Aspect:** 0 **Elevation:** 1427
Sample Date: 22 July, 2003 **Surveyer:** David J. Ode **Plot Size:** 20m x 20m
Soil: loamy sand
Soil Surface: 100% leaf & needle litter 5% wood & bark 0% moss/lichen

Plant Species by Stratum	**Percent Cover**
65% Canopy (15-20m tall)	
Populus deltoides (PODE3)	65% (dbh"=24, 28.5, 22, 23)
85 % Subcanopy (2-10m tall)	
Juniperus virginiana (JUVI)	60% (dbh"=5.5, 1, 5.5, 7.5, 4, 4, 4.5, 3.5, 1, 1.5, 2.5, 5, 2.5, 8, 1.5, 1.5)
Fraxinus pennsylvanica (FRPE)	25% (dbh"= 2, 2, 1, 5, 1.5, 2, 1.5, 2, 2.5, 1, 4, 3.5, 1, 3.5)
Elaegnus angustifolia (ELAN)	1% (dbh"= 1.5, 2)
1% Vines climbing into subcanopy	
Vitis riparia (VIRI)	<1%
Parthenocissus vitacea (PAVI5)	<1%
Clematis ligusticifolia (CLLI2)	<1%
30% Herbaceous Layer (<1m)	
Juniperus viginiana (JUVI)	5% (85 seedlings counted)
Poa pratensis (POPR)	3%
Carex brevior (CABR10)	3%
Muhlenbergia racemosa (MURA)	2%
Agropyron cristatum (AGCR)	2%
Bromus japonicus (BRJA)	<1
Muhlenbergia sp.	<1
Verbascum thapsus (VETH)	<1
Fraxinus pennsylvanica (FRPE)	<1
Melilotus officinalis (MEOF)	<1
Nepeta cataria (NECA2)	<1
Calamovilfa longifolia (CALO)	<1

LaFramboise Island Plot 2

Nomenclature: Populus deltoides/Juniperus virginiana Floodplain Forest CEGL002094
Location: Hughes/Stanley County, SD. A forested island in the Missouri River between Pierre & Ft. Pierre. 260 paces east of pumphouse #9.
Legal Description: Section 34, T5N R31E. **Lat:** 44° 21' 34" **Long:** 100° 21' 26"
Slope: 0 **Aspect:** 0 **Elevation:** 1427
Sample Date: 23 July, 2003 **Surveyer:** David J. Ode **Plot Size:** 20m x 20m
Soil: loamy sand
Soil Surface: 100% leaf & needle litter 5% wood & bark 0% moss/lichen

Plant Species by Stratum	**Percent Cover**
70% Canopy (15-20m tall)	
Populus deltoides (PODE3)	70% (dbh"=21, 17.5, 15, 16.5, 17, 18, 22)
15 % Subcanopy (2-10m tall)	
Juniperus virginiana (JUVI)	7% (dbh"= 3, 5, 5.5)
Ulmus pumila (ULPU)	3% (dbh"= 4)
Elaeagnus angustifolia (ELAN)	1% (dbh"=2.5, 2)
Vitis riparia (VIRI)	3% (tops of Elaeagnus & Juniper)
90% Herbaceous Layer (<1m)	
Equisetum hyemale (EQHY)	80% (uniform throughout)
Poa pratensis (POPR)	5%
Elymus canadensis (ELCA4)	5%
Muhlenbergia racemosa (MURA)	1%
Carex brevior (CABR10)	<1%
Juniperus viginiana (JUVI)	<1% (4 seedlings counted)
Bromus japonicus (BRJA)	<1%
Parthenocissus vitacea ((PAVA5)	<1% (small plants only)
Melilotus officinalis (MEOF)	<1%
Teucrium canadense (TECA#)	<1%
Ambrosia psilostachya (AMPS)	<1%
Verbascum thapsus (VETH)	<1%

LaFramboise Island Plot 3

Nomenclature: Elaeagnus angustifolia/Bromus inermis Naturalized Woodland
Location: Hughes/Stanley County, SD. A forested island in the Missouri River between Pierre & Ft. Pierre. Located near downstream end of island just east of native grass planting.
Legal Description: Section 36, T5N R31E. **Lat:** **Long:**
Slope: 0 **Aspect:** 0 **Elevation:** 1427
Sample Date: 30 July, 2003 **Surveyer:** David J. Ode **Plot Size:** 20m x 20m
Soil: loam
Soil Surface: 100% grass leaf litter 0% moss/lichen

Plant Species by Stratum	**Percent Cover**
75 % Canopy (2-10m tall)	
Elaeagnus angustifolia (ELAN)	75% (12 multiple stemmed trees ca. 20' tall)
Juniperus virginiana (JUVI)	1% (single tree 2"dbh)
99% Herbaceous Layer (<1m)	
Bromus inermis (BRIN)	95%
Cirsium arvense (CIAR)	5%
Poa pratensis (POPR)	2%
Elaeagnus angustifolia (ELAN)	1% (7 seedlings counted)
Juniperus viginiana (JUVI)	1% (9 seedlings counted)
Fraxinus pennsylvanica (FRPE)	<1% (5 seedlings counted)
Nepeta cataria (NECA)	<1%
Scirpus pungens (SCPU)	<1%
Aster ericoides (ASER)	<1%

APPENDIX B

LaFramboise Island Potential Roost Tree Sample Plots

In an attempt to compare the current cottonwood forest of LaFramboise Island to previous studies (i.e. Rogers 1966, McCormick & Sowers 1988), and to measure the abundance of potential bald eagle roost trees on the periphery of the island, circular plots were systematically located approximately 200 yards apart and 50 feet in from the waters edge or the edge of the tree canopy (as shown in the figure below). The diameter at breast height of all potential canopy tree species (e.g.. cottonwood, green ash, etc.) within a 1/10 acre circular plot (37.25' radius) were measured in cm. All shrub/small tree species (e.g. Russian olive, eastern red cedar, chokecherry, etc.) within an inner 1/20 acre circular plot (26.3' radius) were simply counted in two size categories, i.e. >6' tall and <6'. GPS locations are for plot centers or the nearest location toward the water's edge where signals could be received (the canopy often interfered with reception, offsets were not used). Nomenclature is explained in Appendix A.

Figure B-1: Map of circular plot locations around the periphery of LaFramboise Island

Plot: LT-01 **Sample Date:** 15 Oct. 2003 **Lat:** 44° 21' 33.96" N
Surveyer: David J. Ode **Long:** 100° 21' 46.21" W

Tree Species in 1/10 acre plot (dbh in cm):
Populus deltoides: 52, 36, 58, 41, 36, 55, 29, 66, 89.
Fraxinus pennsylvanica: 6, 17, 11

Shrub Species in 1/20 acre plot (total number by size category)

	trees/shrubs >6' tall	seedlings/saplings <6'tall
Juniperus virginiana	4	20
Elaeagnus angustifolia	5	0

Notes: 1 dead Russian olive & 1 dead green ash (7cm dbh) within plot. Understory of mostly smooth brome & *Equisetum hyemale*.

Plot: LT-02 **Sample Date:** 15 Oct. 2003 **Lat:** 44° 21' 27.44" N
Surveyer: David J. Ode **Long:** 100° 21' 47.08" W

Tree Species in 1/10 acre plot (dbh in cm):
Populus deltoides: 62, 43, 63, 47, 29, 24, 59.
Fraxinus pennsylvanica: 11.

Shrub Species in 1/20 acre plot (total number by size category)

	Trees >6' tall	seedlings/saplings <6'tall
Juniperus virginiana	9	1
Elaeagnus angustifolia	0	1

Notes: Sparse understory of *Equisetum hyemale* and leaf litter. Barkless cottonwood snag (34 cm dbh). Plot located just S of pumphouse. Several Russian olive just outside inner plot.

Plot: LT-03 **Sample Date:** 15 Oct. 2003 **Lat:** 44° 21' 21.50" N
Surveyer: David J. Ode **Long:** 100° 21' 45.58" W

Tree Species in 1/10 acre plot (dbh in cm):
Populus deltoides: 48, 32, 26, 35, 51, 48, 38, 24, 28, 43.
Fraxinus pennsylvanica: 5, 6.

Shrub Species in 1/20 acre plot (total number by size category)

	Trees >6' tall	seedlings/saplings <6'tall
Juniperus virginiana	2	0
Prunus virginiana	6	8

Notes: Sparse understory of *Elymus canadensis*, Mullein, few *Equisetum hymale*, litter & logs. Russian olive & more juniper outside inner plot.

Plot: LT-04 **Sample Date:** 15 Oct. 2003 **Lat:** 44° 21' 16.05" N
Surveyer: David J. Ode **Long:** 100° 21' 42.23" W

Tree Species in 1/10 acre plot (dbh in cm):
Populus deltoides: 50, 55, 39, 38, 67, 42, 38, 35, 54.

Shrub Species in 1/20 acre plot (total number by size category)

	trees/shrubs >6' tall	seedlings/saplings <6'tall
Juniperus virginiana:	3	3
Elaeagnus angustifolia	2	0
Prunus virginiana	1	0

Notes: Understory with *Elymus canadensis, Equisetum hymale, Muhlenbergia racemosa, Calamovilfa longifolia.* Dead cottonwood snag 43cm dbh.

Plot: LT-05 **Sample Date:** 15 Oct. 2003 **Lat:** 44° 21' 11.82" N
Surveyer: David J. Ode **Long:** 100° 21' 37.24" W

Tree Species in 1/10 acre plot (dbh in cm):
Populus deltoides: 69, 62, 58, 65, 57.

Shrub Species in 1/20 acre plot (total number by size category)

	trees/shrubs >6' tall	seedlings/saplings <6'tall
Juniperus virginiana:	0	11
Elaeagnus angustifolia	10	7

Notes: Understory with sparse graminoids including *Muhlenbergia racemosa* and sedges, also *Equisetum hymale,* mullein, catnip, bark & sticks.

Plot: LT-06 **Sample Date:** 17 Oct. 2003 **Lat:** 44° 21' 7.62" N
Surveyer: David J. Ode **Long:** 100° 21' 31.87" W

Tree Species in 1/10 acre plot (dbh in cm):
Populus deltoides: 40, 35, 41, 49, 51, 31, 45, 35, 33, 33, 33, 48, 31.

Shrub Species in 1/20 acre plot (total number by size category)

	trees/shrubs >6' tall	seedlings/saplings <6'tall
Juniperus virginiana	6	11

Notes: Understory of leaf litter, few Teucrium canadense.

Plot: LT-07 **Sample Date:** 17 Oct. 2003 **Lat:** 44° 21' 4.78" N
Surveyer: David J. Ode **Long:** 100° 21' 25.60" W

Tree Species in 1/10 acre plot (dbh in cm):
Populus deltoides: 47, 40, 44, 42, 41, 36, 51, 28, 48.

Shrub Species in 1/20 acre plot (total number by size category)

	trees/shrubs >6' tall	seedlings/saplings <6'tall
Juniperus virginiana:	15	10
Elaeagnus angustifolia	1	0

Notes: Understory 100% leaf litter, virtually no herb growth. Cottonwood snag 29cm dbh. Two dead Russian olive just outside inner plot, engulfed by vines. Several of these junipers to 20' tall.

Plot: LT-08 **Sample Date:** 17 Oct. 2003 **Lat:** 44° 21' 1.62" N
Surveyer: David J. Ode **Long:** 100° 21' 18.50" W

Tree Species in 1/10 acre plot (dbh in cm):
Populus deltoides: 21, 34, 46, 31.

Shrub Species in 1/20 acre plot (total number by size category)

	trees/shrubs >6' tall	seedlings/saplings <6'tall
Juniperus virginiana:	4	8
Elaeagnus angustifolia	11	0

Notes: GPS reading at river bank . Started 50' measure in from highbank with outermost cottonwoods, plot center is on trail. Understory of mostly exposed sand, few bunches of *Aristida purpurea*. Dense copse of Russian olive all along cutbank ridge.

Plot: LT-09 **Sample Date:** 17 Oct. 2003 **Lat:** 44° 20' 59.96" N
Surveyer: David J. Ode **Long:** 100° 21' 11.56" W

Tree Species in 1/10 acre plot (dbh in cm):
Populus deltoides: 24, 35, 51, 26, 41, 23, 11.

Shrub Species in 1/20 acre plot (total number by size category)

	trees/shrubs >6' tall	seedlings/saplings <6'tall
Juniperus virginiana:	2	6
Elaeagnus angustifolia	2	0

Notes: Dense stands of juniper and Russian olive just outside inner plot. Measured in 50' from edge of outermost cottonwood canopy, which are relatively small trees. Understory mostly open dry sand with some Spartina pectinata, sedge, & sandbur. Old beaver activity where they have toppled all of the outside cottonwoods S of trail. Beaver cut stump in plot with ca. 25cm dbh.

Plot: LT-10 **Sample Date:** 17 Oct. 2003 **Lat:** 44° 20' 56.57" N
Surveyer: David J. Ode **Long:** 100° 21' 5.57" W

Tree Species in 1/10 acre plot (dbh in cm):
Populus deltoides: 44, 42 (both damaged by beaver).
(Beaver stumps with diameters at 2 dm high: 21, 18, 22, 14, 15, 16, 10, 16, 13, 20, 15, 28, 17.)

Shrub Species in 1/20 acre plot (total number by size category)

	trees/shrubs >6' tall	seedlings/saplings <6'tall
Juniperus virginiana:	24	10
Elaeagnus angustifolia	1	0

Notes: Two dead R. olive in plot. Many dead Russian olive between here & river. Understory mostly bare sand with few *Carex*, *Ambrosia psilostachya*, mullein. Small cattail marsh on N side of this ridge. Reed canary grass meadow just E of plot grading into cattails with dead juniper & Russian olive.

Plot: LT-11 **Sample Date:** 20 Oct. 2003 **Lat:** 44° 20' 56.59" N
Surveyer: David J. Ode **Long:** 100° 20' 57.73" W

Tree Species in 1/10 acre plot (dbh in cm):
Populus deltoides: 30, 39, 50, 54, 37, 43, 58, 60.

Shrub Species in 1/20 acre plot (total number by size category)

	trees/shrubs >6' tall	seedlings/saplings <6'tall
Juniperus virginiana:	28	3

Notes: One large Russian olive just outside inner plot. Mostly bare soil and leaf litter with few mullein, *Nepeta cataria*. Several dead juniper seedlings (from shading?). One tall dead cottonwood snag = 50cm dbh.

Plot: LT-12 **Sample Date:** 20 Oct. 2003 **Lat:** 44° 20' 54.03" N
Surveyer: David J. Ode **Long:** 100° 20' 50.24" W

Tree Species in 1/10 acre plot (dbh in cm):
Populus deltoides: 40 (w/only 1 live branch) (Beaver stumps & dead snags: 38, 33, 41, 34)

Shrub Species in 1/20 acre plot (total number by size category)

	trees/shrubs >6' tall	seedlings/saplings <6'tall
Juniperus virginiana:	130	0

Notes: Dense stand of junipers with dbh ranging from 3 cm to 10 cm, ave. ca. 7cm. Beaver have tipped over virtually all the cottonwood here and have girdled a peach-leaved willow

outside plot. Have even toppled a few juniper. No herbaceous layer, dead needles only. Photos of stumps in needles & juniper.

Plot: LT-13 **Sample Date:** 20 Oct. 2003 **Lat:** 44° 20' 52.30" N
Surveyer: David J. Ode **Long:** 100° 20' 43.24" W

Tree Species in 1/10 acre plot (dbh in cm):
Populus deltoides: 48 (partially girdled by beaver).

Shrub Species in 1/20 acre plot (total number by size category)

	trees/shrubs >6' tall	seedlings/saplings <6'tall
Juniperus virginiana:	69	0

Notes: Dense juniper stand with dbh ranging from 3 cm to 16 cm. No other cottonwoods in plot but lots of old dead wood on ground. No herbaceous layer, just needles & dead wood. Six junipers have been toppled by beaver. Fresh beaver cuttings near duck pond/chute. North of plot is area of large juniper trees, 2 measured with 36 cm dbh. There are still a few very large cottonwoods emergent above these large junipers.

Plot: LT-14 **Not Sampled** **Lat:** 44° 20' 50.27" N
Surveyer: David J. Ode 20 Oct. 2003 **Long:** 100° 20' 35.75" W
Notes: Another stand of dense junipers with dead cottonwoods. Located just N of large inlet in duck pond/chute with sandbar island above & below. R.olive lined shoreline with mostly dead Russian olive on sandbar islands with cattails.

Plot: LT-15 **Not Sampled** **Lat:** 44° 20' 48.04" N
Surveyer: David J. Ode 20 Oct. 2003 **Long:** 100° 20' 29.94" W
Notes: Yet another stand of dense junipers with few live cottonwoods. Located along duck pond/chute and cattail covered sandbar island. Cedars here are chewed off by beaver along with numerous dropped cottonwood. Russian olive and boxelder with large vine located along bank, not touched by beaver yet.

Plot: LT-16 **Sample Date:** 21 Oct. 2003 **Lat:** 44° 20' 45.85" N
Surveyer: David J. Ode **Long:** 100° 20' 21.91" W

Tree Species in 1/10 acre plot (dbh in cm):
Populus deltoides: 68, 54, 66. (all partially dead one with vine.)

Shrub Species in 1/20 acre plot (total number by size category)

	trees/shrubs >6' tall	seedlings/saplings <6'tall
Juniperus virginiana:	14	2
Elaeagnus angustifolia	4	0

Notes: Located along duck chute but cedars have thinned out and grass takes over. Understory is 90% *Bromus inermus* cover with few mustards.. Outer plot contains dead cottonwood snag 60cm dbh, green ash snag 11cm dbh, beaver-cut green ash stump = 9cm. Huge, dead, barkless cottonwood snags outside plot, dbh = 88cm, 85cm.

Plot: LT-17 **Sample Date:** 21 Oct. 2003 **Lat:** 44° 20' 44.41" N
Surveyer: David J. Ode **Long:** 100° 20' 14.27" W

Tree Species in 1/10 acre plot (dbh in cm):
Acer negundo: (34-26-33) triple trunk, (22-21)dble trunk with big vine
Fraxinus pennsylvanica: 15
Morus alba: 34

Shrub Species in 1/20 acre plot (total number by size category)

	trees/shrubs >6' tall	seedlings/saplings <6'tall
Juniperus virginiana:	3	0
Elaeagnus angustifolia	4	0

Notes: Located next to duck chute. GPS is actual plot center. Near COE posts who have cleared at least 1 Russian olive. One long-dead cottonwood stump & log in plot. No nearby live cottonwoods. Few on bank near grass planting. Smooth brome & Canada thistle understory >80% cover with few Nepeta. Two dead Russian olive within inner plot – covered & killed by vines?

Plot: LT-18 **Not Sampled** **Lat:** 44° 20' 42.64" N
Surveyer: David J. Ode 21 Oct. 2003 **Long:** 100° 20' 7.18" W
Notes: GPS reading on bank located just south of eagle nest tree and along duck chute. Trees here are mostly dead, looks like they were killed by high water table. Few live peach-leaved willow and on slight rise near bank, a few live Russian olive, juniper, boxelder. Eagle nest tree on base of bank is only live cottonwood in 100-200 yard radius. Extensive herbaceous layer of smooth brome and Canada thistle.

Plot: LT-19 **Not Sampled** **Lat:** 44° 20' 41.93" N
Surveyer: David J. Ode 21 Oct. 2003 **Long:** 100° 19' 58.98" W
Notes: GPS reading near bank. Here the upland bench closes in on river bank and linear depression tapers down to narrow strip. No cottonwoods here at all. Scattered green ash, Russian olive, and peach-leaved willow – some live, some dead. Continuous herbaceous layer of smooth brome, some Phragmites, scattered Canada thistle.

Plot: LT-20 **Not Sampled** **Lat:** 44° 20' 41.26" N
Surveyer: David J. Ode 21 Oct. 2003 **Long:** 100° 19' 51.29" W
Notes: Bench now comes very close to cattail vegetated shoreline with 10 m wide strip of Canada thistle, phragmites, smooth brome, dead trees. Few live p-l willow, Russian olive, and juniper on bench bank. Dead cottonwoods with maybe 1 live cottonwood per 200 yards. Inside of island on N side of bench is also a cattail marsh ringed by P-L willow, RO, & few cottonwood.

Plot: LT-21 **Sample Date:** 21 Oct. 2003 **Lat:** 44° 20' 40.90" N
Surveyer: David J. Ode **Long:** 100° 19' 42.13" W

Tree Species in 1/10 acre plot (dbh in cm):
Populus deltoides: 59 (partially dead)
Salix amygdaloides: 55 (reclined)
Fraxinus pennsylvanica: 21
Acer negundo: (18-12-26) triple trunk

Shrub Species in 1/20 acre plot (total number by size category)

	trees/shrubs >6' tall	seedlings/saplings <6'tall
Elaeagnus angustifolia	2	0

Notes: Two dead Russian olive within inner plot, numerous RO outside inner plot. Herbaceous layer is almost 100% cover by smooth brome. Old beaver-cut cottonwood stumps 54 cm, 31 cm within plot.

Plot: LT-22 **Sample Date:** 22 Oct. 2003 **Lat:** 44° 20' 40.24" N
Surveyer: David J. Ode **Long:** 100° 19' 32.49" W

Tree Species in 1/10 acre plot (dbh in cm):
Populus deltoides: 82, (59-68) dbl. trunk
Fraxinus pennsylvanica: 9, 14, 8, 14, (19-17)dbl. Trunk

Shrub Species in 1/20 acre plot (total number by size category)

	trees/shrubs >6' tall	seedlings/saplings <6'tall
Juniperus virginiana:	18	1
Elaeagnus angustifolia	1	0

Notes: GPS reading out near edge, not at plot center. Located along duck chute just below sandbag berm. Reed canary grass and Russian olive along shoreline. Recent beaver activity, numerous green ash ca. 4 cm diam. cut. Several dead green ash snags within plot: 18, 16, 10. Several dead Russian olive within outer plot. Sparse herbaceous layer with patches of smooth brome in clearings, few Nepeta, mostly leaf litter.

Plot: LT-23 **Sample Date:** 22 Oct. 2003 **Lat:** 44° 20' 39.68" N
Surveyer: David J. Ode **Long:** 100° 19' 25.30" W

Tree Species in 1/10 acre plot (dbh in cm):
Populus deltoides: 103, 48, 45, 25, 38 (69-63)dbl.trunk
Fraxinus pennsylvanica: 6, 2, 11, 5, 8, 3.
Shrub Species in 1/20 acre plot (total number by size category)

	trees/shrubs >6' tall	seedlings/saplings <6'tall
Juniperus virginiana:	3	1
Elaeagnus angustifolia	2	0

Notes: Located on tip of island just back of rip-rapped jetty. GPS at plot center but poor reception. Lots of downed, long, cottonwood logs. Herbaceous layer is 80-90% smooth brome minus the many logs.

Plot: LT-24 **Not Sampled** **Lat:** 44° 20' 44.53" N
Surveyer: David J. Ode 22 Oct. 2003 **Long:** 100° 19' 30.88" W
Notes: Slight depression which rises toward water and toward inland. Junipers along shoreline with very few persisting cottonwood. See photo of Canada thistle and dead Russian olive. GPS is actual center of would-be plot.

Plot: LT-25 **Sample Date:** 22 Oct. 2003 **Lat:** 44° 20' 48.77" N
Surveyer: David J. Ode **Long:** 100° 19' 35.15" W

Tree Species in 1/10 acre plot (dbh in cm):
Populus deltoides: 58, 23, 17, 18 (54-58)dbl.trunk
Fraxinus pennsylvanica: 10, 6.
Shrub Species in 1/20 acre plot (total number by size category)

	trees/shrubs >6' tall	seedlings/saplings <6'tall
Juniperus virginiana:	11	25
Elaeagnus angustifolia	2	0

Notes: GPS reading is plot center. Tall dead cottonwood snag in plot= 50 cm dbh. Sparse herbaceous layer of few mullein, few tufts of grass; mostly litter covered with lots of dead wood. Vines on some of the cottonwood.

Plot: LT-26 **Sample Date:** 23 Oct. 2003 **Lat:** 44° 20' 50.39" N
Surveyer: David J. Ode **Long:** 100° 19' 42.61" W

Tree Species in 1/10 acre plot (dbh in cm):
Populus deltoides: 57, 19, 57, 56.
Fraxinus pennsylvanica: 5, 8, 10, 4, 6, 6, 8, 8, 12.
Shrub Species in 1/20 acre plot (total number by size category)

	trees/shrubs >6' tall	seedlings/saplings <6'tall
Juniperus virginiana:	11	48
Elaeagnus angustifolia	3	0

Notes: GPS reading is plot center. Undulating sand with ridge at plot center. Tall dead cottonwood snag in plot= 41 cm dbh. Sparse herbaceous layer of sedge & grass tufts in lower areas, Poa, Taraxacum; mostly leaf litter covered with lots of downed cottonwood logs.

Plot: LT-27 **Sample Date:** 23 Oct. 2003 **Lat:** 44° 20' 51.84" N
Surveyer: David J. Ode **Long:** 100° 19' 50.24" W

Tree Species in 1/10 acre plot (dbh in cm):
Populus deltoides: 27, 44, 31, 41, 30, 31, 46, 34, 16, 38, 30, 29, 34, 38, 30.
Fraxinus pennsylvanica: 9, 9, 12, 5, 7.

Shrub Species in 1/20 acre plot (total number by size category)

	trees/shrubs >6' tall	seedlings/saplings <6'tall
Juniperus virginiana:	6	60
Elaeagnus angustifolia	5	0

Notes: GPS reading is plot center. Location similar to LT-26. Tree stand platform just on n side of plot. Tall dead cottonwood snags in plot= 22 cm dbh, 29 cm dbh. Littole or no herbaceous layer, mostly leaf litter with some Elymus canadensis, mullein, Carex, juniper seedlings. Observed some beaver damage here near waters edge.

Plot: LT-28 **Sample Date:** 23 Oct. 2003 **Lat:** 44° 20' 53.84" N
Surveyer: David J. Ode **Long:** 100° 19' 57.84" W

Tree Species in 1/10 acre plot (dbh in cm):
Populus deltoides: 58, 62, 52, 51, 77, 48, 50.
Fraxinus pennsylvanica: 13, 19, 13.
Shrub Species in 1/20 acre plot (total number by size category)

	trees/shrubs >6' tall	seedlings/saplings <6'tall
Juniperus virginiana:	4	30
Elaeagnus angustifolia	1	0

Notes: GPS reading is plot center. Seem to have risen slightly in eleveation from previous undulating stand of cottonwood forest. Here the cottonwood forest narrows down to thin strip north of grass planting/meadow. Smooth brome has marched in from meadow and now forms a nearly continuous understory making this much more savanna-like. Plot is even with downstream end of e-most grass plot. Recent beaver damage – cut and knawed cottonwoods just down from here. Russian olive numerous just outside of inner plot.

Plot: LT-29 **Sample Date:** 23 Oct. 2003 **Lat:** 44° 20' 56.74" N
Surveyer: David J. Ode **Long:** 100° 20' 4.55" W

Tree Species in 1/10 acre plot (dbh in cm):
Populus deltoides: 129 (bark is fairly intact, lots of dead branches).
Fraxinus pennsylvanica: 28.
Acer negundo: 15, 23, 25, 20, 15, 22, 30, 30, 32, 10, 34, 30, 27, 13, 14, 20, 15.

Shrub Species in 1/20 acre plot (total number by size category)

	trees/shrubs >6' tall	seedlings/saplings <6'tall
Juniperus virginiana:	11	25
Elaeagnus angustifolia	2	0

Notes: GPS reading is plot center. Stand of boxelder beneath one ancient cottonwood. Numerous boxelder snags within plot (21, 28, 15, 21 cm dbh) two with big vines. Open grassland to south. Beaver activity along this reach of shoreline. Numerous young cottonwood saplings in riprap adjacent to plot but beaver have been clipping them too. Photos.

Plot: LT-30 **Sample Date:** 24 Oct. 2003 **Lat:** 44° 21' 00.81" N
Surveyer: David J. Ode **Long:** 100° 20' 11.08" W

Tree Species in 1/10 acre plot (dbh in cm):
Fraxinus pennsylvanica: 11, 10, 10, 12, 11, 8, 17, 12.
Ulmus americana: 28.
Acer negundo: 25.

Shrub Species in 1/20 acre plot (total number by size category)

	trees/shrubs >6' tall	seedlings/saplings <6'tall
Juniperus virginiana:	22	0
Prunus virginiana	1	

Notes: GPS reading taken ca. 20 yards west of plot center. Most of plot is within dense juniper stand. The few very large cottonwoods here are well outside the plot. Big, long-dead cottonwood logs have crashed down within plot, stumps have decayed away. Understory beneath junipers is 90% bare ground, needles, downed wood, with very few sprigs of smooth brome, mullein, nepeta, cheatgrass. The 1/3 of the plot outside of the juniper stand has a continuous stand of smooth brome.

Plot: LT-31 **Not Sampled** **Lat:** 44° 21’ 4.37” N
Surveyer: David J. Ode 24 Oct. 2003 **Long:** 100° 20’ 16.23” W
Notes: GPS reading at plot center. No trees for plot. One large clump of 4 cottonwoods (1 a dead snag) right along water’s edge above a few junipers, green ash with few boxelder inland. Otherwise, just a large field of smooth brome coming all the way to the water’s edge. Located just N of small stand of volunteer cottonwood saplings in meadow depression. NW of windmill.

Plot: LT-32 **Not Sampled** **Lat:** 44° 21’ 7.88” N
Surveyer: David J. Ode 24 Oct. 2003 **Long:** 100° 20’ 22.76” W
Notes: GPS reading at plot center. Too few trees for plot here too. Line of cottonwoods back about 50 yards from riverbank with few clusters of green ash & juniper closer to waters edge. Otherwise, continuous stand of smooth brome from adjacent meadow.

Plot: LT-33 **Not Sampled** **Lat:** 44° 21’ 11.46” N
Surveyer: David J. Ode 24 Oct. 2003 **Long:** 100° 20’ 29.23” W
Notes: GPS reading at plot center, right on top of old road grade? Located near old rusty metal culvert or pipe at downstream end of tip of resumption of cottonwood forest. Otherwise, field of smooth brome. Too few trees for plot except right against waters edge. Beaver damage on few remaining cottonwood.

Plot: LT-34 **Sample Date:** 24 Oct. 2003 **Lat:** 44° 21’ 15.44” N
Surveyer: David J. Ode **Long:** 100° 20’ 34.49” W

Tree Species in 1/10 acre plot (dbh in cm):
Populus deltoides: 63, 54, 57, 29, 65, 43, 52, 43.
Fraxinus pennsylvanica: 14, 13, 7, 7, 6, 7, 3, 3, 5, 3, 6, 7, 6, 8.

Shrub Species in 1/20 acre plot (total number by size category)

	trees/shrubs >6’ tall	seedlings/saplings <6’tall
Juniperus virginiana:	6	1
Elaeagnus angustifolia	4	0

Notes: GPS reading is plot center. Located straight south of Downs Marina. Herb layer mostly sprigs of Muhlenbergia racemosa, with few patches of Bromus inermis, cheatgrass, mullein. Mostly just leaf litter. Green ash snags 10 cm, 12 cm. Signs of old beaver activitiy near water.

Plot: LT-35 **Sample Date:** 24 Oct. 2003 **Lat:** 44° 21' 18.28" N
Surveyer: David J. Ode **Long:** 100° 20' 40.39" W

Tree Species in 1/10 acre plot (dbh in cm):
Populus deltoides: 42, 49, 48, 63, 49 (most with broken tops, big barkless branches).
Fraxinus pennsylvanica: 13.

Shrub Species in 1/20 acre plot (total number by size category)

	trees/shrubs >6' tall	seedlings/saplings <6'tall
Juniperus virginiana:	2	0
Elaeagnus angustifolia	3	0

Notes: GPS reading is plot center. Located straight south of hospital. Herbaceous layer is 50-70% smooth brome with mullein and lots of downed logs. Some Muhlenbergia racemosa in shadier spots. Cottonwood snag = 42 cm. Green ash snag = 7 cm.

Plot: LT-36 **Sample Date:** 13 Jan. 2004 **Lat:** 44° 21' 21.47" N
Surveyer: David J. Ode **Long:** 100° 20' 46.74" W

Tree Species in 1/10 acre plot (dbh in cm):
Populus deltoides: 45, 64, 49, 59, 56.
Fraxinus pennsylvanica: 13, 9, 3, 10, 9, 6, 6, 8, 8, 12, 6, 4, 3, 2, 7, 10, 8, 6, 5, 12, 12, 10, 2, 9, 11, 4, 3, 10, 8, 14, 10, 10.

Shrub Species in 1/20 acre plot (total number by size category)

	trees/shrubs >6' tall	seedlings/saplings <6'tall
Juniperus virginiana:	0	1
Elaeagnus angustifolia	5	0

Vines (Parthenocissus vitacea or Vitis riparia): 14

Notes: GPS at plot center. Located along trail ssw of hospital. Trail runs through plot. Lots of downed logs & branches (ca. 10% cover). Ca. 60% grass cover of smooth brome and Elymus canadensis; rest is leaf litter.

Plot: LT-37 **Sample Date:** 13 Jan. 2004 **Lat:** 44° 21' 24.41" N
Surveyer: David J. Ode **Long:** 100° 20' 54.07" W

Tree Species in 1/10 acre plot (dbh in cm):
Populus deltoides: 75, 61, 39.
Acer negundo: 11, 11, 10, 14, 15, 7, 13, 20, 16, 18, 8, 17.
Fraxinus pennsylvanica: 19, 13.

Shrub Species in 1/20 acre plot (total number by size category)

	trees/shrubs >6' tall	seedlings/saplings <6'tall
Juniperus virginiana:	4	5
Elaeagnus angustifolia	1	0
Lonicera tatarica	5	0

Notes: GPS reading just ne of plot center. Mostly grass understory of Elymus canadensis, Carex sp., Bromus inermis. Numerous vines including Clematis ligusticifolia.

Plot: LT-38 **Sample Date:** 13 Jan, 2004 **Lat:** 44° 21' 27.27" N
Surveyer: David J. Ode **Long:** 100° 21' 00.76" W

Tree Species in 1/10 acre plot (dbh in cm):
Populus deltoides: 42, 30, 27, 48, 54, 40, 37, 43, 22, 26, 29, 44, 42, 33, 31, 28, 39, 32, 35.
Fraxinus pennsylvanica: 13, 11.

Shrub Species in 1/20 acre plot (total number by size category)

	trees/shrubs >6' tall	seedlings/saplings <6'tall
Juniperus virginiana:	5	4
Elaeagnus angustifolia	4	0

Vines (*Parthenocissus vitacea or Vitis riparia*): 6 (mostly in Russian olive)

Notes: GPS reading near plot center but few satellites. Understory of sparse grass cover (ca. 10%), mostly leaf litter and downed wood. Old beaver sign (girdled cottonwood) near river.

Plot: LT-39 **Sample Date:** 13 Jan. 2004 **Lat:** 44° 21' 29.87" N
Surveyer: David J. Ode **Long:** 100° 21' 7.42" W

Tree Species in 1/10 acre plot (dbh in cm):
Populus deltoides: 54, 38, 33, 49, 39, 40, 32.
Fraxinus pennsylvanica: 9, 9, 6, 5, 4, 4, 4, 4, 11, 9, 5.
Salix amygdaloides: 31, 31.
Ulmus pumila: 16, 10, 24, 12, 9.

Shrub Species in 1/20 acre plot (total number by size category)

	trees/shrubs >6' tall	seedlings/saplings <6'tall
Juniperus virginiana:	0	18

Vines (*Parthenocissus vitacea or Vitis riparia):* 6

Notes: GPS reading at plot center. Located straight S of capitol building. Steel cable on ground in plot. Thin grass understory *of Elymus canadensis, Muhlenbergia racemosa, Poa pratensis, Bromus japonicus*, with *Nepeta cataria, Verbascum*. Ca. 10% downed wood.

Plot: LT-40 **Sample Date:** 13 Jan, 2004 **Lat:** 44° 21' 32.74" N
Surveyer: David J. Ode **Long:** 100° 21' 15.04" W

Tree Species in 1/10 acre plot (dbh in cm):
Populus deltoides: 36, 43, 28, 35, 45.

Shrub Species in 1/20 acre plot (total number by size category)

	trees/shrubs >6' tall	seedlings/saplings <6'tall
Juniperus virginiana:	3	21
Elaeagnus angustifolia	2	0

Notes: GPS reading at plot center. Tree stand located on N edge of plot. Located S of capitol bldg. on N sid of ditch/channel. Mostly grass understory (ca. 60% cover) of *Elymus canadensis, Muhlenbergia racemosa, Bromus japonicus,* with few *Nepeta cataria, Verbascum thapsus, Equisetum*. This portion of the island is uniformly a gallery forest with a few scattered 20' Junipers and an understory dominated by Canada wildrye.

Plot: LT-41 **Sample Date:** 13 Jan. 2004 **Lat:** 44° 21' 36.14" N
Surveyer: David J. Ode **Long:** 100° 21' 21.56" W

Tree Species in 1/10 acre plot (dbh in cm):
Populus deltoides: 55, 45, 51, 53, 43.
Ulmus pumila: 20, 15.

Shrub Species in 1/20 acre plot (total number by size category)

	trees/shrubs >6' tall	seedlings/saplings <6'tall
Juniperus virginiana:	0	6
Elaeagnus angustifolia	1	0

Notes: GPS reading at plot center. Ca 80% cover by graminoid layer with *Elymus canadensis, Poa, Bromus japonicus, Equisetum,* downed wood. Extensive beaver damage near river here with > 11 cottonwoods cut or girdled.

Plot: LT-42 **Not Sampled** **Lat:** 44° 21' 39.76" N
Surveyer: David J. Ode 13 Jan, 2004 **Long:** 100° 21' 28.35" W
Notes: GPS point falls near center of new road near Well House #10 and electrical box where water pipeline leaves island and crosses LaFramboise Lake. Forest cleared for road, wellhouse and pipeline.

Plot: LT-43 **Sample Date:** 14 Jan, 2004 **Lat:** 44° 21’ 42.16” N
Surveyer: David J. Ode **Long:** 100° 21’ 35.10” W

Tree Species in 1/10 acre plot (dbh in cm):
Populus deltoides: 22, 36, 36, 21, 37, 42, 38, 37, 40, 51, 29, 36, 28, 43, 28, 34.

Shrub Species in 1/20 acre plot (total number by size category)

	trees/shrubs >6’ tall	seedlings/saplings <6’tall
Juniperus virginiana:	0	21
Elaeagnus angustifolia	2	0

Notes: GPS reading at plot center. Erect, 1” iron pipe used as plot center (from some previous sampling plot?). Rapid undulations of sand ridges with *Equisetum hyemale* & leaf litter distributed over 80% of inner plot, absent only under Russian olive & Juniper, otherwise continuous. Minor amounts of *Carex, Elymus canadensis, Verbascum, Poa, Muhlenbergia racemosa*. No vines, no beaver damage adjacent to plot.

Plot: LT-44 **Sample Date:** 15 Jan, 2004 **Lat:** 44° 21’ 42.77” N
Surveyer: David J. Ode **Long:** 100° 21’ 41.79” W

Tree Species in 1/10 acre plot (dbh in cm):
Populus deltoides: 76, 55, 46, 44, 42, 40, 46, 48.

Shrub Species in 1/20 acre plot (total number by size category)

	trees/shrubs >6’ tall	seedlings/saplings <6’tall
Juniperus virginiana:	4	34
Elaeagnus angustifolia	7	0

Notes: GPS reading at plot center. Located just ne of parking lot & outhouses. Undulating sand ridges. Leaf litter understory with sprigs of cheatgrass, mullein, Poa. Total grass cover ca. 20%. Heavy juniper invasion. No obvious beaver damage.

APPENDIX C

Suggested Trees and Shrubs

The following is not intended to be comprehensive list of plant materials suitable for planting on LaFramboise Island, but instead provides examples of appropriate trees and shrubs. The Pierre Native Plant Arboretum is a near ideal laboratory for evaluating suitable plant materials. Located on the Missouri River floodplain on the Hughes County side just opposite the lower end of LaFramboise Island, this arboretum has the same environment as LaFramboise Island. The only difference might be that the island has a greater variety of soils than the smaller arboretum.

Two rules were used in selecting the species listed below and should be applied when selecting plant materials for LaFramboise Island's future forest: 1) Plants should be native to this ecoregion or should be capable of growing here and be capable of naturally reproducing. Exceptions to this rule could be made for ornamental or other specialized purposes, so long as they don't violate the second rule, which is: 2) Do not plant invasive exotic species. Perhaps in the final analysis all that will remain on earth are invasive exotic species. But, for the time-being, it is clear that invasive species are one of the greatest threats to the continued survival of countless native plants and animals. So, until the natives are all gone, land managers should employ the "do no harm" philosophy and refrain from introducing these problem species. Examples of invasive, exotic plants include: Siberian elm (*Ulmus pumila*), buckthorn (*Rhamnus cathartica*), Russian olive (*Elaeagnus angustifolia*), Tatarian honeysuckle (*Lonicera tatarica*), multiflora rose (*Rosa multiflora*), smooth bromegrass (*Bromus inermis*), domesticated reed canary grass cultivars (*Phalaris arundinacea*), and all designated noxious weeds. There are numerous, ongoing efforts to identify and characterize invasive species. Federal land management agencies and The Nature Conservancy all have internet web pages dedicated to providing information on invasive species.

Green Ash (*Fraxinus pennsylvanica*): Green ash is naturally reproducing on LaFramboise Island beneath the declining cottonwood forest. There should not be a need to plant additional green ash.

American elm (*Ulmus americana*): Until decimated by Dutch elm disease, American elm was a co-dominant tree with green ash in riparian woodlands of South Dakota. Disease resistant varieties should be planted onto LaFraboise Island as they become available.

Boxelder (*Acer nigrum*): Stands of native boxelder do occur sporatically on LaFramboise Island but in the absence of flooding it is unlikely that they will continue to reproduce. Irrigating bare soil for cottonwood establishment may also lead to some reestablishment of boxelder so long as seed trees survive in close proximity.

Bur Oak (*Quercus macrocarpa*): Bur oak is a long-lived deciduous tree native to central South Dakota. While no individuals were observed on LaFramboise Island, bur oak does grow naturally in riparian areas in the Pierre area. Bur oak seedlings are notoriously vulnerable to browsing by deer and rabbits so seedlings should be protected when possible. The author is

aware of at least one location in the Pierre area where hand planting of bur oak acorns has been successful.

Black Walnut (*Juglans nigra*): Black walnut is native to forests of southeastern South Dakota including mixed forests of the Missouri River valley. There is no evidence that black walnut historically occurred in the Pierre area. However, black walnut now successfully grows and reproduces within the towns of Pierre and Fort Pierre suggesting that either the environment has changed or that its distribution was simply limited by slow seed dispersal. In either case, black walnut appears to be a good choice for introducing to LaFramboise Island. It does prefer more fertile soils so may be limited to microsites on the island with richer soil profiles.

Hackberry (*Celtis occidentalis*): Native to central South Dakota, it is surprising that hackberries have not colonized LaFramboise Island and soils or the elevated water table may prove to be somewhat limiting. However, hackberries are a good choice for introduction.

Kentucky coffee-tree (*Gymnocladus dioica*), and **honey locust** (*Gleditsia triacanthos*): Both of these trees are native to deciduous forests of southeastern South Dakota and are planted as ornamentals in central South Dakota. In native forests, they tend to grow on fairly rich soils. Whether they would naturally reproduce on LaFramboise Island is anyone's guess but they would be worth trying. Wild strains might be more likely to naturally reproduce than ornamental cultivars.

Peach-leaved willow (*Salix amygdaloides*): This is the only native, tree-sized willow in South Dakota and it occurs naturally on LaFramboise Island but like cottonwood, sandbar willow, and boxelder, requires exposed moist soil for seedling establishment. Peach-leaved willow would be a good choice for planting in those areas on the island where high water levels have killed other deciduous trees (e.g. Photo 4). Unfortunately, there does not appear to be a commercial source for peach-leaved willow, although it can be propogated relatively easily from cuttings.

Sandbar willow (*Salix exigua subsp. interior*): Stands of sandbar willow, although they were once abundant, are now relatvely uncommon around the periphery of LaFramboise Island. While it is unlikely that sandbar willow or peach-leaved willow will naturally reproduce without flooding (and exposed mineral soil), they both could be planted into areas of the island that are now experiencing elevated water levels. Sandbar willow also has the advantage of reproducing vegetatively through underground suckers.

Red osier dogwood (*Cornus stolonifera*): Red osier dogwood is another native, wetland margin shrub with high wildlife value. It provides excellent browse, fruits for birds, and aphids for migrating warblers.

Chokecherry (*Prunus virginiana*): Chokecherry is a common associate with green ash in woody draws of the northern plains. It occurs naturally on LaFramboise Island but, for whatever reason, is not reproducing very successfully. It would help to have several seed producing stands throughout the island. Because it is favored browse plant of deer, plantings should be protected until well established.

Western snowberry (*Symphoricarpos occidentalis*): This is still one of the most common shrubs in non-forested portions of LaFramboise Island but has declined in recent years apparently because of over-browsing by wildlife. Relief from browsing pressure, either through fencing or reduced numbers of browsers, would probably be all that is needed to expand the amount of western snowberry on the island.

Riverbank grape (*Vitis riparia*), **woodbine** (*Parthenocissus vitacea*), **western virgin's bower** (*Clematis ligusticifolia*): All three of these vines naturally occur and are capable of reproducing on LaFramboise Island. However, browsing pressure has apparently been so high that few young plants are surviving. This needs to be verified with exclosures that exclude deer and rabbits. If the problem is overbrowsing, measures should be taken to promote plant recovery either through larger exclosures or increased deer/rabbit harvest. If the problem is seed production and dispersal, plantings might help. Vines like these are characteristic of cottonwood forests but are generally less abundant in upland deciduous forests. It is possible that as the cottonwood forest declines, the environment is becoming less suitable for these species

Wood's Rose (*Rosa woodsii*): According to Everett Smalley (pers. comm. 2004), wild roses were once very abundant on LaFramboise Island. Precisely which species is not known but the two most abundant species in the Pierre area are Wood's rose which often grows in association with woody draws, and prairie rose (*Rosa arkansana*) which is a more typical of grassland habitats. Both species provide wildlife benefits but commercial sources for plant materials are rare.

Nannyberry (*Viburnum lentago*): Nannyberry, like Kentucky coffee-tree and black walnut, is common in forests of the Missouri River farther south but is not known to be native to central South Dakota. Nevertheless, plantings of nannyberry in the Pierre Arboretum have been very successful and it would be worth experimenting with this species on LaFramboise Island.