FINAL REPORT

State: South Dakota Grant Number: T-42-R1

Project Title: Faunal Survey of the Delta Habitat of Upper Lewis & Clark Lake

Period Covered: 5/12/2010 to 12/31/2012

Objectives:

1) Survey the delta for marsh birds, amphibians, reptiles, and freshwater invertebrates; specifically targeting Wildlife Action Plan species of greatest conservation need.
2) Examine the potential for trematode infection in amphibian, snail, and bird hosts.
3) Disseminate information concerning the delta fauna to both wildlife biologists and the general public.

Accomplishments: (See Attached Report)

Amount Obligated: $100,000

Actual cost to date: $100,000

Report prepared by: Jacob Kerby and David Swanson

Report submitted by: David J. Ode

2012

SOUTH DAKOTA DEPARTMENT OF GAME, FISH AND PARKS
WILDLIFE ACTION PLAN COMPETITIVE GRANT-FINAL REPORT

Project Title: **Faunal Survey of the Delta Habitat of Upper Lewis and Clark Lake**

Principal Investigators: Jacob Kerby, David Swanson, Department of Biology, University of South Dakota

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Background information:

The Niobrara Delta region exists from the confluence of the Niobrara and Missouri rivers to the upper end of Lewis and Clark Lake. It contains potential habitat for several species monitored by the South Dakota Natural Heritage Program and the Wildlife Action Plan species of greatest conservation need, such as king rail (*Rallus elegans*) northern water snake (*Nerodia sipedon*), false map (*Graptemys pseudogeographica*) and softshell turtles (*Apalone mutica* and *spinifera*), and several species of freshwater mussels (unionid species). The delta is also a major source of sediment load for the reservoir[1], creating concerns over how to deal with deposition problems. The U.S. Army Corps of Engineers has recently been using computer models to determine the engineering practicality of moving sediment through Lewis and Clark Lake to the river downstream of Gavins Point Dam[2]. Several proposals involve dredging large amounts of sediment at or near the delta[1], which would significantly alter existing habitat. If the Army Corp of Engineers' models show that dredging and flushing sediment is a practical solution, then physical tests of sediment flushing will be planned, which could also have a negative impact on delta habitat and the threatened species that may inhabit it. This project involved three monthly surveys per year during the breeding season to examine the presence and abundance of birds, amphibians, turtles, and freshwater mussels. This report represents the data collected from the delta during the summers of 2010 through 2012, as well as data collected from off-river wetland areas closer to the University of South Dakota in 2011 (when flooding prevented river access).

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Overall Progress: We have completed all three objectives as outlined in this report via three field seasons of data collection on the presence of targeted species across the delta. Analyzed data have been presented in both poster and oral form at a number of regional meetings.

Project Methods:

Site selection

During the summer of 2010, fifteen study sites across the delta were identified using a stratified random design. Geographical Information Systems (GIS) software was used to create a polygon map of the entire delta area. This was then divided into five sections of roughly equal area. Using UTM coordinates and a random number generator, three sites were then randomly selected in each section. This ensured that our surveys were spread throughout the entire delta region, but still randomly placed. During the first week of sampling we attempted to get as close to the original coordinates as possible. Some of the planned survey sites proved inaccessible. In these cases, we chose an accessible site as close to the original coordinates as possible as our final survey site (all within 500m). The maps of survey locations are displayed in Figures 1-3. In 2010, sites were sampled three times over the summer; in May, June, and July, except for turtle trapping, which was done in August. At every site, standard survey techniques were used to determine the presence of particular taxa (see below for specifics). Water quality was also measured using a YSI meter. We collaborated with the National Park Service, borrowing two Song Meter SM2 digital field recorders to record nighttime amphibian and bird sounds in 2010. In 2011, we received a wildlife diversity small grant from South Dakota Game Fish and Parks that allowed the purchase of additional recorders and Songscope audio analysis software license for the University of South Dakota. Severe flooding in June and July 2011 prevented access to all of the delta sites. We decided to survey accessible off-river wetland areas in order to compare the bird and amphibian species between the two habitats. Fifteen sites were surveyed in Clay County, northeast of the town of Vermillion. The distances between these sites and the Missouri River ranged from 3.5 to 5.25 miles. The same survey techniques employed on the delta were used at these sites except no mussel or turtle surveying was conducted, and both sites were surveyed only once rather than three times. A third year of supplemental funding from South Dakota Game Fish and Parks allowed a third field season of sampling at all 15 delta survey sites in May, June, and July of 2012. All of the previously mentioned sampling was conducted again in 2012, including turtle trapping. Several survey sites were moved in 2012 mainly due to the large amount of sediment that was deposited and/or rearranged by severe flooding in 2011 (Figure 4).

During initial data interpretation, survey sites were categorized into age classes by apparent successional age (Table 1). As the delta formed over time, it spread from the mouth of the Niobrara towards the reservoir, and from the banks towards the middle of the channel. This can be seen in aerial photos taken in successive years after the dam was closed. GIS aerial photography layers from different years were compared to each other to determine age classes. As more map layers became available we were able to improve the estimation of site ages and refine our analyses. However, since site age classes were created by comparing GIS map layers from different years, there may have been flooding or scouring of marsh habitat in some areas of the delta between years in which aerial photos were taken, causing a “younger” functional successional age at some sites than we predicted. For this reason we have decided to instead arrange our data based on whether survey sites consist entirely of mid-channel island habitat or are connected to bank habitat (Table 2).

Survey Types

Crews used standard survey techniques focusing on four main types of organisms: marsh birds, amphibians, turtles, and freshwater invertebrates. While targeting these specific organisms, any non-target fauna encountered in our surveys were recorded and included in our analysis.

Birds: The North American Marsh Bird Survey Protocol[3] uses several methods to target secretive marsh bird species, including playback of bird calls and visual scanning from broadcast points. We placed considerable emphasis on the King Rail given its sensitive status in South Dakota. We also recorded the presence of any other bird species we could detect and identify at each site.

Amphibians: We employed Visual Encounter Surveys[4] along three 50 meter transects at each site. We also used dip net sampling to search for tadpoles and egg masses. All captured amphibians were swabbed for chytrid fungus and inspected for parasite-induced deformities.

Turtles*:* We sampled for turtles at each site on the delta with baited hoop traps[5] from 18-20 August 2010. False Map and Softshell turtles were targeted. Turtles were also weighed, measured, sexed, and marked using Cagle's notching scheme[6] for all species except softshell turtles, which were marked exteriorly. Figure 2 shows trap locations. Lack of river access due to severe flooding prevented summer sampling of turtles in 2011. In 2012, baited hoop traps were deployed for a single night at each survey site during each of the three sampling weeks in May, June and July. Turtles were again weighed, measured and sexed but were not marked.

Freshwater Invertebrates: We used visual and tactile searches in transects 1 meter wide by 12 meters long to search for mussels and snails[7]. Dr. Emy Monroe (USD) assisted us in our mussel sampling techniques and identification. In nearby Minnesota, amphibian deformities are known to be caused by a particular trematode parasite[8,9]. We intentionally searched for the specific snail species that transmit the parasite to amphibians in order to attempt to determine the prevalence of the disease on the delta.

SongMeter II Recorders: SongMeter recorders were attached to stakes and placed at different survey sites each day of sampling during afternoon amphibian surveys, and picked up during early morning bird surveys. They were programmed to begin recording at 19:00 and stop recording at 03:00. We analyzed data from these recorders was analyzed with Songscope Bioacoustics software.

Comparisons

In addition to recording species presence at each of the surveyed sites, we also conducted several comparative analyses to better understand patterns across the sites. Due to severe flooding in 2011, we were unable to conduct the June or July surveys on the delta. We supplanted those surveys with similar surveys done at sites off river with the idea of comparing species across different habitats. The delta is unique for its extensive island and sandbar habitat which is very different from other sections of the river. Therefore we also conducted comparisons of species within the delta detected at island sites to those sites that were connected to mainland areas. The

overall idea was to better understand what unique or uncommon species were utilizing these island habitats not found in other locations.

Results:

Bird Species Monitoring:

Overall: We were able to detect five of our target marsh bird species with call playback surveys on the Niobrara Delta, but we detected no species of greatest conservation need. The highest number of detections per site during each sampling season were averaged across all 15 survey sites and compared among years. One Least Bittern was detected at the Delta in 2010 and Virginia Rails were found at the Delta in 2010 and 2012. Pied-billed Grebes were detected in 2011 but not 2010 or 2012 (Figure 5). American Coots were detected on the delta every year. Although we did not find King Rail, we detected 79 total bird species using delta habitat, including 11 species considered uncommon in the state of South Dakota[10] (Table 3).

Comparing the Niobrara Delta to Off-river Marsh Habitats in 2011:

Average Detections per Site: Average detections per site for marsh bird species were compared between the Niobrara Delta and off-river marsh sites. Although Virginia Rails were detected at the Niobrara Delta in 2010 and 2012, this species was only detected at off-river sites in 2011. Flooding may have prevented Virginia Rails from nesting on the delta that year. While average numbers of Sora and Pied-billed Grebe were comparable between the Niobrara Delta and the off-river wetland areas, American Coots were detected in significantly greater averages at off-river wetland sites. Common Moorhen was not detected on the delta, but one individual was detected at an off-river wetland site (Figure 6).

Many of the other bird species observed both at the Niobrara Delta and off-river sites were detected at relatively similar numbers, or numbers too low to be statistically compared between different habitat types. However, some bird species were detected disproportionately at either delta or off-river sites. Average detections of Killdeer, Common Yellowthroat, Yellow-headed Blackbird and Red-winged Blackbird differed significantly between the delta and off-river sites. Common Yellowthroats and Red-winged Blackbirds were found in greater abundance on the delta, while Killdeer and Yellow-headed Blackbirds were found in greater numbers at off-river wetland sites (Figure 7).

Average Species Detected per Site: The number of bird species detected per site was averaged across the 15 survey sites on the Niobrara Delta and the 15 sites at off-river habitats for comparison as well. The average number of species detected per site was significantly but only slightly higher at off-river wetlands (Figure 8). However, there were fewer bird species detected overall at the off-river wetland sites (19) than on the delta (55), and Green Herons were the only uncommon species found at the off-river wetland sites near Vermillion (Table 4). This suggests that delta habitat could be important for several bird species that are uncommon in South Dakota. Migration timing may have impacted comparisons of overall species richness between delta and off-river sites because of slight differences in survey timing. The delta was surveyed in mid-May, during peak bird migration while off-river habitats were surveyed in early June.

Comparing Bank-connected vs. Island Habitats on the Delta:

Chi squared test: Detection of marsh bird species was too low to detect significant differences between actual and expected frequencies of detection at bank-connected vs. mid-channel island habitats. However, a chi-squared test was performed on detection data for several species from all seven survey periods over the three sampling seasons. Three of these species, Least Tern, Blue-winged Teal, and Bank Swallow, were detected at higher frequencies than expected on island habitats, while Bald Eagles were found at higher than expected frequencies in bank-connected habitats (Table 5).

Comparing average detections per site: Average detections of marsh bird species were compared between island habitat and bank-connected habitat sites. The highest detection numbers from each sampling season were used to avoid recounting individuals, and detections per site were averaged for each habitat type across all three years. Differences in detection between habitat types were not statistically significant. However, we note that a Least Bittern was only detected once, at a bank-connected site (Figure 9).

Comparing percentages of sites with detections: The percentages of island and bank-connected sites with detections of marsh bird species during any of the seven survey periods were compared. A higher percentage of bank-connected sites had detections of Sora, while a higher percentage of island sites had detections of Pied-billed Grebe. Percentages were the same for both habitat types for American Coot. Virginia Rail was detected at only one site of each habitat type (Figure 10). We note that because there were fewer land-connected sites than island sites, a detection at a single site represented a larger percentage of bank-connected sites than of island sites, yet this does not affect the analyses in any important way. This analysis was also done for 10 species considered uncommon in the state of South Dakota. Swamp Sparrow, Bell's Vireo and Peregrine Falcon were found only at island sites, which was not expected, however, their overall detection levels were very low. Detections of several other species followed expected patterns. Higher percentages of bank-connected sites had detections of Yellow-billed Cuckoo and Willow Flycatcher, while higher percentages of island sites had detections of Forster's Tern, Least Tern, and Piping Plover (Figure 11).

Detection of Least Terns rose from five in 2010 to nine individuals in 2012. Surprisingly, detections of Piping Plovers remained the same at two in 2010 and two in 2012. (No Least Terns or Piping Plovers were detected in 2011, however, the flood of that year deposited large amounts of ideal sandbar nesting habitat for both species.)

Average numbers of species per site: Numbers of species detected throughout the three sampling periods at sand/bar island sites and bank-connected sites were averaged for comparison. A higher average number of species was detected on island habitats, however this difference was not statistically significant. 57 species were detected on island habitats throughout 2010-2012, while 52 species were detected in habitats connected to the bank (Figure 12).

Songmeter Recordings: We expect that our call recorders may have detected a number of nocturnally calling bird species, which could include the marsh bird species targeted by our call-playback methods, as well as Black-crowned Night Herons, Marsh Wrens, Whip-poor-wills, Great Horned Owls and Eastern Screech-Owls. Due to logistical constraints, nocturnal audio recordings have not yet been analyzed for bird species presence.

Amphibian Visual Encounter Survey Results*:*

Overall: The amphibian species we detected at the delta included bullfrogs, northern leopard frogs, Woodhouse's toads, boreal chorus frogs, and northern cricket frogs (Table 6). These are species that are typically found in backwaters and side-channels and on islands, sandbars and banks in other sections of the river as well. The highest detections per site during each sampling season were averaged across all 15 survey sites and compared among years. Bullfrogs were detected at higher rates than other species in 2010 and 2012 perhaps because they are loud diurnal callers, making them easier to detect. Only boreal chorus frogs displayed a statistically significant difference in detection between years, with much lower detection in 2012 than in the previous two years. Detection of most amphibian species was low in 2011 because surveys were only conducted in May. This was especially true of bullfrogs because this species does not become as active (detectable) as other species until later in the season (Figure 13).

***Comparing the Niobrara Delta to Off-river Habitats in 2011*:** Species found on the Niobrara Delta in May 2011 were compared to those found at off-river wetland areas in June of the same year (Table 6, Figure 14). Tiger salamander larvae and Woodhouse's toads were found only at off-river wetland sites in 2011. No Northern Cricket Frogs or Boreal Chorus Frogs were found at off-river wetland sites. However our surveys of off-river marshes were likely after the breeding season for chorus frogs, as they are present at these sites in large numbers during April and May when they are chorusing[11]. Numbers of leopard frogs were not significantly different between the delta and off-river wetland areas (Figure 14).

Comparing Bank-Connected vs. Island Habitats:

Chi squared tests: Actual detection frequencies at island habitats vs. habitats connected to the bank did not differ significantly from expected frequencies for any amphibian species (Table 7).

Comparing average detections per site: Average detections of each species per site were also graphed according to habitat type. The highest detection numbers for each sampling season were used for comparisons to reduce the chance of recounting individuals. Detections per site were averaged for each habitat type across all three years and compared. There were no significantly different detection rates for any species between island habitat vs. bank-connected habitat (Figure 15).

Comparing percentages of sites with detections: The percentages of island and bank-connected sites with detections of amphibian species during any of the seven sampling periods were compared. A slightly higher percentage of island habitat sites appeared to have detections of most species (Figure 16). This was not expected, since there were fewer land-connected sites than island sites, and a detection at a single site represents a larger portion of bank-connected sites than of island sites.

Average numbers of species per site: Numbers of species detected throughout the three sampling periods at island sites and bank-connected sites were averaged for comparison. While there was a slightly higher number of species detected per site on island sites, this difference was not significant (Figure 17).

Songmeter Recordings: Amphibian species call mainly at night rather than during the day. Our nocturnal recordings include species that we sometimes did not sometimes detect during the day at some sites, such as boreal chorus frogs (*Pseudacris maculata*). Amphibian species

presence/absence data obtained from daytime visual encounter surveys were compared with that obtained from analyzing nighttime audio data. When the number of species detected per site was averaged across all survey sites, nighttime audio analyses resulted in significantly more species per site to be detected. The average number of species detected per site when accounting for both methods was also compared. Species detections for both methods combined did not differe significantly from those for audio monitoring alone (Figure 18). Similar results were found when comparing the percent of survey sites where individual species were detected when using either method or a combination of the two. The only species that did not follow the general trend of being detected at a higher percent of sites when audio data was analyzed was the bullfrog (Figure 19). As mentioned above, bullfrogs are diurnal, and active later in the season, while the audio data were collected at night in May. For purposes of detecting species presence, even surveying only at night using audio data is effective, provided surveys take place several times during the summer to ensure data collection during the breeding season of all target species. A limitation to audio monitoring is that abundance estimates are not possible. Whether nocturnal audio monitoring by itself, or in combination with daytime visual encounter surveys is the best survey option depends on the goals of a particular monitoring project.

Turtle Trapping

Overall: Turtle species detected at the delta include False Map, Spiny Softshell, Snapping, and Painted turtles. Logistics did not allow turtle trapping to take place on the delta or off-river in 2011. Detection rates for turtles were much lower in 2012 than in 2010, with only four snapping turtles and one western painted turtle found throughout the summer (Table 8). Statistical analysis was performed on 2010 data alone rather than include 2012 data because of the differences in sampling timing.

Comparing Bank-Connected vs. Island Habitats:

Chi squared test: Painted turtles were caught at higher than expected frequencies at bank-connected sites in 2010. No other species were caught at frequencies that differed from expected values (Table 9).

Comparing average detections per site: Average detections per site for each turtle species were graphed according to habitat type. Differences in detection between habitat types were not significant for any species (Figure 20).

Comparing percentages of sites with detections: Percentages of island and bank-connected sites with detections of turtle species during any of the seven survey periods were compared. Percentages of sites with detections were the same for Western Painted Turtles, while the other three species were detected at a slightly higher percentage of island/sandbar habitat sites. This was expected because of the smaller number of island sampling sites (Figure 21).

*Average numbers of species per site***:** Numbers of turtle species detected throughout the three sampling periods at island sites and bank-connected sites were averaged for comparison. The average number of turtle species detected per site was slightly higher for island habitats, however this difference was not significant (Figure 22).

Freshwater Invertebrate Detections

In 2010, one live freshwater mussel, a white heelsplitter (*Lasmigona complanata*) was found, at site 104, although empty shells were found at other sites. No freshwater mussels were found in 2011. Live freshwater mussels were found at higher numbers in 2012 than in 2010 or 2011 (Table 10). Detection was too low to conduct effective statistical analyses on this data. The habitat at most of our sites was not ideal for mussels. Mussels prefer habitats with rocky, pebbly, or coarse sandy substrates, and many of our survey sites had very fine silt, and water with a high sediment load, which is not ideal for mussel habitation[12]. The species of snail that carries parasites which infect amphibians was not found on the delta during our surveys, and none of the amphibians we found were visibly deformed or infected.

Discussion:

The Niobrara Delta region represents a unique habitat not only in South Dakota, but also within the Missouri River itself. In particular, the establishment of islands provides wetlands thought to be important for many birds and amphibians. In addition to the islands, surrounding banks in the floodplain are important for other potential wetland habitat. With the current damming of the river, these habitats are much more rare than historical found and so it is thought that these sites could be of utmost importance on the river. Given the concern over sedimentation above the dam though, these habitats might become significantly altered by any future management decisions.

Given this background, we sought to survey the area to determine the presence of sensitive species in the area, in particular, species that might be utilizing this potentially important wetland habitat. Interestingly, as evidenced above, despite extensive survey efforts over three years time, we did not find substantial use of these habitats by sensitive species. Thus, the wetland habitat present on the delta does appear to be particularly suitable for many of these species.

Our observations of the habitat suggest that while the vegetation appears suitable, the water level variation might be a key component precluding the use of these habitats for breeding grounds. The past three years have provided a variety of events underscoring the large variation that these island habitats, in particular, seem to possess. Areas sampled early in May were often seemingly ideal wetlands for many birds and provided shallow marshland conditions. As the season progressed, however, the water levels invariably increased and these areas often would turn to large pools that were not perhaps as ideal for marsh birds, but more ideal for amphibians. As the season progressed further and water levels continued to rise, much of the island would be under water, providing little solid ground for birds and also connections from the deeper water to the river itself providing access for predatory fish. Fluctuating water levels are quite natural in a river system such as the Missouri, but organisms are better able to deal with these alterations on the extended flood plain zone rather than isolated on islands. Moreover, the timing of the water level fluctuation differs from the natural hydrograph of the Missouri River and from typical trends for off-river marshlands, where water levels tend to be high in late spring and drop as the summer progresses. Marsh birds often place their nests in vegetation above the surface of the water or on the ground at the water's edge[13]. This strategy works well when water levels remain stable or recede over the course of the summer. However, increasing water levels, as occurred every year on the delta during this study, might inundate marsh bird nests resulting in nest failure and decreasing marsh bird use of delta habitats relative to other marsh habitat. This could explain

the relatively low use of these habitats by marsh birds, despite their extensive occurrence on the delta.

The extent of habitat use on the delta by freshwater mussels appears minimal, most likely because of the silty substrate in most of the area. Although this habitat is valuable, flooding and fluctuating water levels are also much more of a problem on the Niobrara Delta than at off-river wetland sites, and this may mean there is less fauna in general using the delta than there would be if it the area was not subject to anthropogenic flow regimes. Severe flooding in 2011 deposited and rearranged large amounts of sediment throughout the delta, creating large areas of new bare sandbar habitat. These are potentially ideal nesting areas for endangered Least Terns and Piping Plovers. Least Terns were found at higher numbers in 2012 than in 2010. However, the same process occurred on many other sections of the Missouri River, and it is unknown whether a higher proportion of the Niobrara Delta underwent this process than most other sections of the Missouri.

This being said, a large number of bird species were detected at the Niobrara Delta and several of these species were not detected at off-river wetland sites. While island, or specifically sandbar habitat, is important for Least Terns and Piping Plovers, other species such as Bald Eagles and Painted Turtles appear to prefer bank habitat. While preserving some of the sandbar habitat on the delta is important, bank habitat is also important to wildlife diversity. Maintaining buffers along the Missouri River in order to preserve riparian bank habitat may be just as important for preserving local wildlife diversity as preserving the sandbar habitat present on the Niobrara Delta. Bank habitat, including marshy areas that are connected to the bank may provide refuges for amphibians, turtles and nesting birds to escape periodic water level fluctuations on the delta. The data also suggest the delta habitat is different enough from other wetland habitats in South Dakota to support a higher level of diversity. This diversity is perhaps supported by the mainland habitat more than the island habitat though, and so great efforts should continue to be pushed for maintaining and improving the surrounding wetland and woodland habitats in the area.

Dissemination of information and Future Work:

Results from the portion of this study focusing on marsh birds were presented on October 9, 2010 at the South Dakota Ornithologists' Union meeting at the University of South Dakota. A poster on our findings was presented at the Missouri River Natural Resources Committee Meeting in Nebraska City, Nebraska March 10, 2011. More extensive presentations of our results were given at the annual Missouri River Institute Research Symposium at the University of South Dakota on April 21, and at the annual Dakota Amphibian and Reptile Network meeting in Minot, North Dakota on May 21, 2011.

Nocturnal audio recordings are available for future analysis of bird species presence during all three years, or amphibian species presence during 2012. This could be accomplished either by paid technicians or volunteer undergraduate students.

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Table 1: Site Ages

Estimated Age Classes	Site Numbers
<10 yrs	108, 109
10-25 yrs	101, 102, 103, 106
25-50 yrs	104, 110, 115
>50 yrs	105, 107, 111, 112, 113, 114

Sites were initially divided by apparent successional age for analyses.

Table 2: Sites Habitat Types

Island Habitat Sites (60% of total)	Sites Connected to Land (40% of total)
101	107
102	111
103	112
104	113
105	114
106	115 (year 2010 excluded from analyses)
108	
109	
110	

Table 3: Complete List of Niobrara Delta Bird Species Detected 2010-2012

Wading Birds	*Passerines*
Least Bittern*	American Crow
Great Blue Heron	Willow Flycatcher*
Great Egret (flyover)	Eastern Wood-peewee
Green Heron*	Eastern Kingbird
Geese Ducks and Grebes	Bell's Vireo*
Canada Goose	Yellow-throated Vireo
Wood Duck	Northern Rough-winged
Mallard	Swallow
Gadwall	Bank Swallow
Northern Shoveler	Tree Swallow
Blue-winged Teal	Cliff Swallow
Pied-billed Grebe	Barn Swallow
Rails/Cranes	Marsh Wren
American Coot	Sedge Wren
Virginia Rail	Gray Catbird
Sora	Yellow Warbler
Sandhill Crane	Common Yellowthroat
Gulls and Terns	Rose-breasted Grosbeak
Franklin's Gull	Dickcissel
Ring-billed Gull	American Goldfinch
Forster's Tern*	Chipping Sparrow
Least Tern*	Song Sparrow
Black Tern	Swamp Sparrow*
Raptors and Owls	Western Meadowlark
Bald Eagle	Bobolink
Peregrine Falcon	Brown-headed Cowbird
Great Horned Owl	Yellow-headed Blackbird
Shorebirds	Red-winged Blackbird
Piping Plover*	Common Grackle
Killdeer	Baltimore Oriole
American Avocet	Orchard Oriole
Greater Yellowlegs	*Other*
Lesser Yellowlegs	American Pelican
Spotted Sandpiper	Wild Turkey
Ruddy Turnstone* (flyover)	Mourning Dove
Dunlin	Yellow-billed Cuckoo*
Pectoral Sandpiper	Belted Kingfisher*
White-rumped Sandpiper	Northern Flicker
Semi-palmated Sandpiper	Red-bellied Woodpecker
Least Sandpiper*	Red-headed Woodpecker
Stilt Sandpiper	Chimney Swift
Long-billed Dowitcher (flyover)	
Common Snipe	79 Total Species
Wilson's Phalarope	

Bold denotes species targeted by call playback surveys
*Species considered uncommon in South Dakota[10]

Table 4: List of Bird Species Detected in 2011

Detected ONLY on Niobrara Delta	Detected on Niobrara Delta AND Off-river Sites	Detected ONLY at Off-river Sites
Wading Birds	*Wading Birds*	*Wading Birds*
Least Bittern*	Green Heron*	Great Egret
Great Blue Heron	*Geese Ducks and Grebes*	*Rails*
Geese and Ducks	Wood Duck	**Common Moorhen**
Canada Goose	Mallard	
Gadwall	Blue-winged Teal	
Gulls and Terns	Northern Shoveler	
Ring-billed Gull	**Pied-billed Grebe**	
Forster's Tern*****	*Rails*	
Least Tern*****	**Virginia Rail**	
Raptors	**Sora**	
Bald Eagle	**American Coot**	
Shorebirds	*Plovers, Sandpipers, etc.*	
American Avocet	Killdeer	
Piping Plover*****	*Passerines*	
Lesser Yellowlegs	Yellow Warbler	
Semi-palmated Sandpiper	Song Sparrow	
Least Sandpiper	Red-winged Blackbird	
Pectoral Sandpiper	Yellow-headed Blackbird	
Wilson's Phalarope	Common Grackle	
Passerines	Eastern Kingbird	
Eastern Wood-peewee	Tree Swallow	
Willow Flycatcher*		
Marsh Wren		
Gray Catbird		
Bell's Vireo*		
Common Yellowthroat		
Rose-breasted Grosbeak		
Chipping Sparrow		
Swamp Sparrow*		
Western Meadowlark		
American Goldfinch		
Brown-headed Cowbird		
Orchard Oriole		
Baltimore Oriole		
Bank Swallow		
Cliff Swallow		
Barn Swallow		
Other		
American Pelican		
Wild Turkey		
Belted Kingfisher*****		
Mourning Dove		
Yellow-billed Cuckoo*****		
Northern Flicker		

Bold denotes species targeted by call playback surveys

*Species considered uncommon in South Dakota[10]

Table 5: Contingency Table and Chi Square Test for Bird Species Habitat Preferences

	Least Tern	Blue-winged Teal	Bank Swallow	Bald Eagle
Expected Frequency on Island Sites (60% of total detections)	7	5	7	6
Expected Frequency on Land Sites (40% of total detections)	4	3	4	4
Actual Frequency on Island Sites	10	8	10	1
Actual Frequency on Land Sites	1	0	1	9
p value	0.036	0.021	0.036	0.001
Chi squared value	4.379	5.333	4.379	10.417

Table 6: Amphibian Species Detection Totals

Species	2010 Niobrara Delta Totals	May 2011 Niobrara Delta Totals	June 2011 Off-river Wetlands Totals	2012 Niobrara Delta Totals
Bullfrog	Too numerous	4	1	171 (92)
Leopard Frog	9	5	6	19 (15)
Northern Cricket Frog	11	3	0	25
Boreal Chorus Frog	14	17	0	1
Woodhouse Toad	6	0	28	4
Tiger Salamander	0	0	3	0
Total amphibians	>> 58	29	38	220 (135)

Numbers in parentheses for 2012 are the highest numbers detected, rather than total detections.

Table 7: Contingency Table and Chi Square Test for Amphibian Habitat Preferences

	Woodhouse's Toad	Bullfrog	Leopard Frog	Northern Cricket Frog	Boreal Chorus Frog
Expected Frequency at Island sites (60% of total detections)	2	17	10	8	7
Expected Frequency at Bank-connected sites (40% of total detections)	2	12	7	6	4
Actual Frequency at Island sites	2	20	13	7	8
Actual Frequency at Bank-connected sites	2	9	4	7	3
p value	0.68	0.32	0.16	0.45	0.39
Chi Square	0.17	0.97	1.92	0.58	0.74

Table 8 Turtle Species Totals

Species	2010	2012
False Map	19	0
Spiny Softshell	6	0
Snapping	25	4
Painted	16	1

Table 9 Contingency Table and Chi Square Test for Turtle Species Habitat Preferences

	Snapping Turtle	False Map Turtle	Spiny Softshell	Painted Turtle
Expected Frequency at Island sites (60% of total detections)	15	11	6	10
Expected Frequency at Bank-connected sites (40% of total detections)	10	8	4	6
Actual Frequency at Island sites	18.00	9.00	5.00	3.00
Actual Frequency at Bank-connected sites	7.00	10.00	5.00	13.00
p value	0.22	0.35	0.52	0.0003
Chi square	1.50	1	0.4138	13.07

Table 10 Mussel Species Detection Totals

Species	2010	2011	2012
White Heelsplitter	1	0	1
Giant Floater	0	0	28

All live mussels were found at Island habitat type sites.

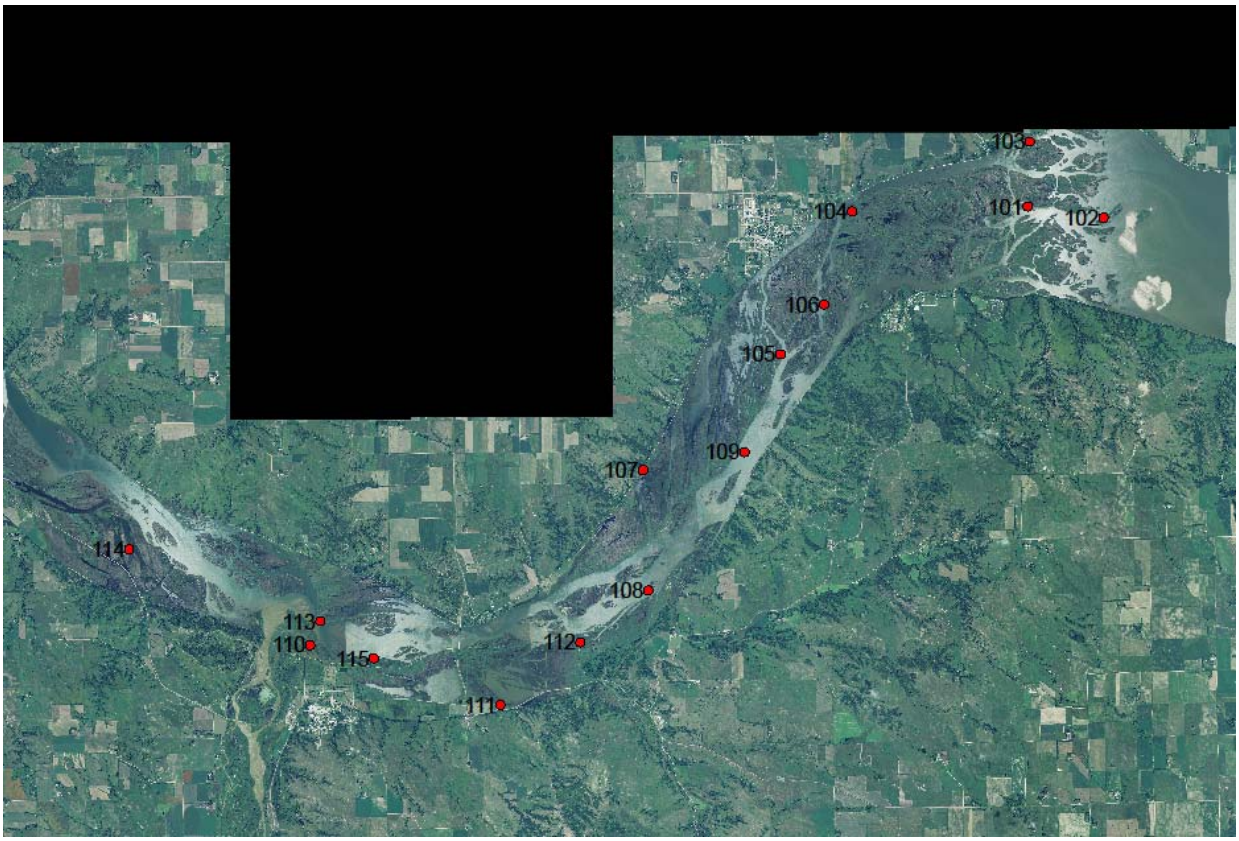

Figure 1. Map of Survey Points on the Delta

Figure 2.Map of 2010 Turtle Trapping Sites

Traps were set in suitable habitat as close as possible to the same survey points used to survey for other species. Site ND101 is at the Northeast end of the Delta and does not show on the map because the data layer is missing. Site 107 was inaccessible during turtle trapping due to flooding, however a trap was set as close as possible to the original point.

Figure 3. 2011 Flooding on the Delta

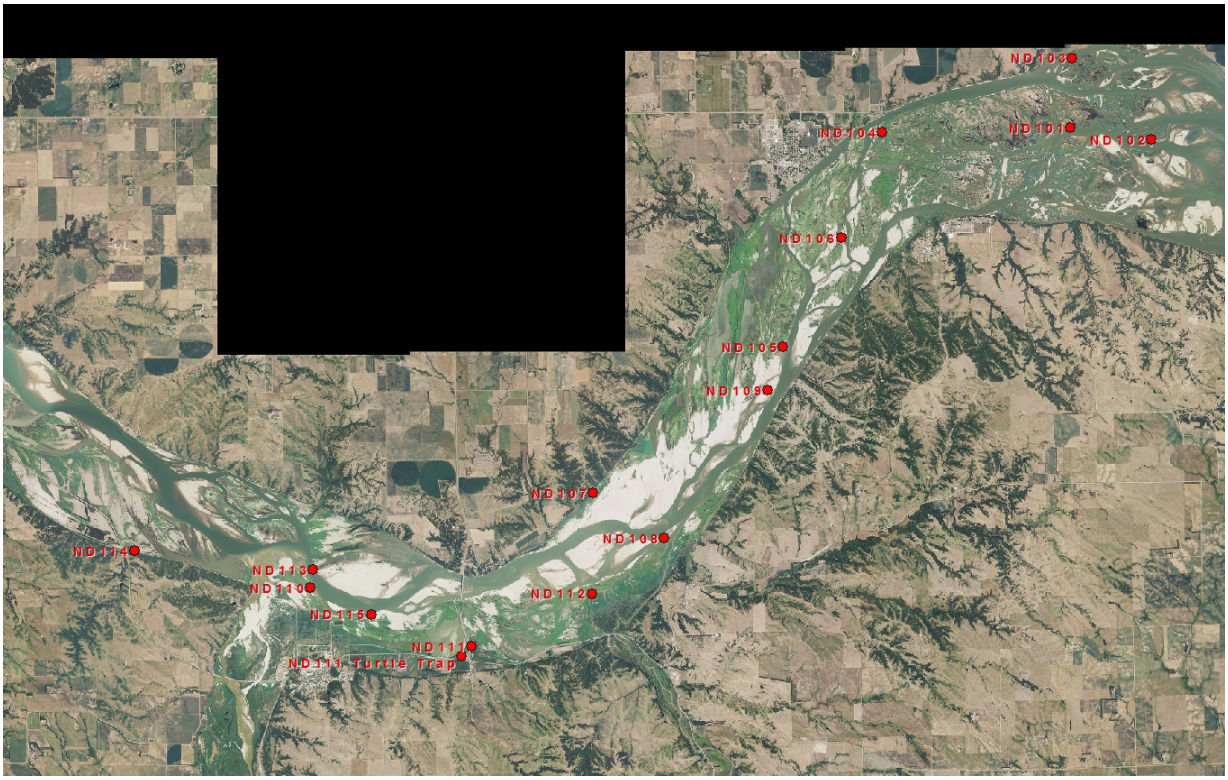

Figure 4. 2012 Sampling Points

The flood of 2011 deposited a large amount of sandy sediment at survey sites ND106, ND110 and ND113, providing potential least tern and piping plover habitat that we did not wish to disturb. Sites ND111 and ND107 were too dry in 2012 to provide true marshy habitat. Multiple new private property signs at the entrance to the gravel road to site ND114 prompted us to move the location to nearby public property.

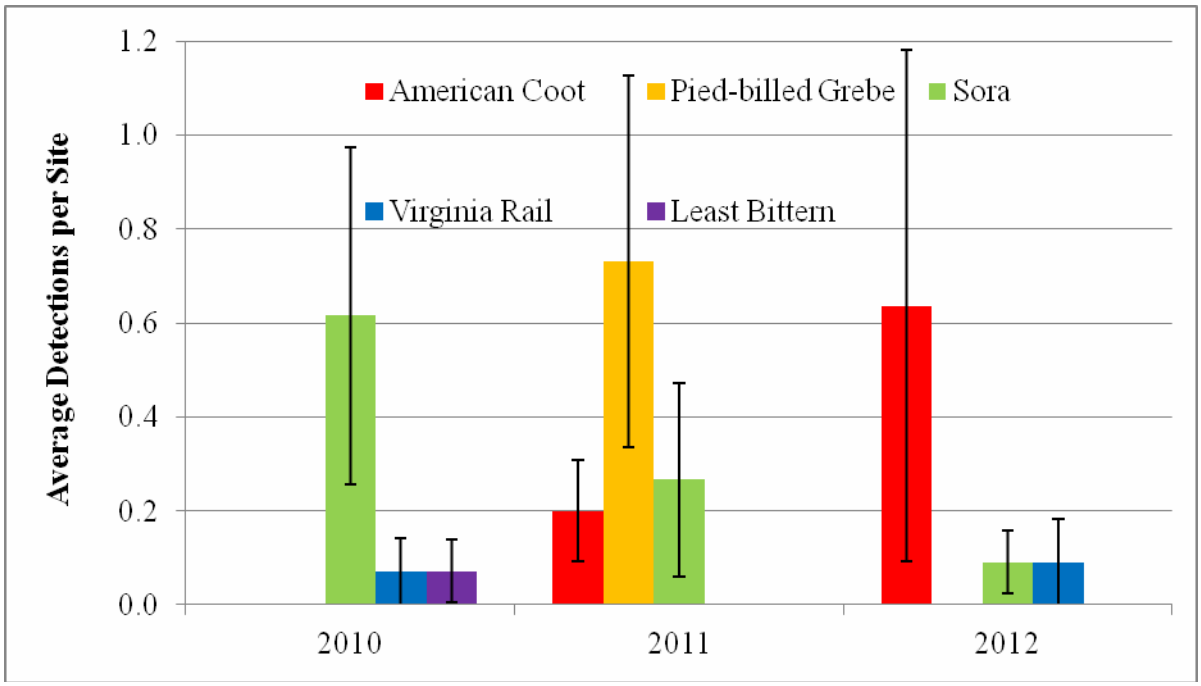

Figure 5 The highest detection numbers from each sampling season were averaged across all 15 survey sites to reduce the chance of potential recounts. This graph compares results between years.

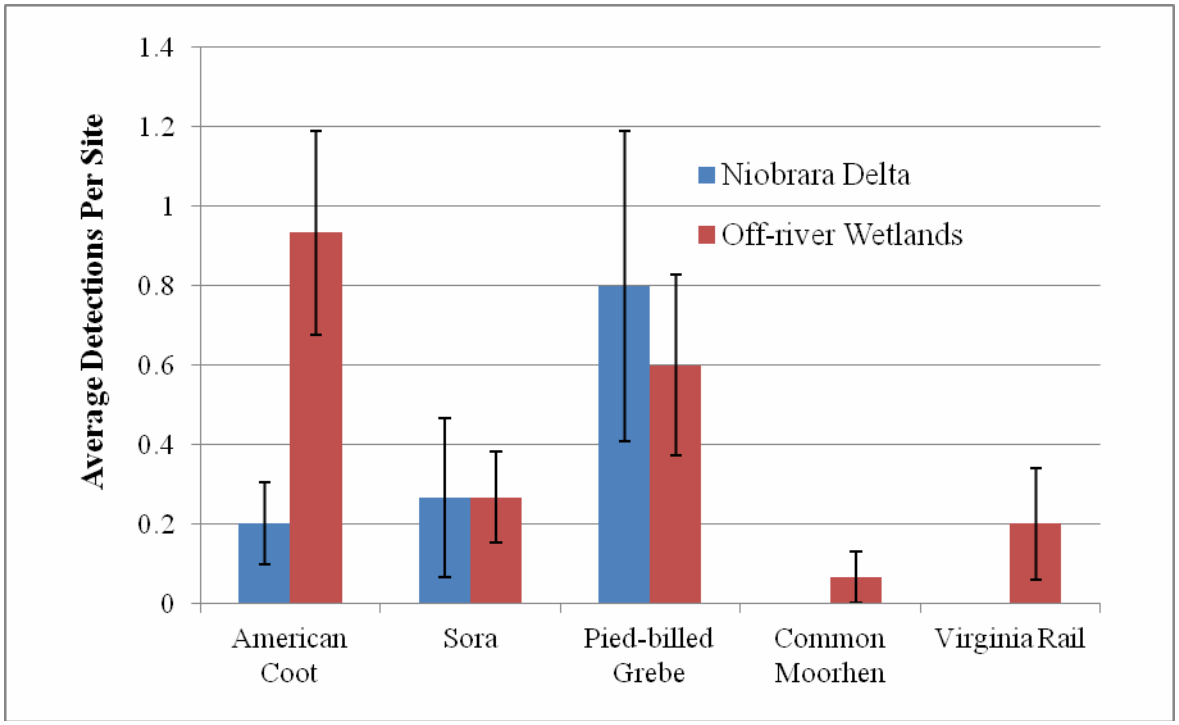

Figure 6 Comparing between marsh bird call playback survey results at Niobrara Delta Sites in May 2011, vs. off-river wetland sites near Vermillion in June of 2011. (This data is from 2011 only. Off-river sites were not surveyed in 2010 or 2012.)

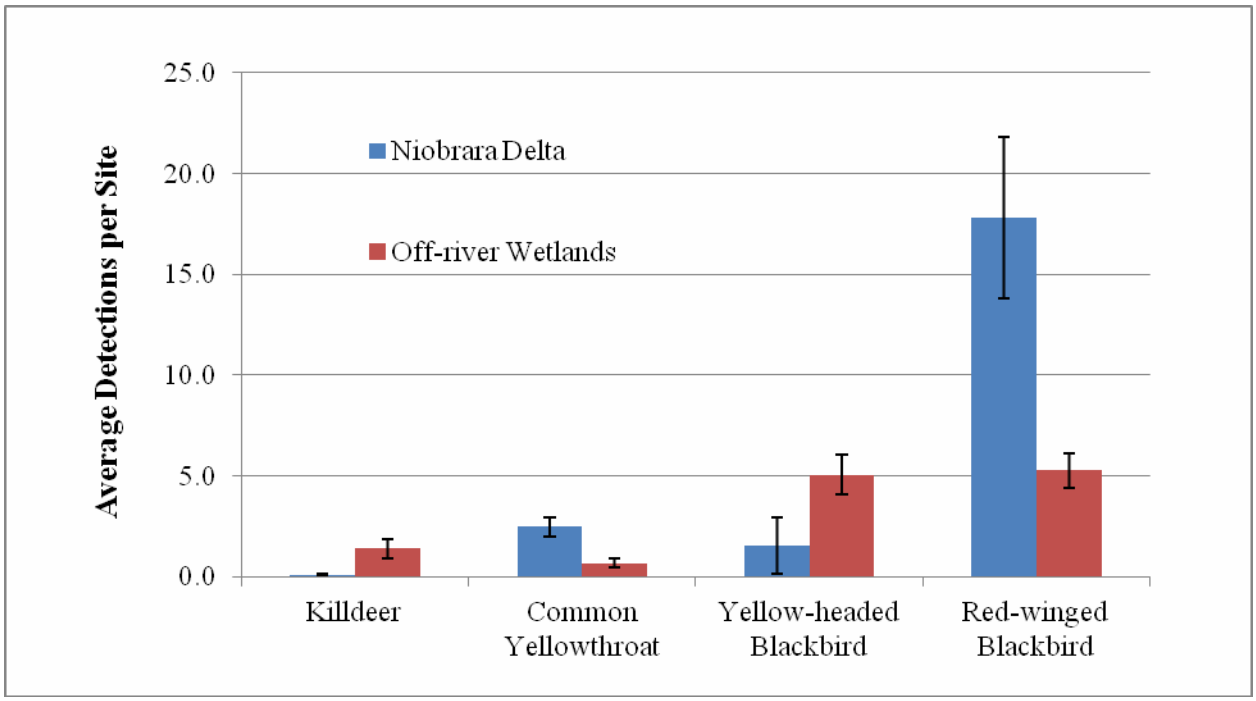

Figure 7 Comparing detections of certain bird species at Niobrara Delta Sites in May 2011, vs. off-river wetland sites near Vermillion in June of 2011. These were species with significant differences in average numbers of individuals detected per site between the Niobrara Delta and off-river marshes.

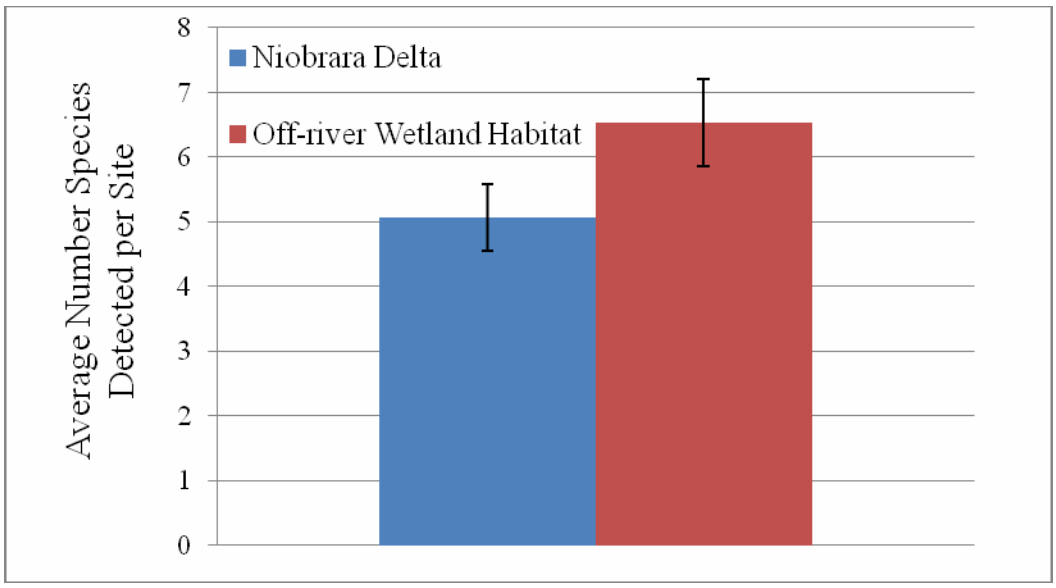

Figure 8 Slightly but significantly higher average numbers of bird species per site were detected off-river in 2011. However, there were 59 total species detected on the Niobrara Delta, while only 19 total species were detected at off-river sites.

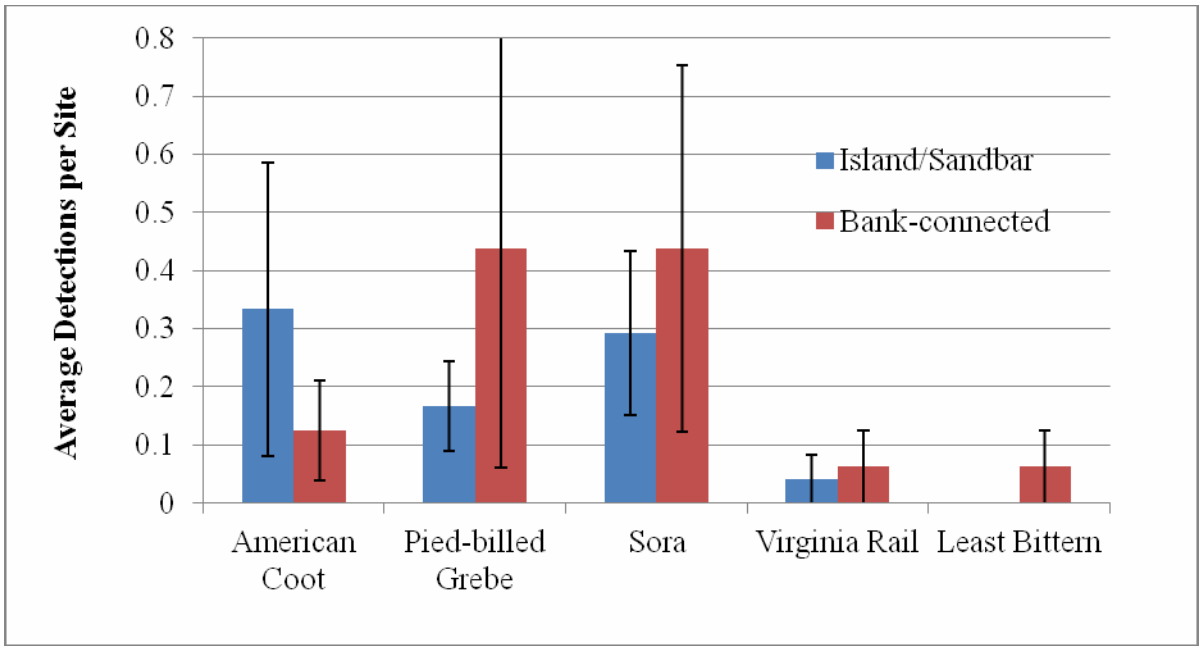

Figure 9 Average detections per site for different marsh bird species at island habitat vs. bank-connected habitat sites. Highest detection numbers for each sampling season were used to avoid recounting individuals. Detections per site were averaged for each habitat type across all three years.

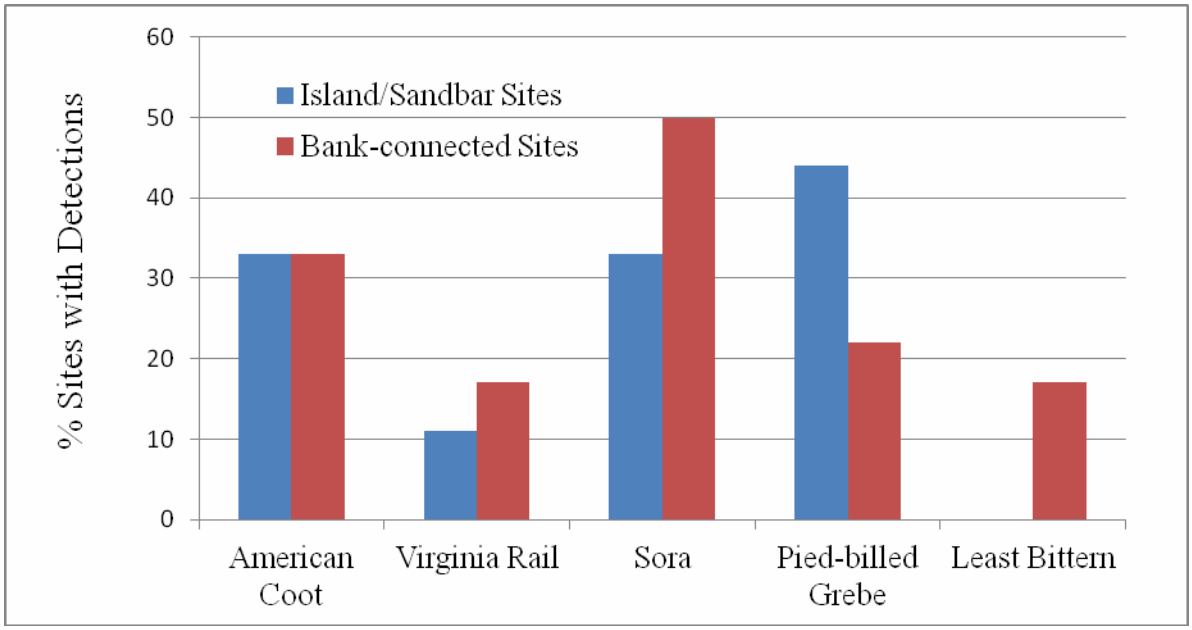

Figure 10 Comparing the percent of island sites with detections vs. the percent of bank-connected sites with detections of different marsh bird species throughout 2010-2012.

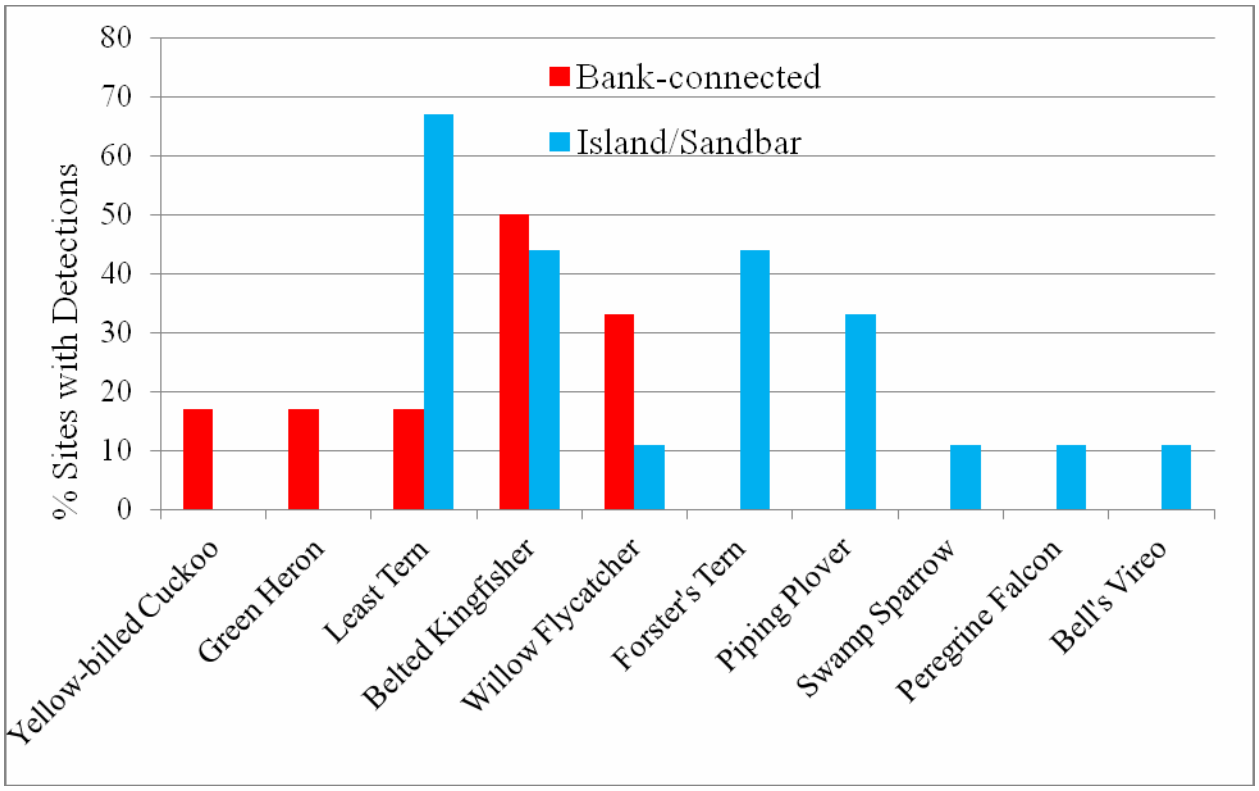

Figure 11 Comparing the percent of island sites vs. the percent of Bank-connected sites with detections of different uncommon bird species throughout 2010-2012.

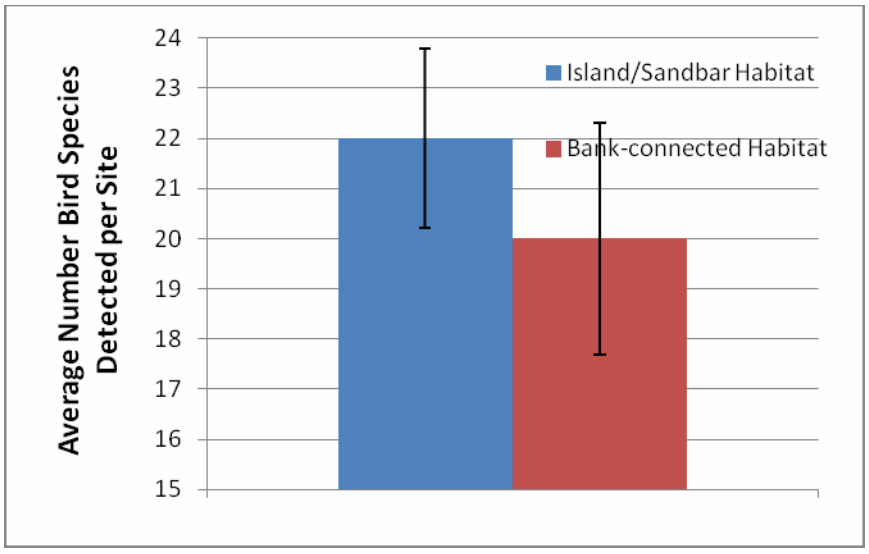

Figure 12 Average number of species detected at island survey sites and bank-connected survey sites throughout 2010-2012.

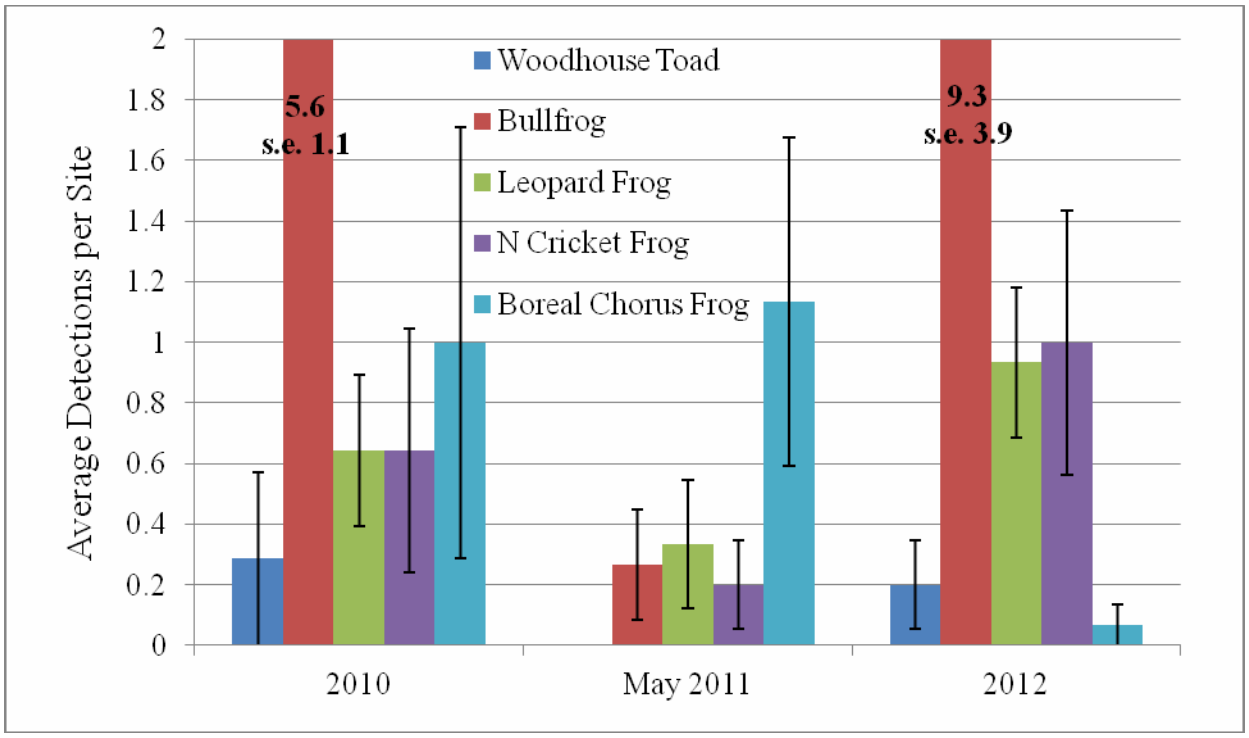

Figure 13 The highest detection numbers from each sampling season were averaged across all 15 survey sites to reduce the chance of potential recounts. This graph compares results between years. Bullfrogs were detected at much higher rates than all other species, so the graph has been altered to make any differences between other species more visible. Average detections per site and standard error values for bullfrogs in 2010 and 2012 are displayed on the bar graph.

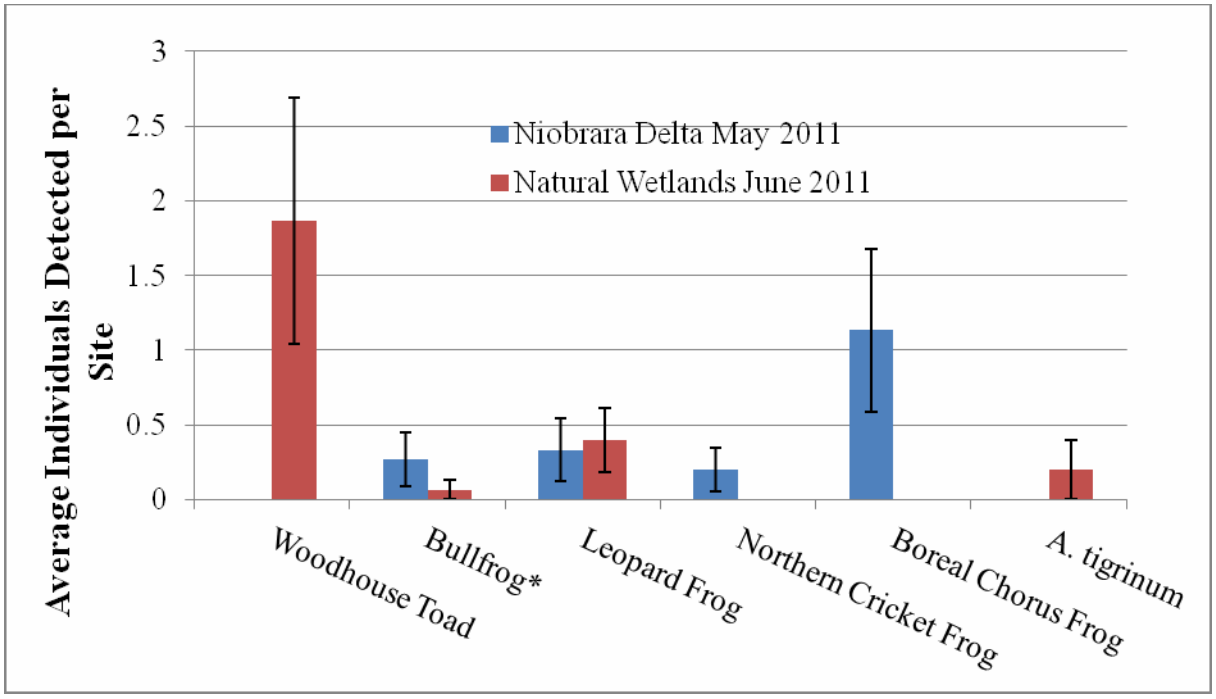

Figure 14 Comparing between amphibian detection data at Niobrara Delta Sites in late May 2011 vs. off-river wetland sites in early June of 2011.

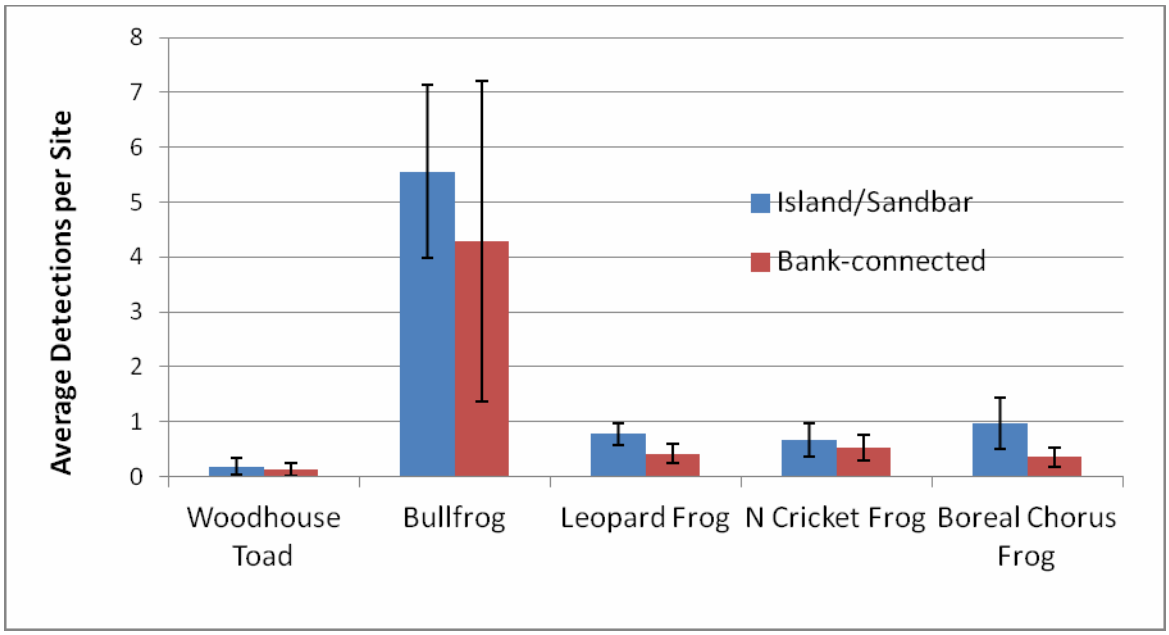

Figure 15 Average detections per site for different amphibian species in island habitat vs. bank-connected habitat. Highest detection numbers for each sampling season were used to avoid recounting individuals. Detections per site were averaged for each habitat type across all three years.

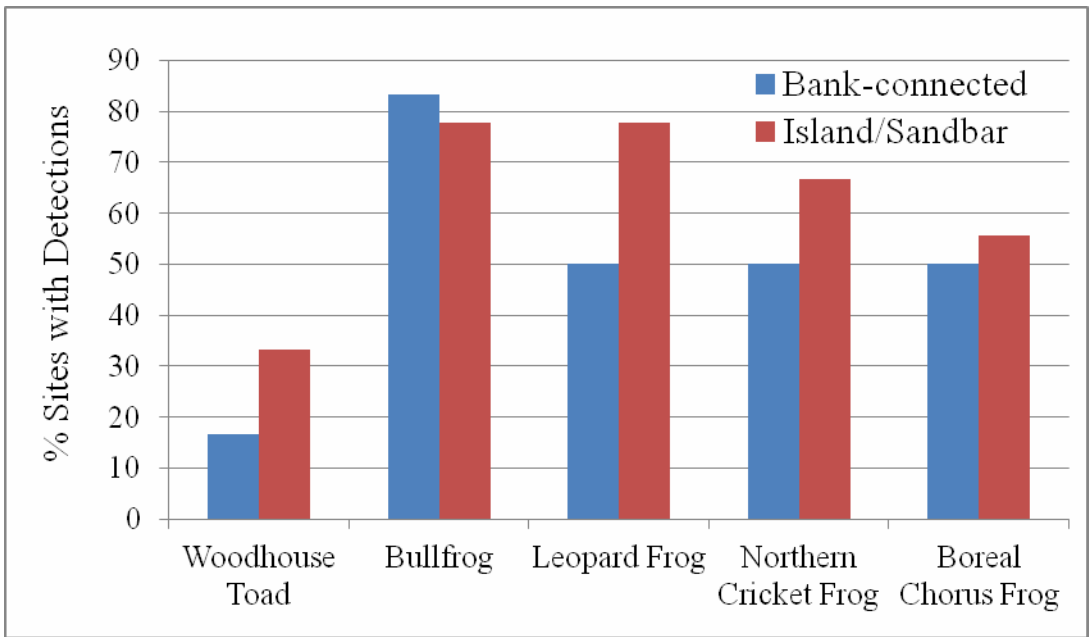

Figure 16 Comparing the percent of island sites with detections vs. the percent of bank-connected sites with detections of different amphibian species throughout 2010-2012.

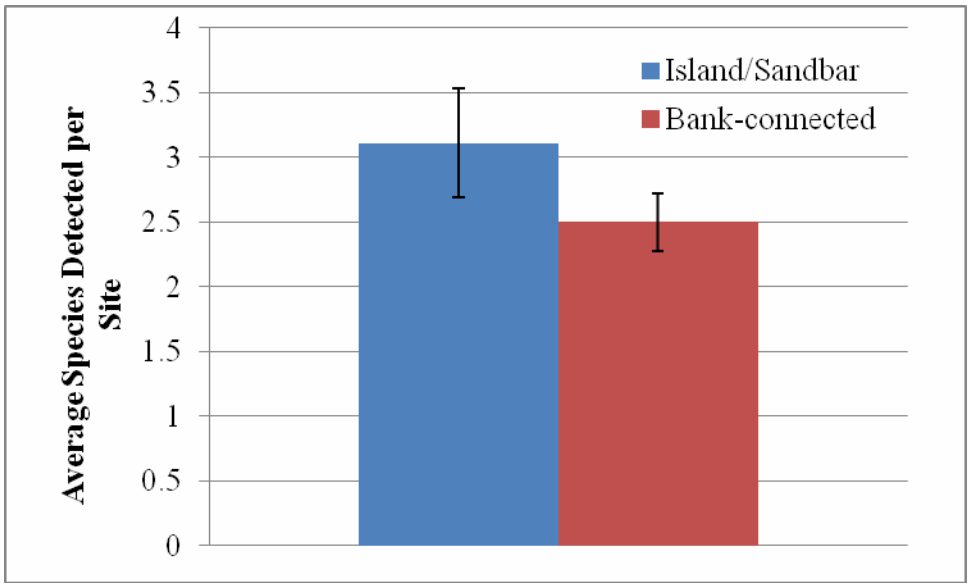

Figure 17 Average number of amphibian species detected at island survey sites and bank-connected survey sites throughout 2010-2012.

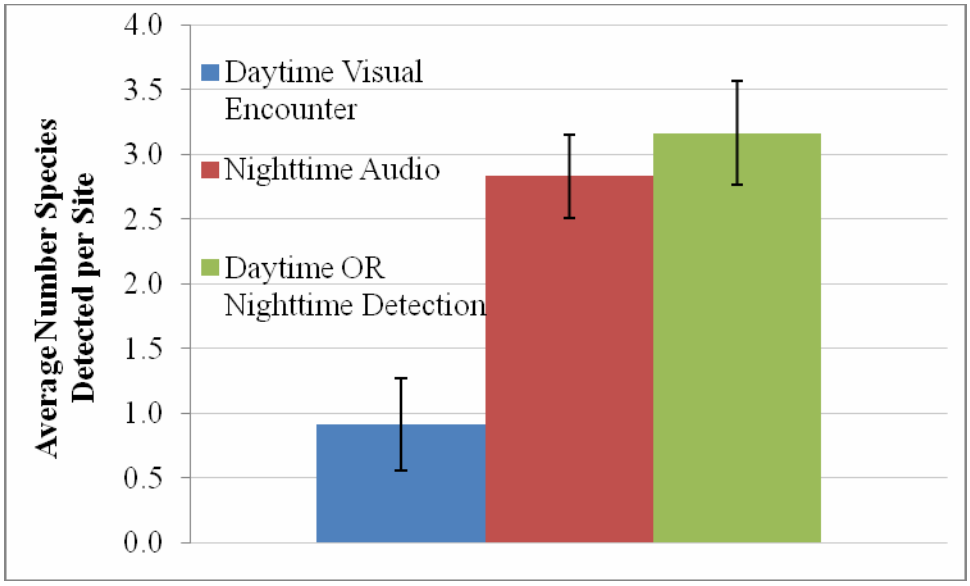

Figure 18 May 2011 presence/absence daytime vs. nighttime audio data. The number of amphibian species detected during the day and at night at each site was averaged across all 15 survey sites.

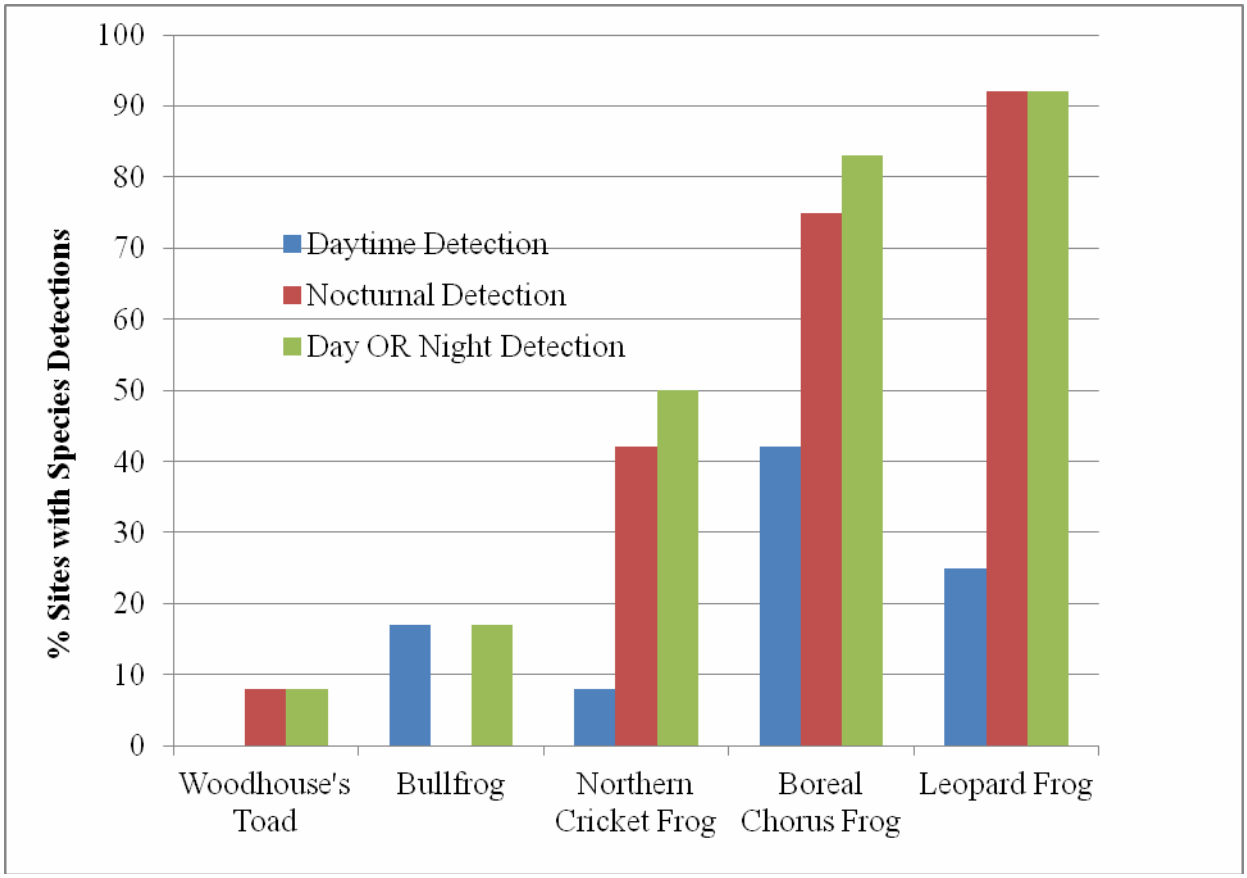

Figure 19 Combining daytime and nighttime audio data produce the best species presence detection results.

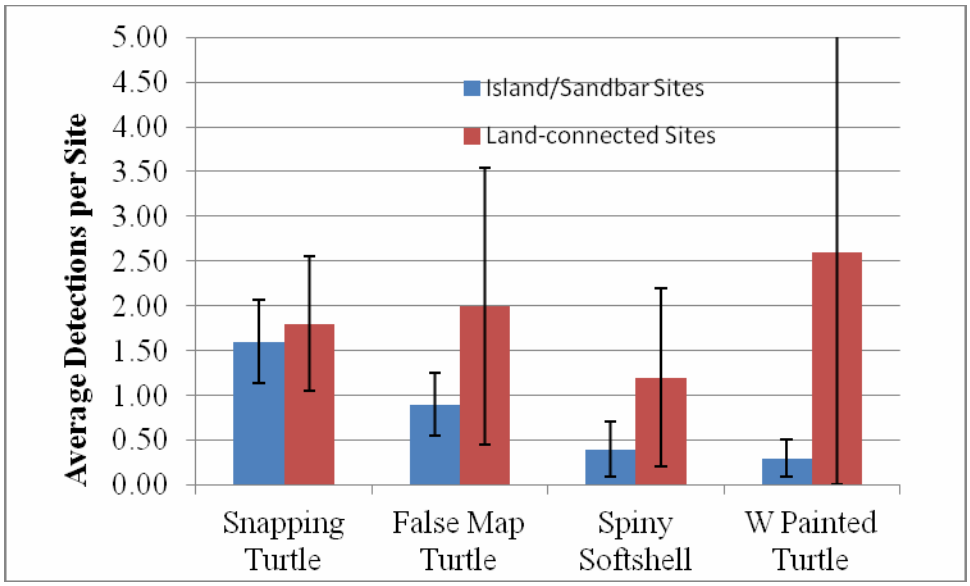

Figure 20 Average detections of turtle species per site in 2011 arranged by island vs. bank-connected habitats.

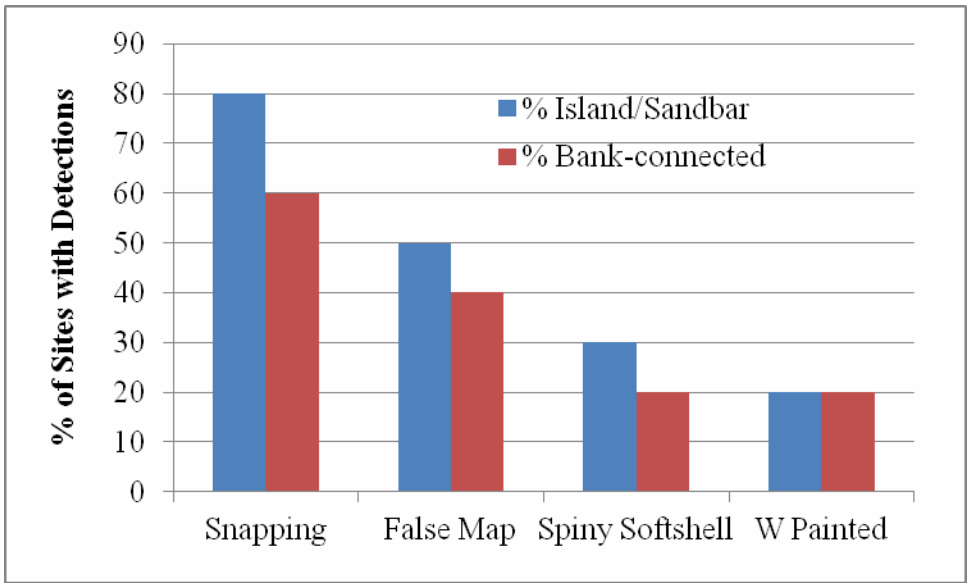

Figure 21 Comparing the percent of island sites with detections vs. the percent of bank-connected sites with detections of different turtle species throughout 2010-2012.

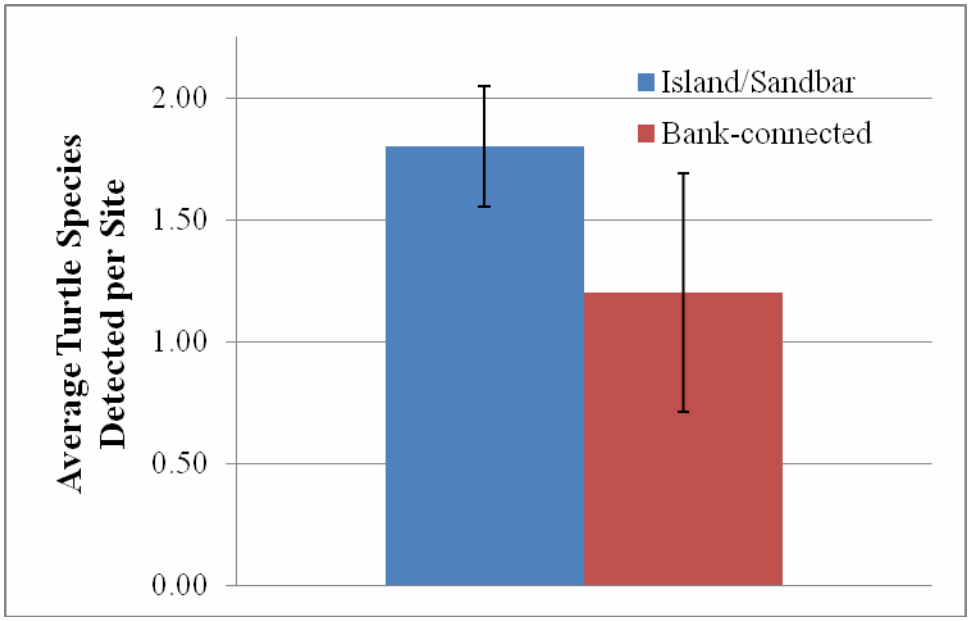

Figure 22 Average number of turtle species detected at island survey sites and bank-connected survey sites throughout 2010-2012.