# Colorado Wetlands Monitoring and Evaluation Project: Migratory Bird Habitat in the South Platte River Corridor

## Final Report to
## Colorado Division of Wildlife and
## United States Fish and Wildlife Service

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# ROCKY MOUNTAIN BIRD OBSERVATORY

***The mission of the Rocky Mountain Bird Observatory (RMBO) is to conserve birds of the Rocky Mountains, Great Plains, and Intermountain West and the habitats on which they depend through research, monitoring, education, and outreach.*** *RMBO practices a multi-faceted approach to bird conservation that integrates scientific research and monitoring studies with education and outreach programs to bring bird conservation issues to the public and other conservation partners. RMBO works closely with state and federal natural resource agencies, private landowners, schools, and other nonprofit organizations. RMBO accomplishes its mission by working in four areas:*

***Research**:* *RMBO studies avian responses to habitat conditions, ecological processes, and management actions to provide scientific information that guides bird conservation actions.*

***Monitoring**:* *RMBO monitors the distribution and abundance of birds through long-term, broad-scale monitoring programs that track population trends for birds of the region.*

***Education**:* *RMBO provides active, experiential, education programs for K-12 students in order to create an awareness and appreciation for birds, with the goal of understanding the need for bird conservation.*

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# EXECUTIVE SUMMARY

This document is the Final Report for a Colorado Division of Wildlife (CDOW) Cooperative Agreement PSC-1323-06 entitled "Wetland Monitoring and Evaluation" and for Cooperative Agreement number 601816J363 with the United States Fish and Wildlife Service (USFWS) to monitor and evaluate wetland and riparian projects. This report focuses on migratory bird use of Colorado Wetlands Partnership conservation sites within the South Platte River corridor in spring of 2006. For a comprehensive review of the project, please see Steel and Cariveau (2006) and previous annual reports (Steel and Cariveau 2005, Reddy and Cariveau 2004, and Reddy *et al*. 2003), all of which are available upon request.

**Elliot State Wildlife Area Unit K**

RMBO's long-term Wetlands Monitoring and Evaluation Project (WMEP) monitors ecological outcomes from wetland conservation projects in the Colorado Wetlands Partnership (CWP), a voluntary, incentive-based program for restoring, enhancing, creating, managing, and protecting biologically significant wetlands and associated uplands.

The WMEP:

1.) Assesses and documents baseline wetland conditions on wetland conservation sites prior to conservation activity;

2.) Documents objectives for each CWP project, as stated by the project partner;

3.) Monitors projects' achievement of stated, measurable, site-specific objectives;

4.) Monitors ecological changes through time on conservation sites to determine the efficacy of conservation measures and project design; and

5.) Generates printed materials and conducts outreach to disseminate monitoring results to CWP partners.

RMBO began implementing the WMEP in 2002. Initial years of the project involved protocol development, establishment of four intensive monitoring efforts to document avian and plant community response to wetland conservation projects, and completion of 165 site assessments in 11 Wetlands Focus Areas. We also developed a database, *Evaluwet*, which contains five database modules with 47,627 data records.

This report documents 2006 activities, during which we conducted weekly waterbird surveys during spring migration on a random sample of CWP wetlands restoration, creation, and enhancement wetland projects in the South Platte River Wetlands Focus Area. Spanning twelve weeks, we conducted 257 surveys of 16 wetlands at 11 sites. We observed 16,527 birds representing 60 species, including 33 species of conservation priority under one of the North American bird conservation iniatives. We also conducted 210 weekly surveys of water depths

and extent of surface area flooding on 26 wetlands at 18 sites. At the conclusion of the migration season, we sampled wetland vegetation, documenting 132 species of plants.

The abundance of wetland-dependent birds as well as species richness varied greatly among sites. Sites that hosted high numbers of birds also hosted high numbers of species. Hydrologic conditions also varied greatly among sites, with some sites never providing wetland conditions throughout the study season and others being wet the entire season. Dry sites rarely hosted wetland-dependent birds. We found strong temporal trends in the abundance of waterfowl and shorebirds through the study season, in part driven by the migration chronologies of various species. Waterfowl and shorebird densities were most highly related to wetland size and percent of unvegetated area flooded in shallow water depth classes. We found no relationships between bird use and specific vegetation characteristics or percent of wetlands in the area surrounding wetland sites.

We calculated avian use-days for the study area and estimated over 75,000 use days on these study areas alone. Because our sites were selected randomly, they should be representative of all restoration sites within the South Platte River WFA. Thus, we can project that restoration projects within this Focus Area collectively support a minimal estimate of 410,760 avian use days per spring migration season.

A number of management implications may be drawn from this work. First, management of surface water levels drives the use of sites by both waterfowl and shorebirds. Sites that hosted high numbers of waterfowl also were used by high numbers of migrating shorebirds, demonstrating the compatibility of managing for both bird groups on the same sites. In March and April when waterfowl are most abundant, flooding of depths less than 40 cm is related to high waterfowl use, while during late April and May flooding of less than 20 cm and especially less than 4 cm will most benefit shorebirds. For both groups, the maintenance of open areas free of vegetation is also related to high bird use. Finally, we found that some sites with augmentation water rights provided high quality habitat, indicating a compatibility of use between augmentation water rights and wildlife habitat conservation.

To bring this information to the land and project managers that can best use the information on the ground, we shared our findings with the South Platte Wetlands Focus Area Committee, which is comprised of state and federal agency wetlands biologists, wetland managers, and other conservation organizations active in wetlands conservation along the South Platte River. We have also compiled a full set of Site Profiles for project and land managers to apply the information we gathered from all of the restoration sites.

The Wetlands Monitoring and Evaluation Project is a model program for evaluating the outcomes of wetland conservation projects, benefiting all participants in the Colorado Wetlands Partnership. The project provides land and project managers feedback on the efficacy of their restoration practices and helps them to design adaptive management practices. Program administrators are provided information about the breadth and successes of their program. In addition, because wetland ecosystems continue to undergo threats and available funds cannot meet all conservation opportunities, WMEP information can help determine the most effective strategies for preserving Colorado's wetlands.

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# 1 PROGRAMMATIC OVERVIEW

Colorado implemented an innovative approach to statewide wetland conservation in 1997 through the creation of the Colorado Wetlands Partnership (CWP), previously known as the Colorado Wetlands Program. The CWP is a voluntary, incentive-based partnership to protect wetlands and wetland-dependent wildlife on public and private land (CDOW 2006). Since its inception, the CWP and partners have invested approximately $40 million in wetland conservation in Colorado on over 750 projects, conserving more than 210,000 acres of wetlands and adjacent habitat and over 200 miles of streams (CDOW 2006).

In 2002, the CWP developed a monitoring program, the Wetlands Monitoring and Evaluation Project (WMEP), to provide information on the results of wetland conservation efforts. The purpose of the WMEP is to monitor and assess the ecological outcomes from CWP projects. The WMEP provides managers, biologists, conservation planners, and funding agencies with information for better understanding wetland restoration and protection outcomes in Colorado, which may be used to further refine strategic approaches to wetlands conservation in the state.

## *1.1 Colorado Wetlands Partnership*

### *CWP Projects*

Most CWP projects are small projects on private land, where a CWP partner such as the United States Fish and Wildlife Service (USFWS) Partners for Fish and Wildlife (PFW) program helps implement the project and the landowner agrees to maintain it for a number of years. Other projects are completed on public lands owned by the State of Colorado, USFWS, and Bureau of Land Management. To date, no CWP projects are located in national forests or national parks. Active management of projects on some state lands is another component of the CWP program; projects on private lands are managed opportunistically.

### *CWP Wetlands Focus Areas*

CWP Wetlands Focus Areas (WFA) are regional, watershed-based units in Colorado where committees have convened for the purpose of wetlands conservation. Based on the Joint Venture concept of the North American Waterfowl Management Plan (NAWMP), eleven WFAs have provided a local forum for coordination and collaboration on wetlands protection and provide a link between local conservation efforts and the state CWP (Figure 1.1.1).

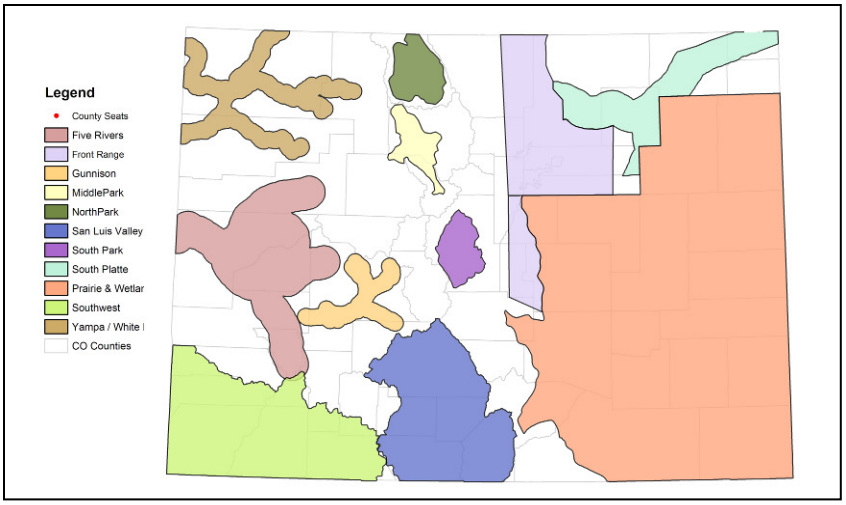



**Figure 1.1.1. CWP Wetlands Focus Areas**

Wetlands Focus Area boundaries are determined primarily by watershed, physiography, and climate; this is particularly important in Colorado where the variety of wetland types result in differing wetland protection needs from region to region. Most CWP projects (94%) are located within the boundaries of a Wetlands Focus Area. A detailed description of each CWP WFA can be found in Reddy and Cariveau 2004.

### *1.2 Wetlands Monitoring and Evaluation Project*

*Development and Significance*

In the conception of the Wetlands Program, eleven key strategies were identified, including a "wetlands program database" and "wetlands projects monitoring and evaluation" (CDOW 2000). The WMEP has implemented these two strategies, providing the CWP Coordinator and major partners with a tracking system and an independent review of CWP projects. The WMEP approach was developed in collaboration with CDOW and the Colorado Natural Heritage Program (CNHP) in 2001. RMBO began pilot monitoring and evaluation of CWP projects in 2002. The WMEP is the primary mechanism by which biological project outcomes may be measured against the goals of the CWP.

Adaptive management is often identified as a key component to resource protection programs, yet programs fall short in the monitoring step. Most programs focus on implementing on-the-ground objectives and without a monitoring component cannot conduct project or programmatic evaluation. In contrast, the WMEP provides a system to conduct monitoring, complete data-based evaluation, and communicate results to project partners. As such, the WMEP distinguishes the CWP from similar endeavors.

*WMEP Initiatives*

The WMEP includes three main components: project tracking, site assessments for a broad range of projects, and intensive monitoring at biologically significant subsets of sites.

Project tracking compiles categorical information for all CWP projects to ensure a complete database resource for the CWP. At the inception of the WMEP, no CWP data were housed in a central database. In 2004 we began gathering and verifying information on CWP projects including objectives, project description, project type, wetland type, location, partners, and contacts.

Site assessments are qualitative site-level reviews of individual projects that may be used to generate statewide information on CWP trends. Site assessments entail visits to CWP projects to document baseline ecological conditions prior to project implementation and then to document changes at 5- and 10-year intervals. To date, 165 site assessments have been completed statewide.

Intensive monitoring projects document species responses to CWP projects with quantitative data from representative subsets of CWP projects. The WMEP has conducted intensive monitoring in three major areas: riparian passerine breeding, waterfowl, waterbird, and shorebird nesting, and waterfowl and shorebird migration. This report focuses on the monitoring of spring migration by waterfowl and shorebirds in the South Platte River Wetlands Focus Area (SPRWFA) during the 2006 spring migration.

### *1.3 Migratory Bird Use of Restored Wetlands along the South Platte River*

Nearly 100 CWP projects at 60 locations along the South Platte River have been designed to provide food and cover for migrating waterbird species. The WMEP initiated intensive monitoring in 2003 on sites in the SPRWFA to determine the level of use by waterbirds and provide local wetland managers with information regarding bird responses to management regimes. We focused on creational, restoration, and enhancement projects that were applied to depressional or wet meadow wetlands, the primary habitat used by migrating waterfowl and shorebirds.

We conducted an initial set of bird surveys in fall of 2003, followed by spring surveys in 2004-2006. For a summary of the years 2003-2005, see Chapter 7 in Steel and Cariveau (2006). This report summarizes data from spring 2006. From our initial fieldwork, we found that much of the variation among sites was explained by the availability of water. Thus, we implemented a detailed hydrologic monitoring component for the 2006 field season. We also complemented the avian use and hydrologic data with quantitative vegetation sampling at the end of the migration season. In addition to collecting these data, we evaluated bird monitoring techniques to guide future monitoring efforts in the most cost effective manner. We examined the effectiveness of vantage surveys, where a wetland is visually scanned with a spotting scope, versus vantages surveys paired with flush surveys, where an observer systematically walks through a wetland to better detect concealed individuals.

Our main objectives for the 2006 study are listed below:

- Determine the conditions affecting bird use of projects in the SPRWFA
- Describe hydrological conditions on projects
- Describe vegetation characteristics of projects
- Randomly sample from all CWP projects
- Provide estimates of waterfowl and shorebird use-days for all SPRWFA projects
- Provide data to wetland managers and program administrators
- Compare two methods for monitoring birds: vantage and flush counts

# 2 INTRODUCTION

Waterfowl and shorebirds must replenish body reserves along their migration routes in order to sustain flight and to arrive at their breeding grounds in adequate body condition (Ricklefs 1974 Davidson and Evans 1988 cited in Farmer 1997). Prior to the 20th century, spring flooding along rivers in the Great Plains created expanses of shallow water habitat to support large numbers of migrating waterfowl and shorebirds. However, most of these rivers are now heavily altered to provide reservoir storage, groundwater pumping, surface flow diversion, flood control, and urban development. Flood events no longer create large spans of shallow water habitat, and migratory bird populations are therefore required to travel further between stopover locations or are relegated to using poorer quality wetlands, such as those of reservoirs or municipalities.

**Blue-winged Teal**

The lower South Platte River of northern Colorado was said to be "an inch deep and a mile wide" in the nineteenth century. Now the lower South Platte functions essentially as a 'recycled river,' exhibiting spatially and temporally disjointed flow along individual reaches heavily affected by localized land and water uses (Strange *et al*. 1999). Heavy agricultural use of both surface and ground water have essentially over-allocated the river, and an elaborate system of recharge wetlands has been developed to allow water users to augment groundwater in order to offset their usage of water for irrigation. A lack of sustained flows in the river and the loss of flood-scoured sandbar habitat have stimulated interstate compacts (and lawsuits) to protect endangered Least Tern, Piping Plover, and Whooping Crane that traditionally used the Platte River downstream. Plant community succession has been interrupted (Strange *et al*. 1999), the relative abundance of fish families and macroinvertebrate diversity have been impacted (USGS 2004), and a major shift in the composition of breeding birds has occurred over the past century in eastern Colorado (Knopf 1986).

Despite these problems, the lower South Platte River has been identified as important wetland habitat for migrating waterbirds by the CDOW, Ducks Unlimited, Inc., and USFWS PFW (CDOW 1989, Ducks Unlimited Inc. 2003, USFWS 2004). Since 1997, the CWP has funded over ninety wetlands protection, restoration, enhancement, and creation projects at sixty sites in the lower South Platte watershed to provide habitat for migrating waterfowl and shorebirds. Found on both private lands and state wildlife areas, projects often entail the construction of levees and installation of water control structures and sometimes the removal of exotic plants and planting of native seed mixes. When projects are managed via water control structures and pumps, then addition and draw down of water levels may be regulated. Some sites have water rights associated with augmentation credits, others are dependent on whenever a particular ditch receives its share of water, while other wetlands are constrained to receiving water only when

there is ample water in the river for all users (e.g., the river is "free"). In addition, some but not all sites are actively managed for wildlife habitat with practices such as mowing, disking, and deliberate drying in the summer to limit the intrusion of cattail and promote annual plant growth for seed and invertebrate production. The CWP was interested in the effect of water rights and site management on the quality of habitat provided for migratory waterfowl and shorebirds.

This study examines the use of these restored areas by migrating waterfowl and shorebirds. Waterfowl and shorebird chronology, hydrology, vegetation characteristics, landscape metrics, and other site characteristics are analyzed to evaluate current management actions and provide guidelines for future management and site selection. We specifically addressed the following issues:

- What are the optimal timing and water levels for migrating wetland dependent birds? Can water levels be effectively managed for different foraging guilds and taxa, or are there too many tradeoffs?
- How are bird abundance and richness affected by vegetation density, species of vegetation cover, and vegetation community types?
- Does the acreage of wetlands surrounding a project site influence avian abundance and diversity?
- Do augmentation ponds provide high quality wildlife habitat?

# 3 METHODS

## *3.1 Study Area and Site Selection*

We randomly sampled from all CWP project locations within the SPRWFA that met the following criteria: a creation, restoration, or enhancement (not solely land protection) project delivered by January 1, 2006 for a depressional or wet meadow wetland type. We then randomly selected 20 study sites from a total of 60 eligible project sites. Two projects were subsequently excluded because modification to the wetland was planned during the study season in one case and in the other case the wetland was known to remain dry for the rest of the season. Fieldwork was thus conducted on 18 sites (see Table 3.1.1 and Figure 3.1.1). We list privately owned sites by the nearest town. We found that we did not have sufficient time to fully survey hydrology and bird use at all sites, so we selected a random subset of eleven sites for full hydrologic and bird monitoring, the rest of which were retained for hydrologic monitoring only. For sites with multiple wetland units, we selected two units randomly for monitoring. Most analyses are at the level of the unit, as units within sites were independent with regard to water control and hydrologic regime. However, surrounding land use, water rights, and in some cases bird use may not have been independent among units within a site.

**Table 3.1.1. Study Site Attributes, South Platte River, Spring 2006.**

| Site Name | Units Surveyed | Project Year | Water Source | Hectares Surveyed |
|---|---|---|---|---|
| **Surveyed for birds and hydrology** | | | | |
| Merino 1 | A and B | 2003 | Augmentation | 1.4 and 5.1 |
| Brush Prairie Ponds SWA | 4 and 4B | 1994 | Augmentation | 6.6 and 1.1 |
| Elliott SWA | Elliott K and Hamlin Gadwall | 1998, 2001 | Irrigation | 5.2 and 7.8 |
| Merino 2 | Wet Meadow | 2005 | Augmentation | 3.5 |
| Greeley 1 | South Oxbow | 2005 | Irrigation | 4.5 |
| Merino 3 | C | 2001 | Augmentation | 5.8 |
| Jackson Lake SWA | A and F | 1993 | Irrigation | 2.3 and 1.2 |
| Sterling 1 | A and B | 2003 | Augmentation | 0.8 and 1.5 |
| Greeley 2 | Pond | 1997 | Irrigation | 9.5 |
| Crook 1 | Pond | 2003 | Runoff | 7.5 |
| Crook 2 | Pond | 2005 | Irrigation/ Augmentation | 9.6 |
| **Surveyed for hydrology only** | | | | |
| Centennial SWA | Centennial 6 and Pritchard 2 | 2002/ 2005 | Irrigation | 4.6 and 2.4 |
| Iliff | 1 and 2 | 2005 | Well/Irrigation | 5.6 and 3.6 |
| Sedgwick | 1 and 2 | 2005 | Irrigation | 0.8 and 1.8 |
| Sterling 2 | Wet Meadow | 2000 | Runoff | Missing data |
| Weldona | 1 | 1999 | Irrigation/ Augmentation | Missing data |
| Snyder | Wet Meadow | 1999 | Seep/Free water diversion | Missing data |
| Merino 4 | Wet Meadow | 2000 | Augmentation | 1.38 |

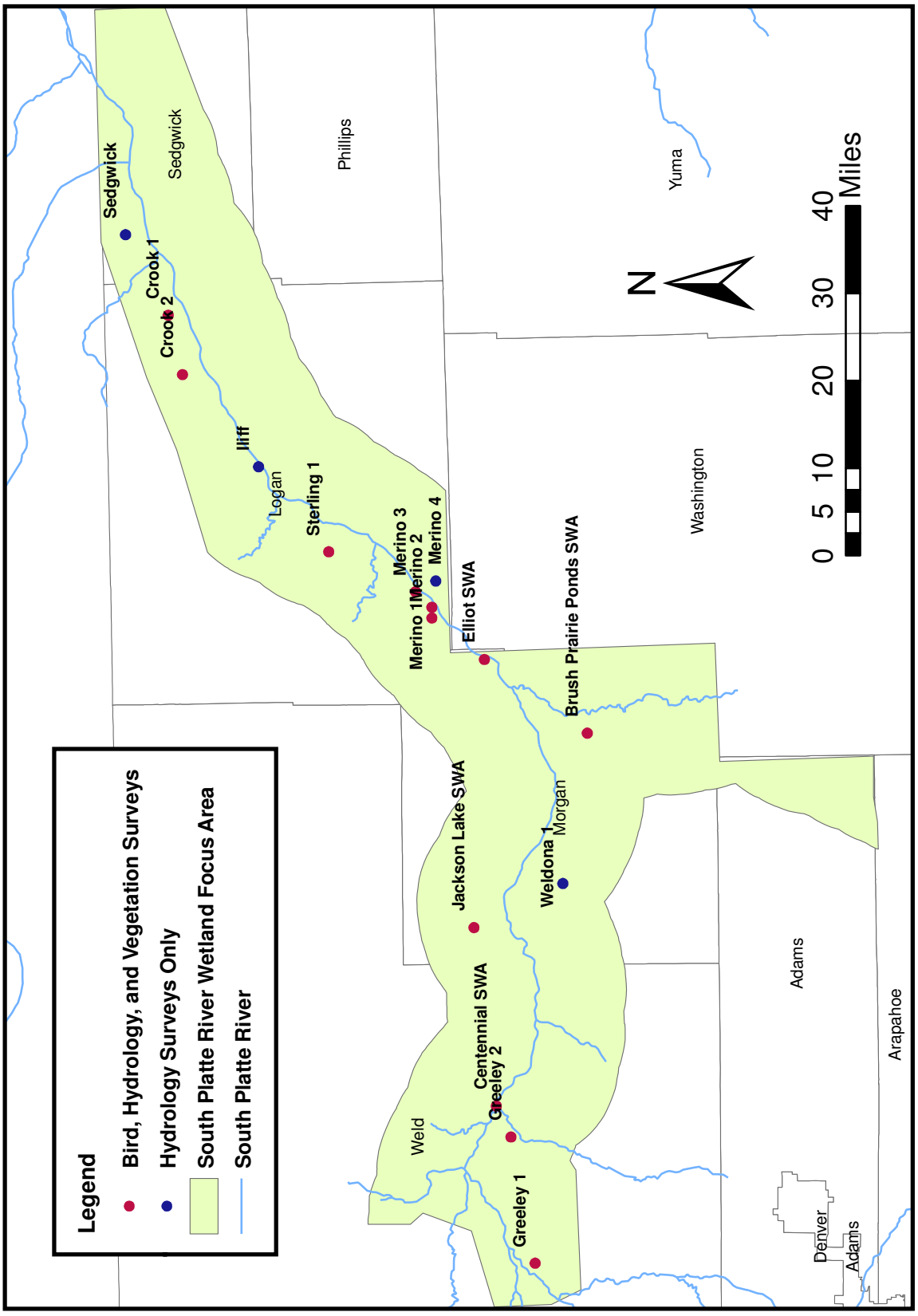



**Figure 3.1.1. Map indicating the location of study sites within the South Platte River Wetlands Focus Area, Spring 2006.**

### *3.2 Survey Effort and Field Protocols*

*Birds*

Bird surveys were conducted on average every five days on 12 sites between March 13 (week 11) and June 2, 2006 (week 22); consistent surveys were implemented across all sites for weeks 13-22. Generally, if a site contained some wetland habitat, two surveys were conducted within the week; dry sites were visited only once per week. Bird surveys on each site alternated between mornings (first light to 10 am) and evenings (3 pm to dark).

**Bird survey at Crook 1, a study wetland.**

We employed a form of double sampling adapted from Farmer and Durbian (2006), who applied similar methods for surveying shorebirds on wetlands in Missouri. Field crews of one or two observers employed two bird survey methods: vantage surveys and flush surveys. A vantage survey was followed directly by the flush survey, to facilitate comparison of the data collected by each technique. Observers were instructed to minimize time elapsed between vantage surveys and flush surveys in order to minimize entrances and exits of birds from the site during the surveys. Protocols for the survey methods are characterized as follows:

> *Vantage survey:* Monitor used spotting scope from remote vantage point to survey birds, attempting not to flush any birds. The spotting scope was positioned such that as many birds as possible (preferably all) could be surveyed from the vantage point location. On occasion, it was necessary to position the scope in several places around the wetland to ensure surveying of individuals on the far side of open water areas or in areas with dense, tall stands of vegetation. When two observers were present, one person was the observer and the other was the recorder. The observer panned from one side of the wetland basin to the other, counting individuals of a given species. The observer repeated this action for each species, until the impoundment was fully surveyed. If few birds were present (e.g., < 50) in the wetland, the panning method was still used, but tallying was done all at once rather than with repeated pans for each species.
>
> *Flush survey:* Following the vantage survey, surveyor(s) walked through or around the wetland flushing any birds, using binoculars or direct observation to identify and do a full re-count of all birds. Walk-through surveys were conducted by using a zigzag pattern to walk through the impoundment, striking stands of dense vegetation with a stick or pole to flush secretive species. Monitors circumnavigated the wetland when field crew consisted of only one observer or in areas where deep water or dense stands of vegetation made the wetland difficult to traverse.

All species of waterfowl, shorebirds, wading birds, and other waterbird species such as grebes and cormorants were identified and counted. If some individuals could not be identified, they were classed into groups (e.g., Greater and Lesser Scaup, Greater and Lesser Yellowlegs, small sandpipers in the genus *Calidris*). Unidentified dowitchers we assumed to be Long-billed

Dowitchers, based on known very low occurrence of Short-billed Dowitchers in eastern Colorado during spring migration (T. Leukering, RMBO, pers. comm.). When conditions and time allowed, the sex of identified birds was recorded. Also, other species of birds were recorded opportunistically.

We noted if birds arrived, were present throughout, or exited during the survey period, to facilitate comparison of the two survey methods. Individuals that approached a wetland but appeared to not settle perhaps due to observer presence were designated as "flyovers." Birds flying high over the site but clearly en route between two distant points were not recorded. If a species exceeded approximately 200 individuals, we grouped birds to estimate the total number of individuals and noted this on our field form. Increments of 10 per species were used for estimating total populations numbering from 200-500 and increments of 25 were allowed for populations exceeding 500 individuals on the wetland.

For each bird survey, the flooded proportion of each impoundment was visually estimated and weather conditions including temperature, cloud cover, and wind speed (using the Beaufort scale) were recorded. The beginning and end time of each survey was also documented.

*Hydrology*

Surface hydrologic surveys were conducted from March 29 (week 13) through June 2 (week 22); consistent weekly monitoring was applied to all sites weeks 15-22. We completed 210 surveys, using two methods for monitoring surface hydrology, as follows.

**Hydrological monitoring along a transect.**

1. *Hydrology Transects*. For most of the wetlands, surveyors walked a grid across the wetland taking measurements. Transects were placed 30 m apart (using a laser rangefinder) running perpendicular to the long axis of the wetland and flagged for subsequent surveys. Measurements of water presence and depth and vegetation presence and height were taken at the wetland edge, after a random number of steps (as determined at the beginning of the season for each transect), and every 10 m (by pacing) thereafter along each transect. Each point was classified as dry, saturated (damp to the touch but no standing water), or wet. For wet points, the depth of standing water was measured to the nearest 0.5 cm. by reading a meter stick at arm's length. Each point was also classified as vegetated if a 0.5 m radius around the observer was at least 25% covered by vegetation (an amount of vegetation we estimated to correspond to providing cover and visual obstruction for birds). We also recorded vegetation heights in categories as follows: A (0-20cm), B (20-50cm), C (50-100cm), and D (>100cm).

*2. Staff Gauge.* For three deep-water wetlands (average water depth exceeding 1 m) and where we expected fairly steady water levels, we used a staff gauge to monitor water depths. We placed a meter stick affixed to a permanent structure (fencepost, pole, blind, etc.) in

a deep area of the wetland to monitor the maximum or nearly maximum depth of water. We placed these at three sites (Greeley 1, Greeley 2, and Crook 1) and read the gauges weekly.

*Vegetation*

For shallow wetlands, vegetation sampling was conducted along hydrology transects. For deeper wetlands, a grid for vegetation sampling was created in the field. The first plot location was randomly selected at 10 m, 20 m, or 30 m along each transect, with subsequent plots located every 30 m thereafter. Plot locations were distant enough from one another as to be considered independent (Elzinga et al. 1998). A Robel pole was placed at each monitoring point and read at a distance of 3 m in four cardinal directions (Robel et al. 1970). In each direction, we assessed the average and maximum heights of vegetation along the rope, as well as water depths at the pole and at the end of the rope, to the nearest cm. Visual obstruction readings (VOR) were determined as the lowest mark that can be read on the Robel pole by the observer from 3 m away, at a 1 m height, to the nearest 5 cm (after Robel et al. 1970).

**Vegetation measurement using Robel pole.**

We categorized each plot into one of several broad community types: short emergent (≤ 50 cm in height, such as *Carex* or *Juncus*), tall emergent (plants >50 cm in height, such as *Typha*), mesic shrub (shrubs preferring wet conditions, such as willows), xeric shrub, (shrubs commonly found in uplands, such as rabbitbrush), salt grass, open water, bare ground, alkali flat (characterized by white precipitate visible on soil, alkaline species), grass, forb, and weed (dominated by exotic species).

**I $m^2$ plot for estimating canopy cover.**

We characterized plant species composition using a $1m^2$ frame placed directly underneath the rope extended in one of the cardinal directions and 1 m from the Robel pole. One plot was surveyed at each Robel point, in a randomly selected cardinal direction. We estimated percent canopy cover for each plant species as well as bare ground, open water, duff (loose, unrooted, dead plant material) and unknown residual (unidentified dead standing plant material). Total percent cover could exceed 100% in some cases due to layering. Unknown plants were collected, pressed, and identified by a local botanical expert, Don Hazlett. Plants in the genera *Carex, Juncus*, and *Eleocharis* were generally not identified to species.

A total of 594 plots were read across all sites, with an average of 33 plots per site (range = 7-81). The average number of plots per hectacre was 8.04 ± 0.12.

*Site Boundaries, Area, and Mapped Community Types*

Units were circumnavigated with a Trimble GPS unit along the wetland margin, as estimated by vegetation ecotone. GPS data were then processed in ArcGIS 9.0 to calculate wetland area. We also delineated the broad community types as indicated in the vegetation section above.

### *3.3 Data Processing and Analysis*

All data processing and analysis was done using Program R, version 2.4.1 (http://www.r-project.org/).

*Birds*

We estimated avian abundance and species richness from 257 bird surveys at 16 units on 11 sites. Of these, 180 were paired vantage and flush surveys. A total of 208 bird surveys were conducted during the period for which we have hydrology data (weeks 14-22), of which 180 (87%) were paired surveys. We calculated a maximum count for each species for each survey, combining data from both techniques and including birds that arrived, exited, and flew over. This is the metric used in our habitat models. Occasionally, some individuals were only identified to group during one of the surveys and to species during the other survey. In such instances, an algorithm was used to allocate a maximum number of the unknown group to identified species. An example of the procedure used is detailed in Table 3.3.1.

**Table 3.3.1. Numbers of birds counted during vantage and flush surveys and maximum count.**

| Species | N Vantage | N Flush | Maximum Count |
|---|---|---|---|
| Green-winged Teal | 5 | 5 | 5 |
| Blue-winged Teal | 5 | 6 | 6 |
| Gadwall | 5 | 4 | 5 |
| Mallard | 5 | 4 | 5 |
| Unknown Duck | 0 | 3 | 1 |
| **Total Birds** | **20** | **22** | **22** |

If multiple bird surveys were completed on a unit within a week, we averaged the data for analysis. We then divided bird abundance estimates by acreages delineated in the field to gain bird density estimates for each survey week.

To calculate avian use-days, we multiplied our weekly season-long totals by 84, representing the 12 weeks of our study period. To extrapolate use-days to the study population of wetlands restoration sites within the South Platte River Focus Area, we multiplied by our sampling fraction (11 of 60 sites). We did not correct for the fact that we did not sample all units at each site, so our estimates are probably biased low.

To determine the conservation status of species we observed, we examined the priority lists of the state of Colorado, the federal Endangered Species List, as well as those of the North American bird conservation initiatives for wetland-dependent birds: the North American Waterfowl Management Plan (NAWMP), the United States Shorebird Conservation Plan (USSCP), the North American Waterbird Conservation Plan (NAWCP).

To model shorebird habitat use, we excluded Killdeer, Wilson's Snipe, Red-necked Phalarope, and Wilson's Phalarope due to habitat preferences different than the bulk of the migrant birds. Our waterfowl habitat use model is limited to dabbling ducks (excludes geese and diving ducks).

*Hydrology Data*

For each week during which hydrology transect data were taken, we summed all of the plots per wetland and generated a proportion in the each water depth class. These values were multiplied by the area of each wetland to create a composite hydrologic profile for the study sites as a whole. We also calculated proportions of sites that were classified as vegetated and nonvegetated within each of the water depth classes.

*Vegetation Data*

We categorized plants with regard to several attributes, to assess whether vegetation composition was related to bird use. Plants were classed as annual or perennial, native or exotic, and according to their wetland indicator status as defined in the United States Department of Agriculture national PLANTS database (USDA, NRCS, 2007). We combined the percent cover of wetland-obligate and facultative wetland plants on our study plots for analysis. We also categorized all plant species as to their forage value for waterfowl, based on consultation with Jim Gammonley, an avian researcher with CDOW who has been investigating waterfowl seed sources on wetlands along the South Platte River. Cover by plants categorized as "high" was summed into a variable of "waterfowl plants" for analysis. To present results from all sites, we summed percent cover values for all sites and then provide the breakdown into categories.

**Seeds from alfalfa and curly dock, good seed sources for waterfowl.**

*Landscape Metrics*

To analyze how the area of wetlands surrounding the study units affected bird abundance and richness, we examined three land use layers as potential data sources: the Colorado Riparian Vegetation Mapping Project,[1] the Colorado Gap Analysis Project[2], and the Colorado Vegetation Classification Project (CVCP).[3]

Although the Colorado Riparian Vegetation Mapping Project is the most detailed data source for wetland, intermittent wetland, and riparian areas, data were not available for two of our study sites (Brush Prairie Ponds and Matlock). In order to have consistent data for all sites, we elected not to use the above project. Of the remaining two layers, the Colorado Gap Analysis

[1] http://ndis1.nrel.colostate.edu/riparian/riparian.htm
[2] http://ndis1.nrel.colostate.edu/cogap/
[3] http://ndis.nrel.colostate.edu/coveg/

Project used Landsat images from 1984-1990, while the Colorado Vegetation Classification Project used Landsat images from 1993-1995. We selected the more recent CVCP data, which also benefited from improvements in technology and methodology.

We summarized the wetland cover types of the CVCP within a 1 km and 5 km buffer for each study site, which included riparian, herbaceous riparian, and open water. We selected two buffer distances because of uncertainty in the area a bird selects during stopover. The smaller radius characterizes the degree to which a unit is directly surrounded by other wetlands, while the larger radius portrays areas of high wetland density.

We used linear regression to examine how mean birds/hectare was affected by the amount of "wetland" within 1 km and 5 km of a site, defined as percent riparian plus percent herbaceous riparian, as well as by percent open water. Mean birds/hectacre was calculated by summing bird data across weeks for each unit and dividing by the field delineated size of each unit. Because units within sites had overlapping buffer areas, we averaged the total birds and the landscape variables for multiple units within sites to avoid pseudoreplication. This yielded a dataset of 11 observations. Residuals for the specifications were examined, and the data were roughly consistent with normality assumptions.

*Avian Use Models*

To describe the response of shorebirds and waterfowl to wetland conditions on our study areas throughout the study season, we created a series of general linear mixed models. We predicted that the amount of wetlands in the landscape surrounding sites, wetland sizes, water depths, and types of vegetation would affect bird use. Some models were simple regressions of bird numbers or densities on several static factors. For these, we report the adjusted R-squared ($\hat{R}^2$). To capture relationships of birds to dynamic water levels and vegetation conditions, we built repeated measures models that also accounted for variance in that bird numbers through the season due to species-specific migration chronologies.

Because our bird metrics were log-normally distributed, we either employed a general linear mixed models with a log-link maximization function (GLMMPQL in R) or transformed our data using the equation: log((bird abundance+1)/area)) and then modeled with normal errors. For the weekly models, weekly surveys were repeated measures on wetland unit, which was entered as a random effect. When comparing alternate models, we used a stepwise approach, starting with a simple model, adding variables, and selecting the simplest model that contained all variables of interest significant at $p<0.05$.

# 4 RESULTS

## *4.1 Avian Species and Abundance*

A total of 16,257 birds of 60 species were recorded on 322 avian surveys (see Appendix A for a comprehensive list and Appendix C for lists by site). We detected 10,863 waterfowl comprising 21 species and 4,084 shorebirds comprising 24 species. Sixty-nine of the surveys (27%) yielded no birds.

Avian numbers were highly correlated with species richness when averaged for the season of surveys and across all study sites ($R^2$ = 0.92; Figure 4.1.1).

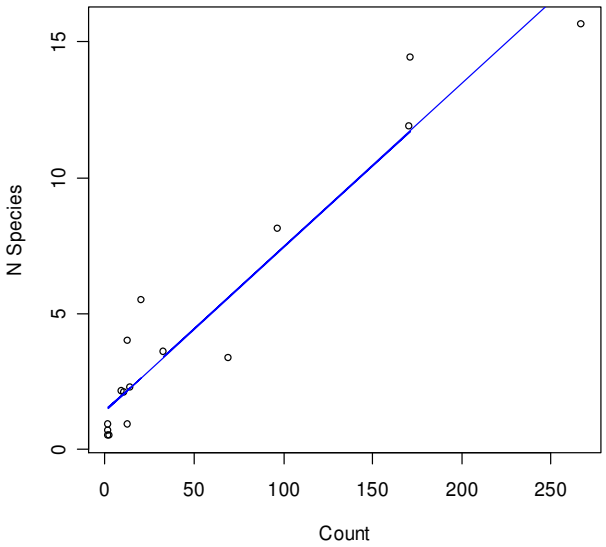



**Figure 4.1.1. Relationship of average avian abundance and species richness across study units.**

*Species of Concern*

Thirty-three species of concern were observed during the course of the study. We observed three species of waterfowl of high concern and six species of moderately high concern under the NAWMP. On study sites, we recorded over 1000 each of Northern Pintail and Mallards, species of high non-breeding need for the this Waterfowl Conservation Region. We observed five shorebird species of high concern by the USSCP, including over 750 Wilson's Phalarope and two Piping Plover, a federally threatened species. An additional seven shorebirds were regional priority species under the USSCP; the study sites hosted high numbers of Baird's Sandpiper, Least Sandpiper, Long-billed Dowitcher, and Stilt Sandpiper. Study sites also hosted five species of waterbirds classified as Moderate Concern under the NAWCP.

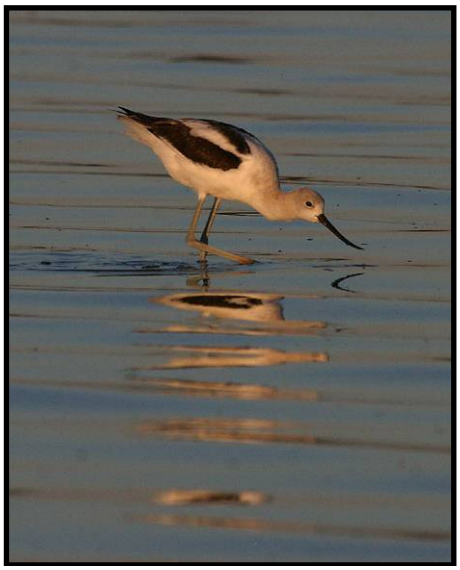
**Lesser Scaup, a high priority species**

*Chronology*

The density of all birds was highest at the beginning of the study season (Figure 4.1.1.A), mostly driven by the abundance of waterfowl at that time (Figure 4.1.1.B). A second spike in overall bird abundance was noted in the middle of April, when shorebird densities reached their peak (Figure 4.1.1.C). Waterfowl density declined linearly through time, indicating that we began monitoring at the height of waterfowl densities and thus may not have fully captured the numbers moving through the study areas for the entirety of the season. Shorebird density spiked in week 18, in the middle of April. It is likely that our sampling period better captured the bulk of the shorebird numbers for the whole season.

*Avian Densities*

We calculated an overall average of approximately 14 birds per hectare surveyed over the entirety of the field season (Table 4.1.1.)



**American Avocet, a priority species**

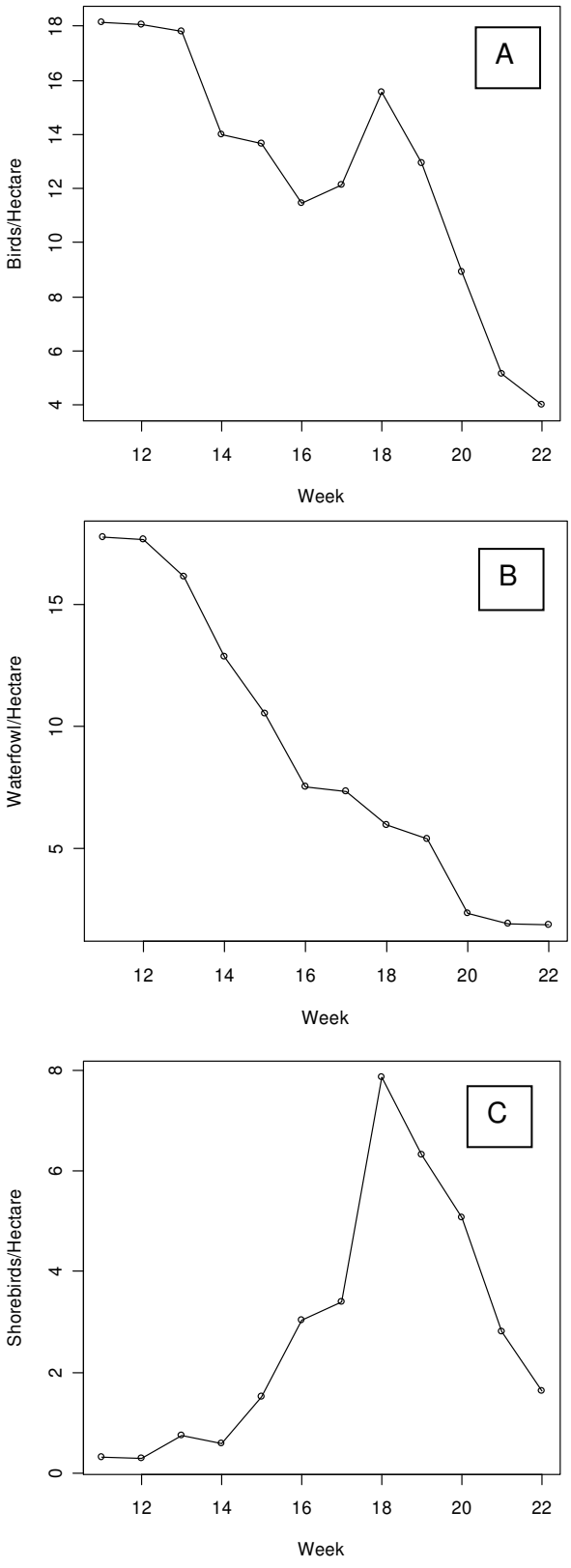



**Figure 4.1.1. Spring migration chronology of all birds, waterfowl, and shorebirds.**

**Table 4.1.1. Average birds/hectare per unit for various avian groups, South Platte River, Spring 2006.**

| | Waterfowl | | | | Shorebirds | | | Marsh -birds | All Birds |
|---|---|---|---|---|---|---|---|---|---|
| Site and Unit | Dabbling Ducks | Diving Ducks | Geese | All | Snipe | Phal-arope | All | | |
| Merino 1 Unit A | 0.65 | 0.00 | 0.00 | 0.80 | 0.10 | 0.00 | 0.35 | 0.00 | 2.31 |
| Merino 1 Unit B | 0.08 | 0.00 | 0.00 | 0.08 | 0.27 | 0.00 | 0.40 | 0.00 | 0.48 |
| Brush Prairie Pond SWA 4 | 10.53 | 0.56 | 0.13 | 14.74 | 0.28 | 2.85 | 8.51 | 0.01 | 27.25 |
| Brush Prairie Pond SWA 4B | 9.99 | 3.52 | 0.20 | 16.67 | 0.25 | 0.76 | 3.31 | 0.00 | 23.50 |
| Elliott SWA: K | 0.95 | 0.00 | 0.03 | 1.04 | 0.03 | 0.00 | 0.14 | 0.00 | 1.21 |
| Elliott SWA: Hamlin Gadwall | 4.13 | 0.00 | 0.08 | 4.76 | 0.04 | 0.02 | 0.62 | 0.01 | 5.38 |
| Merino 2 Wet Meadow | 1.78 | 0.00 | 0.00 | 4.34 | 0.00 | 0.00 | 0.39 | 0.00 | 5.16 |
| Greeley 1 | 1.40 | 0.00 | 0.67 | 2.07 | 0.18 | 0.00 | 0.27 | 0.13 | 2.95 |
| Merino 3 Unit C | 9.15 | 0.02 | 0.06 | 10.53 | 0.00 | 0.03 | 0.89 | 0.00 | 11.44 |
| Jackson Lake SWA A | 4.65 | 0.00 | 0.07 | 4.72 | 1.62 | 0.00 | 2.73 | 0.00 | 7.45 |
| Jackson Lake SWA F | 0.71 | 0.00 | 0.00 | 0.71 | 0.15 | 0.00 | 0.96 | 0.00 | 1.67 |
| Sterling 1 Unit A | 0.99 | 0.00 | 1.76 | 2.75 | 0.00 | 0.00 | 0.23 | 0.00 | 3.13 |
| Sterling 1 Unit B | 1.58 | 0.28 | 0.16 | 2.03 | 0.08 | 0.16 | 6.49 | 0.00 | 8.68 |
| Greeley 2 Pond | 7.45 | 0.60 | 0.58 | 16.27 | 0.00 | 1.95 | 2.22 | 0.19 | 19.92 |
| Crook 1 Pond | 4.42 | 3.21 | 0.07 | 9.13 | 0.02 | 0.65 | 0.74 | 0.02 | 10.61 |
| Crook 2 Pond | 9.90 | 0.44 | 3.88 | 14.68 | 0.00 | 0.61 | 10.60 | 0.00 | 26.99 |
| All Sites | 5.74 | 0.66 | 0.79 | 9.02 | 0.11 | 0.73 | 3.39 | 0.03 | 13.50 |

*Variation among study units*

Use by birds varied greatly among study units, with 87% of all the birds detected from five units (see Table 4.1.1). The units that hosted the greatest numbers of birds throughout the season were Crook 2, followed by Brush Prairie Ponds (Brush) Unit 4, Greeley 2 Pond, Crook 1 Pond, and Merino 3 Unit C. When standardized by area, the densities of all birds were highest on those same sites; in addition, Brush Unit 4B also hosted high densities.

The same sites hosted the top densities of waterfowl, with Brush Unit 4B highest, followed by Greeley 2 Pond, Brush Unit 4, Merino 3 Unit C and Crook 2 Pond. Six of the sixteen study units accounted for 91% of the dabbling ducks surveyed.

The highest densities of shorebirds were found at Crook 2 Pond, followed by Brush Unit 4, Sterling 1 Unit B, Brush Unit 4B, and Jackson Lake SWA Unit A.

Secretive marshbirds were densest at Greeley 2 Pond, followed by Greeley 1; they were also at low densities at three other units: Crook 1 Pond, Elliot SWA Hamlin: Gadwall, and Brush Unit 4.

*Use-days*

We calculated 75,306 avian use-days from our dataset, representing nearly the entirety of the spring migration season (Table 4.1.2). This extrapolation is only to our study sites. Since our sites are a random sample of all restoration sites within the South Platte River WFA, then we can project the area supports approximately 410,760 avian use days per spring migration season. Similarly, the projected number of waterfowl use days would be 281,798 and for shorebirds, 97,088.

**Table 4.1.2. Use-days of various bird groups, by unit, South Platte River, Spring 2006.**

| | Waterfowl | | | | Shorebirds | | | Marsh -birds | All Birds |
|---|---|---|---|---|---|---|---|---|---|
| Site and Unit | Dabbling Ducks | Diving Ducks | Geese | All | Snipe | Phal-arope | All | | |
| Merino 1 A | 53 | 0 | 0 | 74 | 14 | 0 | 39 | 0 | 193 |
| Merino 1 B | 28 | 0 | 0 | 28 | 102 | 0 | 140 | 0 | 168 |
| Brush Prairie Pond SWA 4 | 5,593 | 329 | 74 | 7,934 | 171 | 1,452 | 4,437 | 4 | 14,370 |
| Brush Prairie Pond SWA 4B | 753 | 231 | 17 | 1,163 | 25 | 59 | 252 | 0 | 1,688 |
| Elliott SWA: K | 605 | 0 | 25 | 672 | 92 | 0 | 197 | 0 | 878 |
| Elliott SWA:Hamlin Gadwall | 2,127 | 0 | 46 | 2,432 | 19 | 11 | 344 | 4 | 2,780 |
| Merino 2 Wet Meadow | 344 | 0 | 0 | 817 | 0 | 0 | 118 | 0 | 1,096 |
| Greeley 1 | 490 | 0 | 294 | 784 | 49 | 0 | 88 | 53 | 1,096 |
| Merino 3 C | 4,732 | 7 | 35 | 5,310 | 0 | 21 | 508 | 0 | 5,824 |
| Jackson Lake SWA A | 747 | 0 | 9 | 756 | 247 | 0 | 429 | 0 | 1,185 |
| Jackson Lake SWA F | 53 | 0 | 0 | 53 | 11 | 0 | 80 | 0 | 134 |
| Sterling 1 Unit A | 53 | 0 | 88 | 140 | 0 | 0 | 18 | 0 | 172 |
| Sterling 1 Unit B | 151 | 25 | 14 | 189 | 14 | 14 | 588 | 0 | 791 |
| Greeley 2 Pond | 5,940 | 539 | 417 | 11,022 | 0 | 1,929 | 2,195 | 175 | 14,350 |
| Crook 1 Pond | 3,679 | 2,492 | 53 | 7,214 | 11 | 340 | 396 | 11 | 8,138 |
| Crook 2 Pond | 9,223 | 326 | 2,947 | 13,076 | 0 | 445 | 7,973 | 0 | 22,446 |
| All Sites | 34,567 | 3,948 | 4,018 | 51,663 | 755 | 4,270 | 17,800 | 246 | 75,306 |

## *4.2 Hydrology*

Through hydrologic monitoring of 26 units on 18 sites across the study season, we found that half of the units by week were wet (saturated soils and/or standing water) and half were dry (n=212; Table 4.2.1). In general, some sites were predominantly wet, while others were predominantly or entirely dry. Seven units maintained wet conditions throughout the study period, while three units were never wet.

**Table 4.2.1. Hydrologic conditions on study areas, South Platte River, Spring 2006.**

| | Week | | | | | | | | | | % |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Site and Unit | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | Wet |
| Merino 1 Unit A | | Wet | Wet | Dry | Dry | Dry | Dry | Dry | Dry | Dry | **22** |
| Merino 1 Unit B | | Wet | Wet | Dry | Dry | Dry | Dry | Dry | Dry | Dry | **22** |
| Brush Prairie Ponds SWA 4 | | | Wet | Wet | Wet | Wet | Wet | Wet | Wet | Wet | **100** |
| Brush Prairie Ponds SWA 4B | | | Wet | Wet | Wet | Wet | Wet | Wet | Wet | Wet | **100** |
| Centennial SWA 6 | | Dry | | Wet | Wet | Wet | Wet | Wet | Dry | Dry | **63** |
| Centennial SWA Pritchard 2 | | Dry | | Wet | Dry | Dry | Dry | Wet | Wet | Wet | **50** |
| Elliott SWA: K | | Wet | Wet | Wet | Wet | Dry | Dry | Dry | Dry | Dry | **44** |
| Elliott SWA: Hamlin Gadwall | | | Wet | Wet | Wet | Wet | Dry | Dry | Dry | Dry | **50** |
| Merino 2 Wet Meadow | | | Wet | Dry | Dry | Dry | Dry | Dry | Dry | Dry | **13** |
| Greeley 1 | | | Wet | Wet | Wet | Wet | Wet | Wet | Wet | | **100** |
| Iliff Unit 1 | | Dry | Dry | Dry | Dry | Dry | Dry | Wet | Wet | Wet | **33** |
| Iliff Unit 2 | | Dry | Dry | Dry | Dry | Dry | Dry | Dry | Dry | Dry | **0** |
| Merino 3 Unit C | Wet | Wet | Wet | Wet | Wet | Dry | Dry | Dry | Dry | Dry | **50** |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Sedgwick Unit 1 | | | Dry | Dry | Dry | Dry | Dry | Dry | Dry | | **0** |
| Sedgwick Unit 2 | | | Dry | Dry | Dry | Dry | Dry | | Wet | | **17** |
| Jackson Lake SWA Unit A | | Wet | Wet | Dry | Dry | Dry | Dry | Dry | Dry | Dry | **22** |
| Jackson Lake SWA Unit F | | Wet | Wet | Wet | Wet | Wet | Wet | Wet | Wet | Dry | **89** |
| Sterling 2 Wet Meadow | | | Dry | Dry | Dry | Dry | Dry | Dry | Dry | | **0** |
| Sterling 1 Unit A | | | Wet | Wet | Dry | Dry | Dry | Dry | Dry | Dry | **25** |
| Sterling 1 Unit B | | | Wet | Wet | Wet | Wet | Wet | Wet | Dry | Dry | **75** |
| Weldona 2 Unit 1 | | | Wet | Wet | Wet | Wet | Wet | Wet | Wet | Wet | **100** |
| Greeley 2 Pond | | | Wet | Wet | Wet | Wet | Wet | Wet | Wet | | **100** |
| Crook 1 Pond | | | Wet | Wet | Wet | Wet | Wet | Wet | Wet | Wet | **100** |
| Crook 2 Pond | | | Wet | Wet | Wet | Wet | Wet | Wet | Wet | Wet | **100** |
| Snyder Wet Meadow | | | Dry | Dry | | Dry | Wet | Dry | Dry | Dry | **14** |
| Merino 4 Wet Meadow | | | Wet | Dry | Dry | Dry | Dry | Dry | Dry | Dry | **13** |
| Count of Wet | 1 | 6 | 18 | 15 | 13 | 11 | 11 | 12 | 11 | 7 | 105 |
| Count of Dry | 0 | 4 | 6 | 11 | 12 | 15 | 15 | 13 | 15 | 14 | 105 |
| Proportion of Units Wet | 1.0 | 0.60 | 0.75 | 0.59 | 0.52 | 0.41 | 0.42 | 0.48 | 0.42 | 0.33 | 0.50 |

The greatest proportion of units was wet early in the season (75% in week 15, week of April 10), after which the proportion of wet units dropped to 33% in week 22. Average water depths across all sites varied from about 28 cm in week 15 to 14 cm in week 22 (Figure 4.2.1). Across all shallower units with grid-based hydrologic sampling, the amount of wetland habitat increased to a peak in week 17 (Figure 4.2.2). The shallowest depth classes peaked in week 18. Generally, the amount of habitat in the greater than 40 cm water depth class was most abundant for the duration of the study.

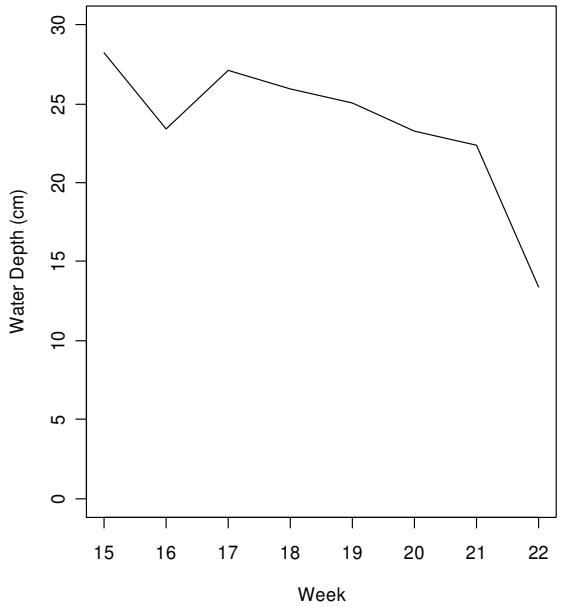



**Figure 4.2.1. Mean water depths across all units in spring 2006.**

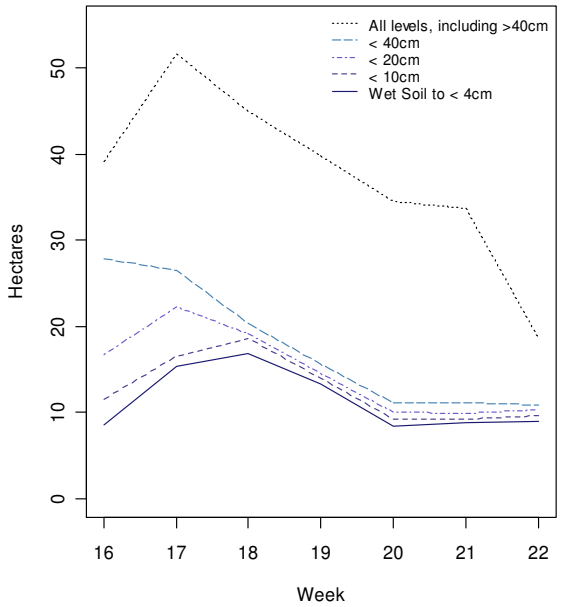



**Figure 4.2.2. The number of hectacres available in various water depth classes across all units in spring 2006.**

We found a strong relationship between a site being characterized as having at least some part of the wetland as saturated or containing standing water ("wet conditions") and hosting wetland-dependent birds. For 36 unit-week surveys that were characterized as "dry," only one hosted any wetland-dependent birds (3%). In contrast, for 54 unit-weeks characterized by wet conditions, 94% of surveys detected wetland birds.

### *4.3 Vegetation*

When combining data across all study areas, approximately one fourth of the vegetation plots were classified into the community type of bare ground/open water (24%; combined here because of the sensitivity of these two classes to changes in water level), one fourth as tall emergent vegetation (24%), one fourth as weed (24%), 16% as grass, and 12% as short emergent vegetation. The range of variation across sites is depicted in Table 4.3.1.

**Table 4.3.1. Community types as classified by vegetation plots, South Platte River, Summer 2006.**

| Site and Unit | Bare Ground | Forb | Grass | Open Water | Short Emergent | Tall Emergent | Weed |
|---|---|---|---|---|---|---|---|
| Merino 1 A | 82% | 0% | 18% | 0% | 0% | 0% | 0% |
| Merino 1 B | 2% | 2% | 45% | 0% | 0% | 0% | 50% |
| Brush Prairie Ponds SWA 4 | 24% | 0% | 5% | 0% | 30% | 30% | 11% |
| Brush Prairie Ponds SWA 4B | 0% | 0% | 0% | 40% | 0% | 60% | 0% |
| Centennial SWA 6 | 0% | 0% | 89% | 0% | 11% | 0% | 0% |
| Centennial SWA Pritchard | 0% | 0% | 64% | 0% | 36% | 0% | 0% |
| Elliott SWA Unit K | 0% | 0% | 49% | 0% | 12% | 0% | 39% |
| Elliott SWA: Hamlin Gadwall | 0% | 0% | 38% | 0% | 7% | 0% | 55% |
| Merino 2 Wet Meadow | 45% | 0% | 55% | 0% | 0% | 0% | 0% |
| Greeley 1 South Oxbow | 0% | 0% | 0% | 35% | 13% | 52% | 0% |
| Merino 3 C | 8% | 0% | 6% | 0% | 0% | 0% | 87% |
| Jackson Lake SWA Unit A | 0% | 0% | 0% | 0% | 100% | 0% | 0% |
| Jackson Lake SWA Unit F | 0% | 0% | 50% | 0% | 50% | 0% | 0% |
| Sterling 1 Unit A | 0% | 0% | 29% | 0% | 0% | 0% | 71% |
| Sterling 1 Unit B | 23% | 0% | 23% | 0% | 0% | 0% | 54% |
| Greeley 2 Pond | 0% | 0% | 0% | 23% | 8% | 69% | 0% |
| Crook 1 Pond | 3% | 0% | 0% | 3% | 3% | 83% | 10% |
| Crook 2 Pond | 64% | 0% | 2% | 15% | 12% | 0% | 6% |

We documented 132 species of plants on the study sites (see Appendix B for comprehensive list and Appendix C for lists of plants by sites). When ranked by percent cover, the top five species were cattail, curly dock, western wheatgrass, cheatgrass, and duckweed.

Sites were quite variable in terms of plant composition (Table 4.3.2). Across all sites over half of the vegetation was non-native (11% could not be classified, usually because it was not identified to species; see Figure 4.3.1). Wetland obligate and facultative wetland plants accounted for 45% of the cover across all sites; see Figure 4.3.2. Vegetation cover across sites was comprised of 39% annual and 60% perennial plants. Across all sites, 25% of the vegetative cover was by plants that were classified as "high quality forage" for waterfowl. Table 4.3.2 portrays the site by site variation in these variables.

**Table 4.3.2. Vegetation characteristics across study sites, South Platte, Spring 2006.**

| Site and Unit | Native | Wetland (Obl/Fac) | Annual | High Forage Value | Mean Plant Ht (cm) |
|---|---|---|---|---|---|
| Merino 1 A | 8% | 0.0% | 99% | 16% | 8 |
| Merino 1 B | 3% | 0.1% | 91% | 9% | 27 |
| Brush Prairie Ponds SWA 4 | 28% | 66.0% | 18% | 42% | 32 |
| Brush Prairie Ponds SWA 4B | 1% | 93.5% | 2% | 1% | 66 |
| Centennial SWA Centennial 6 | 34% | 28.6% | 5% | 3% | 27 |
| Centennial SWA Pritchard 2 | 13% | 14.6% | 26% | 21% | 34 |
| Elliott SWA Elliot: K | 65% | 13.1% | 12% | 7% | 56 |
| Elliott SWA Hamlin: Gadwall | 44% | 45.9% | 27% | 47% | 35 |
| Merino 2 Wet Meadow | 64% | 0.9% | 42% | 7% | 11 |
| Front Range LL South Oxbow | 26% | 89.9% | 0% | 3% | 85 |
| Merino 3 C | 55% | 8.4% | 81% | 26% | 15 |
| Jackson Lake SWA A | 66% | 70.8% | 16% | 32% | 19 |
| Jackson Lake SWA F | 33% | 34.3% | 60% | 49% | 28 |
| Sterling 1 A | 33% | 1.4% | 95% | 27% | 20 |
| Sterling 1 B | 25% | 0.0% | 47% | 9% | 22 |
| Greeley 2 Pond | 32% | 94.1% | 3% | 6% | 124 |
| Crook 1 Pond | 23% | 74.1% | 4% | 9% | 114 |
| Crook 2 Pond | 23% | 32.1% | 84% | 80% | 5 |

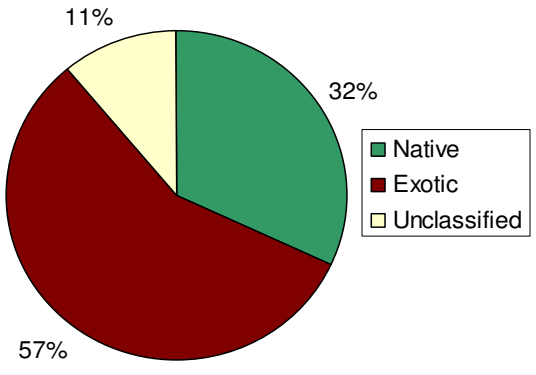



Figure 4.3.1. Percent of vegetative cover across all sites that was native or exotic.

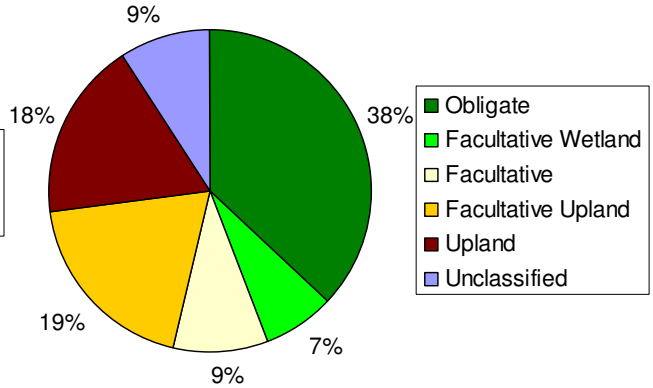



Figure 4.3.2. Percent of vegetative cover on sites classified by wetland dependence.

### *4.4 Landscape Context*

Sites varied in how much wetland habitat directly surrounded them (within 1 km), from less than one percent at two private lands sites to 31% at Brush Prairie Ponds (Table 4.4.1). Likewise, the amount of open water surrounding sites also varied, from a high of 39% at Jackson Lake SWA to less than one percent at some sites.

**Table 4.4.1. The percent of the landscape surrounding study sites along the South Platte River covered by wetland and open water habitat.**

| | 1 km Radius | | 5 km Radius | | |
|---|---|---|---|---|---|
| **Site** | **Wetlands** | **Water** | **Wetlands** | **Water** | **Birds/Ha** |
| Merino 1 | 4% | 1% | 4% | 5% | 1.00 |
| Brush Prairie Ponds SWA | 31% | 2% | 8% | 1% | 22.10 |
| Elliott SWA/Hamlin | 9% | 5% | 5% | 2% | 3.13 |
| Merino 2 | 0% | 0% | 4% | 1% | 3.77 |
| Greeley 1 | 0% | 1% | 4% | 1% | 3.10 |
| Merino 3 | 1% | 3% | 3% | 1% | 11.91 |
| Jackson Lake SWA | 3% | 39% | 1% | 12% | 3.81 |
| Sterling 1 | 2% | 0% | 1% | 0% | 4.57 |
| Greeley 2 | 1% | 3% | 3% | 1% | 18.00 |
| Crook 1 | 2% | 1% | 4% | 2% | 12.92 |
| Crook 2 | 8% | 1% | 4% | 1% | 27.98 |
| **Average (Standard Error)** | **5% (0.03)** | **5% (0.03)** | **4% (0.01)** | **3% (0.01)** | **10.21 (2.62)** |

### *4.5 Avian Habitat Models*

The numbers of all birds, shorebirds, and dabbling ducks all related strongly to wetland area. For all birds, this was a non-linear effect best described by hectares + hectares$^2$ ($\hat{R}^2$ = 0.72; Figure 4.5.1).

Waterfowl abundance also was best described by a model with hectares + hectares$^2$ ($\hat{R}^2$ = 0.73; Figure 4.5.2).

Shorebird abundance related linearly to area ($\hat{R}^2$ = 0.19); the addition of hectares$^2$ was not significant ($p > 0.05$; Figure 4.5.3).

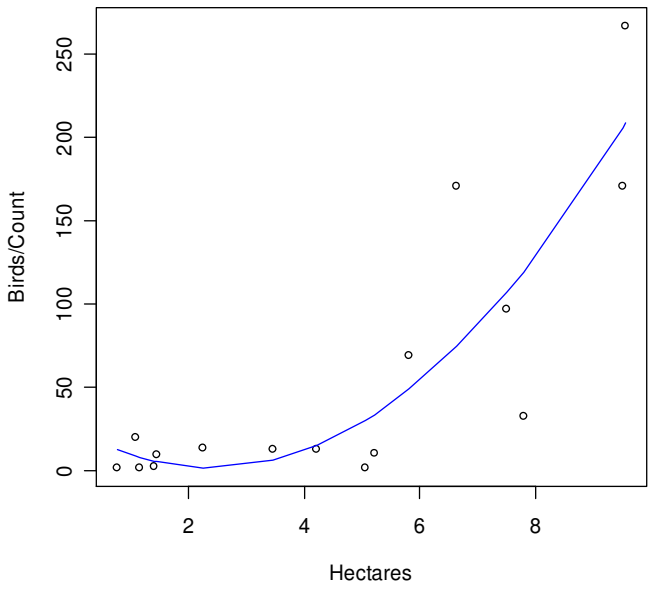



**Figure 4.5.1. Bird numbers in relation to wetland area.**

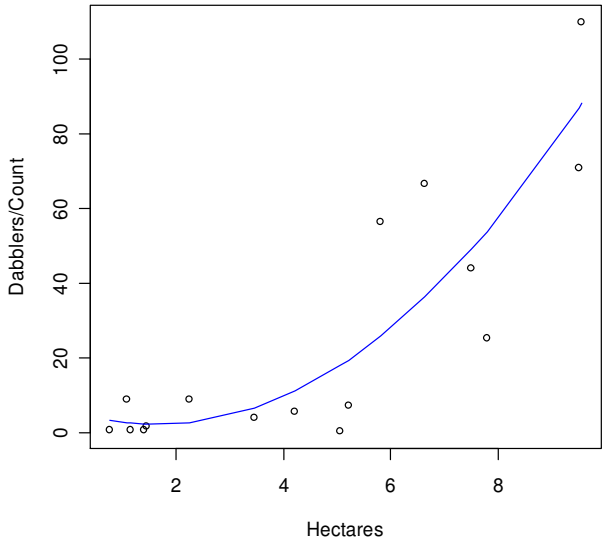



**Figure 4.5.2. Waterfowl numbers in relation to wetland area.**

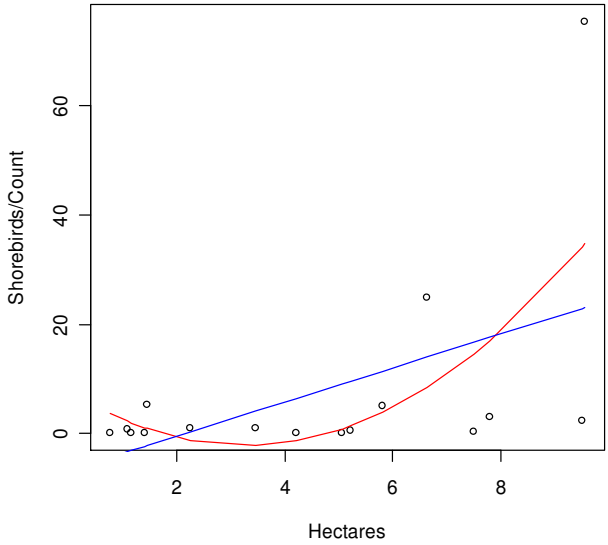



**Figure 4.5.3. Shorebird numbers in relation to wetland area.**

For overall species richness, shorebird species richness, and waterfowl species richness, the relationships with area were linear ( $\hat{R}^2$ = 0.59, 0.58, 0.21, respectively).

Overall bird densities did not increase with increasing percent wetland or wetland and percent open water in the landscape surrounding sites at either the 1 or 5 km scales (all $\hat{R}^2 < 0.15$, $p > 0.10$).

*Dabbling Ducks*

Our habitat model containing hydrologic data was constrained to weeks 15-22, which coincided with declining numbers of waterfowl on the study sites. These models capture 49% of the dabblers in our full study set.

The density of dabbling ducks was positively related to the percentage of habitat in water depths 4-10 cm and 20-40 cm (Model 1 in Table 4.5.1; Table 4.5.2). There was also a trend for greater waterfowl abundance in association with water deeper than 40 cm.

**Table 4.5.1. Models for waterfowl in relation to water depths and vegetation classes.**

| | Response variable[1] | Independent Variables[2] |
|---|---|---|
| 1 | wf_ct/ha | Week + Week$^2$ + 0-4cm + 4-10cm + 10-20cm + 20-40cm + gr40cm |
| 2 | wf_ct/ha | Week + Week$^2$ + 20-40NV + 20-40V |
| 3 | wf_ct/ha | Forb + grass + tall emergent + short emergent + weed |

1. Wf_ct/ha is the average density of waterfowl for the week
2. 0-4cm, etc. are the proportions of unit flooded to those depths, gr40cm is proportion of unit with water deeper than 40 cm, NV is not vegetated, and V is vegetated. For model 5, cover types are proportions of study unit.

**Table 4.5.2. Model 1 for waterfowl density in relation to water depths.**

| Variables | Value | Std.Error | DF | t-value | p-value |
|---|---|---|---|---|---|
| (Intercept) | -1.24 | 0.63 | 103 | -1.96 | 0.05 |
| Week | 0.81 | 0.19 | 103 | 4.15 | <0.01 |
| Week2 | -0.09 | 0.02 | 103 | -4.055 | <0.01 |
| 0-4cm | 3.17 | 2.99 | 103 | 1.06 | 0.29 |
| 4-10cm | 6.58 | 3.13 | 103 | 2.10 | 0.04 |
| 10-20cm | 0.04 | 1.45 | 103 | 0.03 | 0.98 |
| 20-40cm | 3.71 | 0.90 | 103 | 4.10 | <0.01 |
| gr40cm | 1.11 | 0.62 | 103 | 1.80 | 0.07 |

When distinguishing vegetated from unvegetated habitat in water depth 20-40 cm, waterfowl densities related to the proportion unvegetated but not to the proportion vegetated (Model 2 in Table 4.5.1, Table 4.5.3).

**Table 4.5.3. Model 2 for waterfowl density related to proportion of shallow water habitat that is vegetated.**

| Variables | Value | Std.Error | DF | t-value | p-value |
|---|---|---|---|---|---|
| (Intercept) | 0.21 | 0.57 | 90 | 0.36 | 0.72 |
| Week | 0.51 | 0.22 | 90 | 2.33 | 0.02 |
| Week2 | -0.08 | 0.03 | 90 | -2.89 | <0.01 |
| 20-40NV | 2.73 | 0.96 | 90 | 2.86 | <0.01 |
| 20-40V | -7.25 | 10.26 | 90 | -0.71 | 0.48 |

Dabbling duck densities appeared to be positively related to the proportion of a site in bare ground/open water/duff and negatively related to proportion of cover in grass (Model 3 in Table 4.5.1, Table 4.5.4).

**Table 4.5.4. Model 3 for waterfowl density in relation to vegetation community types.**

| Variables | Estimate | Std. Error | t-value | Pr(>\|t\|) |
|---|---|---|---|---|
| (Intercept)[1] | 7.50 | 2.87 | 2.61 | 0.03 |
| forb | -53.80 | 162.89 | -0.33 | 0.75 |
| grass | -14.02 | 5.92 | -2.37 | 0.04 |
| tall emergent | -1.49 | 4.71 | -0.32 | 0.76 |
| short emergent | -1.72 | 4.22 | -0.41 | 0.69 |
| weed | 0.38 | 3.92 | 0.10 | 0.92 |

1. Intercept is bare ground + duff + open water.

We did not find any significant relationships between dabbling duck densities and vegetation species composition (percent annual, $\hat{R}^2$ = - 0.03; percent native, $\hat{R}^2$ = - 0.07; or percent of high quality forage plants, $\hat{R}^2$ = 0.10), or plant density (visual obstruction readings, $\hat{R}^2$ = -0.06).

Dabbler densities were not significantly related to the percent of wetlands or wetlands and open water habitats in the areas surrounding study sites, at either the 1 km or 5 km scales (all $\hat{R}^2$ < -0.10, p > 0.22).

*Shorebirds*

Shorebirds responded to the percent of a wetland in saturated ground, 0-4 cm and 10-20 cm water depth, according to Model 1 in Table 4.5.5 (see also Table 4.5.6).

**Table 4.5.5. Models assessing the relationship between shorebird density or species richness and water depth classes and vegetation.**

| Model | Response variable[1] | Independent Variables[2] |
|---|---|---|
| 1 | Log(sb_ct + 1) | Week + Week$^2$ + Ha + Sat + 0-4cm + 4-10cm + 10-20cm + gr20cm |
| 2 | Log(sb_rich + 1/ha)) | Week + Week$^2$ + Sat + 0-4cm + 4-10cm + 10-20cm + gr20cm |
| 3 | Sb_ct/ha | Week + Week$^2$ + Sat_0-4NV + Sat_0-4Vlow + Sat_0-4Vtall |
| 4 | Log((sb_ct +1)ha)) | Week + Week$^2$ + Sat_0-4NV + 4-10NV + 10-20NV + gr20NV + allV |

1. Sb_ct is the average count of shorebirds for the week
2. Sat = proportion of unit that is saturated, 0-4cm, 4-10cm, and 10-20cm are proportions of unit flooded to that depth, gr20cm is proportion of unit with water deeper than 20 cm, Sat_0-4NV is saturated to 4 cm deep, not vegetated, , Sat_0-4Vlow is saturated to 4 cm deep, vegetation less than 10 cm tall, Vtall is vegetation greater than 10 cm tall.

**Table 4.5.6. Model 1 for relationship of shorebird abundance to water depths.**

| Variables | Value | Std.Error | DF | t-value | p-value |
|---|---|---|---|---|---|
| (Intercept) | -1.02 | 0.42 | 103 | -2.42 | 0.02 |
| Week | 0.40 | 0.12 | 103 | 3.33 | <0.01 |
| Week2 | -0.04 | 0.01 | 103 | -3.41 | <0.01 |
| Hectares | 0.16 | 0.07 | 14 | 2.22 | 0.04 |
| Sat | 1.62 | 0.47 | 103 | 3.48 | <0.01 |
| 0-4cm | 7.35 | 2.85 | 103 | 2.58 | 0.01 |
| 4-10cm | 1.19 | 3.18 | 103 | 0.37 | 0.71 |
| 10-20cm | 3.20 | 1.57 | 103 | 2.03 | 0.04 |
| gr20cm | -0.04 | 0.42 | 103 | -0.09 | 0.92 |

Shorebird species richness was positively associated with the proportion of the wetland in saturated ground ( $\hat{\beta}_{Sat} = 0.70; SE = 0.22$ ; Model 2 in Table 4.5.5).

When we examined the effect of whether the saturated or shallow water area was vegetated at the time of the survey, we found that the unvegetated saturated and shallow water areas were significantly related to shorebird numbers while the vegetated areas were not, regardless of the vegetation height; (Models 3 and 4 in Table 4.5.5. and Table 4.5.7 and Table 4.5.8).

**Table 4.5.7. Model 3 for relationship of shorebird abundance to vegetation heights in shallow water habitat.**

| Variables | Value | Std.Error | DF | t-value | p-value |
|---|---|---|---|---|---|
| (Intercept) | -2.00 | 1.04 | 89 | -1.92 | 0.06 |
| Week | 1.36 | 0.42 | 89 | 3.23 | <0.01 |
| Week2 | -0.16 | 0.05 | 89 | -3.57 | <0.01 |
| Sat_0-4_NV | 0.90 | 0.47 | 89 | 1.93 | 0.06 |
| Sat_0-4_Vlow | -1.09 | 1.78 | 89 | -0.61 | 0.54 |
| Sat_0-4_Vtall | -1.84 | 7.65 | 89 | -0.24 | 0.81 |

**Table 4.5.8. Model 4 indicating shorebird relationship to vegetated or not vegetated area in shallow water habitat.**

| Variables | Value | Std.Error | DF | t-value | p-value |
|---|---|---|---|---|---|
| (Intercept) | -1.42 | 0.39 | 87 | -3.62 | <0.01 |
| Week | 0.41 | 0.12 | 87 | 3.38 | <0.01 |
| Week2 | -0.04 | 0.01 | 87 | -3.42 | <0.01 |
| Sat_0-4_NV | 2.73 | 1.03 | 87 | 2.64 | <0.01 |
| 4-10_NV | 15.11 | 4.82 | 87 | 3.13 | <0.01 |
| 10-20_NV | 2.79 | 1.47 | 87 | 1.89 | 0.06 |
| gr20_NV | 0.44 | 0.55 | 87 | 0.80 | 0.43 |
| all_V | 0.28 | 0.63 | 87 | 0.44 | 0.66 |

Shorebird densities were not related to the proportion of vegetation per site that was annual vegetation ( $\hat{R}^2$ = -0.03). Nor was shorebird density related to the percent of vegetation that was native ( $\hat{R}^2$ = -0.04).

Shorebird densities were positively related to the proportion of the study site that consisted of bare ground, open water, and duff combined ( $\hat{R}^2$ = 0.24, F-statistic 5.8, df = 1, 14, p = 0.03).

In the area surrounding our study sites, we found no relationship between shorebird numbers and percent of wetland or wetland and open water habitats combined, at either the 1 km or 5 km scales (all $\hat{R}^2$ < 0.10, p > 0.38).

# 5 DISCUSSION

**Wilson's Snipe.**

Use of restored wetlands along the South Platte River by a wide variety of waterfowl, shorebird, and other wetland-dependent waterbird species indicate the importance of these wetlands for providing regional wildlife habitat. Further, estimated waterbird use-days for the spring migration season on the study sites exceeded 75,000, and if extrapolated to all of the wetlands conservation projects in the SPRWFA, the number of avian use days exceeds 410,000. This is probably an underestimate because we did not sample all of the units at each site, and did not factor that into our calculations. In addition, because waterfowl numbers declined steadily throughout the study season, our estimates of waterfowl use-days may be a bit low if we missed the earliest migrants.

By observing a random sample of CWP projects within the South Platte Wetlands Focus Area, we are able to characterize the projects as a group. For the study season, half of our visits were to entirely dry units. For years with similar weather and water availability, we can then expect only about half of our mapped wetland acres to provide habitat for migration wetland-dependent species. This has implications for conservation planning. In addition, across all sites, non-native plant species comprised over half of the plant cover, indicating that weed management is an important conservation issue for wetland management in the corridor.

We expected higher avian use at wetlands embedded in wetland complexes, but did not find such a relationship. Our inability to detect avian relationships to percent wetlands in the surrounding landscape may be related to small sample size of only 11 sites. In addition, the percent wetland calculated using GIS is an imperfect measure of the wetlands encountered by migratory birds in 2006. It is probable that not all of the mapped wetland habitats were wet during the time of the study, thus over-representing the habitat available. For example, the 1 km buffer surrounding Elliott was 8.5% wetland (second highest), but this entire area was dry for much of the 2006 season.

Waterfowl were predicted to respond positively to the percent annual vegetation and of vegetation classified as high quality forage (plants producing copious amounts of nutritious seeds). We did not see such a relationship perhaps due to low sample size of sites. In addition, our sampling of vegetation in June may not properly represent the vegetation encountered by the migrant birds moving through earlier in the season. Our dabbler habitat model also only incorporates only half of the waterfowl from the season, because we did not initiate comprehensive hydrologic surveys until week 15. Northern Pintail were more abundant earlier in the season than during the weeks covered by hydrologic surveys (representing 17% and 4% of all dabblers during the two periods, respectively). However, we do not have any reason to believe that their habitat preferences differ substantially from the other dabbling ducks comprising our study group, and generally management efforts target the guild as a whole.

We observed use of restoration sites by 24 species of migrant shorebirds, the same number of species observed by Andres in reservoirs along the South Platte River during fall (2007). Similarly, a study of migrating shorebirds in the Prairie Coteau region also documented 25 species (Niemuth et al. 2006). We found shorebirds were associated with the shallowest habitats, saturated ground and less than 4 cm of water. This type of habitat provides the best foraging opportunity for species that are limited to different water depths – the shallowest habitats are good for most species (Helmers 1992).

Shorebirds are generally limited to shallow habitats, and will use mudflats associated with large reservoirs in this part of Colorado for migration stopover habitat (Andres 2007). However, these reservoirs are often filled to capacity in the spring, and spring migration habitat is therefore thought to be more limiting. In addition, the spring migration is more rapid for shorebirds that need to arrive on their high arctic breeding grounds for a short breeding season; high quality habitat in spring is therefore especially important (Skagen and Knopf 1993).

Bird use varied greatly among study sites, with some of the best sites being on private land and others on State Wildlife Areas. Bird use was positively related to wetland acreage, and for waterfowl this was a nonlinear relationship. Thus, larger wetlands hosted even greater densities of waterfowl than would be predicted based on area alone. This is probably due to the tendency of waterfowl to migrate in large flocks. Dabbling ducks and shorebirds alike preferred open and shallow water habitat. Preferred depth classes were 4-10 cm and 20-40 cm for waterfowl, and saturated ground (mud), 0-4 cm and 10-20 cm for shorebirds. For both groups, these are very shallow depths (all less than 17 inches) that might require attention to draw down impoundments during the migration season to provide these conditions.

A number of management implications may be drawn from this work. First, management of surface water levels drives the use of sites by both waterfowl and shorebirds. Sites that hosted many birds also hosted a high diversity of species. The highest numbers and diversity of birds were found on wetlands that provided water throughout the migration season and drew down to shallow levels by the end of the season. Sites that hosted high numbers of waterfowl also were used by high numbers of migrating shorebirds, demonstrating the compatibility of managing for both bird groups on the same sites. In March and April when waterfowl are most abundant, flooding of depths less than 40 cm is related to high waterfowl use, while during late April and May flooding of less than 20 cm and especially less than 4 cm will most benefit shorebirds. For both groups, the maintenance of open areas free of vegetation is also related to high bird use. Due to the natural tendency of perennials such as cattails to encroach on wetlands in this region, disking, burning, or other types of management practices may be needed to create and maintain these open conditions. Finally, we found that some sites with augmentation water rights provided high quality habitat, providing evidence that augmentation projects can be compatible with creating high quality wetland habitat. Such combined projects have the potential to effectively leverage limited water and financial resources to benefit both water users and wildlife conservation.

The Wetlands Monitoring and Evaluation Project is a model program for evaluating the outcomes of wetland conservation projects, benefiting all participants in the Colorado Wetlands Partnership. The project provides land and project managers feedback on the efficacy of their restoration practices and helps them to design adaptive management practices. Program administrators are provided information about the breadth and successes of their program. In addition, because wetland ecosystems continue to undergo threats and available funds cannot meet all conservation opportunities, WMEP information can help determine the most effective strategies for preserving Colorado's wetlands.

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## Appendix A. Avian Species List for all study sites in the South Platte River Wetlands Focus Area, Spring 2006.

| | Common Name | Scientific Name | Total Count | Total Birds /100 ha | Season-long Use Days |
|---|---|---|---|---|---|
| 1 | American Avocet | *Recurvirostra americana* | 143 | 11.9 | 550 |
| 2 | American Bittern | *Botaurus lentiginosus* | 6 | 0.5 | 32 |
| 3 | American Coot | *Fulica americana* | 595 | 49.4 | 2,569 |
| 4 | American White Pelican | *Pelecanus erythrorhynchos* | 269 | 22.3 | 1,067 |
| 5 | American Wigeon | *Anas americana* | 407 | 33.8 | 2,108 |
| 6 | Baird's Sandpiper | *Calidris bairdii* | 194 | 16.1 | 719 |
| 7 | Black-bellied Plover | *Pluvialis squatarola* | 4 | 0.3 | 14 |
| 8 | Black-crowned Night-Heron | *Nycticorax nycticorax* | 3 | 0.2 | 18 |
| 9 | Black-necked Stilt | *Himantopus mexicanus* | 6 | 0.5 | 21 |
| 10 | Black Tern | *Chlidonias niger* | 27 | 2.2 | 113 |
| 11 | Blue-winged Teal | *Anas discors* | 661 | 54.9 | 2,856 |
| 12 | Bufflehead | *Bucephala albeola* | 24 | 2.0 | 126 |
| 13 | Canada Goose | *Branta canadensis* | 579 | 48.1 | 2,642 |
| 14 | Canvasback | *Aythya valisineria* | 32 | 2.7 | 161 |
| 15 | Cinnamon Teal | *Anas cyanoptera* | 61 | 5.1 | 312 |
| 16 | Common Goldeneye | *Bucephala clangula* | 2 | 0.2 | 8 |
| 17 | Double-crested Cormorant | *Phalacrocorax auritus* | 75 | 6.2 | 382 |
| 18 | Dunlin | *Calidris alpina* | 2 | 0.2 | 7 |
| 19 | Eared Grebe | *Podiceps nigricollis* | 31 | 2.6 | 112 |
| 20 | Forster's Tern | *Sterna forsteri* | 5 | 0.4 | 20 |
| 21 | Franklin's Gull | *Larus pipixcan* | 35 | 2.9 | 147 |
| 22 | Gadwall | *Anas strepera* | 871 | 72.3 | 3,991 |
| 23 | Greater Scaup | *Aythya marila* | 1 | 0.1 | 4 |
| 24 | Greater White-fronted Goose | *Anser albifrons* | 132 | 11.0 | 476 |
| 25 | Greater Yellowlegs | *Tringa melanoleuca* | 102 | 8.5 | 548 |
| 26 | Green-winged Teal | *Anas crecca* | 1,445 | 120.0 | 7,633 |
| 27 | Killdeer | *Charadrius vociferus* | 610 | 50.6 | 2,703 |
| 28 | Least Sandpiper | *Calidris minutilla* | 325 | 27.0 | 1,251 |
| 29 | Lesser Scaup | *Aythya affinis* | 137 | 11.4 | 688 |
| 30 | Lesser Yellowlegs | *Tringa flavipes* | 149 | 12.4 | 739 |
| 31 | Long-billed Dowitcher | *Limnodromus scolopaceus* | 370 | 30.7 | 2,036 |
| 32 | Mallard | *Anas platyrhynchos* | 1,300 | 107.9 | 6,514 |
| 33 | Marbled Godwit | *Limosa fedoa* | 5 | 0.4 | 22 |
| 34 | Northern Pintail | *Anas acuta* | 1,189 | 98.7 | 6,523 |
| 35 | Northern Shoveler | *Anas clypeata* | 919 | 76.3 | 4,376 |
| 36 | Pectoral Sandpiper | *Calidris melanotos* | 11 | 0.9 | 60 |
| 37 | Pied-billed Grebe | *Podilymbus podiceps* | 37 | 3.1 | 188 |
| 38 | Piping Plover | *Charadrius melodus* | 2 | 0.2 | 7 |
| 39 | Red-breasted Merganser | *Mergus serrator* | 1 | 0.1 | 7 |
| 40 | Red-necked Phalarope | *Phalaropus lobatus* | 64 | 5.3 | 262 |
| 41 | Redhead | *Aythya americana* | 492 | 40.8 | 2,563 |
| 42 | Ring-billed Gull | *Larus delawarensis* | 102 | 8.5 | 515 |
| 43 | Ring-necked Duck | *Aythya collaris* | 33 | 2.7 | 141 |
| 44 | Ruddy Duck | *Oxyura jamaicensis* | 57 | 4.7 | 250 |
| 45 | Semipalmated Plover | *Charadrius semipalmatus* | 28 | 2.3 | 101 |

| | | | | | |
|---|---|---|---|---|---|
| 46 | Semipalmated Sandpiper | *Calidris pusilla* | 445 | 36.9 | 1,833 |

| | Common Name | Scientific Name | Total Count | Total Birds /100 ha | Season-long Use Days |
|---|---|---|---|---|---|
| 47 | Snow Goose | *Chen caerulescens* | 235 | 19.5 | 900 |
| 48 | Solitary Sandpiper | *Tringa solitaria* | 6 | 0.5 | 23 |
| 49 | Sora | *Porzana carolina* | 15 | 1.2 | 88 |
| 50 | Spotted Sandpiper | *Actitis macularia* | 60 | 5.0 | 230 |
| 51 | Stilt Sandpiper | *Calidris himantopus* | 233 | 19.3 | 827 |
| 52 | Unknown Dowitcher | | 115 | 9.5 | |
| 53 | Unknown Duck | | 2,205 | 183.1 | 9,130 |
| 54 | Unknown Gull | | 18 | 1.5 | 71 |
| 55 | Unknown Peep | *Calidris Sp.* | 49 | 4.1 | 187 |
| 56 | Unknown Phalarope | | 42 | 3.5 | 176 |
| 57 | Unknown Rail | | 1 | 0.1 | 7 |
| 58 | Unknown Sandpiper | | - | 0.0 | 0 |
| 59 | Unknown Scaup | | 21 | 1.7 | |
| 60 | Unknown Shorebird | | 113 | 9.4 | 498 |
| 61 | Unknown Teal | *Anas sp.* | 48 | 4.0 | 201 |
| 62 | Unknown Yellowleg | | 42 | 3.5 | 176 |
| 63 | Virginia Rail | *Rallus limicola* | 19 | 1.6 | 119 |
| 64 | Western Grebe | *Aechmophorus occidentalis* | 2 | 0.2 | 8 |
| 65 | Western Sandpiper | *Calidris mauri* | 32 | 2.7 | 116 |
| 66 | White-faced Ibis | *Plegadis chihi* | 70 | 5.8 | 389 |
| 67 | White-rumped Sandpiper | *Calidris fuscicollis* | 24 | 2.0 | 85 |
| 68 | Willet | *Tringa semipalmata* | 5 | 0.4 | 23 |
| 69 | Wilson's Phalarope | *Phalaropus tricolor* | 771 | 64.0 | 3,831 |
| 70 | Wilson's Snipe | *Gallinago delicata* | 132 | 11.0 | 755 |
| 71 | Wood Duck | *Aix sponsa* | 11 | 0.9 | 53 |
| | Total | | 16,257 | 1349.7 | 75,306 |

Counts from 257 surveys from March 16 to June 2, 2006.

## Appendix B. Plant species list and other cover types, listed by overall percent cover, for all study sites in the SPWFA, Spring 2006.

| Common Name | Scientific Name | Family | Percent |
|---|---|---|---|
| Bare Ground | | | 23.44% |
| narrowleaf cattail | *Typha angustifolia* | Typhaceae | 9.02% |
| Open Water | | | 8.90% |
| Unknown Residual | | | 8.00% |
| Duff | | | 6.08% |
| curly dock | *Rumex crispus* | Polygonaceae | 2.64% |
| western wheatgrass | *Pascopyrum smithii* | Poaceae | 2.51% |
| cheatgrass | *Bromus tectorum* | Poaceae | 2.44% |
| duckweed | *Lemna* | Lemnaceae | 2.11% |
| creeping bentgrass | *Agrostis stolonifera* | Poaceae | 1.72% |
| Canada thistle | *Cirsium arvense* | Asteraceae | 1.68% |
| Unknown grass | | | 1.56% |
| green bristlegrass | *Setaria viridis* | Poaceae | 1.42% |
| inland saltgrass | *Distichlis spicata* | Poaceae | 1.37% |
| spikerush | *Eleocharis* | Cyperaceae | 1.24% |
| lambsquarters | *Chenopodium album* | Chenopodiaceae | 1.22% |
| Mexican-fireweed | *Kochia scoparia* | Chenopodiaceae | 1.11% |
| common threesquare | *Schoenoplectus pungens* | Cyperaceae | 1.07% |
| foxtail barley | *Hordeum jubatum ssp. jubatum* | Poaceae | 1.05% |
| prostrate pigweed | *Amaranthus albus* | Amaranthaceae | 1.03% |
| American licorice | *Glycyrrhiza lepidota* | Fabaceae | 1.02% |
| Cuman ragweed | *Ambrosia psilostachya* | Asteraceae | 0.98% |
| common sunflower | *Helianthus annuus* | Asteraceae | 0.96% |
| leathery knotweed | *Polygonum achoreum* | Polygonaceae | 0.95% |
| pitseed goosefoot | *Chenopodium berlandieri* | Chenopodiaceae | 0.93% |
| smooth brome | *Bromus inermis ssp. inermis var. inermis* | Poaceae | 0.78% |
| field bindweed | *Convolvulus arvensis* | Convolvulaceae | 0.74% |
| bearded sprangletop | *Leptochloa fusca ssp. fascicularis* | Poaceae | 0.70% |
| mountain rush | *Juncus balticus var. montanus* | Juncaceae | 0.70% |
| smartweed | *Persicaria species* | Polygonaceae | 0.66% |
| broadleaf cattail | *Typha latifolia* | Typhaceae | 0.58% |
| Unknown forb | | | 0.50% |
| showy milkweed | *Asclepias speciosa* | Asclepiadaceae | 0.46% |
| knotweed | *Polygonum* | Polygonaceae | 0.42% |
| bulrush | *Scirpus* | Cyperaceae | 0.40% |
| softstem bulrush | *Schoenoplectus tabernaemontani* | Cyperaceae | 0.34% |
| sixweeks fescue | *Vulpia octoflora* | Poaceae | 0.34% |
| alfalfa | *Medicago sativa* | Fabaceae | 0.33% |
| rough cockleburr | *Xanthium strumarium* | Asteraceae | 0.32% |
| rescuegrass | *Bromus catharticus* | Poaceae | 0.31% |
| threeawn | *Aristida* | Poaceae | 0.31% |
| prickly Russian thistle | *Salsola tragus* | Chenopodiaceae | 0.27% |
| tall tumblemustard | *Sisymbrium altissimum* | Brassicaceae | 0.27% |
| herb sophia | *Descurainia sophia* | Brassicaceae | 0.25% |
| yellow salsify | *Tragopogon dubius* | Asteraceae | 0.25% |
| cattail | *Typha* | Typhaceae | 0.24% |

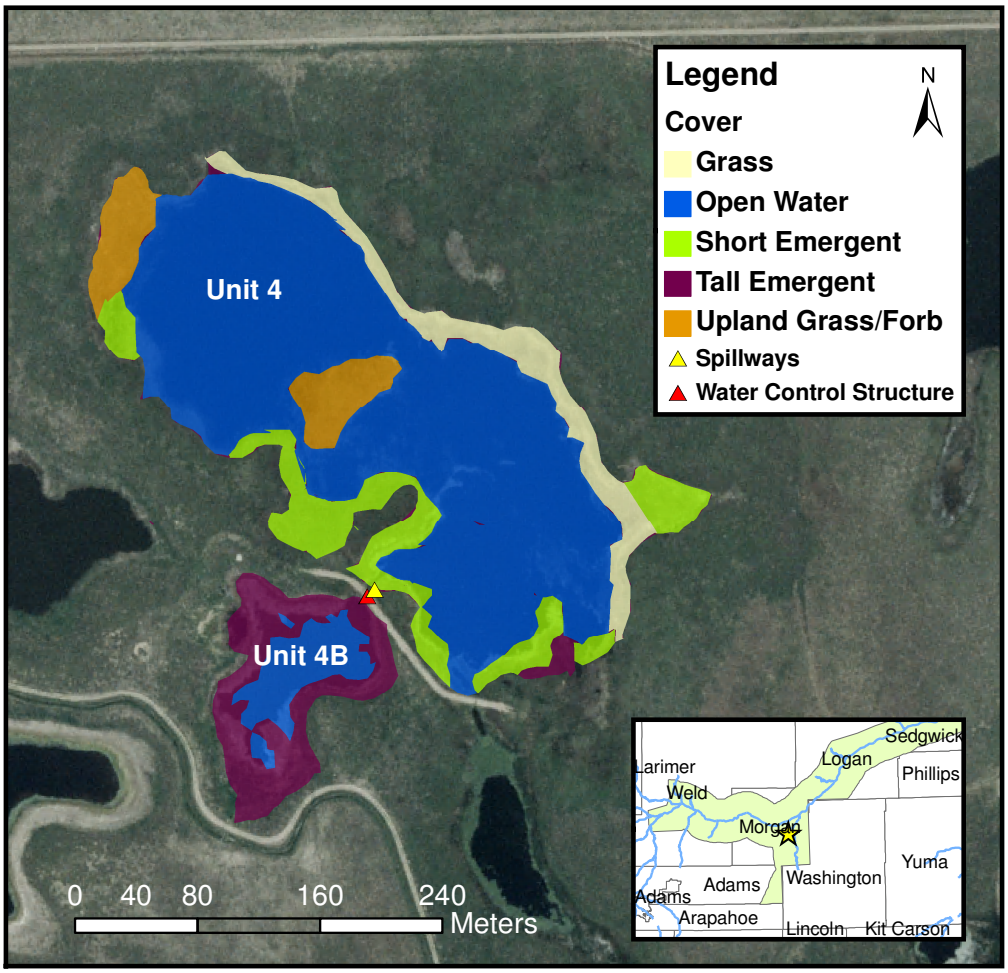
| Common Name | Scientific Name | Family | Percent |
|---|---|---|---|
| switchgrass | *Panicum virgatum* | Poaceae | 0.24% |
| globemallow | *Sphaeralcea* | Malvaceae | 0.23% |
| fescue | *Festuca* | Poaceae | 0.22% |
| prickly lettuce | *Lactuca serriola* | Asteraceae | 0.21% |
| barnyardgrass | *Echinochloa crus-galli* | Poaceae | 0.20% |
| brome | *Bromus* | Poaceae | 0.19% |
| goldenrod | *Solidago* | Asteraceae | 0.19% |
| yellow sweetclover | *Melilotus officinalis* | Fabaceae | 0.19% |
| lenspod whitetop | *Cardaria chalapensis* | Brassicaceae | 0.18% |
| pennycress | *Thlaspi* | Brassicaceae | 0.18% |
| spotted ladysthumb | *Polygonum persicaria* | Polygonaceae | 0.17% |
| redroot amaranth | *Amaranthus retroflexus* | Amaranthaceae | 0.17% |
| sprangletop | *Leptochloa* | Poaceae | 0.16% |
| cutleaf vipergrass | *Scorzonera laciniata* | Asteraceae | 0.16% |
| sedge | *Carex* | Cyperaceae | 0.16% |
| reed canarygrass | *Phalaris arundinacea* | Poaceae | 0.15% |
| wheatgrass | *Agropyron* | Poaceae | 0.15% |
| rush | *Juncus* | Juncaceae | 0.15% |
| salt sandspurry | *Spergularia salina* | Caryophyllaceae | 0.14% |
| sand dropseed | *Sporobolus cryptandrus* | Poaceae | 0.13% |
| needleleaf sedge | *Carex duriuscula* | Cyperaceae | 0.11% |
| Unknown | | | 0.11% |
| woolly plantain | *Plantago patagonica* | Plantaginaceae | 0.10% |
| Japanese brome | *Bromus japonicus* | Poaceae | 0.10% |
| bigbract verbena | *Verbena bracteata* | Verbenaceae | 0.10% |
| bluegrass | *Poa* | Poaceae | 0.10% |
| oval-leaf knotweed | *Polygonum arenastrum* | Polygonaceae | 0.10% |
| Broccoli | *Brassica oleracea* | Brassicaceae | 0.09% |
| vetch | *Vicia* | Fabaceae | 0.07% |
| bulrush | *Schoenoplectus* | Cyperaceae | 0.07% |
| red swampfire | *Salicornia rubra* | Chenopodiaceae | 0.07% |
| false buffalograss | *Monroa squarrosa* | Poaceae | 0.07% |
| carelessweed | *Amaranthus palmeri* | Amaranthaceae | 0.07% |
| witchgrass | *Panicum capillare* | Poaceae | 0.06% |
| puncturevine | *Tribulus terrestris* | Zygophyllaceae | 0.06% |
| bluntleaf yellowcress | *Rorippa curvipes* | Brassicaceae | 0.06% |
| mint | *Mentha* | Lamiaceae | 0.06% |
| curlytop knotweed | *Polygonum lapathifolium* | Polygonaceae | 0.06% |
| aster | *Aster* | Asteraceae | 0.06% |
| broadleaved pepperweed | *Lepidium latifolium* | Brassicaceae | 0.06% |
| ragweed | *Ambrosia* | Asteraceae | 0.06% |
| meadow foxtail | *Alopecurus pratensis* | Poaceae | 0.06% |
| prostrate knotweed | *Polygonum aviculare* | Polygonaceae | 0.06% |
| nightshade | *Solanum* | Solanaceae | 0.06% |
| milkweed | *Asclepias* | Asclepiadaceae | 0.05% |
| nettleleaf goosefoot | *Chenopodium murale* | Chenopodiaceae | 0.05% |
| cryptantha | *Cryptantha* | Boraginaceae | 0.05% |
| buffalobur nightshade | *Solanum rostratum* | Solanaceae | 0.05% |

| Common Name | Scientific Name | Family | Percent |
|---|---|---|---|
| common dandelion | *Taraxacum officinale* | Asteraceae | 0.04% |
| leafy spurge | *Euphorbia esula var. esula* | Euphorbiaceae | 0.04% |
| crested wheatgrass | *Agropyron cristatum* | Poaceae | 0.04% |
| horsetail | *Equisetum* | Equisetaceae | 0.04% |
| annual rabbitsfoot grass | *Polypogon monspeliensis* | Poaceae | 0.04% |
| rough bugleweed | *Lycopus asper* | Lamiaceae | 0.03% |
| sage | *Salvia* | Lamiaceae | 0.03% |
| bristlegrass | *Setaria* | Poaceae | 0.03% |
| shaggy dwarf morning-glory | *Evolvulus nuttallianus* | Convolvulaceae | 0.03% |
| cosmopolitan bulrush | *Schoenoplectus maritimus* | Cyperaceae | 0.03% |
| caraway | *Carum carvi* | Apiaceae | 0.02% |
| absinthium | *Artemisia absinthium* | Asteraceae | 0.02% |
| horehound | *Marrubium vulgare* | Lamiaceae | 0.02% |
| marsh skullcap | *Scutellaria galericulata* | Lamiaceae | 0.02% |
| needle and thread | *Hesperostipa comata* | Poaceae | 0.02% |
| plumeless thistle | *Carduus* | Asteraceae | 0.02% |
| lettuce | *Lactuca* | Asteraceae | 0.02% |
| pricklypear | *Opuntia* | Cactaceae | 0.02% |
| common plantain | *Plantago major* | Plantaginaceae | 0.02% |
| water speedwell | *Veronica anagallis-aquatica* | Scrophulariaceae | 0.02% |
| vervain | *Verbena* | Verbenaceae | 0.02% |
| great ragweed | *Ambrosia trifida* | Asteraceae | 0.01% |
| beeblossom | *Gaura* | Onagraceae | 0.01% |
| squirreltail | *Elymus elymoides* | Poaceae | 0.01% |
| goosefoot | *Chenopodium* | Chenopodiaceae | 0.01% |
| climbing nightshade | *Solanum dulcamara* | Solanaceae | 0.01% |
| common pepperweed | *Lepidium densiflorum* | Brassicaceae | 0.01% |
| gumweed | *Grindelia* | Asteraceae | 0.01% |
| Jack-go-to-bed-at-noon | *Tragopogon pratensis* | Asteraceae | 0.01% |
| pepperweed | *Lepidium* | Brassicaceae | 0.01% |
| plains pricklypear | *Opuntia polyacantha* | Cactaceae | 0.01% |
| matted sandmat | *Chamaesyce serpens* | Euphorbiaceae | 0.01% |
| snow on the mountain | *Euphorbia marginata* | Euphorbiaceae | 0.01% |
| mallow | *Malva* | Malvaceae | 0.01% |
| redtop | *Agrostis gigantea* | Poaceae | 0.01% |
| tumblegrass | *Schedonnardus paniculatus* | Poaceae | 0.01% |
| little hogweed | *Portulaca oleracea* | Portulacaceae | 0.01% |
| common cowparsnip | *Heracleum maximum* | Apiaceae | 0.01% |
| stinging nettle | *Urtica dioica ssp. holosericea* | Urticaceae | 0.01% |
| oakleaf goosefoot | *Chenopodium glaucum* | Chenopodiaceae | 0.00% |
| American water horehound | *Lycopus americanus* | Lamiaceae | 0.00% |
| loosestrife | *Lythrum* | Lythraceae | 0.00% |
| spotted evening-primrose | *Oenothera canescens* | Onagraceae | 0.00% |
| little barley | *Hordeum pusillum* | Poaceae | 0.00% |
| swamp milkweed | *Asclepias incarnata* | Asclepiadaceae | 0.00% |
| field sagewort | *Artemisia campestris ssp. caudata* | Asteraceae | 0.00% |
| oppositeleaf bahia | *Picradeniopsis oppositifolia* | Asteraceae | 0.00% |

| Common Name | Scientific Name | Family | Percent |
|---|---|---|---|
| common spikerush | *Eleocharis palustris* | Cyperaceae | 0.00% |
| Texas croton | *Croton texensis* | Euphorbiaceae | 0.00% |
| Virginia groundcherry | *Physalis virginiana* | Solanaceae | 0.00% |
| arrowhead | *Sagittaria* | Alismataceae | 0.00% |
| Queen Anne's lace | *Daucus carota* | Apiaceae | 0.00% |
| wild parsnip | *Pastinaca sativa* | Apiaceae | 0.00% |
| agoseris | *Agoseris* | Asteraceae | 0.00% |
| curlycup gumweed | *Grindelia squarrosa* | Asteraceae | 0.00% |
| roundspike cryptantha | *Cryptantha humilis* | Boraginaceae | 0.00% |
| flatspine stickseed | *Lappula occidentalis var. occidentalis* | Boraginaceae | 0.00% |
| wormseed wallflower | *Erysimum cheiranthoides* | Brassicaceae | 0.00% |
| clover | *Trifolium* | Fabaceae | 0.00% |
| waterhorehound | *Lycopus* | Lamiaceae | 0.00% |
| rice cutgrass | *Leersia oryzoides* | Poaceae | 0.00% |
| prairie wedgescale | *Sphenopholis obtusata* | Poaceae | 0.00% |
| longroot smartweed | *Polygonum amphibium var. emersum* | Polygonaceae | 0.00% |
| bushy knotweed | *Polygonum ramosissimum* | Polygonaceae | 0.00% |
| cottonwood | *Populus* | Salicaceae | 0.00% |
| speedwell | *Veronica* | Scrophulariaceae | 0.00% |

# Brush Prairie Ponds SWA

Unit 4: 6.6 ha, 19 Bird Surveys, 8 Hydrologic Surveys, 67 Vegetation Plots
Unit 4B: 1.1 ha, 18 Bird Surveys, 8 Hydrologic Surveys, 10 Vegetation Plots

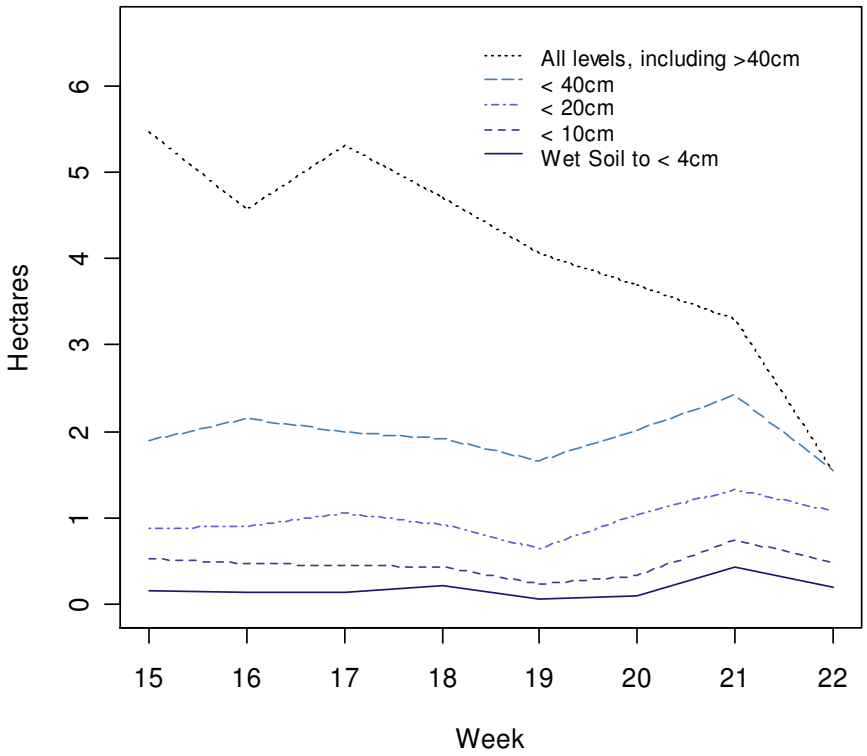



**Unit 4**

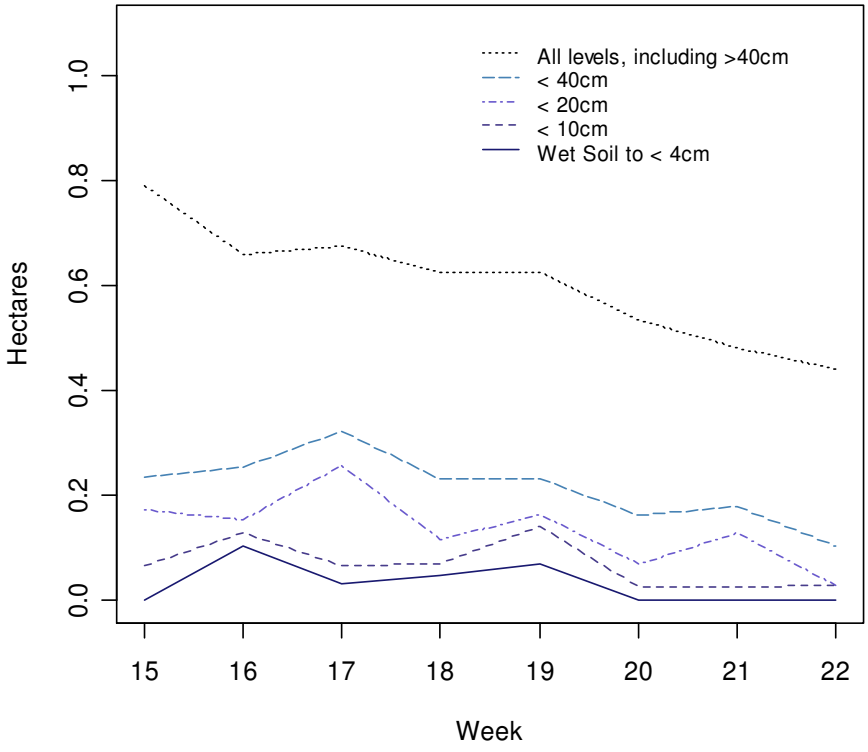
**Unit 4B**

# Hydrographs

**Unit 4**




**Unit 4B**



## Bird Species List

| Unit | Species | Scientific Name | Count | All Sites | % Total | Avg birds / 100 ha |
|---|---|---|---|---|---|---|
| 4 | American Avocet | *Recurvirostra americana* | 9 | 143 | 6% | 7.1 |
| 4 | American Bittern | *Botaurus lentiginosus* | 1 | 6 | 17% | 0.8 |
| 4 | American Coot | *Fulica americana* | 315 | 595 | 53% | 249.7 |
| 4 | American White Pelican | *Pelecanus erythrorhynchos* | 59 | 269 | 22% | 46.8 |
| 4 | American Wigeon | *Anas americana* | 33 | 407 | 8% | 26.2 |
| 4 | Baird's Sandpiper | *Calidris bairdii* | 10 | 194 | 5% | 7.9 |
| 4 | Black-necked Stilt | *Himantopus mexicanus* | 3 | 6 | 50% | 2.4 |
| 4 | Black Tern | *Chlidonias niger* | 26 | 27 | 96% | 20.6 |
| 4 | Blue-winged Teal | *Anas discors* | 185 | 661 | 28% | 146.6 |
| 4 | Bufflehead | *Bucephala albeola* | 12 | 24 | 50% | 9.5 |
| 4 | Canada Goose | *Branta canadensis* | 17 | 579 | 3% | 13.5 |
| 4 | Cinnamon Teal | *Anas cyanoptera* | 10 | 61 | 16% | 7.9 |
| 4 | Common Goldeneye | *Bucephala clangula* | 1 | 2 | 50% | 0.8 |
| 4 | Double-crested Cormorant | *Phalacrocorax auritus* | 29 | 75 | 39% | 23.0 |
| 4 | Eared Grebe | *Podiceps nigricollis* | 28 | 31 | 90% | 22.2 |
| 4 | Forster's Tern | *Sterna forsteri* | 3 | 5 | 60% | 2.4 |
| 4 | Gadwall | *Anas strepera* | 167 | 871 | 19% | 132.4 |
| 4 | Greater Yellowlegs | *Tringa melanoleuca* | 18 | 102 | 18% | 14.3 |
| 4 | Green-winged Teal | *Anas crecca* | 209 | 1445 | 14% | 165.7 |
| 4 | Killdeer | *Charadrius vociferus* | 171 | 610 | 28% | 135.5 |
| 4 | Least Sandpiper | *Calidris minutilla* | 42 | 325 | 13% | 33.3 |
| 4 | Lesser Scaup | *Aythya affinis* | 34 | 137 | 25% | 26.9 |
| 4 | Lesser Yellowlegs | *Tringa flavipes* | 39 | 149 | 26% | 30.9 |
| 4 | Long-billed Dowitcher | *Limnodromus scolopaceus* | 33 | 370 | 9% | 26.2 |
| 4 | Mallard | *Anas platyrhynchos* | 359 | 1300 | 28% | 284.6 |
| 4 | Marbled Godwit | *Limosa fedoa* | 1 | 5 | 20% | 0.8 |
| 4 | Northern Pintail | *Anas acuta* | 82 | 1189 | 7% | 65.0 |
| 4 | Northern Shoveler | *Anas clypeata* | 255 | 919 | 28% | 202.1 |
| 4 | Pied-billed Grebe | *Podilymbus podiceps* | 3 | 37 | 8% | 2.4 |
| 4 | Red-necked Phalarope | *Phalaropus lobatus* | 45 | 64 | 70% | 35.7 |
| 4 | Redhead | *Aythya americana* | 6 | 492 | 1% | 4.8 |
| 4 | Ring-billed Gull | *Larus delawarensis* | 5 | 102 | 5% | 4.0 |
| 4 | Ruddy Duck | *Oxyura jamaicensis* | 6 | 57 | 11% | 4.8 |
| 4 | Semipalmated Plover | *Charadrius semipalmatus* | 4 | 28 | 14% | 3.2 |
| 4 | Semipalmated Sandpiper | *Calidris pusilla* | 93 | 445 | 21% | 73.7 |
| 4 | Spotted Sandpiper | *Actitis macularia* | 37 | 60 | 62% | 29.3 |
| 4 | Stilt Sandpiper | *Calidris himantopus* | 17 | 233 | 7% | 13.5 |
| 4 | Unknown Dowitcher | | 81 | 115 | 70% | 64.2 |
| 4 | Unknown Duck | | 444 | 2205 | 20% | 351.9 |
| 4 | Unknown Gull | | 6 | 18 | 33% | 4.8 |
| 4 | Unknown Peep | *Calidris Sp.* | 28 | 49 | 57% | 22.2 |
| 4 | Unknown Phalarope | | 42 | 42 | 100% | 33.3 |
| 4 | Unknown Sandpiper | | 0 | 0 | 0% | 0.0 |
| 4 | Unknown Shorebird | | 77 | 113 | 68% | 61.0 |
| 4 | Unknown Teal | *Anas sp.* | 28 | 48 | 58% | 22.2 |

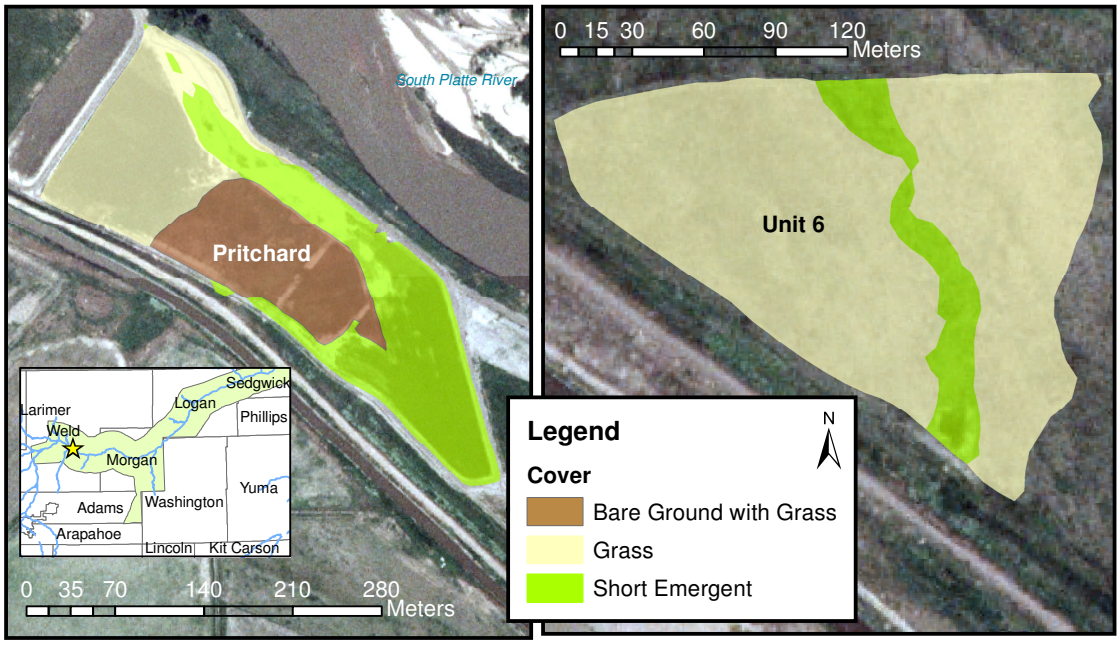
| Unit | Species | Scientific Name | Count | All Sites | % Total | Avg birds / 100 ha |
|---|---|---|---|---|---|---|
| 4 | Unknown Yellowleg | | 11 | 42 | 26% | 8.7 |
| 4 | Western Grebe | *Aechmophorus occidentalis* | 2 | 2 | 100% | 1.6 |
| 4 | White-faced Ibis | *Plegadis chihi* | 27 | 70 | 39% | 21.4 |
| 4 | White-rumped Sandpiper | *Calidris fuscicollis* | 2 | 24 | 8% | 1.6 |
| 4 | Willet | *Tringa semipalmata* | 3 | 5 | 60% | 2.4 |
| 4 | Wilson's Phalarope | *Phalaropus tricolor* | 273 | 771 | 35% | 216.4 |
| 4 | Wilson's Snipe | *Gallinago delicata* | 35 | 132 | 27% | 27.7 |
| 4B | American Coot | *Fulica americana* | 59 | 595 | 10% | 300.7 |
| 4B | Black-necked Stilt | *Himantopus mexicanus* | 1 | 6 | 17% | 5.1 |
| 4B | Blue-winged Teal | *Anas discors* | 65 | 661 | 10% | 331.3 |
| 4B | Bufflehead | *Bucephala albeola* | 6 | 24 | 25% | 30.6 |
| 4B | Canada Goose | *Branta canadensis* | 4 | 579 | 1% | 20.4 |
| 4B | Cinnamon Teal | *Anas cyanoptera* | 1 | 61 | 2% | 5.1 |
| 4B | Double-crested Cormorant | *Phalacrocorax auritus* | 2 | 75 | 3% | 10.2 |
| 4B | Gadwall | *Anas strepera* | 25 | 871 | 3% | 127.4 |
| 4B | Greater Scaup | *Aythya marila* | 1 | 1 | 100% | 5.1 |
| 4B | Greater Yellowlegs | *Tringa melanoleuca* | 1 | 102 | 1% | 5.1 |
| 4B | Green-winged Teal | *Anas crecca* | 20 | 1445 | 1% | 101.9 |
| 4B | Killdeer | *Charadrius vociferus* | 22 | 610 | 4% | 112.1 |
| 4B | Lesser Scaup | *Aythya affinis* | 21 | 137 | 15% | 107.0 |
| 4B | Lesser Yellowlegs | *Tringa flavipes* | 7 | 149 | 5% | 35.7 |
| 4B | Mallard | *Anas platyrhynchos* | 63 | 1300 | 5% | 321.1 |
| 4B | Northern Shoveler | *Anas clypeata* | 12 | 919 | 1% | 61.2 |
| 4B | Pied-billed Grebe | *Podilymbus podiceps* | 5 | 37 | 14% | 25.5 |
| 4B | Red-necked Phalarope | *Phalaropus lobatus* | 3 | 64 | 5% | 15.3 |
| 4B | Redhead | *Aythya americana* | 32 | 492 | 7% | 163.1 |
| 4B | Ring-necked Duck | *Aythya collaris* | 3 | 33 | 9% | 15.3 |
| 4B | Ruddy Duck | *Oxyura jamaicensis* | 2 | 57 | 4% | 10.2 |
| 4B | Unknown Duck | | 58 | 2205 | 3% | 295.6 |
| 4B | Unknown Peep | *Calidris Sp.* | 2 | 49 | 4% | 10.2 |
| 4B | Unknown Scaup | | 4 | 21 | 19% | 20.4 |
| 4B | Unknown Shorebird | | 12 | 113 | 11% | 61.2 |
| 4B | Unknown Teal | *Anas sp.* | 10 | 48 | 21% | 51.0 |
| 4B | White-faced Ibis | *Plegadis chihi* | 3 | 70 | 4% | 15.3 |
| 4B | Wilson's Phalarope | *Phalaropus tricolor* | 12 | 771 | 2% | 61.2 |
| 4B | Wilson's Snipe | *Gallinago delicata* | 5 | 132 | 4% | 25.5 |

## Plant Species List

| Unit | Common Name | Scientific Name | Percent Cover |
|---|---|---|---|
| 4 | Duff | | 28.3% |
| 4 | Bare ground | | 26.7% |
| 4 | Narrowleaf cattail | *Typha angustifolia* | 6.0% |
| 4 | Unknown residual | | 5.8% |
| 4 | Curly dock | *Rumex crispus* | 5.5% |
| 4 | Smartweed | *Persicaria species* | 3.9% |
| 4 | Spikerush | *Eleocharis* | 3.6% |
| 4 | Bulrush | *Scirpus* | 3.5% |
| 4 | Canada thistle | *Cirsium arvense* | 2.6% |
| 4 | Switchgrass | *Panicum virgatum* | 2.2% |
| 4 | Bearded sprangletop | *Leptochloa fusca ssp. fascicularis* | 1.7% |
| 4 | Mexican-fireweed | *Kochia scoparia* | 1.4% |
| 4 | Prostrate pigweed | *Amaranthus albus* | 1.1% |
| 4 | Sedge | *Carex* | 1.0% |
| 4 | Broadleaf cattail | *Typha latifolia* | 0.9% |
| 4 | Lambsquarters | *Chenopodium album* | 0.8% |
| 4 | Green bristlegrass | *Setaria viridis* | 0.7% |
| 4 | Unknown grass | | 0.7% |
| 4 | Unknown forb | | 0.5% |
| 4 | Nettleleaf goosefoot | *Chenopodium murale* | 0.5% |
| 4 | Showy milkweed | *Asclepias speciosa* | 0.4% |
| 4 | Bluntleaf yellowcress | *Rorippa curvipes* | 0.4% |
| 4 | Common threesquare | *Schoenoplectus pungens* | 0.4% |
| 4 | Plumeless thistle | *Carduus* | 0.2% |
| 4 | Broccoli | *Brassica oleracea* | 0.2% |
| 4 | Cosmopolitan bulrush | *Schoenoplectus maritimus* | 0.2% |
| 4 | Softstem bulrush | *Schoenoplectus tabernaemontani* | 0.1% |
| 4 | Cattail | *Typha* | 0.1% |
| 4 | Prickly russian thistle | *Salsola tragus* | 0.1% |
| 4 | Leathery knotweed | *Polygonum achoreum* | 0.1% |
| 4 | Prickly lettuce | *Lactuca serriola* | 0.1% |
| 4 | Goldenrod | *Solidago* | 0.0% |
| 4 | Knotweed | *Polygonum* | 0.0% |
| 4 | Foxtail barley | *Hordeum jubatum ssp. jubatum* | 0.0% |
| 4 | Bigbract verbena | *Verbena bracteata* | 0.0% |
| 4 | Witchgrass | *Panicum capillare* | 0.0% |
| 4 | Rough bugleweed | *Lycopus asper* | 0.0% |
| 4B | Open water | | 59.8% |
| 4B | Narrowleaf cattail | *Typha angustifolia* | 20.1% |
| 4B | Bare ground | | 9.8% |
| 4B | Duff | | 6.1% |
| 4B | Unknown residual | | 2.7% |
| 4B | Unknown forb | | 1.1% |
| 4B | Green bristlegrass | *Setaria viridis* | 0.1% |
| 4B | Mexican-fireweed | *Kochia scoparia* | 0.1% |
| 4B | Prickly russian thistle | *Salsola tragus* | 0.1% |
| 4B | Longroot smartweed | *Polygonum amphibium var. emersum* | 0.1% |

# Centennial SWA

Centennial 6: 4.6 ha, 8 Hydrologic Surveys, 18 Vegetation Plots
Pritchard: 2.4 ha, 8 Hydrologic Surveys, 42 Vegetation Plots




**Pritchard**

**Unit 6**

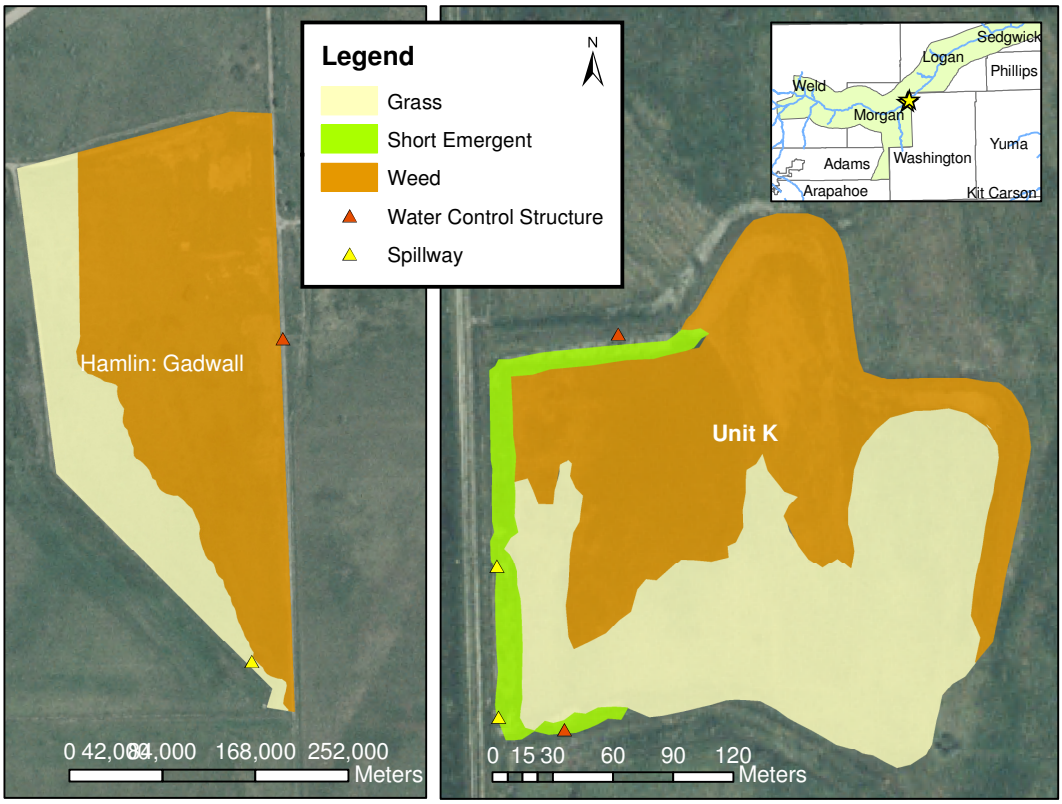
## Plant Species List

| Unit | Common Name | Scientific Name | Percent |
|---|---|---|---|
| Centennial 6 | Unknown residual | | 39.7% |
| Centennial 6 | Unknown grass | | 14.9% |
| Centennial 6 | Mountain rush | *Juncus balticus var. montanus* | 13.5% |
| Centennial 6 | Canada thistle | *Cirsium arvense* | 6.5% |
| Centennial 6 | Lenspod whitetop | *Cardaria chalapensis* | 5.8% |
| Centennial 6 | Bare ground | | 4.8% |
| Centennial 6 | Vetch | *Vicia* | 2.4% |
| Centennial 6 | Western wheatgrass | *Pascopyrum smithii* | 2.4% |
| Centennial 6 | Ragweed | *Ambrosia* | 1.9% |
| Centennial 6 | Prickly russian thistle | *Salsola tragus* | 1.7% |
| Centennial 6 | Duff | | 1.3% |
| Centennial 6 | Horsetail | *Equisetum* | 1.2% |
| Centennial 6 | Yellow sweetclover | *Melilotus officinalis* | 1.1% |
| Centennial 6 | Unknown forb | | 1.0% |
| Centennial 6 | Common threesquare | *Schoenoplectus pungens* | 0.8% |
| Centennial 6 | Sedge | *Carex* | 0.6% |
| Centennial 6 | Unknown | | 0.2% |
| Centennial 6 | Tall tumblemustard | *Sisymbrium altissimum* | 0.2% |
| Centennial 6 | Field bindweed | *Convolvulus arvensis* | 0.1% |
| Pritchard | Creeping bentgrass | *Agrostis stolonifera* | 24.8% |
| Pritchard | Bare ground | | 18.1% |
| Pritchard | Open water | | 6.9% |
| Pritchard | Unknown residual | | 5.8% |
| Pritchard | Smooth brome | *Bromus inermis ssp. inermis var. inermis* | 4.3% |
| Pritchard | Foxtail barley | *Hordeum jubatum ssp. jubatum* | 3.3% |
| Pritchard | Leathery knotweed | *Polygonum achoreum* | 3.1% |
| Pritchard | Western wheatgrass | *Pascopyrum smithii* | 3.0% |
| Pritchard | Barnyardgrass | *Echinochloa crus-galli* | 2.8% |
| Pritchard | Lambsquarters | *Chenopodium album* | 2.8% |
| Pritchard | Pennycress | *Thlaspi* | 2.5% |
| Pritchard | Wheatgrass | *Agropyron* | 2.2% |
| Pritchard | Bearded sprangletop | *Leptochloa fusca ssp. fascicularis* | 2.1% |
| Pritchard | Field bindweed | *Convolvulus arvensis* | 2.0% |
| Pritchard | Unknown grass | *Unknown grass* | 1.9% |
| Pritchard | Tall tumblemustard | *Sisymbrium altissimum* | 1.8% |
| Pritchard | Bluegrass | *Poa* | 1.4% |
| Pritchard | Curly dock | *Rumex crispus* | 1.3% |
| Pritchard | Alfalfa | *Medicago sativa* | 1.3% |
| Pritchard | Mexican-fireweed | *Kochia scoparia* | 1.0% |
| Pritchard | Canada thistle | *Cirsium arvense* | 0.9% |
| Pritchard | Prostrate knotweed | *Polygonum aviculare* | 0.8% |
| Pritchard | Prickly lettuce | *Lactuca serriola* | 0.7% |
| Pritchard | Duff | | 0.7% |
| Pritchard | Brome | *Bromus* | 0.6% |
| Pritchard | Crested wheatgrass | *Agropyron cristatum* | 0.6% |
| Pritchard | Cheatgrass | *Bromus tectorum* | 0.3% |
| Pritchard | Broccoli | *Brassica oleracea* | 0.3% |

| Unit | Common Name | Scientific Name | Percent |
|---|---|---|---|
| Pritchard | Lettuce | *Lactuca* | 0.3% |
| Pritchard | Common dandelion | *Taraxacum officinale* | 0.2% |
| Pritchard | Common plantain | *Plantago major* | 0.2% |
| Pritchard | Knotweed | *Polygonum* | 0.2% |
| Pritchard | Bigbract verbena | *Verbena bracteata* | 0.1% |
| Pritchard | Mallow | *Malva* | 0.1% |
| Pritchard | Jack-go-to-bed-at-noon | *Tragopogon pratensis* | 0.1% |
| Pritchard | Gumweed | *Grindelia* | 0.1% |
| Pritchard | Little hogweed | *Portulaca oleracea* | 0.1% |
| Pritchard | Snow on the mountain | *Euphorbia marginata* | 0.1% |
| Pritchard | Japanese brome | *Bromus japonicus* | 0.1% |
| Pritchard | Common cowparsnip | *Heracleum maximum* | 0.1% |
| Pritchard | Little barley | *Hordeum pusillum* | 0.1% |
| Pritchard | Oakleaf goosefoot | *Chenopodium glaucum* | 0.1% |
| Pritchard | Sedge | *Carex* | 0.0% |
| Pritchard | Unknown forb | | 0.0% |
| Pritchard | Queen anne's lace | *Daucus carota* | 0.0% |
| Pritchard | Clover | *Trifolium* | 0.0% |
| Pritchard | Reed canarygrass | *Phalaris arundinacea* | 0.0% |
| Pritchard | Cottonwood | *Populus* | 0.0% |

# Elliot SWA

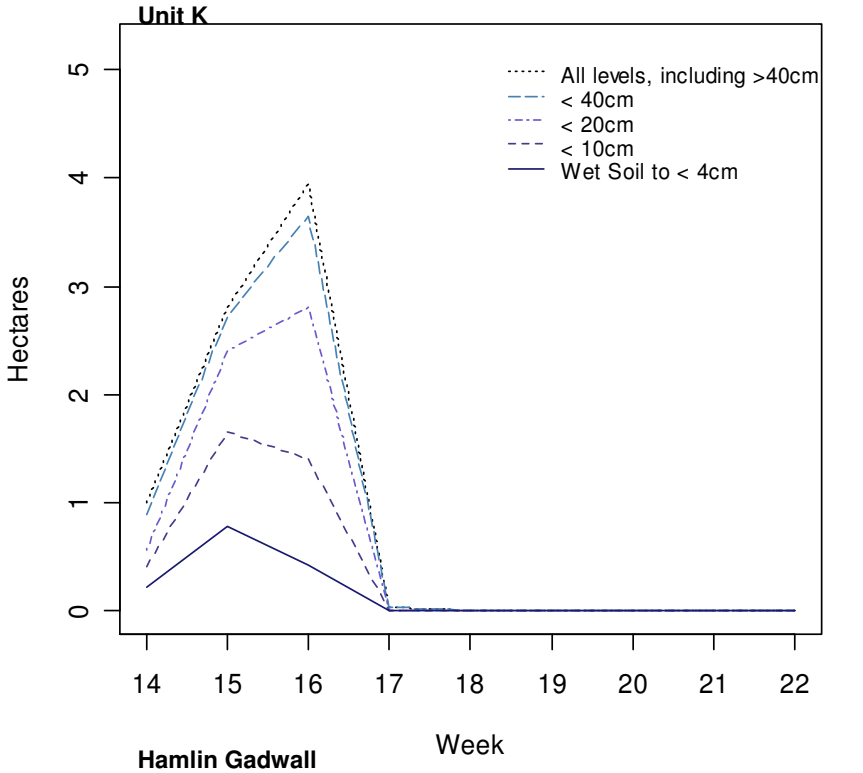
Unit K: 5.2 ha, 14 Bird Surveys, 9 Hydrologic Surveys, 42 Vegetation Plots
Hamlin Gadwall: 7.8 ha, 16 Bird Surveys, 8 Hydrologic Surveys, 46 Vegetation Plots

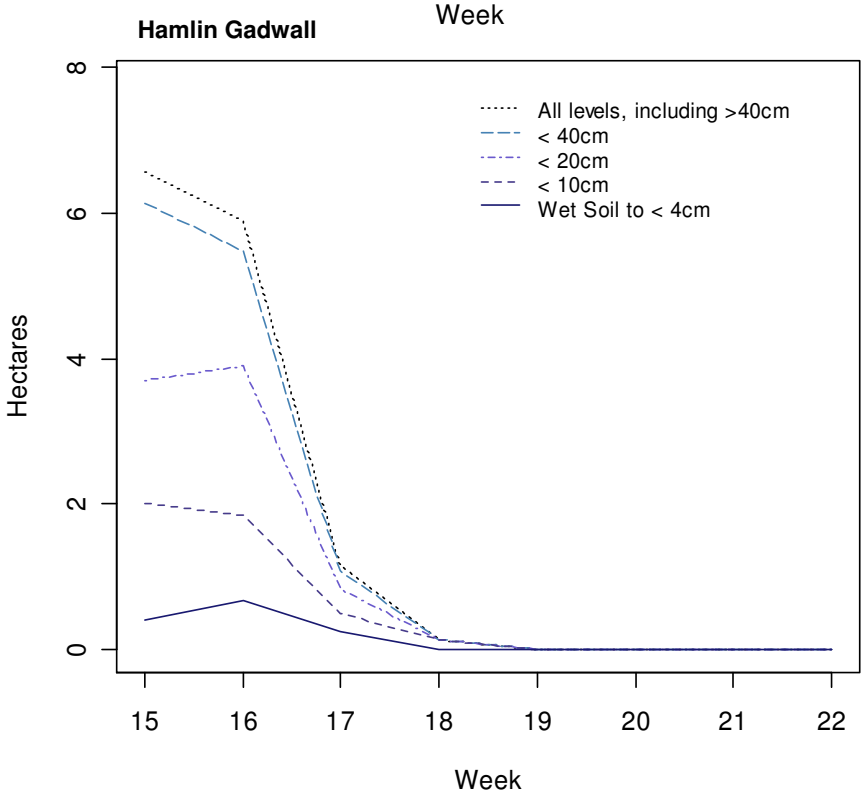



**Hamlin Gadwall**

**Unit K**

## Hydrographs



## Bird Species List

| Unit | Species | Scientific Name | Count | All Sites | % Total | Avg birds / 100 ha |
|---|---|---|---|---|---|---|
| Elliott: K | American Coot | *Fulica americana* | 1 | 595 | 0% | 1.4 |
| Elliott: K | Blue-winged Teal | *Anas discors* | 10 | 661 | 2% | 13.7 |
| Elliott: K | Canada Goose | *Branta canadensis* | 2 | 579 | 0% | 2.7 |
| Elliott: K | Cinnamon Teal | *Anas cyanoptera* | 4 | 61 | 7% | 5.5 |
| Elliott: K | Greater Yellowlegs | *Tringa melanoleuca* | 2 | 102 | 2% | 2.7 |
| Elliott: K | Green-winged Teal | *Anas crecca* | 9 | 1445 | 1% | 12.3 |
| Elliott: K | Killdeer | *Charadrius vociferus* | 6 | 610 | 1% | 8.2 |
| Elliott: K | Mallard | *Anas platyrhynchos* | 45 | 1300 | 3% | 61.7 |
| Elliott: K | Northern Shoveler | *Anas clypeata* | 1 | 919 | 0% | 1.4 |
| Elliott: K | Ring-billed Gull | *Larus delawarensis* | 1 | 102 | 1% | 1.4 |
| Elliott: K | Unknown Duck | | 5 | 2205 | 0% | 6.9 |
| Elliott: K | Wilson's Snipe | *Gallinago delicata* | 2 | 132 | 2% | 2.7 |
| Gadwall | American Wigeon | *Anas americana* | 5 | 407 | 1% | 4.0 |
| Gadwall | Blue-winged Teal | *Anas discors* | 142 | 661 | 21% | 114.1 |
| Gadwall | Canada Goose | *Branta canadensis* | 10 | 579 | 2% | 8.0 |
| Gadwall | Cinnamon Teal | *Anas cyanoptera* | 10 | 61 | 16% | 8.0 |
| Gadwall | Gadwall | *Anas strepera* | 11 | 871 | 1% | 8.8 |
| Gadwall | Greater Yellowlegs | *Tringa melanoleuca* | 8 | 102 | 8% | 6.4 |
| Gadwall | Green-winged Teal | *Anas crecca* | 112 | 1445 | 8% | 90.0 |
| Gadwall | Killdeer | *Charadrius vociferus* | 13 | 610 | 2% | 10.4 |
| Gadwall | Least Sandpiper | *Calidris minutilla* | 3 | 325 | 1% | 2.4 |
| Gadwall | Lesser Yellowlegs | *Tringa flavipes* | 35 | 149 | 23% | 28.1 |
| Gadwall | Mallard | *Anas platyrhynchos* | 105 | 1300 | 8% | 84.4 |
| Gadwall | Marbled Godwit | *Limosa fedoa* | 2 | 5 | 40% | 1.6 |
| Gadwall | Northern Pintail | *Anas acuta* | 76 | 1189 | 6% | 61.1 |
| Gadwall | Northern Shoveler | *Anas clypeata* | 50 | 919 | 5% | 40.2 |
| Gadwall | Solitary Sandpiper | *Tringa solitaria* | 5 | 6 | 83% | 4.0 |
| Gadwall | Sora | *Porzana carolina* | 1 | 15 | 7% | 0.8 |
| Gadwall | Unknown Dowitcher | | 3 | 115 | 3% | 2.4 |
| Gadwall | Unknown Duck | | 68 | 2205 | 3% | 54.6 |
| Gadwall | Unknown Teal | *Anas sp.* | 1 | 48 | 2% | 0.8 |
| Gadwall | Wilson's Phalarope | *Phalaropus tricolor* | 3 | 771 | 0% | 2.4 |
| Gadwall | Wilson's Snipe | *Gallinago delicata* | 5 | 132 | 4% | 4.0 |
| Gadwall | Wood Duck | *Aix sponsa* | 2 | 11 | 18% | 1.6 |

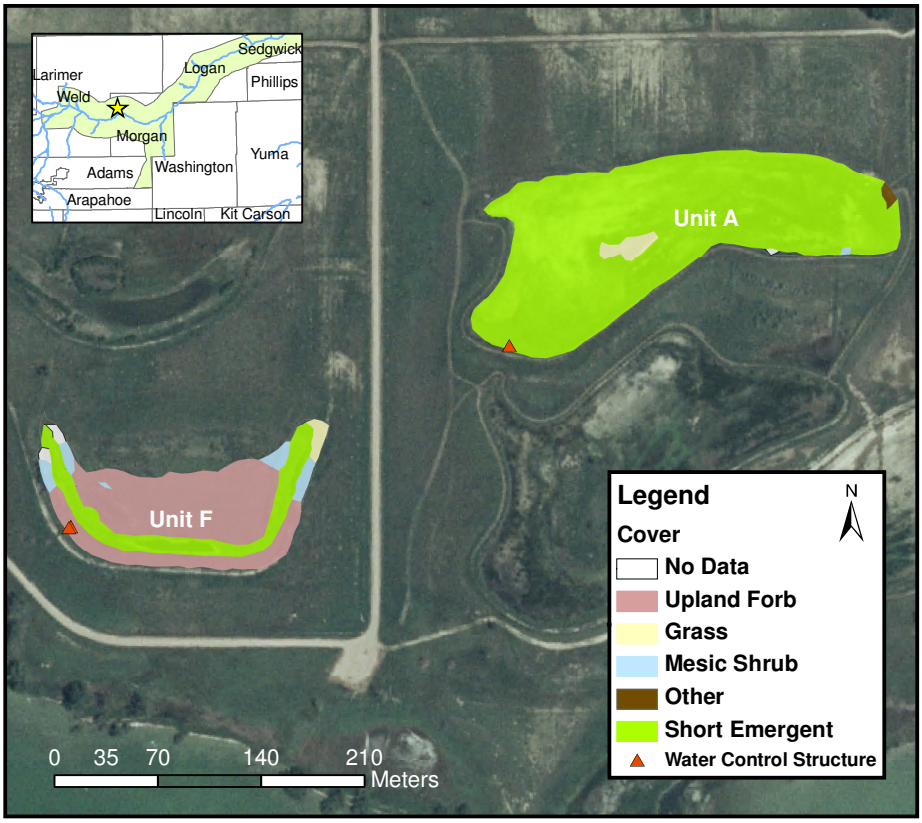
## Plant Species List

| Unit | Common Name | Scientific Name | Percent |
|---|---|---|---|
| Elliott: K | Western wheatgrass | *Pascopyrum smithii* | 20.0% |
| Elliott: K | American licorice | *Glycyrrhiza lepidota* | 13.4% |
| Elliott: K | Unknown residual | | 10.8% |
| Elliott: K | Unknown grass | | 7.6% |
| Elliott: K | Smooth brome | *Bromus inermis ssp. inermis var. inermis* | 6.4% |
| Elliott: K | Foxtail barley | *Hordeum jubatum ssp. jubatum* | 5.7% |
| Elliott: K | Inland saltgrass | *Distichlis spicata* | 5.5% |
| Elliott: K | Showy milkweed | *Asclepias speciosa* | 5.2% |
| Elliott: K | Rough cockleburr | *Xanthium strumarium* | 3.7% |
| Elliott: K | Bare ground | | 2.3% |
| Elliott: K | Lambsquarters | *Chenopodium album* | 1.9% |
| Elliott: K | Common sunflower | *Helianthus annuus* | 1.8% |
| Elliott: K | Common threesquare | *Schoenoplectus pungens* | 1.5% |
| Elliott: K | Needleleaf sedge | *Carex duriuscula* | 1.5% |
| Elliott: K | Curly dock | *Rumex crispus* | 1.5% |
| Elliott: K | Canada thistle | *Cirsium arvense* | 1.5% |
| Elliott: K | Brome | *Bromus* | 1.4% |
| Elliott: K | Spikerush | *Eleocharis* | 1.0% |
| Elliott: K | Rescuegrass | *Bromus catharticus* | 1.0% |
| Elliott: K | Rush | *Juncus* | 0.8% |
| Elliott: K | Green bristlegrass | *Setaria viridis* | 0.6% |
| Elliott: K | Leafy spurge | *Euphorbia esula var. esula* | 0.5% |
| Elliott: K | Mint | *Mentha* | 0.5% |
| Elliott: K | Sage | *Salvia* | 0.4% |
| Elliott: K | Duff | | 0.4% |
| Elliott: K | Milkweed | *Asclepias* | 0.4% |
| Elliott: K | Prostrate pigweed | *Amaranthus albus* | 0.4% |
| Elliott: K | Mexican-fireweed | *Kochia scoparia* | 0.3% |
| Elliott: K | Absinthium | *Artemisia absinthium* | 0.3% |
| Elliott: K | Yellow sweetclover | *Melilotus officinalis* | 0.3% |
| Elliott: K | Bluntleaf yellowcress | *Rorippa curvipes* | 0.2% |
| Elliott: K | Unknown forb | | 0.2% |
| Elliott: K | Nightshade | *Solanum* | 0.2% |
| Elliott: K | Smartweed | *Persicaria species* | 0.2% |
| Elliott: K | Buffalobur nightshade | *Solanum rostratum* | 0.1% |
| Elliott: K | Redtop | *Agrostis gigantea* | 0.1% |
| Elliott: K | Goldenrod | *Solidago* | 0.1% |
| Elliott: K | Great ragweed | *Ambrosia trifida* | 0.0% |
| Elliott: K | Goosefoot | *Chenopodium* | 0.0% |
| Elliott: K | Leathery knotweed | *Polygonum achoreum* | 0.0% |
| Elliott: K | Prickly lettuce | *Lactuca serriola* | 0.0% |
| Elliott: K | Bigbract verbena | *Verbena bracteata* | 0.0% |
| Elliott: K | Redroot amaranth | *Amaranthus retroflexus* | 0.0% |
| Elliott: K | Spotted ladysthumb | *Polygonum persicaria* | 0.0% |
| Gadwall | Curly dock | *Rumex crispus* | 20.4% |
| Gadwall | Bare ground | | 15.2% |

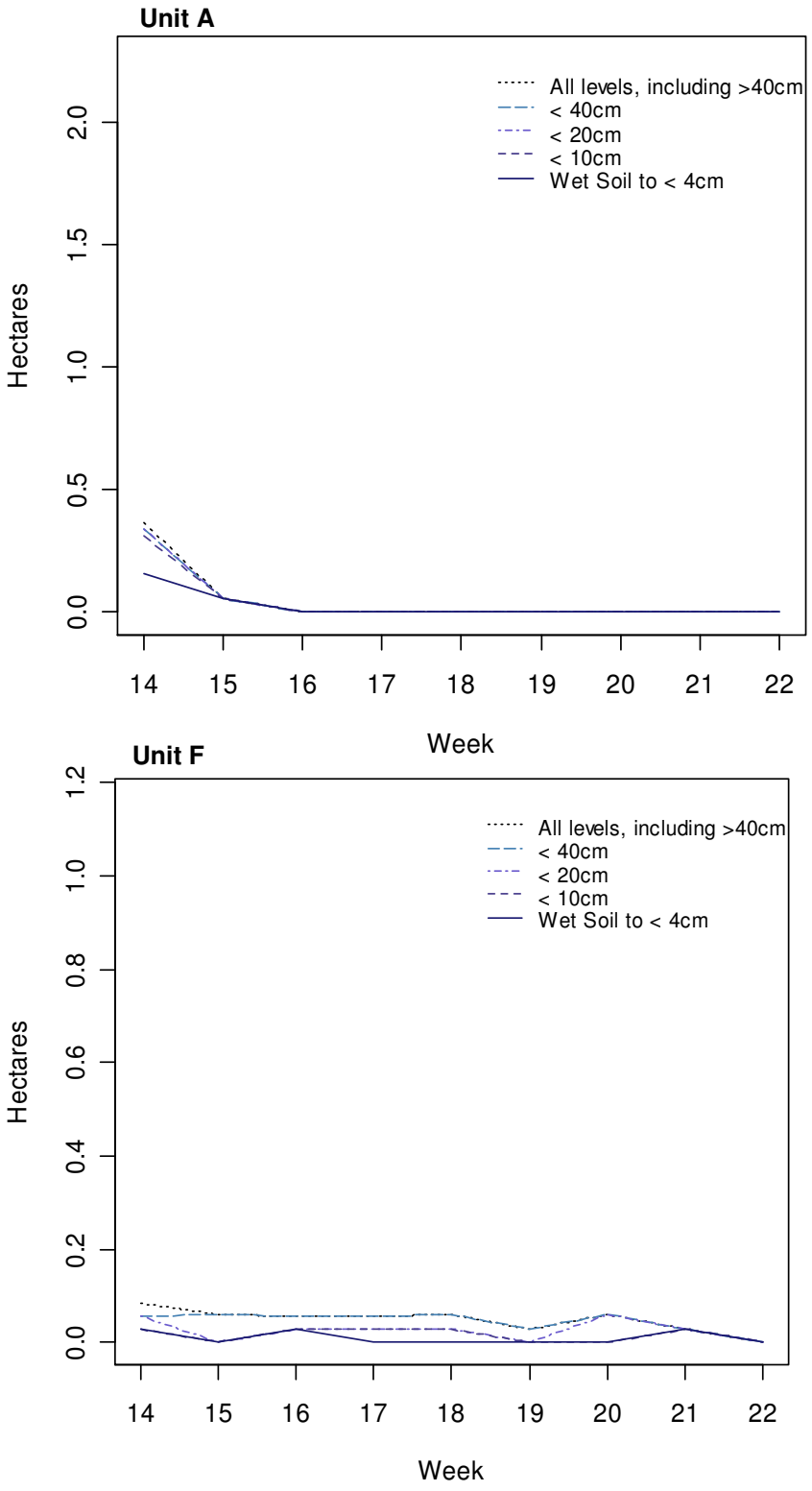
| Unit | Common Name | Scientific Name | Percent |
|---|---|---|---|
| Gadwall | Unknown residual | | 15.0% |
| Gadwall | Inland saltgrass | *Distichlis spicata* | 9.7% |
| Gadwall | Green bristlegrass | *Setaria viridis* | 7.8% |
| Gadwall | Western wheatgrass | *Pascopyrum smithii* | 4.9% |
| Gadwall | Foxtail barley | *Hordeum jubatum ssp. jubatum* | 3.9% |
| Gadwall | Common threesquare | *Schoenoplectus pungens* | 3.3% |
| Gadwall | Fescue | *Festuca* | 2.8% |
| Gadwall | Lambsquarters | *Chenopodium album* | 2.3% |
| Gadwall | Prostrate pigweed | *Amaranthus albus* | 2.2% |
| Gadwall | Sprangletop | *Leptochloa* | 2.1% |
| Gadwall | Common sunflower | *Helianthus annuus* | 1.6% |
| Gadwall | Leathery knotweed | *Polygonum achoreum* | 1.2% |
| Gadwall | Yellow sweetclover | *Melilotus officinalis* | 1.0% |
| Gadwall | Red swampfire | *Salicornia rubra* | 0.9% |
| Gadwall | Aster | | 0.8% |
| Gadwall | Unknown grass | | 0.7% |
| Gadwall | Witchgrass | *Panicum capillare* | 0.6% |
| Gadwall | Mountain rush | *Juncus balticus var. montanus* | 0.5% |
| Gadwall | Goldenrod | *Solidago* | 0.5% |
| Gadwall | Smartweed | *Persicaria species* | 0.5% |
| Gadwall | Rough cockleburr | *Xanthium strumarium* | 0.5% |
| Gadwall | Duff | | 0.4% |
| Gadwall | Mexican-fireweed | *Kochia scoparia* | 0.3% |
| Gadwall | Buffalobur nightshade | *Solanum rostratum* | 0.2% |
| Gadwall | Spikerush | *Eleocharis* | 0.2% |
| Gadwall | Prickly lettuce | *Lactuca serriola* | 0.1% |
| Gadwall | Prickly russian thistle | *Salsola tragus* | 0.1% |
| Gadwall | Milkweed | *Asclepias* | 0.1% |
| Gadwall | Wild parsnip | *Pastinaca sativa* | 0.0% |
| Gadwall | Redroot amaranth | *Amaranthus retroflexus* | 0.0% |
| Gadwall | Cuman ragweed | *Ambrosia psilostachya* | 0.0% |
| Gadwall | Sedge | *Carex* | 0.0% |

# Jackson SWA

Unit A: 2.3 ha, 12 Bird Surveys, 9 Hydrologic Surveys, 15 Vegetation Plots
Unit F: 1.2 ha, 17 Bird Surveys, 9 Hydrologic Surveys, 7 Vegetation Plots




# Hydrographs



## Bird Species List

| Unit | Species | Scientific Name | Count | Count in All Sites | % Total | Avg birds / 100 ha |
|---|---|---|---|---|---|---|
| A | Blue-winged Teal | *Anas discors* | 1 | 661 | 0% | 3.7 |
| A | Canada Goose | *Branta canadensis* | 2 | 579 | 0% | 7.4 |
| A | Cinnamon Teal | *Anas cyanoptera* | 1 | 61 | 2% | 3.7 |
| A | Gadwall | *Anas strepera* | 50 | 871 | 6% | 184.4 |
| A | Greater Yellowlegs | *Tringa melanoleuca* | 14 | 102 | 14% | 51.6 |
| A | Green-winged Teal | *Anas crecca* | 60 | 1445 | 4% | 221.2 |
| A | Killdeer | *Charadrius vociferus* | 15 | 610 | 2% | 55.3 |
| A | Lesser Yellowlegs | *Tringa flavipes* | 1 | 149 | 1% | 3.7 |
| A | Mallard | *Anas platyrhynchos* | 10 | 1300 | 1% | 36.9 |
| A | Northern Shoveler | *Anas clypeata* | 2 | 919 | 0% | 7.4 |
| A | Unknown Teal | *Anas sp.* | 2 | 48 | 4% | 7.4 |
| A | Wilson's Snipe | *Gallinago delicata* | 44 | 132 | 33% | 162.2 |
| F | Gadwall | *Anas strepera* | 2 | 871 | 0% | 10.1 |
| F | Killdeer | *Charadrius vociferus* | 13 | 610 | 2% | 65.9 |
| F | Lesser Yellowlegs | *Tringa flavipes* | 3 | 149 | 2% | 15.2 |
| F | Mallard | *Anas platyrhynchos* | 6 | 1300 | 0% | 30.4 |
| F | Northern Shoveler | *Anas clypeata* | 6 | 919 | 1% | 30.4 |
| F | Wilson's Snipe | *Gallinago delicata* | 3 | 132 | 2% | 15.2 |

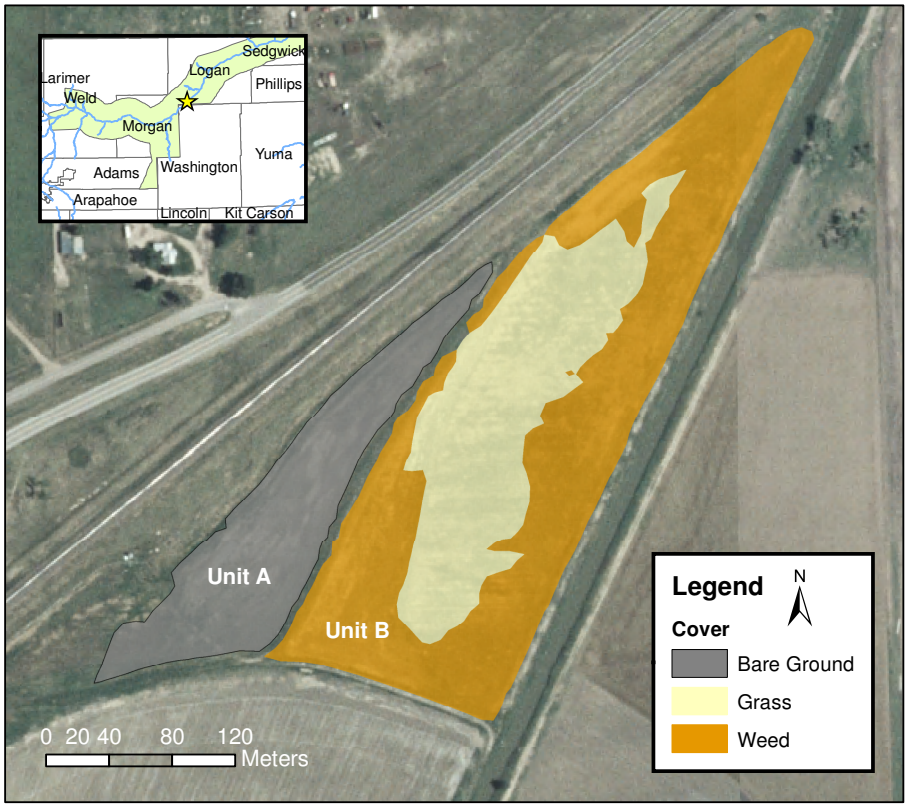
## Plant Species List

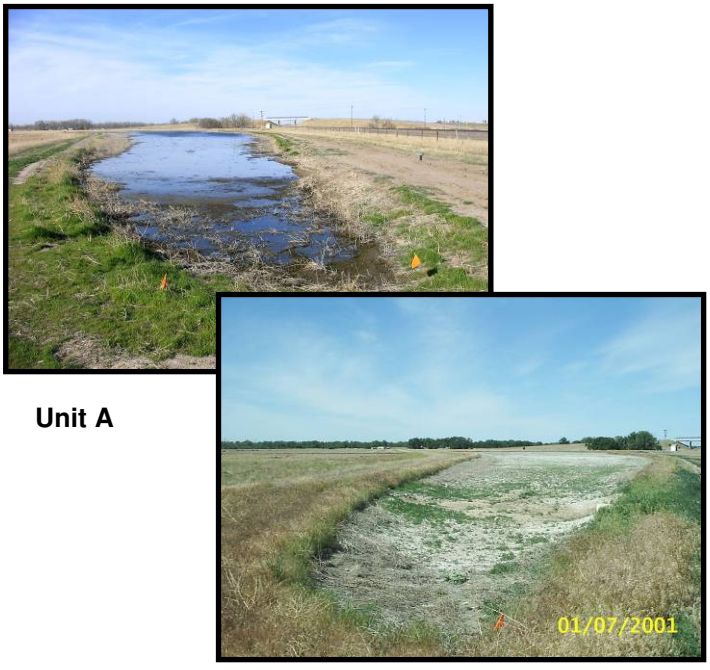
| Unit | Common Name | Scientific Name | Percent |
|---|---|---|---|
| A | Bare ground | | 21.9% |
| A | Duff | | 18.7% |
| A | Spikerush | *Eleocharis* | 15.4% |
| A | Softstem bulrush | *Schoenoplectus tabernaemontani* | 11.9% |
| A | Knotweed | *Polygonum* | 11.7% |
| A | Salt sandspurry | *Spergularia salina* | 5.5% |
| A | Common threesquare | *Schoenoplectus pungens* | 3.1% |
| A | Narrowleaf cattail | *Typha angustifolia* | 2.6% |
| A | Unknown forb | | 1.7% |
| A | Curly dock | *Rumex crispus* | 1.4% |
| A | Mexican-fireweed | *Kochia scoparia* | 1.4% |
| A | Common sunflower | *Helianthus annuus* | 1.3% |
| A | Unknown residual | | 1.0% |
| A | Foxtail barley | *Hordeum jubatum ssp. jubatum* | 0.6% |
| A | Leathery knotweed | *Polygonum achoreum* | 0.5% |
| A | Bearded sprangletop | *Leptochloa fusca ssp. fascicularis* | 0.5% |
| A | Unknown grass | | 0.3% |
| A | Spotted ladysthumb | *Polygonum persicaria* | 0.3% |
| A | Lambsquarters | *Chenopodium album* | 0.1% |
| A | Witchgrass | *Panicum capillare* | 0.1% |
| F | Mexican-fireweed | *Kochia scoparia* | 15.4% |
| F | Common sunflower | *Helianthus annuus* | 12.4% |

| Unit | Common Name | Scientific Name | Percent |
|---|---|---|---|
| F | Spikerush | *Eleocharis* | 11.5% |
| F | Spotted ladysthumb | *Polygonum persicaria* | 11.5% |
| F | Unknown residual | | 9.5% |
| F | Knotweed | *Polygonum* | 9.1% |
| F | Bare ground | | 8.8% |
| F | Field bindweed | *Convolvulus arvensis* | 8.8% |
| F | Lambsquarters | *Chenopodium album* | 3.8% |
| F | Prickly lettuce | *Lactuca serriola* | 3.4% |
| F | Foxtail barley | *Hordeum jubatum ssp. jubatum* | 2.7% |
| F | Annual rabbitsfoot grass | *Polypogon monspeliensis* | 2.0% |
| F | Prickly russian thistle | *Salsola tragus* | 0.4% |
| F | Cosmopolitan bulrush | *Schoenoplectus maritimus* | 0.3% |
| F | Softstem bulrush | *Schoenoplectus tabernaemontani* | 0.3% |
| F | Ragweed | *Ambrosia* | 0.1% |

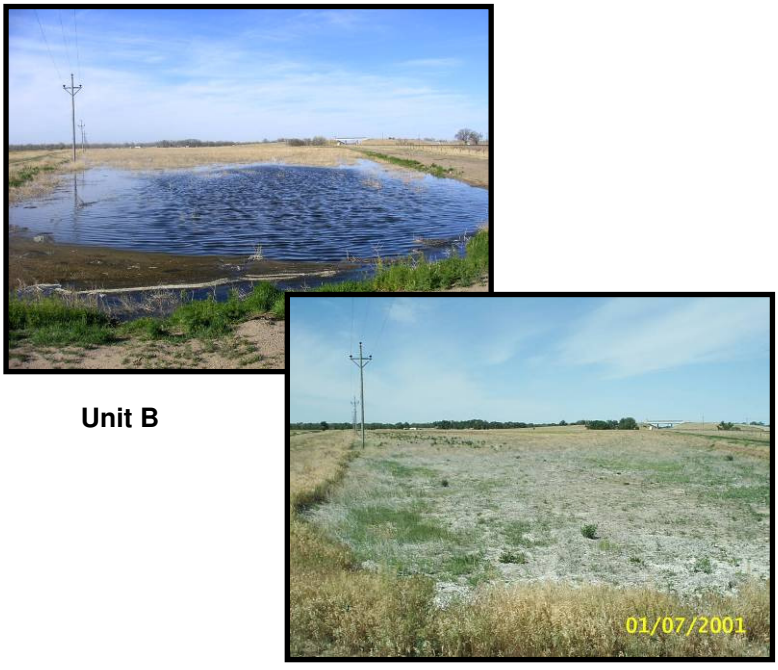
# Merino 1

WEA: CO-SP-03-009
Unit A: 1.4 ha, 14 Bird Surveys, 9 Hydrologic Surveys, 12 Vegetation Plots
Unit B: 5.1 ha, 14 Bird Surveys, 9 Hydrologic Surveys, 44 Vegetation Plots



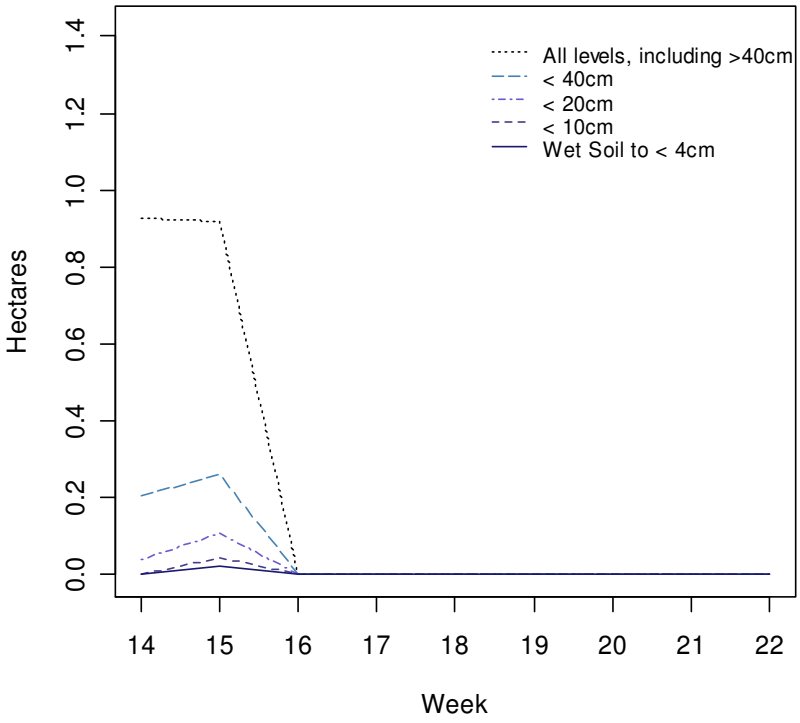

**Unit A**



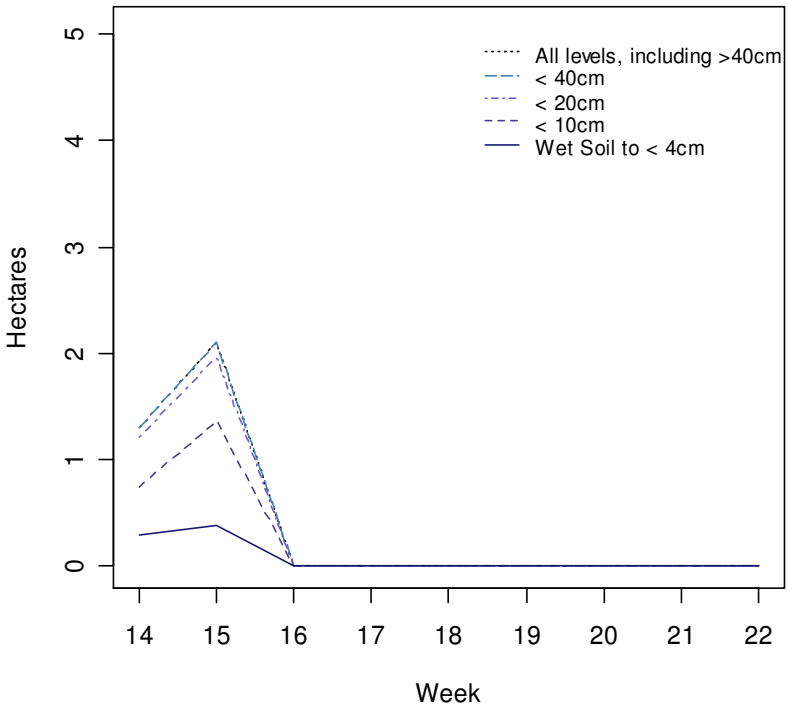

**Unit B**

# Hydrographs

**Unit A**




**Unite B** - - -



## Bird Species List

| Unit | Common Name | Scientific Name | Count | Count in All Sites | % Total | Avg birds / 100 ha |
|---|---|---|---|---|---|---|
| A | Blue-winged Teal | *Anas discors* | 1 | 661 | 0% | 5.0 |
| A | Cinnamon Teal | *Anas cyanoptera* | 1 | 61 | 2% | 5.0 |
| A | Gadwall | *Anas strepera* | 5 | 871 | 1% | 25.2 |
| A | Green-winged Teal | *Anas crecca* | 2 | 1445 | 0% | 10.1 |
| A | Killdeer | *Charadrius vociferus* | 5 | 610 | 1% | 25.2 |
| A | Mallard | *Anas platyrhynchos* | 2 | 1300 | 0% | 10.1 |
| A | Ring-billed Gull | *Larus delawarensis* | 23 | 102 | 23% | 115.7 |
| A | Unknown Duck | | 3 | 2205 | 0% | 15.1 |
| A | Unknown Teal | *Anas sp.* | 2 | 48 | 4% | 10.1 |
| A | Wilson's Snipe | *Gallinago delicata* | 2 | 132 | 2% | 10.1 |
| B | Greater Yellowlegs | *Tringa melanoleuca* | 4 | 102 | 4% | 5.7 |
| B | Killdeer | *Charadrius vociferus* | 5 | 610 | 1% | 7.1 |
| B | Mallard | *Anas platyrhynchos* | 6 | 1300 | 0% | 8.5 |
| B | Wilson's Snipe | *Gallinago delicata* | 19 | 132 | 14% | 26.9 |

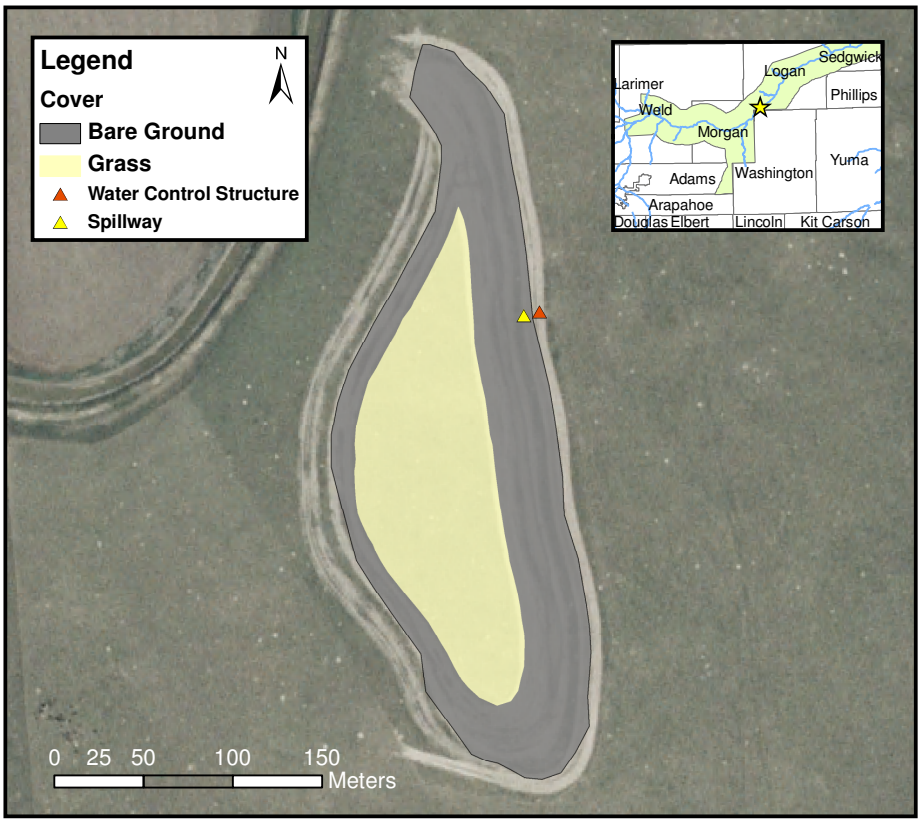
## Plant Species List

| Unit | Common Name | Scientific Name | Percent |
|---|---|---|---|
| A | Bare ground | | 68.0% |
| A | Green bristlegrass | *Setaria viridis* | 12.7% |
| A | Unknown residual | | 4.3% |
| A | Cheatgrass | *Bromus tectorum* | 4.1% |
| A | Mexican-fireweed | *Kochia scoparia* | 3.3% |
| A | Duff | | 2.1% |
| A | Common sunflower | *Helianthus annuus* | 1.8% |
| A | Yellow salsify | *Tragopogon dubius* | 1.7% |
| A | Leathery knotweed | *Polygonum achoreum* | 0.7% |
| A | Prickly lettuce | *Lactuca serriola* | 0.3% |
| A | Buffalobur nightshade | *Solanum rostratum* | 0.2% |
| A | Tall tumblemustard | *Sisymbrium altissimum* | 0.2% |
| A | Sand dropseed | *Sporobolus cryptandrus* | 0.2% |
| A | Prickly russian thistle | *Salsola tragus* | 0.1% |
| A | Herb sophia | *Descurainia sophia* | 0.1% |
| A | Yellow sweetclover | *Melilotus officinalis* | 0.1% |
| A | Redroot amaranth | *Amaranthus retroflexus* | 0.1% |
| B | Cheatgrass | *Bromus tectorum* | 30.9% |
| B | Duff | | 19.7% |
| B | Bare ground | | 16.4% |

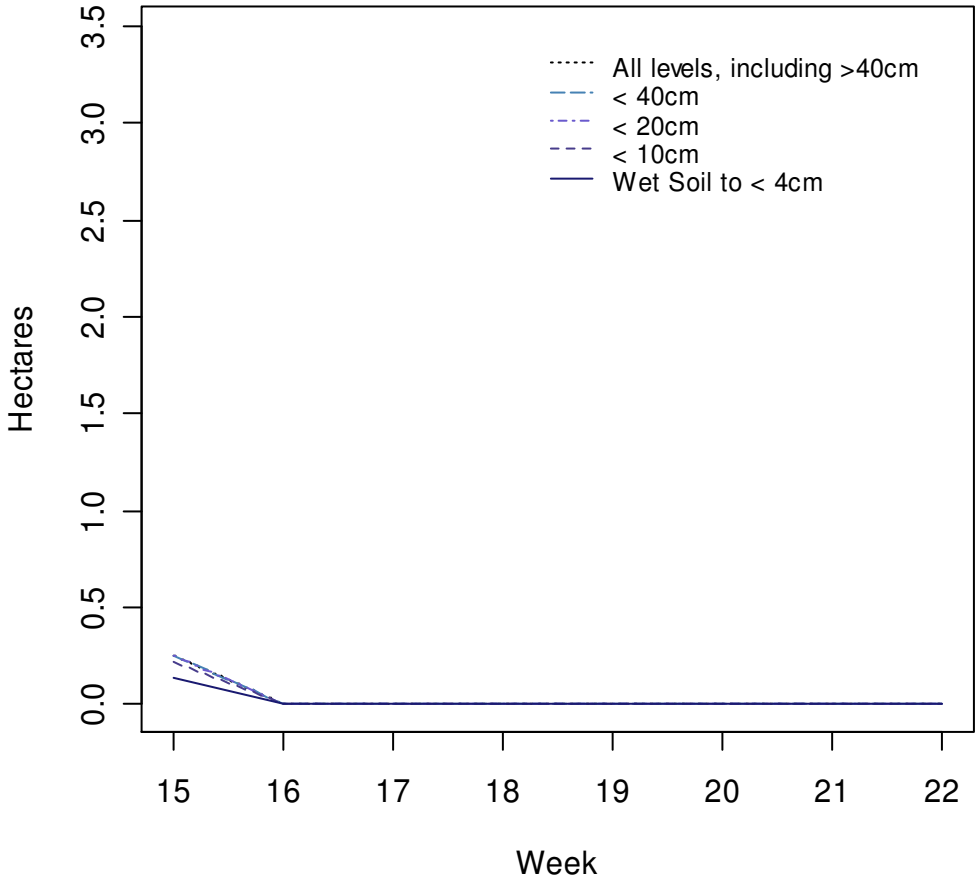
| Unit | Common Name | Scientific Name | Percent |
|---|---|---|---|
| B | Unknown residual | | 7.0% |
| B | Mexican-fireweed | *Kochia scoparia* | 4.5% |
| B | Herb sophia | *Descurainia sophia* | 3.5% |
| B | Green bristlegrass | *Setaria viridis* | 3.3% |
| B | Yellow salsify | *Tragopogon dubius* | 2.7% |
| B | Cutleaf vipergrass | *Scorzonera laciniata* | 2.2% |
| B | Alfalfa | *Medicago sativa* | 1.9% |
| B | Tall tumblemustard | *Sisymbrium altissimum* | 1.4% |
| B | Sand dropseed | *Sporobolus cryptandrus* | 1.1% |
| B | Yellow sweetclover | *Melilotus officinalis* | 0.7% |
| B | Broccoli | *Brassica oleracea* | 0.7% |
| B | Prickly lettuce | *Lactuca serriola* | 0.7% |
| B | Puncturevine | *Tribulus terrestris* | 0.6% |
| B | Prickly russian thistle | *Salsola tragus* | 0.6% |
| B | Bristlegrass | *Setaria* | 0.4% |
| B | Goldenrod | *Solidago* | 0.4% |
| B | Lambsquarters | *Chenopodium album* | 0.3% |
| B | Unknown forb | | 0.2% |
| B | Common dandelion | *Taraxacum officinale* | 0.2% |
| B | Common sunflower | *Helianthus annuus* | 0.2% |
| B | Redroot amaranth | *Amaranthus retroflexus* | 0.2% |
| B | Buffalobur nightshade | *Solanum rostratum* | 0.1% |
| B | Great ragweed | *Ambrosia trifida* | 0.0% |
| B | Agoseris | *Agoseris* | 0.0% |

# Merino 2

WEA: CO-SP-05-004
Wet Meadow: 3.46 ha, 14 Bird Surveys, 8 Hydrologic Surveys, 24 Vegetation Plots




## Hydrograph




## Bird Species List

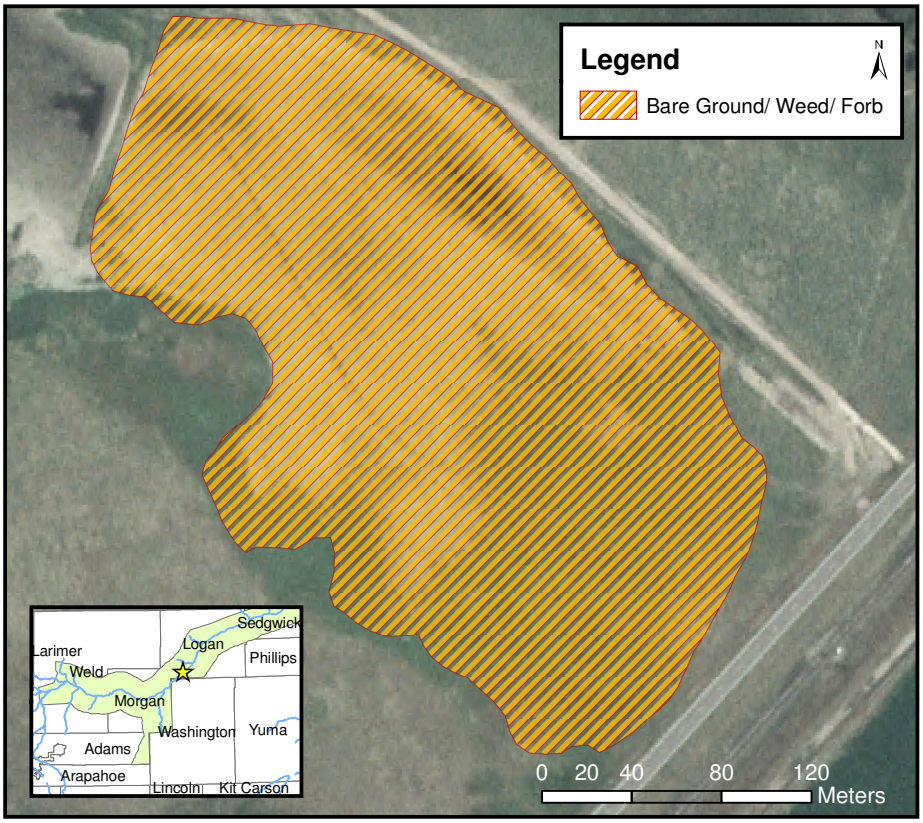
| Unit | Species | Scientific Name | Count | Count in All Sites | % Total | Avg birds / 100 ha |
|---|---|---|---|---|---|---|
| Wet Meadow | American Wigeon | *Anas americana* | 12 | 407 | 3% | 24.8 |
| Wet Meadow | Blue-winged Teal | *Anas discors* | 1 | 661 | 0% | 2.1 |
| Wet Meadow | Gadwall | *Anas strepera* | 4 | 871 | 0% | 8.3 |
| Wet Meadow | Greater Yellowlegs | *Tringa melanoleuca* | 13 | 102 | 13% | 26.8 |
| Wet Meadow | Green-winged Teal | *Anas crecca* | 62 | 1445 | 4% | 128.0 |
| Wet Meadow | Killdeer | *Charadrius vociferus* | 6 | 610 | 1% | 12.4 |
| Wet Meadow | Mallard | *Anas platyrhynchos* | 7 | 1300 | 1% | 14.5 |
| Wet Meadow | Ring-billed Gull | *Larus delawarensis* | 21 | 102 | 21% | 43.4 |
| Wet Meadow | Unknown Duck | | 124 | 2205 | 6% | 256.0 |

## Plant Species List

| Unit | Common Name | *Scientific Name* | Percent |
|---|---|---|---|
| Wet Meadow | Bare ground | | 40.3% |
| Wet Meadow | Sixweeks fescue | *Vulpia octoflora* | 8.4% |
| Wet Meadow | Threeawn | *Aristida* | 7.6% |
| Wet Meadow | Unknown residual | | 6.2% |
| Wet Meadow | Western wheatgrass | *Pascopyrum smithii* | 6.2% |
| Wet Meadow | Globemallow | *Sphaeralcea* | 5.8% |
| Wet Meadow | Redroot amaranth | *Amaranthus retroflexus* | 3.3% |
| Wet Meadow | Inland saltgrass | *Distichlis spicata* | 3.1% |
| Wet Meadow | Woolly plantain | *Plantago patagonica* | 2.6% |
| Wet Meadow | Duff | | 2.0% |
| Wet Meadow | Unknown grass | | 1.9% |
| Wet Meadow | False buffalograss | *Monroa squarrosa* | 1.7% |
| Wet Meadow | Alfalfa | *Medicago sativa* | 1.4% |
| Wet Meadow | Bigbract verbena | *Verbena bracteata* | 1.3% |
| Wet Meadow | Cryptantha | *Cryptantha* | 1.3% |
| Wet Meadow | Sand dropseed | *Sporobolus cryptandrus* | 1.2% |
| Wet Meadow | Tall tumblemustard | *Sisymbrium altissimum* | 0.8% |
| Wet Meadow | Shaggy dwarf morning-glory | *Evolvulus nuttallianus* | 0.7% |
| Wet Meadow | Yellow salsify | *Tragopogon dubius* | 0.6% |
| Wet Meadow | Pricklypear | *Opuntia* | 0.5% |
| Wet Meadow | Cheatgrass | *Bromus tectorum* | 0.4% |
| Wet Meadow | Squirreltail | *Elymus elymoides* | 0.3% |
| Wet Meadow | Mint | *Mentha* | 0.3% |
| Wet Meadow | Common pepperweed | *Lepidium densiflorum* | 0.2% |
| Wet Meadow | Prickly russian thistle | *Salsola tragus* | 0.2% |
| Wet Meadow | Mexican-fireweed | *Kochia scoparia* | 0.2% |
| Wet Meadow | Tumblegrass | *Schedonnardus paniculatus* | 0.2% |
| Wet Meadow | Beeblossom | *Gaura* | 0.2% |
| Wet Meadow | Unknown forb | | 0.2% |
| Wet Meadow | Spotted evening-primrose | *Oenothera canescens* | 0.1% |
| Wet Meadow | Pennycress | *Thlaspi* | 0.1% |
| Wet Meadow | Brome | *Bromus* | 0.1% |
| Wet Meadow | Goldenrod | *Solidago* | 0.1% |
| Wet Meadow | Curlycup gumweed | *Grindelia squarrosa* | 0.0% |
| Wet Meadow | Roundspike cryptantha | *Cryptantha humilis* | 0.0% |
| Wet Meadow | Flatspine stickseed | *Lappula occidentalis var. occidentalis* | 0.0% |
| Wet Meadow | Texas croton | *Croton texensis* | 0.0% |

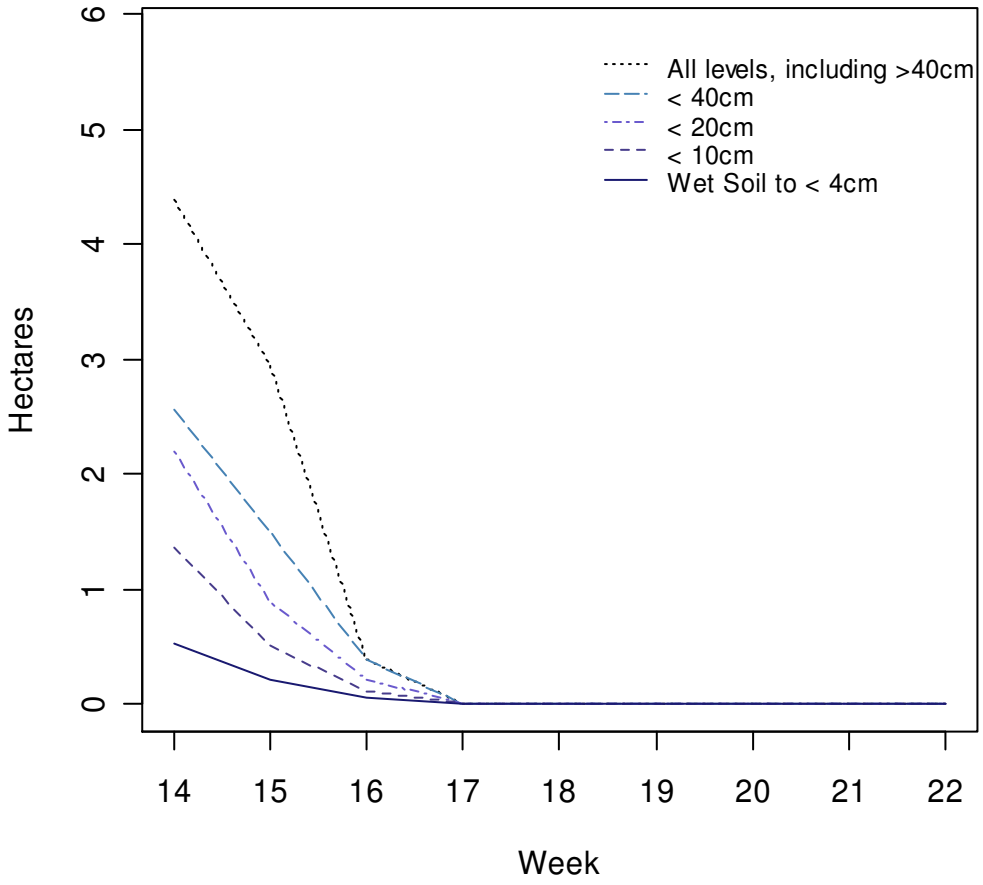
# Merino 3

WEA: CO-SP-1-003
Unit C: 5.8 ha, 15 Bird Surveys, 10 Hydrologic Surveys, 53 Vegetation Plots





## Hydrograph




## Bird Species List

| Unit | Species | Scientific Name | Count | Count in All Sites | % Total | Avg birds / 100 ha | Birds / Effective Area |
|---|---|---|---|---|---|---|---|
| C | American Wigeon | *Anas americana* | 15 | 407 | 4% | 17.2 | 0.51 |
| C | Blue-winged Teal | *Anas discors* | 25 | 661 | 4% | 28.6 | 0.52 |
| C | Canada Goose | *Branta canadensis* | 5 | 579 | 1% | 5.7 | 0.12 |
| C | Cinnamon Teal | *Anas cyanoptera* | 7 | 61 | 11% | 8.0 | 1.58 |
| C | Franklin's Gull | *Larus pipixcan* | 2 | 35 | 6% | 2.3 | 0.79 |
| C | Gadwall | *Anas strepera* | 186 | 871 | 21% | 213.1 | 2.95 |
| C | Greater Yellowlegs | *Tringa melanoleuca* | 4 | 102 | 4% | 4.6 | 0.54 |
| C | Green-winged Teal | *Anas crecca* | 94 | 1445 | 7% | 107.7 | 0.90 |
| C | Killdeer | *Charadrius vociferus* | 13 | 610 | 2% | 14.9 | 0.29 |
| C | Least Sandpiper | *Calidris minutilla* | 1 | 325 | 0% | 1.1 | 0.04 |
| C | Lesser Yellowlegs | *Tringa flavipes* | 25 | 149 | 17% | 28.6 | 2.31 |
| C | Mallard | *Anas platyrhynchos* | 23 | 1300 | 2% | 26.3 | 0.24 |
| C | Northern Pintail | *Anas acuta* | 355 | 1189 | 30% | 406.6 | 4.12 |
| C | Northern Shoveler | *Anas clypeata* | 94 | 919 | 10% | 107.7 | 1.41 |
| C | Pectoral Sandpiper | *Calidris melanotos* | 1 | 11 | 9% | 1.1 | 1.25 |
| C | Redhead | *Aythya americana* | 2 | 492 | 0% | 2.3 | 0.06 |
| C | Unknown Dowitcher | | 25 | 115 | 22% | 28.6 | 3.00 |

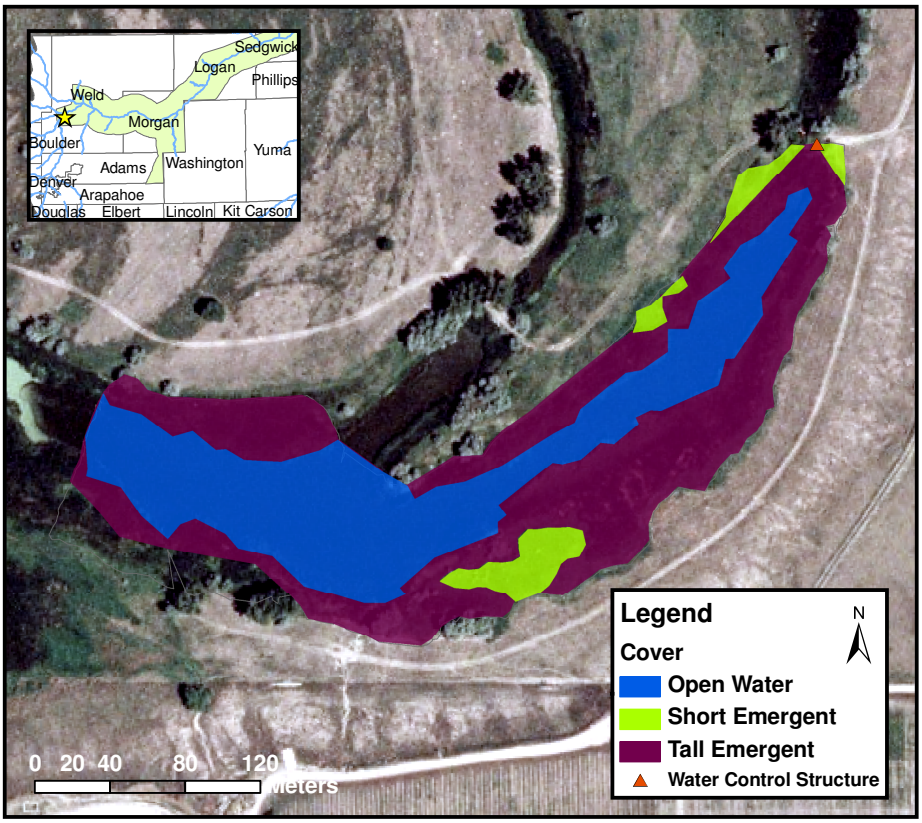
| Unit | Species | Scientific Name | Count | Count in All Sites | % Total | Avg birds / 100 ha | Birds / Effective Area |
|---|---|---|---|---|---|---|---|
| C | Unknown Duck | | 113 | 2205 | 5% | 129.4 | 0.71 |
| C | Unknown Yellowleg | | 6 | 42 | 14% | 6.9 | 1.97 |
| C | Wilson's Phalarope | *Phalaropus tricolor* | 3 | 771 | 0% | 3.4 | 0.05 |

## Plant Species List

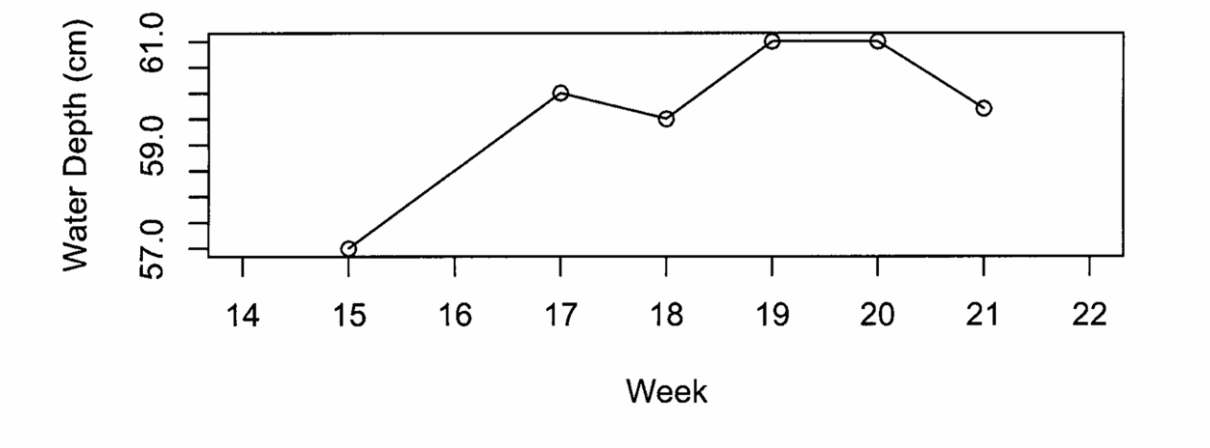
| Unit | Common Name | Scientific Name | Percent |
|---|---|---|---|
| C | Bare ground | | 33.9% |
| C | Unknown residual | | 17.4% |
| C | Cuman ragweed | *Ambrosia psilostachya* | 10.9% |
| C | Pitseed goosefoot | *Chenopodium berlandieri* | 10.6% |
| C | Leathery knotweed | *Polygonum achoreum* | 5.6% |
| C | Duff | | 4.6% |
| C | Curly dock | *Rumex crispus* | 2.7% |
| C | Field bindweed | *Convolvulus arvensis* | 1.8% |
| C | Unknown forb | | 1.6% |
| C | Prickly russian thistle | *Salsola tragus* | 1.4% |
| C | Oval-leaf knotweed | *Polygonum arenastrum* | 1.1% |
| C | Cheatgrass | *Bromus tectorum* | 1.0% |
| C | Japanese brome | *Bromus japonicus* | 1.0% |
| C | Inland saltgrass | *Distichlis spicata* | 1.0% |
| C | Carelessweed | *Amaranthus palmeri* | 0.8% |
| C | Curlytop knotweed | *Polygonum lapathifolium* | 0.7% |
| C | Prostrate pigweed | *Amaranthus albus* | 0.7% |
| C | Common sunflower | *Helianthus annuus* | 0.5% |
| C | Goldenrod | *Solidago* | 0.4% |
| C | Bigbract verbena | *Verbena bracteata* | 0.4% |
| C | Lambsquarters | *Chenopodium album* | 0.3% |
| C | Needle and thread | *Hesperostipa comata* | 0.3% |
| C | Prickly lettuce | *Lactuca serriola* | 0.2% |
| C | Spikerush | *Eleocharis* | 0.2% |
| C | Witchgrass | *Panicum capillare* | 0.1% |
| C | Unknown grass | | 0.1% |
| C | Goosefoot | *Chenopodium* | 0.1% |
| C | Plains pricklypear | *Opuntia polyacantha* | 0.1% |
| C | Mexican-fireweed | *Kochia scoparia* | 0.1% |
| C | Green bristlegrass | *Setaria viridis* | 0.1% |
| C | Smartweed | *Persicaria species* | 0.1% |
| C | Beeblossom | *Gaura* | 0.1% |
| C | Virginia groundcherry | *Physalis virginiana* | 0.0% |
| C | Field sagewort | *Artemisia campestris ssp. caudata* | 0.0% |
| C | Buffalobur nightshade | *Solanum rostratum* | 0.0% |
| C | Puncturevine | *Tribulus terrestris* | 0.0% |
| C | Texas croton | *Croton texensis* | 0.0% |
| C | Brome | *Bromus* | 0.0% |
| C | Matted sandmat | *Chamaesyce serpens* | 0.0% |

# Greeley 1

WEA: CO-SP-05-008
South Oxbow: 4.5 ha, 15 Bird Surveys, 7 Hydrologic Surveys, 29 Vegetation Plots




## Hydrograph




## Bird Species List

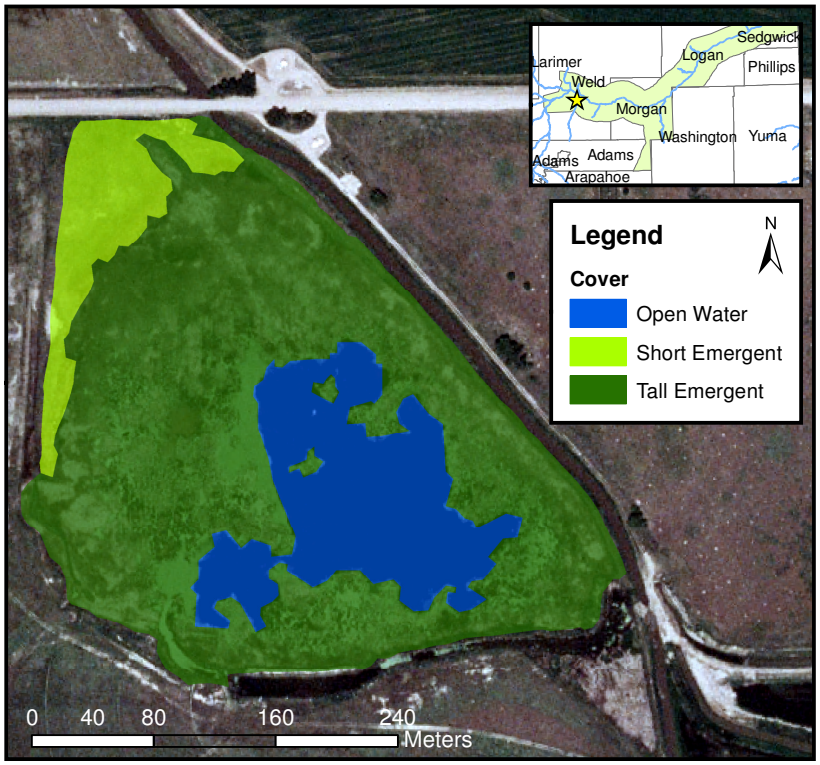
| Unit | Species | Scientific Name | Count | Count in All Sites | % Total | Avg birds / 100 ha |
|---|---|---|---|---|---|---|
| S. Oxbow | American Bittern | *Botaurus lentiginosus* | 1 | 6 | 17% | 1.5 |
| S. Oxbow | American Coot | *Fulica americana* | 6 | 595 | 1% | 8.9 |
| S. Oxbow | American White Pelican | *Pelecanus erythrorhynchos* | 4 | 269 | 1% | 6.0 |
| S. Oxbow | Blue-winged Teal | *Anas discors* | 2 | 661 | 0% | 3.0 |
| S. Oxbow | Canada Goose | *Branta canadensis* | 45 | 579 | 8% | 67.1 |
| S. Oxbow | Double-crested Cormorant | *Phalacrocorax auritus* | 2 | 75 | 3% | 3.0 |
| S. Oxbow | Gadwall | *Anas strepera* | 4 | 871 | 0% | 6.0 |
| S. Oxbow | Killdeer | *Charadrius vociferus* | 6 | 610 | 1% | 8.9 |
| S. Oxbow | Mallard | *Anas platyrhynchos* | 79 | 1300 | 6% | 117.8 |
| S. Oxbow | Northern Shoveler | *Anas clypeata* | 1 | 919 | 0% | 1.5 |
| S. Oxbow | Pied-billed Grebe | *Podilymbus podiceps* | 20 | 37 | 54% | 29.8 |
| S. Oxbow | Sora | *Porzana carolina* | 2 | 15 | 13% | 3.0 |
| S. Oxbow | Unknown Duck | | 0 | 2205 | 0% | 0.0 |
| S. Oxbow | Virginia Rail | *Rallus limicola* | 6 | 19 | 32% | 8.9 |
| S. Oxbow | Wilson's Snipe | *Gallinago delicata* | 12 | 132 | 9% | 17.9 |
| S. Oxbow | Wood Duck | *Aix sponsa* | 8 | 11 | 73% | 11.9 |

## Plant Species List

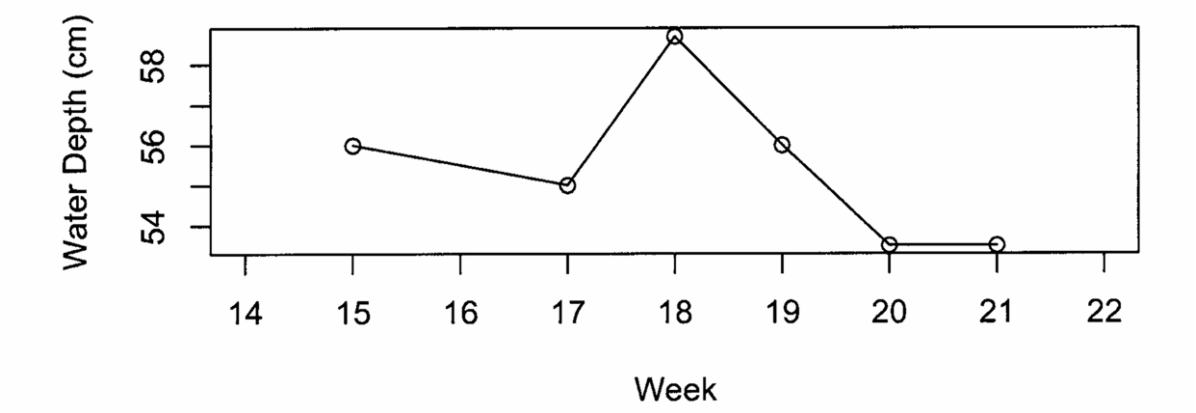
| Unit | Common Name | Scientific Name | Percent |
|---|---|---|---|
| South Oxbow | Open water | | 48.7% |
| South Oxbow | Narrowleaf cattail | *Typha angustifolia* | 25.9% |
| South Oxbow | Duckweed | *Lemna* | 5.8% |
| South Oxbow | Cattail | *Typha* | 3.2% |
| South Oxbow | Reed canarygrass | *Phalaris arundinacea* | 2.9% |
| South Oxbow | Spikerush | *Eleocharis* | 1.9% |
| South Oxbow | Canada thistle | *Cirsium arvense* | 1.7% |
| South Oxbow | Common threesquare | *Schoenoplectus pungens* | 1.5% |
| South Oxbow | Bulrush | *Schoenoplectus* | 1.4% |
| South Oxbow | Bare ground | | 1.1% |
| South Oxbow | Unknown forb | | 1.0% |
| South Oxbow | Unknown | | 0.8% |
| South Oxbow | Nightshade | *Solanum* | 0.8% |
| South Oxbow | Rough bugleweed | *Lycopus asper* | 0.6% |
| South Oxbow | Foxtail barley | *Hordeum jubatum ssp. jubatum* | 0.5% |
| South Oxbow | Marsh skullcap | *Scutellaria galericulata* | 0.5% |
| South Oxbow | Water speedwell | *Veronica anagallis-aquatica* | 0.3% |
| South Oxbow | Milkweed | *Asclepias* | 0.3% |
| South Oxbow | Broadleaf cattail | *Typha latifolia* | 0.3% |
| South Oxbow | Climbing nightshade | *Solanum dulcamara* | 0.2% |
| South Oxbow | Pepperweed | *Lepidium* | 0.2% |
| South Oxbow | American water horehound | *Lycopus americanus* | 0.1% |
| South Oxbow | Knotweed | *Polygonum* | 0.1% |
| South Oxbow | Swamp milkweed | *Asclepias incarnata* | 0.1% |
| South Oxbow | Curly dock | *Rumex crispus* | 0.1% |
| South Oxbow | Common spikerush | *Eleocharis palustris* | 0.1% |
| South Oxbow | Waterhorehound | *Lycopus* | 0.0% |
| South Oxbow | Unknown grass | *Unknown grass* | 0.0% |
| South Oxbow | Speedwell | *Veronica* | 0.0% |
| South Oxbow | Stinging nettle | *Urtica dioica ssp. holosericea* | 0.0% |

# Greeley 2

WEA: CO-GO-7-011
Pond: 9.5 ha, 15 Bird Surveys, 7 Hydrologic Surveys, 44 Vegetation Plots




## Hydrograph




## Bird Species List

| Unit | Species | Scientific Name | Count | Count in All Sites | % Total | Avg birds / 100 ha |
|---|---|---|---|---|---|---|
| Pond | American Avocet | *Recurvirostra americana* | 4 | 143 | 3% | 2.8 |
| Pond | American Bittern | *Botaurus lentiginosus* | 2 | 6 | 33% | 1.4 |
| Pond | American Coot | *Fulica americana* | 147 | 595 | 25% | 103.3 |
| Pond | American White Pelican | *Pelecanus erythrorhynchos* | 7 | 269 | 3% | 4.9 |
| Pond | American Wigeon | *Anas americana* | 122 | 407 | 30% | 85.7 |
| Pond | Black-crowned Night-Heron | *Nycticorax nycticorax* | 3 | 3 | 100% | 2.1 |
| Pond | Blue-winged Teal | *Anas discors* | 40 | 661 | 6% | 28.1 |
| Pond | Bufflehead | *Bucephala albeola* | 6 | 24 | 25% | 4.2 |
| Pond | Canada Goose | *Branta canadensis* | 81 | 579 | 14% | 56.9 |
| Pond | Canvasback | *Aythya valisineria* | 1 | 32 | 3% | 0.7 |
| Pond | Cinnamon Teal | *Anas cyanoptera* | 15 | 61 | 25% | 10.5 |
| Pond | Double-crested Cormorant | *Phalacrocorax auritus* | 4 | 75 | 5% | 2.8 |
| Pond | Eared Grebe | *Podiceps nigricollis* | 1 | 31 | 3% | 0.7 |
| Pond | Gadwall | *Anas strepera* | 232 | 871 | 27% | 163.0 |
| Pond | Greater White-fronted Goose | *Anser albifrons* | 1 | 132 | 1% | 0.7 |
| Pond | Greater Yellowlegs | *Tringa melanoleuca* | 2 | 102 | 2% | 1.4 |
| Pond | Green-winged Teal | *Anas crecca* | 85 | 1445 | 6% | 59.7 |
| Pond | Killdeer | *Charadrius vociferus* | 10 | 610 | 2% | 7.0 |
| Pond | Lesser Scaup | *Aythya affinis* | 11 | 137 | 8% | 7.7 |
| Pond | Long-billed Dowitcher | *Limnodromus scolopaceus* | 22 | 370 | 6% | 15.5 |
| Pond | Mallard | *Anas platyrhynchos* | 341 | 1300 | 26% | 239.6 |
| Pond | Northern Pintail | *Anas acuta* | 70 | 1189 | 6% | 49.2 |
| Pond | Northern Shoveler | *Anas clypeata* | 151 | 919 | 16% | 106.1 |
| Pond | Pied-billed Grebe | *Podilymbus podiceps* | 6 | 37 | 16% | 4.2 |
| Pond | Red-breasted Merganser | *Mergus serrator* | 1 | 1 | 100% | 0.7 |
| Pond | Red-necked Phalarope | *Phalaropus lobatus* | 2 | 64 | 3% | 1.4 |
| Pond | Redhead | *Aythya americana* | 47 | 492 | 10% | 33.0 |
| Pond | Ring-billed Gull | *Larus delawarensis* | 7 | 102 | 7% | 4.9 |

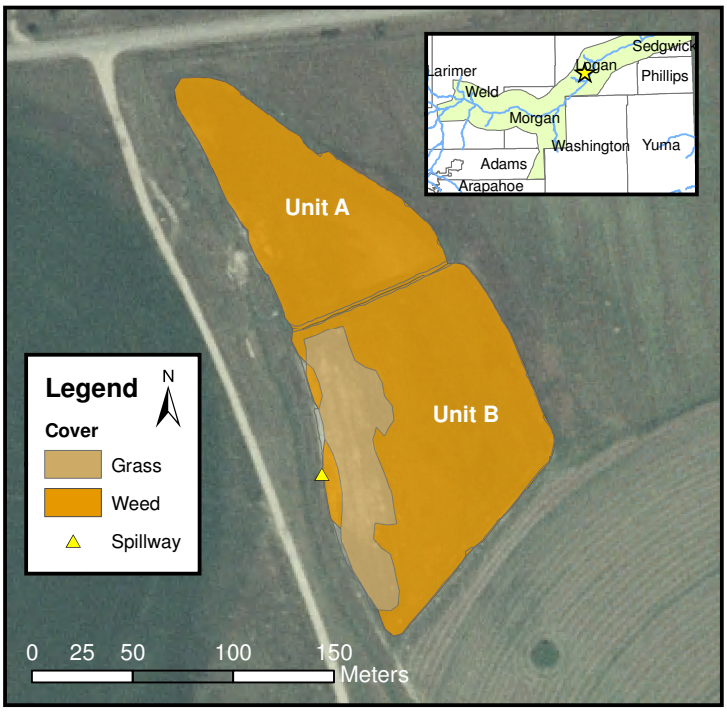
| Unit | Species | Scientific Name | Count | Count in All Sites | % Total | Avg birds / 100 ha |
|---|---|---|---|---|---|---|
| Pond | Ring-necked Duck | *Aythya collaris* | 3 | 33 | 9% | 2.1 |
| Pond | Ruddy Duck | *Oxyura jamaicensis* | 12 | 57 | 21% | 8.4 |
| Pond | Sora | *Porzana carolina* | 11 | 15 | 73% | 7.7 |
| Pond | Unknown Duck | | 1087 | 2205 | 49% | 763.6 |
| Pond | Unknown Rail | | 1 | 1 | 100% | 0.7 |
| Pond | Unknown Scaup | | 5 | 21 | 24% | 3.5 |
| Pond | Unknown Teal | *Anas sp.* | 4 | 48 | 8% | 2.8 |
| Pond | Virginia Rail | *Rallus limicola* | 13 | 19 | 68% | 9.1 |
| Pond | White-faced Ibis | *Plegadis chihi* | 2 | 70 | 3% | 1.4 |
| Pond | Wilson's Phalarope | *Phalaropus tricolor* | 276 | 771 | 36% | 193.9 |
| Pond | Wood Duck | *Aix sponsa* | 1 | 11 | 9% | 0.7 |

## Plant Species List

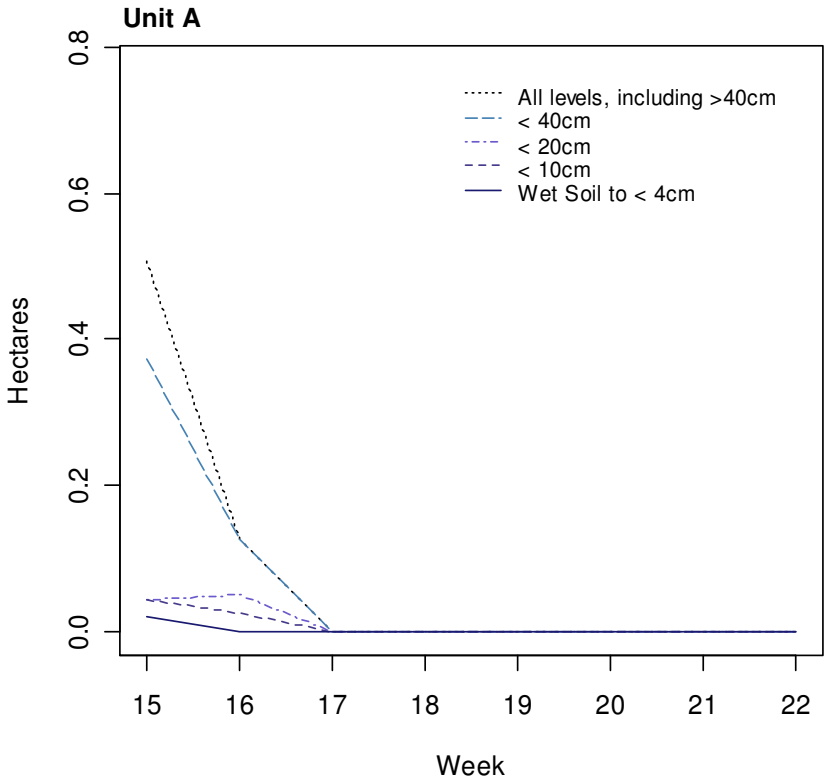
| Unit | Common Name | Scientific Name | Percent |
|---|---|---|---|
| Pond | Narrowleaf cattail | *Typha angustifolia* | 46.7% |
| Pond | Open water | | 21.8% |
| Pond | Duckweed | *Lemna* | 21.0% |
| Pond | Common threesquare | *Schoenoplectus pungens* | 2.7% |
| Pond | Lambsquarters | *Chenopodium album* | 2.0% |
| Pond | Western wheatgrass | *Pascopyrum smithii* | 1.1% |
| Pond | Bare ground | | 0.9% |
| Pond | Unknown | | 0.8% |
| Pond | Cattail | *Typha* | 0.7% |
| Pond | Broadleaved pepperweed | *Lepidium latifolium* | 0.7% |
| Pond | Meadow foxtail | *Alopecurus pratensis* | 0.7% |
| Pond | Canada thistle | *Cirsium arvense* | 0.6% |
| Pond | Duff | | 0.2% |
| Pond | Softstem bulrush | *Schoenoplectus tabernaemontani* | 0.1% |
| Pond | Inland saltgrass | *Distichlis spicata* | 0.1% |
| Pond | Foxtail barley | *Hordeum jubatum ssp. jubatum* | 0.0% |
| Pond | Mexican-fireweed | *Kochia scoparia* | 0.0% |
| Pond | Prickly russian thistle | *Salsola tragus* | 0.0% |
| Pond | Bushy knotweed | *Polygonum ramosissimum* | 0.0% |
| Pond | Prickly lettuce | *Lactuca serriola* | 0.0% |

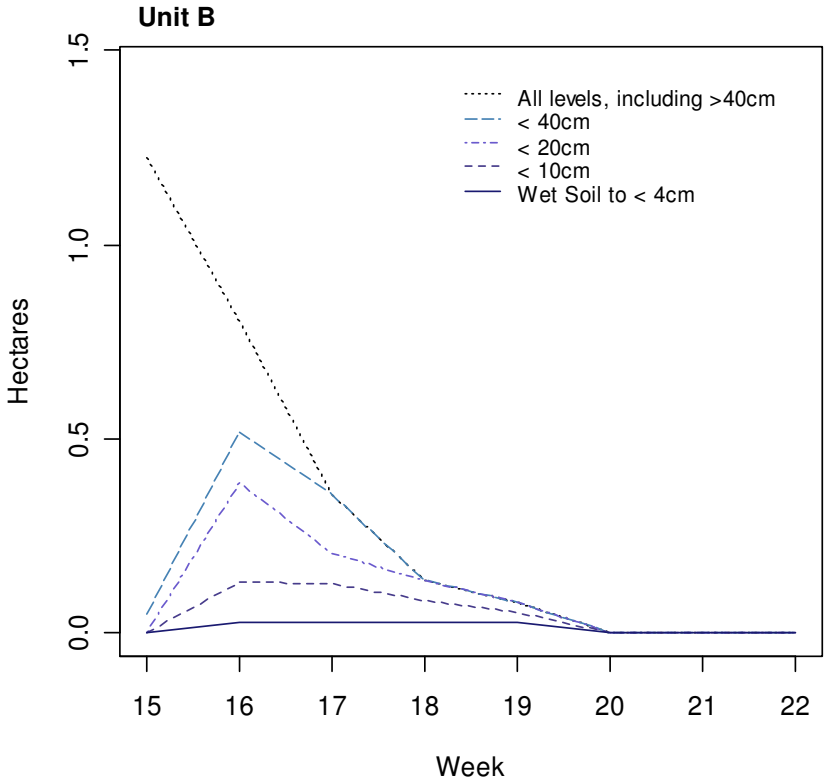
# Sterling 1

WEA: CO-SP-3-002
Unit A: 0.8 ha, 17 Bird Surveys, 8 Hydrologic Surveys, 7 Vegetation Plots
Unit B: 1.5 ha, 17 Bird Surveys, 8 Hydrologic Surveys, 13 Vegetation Plots




## Hydrograph


Unit A
All levels, including >40cm
< 40cm
< 20cm
< 10cm
Wet Soil to < 4cm
Hectares
0.0
0.2
0.4
0.6
0.8
15
16
17
18
19
20
21
22
Week


Unit B
All levels, including >40cm
< 40cm
< 20cm
< 10cm
Wet Soil to < 4cm
Hectares
0.0
0.5
1.0
1.5
15
16
17
18
19
20
21
22
Week

## Bird Species List

| Unit | Species | Scientific Name | Count | Count in All Sites | % Total | Avg birds / 100 ha |
|---|---|---|---|---|---|---|
| A | Canada Goose | *Branta canadensis* | 23 | 579 | 4% | 175.7 |
| A | Green-winged Teal | *Anas crecca* | 2 | 1445 | 0% | 15.3 |
| A | Killdeer | *Charadrius vociferus* | 3 | 610 | 0% | 22.9 |
| A | Mallard | *Anas platyrhynchos* | 9 | 1300 | 1% | 68.8 |
| A | Northern Pintail | *Anas acuta* | 2 | 1189 | 0% | 15.3 |
| A | Ring-billed Gull | *Larus delawarensis* | 2 | 102 | 2% | 15.3 |
| B | American Wigeon | *Anas americana* | 2 | 407 | 0% | 8.1 |
| B | Baird's Sandpiper | *Calidris bairdii* | 3 | 194 | 2% | 12.2 |
| B | Canada Goose | *Branta canadensis* | 4 | 579 | 1% | 16.2 |
| B | Greater Yellowlegs | *Tringa melanoleuca* | 2 | 102 | 2% | 8.1 |
| B | Green-winged Teal | *Anas crecca* | 9 | 1445 | 1% | 36.5 |
| B | Killdeer | *Charadrius vociferus* | 29 | 610 | 5% | 117.6 |
| B | Least Sandpiper | *Calidris minutilla* | 68 | 325 | 21% | 275.9 |
| B | Long-billed Dowitcher | *Limnodromus scolopaceus* | 3 | 370 | 1% | 12.2 |
| B | Mallard | *Anas platyrhynchos* | 9 | 1300 | 1% | 36.5 |
| B | Northern Pintail | *Anas acuta* | 19 | 1189 | 2% | 77.1 |
| B | Redhead | *Aythya americana* | 7 | 492 | 1% | 28.4 |
| B | Ring-billed Gull | *Larus delawarensis* | 4 | 102 | 4% | 16.2 |
| B | Semipalmated Plover | *Charadrius semipalmatus* | 5 | 28 | 18% | 20.3 |
| B | Semipalmated Sandpiper | *Calidris pusilla* | 19 | 445 | 4% | 77.1 |
| B | Solitary Sandpiper | *Tringa solitaria* | 1 | 6 | 17% | 4.1 |
| B | Unknown Dowitcher | | 2 | 115 | 2% | 8.1 |
| B | Unknown Peep | *Calidris Sp.* | 1 | 49 | 2% | 4.1 |
| B | Unknown Yellowleg | | 20 | 42 | 48% | 81.1 |
| B | Western Sandpiper | *Calidris mauri* | 1 | 32 | 3% | 4.1 |
| B | Wilson's Phalarope | *Phalaropus tricolor* | 4 | 771 | 1% | 16.2 |
| B | Wilson's Snipe | *Gallinago delicata* | 2 | 132 | 2% | 8.1 |

## Plant Species List

| Unit | Common Name | Scientific Name | Percent |
|---|---|---|---|
| A | Bare ground | | 32.6% |
| A | Duff | | 16.9% |
| A | Common sunflower | *Helianthus annuus* | 15.7% |
| A | Rescuegrass | *Bromus catharticus* | 14.8% |
| A | Mexican-fireweed | *Kochia scoparia* | 8.0% |
| A | Leathery knotweed | *Polygonum achoreum* | 4.8% |
| A | Brome | *Bromus* | 1.4% |
| A | Unknown forb | | 0.8% |
| A | Prickly russian thistle | *Salsola tragus* | 0.7% |
| A | Great ragweed | *Ambrosia trifida* | 0.7% |
| A | Unknown residual | *Unknown Residual* | 0.7% |
| A | Green bristlegrass | *Setaria viridis* | 0.7% |
| A | Matted sandmat | *Chamaesyce serpens* | 0.6% |
| A | Cuman ragweed | *Ambrosia psilostachya* | 0.4% |
| A | Lambsquarters | *Chenopodium album* | 0.4% |
| A | Redroot amaranth | *Amaranthus retroflexus* | 0.3% |
| A | Wormseed wallflower | *Erysimum cheiranthoides* | 0.1% |
| A | Alfalfa | *Medicago sativa* | 0.1% |
| A | Sedge | *Carex* | 0.1% |
| B | Bare ground | | 37.3% |
| B | Field bindweed | *Convolvulus arvensis* | 14.9% |
| B | Common sunflower | *Helianthus annuus* | 11.0% |
| B | Unknown residual | | 9.5% |
| B | Unknown grass | | 8.1% |
| B | Duff | | 6.3% |
| B | Mexican-fireweed | *Kochia scoparia* | 3.3% |
| B | Rescuegrass | *Bromus catharticus* | 3.1% |
| B | Alfalfa | *Medicago sativa* | 2.2% |
| B | Brome | *Bromus* | 1.3% |
| B | Cuman ragweed | *Ambrosia psilostachya* | 0.7% |
| B | Leathery knotweed | *Polygonum achoreum* | 0.4% |
| B | Prickly lettuce | *Lactuca serriola* | 0.4% |
| B | Common dandelion | *Taraxacum officinale* | 0.4% |
| B | Redroot amaranth | *Amaranthus retroflexus* | 0.3% |
| B | Yellow sweetclover | *Melilotus officinalis* | 0.2% |
| B | Prickly russian thistle | *Salsola tragus* | 0.1% |
| B | Lambsquarters | *Chenopodium album* | 0.1% |
| B | Green bristlegrass | *Setaria viridis* | 0.1% |
| B | Puncturevine | *Tribulus terrestris* | 0.1% |
| B | Herb sophia | *Descurainia sophia* | 0.1% |

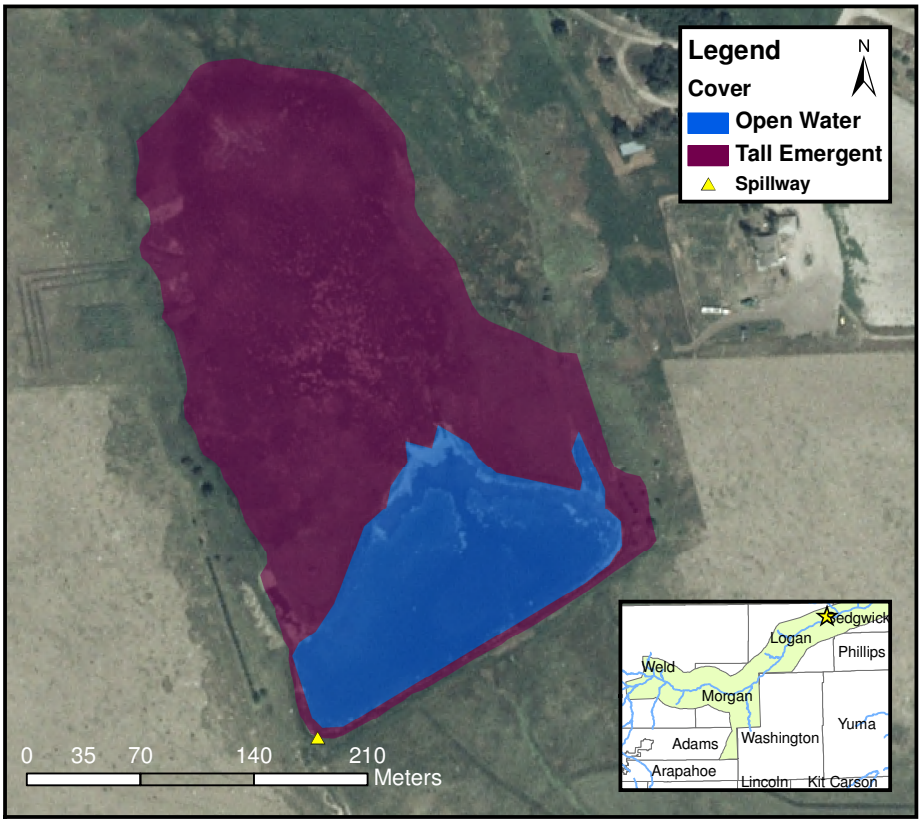
# Sterling 2

WEA: CO-GO-0-002
Wet Meadow: 7 Hydrologic Surveys

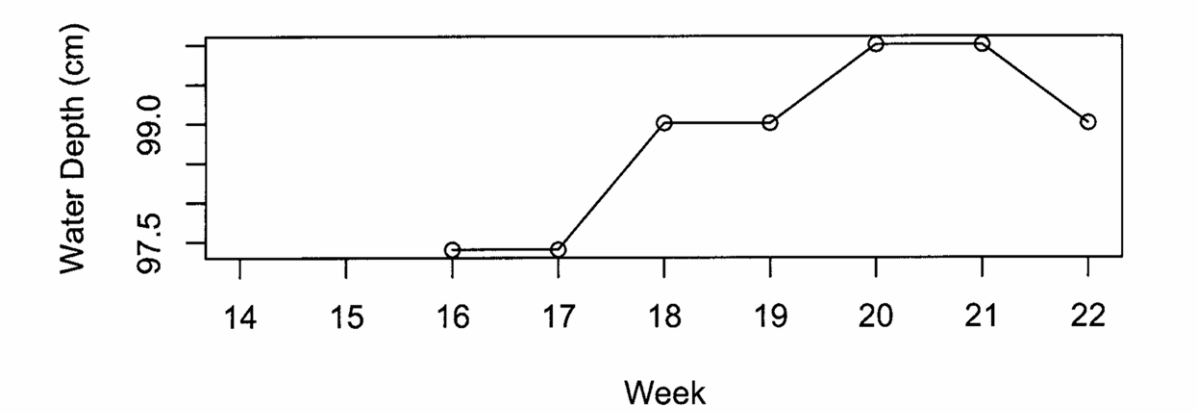
# Crook 1

WEA: CO-SP-3-003

Pond: 7.5 ha, 20 Bird Surveys, 8 Hydrologic Surveys, 40 Vegetation Plots




## Hydrograph




## Bird Species List

| Unit | Species | Scientific Name | Count | Count in All Sites | % Total | Avg birds / 100 ha |
|---|---|---|---|---|---|---|
| Pond | American Bittern | *Botaurus lentiginosus* | 2 | 6 | 33% | 1.3 |
| Pond | American Coot | *Fulica americana* | 62 | 595 | 10% | 41.3 |
| Pond | American White Pelican | *Pelecanus erythrorhynchos* | 11 | 269 | 4% | 7.3 |
| Pond | American Wigeon | *Anas americana* | 49 | 407 | 12% | 32.7 |
| Pond | Blue-winged Teal | *Anas discors* | 115 | 661 | 17% | 76.7 |
| Pond | Canada Goose | *Branta canadensis* | 6 | 579 | 1% | 4.0 |
| Pond | Canvasback | *Aythya valisineria* | 31 | 32 | 97% | 20.7 |
| Pond | Cinnamon Teal | *Anas cyanoptera* | 7 | 61 | 11% | 4.7 |
| Pond | Common Goldeneye | *Bucephala clangula* | 1 | 2 | 50% | 0.7 |
| Pond | Double-crested Cormorant | *Phalacrocorax auritus* | 23 | 75 | 31% | 15.3 |
| Pond | Eared Grebe | *Podiceps nigricollis* | 2 | 31 | 6% | 1.3 |
| Pond | Forster's Tern | *Sterna forsteri* | 2 | 5 | 40% | 1.3 |
| Pond | Gadwall | *Anas strepera* | 69 | 871 | 8% | 46.0 |
| Pond | Green-winged Teal | *Anas crecca* | 177 | 1445 | 12% | 118.0 |
| Pond | Killdeer | *Charadrius vociferus* | 6 | 610 | 1% | 4.0 |
| Pond | Lesser Scaup | *Aythya affinis* | 40 | 137 | 29% | 26.7 |
| Pond | Mallard | *Anas platyrhynchos* | 85 | 1300 | 7% | 56.7 |
| Pond | Northern Pintail | *Anas acuta* | 148 | 1189 | 12% | 98.7 |
| Pond | Northern Shoveler | *Anas clypeata* | 12 | 919 | 1% | 8.0 |
| Pond | Pectoral Sandpiper | *Calidris melanotos* | 1 | 11 | 9% | 0.7 |
| Pond | Pied-billed Grebe | *Podilymbus podiceps* | 3 | 37 | 8% | 2.0 |
| Pond | Redhead | *Aythya americana* | 383 | 492 | 78% | 255.3 |
| Pond | Ring-billed Gull | *Larus delawarensis* | 4 | 102 | 4% | 2.7 |
| Pond | Ring-necked Duck | *Aythya collaris* | 25 | 33 | 76% | 16.7 |
| Pond | Ruddy Duck | *Oxyura jamaicensis* | 1 | 57 | 2% | 0.7 |
| Pond | Snow Goose | *Chen caerulescens* | 5 | 235 | 2% | 3.3 |
| Pond | Sora | *Porzana carolina* | 1 | 15 | 7% | 0.7 |
| Pond | Spotted Sandpiper | *Actitis macularia* | 3 | 60 | 5% | 2.0 |
| Pond | Unknown Duck | | 215 | 2205 | 10% | 143.3 |

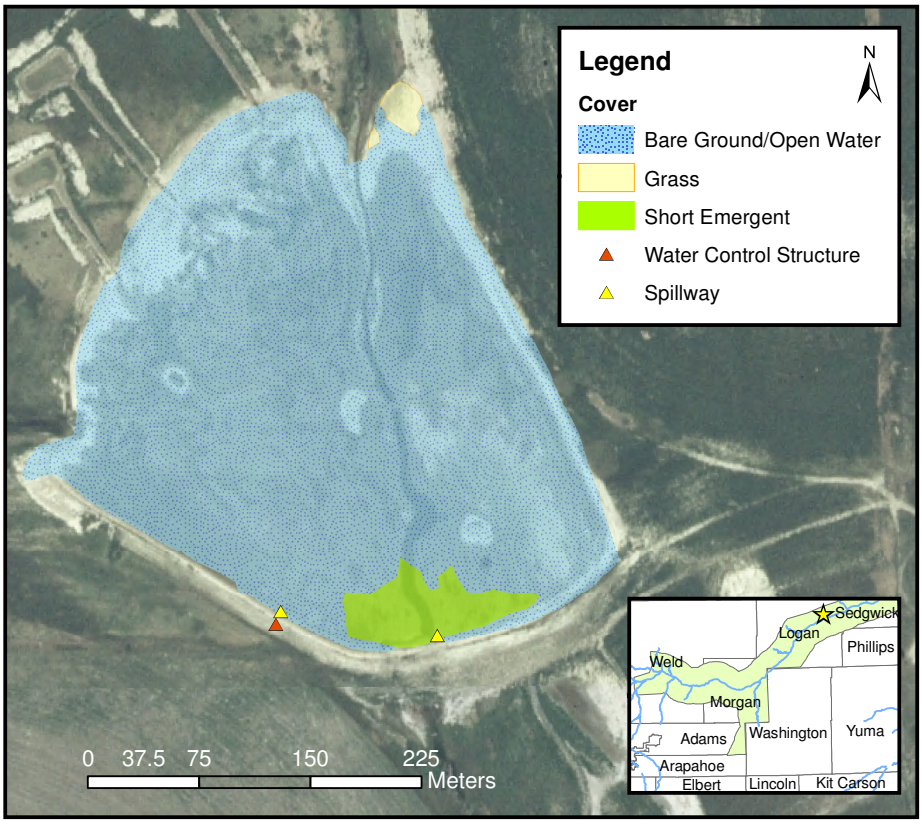
| Unit | Species | Scientific Name | Count | Count in All Sites | % Total | Avg birds / 100 ha |
|---|---|---|---|---|---|---|
| Pond | Unknown Shorebird | | 1 | 113 | 1% | 0.7 |
| Pond | Unknown Teal | *Anas sp.* | 1 | 48 | 2% | 0.7 |
| Pond | Wilson's Phalarope | *Phalaropus tricolor* | 97 | 771 | 13% | 64.7 |
| Pond | Wilson's Snipe | *Gallinago delicata* | 3 | 132 | 2% | 2.0 |

## Plant Species List

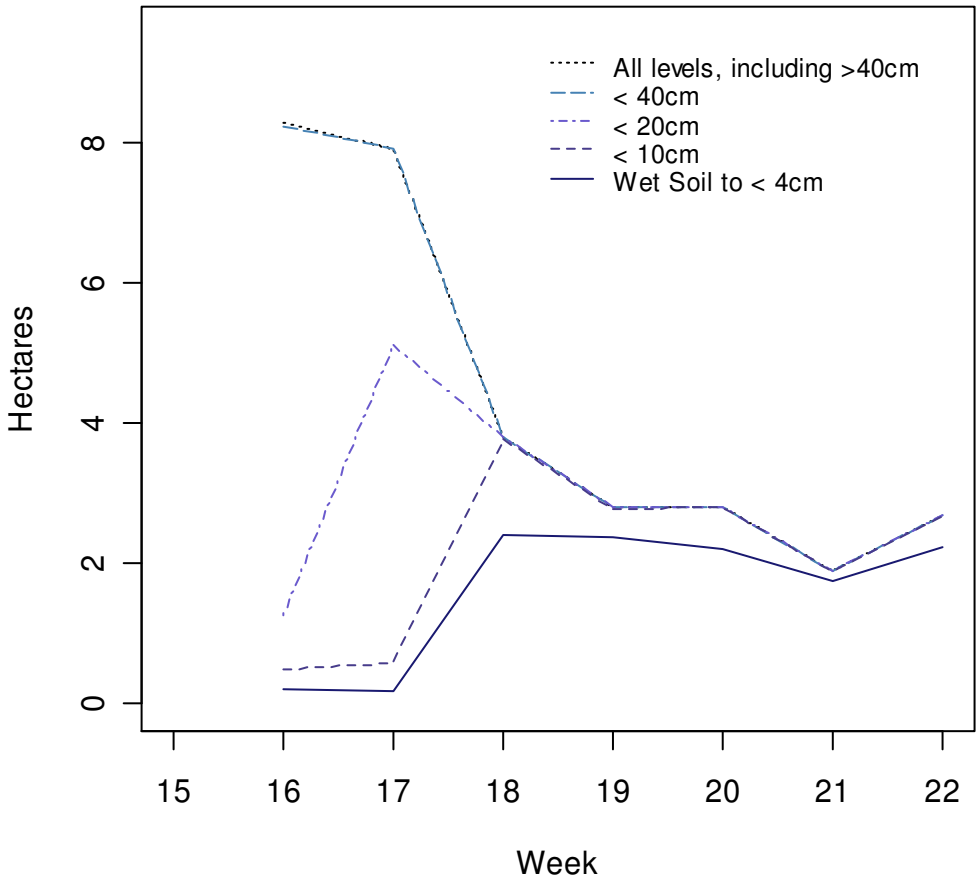
| Unit | Common Name | Scientific Name | Percent |
|---|---|---|---|
| Pond | Narrowleaf cattail | Typha angustifolia | 39.7% |
| Pond | Unknown residual | | 15.4% |
| Pond | Canada thistle | Cirsium arvense | 13.3% |
| Pond | Broadleaf cattail | Typha latifolia | 7.1% |
| Pond | Open water | | 4.7% |
| Pond | Mountain rush | Juncus balticus var. montanus | 3.7% |
| Pond | Common threesquare | Schoenoplectus pungens | 3.4% |
| Pond | Lambsquarters | Chenopodium album | 3.0% |
| Pond | Spikerush | Eleocharis | 1.7% |
| Pond | Rush | Juncus | 1.3% |
| Pond | Unknown forb | | 1.1% |
| Pond | Goldenrod | Solidago | 1.1% |
| Pond | Bare ground | | 0.8% |
| Pond | Smartweed | Persicaria species | 0.5% |
| Pond | Sedge | Carex | 0.4% |
| Pond | Caraway | Carum carvi | 0.4% |
| Pond | Horehound | Marrubium vulgare | 0.4% |
| Pond | Duff | | 0.2% |
| Pond | Showy milkweed | Asclepias speciosa | 0.2% |
| Pond | Prickly lettuce | Lactuca serriola | 0.2% |
| Pond | Vervain | Verbena | 0.2% |
| Pond | Foxtail barley | Hordeum jubatum ssp. jubatum | 0.2% |
| Pond | Duckweed | Lemna | 0.2% |
| Pond | Annual rabbitsfoot grass | Polypogon monspeliensis | 0.2% |
| Pond | Mint | Mentha | 0.1% |
| Pond | Softstem bulrush | Schoenoplectus tabernaemontani | 0.1% |
| Pond | Loosestrife | Lythrum | 0.1% |
| Pond | Reed canarygrass | Phalaris arundinacea | 0.1% |
| Pond | Stinging nettle | Urtica dioica ssp. holosericea | 0.1% |
| Pond | Japanese brome | Bromus japonicus | 0.0% |
| Pond | Cattail | Typha | 0.0% |
| Pond | Prairie wedgescale | Sphenopholis obtusata | 0.0% |
| Pond | Rice cutgrass | Leersia oryzoides | 0.0% |

# Crook 2

WEA: CO-SP-05-005
Pond: 9.6 ha, 20 Bird Surveys, 8 Hydrologic Surveys, 81 Vegetation Plots




## Hydrograph




## Bird Species List

| Unit | Species | Scientific Name | Count | Count in All Sites | % Total | Avg birds / 100 ha |
|---|---|---|---|---|---|---|
| Pond | American Avocet | *Recurvirostra americana* | 130 | 143 | 91% | 68.1 |
| Pond | American Coot | *Fulica americana* | 5 | 595 | 1% | 2.6 |
| Pond | American White Pelican | *Pelecanus erythrorhynchos* | 188 | 269 | 70% | 98.4 |
| Pond | American Wigeon | *Anas americana* | 169 | 407 | 42% | 88.5 |
| Pond | Baird's Sandpiper | *Calidris bairdii* | 181 | 194 | 93% | 94.8 |
| Pond | Black-bellied Plover | *Pluvialis squatarola* | 4 | 4 | 100% | 2.1 |
| Pond | Black-necked Stilt | *Himantopus mexicanus* | 2 | 6 | 33% | 1.0 |
| Pond | Black Tern | *Chlidonias niger* | 1 | 27 | 4% | 0.5 |
| Pond | Blue-winged Teal | *Anas discors* | 74 | 661 | 11% | 38.7 |
| Pond | Canada Goose | *Branta canadensis* | 380 | 579 | 66% | 199.0 |
| Pond | Cinnamon Teal | *Anas cyanoptera* | 5 | 61 | 8% | 2.6 |
| Pond | Double-crested Cormorant | *Phalacrocorax auritus* | 15 | 75 | 20% | 7.9 |
| Pond | Dunlin | *Calidris alpina* | 2 | 2 | 100% | 1.0 |
| Pond | Franklin's Gull | *Larus pipixcan* | 33 | 35 | 94% | 17.3 |
| Pond | Gadwall | *Anas strepera* | 116 | 871 | 13% | 60.7 |

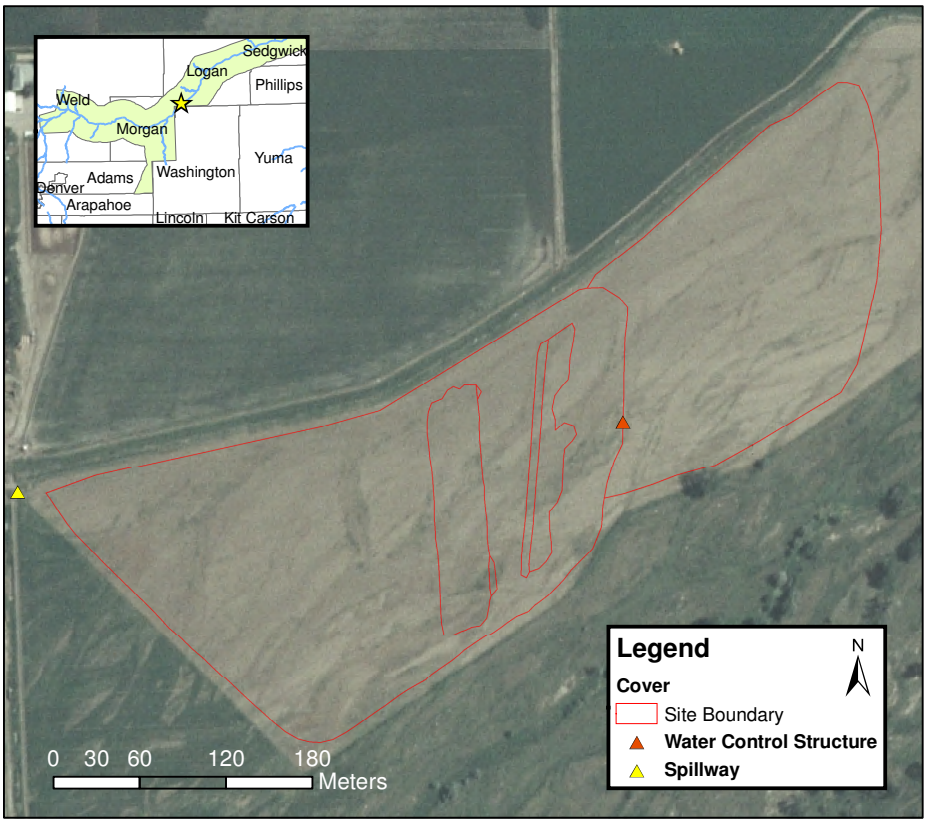
| Unit | Species | Scientific Name | Count | Count in All Sites | % Total | Avg birds / 100 ha |
|---|---|---|---|---|---|---|
| Pond | Greater White-fronted Goose | *Anser albifrons* | 131 | 132 | 99% | 68.6 |
| Pond | Greater Yellowlegs | *Tringa melanoleuca* | 34 | 102 | 33% | 17.8 |
| Pond | Green-winged Teal | *Anas crecca* | 604 | 1445 | 42% | 316.2 |
| Pond | Killdeer | *Charadrius vociferus* | 287 | 610 | 47% | 150.3 |
| Pond | Least Sandpiper | *Calidris minutilla* | 211 | 325 | 65% | 110.5 |
| Pond | Lesser Scaup | *Aythya affinis* | 31 | 137 | 23% | 16.2 |
| Pond | Lesser Yellowlegs | *Tringa flavipes* | 39 | 149 | 26% | 20.4 |
| Pond | Long-billed Dowitcher | *Limnodromus scolopaceus* | 312 | 370 | 84% | 163.4 |
| Pond | Mallard | *Anas platyrhynchos* | 151 | 1300 | 12% | 79.1 |
| Pond | Marbled Godwit | *Limosa fedoa* | 2 | 5 | 40% | 1.0 |
| Pond | Northern Pintail | *Anas acuta* | 437 | 1189 | 37% | 228.8 |
| Pond | Northern Shoveler | *Anas clypeata* | 335 | 919 | 36% | 175.4 |
| Pond | Pectoral Sandpiper | *Calidris melanotos* | 9 | 11 | 82% | 4.7 |
| Pond | Piping Plover | *Charadrius melodus* | 2 | 2 | 100% | 1.0 |
| Pond | Red-necked Phalarope | *Phalaropus lobatus* | 14 | 64 | 22% | 7.3 |
| Pond | Redhead | *Aythya americana* | 15 | 492 | 3% | 7.9 |
| Pond | Ring-billed Gull | *Larus delawarensis* | 35 | 102 | 34% | 18.3 |
| Pond | Ring-necked Duck | *Aythya collaris* | 2 | 33 | 6% | 1.0 |
| Pond | Ruddy Duck | *Oxyura jamaicensis* | 36 | 57 | 63% | 18.8 |
| Pond | Semipalmated Plover | *Charadrius semipalmatus* | 19 | 28 | 68% | 9.9 |
| Pond | Semipalmated Sandpiper | *Calidris pusilla* | 333 | 445 | 75% | 174.3 |
| Pond | Snow Goose | *Chen caerulescens* | 230 | 235 | 98% | 120.4 |
| Pond | Spotted Sandpiper | *Actitis macularia* | 20 | 60 | 33% | 10.5 |
| Pond | Stilt Sandpiper | *Calidris himantopus* | 216 | 233 | 93% | 113.1 |
| Pond | Unknown Dowitcher | | 4 | 115 | 3% | 2.1 |
| Pond | Unknown Duck | | 88 | 2205 | 4% | 46.1 |
| Pond | Unknown Gull | | 12 | 18 | 67% | 6.3 |
| Pond | Unknown Peep | *Calidris Sp.* | 18 | 49 | 37% | 9.4 |
| Pond | Unknown Shorebird | | 23 | 113 | 20% | 12.0 |
| Pond | Unknown Yellowleg | | 5 | 42 | 12% | 2.6 |
| Pond | Western Sandpiper | *Calidris mauri* | 31 | 32 | 97% | 16.2 |
| Pond | White-faced Ibis | *Plegadis chihi* | 38 | 70 | 54% | 19.9 |
| Pond | White-rumped Sandpiper | *Calidris fuscicollis* | 22 | 24 | 92% | 11.5 |
| Pond | Willet | *Tringa semipalmata* | 2 | 5 | 40% | 1.0 |
| Pond | Wilson's Phalarope | *Phalaropus tricolor* | 103 | 771 | 13% | 53.9 |

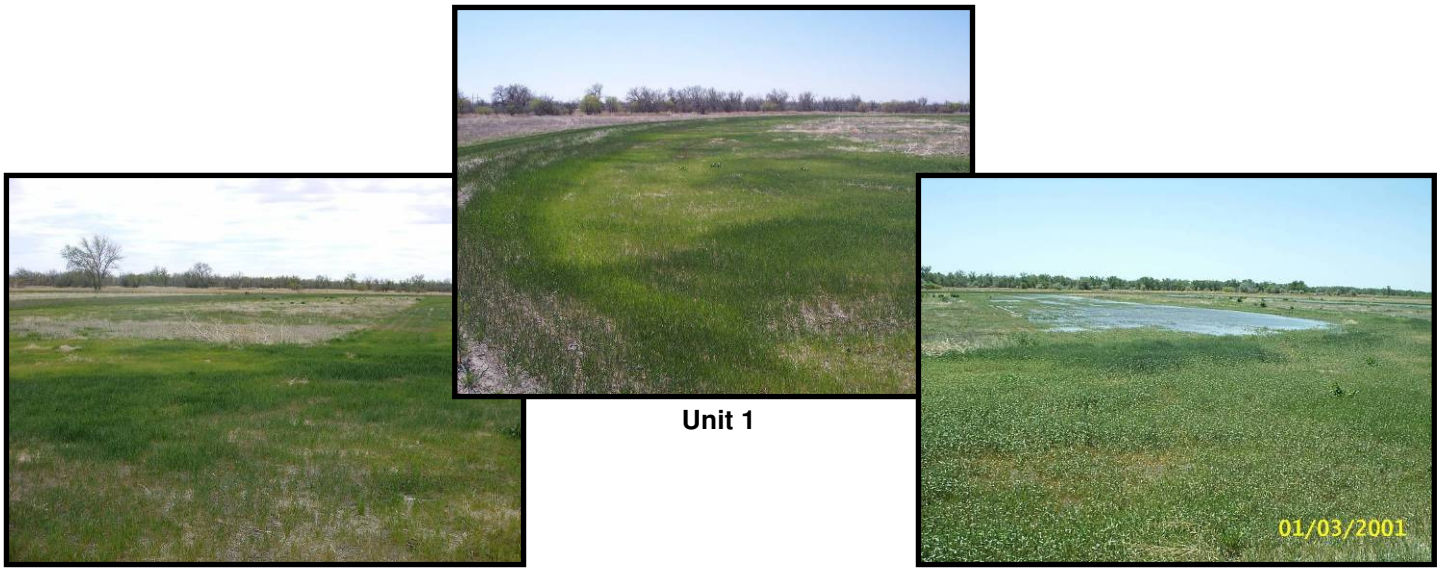
## Plant Species List

| Unit | Common Name | Scientific Name | Percent |
|---|---|---|---|
| Pond | Bare ground | Bare Ground | 64.6% |
| Pond | Open water | Open Water | 21.7% |
| Pond | Prostrate pigweed | Amaranthus albus | 5.0% |
| Pond | Bearded sprangletop | Leptochloa fusca ssp. fascicularis | 2.7% |
| Pond | Green bristlegrass | Setaria viridis | 1.5% |
| Pond | Smartweed | Persicaria species | 1.0% |
| Pond | Lambsquarters | Chenopodium album | 1.0% |
| Pond | Mexican-fireweed | Kochia scoparia | 0.4% |
| Pond | Leathery knotweed | Polygonum achoreum | 0.3% |
| Pond | Unknown forb | Unknown forb | 0.3% |
| Pond | Bulrush | Scirpus | 0.2% |
| Pond | Unknown residual | Unknown Residual | 0.1% |
| Pond | Common threesquare | Schoenoplectus pungens | 0.1% |
| Pond | Puncturevine | Tribulus terrestris | 0.1% |
| Pond | Spikerush | Eleocharis | 0.1% |
| Pond | Field bindweed | Convolvulus arvensis | 0.1% |
| Pond | Buffalobur nightshade | Solanum rostratum | 0.1% |
| Pond | Curly dock | Rumex crispus | 0.1% |
| Pond | Redroot amaranth | Amaranthus retroflexus | 0.1% |
| Pond | Cosmopolitan bulrush | Schoenoplectus maritimus | 0.0% |
| Pond | Common sunflower | Helianthus annuus | 0.0% |
| Pond | Softstem bulrush | Schoenoplectus tabernaemontani | 0.0% |
| Pond | Prickly lettuce | Lactuca serriola | 0.0% |
| Pond | Salt sandspurry | Spergularia salina | 0.0% |
| Pond | Oppositeleaf bahia | Picradeniopsis oppositifolia | 0.0% |
| Pond | Yellow sweetclover | Melilotus officinalis | 0.0% |
| Pond | Arrowhead | Sagittaria | 0.0% |
| Pond | Sprangletop | Leptochloa | 0.0% |
| Pond | Canada thistle | Cirsium arvense | 0.0% |
| Pond | Narrowleaf cattail | Typha angustifolia | 0.0% |
| Pond | Rough cockleburr | Xanthium strumarium | 0.0% |

# Iliff

WEA: CO-SP-05-015
Unit 1: 9 Hydrologic surveys
Unit 2: 9 Hydrologic surveys




**Unit 1**

**Unit 2**

**Unit 1**

# Sedgwick

WEA: CO-SP-05-010
Unit 1: 7 Hydrologic Surveys
Unit 2: 6 Hydrologic Surveys

**Unit 1**

**Unit 2**

# Snyder

WEA: CO-GO-9-014
Wet Meadow: 7 Hydrologic Surveys

# Weldona 2

WEA: CO-GO-9-015, CO-SP-2-002, CO-SP-2-003, CO-SP-2-004
Unit 1: 8 Hydrologic Surveys