CITY OF LINCOLN NEBRASKA

LINCOLN PARKS & RECREATION DEPARTMENT
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**MEMORANDUM**

DATE: April 4, 2014

TO: Lincoln City Council, Lower Platte South Natural Resources District Board of Directors, Nebraska Game and Parks Commission, and The Nature Conservancy

FROM: Tom Malmstrom
Natural Resources Coordinator
Parks and Recreation Department
Saline Wetlands Conservation Partnership

RE: Saline Wetlands Conservation Partnership – 2013 Progress Report

On behalf of the Saline Wetlands Conservation Partnership (SWCP) I want to make you aware of the activities, which occurred in 2013. The SWCP was initiated in 2003 and continues to progress. The City of Lincoln has been awarded four Nebraska Environmental Trust Fund (NET) grants for the eastern saline wetlands. The grants were received in 2002, 2005, 2008 and 2012. The City of Lincoln received a $1,400,000 grant over a three year period in 2012. The current grant period will terminate on June 30, 2015. These grants have been used for land acquisition and restoration purposes and provide matching funds for other grant opportunities.

Efforts of the SWCP are to protect, restore, and manage the rare and unique saline wetland habitat. The Partnership continues to utilize the "Implementation Plan for the Conservation of Nebraska's Eastern Saline Wetlands (2003)," for guidance in efforts to conserve the saline wetlands. Since its inception, partners have purchased nearly 1,250 acres of saline wetlands and other associated upland habitat, initiated educational activities, participated in saline wetland restoration projects, and provided for operation and maintenance of these areas.

In August of 2013, the Partnership sponsored a saline wetlands informational seminar. The seminar was attended by over 60 persons. Presentations were made on hydrology, amphibian and bird usage of saline wetlands, invertebrate inventories and Salt Creek tiger beetle re-introduction on saline wetland areas, vegetative mapping, saline soil assessment, and restoration techniques used in eastern saline wetlands. The seminar agenda is included in Appendix A.

Illustration 1 identifies saline wetland properties, which have been acquired through fee-title acquisitions or conservation easements since the 1980's. Illustration 2 identifies other saline wetland locations including Pioneers Park and saline wetland conservation easements.

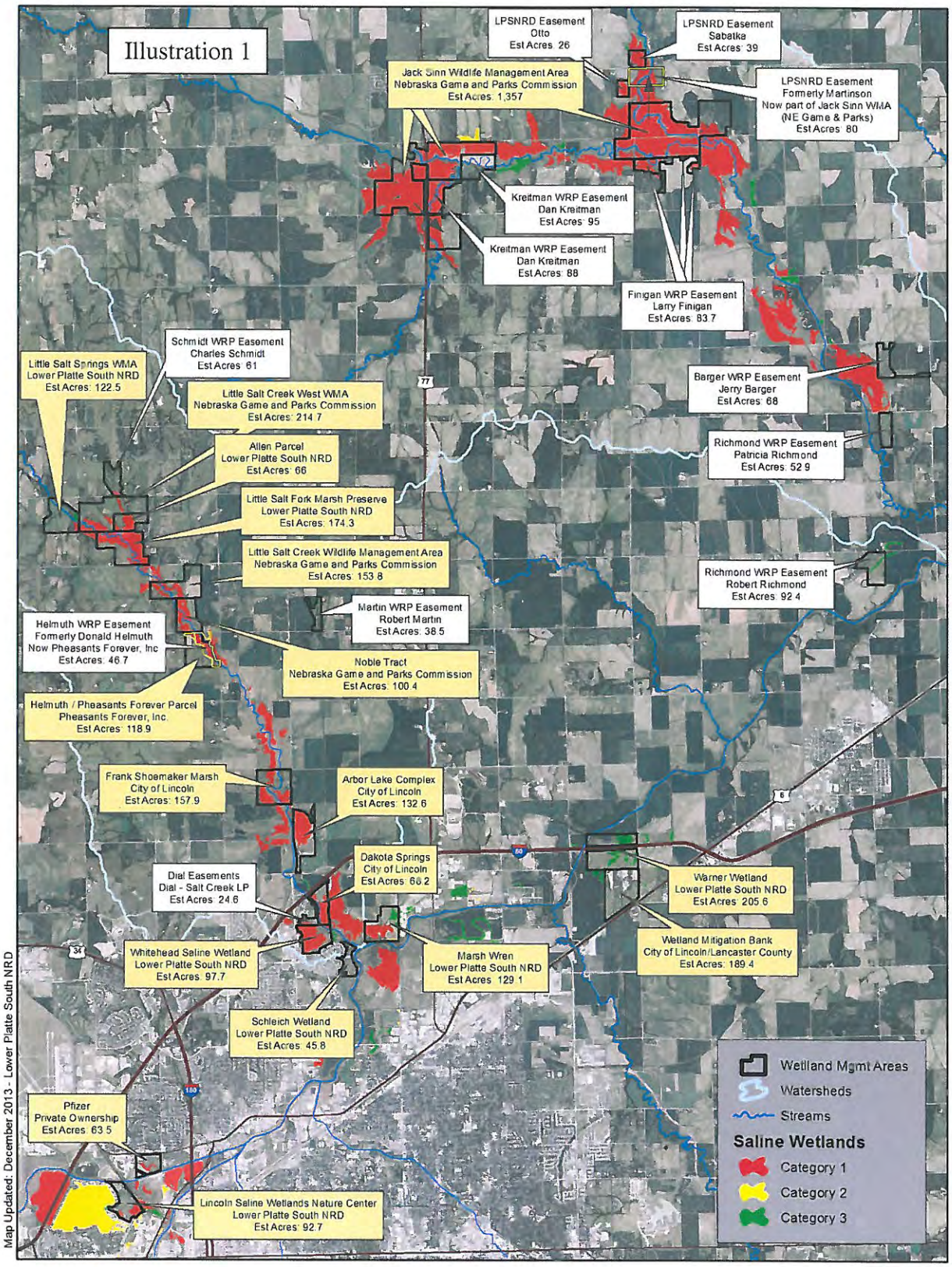
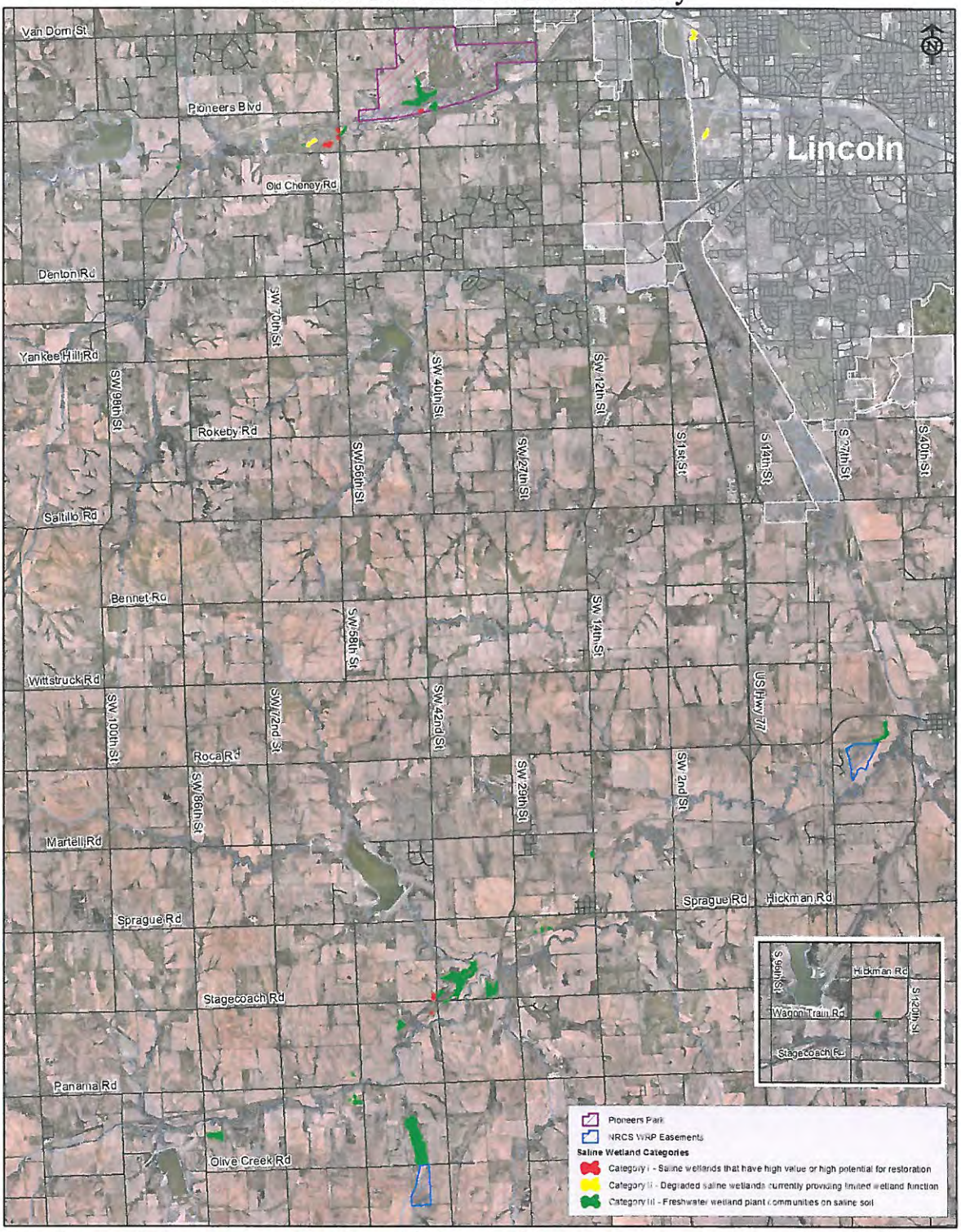


Illustration 1
LPSNRD Easement
Otto
Est Acres: 26
LPSNRD Easement
Sabatka
Est Acres: 39
Jack Sinn Wildlife Management Area
Nebraska Game and Parks Commission
Est Acres: 1,357
LPSNRD Easement
Formerly Martinson
Now part of Jack Sinn WMA
(NE Game & Parks)
Est Acres: 80
Kreitman WRP Easement
Dan Kreitman
Est Acres: 95
Kreitman WRP Easement
Dan Kreitman
Est Acres: 88
Finigan WRP Easement
Larry Finigan
Est Acres: 83.7
Schmidt WRP Easement
Charles Schmidt
Est Acres: 61
Little Salt Springs WMA
Lower Platte South NRD
Est Acres: 122.5
Little Salt Creek West WMA
Nebraska Game and Parks Commission
Est Acres: 214.7
Barger WRP Easement
Jerry Barger
Est Acres: 68
Allen Parcel
Lower Platte South NRD
Est Acres: 66
Richmond WRP Easement
Patricia Richmond
Est Acres: 52.9
Little Salt Fork Marsh Preserve
Lower Platte South NRD
Est Acres: 174.3
Little Salt Creek Wildlife Management Area
Nebraska Game and Parks Commission
Est Acres: 153.8
Richmond WRP Easement
Robert Richmond
Est Acres: 92.4
Martin WRP Easement
Robert Martin
Est Acres: 38.5
Helmuth WRP Easement
Formerly Donald Helmuth
Now Pheasants Forever, Inc
Est Acres: 46.7
Noble Tract
Nebraska Game and Parks Commission
Est Acres: 100.4
Helmuth / Pheasants Forever Parcel
Pheasants Forever, Inc.
Est Acres: 118.9
Frank Shoemaker Marsh
City of Lincoln
Est Acres: 157.9
Arbor Lake Complex
City of Lincoln
Est Acres: 132.6
Dakota Springs
City of Lincoln
Est Acres: 66.2
Dial Easements
Dial - Salt Creek LP
Est Acres: 24.6
Warner Wetland
Lower Platte South NRD
Est Acres: 205.6
Wetland Mitigation Bank
City of Lincoln/Lancaster County
Est Acres: 189.4
Whitehead Saline Wetland
Lower Platte South NRD
Est Acres: 97.7
Marsh Wren
Lower Platte South NRD
Est Acres: 129.1
Schleich Wetland
Lower Platte South NRD
Est Acres: 45.8
Pfizer
Private Ownership
Est Acres: 63.5
Lincoln Saline Wetlands Nature Center
Lower Platte South NRD
Est Acres: 92.7
Wetland Mgmt Areas
Watersheds
Streams
Saline Wetlands
Category 1
Category 2
Category 3
Map Updated: December 2013 - Lower Platte South NRD

Illustration 2

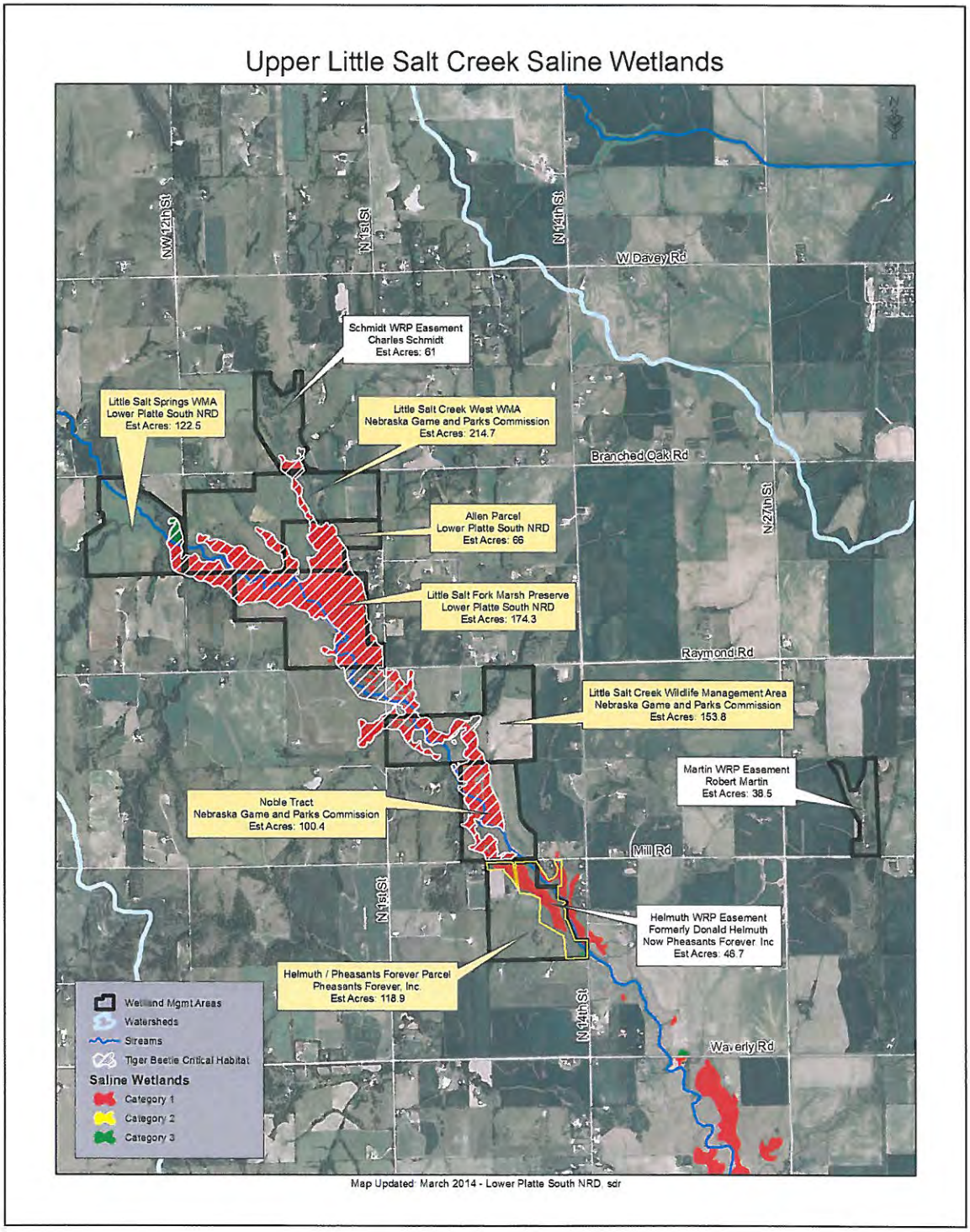
# Southwestern Lancaster County




Q:\ArcGIS_projects\Wetlands\ManagementAreas_Grouped\SW_Lancaster\SW_LancasterCo_8x11.mxd - Map Created: April 2014, LPSNRD

## WETLAND RESTORATION

In January 2013, the City of Lincoln requested proposals for Professional Services regarding developing a plan for the "Upper Little Salt Creek Saline Wetlands." The Plan objective is to evaluate the unique environmental resource and provide recommendations for future planning and project development.

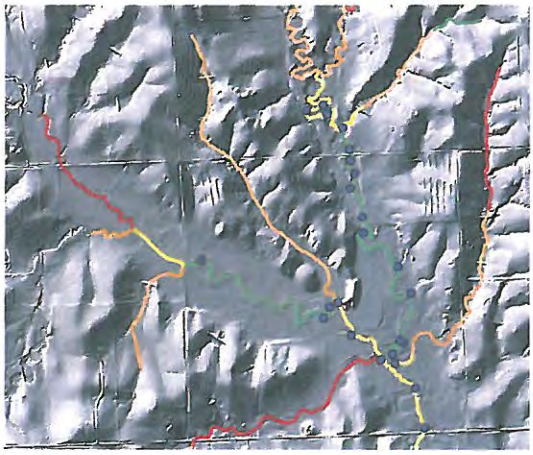


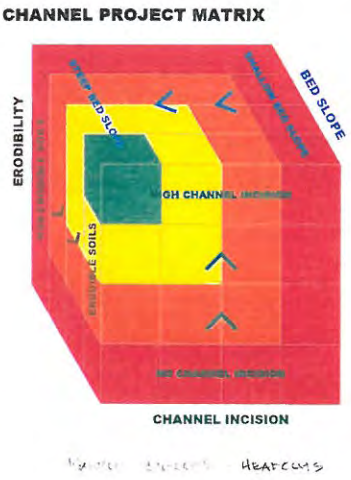
A contract was executed with The Flatwater Group, Inc. in June 2013, to perform the preliminary design study and survey properties managed by the Saline Wetlands Conservation Partnership. The identification, evaluation, and mapping of sensitive biological resources and constraints began in the summer/fall of 2013. The following illustrations indicate some of the initial work completed for the plan project.

**Spatial Analysis Objective 1:**
**Channel Rehabilitation Project Suitability**

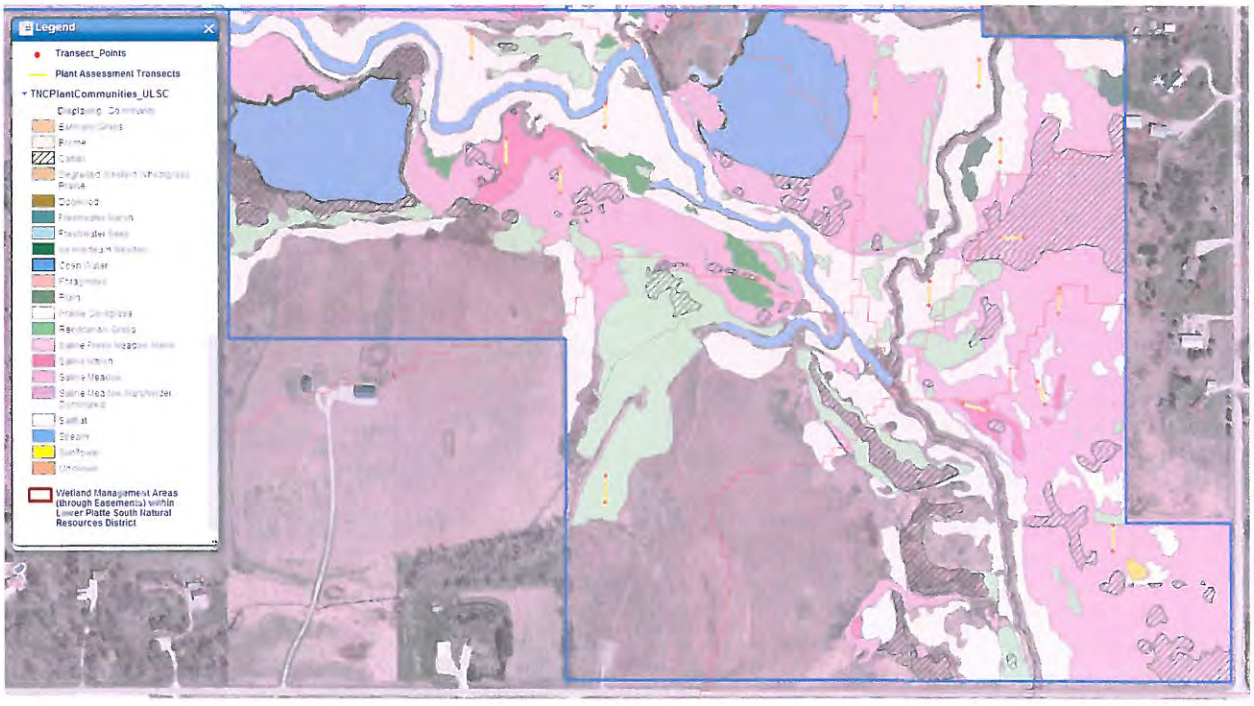
Identifies stream grade control and bank stabilization project locations based on stream geomorphology with soil erodibility, channel slope and streambed incision as inputs.

1.1 Erodibility – uses soil type characteristics to determine erodibility
1.2 Channel Slope – uses LiDAR data to determine slope of stream
1.3 Bed Incision – uses LiDAR data for stream overbank compared to streambed elevation from LiDAR data. The extent of incision ranges will be relative to areas within planning boundary only.






*ULSC Saline Wetlands Planning Project – Handout for Coordination Mtg 16 Dec 2013*
*Task 203: Define Planning Area Boundary*



## WETLAND MANAGEMENT

Three seasonal employees were hired by the City of Lincoln in 2013 to perform management on the saline wetland areas. Members of the Partnership established management activities to be addressed within the saline wetlands complex. These employees primarily worked on noxious weed and woody vegetation removal, structure maintenance, and access. Funding for these positions is provided with 2001 State Wildlife Grant funds the NGPC received from the U.S. Fish and Wildlife Service. A total of 582.0 hours were worked by the seasonal employees in 2013 on saline wetland management activities primarily from May through mid-August. The Coordinator provided supervision of the employees.

## SALINE WETLAND RESEARCH

The SWCP has worked with partners on a variety of projects within the saline wetlands. Funding for some of these projects has come from the U.S. Fish and Wildlife Service and the U.S. Environmental Protection Agency. Following is a summary of research conducted in 2013.

### Salt Creek Tiger Beetle Research

The following research information provided by:
Stephen M. Spomer
Entomology Department, University of Nebraska-Lincoln
Federal Permit #TE37351A-0
State Permit #9

**2013 Salt Creek tiger beetle Surveys & Research**

**Field Collection and Rearing – Summary for 2013**

Permits for obtaining eggs from *C. n. lincolniana* allowed field collection of females and males. A total of 12 SCTB were collected on June 13, 2013 and 19 collected on June 18, 2013 and transported to Omaha's Henry Doorly Zoo. The Adults were returned to the collection site.

Captive rearing is being conducted in cooperation with the Omaha Henry Doorly Zoo and Lincoln's Children Zoo. Surrogate beetles (*C.togata*) were collected on August 9, 2012 at Arbor Lake for ovipositional and soil studies being conducted at the Omaha Henry Doorly Zoo.

**Population Estimates for 2013**

The first visual of a Salt Creek tiger beetle adult was on June 13, 2013. Preliminary surveys began on May 18, 2013. The population estimates were conducted between June 28, 2013 and July 2, 2013. A total of 365 Salt Creek tiger beetles were counted. The adult beetles were mostly gone by August 9, 2013.

**Measurement of greenhouse gas fluxes originating from saline soils**

The following research information provided by:
Alicia Lenners
Environmental Studies Under-graduate Candidate
University of Nebraska-Lincoln

Dr. Amy Burgin, Assistant Professor
School of Natural Resources
University of Nebraska –Lincoln

During the summer of 2012 four gas collection chambers were placed at Frank Shoemaker Marsh to collect data. The chambers were located 40 meters apart near the center of a saline wetland area to measure the greenhouse gas fluxes originating from the soils. The cylinder chambers made of PVC pipe were situated 1-2" below the soil surface. The gas was collected by placing a lid over the chambers, when idle the chambers remained open to allow sunlight and rain to pass through. The measurements were taken every two weeks for a 12 week period concluding in November 2012. The results of the research were completed in the spring of 2013. A copy of this study is included in Appendix B.

**2013 Secretive Marshbird Survey of Nebraska's Eastern Saline Wetlands**

The following research information provided by:
Joel Jorgensen
Nongame Bird Program Manager
Nebraska Game and Parks Commission

Lauren Dinan
Nongame Bird Program Assistant
Nebraska Game and Parks Commission

The purpose of this project is to summarize a pilot marsh bird survey in Nebraska's Eastern Saline Wetlands. The intent is to establish a long-term marsh bird monitoring in the saline wetlands to understand abundance, site use, and breeding status of marsh birds in the eastern saline wetland complex. Information from the monitoring program will be useful in evaluating management actions and developing future conservation strategies for Nebraska's eastern saline wetlands. The primary objectives in 2013 were to develop survey methods, select and become familiar with survey locations, and to collect baseline data.

In 2013, surveys were conducted at 24 points at 17 wetlands within the nine survey sites during two survey periods. A total of five focal species and 46 individual birds were detected. Four species and 38 birds were detected during the first survey period, and three species and eight birds were detected during the second survey period. Surveyors detected Virginia Rail, Sora, American Bittern, Pied-billed Grebe, and American Coot. American Coot was the most frequently detected species comprising 70 percent of all detections. Virginia Rail was the second most frequently detected species comprising 13 percent of all detections. The complete report of the "2013 Secretive Marsh Bird Survey of Nebraska's Eastern Saline Wetlands" is included in Appendix C.

**Biogeochemical controls on saline wetland plant establishment in Nebraska's Eastern Saline Wetlands**

Dr. Amy Burgin, Assistant Professor
School of Natural Resources
University of Nebraska –Lincoln

In December 2013, the City of Lincoln executed and approved a Memorandum of Understanding with the Nebraska Game and Parks Commission to cooperate on the research project "Biogeochemical controls on saline wetland plant establishment in Nebraska's Eastern Saline Wetlands." The University of Nebraska – Lincoln will complete the project over a two year period. Funding for this research is provided by a Nebraska Natural Legacy Project grant received from the Nebraska Environmental Trust and funds contributed by the Saline Wetlands Conservation Partnership. The approved research project is included in Appendix D.

**UNL Project Team**

The project will create nine experimental plots to test the effect of groundwater of varying salinity has on the establishment of native plant communities, soil chemical properties and biogeochemical functions. Plots (2 x 2 $m^2$) will be established at the same time by chemical removal of the weeds and mechanical removal of topsoil (with assistance from Saline Wetlands Conservation Partnership/NGPC/City of Lincoln). Plots will be established in the spring of 2014. Prior to any treatments, plots will be sampled for: soil texture, soil iron, sulfur, nitrogen and carbon pools, soil salinity and moisture.

The nine plots will be assigned to one of three experimental treatments with three replicate plots per treatment: 1) high salinity groundwater, 2) medium salinity groundwater or 3) low salinity groundwater. The ground water treatments will originate from nearby wells (drilled to 180 feet, 80 feet and 40 feet, respectively). Water will be added to the plots in as similar of a manner as would be possible for mimicking potential restoration techniques. The details of the design will be addressed by the post-doctoral associate in close consultation with the Saline Wetlands Conservation Partnership, which will ensure we use a technique to add water to the sites that is potentially transferable to future restoration efforts.

## ENDANGERED SPECIES

Efforts of the SWCP are to protect, restore, and manage the rare and unique saline wetland habitat and not just endangered species. The Salt Creek tiger beetle and Saltwort plant are indicator or bio species where their presence or absence in Nebraska's eastern saline wetlands indicate certain environmental conditions, such as soil type, pollution levels etc. Therefore it is imperative the SWCP helps to monitor the endangered species of these wetlands for conservation efforts, as well as monitoring other indicator species.

The Salt Creek tiger beetle (*Cicindela nevadica lincolniana* Casey) was listed a state endangered species in 2000 and Federal endangered species on October 2005. It is endemic to the saline wetlands in Lancaster and southern Saunders counties. Saltwort (*Salicornia rubra*) is a state listed endangered species. In Nebraska, the Saltwort is only found in these saline wetlands.

In 2007, the U.S. Fish and Wildlife Service (USFWS) listed the Proposed Rule in the Federal Register for the Designation of Critical Habitat for the Salt Creek tiger beetle. In April 2009, the USFWS reopened Critical Habitat Designation to add a total of 138 acres to three of the four previously proposed units. The proposed revised critical habitat designation for the species included four critical habitat units totaling approximately 1,933 acres. The rule was made final on April 6, 2010.

In February 2011, three conservation groups; The Center for Native Ecosystems; Center for Biological Diversity; and the Xerces Society sued the USFWS saying it was not protecting enough habitat to save the insect. An agreement was reached in June 2011, to require the Service to re-examine the areas already designated as critical habitat but also new areas in Lancaster County. The re-evaluation must be completed by April 1, 2013.

In June 2013, the USFWS proposed to revise critical habitat for the endangered Salt Creek tiger beetle. Public comments were accepted until August 3, 2013. The revision was required by the terms of a June 7, 2011 settlement agreement between the USFWS and the Center for Native Ecosystems, the Center for Biological Diversity, and the Xerces Society. Based on the best available information, the USFWS recommended a proposal to designate 1,110 acres along four stream corridors as critical habitat; less than the current designation of 1,933 acres. However, it increases the number of unoccupied units from one to three.

The proposal is to designate 1,110 acres of critical habitat along four streams that still contain sufficient potential habitat to support viable populations of Salt Creek tiger beetle; Little Salt Creek, Rock Creek, Oak Creek, and Haines Branch Creek. The Little Salt Creek unit includes the three remaining populations, while the Rock, Oak, and Haines Branch Creek units are currently unoccupied. The designation consists of stream corridors with exposed salt seeps and salt flats that provide habitat for the species, and surrounding vegetative areas that provide food resources and shade. It is estimated the critical habitat being proposed can support at least six viable populations of Salt Creek tiger beetles and will ensure recovery of the species.

The proposed critical habitat includes land under private ownership, lands owned by the Nebraska Game and Parks Commission, the City of Lincoln, the Lower Platte South Natural Resources District, and Pheasants Forever. Approximately 29 percent of proposed critical habitat is protected from future disturbance by conservation easements or fee title land acquisitions as a result of a conservation plan developed in 2003 by the Nebraska Game and Parks Commission, the City of Lincoln, Lancaster County, the Lower Platte South Natural Resources District, and The Nature Conservancy.

A final rule to re-designate critical habitat for the Salt Creek tiger beetle under the Endangered Species Act in accordance with the June 7, 2011 settlement agreement is expected in 2014.

In 2013, the City of Lincoln, Nebraska Game and Parks Commission, and the Lower Platte South Natural Resources District worked with the USFWS, Omaha Henry Doorly Zoo, and Lincoln Children Zoo to identify areas for re-introduction of the endangered species. Two field visits were held to various saline wetland areas to examine the potential for the reintroduction of the Salt Creek tiger beetle in 2014.

In 2014, it is expected approximately 100 larvae of the Salt Creek tiger beetle reared in 2013 will be available for reintroduction. This was accomplished through a cooperative captive rearing program between the USFWS, NGPC, UNL, Omaha Henry Doorly Zoo, and the Lincoln Children Zoo. Researchers will intensively monitor the released larvae.

Weekly visual inspections include recording burrow size changes and monitoring equipment (HOBO Stations) record the soil temperature at 6, 12, to 18 inches below the surface (depth of most larval burrows) and surface moisture.

## SUMMARY OF SALINE WETLANDS AND SOILS PROTECTED (2001-2013)

In order to preserve and restore these wetlands, an Implementation Plan for the Conservation of Nebraska's Eastern Saline Wetlands was completed in 2003. This plan identifies four Landscape Objectives, which establish projection and restoration targets for the conservation of the Eastern Saline Wetlands. A summary of acres acquired through fee-title acquisition since 2001 by the SWCP is provided below. Conservation easement information is not provided in the summary.

| LANDSCAPE OBJECTIVE | ACRES OF WETLAND PROTECTED OR RESTORED |
|---|---|
| 1 – Permanently protect 100% (148 acres) of intact Category 1 saline wetlands and their associated conservation zones to ensure that the wetlands and their functions are sustained | 28.7 |
| 2 – Restore and Protect 80% (1,412 acres) of unprotected degraded Category 1 saline wetlands and their associated conservation zones to ensure that the wetlands and their functions are sustained | 230.1 |
| 3 – Restore (to intact Category 1 wetlands) and protect 50% (167 acres) of unprotected Category 3 saline wetlands and their associated conservation zones to ensure that the wetlands and their functions are sustained as intact Category 1 wetlands | 62.0 |
| 4 – Restore (to intact Category 1 wetlands) and protect 50% (2,360 acres) of unprotected current non-wetland areas on saline hydric soils so that they become intact and sustained Category 1 saline wetlands | 287.4 |
| **TOTAL** | **608.2** |

Source: Ted LaGrange and Rachel Simpson of the NGPC, August 2011 - 2013

## EDUCATION

- The Saline Wetlands Conservation Partnership sponsored a seminar in Lincoln, Nebraska on August 30, 2013 at the Lower Platte South NRD office. The seminar provided information related to research and wetland conservation projects conducted within Nebraska's eastern saline wetlands. The seminar was attended by over 60 persons. The Seminar Agenda is included in Appendix A.

- North Star High School – Coordinator established annual program with environmental studies class on saline wetlands in 2005. The coordinator in cooperation with the environmental studies instructor at North Star sponsors field trips for a selected group of students to the saline wetlands. The field trips include presentations to the students by personnel of the LPSNRD, UNL, NGPC, and the NRCS. Topics covered regarding the saline wetlands included vegetation, hydrology, entomology, restoration and mitigation, management, soils, well monitoring and sampling, wildlife, and the relationship of urbanized development with natural areas. In the fall of 2013, a total of six (6) field trips and two (2) class presentations were held.

- Coordinator educational presentations - The Coordinator continues to present "saline wetland jeopardy" to fifth grade students attending the Earth Wellness Festival. Other presentations were given to local groups and conservation agencies.

- Coordinator participates in Elementary School Nature Nights and field trips to saline wetlands sponsored by the LPSNRD

## FUNDING RESOURCES

- Federal Section 319 Grant (2007 and 2009) – The coordinator on behalf of the City of Lincoln submitted a grant in 2005 for Federal Section 319 funds in the amount of $500,000 for the saline wetland complex. The 2005 grant application was approved and the City was awarded $250,000 in 2007 and an additional $250,000 in 2009. A total of $279,125.44 was expended for engineering services related to the Arbor Lake Wetland Restoration Project. A total of $51,804.34 was expended for Arbor Lake Wetland Restoration construction. The Grant Period ended on September 30, 2012. A total of $169,070.22 was not expended. A Final Report was completed and submitted to the Nebraska Department of Environmental Quality on September 30, 2012.

- 2008 Nebraska Environmental Trust Grant – The grant amount is $1,200,000 over a three year period. A total of $649,250.40 was expended for land acquisition and a total of $525,571.80 was expended on wetland restoration projects. A remaining total of $25,177.80 was transferred to the 2012 grant for continued use of saline wetland projects. A Final Report was completed and submitted to the Nebraska Environmental Trust in September 2012.

- Federal Section 6 – In 2011, the NGPC through the U.S. Fish and Wildlife Service was awarded $135,000 for the acquisition of a property containing saline wetlands. This funding was used for the acquisition of the Marsh Wren addition in 2012.

  In 2012, the NGPC through the U.S. Fish and Wildlife Service was awarded $270,000 for the acquisition of a property containing saline wetlands. Discussions were held with the landowner in the fall of 2012. The property has been appraised and negotiations are on-going with the landowner.

  In 2013, the NGPC through the U.S. Fish and Wildlife Service was awarded $190,300 for the acquisition of a property containing saline wetlands. Discussions were held with the landowner in 2013. The property has been appraised and negotiations are on-going with the landowner.

- A grant was submitted to the Nebraska Environmental Trust in 2011 for the "Eastern Saline Wetlands Project – 2012." The grant was approved in the amount $1.4 million for land acquisition, restoration, and planning activities for a three year grant period. To date, $121,345 has been expended.

- In 2012, The Nature Conservancy and the Lower Platte South Natural Resources District amended a previous grant agreement to specifically build, enhance and/or maintain effective ecological stewardship of the saline wetlands. Beginning June 30, 2012 and through July 1, 2019 The Nature Conservancy will disburse $7,500 annually contingent upon corresponding disbursement of matching funds from the Lower Platte South Natural Resources District for the Project.

## SUMMARY OF OTHER COORDINATOR ACTIVITIES

- Participate in Nebraska inter-agency wetland meetings sponsored by the U.S. Corps of Engineers
- Attended meetings regarding City and County projects regarding construction activities scheduled near or on saline wetland areas
- Presented information regarding the saline wetlands to LPSNRD Recreation, Forestry, and Wildlife sub-committee, LPSNRD Board of Directors, Saline Wetland Planning Seminar attendees, and several UNL classes
- Toured saline wetland areas with several agencies and local zoos regarding endangered species recovery habitat for re-introduction and participated in monitoring discussions with the Master Naturalist and USFWS
- Youth education – presented and participated in the Earth Wellness Festival and UNL Career Day
- Land management – Supervision of seasonal employees, annual saline wetland discussions with agency land managers, and noxious weed and woody vegetation control and GPS location identification at saline wetland sites. Participated in one prescribed burn on saline wetland area
- Coordinated and sponsored Saline Wetlands Seminar and presented "Outstanding Wildlife Conservationist of the Year" for 2012 from NGPC and Pheasants Forever at the Seminar
- Identified wells located in the within saline wetland areas, plotted locations on map, and assisted with the change of ownership status for many wells
- Toured saline wetland areas with participants of the Museum Interpreters Conference, UNL Freshman Engineering Class, and LPSNRD Board of Directors
- Assisted Nebraska Environmental Trust with informational video on-site at saline wetlands
- Wrote and assisted with news articles for the Lincoln Journal Star and LPSNRD Newsletter
- Participated in several meetings and discussions regarding 27$^{th}$ Street Right-of-Way acquisition on Frank Shoemaker Marsh with County Roads and the NGPC
- Attended Wetland Delineation and Identification training
- Assisted with information regarding the Air Quality Index for conservation burning
- Participate with Natural Resources and Conservation Service (NRCS) B Team regarding the scoring and design of Wetland Reserve Program applications in Lancaster County
- Participant and core team representative of Nebraska Wetland Assessment grant project
- Miscellaneous grant administration and participation in grant applications through conservation agencies regarding wetland projects
- Worked on proposal for Plan for the Upper Little Salt Creek Saline Wetlands

## SALINE WETLAND PROPERTIES

- **Frank Shoemaker Marsh** – 27th Street and Bluff Road

| | |
|---|---|
| Size: | 160 acres |
| Purchase price and date: | $472,000 on June 12, 2003 |
| Funding sources: | 2001 State Wildlife Grant through the USFWS ($222,000)<br>2002 NET grant ($250,000) |
| Owner: | City of Lincoln |

**Activity summary** – Noxious weed removal continued and included the documentation of several new plots of Phragmites. Firebreaks were completed in southwest cell for potential 2013 burn. Burn was not completed due to high Air Quality Index on desirable dates for prescribed burn. Undesirable vegetation in northwest wetland cell was treated to reduce competition with desirable wetland plant communities. Bridge entry-points built up due to settling of soil.

Several monitoring wells installed by UNL are continually monitored. The total number of wells includes three shallow wells (15-30 feet), three intermediate wells (60-90 feet), and one deep well (~180 feet).

Lancaster County Roads Department identified location of right-of-way, which is to be acquired along the east side of property along 27th Street in 2014. This would include tree removal and replacement, fence removal and re-installation, and parking lot modification.

- **Dakota Springs** – South of Arbor Road and East of 27th Street

| | |
|---|---|
| Size: | 68.7 acres |
| Purchase price and date: | $204,700 in January 2004 |
| Funding sources: | Federal Section 6 ($153,525)<br>2002 NET grant ($51,175) |
| Owner: | City of Lincoln |

**Dakota Springs Extension Purchase (Dial Realty, 7.45 acres)**

| | |
|---|---|
| Purchase price and date: | $48,500 on December 31, 2008 |
| Funding source: | Federal Section 6 |

**Activity summary** – Noxious weed and woody vegetation removal continued. Portion of property hayed. Trees cleared along access road. Significant invasion of musk thistles treated in 2013.

Monitoring wells installed by UNL and are continually monitored. The total number of wells in place includes two shallow wells (15-30 feet) and two intermediate wells (60-90 feet).

- **Warner Saline Wetlands** - 98th Street and Interstate 80

| | |
|---|---|
| Size: | 140 acres |
| Purchase price and date: | $298,580 on December 7, 2004 |
| Funding sources: | Federal Section 319 ($179,148) |
| | LPSNRD ($43,043.20) |
| | SWCP ($76,388.80) |
| Owner: | LPSNRD |

**Activity summary** – Noxious weed control and woody vegetation removal continues with honey locust and cedars. Fence installed on east side of property after Interstate 80 construction was completed. South property was grazed. North parcel is a youth mentor hunt site.

- **Little Salt Creek Wildlife Management Area** – 1st Street and Raymond Road

| | |
|---|---|
| Total Size: | 256.5 acres |
| Purchase price and date: | $476,000 in June 2004 (original 156 acres) |
| Funding sources: | Federal Section 6 ($276,000) |
| | 2004 NET grant through NGPC ($200,000) |
| Owner: | NGPC |

**Noble Tract Extension** - Along Little Salt Creek, between Mill Road and the southern boundary of the original Little Salt Creek Wildlife Management Area. (100.5 acres)

**Activity summary** – Prescribed grazing and haying of upland was conducted. Cedar removal and noxious weed control continues.

Monitoring wells were installed by UNL and are continually monitored. The total number of wells includes three shallow wells (15-30 feet) and three intermediate wells (60-90 feet).

- **Little Salt Creek West Wildlife Management Area –** South of Branched Oak Road between NW 12th and 1st Streets

| | |
|---|---|
| Total Size: | 220.0 acres |
| Purchase price and date: | $979,000 on October 9, 2009 |
| Funding sources: | Federal Section 6 ($560,000) |
| | 2005 NET Grant ($42,838.58) |
| | 2008 NET Grant ($366,250.42) |
| | Ducks Unlimited ($10,000) |
| Owner: | Nebraska Game and Parks Commission |

**Activity summary** – Prescribed grazing was conducted. Cedar removal and noxious weed control continues. Food plots were established and ground previously farmed was planted with natives.

- **Arbor Lake Complex** – North of Arbor Road and east of 27th Street.
  Total Size: 132.5 acres
  Owner: City of Lincoln

  **Arbor Lake Extension Purchase (Anderson Property, 69.2 acres)**
  Purchase price and date: $361,710.67 on September 1, 2004
  Funding source: 2002 NET grant through City of Lincoln

  **Activity summary** –Wetland restoration construction was completed in May 2012. In 2013, gates were installed at access points and bridge entry-points were built up due to settling of soil. Post-restoration monitoring is continual.

  Monitoring wells installed by UNL are continually monitored. The total number of wells includes three shallow wells (15-40 feet) and two intermediate wells (60-90 feet).

- **Little Salt Springs** – NW 12th Street and Branched Oak Road
  Size: 123 acres
  Purchase price and date: $472,188 on July 31, 2007
  Funding sources: Lower Platte South NRD ($187,960.35)
  2005 NET grant ($227,227.95)
  Partnership Funds ($57,000)
  Owner: Lower Platte South NRD

  **Activity summary** – Continue to control noxious weeds and woody vegetation with emphasis on phragmites along west side of Little Salt Creek. South access to NW 12th Street through trees developed and old farm dump cleaned up. Prescribed fire completed during spring of 2013 on approximately 65-acres.

**Marsh Wren** – Between 40th and 56th Streets and north of Salt Creek

| | |
|---|---|
| Total Size: | 80.0 acres |
| Purchase price and date: | $320,000 on May 27, 2009 |
| Funding sources: | Lower Platte South NRD ($25,000)<br>SWCP ($25,000)<br>City of Lincoln floodplain acquisition funds ($178,000 ($89,250 each from the City of Lincoln and the LPSNRD)<br>2005 NET Grant ($91,500) |
| Owner: | Lower Platte South Natural Resources District |

**Marsh Wren addition** – East of 40th Street and immediately north of Salt Creek

| | |
|---|---|
| Size: | 49.4 acres |
| Purchase price and date: | $270,000 on June 19, 2012 |
| Funding sources: | Federal Section 6 ($135,000)<br>2008 NET Grant ($130,000)<br>SWCP ($5,000) |
| Owner: | Lower Platte South Natural Resources District |

**Activity summary** – Noxious weed and woody vegetation removal continued. Lease terminated with local Hunt Club on December 31, 2013. Fence was completed along northerly boundary of addition property. A draft proposal for a potential restoration project was completed in 2013 for a project to begin in 2014.

- **Allen Parcel** – Between Branched Oak Road and Raymond Road and west of 1st Street

| | |
|---|---|
| Size: | 66.6 acres |
| Purchase price and date: | $304,000 on February 17, 2010 |
| Funding sources: | Lower Platte South NRD ($76,000)<br>SWCP ($75,000)<br>2008 NET Grant ($153,000) |
| Owner: | Lower Platte South Natural Resources District |

**Activity summary** – Noxious weed and woody vegetation removal continued. Property was grazed in 2013. Fence along east boundary was removed and area cleared for new fence to be installed in 2014.

- **Helmuth Parcel** – South of Mill Road and west of 14th Street

| | |
|---|---|
| Size: | 119.0 acres |
| Purchase price and date: | $630,000 on November 23, 2010 |
| Funding sources: | Federal Section 6 ($275,000)<br>2001 State Wildlife Grant through the U.S. Fish and Wildlife Service ($131,666.50)<br>NGPC ($23,333.50)<br>Donation from Helmuth family ($200,000) |
| Owner: | Pheasants Forever, Inc. |

**Activity summary** – Prescribed grazing and haying of upland was conducted. Cedar removal and noxious weed control continues. Driveway removed, signage installed, and parking lot developed off of Mill Road in northwest corner of property.

- **Seacrest Range** (43 acres) – Located west of Folsom Street along both the north and south sides of Rosa Parks Way. The area is owned by the City of Lincoln. Efforts continued to remove woody vegetation and to control noxious weeds (Leafy spurge).

- **Lincoln Saline Wetlands Nature Center** (92.7 acres) – It is located near Capitol Beach in Lincoln. The area is owned by the LPSNRD. Management activities in 2013 were noxious weed control and removal of Russian olive, Honey locust, and cedar trees. Considerable efforts to control Phragmites. Access easement granted by Homeowners Association to access phragmites infestations. Well installed by UNL is monitored for groundwater levels and water quality.

- **Schleich Wetlands** (50.2 acres) – It is located southwest of Little Salt Creek near where it empties into Salt Creek and east of the Northbridge subdivision in Lincoln. The area is owned by the LPSNRD. Management activities in 2013 were noxious weed and significant efforts to remove invasive trees.

- **Whitehead Wetlands** (98.8 acres) – It is located east of 27$^{th}$ street and a short distance south of Interstate 80. The area is owned by the LPSNRD. Management activities in 2013 were noxious weed control and removal of woody vegetation.

  The LPSNRD contracted with a consultant to complete an engineering design to assist with site hydrology. Construction is expected to be initiated and completed in 2014.

  Monitoring wells installed by UNL are continually monitored. The total number of wells includes five shallow wells (15-30 feet), four intermediate wells (60-90 feet), and one deep well (~180 feet).

- **Little Salt Fork Marsh Preserve** (174.2 acres) – It is located northwest of 1$^{st}$ and Raymond Road and owned by the Lower Platte South NRD. Ownership of the property was transferred from The Nature Conservancy to the Lower Platte South NRD in 2013. The Nature Conservancy placed a conservation easement on the property prior to the change in ownership. Management activities in 2013 included a prescribed grazing rotation throughout the property for the majority of the growing season and control of noxious weeds.

- **Jack Sinn Wildlife Management Area** (1,352.3 acres) – Located south of Ceresco in Saunders and Lancaster counties. This area is owned by the NGPC. Perimeter fencing construction continues. Management activities in 2013 were noxious weed control, woody vegetation removal, and prescribed fire and grazing.

This program has been very successful and continues to accomplish many of the goals of the Implementation Plan for the Conservation of the Eastern Saline Wetlands. Your continued support for the conservation of these natural areas is appreciated. If you have any questions, please contact me at 402-476-2729 or tmalmstrom@lpsnrd.org. You can visit the saline wetland website at http://lincoln.ne.gov/city/parks/ParksFacilities/wetlands/index.htm

# APPENDICES

# Appendix A

**Saline Wetlands**
**Informational Seminar**
**Agenda**

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email: *tmalmstrom@lpsnrd.org*

# Nebraska's Eastern Saline Wetlands Informational Seminar August 30, 2013

0800 – Check-in

0830 – Introduction – Saline Wetlands Conservation Partnership
Tom Malmstrom, City of Lincoln and Saline Wetlands Conservation Partnership

0900 – Hydrology – groundwater and surface water connections in saline wetlands
Ed Harvey – UNL (currently with the National Park Service)

0945 – Hydrology – seep and springs study
Ed Harvey – UNL (currently with the National Park Service)
Jessie Winter – UNL (currently with Nebraska Department of Natural Resources)

1030 – Break

1045 – Wetland Assessment of Eastern Saline Wetlands (including amphibian inventory)
Nick Smeenk – UNL, Ph.D. student

1115 – "Are eastern saline wetlands important to birds?"
Joel Jorgensen – Nongame Bird Program Manager, NGPC

1145 – Open discussion on morning session

Noon – Box Lunch

(Over)

***Before settlers scraped the Salt Basin, saline wetlands were few, both in number and extent. Today but a handful remain. They are an imperiled community.***

1300 – Salt Creek tiger beetle history and other saline wetland invertebrate inventories
Steve Spomer, UNL

1330 – Salt Creek Tiger Beetle re-introduction monitoring
Jessica Jurzenski, UNL (currently with Felsburg Holt & Ullevig)

1400 – Hydrology – electrical resistivity imaging and restoration considerations
Ed Harvey – UNL (currently with the National Park Service)

1430 – Break

1445 – Vegetative mapping of saline wetland areas
Tyler Janke, TNC

1515 – Assessment of Salmo soils
Bruce Evans, NRCS

1545 – Restoration techniques used in eastern saline wetlands
The Flatwater Group, Inc.

1615 – Open discussion on afternoon session and adjournment

# Appendix B

**Research – Greenhouse gas flux in Nebraska's saline soils**

# Greenhouse gas flux in Nebraska's saline marshes: an analysis of Frank Shoemaker Marsh

Thesis by:

Alicia Lenners

In partial fulfillment of the requirements

for the degree of

Bachelor of Science in Environmental Studies-Biology

University of Nebraska

Lincoln, Nebraska

Spring 2013

## Introduction

For my thesis I will be studying the flux of greenhouse gases ($CH_4$, $CO_2$, and $N_2O$), focusing on methane production, released from wetlands, specifically the saline wetlands of Lincoln, NE. Methane is an important greenhouse gas (GHG), and wetlands are the biggest producers of the gas. With time most of the methane will be oxidized into the atmosphere as carbon dioxide ($CO_2$), but meth (Laing, Shreeve, & Pearce, 2008).

The greenhouse effect is what makes life on Earth possible by trapping energy from the Sun's rays to keep the Earth warm and from going through drastic temperature changes; however, with too much GHG, the overall temperature of the Earth will increase with it. $CO_2$ is the most well-known and studied GHG because it is the most abundant, but $CH_4$ is 25 times more potent than $CO_2$ over a 100 year time span (Jorgenson, 2006). This means that a smaller amount of methane will have a significant effect on the environment than carbon dioxide.

Another potent greenhouse gas is nitrous oxide ($N_2O$). $N_2O$ is found in much lower concentrations in the Earth's atmosphere than $CH_4$, but it is also more potent than methane, having 300 times the heat trapping capacity of $CO_2$. $N_2O$ is produced through the microbial process of nitrification and denitrification. The last step of this process is the conversion of $N_2O$ to $N_2$, which is currently the only known way terrestrial processes reduce $N_2O$ concentration (Hénault & Revellin, 2011).

Plant-life has a huge influence on the amount of methane released from the wetlands. Methane is produced through the decomposition of organic matter (Figure 1). The gas is then released through the vascular tissue of plants in a gas exchange when plants pump oxygen into the anaerobic soils so their roots can function. Some of the methane will be converted into carbon dioxide as a byproduct of the gas exchange (Ström, Mastepanov, & Christensen, 2004).

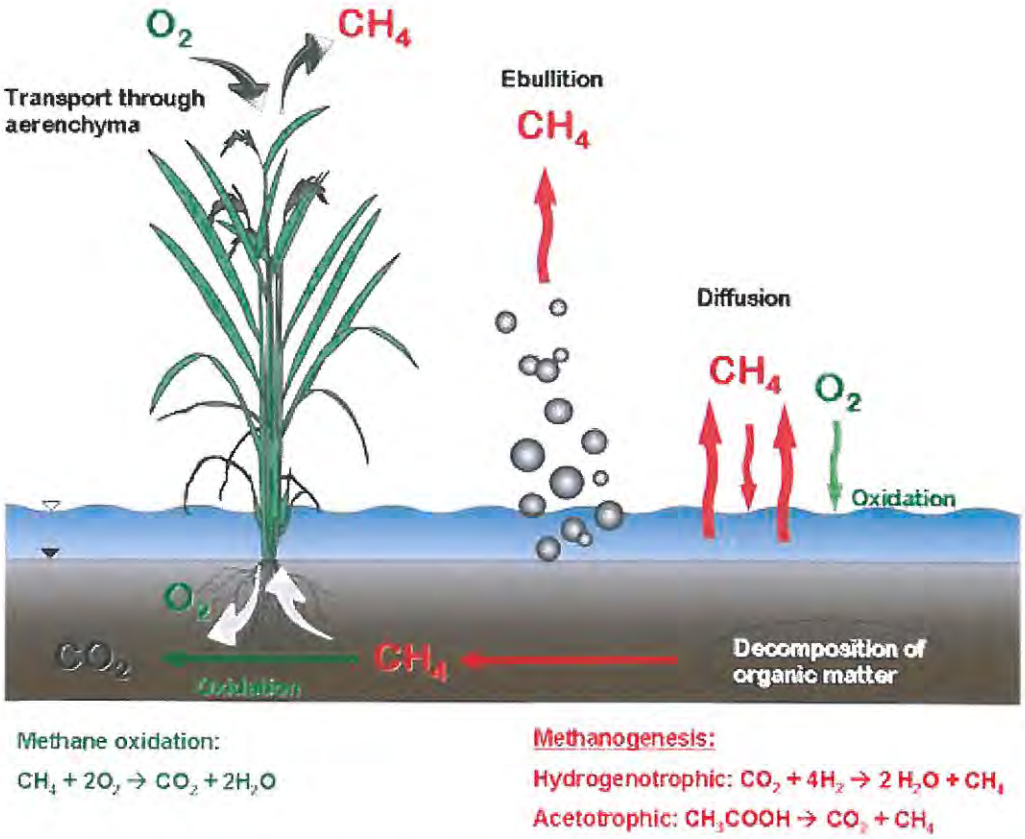


Figure 1. Shows how $CH_4$ is transported out of wetlands. The $CH_4$ produced when decomposers break down organic matter is transported through the vascular system of hydrophytes as oxygen is pumped into the roots.

The people who founded Lincoln were attracted to these wetlands and built the city on top of them. Since then, the majority of the wetlands have been drained away, but with increasing urbanization, Lincoln's saline wetlands are slowly declining even further. The saline wetlands provide a habitat for plant species such as saltgrass (*Distichlis spicata*), sea blite (*Suaeda depressa*), and saltwort (*Salicornia rubra*), the latter of which is endangered, and insect species like the endangered Salt Creek Tiger Beetle (Harvey, Ayers, & Gosselin, 2007). Even though these wetlands are unique in the Nebraska area, they have not been studied to a great extent. This is why it is important to study these habitats as much as possible.

My hypothesis is freshwater wetlands will produce more methane than saline wetlands because methane production is reliant on plant productivity. My broader research question is how do salinity and plant cover affect greenhouse gas fluxes in Shoemaker Marsh? In my study, my aim is to measure the amount of methane and other GHGs ($CO_2$ and $N_2O$) gas transmitted through different species of wetland plant life in both habitats. To do this, I will be taking gas samples from soil sites with different salinity levels and plant treatments at Shoemaker Marsh, located 1 mile north of Lincoln, NE and comparing the fluxes with the different salinity and plant treatments.

One of the limiting factors to this study is the location of the two collection sites. The first limitation is the type of soil might affect how well the plants transport the gases. The second limitation is the species of plants that grow in the different salinity areas. Because of this, it is important that I collect data from a wide variety of plant life. The third limitation is the climate and weather. Because biological activity is dependent on moisture and temperature, it will be important for me to study the weather conditions of all the areas and factor them into my data.

**Literature Review**

There have been many studies that have looked into how plants transport methane. In a study performed by Lena Ström, Mikhail Mastepanov, & Torben R. Christensen, the how role of vascular composition in plants in relation to methane emission was explored. They took three different species of plants, *Eriophorum vaginatum, Carex rostrata and Juncus effusus,* from the same wetland in southern Sweden. What the researchers found was *E. vaginatum* contributed over 90% of the plant-transported methane in the wetland observed. Because some plants are better at transporting methane than others, it is important to sample various types of plants in each type of system (Ström, Mastepanov, & Christensen, 2004).

Another study, by Albert Koelbener, Lena Ström, Peter J. Edwards, and Harry Olde Venterink, tested how the presence of vascular plants affect methane emissions in peatlands. They used eight different plant species to observe whether the root biomass had any effect on methane production. Out of the 8 species tested, 5 of them produced 5 times as much methane than the control peat soil with no plants. However, only one of the plant species showed a positive relationship of root biomass and methane production (Koelbener, Ström, Edwards, & Venterink, 2010).

An investigation carried out by Pantip Klomjeka and Suwanchai Nitisoravut explored plant growth in a saline wetland environment. 8 plant species were studied under artificially-created saline conditions, and 6 of the species were salt-tolerant. It was found that the plant species were less productive in the saline soils than in the freshwater soils, creating less methane (Klomjeka & Nitisoravut, 2005).

**Methods and Materials**

The main goal of this study was to observe if there was any noticeable difference in greenhouse gas production between saline and freshwater areas of a wetland. All samples were collected at Shoemaker Marsh, which is the largest protected saline wetland in Nebraska and is located 1 mile north outside Lincoln, NE. Saline areas were differentiated from freshwater areas based on the local plant-life. The freshwater areas will be high in cattail (*Typha capensis*) and marsh elder (*Iva annua*) growth, and saline areas are higher in saltwort (*Salicornia rubra*) and sea blite (*Suaeda depressa*).

Before collecting any samples, permission was needed due to the many endangered species, including the Salt Creek Tiger Beetle (*Cicindela nevadica lincolniana*) and *S. rubra*, which occupy Frank Shoemaker Marsh. Permission was granted by Tom Malmstrom of the

Lower Platte South Natural Resources District on the condition that any results gathered would be shared with the City of Lincoln, NE.

8 PVC chambers were divided into 4 overlapping treatments: saline soil with plant (*S. rubra* and *S. depressa*), saline soil with no plant, freshwater soil with plant (*I. annua*), and freshwater soil with no plant. Due to the size, *T. capensis* could not be used in the chambers, so *I. annua* was used in both duplicates. Figure 2 shows images of the chamber set up of the two collection sites. The idea was to compare the different rates of GHG production of plants growing in different salinity conditions while also comparing GHG flux produced by plants against bare soil. The chambers were evenly spread out approximately 20-m from each other to prevent the soil activity in one chamber from interfering with the soil activity in a nearby chamber and were grouped into two different sites (figure 3).

Figure 2a. Chambers from site 1 (read clockwise starting from the top-left): saline/bare, saline/plant *(S. rubra)*, fresh/plant (*I. annua)*, and fresh/bare.

Figure 2b. Chambers from site 2 (read clockwise starting from the top-left): saline/bare, saline/plant *(S. depressa)*, fresh/plant *(I. annua)*, and fresh/bare.

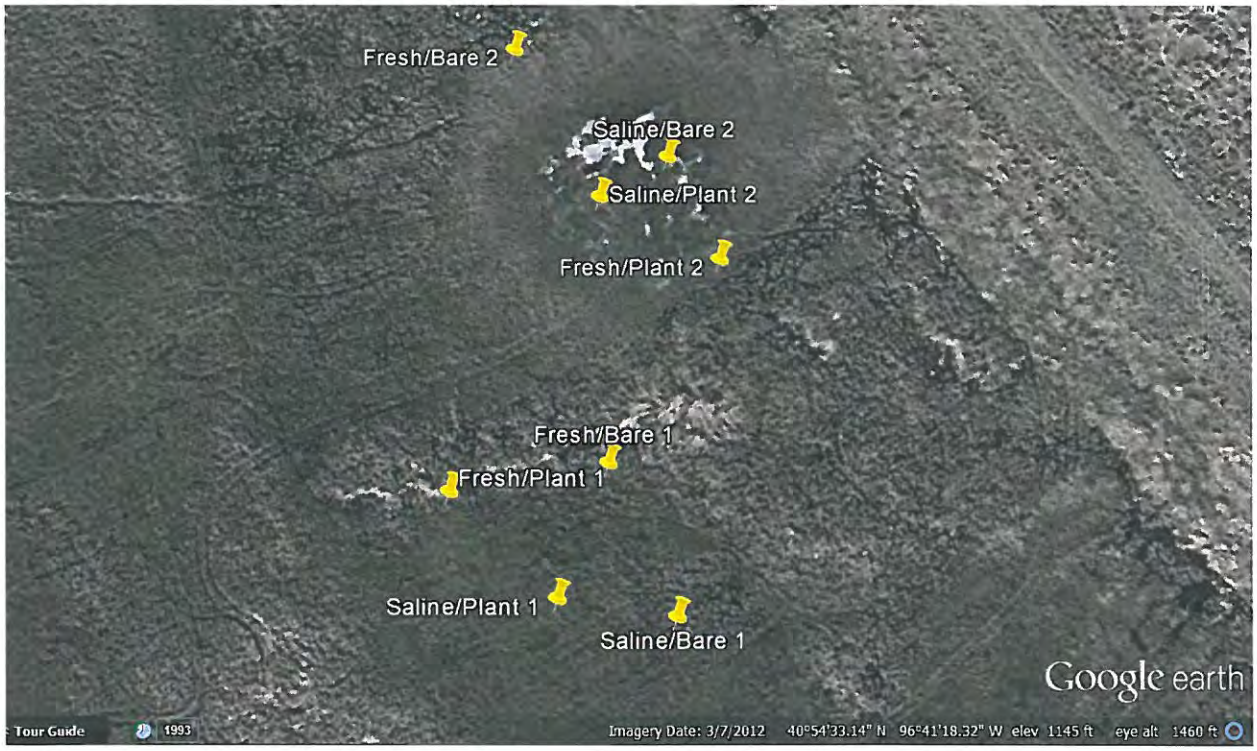


Figure 3. The locations of the chambers in sites 1 and 2.

Saline/Bare1 (40°54'32.43"N, 96°41'18.00"W); Saline/Plant1 (40°54'32.44"N, 96°41'18.45"W); Fresh/Bare1 (40°54'32.83"N, 96°41'18.33"W); Fresh/Plant1 (40°54'32.69"N, 96°41'18.90"W); Saline/Bare2 (40°54'33.72"N, 96°41'18.26"W); Saline/Plant2 (40°54'33.58"N, 96°41'18.50"W); Fresh/Bare2 (40°54'33.98"N, 96°41'18.90"W); Fresh/Plant2 (40°54'33.44"N, 96°41'18.01"W).

Samples were taken approximately every two weeks from mid-August to the end of September 2012. During each trip 4 air samples were taken from each chamber every 15 minutes, making a total of 32 samples. To do this, the chambers were forced 1 inch into the soil and were covered with a PVC lid. The chamber lids were then sealed with a large latex band. The lid was then connected to PVC plastic tubing, which would lead to a 20-ml syringe. During each round, the syringe would be aerated and pull 20-ml of air from the chamber. The air would then be injected into the appropriately labeled sample glass vial. Additional measurements taken on site included soil temperature and chamber volume. The soil temperature was taken with a digital meat thermometer, and the chamber volume was calculated by averaging the height measurements taken from four sides of the chamber and calculating it with the diameter of the chamber.

After the samples were collected, they were taken to the Aquatic Ecology and Water Chemistry Lab at the University of Nebraska-Lincoln. The samples were injected into a Gerstel MultiPurpose Sampler to be analyzed for $CH_4$, $CO_2$, and $N_2O$ content. All of the results were compiled into an Excel spread sheet, which were compared against the standard curve of the local ambient air levels.

**Results**

Neither soil salinity nor plant cover had a significant effect of $CH_4$ flux (figure 4a). All of the flux averages had a high amount of variation between chamber site and date of collection. Even though the saline/plant category had the lowest $CH_4$ flux average, the graph below shows

that it also had the highest amount of variation. Conversely, even though the fresh/plant category had the highest average of $CH_4$ flux, it had the lowest amount of variation. The differences between the saline and freshwater soil types in the no plant category were negligible.

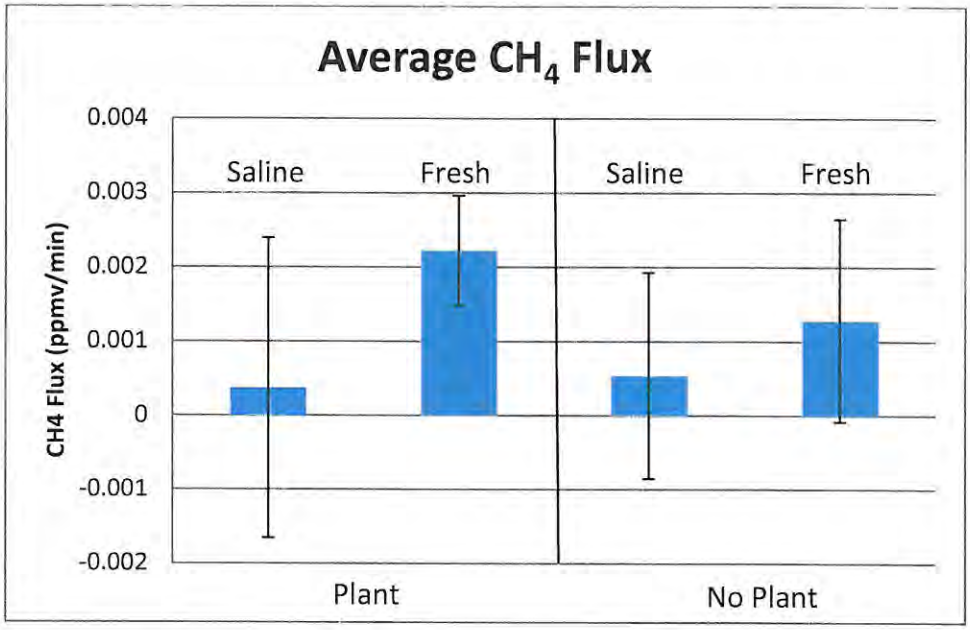


Figure 4a. The average $CH_4$ flux of each of the four soil types. Df=14; p-value (saline/plant vs. fresh/plant)=0.47; p-value (saline/plant vs. saline/no plant)=0.20; p-value (saline/plant vs. fresh/no plant)=0.35; p-value (fresh/plant vs. saline/no plant)=0.15; p-value (fresh/plant vs. fresh/no plant)=0.35; p-value (saline/no plant vs. fresh/no plant)=0.28.

$CO_2$ flux is higher in chambers with saline soil than in freshwater soil (figure 4b). The presence of plants seems to have minimal effect on $CO_2$ flux, but soil salinity had a greater effect on flux. The most drastic difference in $CO_2$ flux occurred between the fresh/plant and the saline/no plant groups, where the flux in the fresh/plant chambers averaged to 9 ppmv/min and the flux in the saline/no plant chamber averaged to 40 ppmv/min.

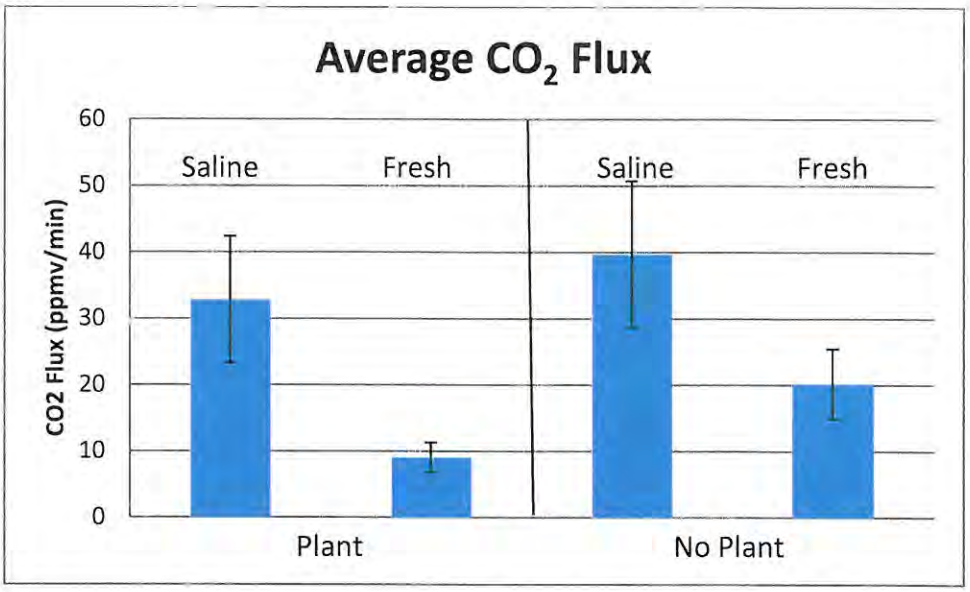


Figure 4b. The average $CH_4$ flux of each of the four soil types. Df=14; p-value (saline/plant vs. fresh/plant)=0.32; p-value (saline/plant vs. saline/no plant)=0.014; p-value (saline/plant vs. fresh/no plant)=0.13; p-value (fresh/plant vs. saline/no plant)=0.0082; p-value (fresh/plant vs. fresh/no plant)=0.066; p-value (saline/no plant vs. fresh/no plant)=0.035.

Freshwater soils with low plant cover were the biggest producers of $N_2O$ flux out of all of the chamber collection sites (figure 4c). $N_2O$ flux from the fresh/no plant sites had an average rate of 0.16 mmv/min and were on average 3 times as much as any of the other three categories. The saline/plant chamber sites produced the least amount of $N_2O$, with a flux rate of 0.001 ppmv/min.

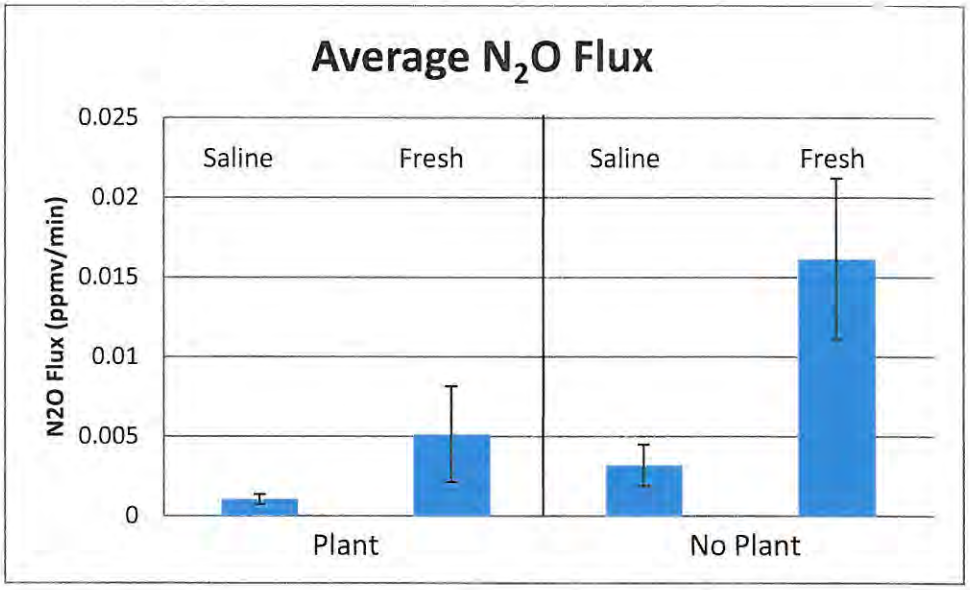


Figure 4c. The average $CH_4$ flux of each of the four soil types. Df=16; p-value (saline/plant vs. fresh/plant)=0.064; p-value (saline/plant vs. saline/no plant)=0.098; p-value (saline/plant vs. fresh/no plant)=0.0057; p-value (fresh/plant vs. saline/no plant)=0.28; p-value (fresh/plant vs. fresh/no plant)=0.015; p-value (saline/no plant vs. fresh/no plant)=0.044.

**Discussion**

With any type of field study, there are going to be limitations. One of the major limitations with this study was the limited amount of time and equipment to produce enough Also, because the rate of GHG emissions from saline wetlands has not been studied that much, there was no means of comparing the data collected at Shoemaker Marsh with other wetlands. Because of the drought in the summer of 2012, there was very little variation in weather and moisture, which would have given deeper insight to how GHGs would fluctuate while the marsh was saturated.

When running the t-test between the different soil and plant categories, there appeared to be little statistical significance between the average flux in methane emissions; however, the chambers located in the saline sites showed a higher level of variation than in the freshwater sites (figure 4a). While methane flux tended to constantly stay positive in the freshwater sites, the

saline sites showed both positive and negative fluxes. An interesting point was the presence of plants had a seemingly minimal effect on methane flux. This is interesting because the presence of plants usually act as a bio-conductor for methane emission in wetlands (Potter, et al, 2006). $CH_4$ is normally produced by microbes and released into the atmosphere through hydrophytes vascular tissue when $O_2$ is directed to their roots when soils are saturated; this process is referred to as methanogenesis (Koelbener et al, 2005). While the methane emissions from the fresh/plant chamber was higher on average, the similarity among the other three chamber groups does not support this principle.

Another possibility is the presence of methanotrophs. Because negative flux indicates that a gas is being consumed, figure 4a indicates that there are methane-consuming bacteria inhabiting the saline soils. These microbes often inhibit aerobic soils and will consume methane as their source of carbon and energy (Hanson & Hanson, 1996). Wetlands are typically anaerobic due to saturated soils, but because the summer of 2012 in Nebraska was particularly dry, aerobic organisms were allowed to flourish. The main difference between the saline groups and the freshwater groups may have been the fact that the freshwater areas had a higher concentration of dead plant matter, thus trapping in more moisture and preventing aerobic bacteria populations from growing.

Concerning $CO_2$ emissions, figure 4b demonstrates that soil salinity has higher effect on $CO_2$ flux than plant cover. Because there is little literature on how gas flux is influenced by soil salinity, a proper comparison cannot be made, but it is known that $CO_2$ is released in relation to organic matter decomposition (Potter et al, 2006). Along with the flux differences between salinity states, the areas with plant cover also showed a small decrease in $CO_2$ flux compared

with the areas with no plant cover. Because plants use $CO_2$ as a part of their photosynthesis process (Rasse et al, 2003), the decrease in $CO_2$ flux makes sense when put in this context.

Fresh, bare soils have the highest $N_2O$ flux (figure 4c), and saline soils with plants have the lowest flux. In the nitrogen cycle, $N_2O$ is a byproduct of nitrification and denitrification processes carried out by bacteria in soils (Johansson et al, 2002). The lower salinity in the soil and nitrogen competition with the local plant may have led to the increased $N_2O$ production. Microbes will convert inorganic Ammonium ($NH_4^+$) into Nitrite ($NO_2^-$) and Nitrate ($NO_3^-$) through nitrification. When plants are within the area, they will take up the Nitrate nutrients; however, when there is little plant cover, some of the nitrogen is lost as nitrogen gas ($N_2$) and $N_2O$ through denitrification (Jiang et al, 2013).

This study shows that there are many factors into what determines GHG production. An appropriate continuation to this study would be to determine how soil moisture affects methane consumption by methanotrophs. This would need to be performed in a more controlled environment, but it would give more insight into the results figure 4a gives.

**Acknowledgements**

This work was financially supported through the UCARE program. I want to give thanks Dr. Amy Burgin for her assistance as my thesis adviser and to Dr. David Wedin for acting as my thesis reader. I also want to thank Karla Jarecke for training me in using the equipment and the staff of the UNL Aquatic Ecology and Water Chemistry Lab for providing use of the gas analyzing equipment. Finally, I want to thank Tom Malmstrom for giving permission to use Shoemaker Marsh as my site of study.

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# Appendix C

**Research – 2013 Secretive Marsh Bird Survey of Nebraska's Eastern Saline Wetlands**

# 2013 Secretive Marshbird Survey of Nebraska's Eastern Saline Wetlands

NEBRASKA GAME & PARKS
Nongame Bird Program

Lauren R. Dinan and Joel G. Jorgensen
Nongame Bird Program
Nebraska Game and Parks Commission

13 January 2014

Nebraska's eastern saline wetlands (ESW) harbor a unique community of organisms and are considered critically endangered (LaGrange 2007). The ESW ecological community type is one of the rarest and most imperiled in the state (Clausen et al. 1989). ESW occur in floodplain swales and depressions within the Salt and Rock Creek watersheds in Lancaster and southern Saunders counties. ESW are temporarily and seasonally flooded palustrine wetlands (Gersib and Steinauer 1991, Gilbert et al. 1994). These wetlands are characterized by saline mineral soils and salt-tolerant vegetation (LaGrange et al. 2003). Their salinity originates from groundwater passing through an underlying rock formation containing salts deposited by an ancient sea that once covered Nebraska (LaGrange 2007).

Nebraska's ESW have been converted and degraded through commercial, residential, and agricultural development (Gersib and Steinauer 1991). ESW were estimated to once total approximately 20,000 acres; approximately 4,000 acres remain today (LaGrange et al. 2003). The remaining saline wetlands are a high conservation priority because they provide habitat for a diversity of plant and wildlife species, including the state and federally endangered Salt Creek Tiger Beetle (*Cicindela nevadica lincolniana*) and state endangered Saltwort (*Salicornia rubra*; LaGrange et al. 2003).

Nebraska's ESW also provide important nesting and migratory habitat for a number of bird species, including several species with limited distributions in Nebraska (Ducey 1987). These wetlands provide stopover habitat for shorebirds and waterfowl during migration (Poague and Dinan 1997). The wetlands also provide habitat for a small number of rare to uncommon marsh denizens, several of which are secretive and not easily detected. The status of these species, particularly breeding status, is poorly understood not only in the ESW complex, but throughout Nebraska. The suite of marsh denizen species includes the Virginia Rail (*Rallus limicola*), King Rail (*Rallus elegans*), Black Rail (*Laterallus jamaicensis*), Sora (*Porzana carolina*), American Bittern (*Botaurus lentiginosus*), Least Bittern (*Ixobrychus exilis*) and Common Moorhen (*Gallinula galeata*). These species, along with Pied-billed Grebe (*Podilymbus podiceps*) and American Coot (*Fulica americana*), are collectively referred to as marshbirds throughout this report.

The purpose of this report is to summarize a pilot marshbird survey in the ESW. The intent of this project is to establish long-term marshbird monitoring in Nebraska's ESW to understand the abundance, site use, and breeding status of marshbirds in this ESW complex. Information from this monitoring program will be useful in evaluating management actions and developing future conservation strategies for Nebraska's ESW. Our primary objectives in 2013 were to develop our survey methods, select and become familiar with our survey sites, and collect baseline data. Here, we present the preliminary results of the 2013 pilot survey.

## METHODS

### Study Area and Site Selection

We surveyed marshbirds in Nebraska's ESW complex in northern Lancaster and extreme southern Saunders counties (Figure 1). We used the National Wetland Inventory (NWI; U.S. Fish and Wildlife Service 2012) and aerial imagery to identify individual wetlands. NWI data were modified by the Rainwater Basin Joint Venture based on ground-thruthing (Ted LaGrange, personal communication). We imported these data into ArcGIS (version 10.1). We identified 15 public sites in our study area (Figure 1). Based on field observations and time constraints, we selected 11 public sites to survey. Three of these sites shared boundaries and were merged into one survey site. This process reduced the number of survey sites to nine (Table 1, Figure 2). We developed maps for each survey site.

We used the modified NWI data and field observations to select individual wetlands within survey sites. We selected Palustrine (P) and Lacustrine (L) wetlands classified as Aquatic Bed (AB), Emergent (EM), and Unconsolidated Bottom (UB) with Seasonally Flooded (C), Seasonally Flooded/Saturated (E), Semipermanently Flooded (F), Intermittently Exposed (G), and Permanently Flooded (H) water regimes. In 2013, we selected wetlands and survey points during our initial visit to each site based on visual observations and site maps (Figure 3). In future years we will modify our methods and use a probabilistic sampling approach to select wetlands and survey points.

Marshbird Surveys

We used methods outlined by Conway (2011) and modified by Harms and Dinsmore (2012, 2013). We conducted surveys during two survey periods, 15 April to 31 May and 1 June to 16 July. We originally planned to conduct surveys at each site once during each survey period. However, we limited our surveys during the early period because this period occurs during the migratory period for several focal species. We were also constrained by available time. We conducted the remaining surveys during the later period (1 June to 16 July), when each site was surveyed once. Surveys were conducted either in the morning, 30 minutes before sunrise to two hours after sunrise, or in the evening, two hours before sunset to 30 minutes after sunset. We surveyed nine species: Virginia Rail, King Rail, Black Rain, Sora, American Bittern, Least Bittern, Common Moorhen, Pied-billed Grebe, and American Coot (Table 2).

We evaluated sites, identified survey points, developed survey routes, and conducted call-broadcast surveys during initial site visits. We defined a survey route as a group of survey points that were surveyed together by the same surveyor on the same day and during the same time period (morning or evening). At each survey point we recorded location using a handheld Global Positioning System (GPS). We recorded the general location description for each survey point using the 11 location types outlined in the standardized North American marshbird monitoring protocol (Appendix A; Conway 2011). If the point was along a road we recorded the road type (gravel, dirt, paved, Highway, etc.). At each survey point we also recorded the level of background noise, ambient temperature, wind speed, sky condition, and water conditions (Appendix A). Most survey points were spaced at least 400 m apart to avoid disturbing birds at nearby points during the call-broadcast (Conway 2011). A few of our points were closer than 400 m, but none were less than 200 m.

We conducted a 13-minute point-count with call-broadcast at each survey point. Our call broadcast sequence was provided by the North American Marsh Bird Monitoring Program coordinator (Conway 2011). The broadcast calls included eight of the nine focal species. We did not include American Coot in our broadcast sequence because they are often observed visually and do not frequently respond to calls (Harms and Dinsmore, unpublished). We used a game caller with speakers (Western Rivers digital game caller) to broadcast calls. The survey sequence consisted of a five-minute period of silence, followed by 30 seconds of calls and 30 seconds of silence for each focal species, excluding American Coot (Table 3). The five-minute period of silence was divided into one-minute intervals. We recorded all focal species detected (visual and aural) during each one-minute interval throughout the entire 13-minute survey sequence. We used a laser rangefinder to measure the distance to each bird(s) detected. If the same individual bird was detected several times during the first one-minute interval we only recorded that bird once on the datasheet in the first one-minute interval column. If the same bird was detected again during the second one-minute interval we recorded that bird's presence again in the second one-minute interval column. We recorded "1" if the individual was detected aurally, "s" if the individual was detected visually, and "1s" if the individual was detected aurally and visually. We recorded all data on data sheets obtained from the North American Marsh Bird Monitoring website (http://cals.arizona.edu/research/azfwru/NationalMarshBird/). Surveys were not conducted during periods of sustained rain, heavy fog, or when wind speed was greater than 12 mph as recommended by Conway (2011).

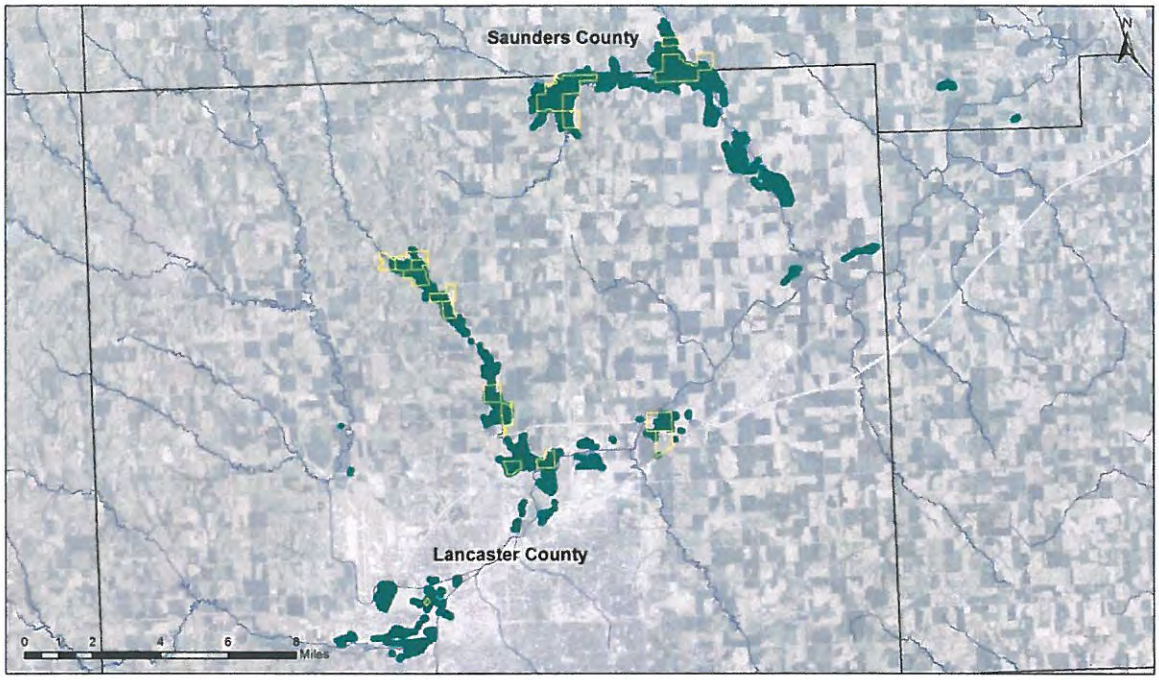



Figure 1. Nebraska's eastern saline wetlands (areas in green) in Lancaster and Saunders County. The yellow polygons outline the the 15 public sites in our study area.

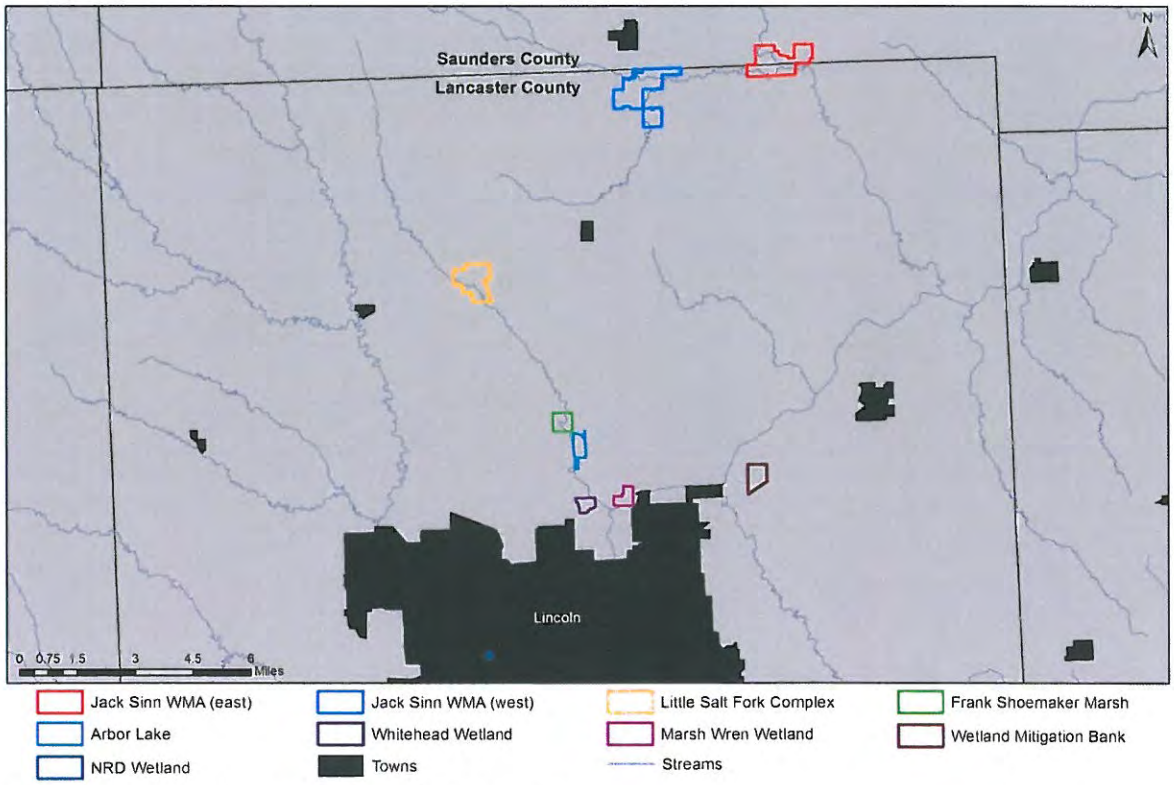



Figure 2. Survey sites for marshbird monitoring surveys.

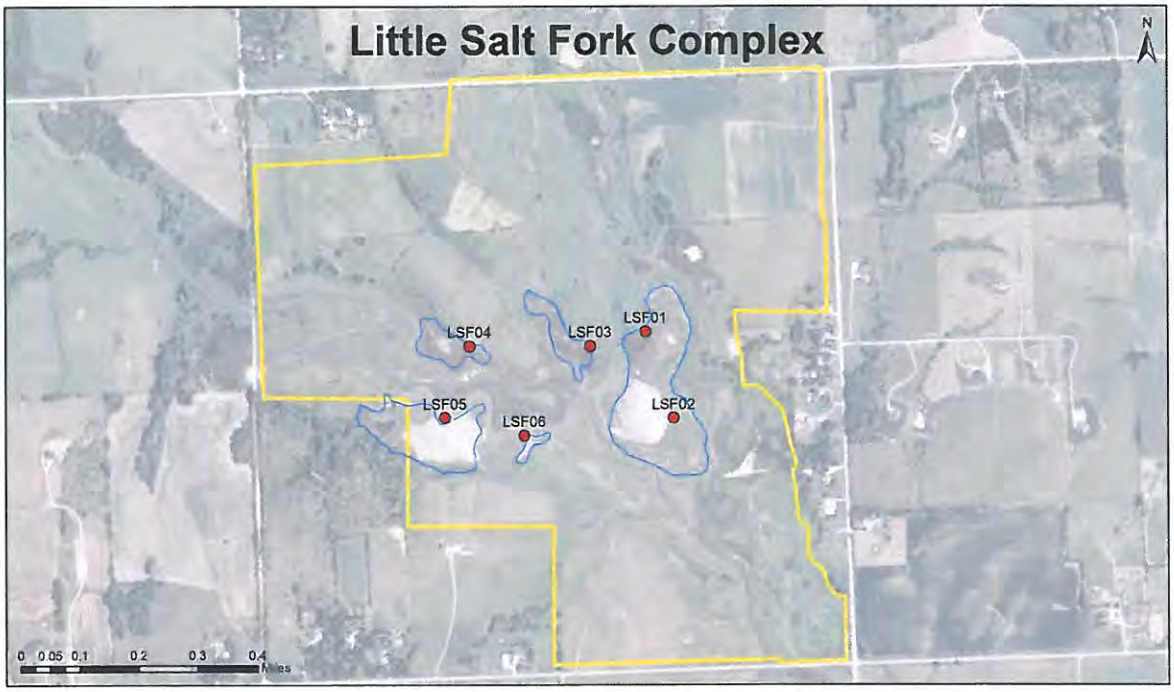



Figure 3. Example of a survey site (yellow outline) with wetlands (blue outline) and survey points (red dots).

Table 1. List of survey sites in our study area. Sites in blue text were surveyed together as one survey site named "Little Salt Fork Complex".

| Survey Route | Property Owner | Acres | # of Survey Points |
|---|---|---|---|
| Jack Sinn WMA (east) | Nebraska Game and Parks Commission | 618.9 | 7 |
| Jack Sinn WMA (west) | Nebraska Game and Parks Commission | 736.4 | 4 |
| *Little Salt Creek West WMA* | *Nebraska Game and Parks Commission* | *214.9* | *1* |
| *Alten Parcel* | *Lower Platte South NRD* | *73.7* | *2* |
| *Little Salt Fork Marsh Preserve* | *The Nature Conservancy of Nebraska* | *162.9* | *3* |
| Frank Shoemaker Marsh | City of Lincoln | 155.9 | 1 |
| Arbor Lake | City of Lincoln | 136.0 | 1 |
| Whitehead Wetland | Lower Platte South NRD | 98.2 | 2 |
| Marsh Wren Wetland | Lower Platte South NRD | 123.6 | 1 |
| Wetland Mitigation Bank | City of Lincoln/Lancaster County | 192.1 | 1 |
| NRD Wetland | Lower Platte South NRD | 11.3 | 1 |

Table 2. List of nine focal species.

| Acronym | Common Name | Scientific Name |
|---|---|---|
| VIRA | Virginia Rail | *Rallus limicola* |
| KIRA | King Rail | *Rallus elegans* |
| BLRA | Black Rail | *Laterallus jamaicensis* |
| SORA | Sora | *Porzana carolina* |
| AMBI | American Bittern | *Botaurus lentiginosus* |
| LEBI | Least Bittern | *Ixobrychus exilis* |
| COMO | Common Moorhen | *Gallinula galeata* |
| PBGR | Pied-billed Grebe | *Podilymbus podiceps* |
| AMCO | American Coot | *Fulica americana* |

Table 3. Survey sequence for each survey point.

| Time | Activity Description |
|---|---|
| 5:00 | 5 minute point count in silence (verbal statement at each minute) |
| 6:00 | 30 seconds Black Rail calls, 30 seconds silence |
| 7:00 | 30 seconds Least Bittern calls, 30 seconds silence |
| 8:00 | 30 seconds Sora calls, 30 seconds silence |
| 9:00 | 30 seconds Virginia Rail calls , 30 seconds silence |
| 10:00 | 30 seconds King Rail calls, 30 seconds silence |
| 11:00 | 30 seconds American Bittern calls, 30 seconds silence |
| 12:00 | 30 seconds Common Moorhen calls, 30 seconds silence |
| 13:00 | 30 seconds Pied-billed Grebe calls, 30 seconds silence (verbal statement "stop") |
| Total Time = 13 minutes | |

RESULTS

We surveyed 24 points at 17 wetlands within the nine survey sites. We detected five focal species and 46 individual birds (Table 4). Most detections (83%) occurred during two surveys conducted in the first survey period (May). Four species and 38 birds were detected during the first survey period, and three species and eight birds were detected during the second survey period. We detected Virginia Rail, Sora, American Bittern, Pied-billed Grebe, and American Coot. We did not detect Black Rail, King Rail, Least Bittern, or Common Moorhen. American Coot was the most frequently detected species comprising 70% of all detections. Virginia Rail was the second most frequently detected species comprising 13% of all detections. Most detections were visual (80%) but this differed by species. All detections of Pied-billed Grebe, American Coot, and American Bittern were visual and all detections of Virginia Rail and Sora were aural.

Table 4. Number of focal species detected at each site during each survey period.

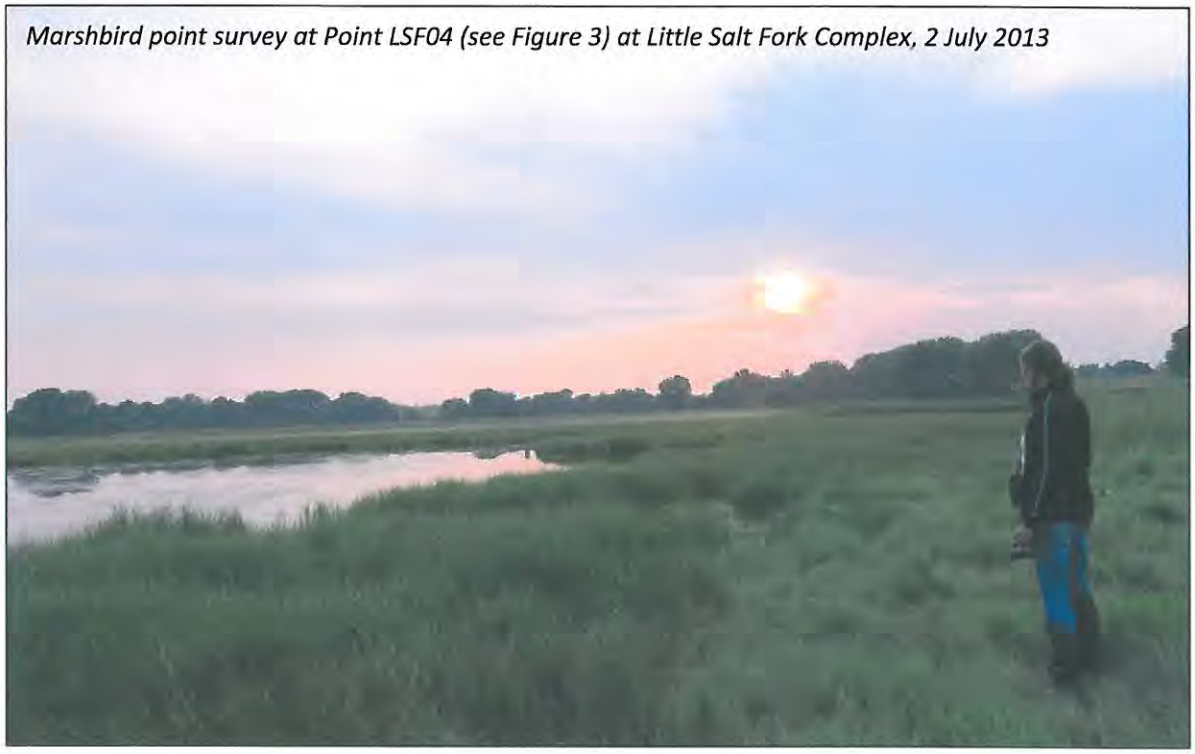
| Site Name | Date | VIRA | SORA | AMBI | PBGR | AMCO | Total |
|---|---|---|---|---|---|---|---|
| FIRST SURVEY PERIOD (15 April - 31 May) | | | | | | | |
| Jack Sinn East | 05/06/13 | 4 | 3 | 1 | 0 | 25 | 33 |
| Little Salt Fork Complex | 05/07/13 | 1 | 0 | 0 | 0 | 4 | 5 |
| SECOND SURVEY PERIOD (1 June - 16 July) | | | | | | | |
| Little Salt Fork Complex | 07/02/13 | 1 | 0 | 0 | 0 | 0 | 1 |
| Whitehead Marsh | 07/03/13 | 0 | 0 | 0 | 2 | 1 | 3 |
| Arbor Lake | 07/03/13 | 0 | 0 | 0 | 0 | 0 | 0 |
| Shoemaker Marsh | 07/03/13 | 0 | 0 | 0 | 0 | 0 | 0 |
| Jack Sinn East | 07/10/13 | 0 | 0 | 0 | 2 | 0 | 2 |
| Jack Sinn West | 07/11/13 | 0 | 0 | 0 | 0 | 1 | 1 |
| Wetland Mitigation Bank | 07/16/13 | 0 | 0 | 0 | 0 | 1 | 1 |
| Marsh Wren | 07/16/13 | 0 | 0 | 0 | 0 | 0 | 0 |
| NRD Wetland | 07/16/13 | 0 | 0 | 0 | 0 | 0 | 0 |
| TOTAL | | 6 | 3 | 1 | 4 | 32 | 46 |

DISCUSSION

Our 2013 marshbird pilot survey of ESW serves as a useful springboard for developing future surveys in the ESW complex and throughout Nebraska. Our ability to make inferences about marshbird breeding status in the ESW is limited because of our sampling approach. Furthermore, we were unable to conduct analyses (e.g., occupancy, Distance Sampling) because we had very few detections. Nevertheless, we were surprised by the apparent absence of several focal species during the late survey period. These results suggest that the focal species may not currently use Nebraska's ESW as breeding sites. A similar study completed in the ESW in 2003 showed similar results (NGPC unpublished data). However, there were notable differences. In 2003, six American Bitterns were recorded compared to none in 2013. There was an increase in the number of Sora and American Coots in 2013 but most of these detections occurred in early May and were likely migrants. In 2003, there was also a confirmed breeding record of a Least Bittern, a species not detected in 2013.

Even though breeding records for most species exist, it is unclear whether any of these species were ever regular breeders in the ESW complex. It is possible that all focal species that have bred in the ESW have occurred irregularly. However, nearly 90% of ESW have been lost or are degraded (LaGrange et al. 2003) and it is possible these species have been extirpated as regular breeders. Regardless, future iterations of this survey should indicate whether any of the focal species currently breed in the ESW complex.

We used NWI data to identify wetlands and it was our assumption that NWI data would be useful to stratify wetlands by size or other characters. However, we found NWI data to be inconsistent with the location and extent of some wetlands. The inconsistencies could not be explained by yearly or seasonal variation in wetlands due to hydrology. An important challenge of future surveys is modifying the NWI data to make it usable or developing a different data set that can be used to stratify wetlands.



*Marshbird point survey at Point LSF04 (see Figure 3) at Little Salt Fork Complex, 2 July 2013*

ACKNOWLEDGEMENTS

We thank Tom Malmstrom, Chris Helzer, Terry Genrich, Kirk Hansen, Karie Decker, Ted LaGrange, Charles Lesiak, and Heather Modrow for providing comments on the study proposal. We thank Meagan Conway and Courtney Conway for providing the call-broadcast sequence. We thank Carey Grell for providing data from marshbird surveys completed in 2003. We also appreciate discussions with Stephen J. Dinsmore regarding our methods and survey timing. All photographs by Joel Jorgensen.

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APPENDIX A. Categories for recording location description, background noise, wind speed, sky condition, and water conditions outlined in the standardized North American marsh bird monitoring protocol (Conway 2011).

| # | Location Description |
|---|---|
| 1 | along a ditch, dike or berm with emergent vegetation on both sides |
| 2 | along a ditch, dike or berm with emergent vegetation on only one side |
| 3 | along a public road (within 25m) with emergent vegetation on both sides |
| 4 | along a public road (within 25m) with emergent vegetation on only one side |
| 5 | along a grassland/emergent edge |
| 6 | along a scrub-shrub/emergent edge |
| 7 | along a forest/emergent edge |
| 8 | along an open water/emergent edge |
| 9 | within a narrow water channel or tidal creek with emergent vegetation on both sides |
| 10 | within a contiguous patch of emergent vegetation (also record distance from edge) |
| 11 | other (and provide description of point placement) |
| Background Noise | |
| 0 | No background noise during virtually entire 13-minute survey |
| 1 | Faint background noise during at least half of 13-minute survey |
| 2 | Moderate background noise during more than 30 seconds of 13-minute survey (probably cannot hear some birds beyond 100m) |
| 3 | Loud background noise during more than 30 seconds of 13-minute survey (probably cannot hear some birds beyond 50m) |
| 4 | Intense background noise during more than 30 seconds of 13-minute survey (probably cannot hear some birds beyond 25m) |
| 9 | Not recorded |
| Wind Speed (Beaufort Scale) | |
| 0 | smoke rises vertically |
| 1 | wind direction shown by smoke drift |
| 2 | wind felt on face; leaves rustle |
| 3 | leaves and small twigs in constant motion and light flag extended |
| 4 | raises dust and loose paper -- small branches are moved |
| 5 | small trees with leaves sway --crested wavelets on inland waters |
| Sky Conditions | |
| 0 | clear or a few clouds |
| 1 | partial cloud cover or variable sky |
| 2 | cloudy or overcast |
| 4 | fog or smoke |
| 5 | drizzle |
| 6 | snow |
| 8 | showers |
| Water Conditions | |
| 0 | Hydric soils (inundated) |
| 1 | Wet-mesic soils (saturated) |
| 2 | Mesic soils (moise) |
| 3 | Dry-mesic soils |
| 4 | Xeric soils (dry) |

# Appendix D

**Biogeochemical controls on saline wetland plant establishment in Nebraska's Eastern Saline Wetlands**

CITY OF LINCOLN NEBRASKA
MAYOR CHRIS BEUTLER

Smart # 13120160
12-18-13 P&R/mbb

# DIRECTORIAL ORDER

NO. 10493

**BY VIRTUE OF THE AUTHORITY VESTED IN ME BY THE CHARTER OF THE CITY OF LINCOLN, NEBRASKA:**

Pursuant to the delegation of authority under AR26 adopted by Executive Order No. 81495, I hereby execute and approve on behalf of the City of Lincoln the attached amendment **with Nebraska Game and Parks Commission where the City will reimburse the Nebraska Game and Parks Commission up to $25,000 for a research project on "Biogeochemical controls on saline wetland plant establishment in Nebraska's Eastern Saline Wetlands".**
The City Clerk is hereby directed to return a signed copy of this Directorial Order and Contract to Mary Brock of Lincoln Parks and Recreation Department.

Dated this 24 day of December, 2013.

Approved as to
Form & Legality:

for City Attorney

Approved:

Lynn Johnson
Parks & Recreation Department

Steve Hubka
Finance Department

FILED
DEC 24 2013
CITY CLERK'S OFFICE
LINCOLN, NEBRASKA

# MEMORANDUM OF UNDERSTANDING
# BETWEEN CITY OF LINCOLN AND NEBRASKA GAME AND PARKS COMMISSION

## 1. INTRODUCTION

This Agreement is between the City of Lincoln, Nebraska ("City"), on behalf of the Lincoln Parks & Recreation Department ("LPRD"), and Nebraska Game and Parks Commission (NGPC). Both parties recognize the importance of the University of Nebraska – Lincoln project at the Arbor Lake Complex identified as "Biogeochemical controls on saline wetland plant establishment in Nebraska's Eastern Saline Wetlands" to assist with the comprehensive strategies of the *Implementation Plan for the Conservation of Nebraska's Eastern Wetlands* (2003) identifying salinity interactions to guide protection and future restoration efforts. This Agreement is intended to create a Partnership committed toward the conservation and restoration of Nebraska's eastern saline wetlands. Both parties agree upon the following services as outlined below:

## 2. SERVICES AND COMPENSATION

A. The NGPC will enter into an agreement with the University of Nebraska – Lincoln to complete the project identified in Attachment A.

B. City shall provide reimbursement to NGPC of up to $25,000 in year one of the project. Funds for the reimbursement will come from funds contributed for the continuation of the Saline Wetlands Conservation Partnership through the Inter-local Cooperation Agreement for Saline Wetlands (Resolution No. A-86722). The City shall reimburse NGPC within thirty (30) days of receipt of the invoice and proof of payment of the costs of construction.

## 3. TERM

The term of the Agreement shall commence upon the date of full execution of this Agreement and shall continue until completion of all the obligations of this Agreement, but in no event longer than one year after the date of execution by City.

## 4. TERMINATION FOR BREACH

Either party has the right to terminate this Agreement if the other party fails to perform as required in this Agreement. Termination rights under this section may be exercised only after the non-breaching party notifies the breaching party of the failure to perform in writing upon giving the other party thirty (30) days written notice. Breaching party's failure to cure the breach within the thirty (30) days shall permit the non-breaching party to seek any remedy at law or in equity without notice or demand.

5. INTEGRATION, AMENDMENTS, ASSIGNMENTS

This Agreement represents the entire agreement between the parties and all prior negotiations and representations are hereby expressly excluded from this Agreement. This Agreement may be amended only by written agreement of both parties. This Agreement may not be assigned without the prior written consent of the other party.

6. CAPACITY

The undersigned persons representing NGPC and City do hereby agree and represent that each is legally capable to sign this Agreement and to lawfully bind their respective parties to this Agreement.

IN WITNESS WHEREOF, Nebraska Game and Parks Commission and City do hereby execute this Agreement.

**NEBRASKA GAME & PARKS COMMISSION**

Tim McCoy, Deputy Director

12/5/2013
Date

**CITY OF LINCOLN, NEBRASKA**

Lynn Johnson, Director
Parks and Recreation Department

12/19/13
Date

ATTACHMENT A

**Biogeochemical controls on saline wetland plant establishment in Nebraska's Eastern Saline Wetlands**

Drafted by Dr. Amy Burgin, University of Nebraska-Lincoln (the Contractor)

Background:

The eastern saline wetlands are a localized complex around Lincoln, which occur in close proximity to the Little Salt and Rock Creeks. Saline wetlands are a unique feature of the interior Great Plains, resulting from groundwater that passes through a buried rock formation containing salt deposits (Kelly 2011, Harvey et al. 2007, LaGrange 2005). While they are some of the most unique wetlands in Nebraska, they are also some of the most critically imperiled due to urban encroachment and adjacent agricultural activities (LaGrange 2005).

Due to both their uniqueness and threats, relatively little is known regarding how to approach restoration of these wetlands. Soil moisture (inundation) and salt content are the most critical factors in establishing a saline-obligate plant community (Farrar and Gersib 1991, Harvey et al. 2007). Saline wetlands can be divided into different zones of plant species distribution based largely on ecohydrology (Farrar and Gersib 1991, Harvey et al. 2007), which further complicates efforts to restore wetlands in a manner that will achieve a balance of the different types of zones. Salt flats are the zone where the most endangered species establish, including saltwort and sea blight (Harvey et al. 2007). Therefore, this project will focus on restoration techniques that can mimic the soil properties and chemical variability needed to develop salt flat formation in saline wetland restoration activities. The goal of the proposed work is to scientifically test plausible restoration techniques for saline wetlands.

Proposed study design:

The Contractor will create nine experimental plots wherein the effect of groundwater of varying salinity on the establishment of native plant communities, soil chemical properties and biogeochemical functions can be tested. Plots (2 x 2 $m^2$) will be established at the same time by chemical removal of the weeds and mechanical removal of topsoil (with assistance from Saline Wetlands Partnership/NGPC/City of Lincoln). Plots will be established in the early spring (March) of 2014. Prior to any treatments, plots will be sampled for: soil texture, soil iron, sulfur, nitrogen and carbon pools, soil salinity and moisture. Initial sampling will ensure homogeneity of conditions between the experimental units.

The nine plots will be assigned to one of three experimental treatments with three replicate plots per treatment: 1) high salinity groundwater, 2) medium salinity groundwater or 3) low salinity groundwater. The ground water treatments will originate from nearby wells (drilled to 180 ft., 80 ft. and 40 ft., respectively). Water will be added to the plots in as similar of a manner as would be possible for mimicking potential restoration techniques. The details of the design will be addressed by the post-doctoral associate in close consultation with the Saline Wetland Partnership, which will ensure a technique is used to add water to the sites that is potentially transferable to future restoration efforts.

In year 1, plots will not be planted, but will be kept plant-free by chemical removal (e.g., herbicide). This will allow the Contractor to study the effects of the water additions to the soil. In Year 1, the Contractor will monitor the plots for the responses of the soil to the water

additions in the absence of plants. This will allow the Contractor to study the geochemical interactions between the water and soil in isolation from the effects of plants, which can imprint large signatures on oxygen, carbon and nitrogen cycling in soils. Furthermore, this approach mimics likely restoration timelines, wherein a summer period would be used to chemically remove extant plant communities and topsoil, followed by a period of "salinizing" the soil to achieve the conditions necessary for saline-obligate species to establish.

During Year 1, the Contractor will collect soil samples monthly from the cores to analyze for changes in soil chemistry and microbial processes that are not monitored by the sensor network. The Contractor will begin water additions as soon as possible in the spring (April), and will collect samples on a monthly basis from all nine plots. In the fall of year 1, seeds from native plants in adjacent saline wetlands will be collected to use for seeding the plots in spring of year 2. Collected seeds will be overwintered in a freezer.

In year 2, soils will be assessed on a monthly basis as described for year 1. In addition, during monthly sampling, plant community establishment will be assessed at each of the plots. The Contractor will take pictures of the groundcover to assess total biomass, and also record data on plant species percent coverage. While plant community assessment is only funded for one year under this project description, the plots will become valuable long-term monitoring resources for understanding how saline plants respond to restoration and environmental change.

Restoration success will be based on assessment of the resultant plot properties by comparison to a reference condition wetland. That is, a reference condition wetland (selected by Ted LaGrange) will be used as a standard to which to compare our treatments. Treatments will be established by first assessing the potential range of conditions within the reference wetland. In the fall of 2013 (Oct/Nov), Schoepfer and Burgin will visit the Little Salt Creek West WMA and collect soil samples to assess the variability of soil salinity and moisture. At the soil sampling locations (~20 plots in the reference site), the Contractor will assess plant community coverage (biomass – by photography, not harvesting), collect plant samples to dry for chemical composition (Fe, S, N, C) and assess the community for the percent composition of known saline-obligate species. These data will be analyzed from Dec 2013-Jan 2014, which will aid the post-doc in planning for the target salinities to achieve with the well-water additions. After the additions are complete in year 2, the Contractor will return to the sample plots in the reference wetland to conduct a follow up assessment for comparison of soil and plant + soil treatments.

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Timeline:

| Milestone | Time | Responsible Lead |
|---|---|---|
| Assess Reference Standard Wetland | Oct/Nov 2013 | Burgin and Schoepfer |
| Plan field season | Feb – April 2014 | Burgin and Schoepfer |
| Field site installation | 1 April 2014 | Schoepfer with lab assistance |
| Plant removal/herbicide application | On-going | Saline Wetlands Partnership |
| Monitor sites over field season | On-going | Schoepfer with lab assistance |
| Process samples for chemistry | On-going | Schoepfer |
| 1st year data analysis | Fall 2014 | Burgin |
| Initial Results Meeting for Saline Wetlands Partnership | Nov/Dec 2014 | Burgin |
| Hire postdoc | 1 January 2014 | Burgin |
| Plan field season | Feb – April 2015 | Postdoc |
| Monitor sites over field season | On-going | Postdoc w/ support from Schoepfer |
| Process samples for chemistry | On-going | Schoepfer |
| 1st year data analysis | Fall 2014 | Postdoc w/ support from Burgin |
| Year 2 Results Meeting for Saline Wetlands Partnership | Nov/Dec 2015 | Postdoc w/ support from Burgin |
| Manuscript Preparation | Fall 2015/Spring 2016 | Postdoc, Burgin & Schoepfer with input from Saline Wetlands Partnership Cooperators |

Budget and Justification:

| Item | 2014 (Jan – Dec) | 2015 (Jan – Dec) | Total |
|---|---|---|---|
| *Salary* | | | |
| Amy Burgin (1 month summer + fringe) | | $11,647 | $11,647 |
| Post-doctoral Associate (1 yr + fringe) | | $53,560 | $53,560 |
| Valerie Schoepfer (4-6 mo/year + fringe) | $21,900 | $15,038 | $44,457 |
| Undergraduate | | $2,500 | |
| | | | |
| *Travel* | | | |
| Field Site | $2,000 | $2,000 | $4,000 |
| | | | |
| *Materials & Supplies* | | | |
| See budget justification | $7,000 | $4,000 | $11,000 |
| | | | |
| ***Grand Total*** | ***$30,900*** | ***$88,820*** | **$119,720** |

The Contractor is requesting one year of postdoctoral salary, at a base of $40,000 and 30% fringe rate. In year one, the Contractor is also requesting 6 months per year of technician time at a base of $30,000 and fringe of 46%. In year 2, technician time will be reduced to 4 months. The postdoc (person to be determined) will be the intellectual leader for the continuing

development of these ideas and eventual publication/presentation of results. The technician time will support Ms. Valerie Schoepfer, a recent M.S. graduate from Amy Burgin's lab, who will help with the field components and will be responsible for running the chemical analyses associated with the project. Valerie is skilled in the lab and familiar with all of the analyses required. In year 2, $2500 is requested for undergraduate salary to offset the reduction in Valerie's time to 4 months. $2500 will cover approximately 10 weeks at 40 hours/week (a summer position).

The Contractor is also requesting one month of summer salary plus fringe for Amy Burgin, Ph.D. in the 2nd year of the grant (2014). At UNL, Amy Burgin is on a 9-month appointment, so any additional work completed during the summer field season is paid from grant support. Amy Burgin's summer salary in the first year (2014) is covered by other sources, and thus funds from this grant will be used in support of Amy Burgin's time in 2015, which will focus on analyzing and interpreting the results with occasional field assistance.

Travel: The Contractor is requesting $2000 per year in travel, which will support travel to meetings and field sites. Field travel is estimated to require approximately 100 miles/week for the 24-week field season (total of 2400 miles; $1344) and approximately 200 miles per month for maintenance trips in the off-season (6 months = 1200 miles). At a rate of $0.56/mile (approximate) this will cover ~3600 miles at a total of $2,000.

Materials and Supplies: The majority of the materials budget is allocated to the first year $7,000 of which will be used to purchase bottles, filters, reagents and any associated sampling gear. These funds will also cover the installation of the water addition apparatus in the first year. Requested amount for materials and supplies is reduced to $4000 in Year 2 to reflect the decreased costs associated with the start up of a new project. The estimate on the laboratory materials and installation materials are based on Amy Burgin's prior experience with expenditures associated with running the OH wetland restoration project.

Total funds requested: $119,720. This total does not include any F&A as is required by NGPC funds.

At least $25,000 will be expended and invoiced to NGPC by 11/31/2014.

# Appendix E

**Other**

**"Remaining salt basins are unique natural resource," Lincoln Journal Star, June 16, 2013**

**Know your NRD Newsletter – "Get Wet and Learn," Spring 2014**

JournalStar.com

# Remaining salt basins are unique natural resource

JUNE 16, 2013 9:30 AM • BY TOM MALMSTROM / FOR THE LINCOLN JOURNAL STAR

Back in 1869, Horace Smith of the well-known firm of Smith & Wesson had a significant interest in the salt basins surrounding Lincoln.

In the early 1870s, he invested in salt manufacturing improvements. A.B. Hayes and Sam B. Cox in the "History of the City of Lincoln, Nebraska" described the early fame of the salt basins in Nebraska's Eastern Saline Wetlands and their important role in the founding of the city. Today, the remaining salt basin areas are recognized as a unique natural resource.

Of the types of wetlands found in Nebraska, the Eastern Saline Wetlands of Lancaster and Saunders counties are among the most unique and threatened in the state. Limited to the floodplain swales and depressions within the Salt Creek, Little Salt Creek and Rock Creek drainages, it's estimated that the Eastern Saline Wetlands once covered an area of more than 20,000 acres. Today, because of degradation, draining and filling, and development for agriculture and expansion of the urban area, less than 4,000 acres remain. Many of these remnants are highly degraded.

The seepage of groundwater over thousands of years from deeply buried saline aquifers has accumulated salts in the floodplain soils, allowing this unique wetland type to form. Nebraska's saline wetlands are characterized by saline soils and halophytic (salt tolerant) plant species such as spearscale, inland salt grass, sea blite, prairie bulrush and the state-endangered saltwort. The abundant mud flats of the saline wetlands are rich in invertebrate life and visited by a variety of migratory shore birds, other bird species and wildlife. Audubon Nebraska has recognized the eastern saline wetland complex as an Important Bird Area.

In 2003, a group of local and state agencies and organizations established the Saline Wetlands Conservation Partnership, including the city of Lincoln, Lower Platte South Natural Resources District, The Nature Conservancy and Nebraska Game and Parks Commission. The Nebraska Environmental Trust provides support to the partnership to implement and continue efforts to conserve the wetlands. Several other local, state and federal partners also have provided significant resources for the conservation of the wetlands.

The partnership established a plan to address the conservation of this fragile resource and

the needs of the community. The goal: "No net loss of saline wetlands and their associated functions with a long-term gain in sustaining wetland functions through the restoration of hydrology, prescribed wetland management and watershed protection."

In order to achieve this, the plan identifies comprehensive strategies and landscape objectives. In the past 10 years, the partnership has acquired nearly 1,300 acres containing saline wetlands and has worked to restore more than 500 acres of saline wetlands. These wetlands not only provide wildlife habitat, but they help to improve water quality and reduce flooding. Several of these properties also include high-quality native prairie.

More than 3,500 fifth-grade students have gone through educational programs about the wetlands and, since 2005, there has been an outdoor learning program for Lincoln North Star High School students.

The wetlands offer visitors a number of outdoor activities such as wildlife watching, nature viewing, photography and short hikes. Several saline wetland sites are available for the public, including Whitehead Wetlands (27th Street and Interstate 80), Frank Shoemaker Marsh (North 27th and Arbor Road), Little Salt Fork Marsh Preserve and Little Salt Creek Wildlife Management Area (First Street and Raymond Road), and Jack Sinn Wildlife Management Area (U.S. 77 and Ashland Road). Several saline wetland sites are open to public hunting opportunities.

People can enjoy these areas at all times of the year. In the fall and early winter the temperature is mild and there are fewer insects, while spring provides excellent bird watching. The summer months provide wildlife viewing and observation of prairie and wetland plant communities.

# Get Wet & Learn!

## Professionals Help Students

It only seems logical that a high school located adjacent to one of the most rare land types on the planet takes advantage. Lincoln's North Star High School is just south of a complex of saline wetland properties many call Whitehead Saline Wetlands, along North 27th Street near Interstate 80. North Star students and teachers do their best to learn about Nebraska's most rare and threatened natural community. It is one of two high schools in Lincoln that offers an Environmental Studies class. Tracy Chapo, winner of the Nebraska Association of Resources District's "Educator of the Year" award in 2011, teaches the North Star class. Her Environmental Studies curriculum includes lots of time in the wetlands and some of that time is orchestrated by Tom Malmstrom, coordinator of the Saline Wetlands Conservation Partnership. Malmstrom meets students in the Environmental Studies class on several Fridays during the fall months and they venture out to Whitehead to learn more from a representative of a Partnership member organization like Nebraska Game and Parks Commission, University of Nebraska or, many times, the NRD.

Each fall, Malmstrom and the volunteer experts, like NRD Water Resources Specialist Dick Ehrman, make presentations to the class. Ehrman said, "We take the class out to Whitehead and give them a demonstration on how we collect well data and talk about how that data relates back to the formation of saline wetlands." Malmstrom said, "Most of the same volunteers have been presenting to the students since the program began, in 2005. Students always seem to get more out of an actual field experience than being told about it in a classroom or reading a textbook."

continued on page 6

### Tributary Award

The Cornhusker Chapter of Pheasants Forever received the NRD's Tributary Award in January for their partnering with the NRD on a recent grassland restoration project at Meadowlark Lake. The award also recognized the organization's habitat enhancement activities and its promotion of the NRD's annual seedling tree sales.

*Saline Wetlands Conservation Partnership Coordinator Tom Malmstrom (back-left) has North Star students ready for a visit to Whitehead Saline Wetlands.*

# Protecting Lives, Property, Future

## Professionals Help Students

continued from page 5

Other presentations each year feature the benefits and wonders of wetland soils, hydrology, stream invertebrates and water quality, wetland management and conservation, urban open spaces, entomology and more. Ehrman said he enjoys the interaction with the students and gets a feeling of satisfaction that he, "may be helping one or more students decide to make a career of geology or a related field." For Malmstrom, the program has become a way to help young people realize the importance of understanding and preserving our environment.

*NRD Water Resources Specialist Dick Ehrman helps a North Star High School Environmental Studies student test a water sample for temperature, pH and conductivity using a hand-held water quality meter.*

### 20th Festival!

The 20th Earth Wellness Festival is March 26 & 27 at Southeast Community College, where 3,100 fifth graders will learn more about land, water, air and living resources. Thanks to the many who have made presentations and volunteered their time over the years and who continue to help make this event a highlight for fifth graders throughout the District.

### Camp Scholarships

When planning their summer, middle school-aged students should consider Adventure Camp about the Environment or ACE Camp! The annual camp is held each June at the State 4H Center, near Halsey and the Lower Platte South NRD offers scholarships. Learn more by looking for the ACE Camp link at lpsnrd.org.

## NRD Project Update

**Salt Creek Levee Drainage Structure Repairs, Lincoln** - Under construction. Three seperate contracts totaling about $1.5 million; NRD 100%.

**Stevens Creek Master Plan #17, 98th & Van Dorn, Lincoln** - Stream stability project. Under construction, $400,000; NRD 50%, Lincoln 50%.

**Stevens Creek Master Plan #5, 7, 8 & 9, Adams to Holdrege near 112th Street** - Stream stability projects. Right -of-way acquisition phase. NRD 50%, Lincoln 50%.

**Haymarket Ballpark Trail Extension, Lincoln** - Charleston to 14th Street. Design/Environmental Review Phase. Estimated total cost, $935,000; NRD 20%, Federal Transportation Enhancement 80%. Construction this spring.

**Piening Dam, Hwy34 & Lancaster-Seward Co. Line** - Flood control dam above Pawnee Lake. Construction est. $225,000; NRD & landowner. Permitting phase.

**Havlat Seward Co. Road Structure, south of Pleasant Dale** - Design and right-of-way acquisition currently underway. Construction est. $352,000; NRD 75%, Seward County 25%.