Evaluation of Wetland Conservation Sites in Colorado

Phase II Final Project Report to the US Environmental Protection Agency

June 2006

Emily Steel, Wetlands Monitoring and Evaluation Project Leader
Alison Banks Cariveau, Research Division Director

Rocky Mountain Bird Observatory
14500 Lark Bunting Lane
Brighton, CO 80603
303.659.4348
www.rmbo.org

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.*

***Outreach**: RMBO shares the latest information in land management and bird conservation practices with private landowners, land managers, and resource professionals at natural resource agencies. RMBO develops voluntary, working partnerships with these individuals and groups for habitat conservation throughout the region.*

Suggested Citation:
Steel, E. and A.B. Cariveau. 2006. *Colorado Wetlands Monitoring and Evaluation Project, Final Report to the US Environmental Protection Agency.* Rocky Mountain Bird Observatory, Brighton, CO, 80 pp.

***Cover Photos**:*
All photos courtesy of RMBO. Colorado Wetland Partnership project site, Emily Steel; Wilson's Snipe, Tony Leukering; Field Technician, Emily Steel.

Contact Information:
Emily Steel emily.steel@rmbo.org
Alison Banks Cariveau alison.cariveau@rmbo.org
RMBO Fort Collins Office
230 Cherry Street
Fort Collins, CO 80521
970.482.1707

ACKNOWLEDGEMENTS

Rocky Mountain Bird Observatory (RMBO) thanks the United States Environmental Protection Agency (US EPA) and the Colorado Division of Wildlife (CDOW) for providing funding for this project. This project has been supported in past years through funding from CDOW, US EPA, the Colorado Governor's Office of Energy Management and Conservation, United States Fish and Wildlife Service, the Intermountain West Joint Venture, and the Playa Lakes Joint Venture. We value their contributions to funding this long-term monitoring effort.

We appreciate the Colorado Wetlands Partnership (CWP) and its partners for their help in facilitating our monitoring work and for providing us with information regarding projects. We thank the CWP partners, land managers, and private landowners who allowed us access to their land and who assisted us in our investigations. We thank Jim Gammonley, Lacrecia Haynie, and Susi Kelsall from the CDOW, and Mike D'Errico, Craig Garner, Greg Kernohan, and John Vradenburg of Ducks Unlimited, Inc. for their assistance with fieldwork. Emily Darany, Floyd Diebbern, Kelli Stone, Robin Vaughn, John Vigil and Jodie Vigil helped with waterfowl nesting surveys in the San Luis Valley. Jason Beason, Coen Dexter, Chris Wood, Rich Levad, and Tony Leukering of RMBO collected data on riparian passerines. Tony Leukering shared photos with us that are included throughout this report. We gratefully thank RMBO's Wetlands Monitoring and Evaluation Project team: Cary Aloia, Adam Bauer, Alison Banks Cariveau, Matt Reddy, Rachel Rilling, and Michele Shimomura for their hard work in the field collecting the data presented in this report, and also recognize Cary and Michele's contributions to this final product.

EXECUTIVE SUMMARY

This document is the Final Project Report for a U.S. Environmental Protection Agency (US EPA) Wetlands Program Development Grant titled "*Developing Statewide Monitoring and Assessment Tools & Strategies: Evaluation of Wetland Conservation Sites in Colorado – Phase II.*" This report fulfills the requirements under contract C100363 between the US EPA and the Rocky Mountain Bird Observatory (RMBO), and represents the concluding deliverable under the Final Workplan for this project. During the grant period, WMEP work was funded through this WET11 grant from the US EPA and matching funds from the Colorado Division of Wildlife.

Previous phases of the project are reported in annual reports (Reddy *et al*. 2003, Reddy and Cariveau 2004, Steel and Cariveau 2005) which are available upon request.

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

The WMEP aims to:

1.) Assess and document baseline wetland conditions on wetland conservation sites prior to conservation activity;
2.) Document objectives for each CWP project, as stated by the project partner;
3.) Monitor projects' achievement of stated, measurable, site-specific objectives;
4.) Monitor ecological changes through time on conservation sites to determine the efficacy of conservation measures and project design; and
5.) Generate printed materials and conduct 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 125 site assessments in 11 Wetlands Focus Areas. This report documents activities completed in 2004 and 2005, during the US EPA grant period. The WMEP:

1.) Implemented, evaluated, and revised monitoring protocols;
2.) Developed and populated a Project Tracking component for the *Evaluwet* database, to tabulate basic site information;
3.) Populated five *Evaluwet* database modules with 47,627 data records;
4.) Developed a Geographic Information System database for all CWP sites, including relevant features for intensive monitoring sites;
5.) Completed baseline assessments on 40 CWP sites in four Wetlands Focus Areas;
6.) Conducted surveys of migrating waterbirds during spring on twelve CWP sites in the South Platte River Wetlands Focus Area;
7.) Conducted two rounds of nest searches each year for breeding waterbirds on eight sites in the San Luis Valley Wetlands Focus Area;

8.) Conducted 24 surveys for breeding passerine birds on eight CWP riparian restoration sites in six Wetlands Focus Areas across Colorado;

9.) Conducted outreach to share monitoring findings with wetland restoration and protection entities in Colorado, including state and federal government agency biologists, managers, and administrators, conservation organizations, and local wetlands groups; and

10.) Presented WMEP findings at the 2004 annual meeting of the Colorado Riparian Association, 2004 national meeting of the Association of State Wetland Managers, three presentations at the 2005 Western Wetlands Conference, and an article in the May-June 2006 issue of the National Wetlands Newsletter, published by the Environmental Law Institute.

With these accomplishments, Rocky Mountain Bird Observatory's Wetlands Monitoring and Evaluation Project has created a model program for evaluating the outcomes of wetlands conservation projects, benefiting all participants in the Colorado Wetlands Partnership. Because available funds cannot meet all conservation opportunities, our information will help determine the most effective strategies for preserving Colorado's wetlands. As wetland ecosystems continue to undergo threats, our effort provides data needed for adaptive management and conservation of this important resource.

EPA WORK PLAN ACCOMPLISHMENTS

The following summarizes the Task List as documented in the Final Work Plan with notes regarding compliance or deviation from the original plan.

1. Quality Assurance Project Plan: In concordance with US EPA Order 5360.1 A2, we will produce and revise a Quality Assurance Project Plan. This document will relate the necessary elements of the project devised to ensure the quality of data collected for the project. These elements embody information related to project management, data generation and acquisition, assessment and oversight, and data validation and usability (US EPA 2001).

   Completed as described. Reddy, M. 2003. Developing Statewide Monitoring and Assessment Tools & Strategies: Evaluation of Wetland Conservation Sites in Colorado, Quality Assurance Project Plan. Available upon request.

2. Intensive Monitoring of Colorado Wetlands Partnership sites:

   (a) Surface hydrology (surface acres flooded, average and range of water depth, flow rates) will be measured;

   (b) Vegetation attributes will be measured in sample plots within each major vegetation community for the project. Control plots will be established whenever feasible; and

   (c) Avian use will be monitored. Monitoring techniques will be selected according to site characteristics, species composition, timing of bird use, and the biological objectives of the project. For waterfowl breeding success, we propose two nest searches, followed by nest visits, to account for both nest density and success on project sites. For songbirds, we will conduct line or point transect surveys following protocols of the Monitoring Colorado Birds program (Leukering and Levad 2000). For secretive marshbirds, we will use standard playback techniques developed and implemented at the national level. For waterbirds during migration and colonial nesting birds, direct counts will be employed. Photo points for each plot will be established. Abiotic factors will be taken into consideration (i.e., precipitation, climate). Land use management plans for each site will also be documented.

   Completed as described with two minor deviations. We did not document the flow rate component of surface hydrology, and we did not intensively monitor colonial waterbirds as they are already monitored by another program (RMBO's Monitoring Colorado's Birds).

3. Assessments of Colorado Wetlands Partnership sites:

   (a) For each project site, water sources and the frequency, timing, duration, depth, and extent (i.e., surface acres) of surface flooding will be categorized. Pre-project hydrologic conditions on completed projects will be derived from interviews with site managers and available historic data (e.g., aerial photographs);

(b) Vegetation communities will be described according to vegetative associations, as delineated by the Comprehensive Statewide Wetlands Classification developed by the Colorado Natural Heritage Program, if possible. If a plant association is found that is not classified within this existing scheme, then we will visually estimate cover by the dominant plant species. The extent of each plant association within the site will be estimated and described. The extent of each plant association within the site will be assessed according to the evaluation methodology developed by the Natural Heritage Network. This assessment includes a qualitative ecological assessment (size, quality, landscape condition, and vegetation height and density) of the project site's plant associations within each of the wetland types; and,

(c) When available, data regarding bird use of Colorado Wetlands Partnership project sites (both pre- and post-delivery) will be acquired and included in the assessment; and

(d) The pilot phase of this project demonstrated that existing functional assessment methodology implemented in Colorado needed to be modified for application to highly disturbed or managed wetlands. We developed a set of guidelines for the assessment that tailored existing methodology (which assessed overall functional integrity, flood attenuation and storage, sediment/shoreline stabilization, groundwater discharge/recharge, dynamic surface water storage, elemental cycling, removal of imported nutrients, toxicants, and sediments, production export/food chain support, habitat diversity, general wildlife habitat, general fish habitat, and uniqueness) to describe the range of project sites on which we worked. Our protocol adopts and applies a subset of these criteria to particular wetland types and is currently under final revision.

Completed as described.

4. GIS development:

(a) Intensively monitored site boundaries, habitats, and other critical features will be plotted within a GIS database to document and analyze project impacts on a site; and,

(b) All Colorado Wetlands Partnership sites will be located within a GIS database.

4(a) was partially completed based on sites for which GIS data were readily available from CWP partners. The WMEP is actively pursuing shapefile and habitat acreage for sites where such data were not available. 4(b) was completed as described for all sites for which UTM locations could be obtained.

5. We will build a comprehensive database of all the projects in the Colorado Wetlands Partnership, for use by partners in tracking project locations, wetland types protected, protection strategies employed, and measures of project success.

(a) Colorado Wetlands Partnership data acquisition, normalization, and analysis will be managed through the use of the *Evaluwet* comprehensive database application that tracks projects from funding through delivery to the evaluation stage;

(b) Periodic updates and revisions to this database application will be made; and,

(c) Data collected regarding sites will be appended to appropriate tables found in the database to ease analysis and reporting.

Completed as described.

6. Statistical analyses: Qualitative data obtained for the extensive assessment of all Colorado Wetlands Partnership projects will be summarized and analyzed to determine differences between pre- and post-project conditions. Quantitative measures obtained on intensively sampled sites will be summarized to examine the range of variation in conditions and to determine appropriate sample sizes required to detect meaningful changes in conditions over time.

   Data have been summarized but comparison of pre- and post-project assessments is not yet available as the WMEP has only existed for three years. First re-visits are expected in 2008, after which comparisons will be possible.

7. Protocol development, evaluation and revision: Field protocols will be developed using the expertise of Colorado Wetlands Partnership staff, project managers, outside members of the conservation community, and other interested individuals. These protocols will be tested as to their utility, validity, economy, and applicability to the range of project types and objectives presented by the Colorado Wetlands Partnership. These protocols will be evaluated and revised as the project develops. Findings regarding protocol choice and evaluation will be presented in reports.

   Completed as described, detailed most extensively in the Phase I report to US EPA (Reddy and Cariveau 2004).

8. Project reports:

   (a) Progress reports at the end of Month 6 and Month 12 will give project overview, updates on funding acquired, notes on any project deficiencies, accomplishments to date, and activities planned for the next work period; and,

   (b) Project Final Report will include a GIS map of all project locations evaluated, an analysis of the proportion and number of projects that have been implemented for various objectives, a summary of additional wetland benefits that accompany projects, a detailed explanation of protocols used for site assessments and monitoring, recommendations regarding future monitoring techniques, and a presentation of results from nearly five years of project assessment and monitoring.

   Completed as described with one deviation. The Progress Report for Month 12 was submitted in Month 16.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

CHAPTER 1. BACKGROUND

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 program for restoring, enhancing, creating, managing, and protecting biologically significant wetlands and associated uplands. The goal of the CWP is to protect 100,000 acres of biologically significant wetlands and associated uplands for wetland-dependent species throughout the state. Since its inception, the CWP and partners have invested over $69 million (B. Goosmann, pers. comm.) in wetland conservation in Colorado on over 750 projects.

The CWP has developed a monitoring program to provide information on the results of wetland conservation efforts. ***The purpose of the Wetlands Monitoring and Evaluation Project (WMEP) is to monitor and assess the ecological outcomes from CWP projects.*** The WMEP collects data from CWP projects and provides managers, biologists, conservation planners, and funding agencies with information for developing strategic approaches to wetlands conservation and for gaining a better understanding of wetland restoration and protection outcomes in Colorado.

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.

CARY ALOIA

CWP site in southwestern Colorado

CWP Wetlands Focus Areas

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

Wetlands Focus Areas (Figure 1-1) have been designated, although the Front Range Urban and Middle Park Focus Areas are not currently active.

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. Conservation alliances can also affect Wetlands Focus Area boundaries; for instance, the Prairie and Wetlands Focus Area has expanded its reach to incorporate entire counties. While CWP projects may be located anywhere in the state, most (94%) are located within the boundaries of a Wetlands Focus Area.

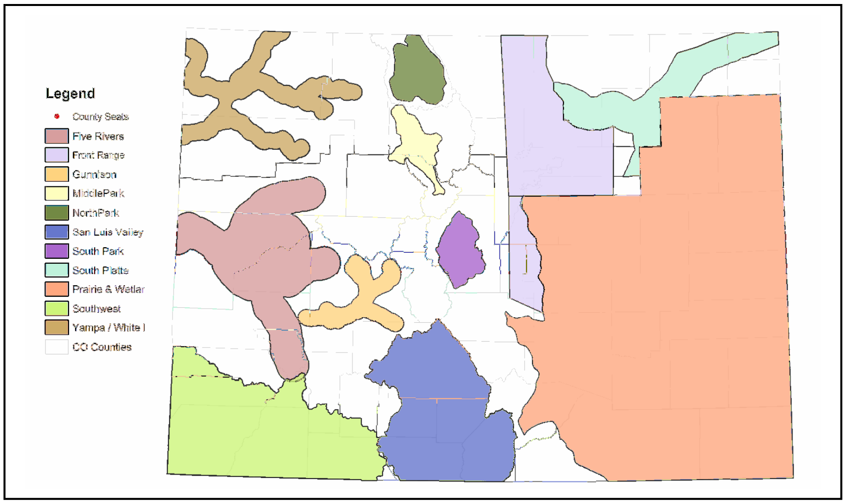


Figure 1-1. CWP Wetlands Focus Areas

A detailed description of each CWP Wetlands Focus Area can be found in RMBO's Colorado Wetlands Program Monitoring & Evaluation Project 2002-2003 Report (Reddy and Cariveau 2004).

WMEP Overview

Program Significance

As one of the eleven key strategies of the CWP, the WMEP provides the CWP Coordinator and major partners with an independent review of CWP projects. Monitoring yields data useful for managers, conservation partners, and funders to implement the most effective means for protecting wetland resources (US EPA 2002a).

Conservation planning and resource protection endeavors often highlight adaptive management as the optimal approach to program design, yet many 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.

Monitoring Approach

The WMEP approach was developed in collaboration with CDOW and the Colorado Natural Heritage Program (CNHP), and 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. The WMEP model combines adaptive management at the program level with a hierarchical monitoring approach at the project level (Figure 1-2).

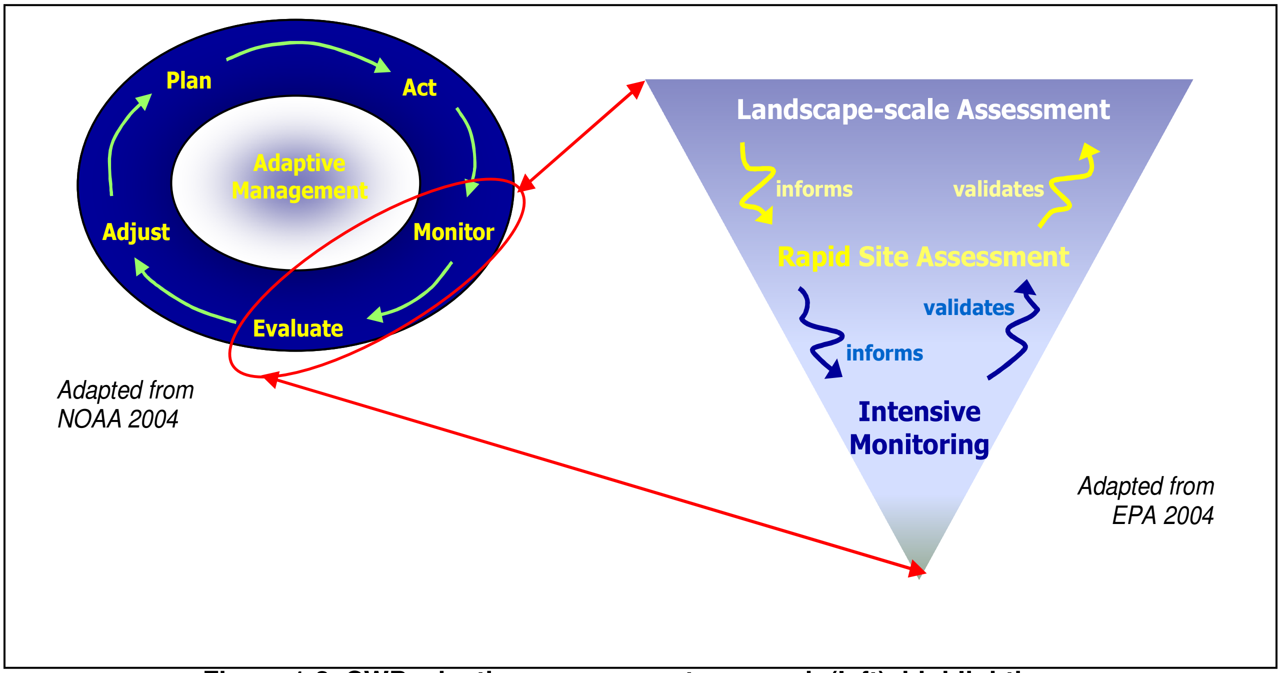


Figure 1-2. CWP adaptive management approach (left), highlighting WMEP's hierarchical monitoring approach (right)

The hierarchical monitoring framework integrates quantitative intensive monitoring data with qualitative rapid assessment data. Each level of the US EPA approach can be used to validate and inform the data collected at the other levels (US EPA 2004). To date, the WMEP has focused on the intensive monitoring and rapid assessment levels of the model. Landscape-level analyses will be incorporated in the future if additional funding is secured.

WMEP Initiatives

The WMEP utilizes a combination of modular efforts to obtain data on CWP projects. Our approach meets the CWP and its partners' data needs as follows:

WMEP Component		Type	Level
Project Tracking & Site Assessments	=>	Programmatic	Broad Descriptive (Qualitative)
Intensive Monitoring	=>	Ecological	Research Questions (Quantitative)

Project Tracking

Project tracking entails compiling categorical information for all CWP projects to ensure a complete database resource for the CWP. At the inception of the project, no CWP data were housed in a central database. In 2004 we initiated an effort to gather and verify information on all projects in the CWP in categories including objectives, project description, project type, wetland type, location, partners, and contacts. Project tracking information is verified and updated during the site assessment process.

Site Assessments

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.

Intensive Monitoring

Intensive monitoring projects document species responses to CWP projects with quantitative data from representative subsets of CWP projects. The WMEP conducts on-going intensive monitoring in three major areas: riparian passerine breeding, waterfowl and shorebird migration, and waterfowl, waterbird, and shorebird nesting.

CHAPTER 2. PROJECT TRACKING

Project tracking entails the creation of one complete dataset containing all relevant project information for the CWP and is an absolutely critical component of a program of this scope. Prior to the creation of the project tracking database, information regarding wetland projects funded in whole or in part by the CWP since 1997 was not stored in any centralized database. This prohibited the ability to characterize or evaluate the CWP, as well as hindered program-wide monitoring efforts.

The project tracking database provides logistic information, houses data regarding project objectives, and contains fields for basic ecological data. Standardized, project-level information is thus now available for characterizing conservation projects, providing context for monitoring data, and enabling program-wide summaries.

Methods

In 2004, the WMEP initiated the development of an MS Access Project Tracking module for the *Evaluwet* application, a series of databases created by RMBO to house data from WMEP site assessments and intensive monitoring efforts. Project tracking data are obtained from interviews with landowners and land managers, CWP applications, USFWS Wildlife Extension Agreements, and maps such as United States Geological Survey (USGS) topographic quadrangles and Colorado road atlases.

WMEP landowner interview

Logistical data tracked through the project tracking database are tracking number, site name, Wetlands Focus Area, location (UTMs and driving directions), and site contact information. The tracking number is the single, unique identifier for each project. Information regarding CWP involvement includes funding source, funded amount, project partners, and dates and descriptions of project milestones. Ecologically relevant data are the number of total project acres, wetland acres, and riparian miles, project type, project objectives, and wetland hydrogeomorphic class (Cooper 1998). A comment field allows miscellaneous project notes to be stored with the tracking data.

RMBO created a user manual for the Project Tracking database (Appendix A), which details exactly what types of entries are allowed for each field in the database. This user manual standardizes entries among individuals, and also serves to document the data stored in this database.

Four report templates were created to provide administrators with quick access to program-wide data at the click of a button. The reports summarize all of the data in the Project Tracking database in several categories. The user can generate all information known for a given location (project, site, or Wetlands Focus Area), year, funding status, or funding source.

Once the Project Tracking database is fully completed with past projects, categories that require updates (e.g., additions of new projects, project milestones achieved, contact information) will be reviewed and updated annually.

Ecological Data Stored in Project Tracking Database

In order to summarize basic information for all the projects in the CWP, it was necessary to store some ecological data in the Project Tracking database. The organization of these data forms the foundation of WMEP monitoring summaries, and can serve as the strata by which intensive monitoring sites are selected. Here we provide a brief description of relevant categories of data.

<u>Sites, Units, and Projects</u>

The WMEP distinguishes among three non-hierarchical strata when categorizing a project: site, unit, and project. Projects occur on sites, and within units on those sites. A site may be comprised of one or more units. A unit is a sub-area of a site, and represents the area affected by the project whose hydrology can be managed independently from other units, or sub-areas on a site. A project may span more than one unit within a site, or even more than one site. Conversely, multiple projects may occur within any given site or unit. The project is the fundamental level at which an action is taken under the CWP, and therefore all tracking information is tied to this stratum.

<u>Project Types</u>

The types of conservation action implemented (restoration, enhancement, creation, or protection) were documented for each project. This information was obtained from CWP funding applications or agreements as stated by the project partner, and then verified during the site assessment.

Various CWP partners define conservation actions differently; therefore the WMEP developed a standard set of definitions for project type. Our definitions standardize project type categorization and enable the comparison of WMEP findings to similar efforts nationwide. We categorized sites according to the following definitions (Reddy and Cariveau 2004):

1.) **<u>Restoration</u> is defined as the process of returning a site back to some pre-existing condition** (Aronson *et al.* 1984, Cairns 1990, Lewis 1990, US EPA 1990, National Research Council 1992, Middleton 1999). Many definitions also include statements that the process should restore the site's functions and native vegetation (Jordan *et al.* 1988, Cairns 1991, Mitsch and Gosselink 2000, Kauffman *et al.* 1997, Hammer 1997).

2.) **<u>Enhancement</u> of a wetland is the improvement of a wetland's function for specific management goals, sometimes at the expense of other functions** (Lewis 1990; National Research Council 1992; Middleton 1999). The Natural Resources Conservation Service (NRCS) defines enhancement as the modification or rehabilitation of an existing or degraded wetland, where specific functions and/or values are improved for the purpose of meeting specific project objectives; some functions may remain unchanged while others may be degraded (NRCS, Conservation Practice Standard, Wetland Restoration, Code 657).

3.) **Creation is the construction of wetlands where they did not exist before and involves manipulation of hydrology and soils** (Lewis 1990; National Research Council 1992; Kentula *et al.* 1993; Mitsch and Gosselink 2000; Middleton 1999; Streever 1999). The NRCS uses the following definition: a wetland that has been created on a site location which historically was not a wetland (NRCS, Conservation Practice Standard, Wetland Restoration, Code 657).

4.) **Protection applies to projects that preserve or maintain wetland and when present, associated upland ecological conditions** through the purchase of easements, leases, or fee-title.

Wetland Type

The type of wetland conserved was documented using a classification which incorporated geomorphology, hydrology, and vegetation communities, and employed an existing hydrogeomorphic (HGM) classification methodology (Cooper 1998) (Table 2-1). Predominant wetland types in Colorado include riparian, wet meadow, short emergent marsh, tall emergent marsh, and playa. HGM classes used by the WMEP were depressional, flat, riverine, and slope. Any project may occur in one or more of these classes.

Project Objectives

We documented project objectives as articulated by the project partner for each project. Project objectives were obtained from interviews with landowners and land managers, CWP funding applications, and contractual agreements that specify biological project purpose, such as USFWS Wildlife Extension Agreements. We categorized projects according to vegetation, hydrology, species, and species habitat-oriented statements, and documented the direction of change specified (increase, decrease, maintain). Each project could specify multiple objectives.

Location

We compiled GPS points in UTM coordinates for as many projects as possible, which included coordinates supplied by CWP partners and sites included in WMEP monitoring efforts since 2002. These coordinates are displayed as points on statewide maps. We also track whether the coordinates have been confirmed during a site visit.

CARY ALOIA

Wetland enhancement project in South Platte River Wetlands Focus Area

Table 2-1. Key to hydrogeomorphic (HGM) classes based on Cooper (1998)

1a.	Wetland is topographically flat and has precipitation as a dominant source of water	**Mineral Soil Flats Class**—Flats Subclass 1 (F1)
1b.	Wetland is not topographically flat and does not have precipitation as a dominant source of water	2
2a.	Wetland is associated with a stream channel, floodplain, or terrace	3
2b.	Wetland is in a natural or artificial topographic depression (depression may occur near a stream channel or on a floodplain or terrace) or on a slope	7
3a.	Stream is intermittent or ephemeral	**Non-perennial Riverine Class**
3b.	3b. Stream is perennial	**Perennial Riverine Class** 4
4a.	Stream is 1st or 2nd order, typically occurs at mid-to-high elevations but can also be in the plains	5
4b.	4b. Stream is 3rd order or higher, typically at lower elevation in the foothills, plains, or plateaus	6
5a.	Stream typically in the alpine or subalpine, a steep gradient and coarse-textured substrate	**Riverine Subclass 1 (R1)**
5b.	5b. Stream is in the subalpine or montane zone, has a moderate gradient and coarse or fine-textured substrate, often dominated by willows	**Riverine Subclass 2 (R2)**
6a.	Mid-to-high order streams at lower elevations in the foothills, plains or plateaus, often dominated by shrubs or trees	**Riverine Subclass 3 & 4 (R3/4)**
6b.	6b. Low elevation floodplains with fine-textured substrate, dominated by shrublands, grasslands or deciduous woodlands	**Riverine Subclass 5 (R5)**
7a.	Wetland located in a natural or artificial (dammed) topographic depression	**Depressional Class** 8
7b.	Wetland located on a topographic slope	**Slope Class** 10
8a.	Wetland occurs in mid-to-high elevation basins with peat soils or lake fringes with or without peat soils	**Depressional Subclass (D1)**
8b.	Wetland occurs at lower elevations and are either permanently or intermittently flooded	9
9a.	Wetland is permanently or semi-permanently flooded, includes reservoirs, pond margins, marshes, typically dominated by cattail, bulrush	**Depressional Subclasses 2 and 3 (D2/3)**
9b.	Wetland is temporarily or intermittently flooded, playas, dominated by forbs, graminoids	**Depressional Subclasses 4 and 5 (D4/5)**
10a.	Wetland is in the alpine and subalpine, organic and mineral soils, fens and wet meadows	11
10b.	Wetland is in montane, foothills, or plains, with seasonally high water table	12
11a.	Wetland is on non-calcareous substrate	**Slope Subclass 1 (S1)**
11b.	Wetland is on calcareous substrate, only found in South Park (extreme rich fens)	**Slope Subclass 2 (S2)**
12a.	Wetland occurs in subalpine to middle elevations with a seasonally high water table, pH is neutral or acidic, dominated by herbaceous plants and/or *Sphagnum* spp. (iron fens)	**Slope Subclass 3 (S3)**
12b.	Wetland occurs at middle to lower elevations with a seasonally high water table, pH is neutral, dominated by herbaceous plants or shrubs, occur on floodplains or springs, sometimes supported by irrigation, widespread throughout Colorado	**Slope Subclass 4 (S4)**

Results

The Project Tracking module of the *Evaluwet* database was successfully designed, created, and integrated with the WMEP Site Assessment module. Some data categories within the database are predominantly populated (75-100%), while others are missing data for earlier projects, such as project objectives, project type, and wetland type, which were not well articulated in the early years of the CWP.

To date, we have determined that 754 projects have been completed on 554 sites, representing 15 partners, 11 Wetlands Focus Areas, and 522 private landowners. Though only partially populated (55%), an estimation of how project types are distributed is presented in Figure 2-1.

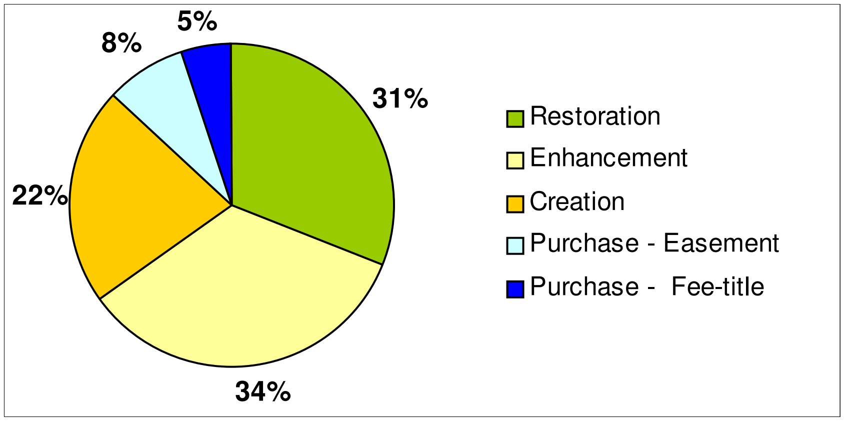


Figure 2-1. Project types comprising the CWP (preliminary estimate)

Similar data are not yet available for wetland type, as tabulation of that information requires delving into CWP archives, locating managers and landowners, and confirming wetland characteristics via interviews; a time intensive undertaking. However, those data have been collected and summarized on sites assessed through the WMEP (refer to Chapter 3).

Project Objectives

Project objectives require validation during a site assessment. We recorded 34 objectives for 26 projects assessed in 2004 (Table 2-2). The remaining 11 projects did not possess clearly articulated or interpretable objectives, and attempts to contact the project proponent were unanswered. For projects where objectives were known, the number of objectives ranged from 1 to 15, with an average of 5. The most frequent objective was to improve native vegetation, followed by reducing noxious weeds. Many projects (45% of those assessed with objectives) stated wildlife-related objectives.

We observed a "cut and paste" approach to articulation of project objectives. Some managers undertaking many projects listed a repeating series of wide-ranging and broad objectives for each project. This approach to stating objectives skews the data summary toward certain repeated objectives.

Table 2-2. Project objectives as stated by project proponents for 26 sites assessed in 2004

Vegetation/Hydrology Oriented Objectives	Frequency
enhance native vegetation	25
reduce/maintain noxious weeds	9
bank stabilization	5
recharge unconfined aquifer	2
improve water quality	2
Species/Habitat Oriented Objectives	**Frequency**
reptile habitat	8
migrational habitat/benefit	7
waterfowl foraging habitat	7
waterfowl loafing habitat	7
waterfowl nesting habitat	7
amphibian habitat	6
raptor habitat	6
shorebird habitat	5
small mammal habitat	5
general habitat function	4
grassland nesting passerines	3
secretive marshbird habitat	3
shorebird foraging	3
shorebird loafing	3
shorebird nesting	3
wildlife habitat	3

Site Location

Of the 11 Wetlands Focus Areas, the Prairie and Wetlands Focus Area has the highest number of sites (25%, Figure 2-2), followed closely by the San Luis Valley Wetlands Focus Area (SLVWFA, 23%). The SLVWFA and South Platte River Wetlands Focus Areas (11% of CWP sites) host the highest densities of conservation project sites. 5% of sites are not located within the boundaries of any existing wetlands focus area, and 12% of site locations are not yet entered into the database. We created a GIS map showing a point location for each CWP site in the state (Figure 2-3). 75% of sites are represented on this map; we are still gathering UTM coordinates for the remaining 25% from CWP partners and archives.

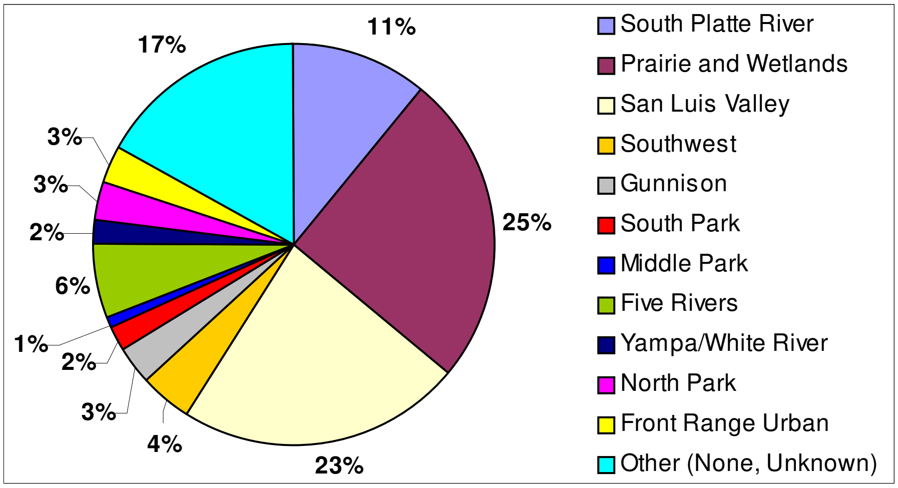


Figure 2-2. CWP sites by Wetlands Focus Area

Discussion

Creation and population of the Project Tracking database represents the sole attempt to gather comprehensive information on the over 750 projects in the CWP, and is of significant value to several CWP partners. The lack of a Project Tracking component in the CWP to date has been an impediment to compiling and evaluating wetland restoration outcomes. This database greatly improves the efficiency of the WMEP by providing a resource for both examining CWP trends and planning of annual monitoring efforts. These data can be utilized to help improve the randomness of sites selected for intensive monitoring or site assessments, thereby allowing annual monitoring data to be more representative of the CWP overall than has previously been possible.

Partners and administrators at the local and state levels also benefit from the Project Tracking database, as current information on all projects is readily available. Wetlands Focus Areas and CWP partners are increasingly being required to provide this information to funders and regional or national agency offices; through compilation of the database the CWP will be able to distribute information as needed to these groups.

The Project Tracking dataset has also allowed us to examine CWP partners' restoration objectives, project types, and wetland types being restored in Colorado, yielding insight into statewide restoration efforts.

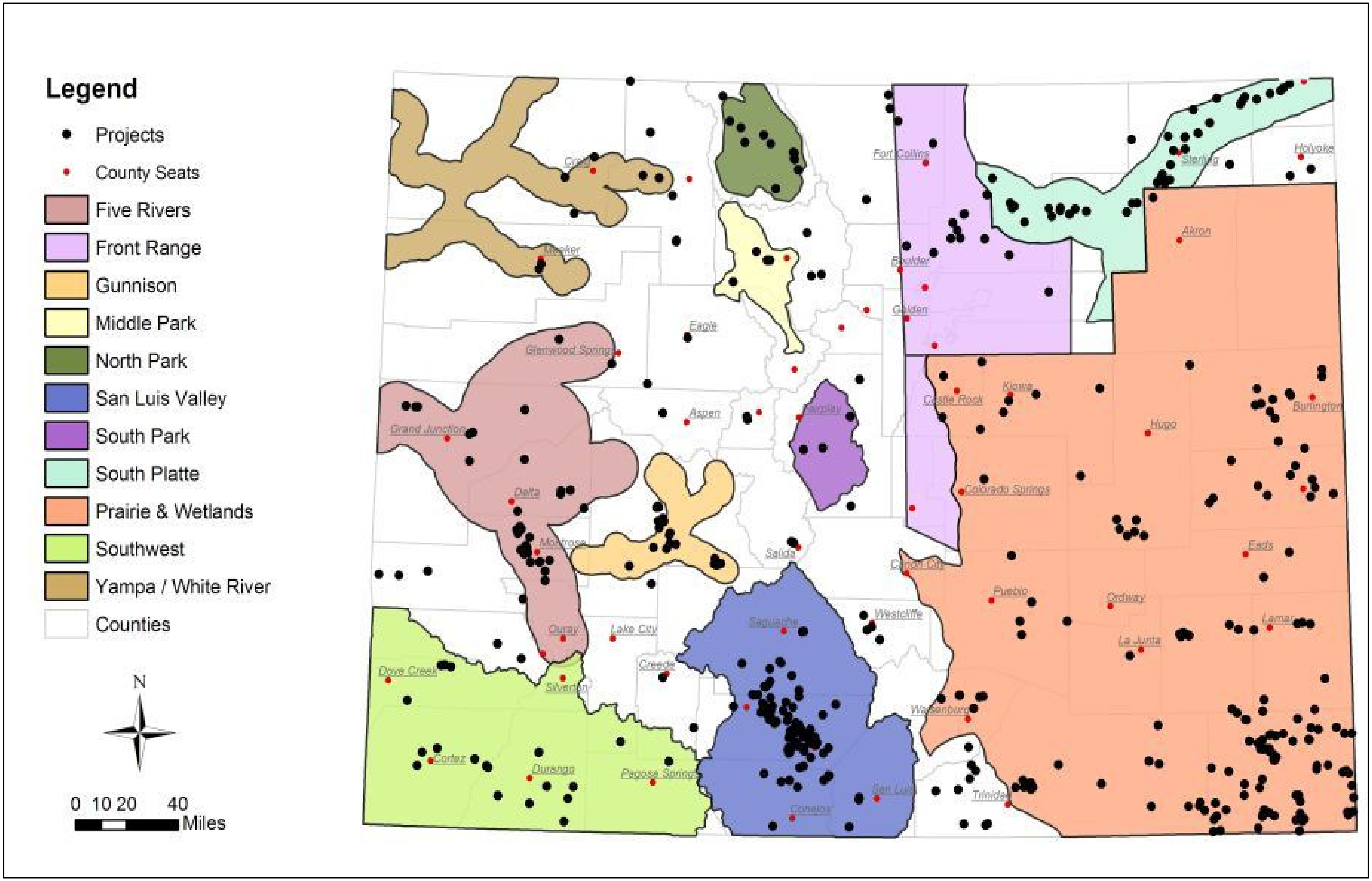


Figure 2-3. GIS Map of all CWP Wetlands Focus Areas and sites

Project Objectives

Major findings of the WMEP regarding project objectives are that they vary widely throughout the program, are often not clearly articulated at the outset of projects, and they change over time (Reddy and Cariveau 2004). Variation in project objectives is due to a combination of the difference in landscape features throughout the state, site histories, and conservation options for a given site based on factors such as surrounding land use, funds, time, landowner/manager preferences, etc. In recent years of the CWP, partners have been asked to articulate project objectives on funding applications. Even in these cases, objectives are often extremely general. Objectives tend to change when unforeseen events or environmental conditions arise that alter the course of a project, and managers require flexibility to respond to such events. Despite these challenges in tracking project objectives, we feel that articulation of clear project objectives is an important step in implementing conservation projects, and that tracking progress according to objectives is still an ideal framework for the adaptive management process.

An average of five objectives per site in 2004 is consistent with what was found in previous years (Reddy and Cariveau 2004). Multiple objectives for a project are appropriate because wetland restoration projects often serve many functions. Additionally, some program participants are reluctant to articulate specific objectives which can be used at some later date as performance standards. Furthermore, the application of the same set of objectives to several or all projects delivered by a given partner reflects the overall restoration goals of that partner.

Project Types

The majority of projects in the CWP are wetland enhancements, closely followed by restorations. The preponderance of enhancement and restoration projects reflects both the availability of such sites for conservation in Colorado and the focus of the CWP on creating wildlife habitat (Reddy and Cariveau 2004). Other factors which may be driving this trend are the challenging nature of wetland creation, which requires development of wetland hydrology in upland areas, and the high cost and opportunistic nature of wetland protection projects (easement and fee-title). It is to be expected that these types of projects would be less common in a program such as the CWP, which distributes limited funds among a large number of projects to maximizing wetland benefits statewide.

Project Locations

Projects are not distributed evenly across Colorado. By design, 95% of the sites in the CWP are located within Wetlands Focus Areas (WFA), selected for important resource values and designed to fit conservation communities. Three of the WFA host 59% of the projects, due to activity by the WFA, number of distinct conservation opportunities, and interest in the locality by major conservation partners. The availability of monetary resources to a WFA appears to correlate with committee activity levels; currently, WFA receiving support for a chairperson are active, while most of the WFA operating solely on a volunteer basis rarely meet. Clearly, coordination among partners working on wetland conservation in a region increases on-the-ground conservation activity.

In addition to partnerships, two other factors likely contribute to spatial distribution of projects. First, higher historic wetland density in some regions provides greater opportunity for wetland restoration than in more arid areas. Secondly, areas experiencing rapid urbanization and population growth, such as the Front Range Urban Wetlands Focus Area, are subject to development pressures that translate into high levels of watershed degradation and soaring land costs. Thus, major conservation partners tend to concentrate their staff time in more rural areas where more cost-effective new projects are thought to be more likely to provide high-quality wildlife habitat.

CHAPTER 3. SITE ASSESSMENTS

The WMEP aims to complete rapid, qualitative assessments of CWP projects to document ecological conditions on wetland conservation sites, characterize the biological contributions of the CWP, and aid in programmatic evaluation at the statewide level.

Methods

Site Selection

Site assessment locations could not be randomly selected in 2004 due to a lack of project tracking data. Because most of the assessments in 2002 and 2003 were conducted on completed projects, in 2004, new sites were prioritized for completion of baseline assessments. Sites were also selected to achieve spatial dispersion across Colorado (Figure 3-1) and to characterize the variety of habitats and project types in the CWP. These projects were sufficiently few in number that additional sites within 10km of the pre-project sites were also assessed. This process economized data collection by limiting travel to fewer geographical areas. An additional focus was placed on unique or demonstrative projects of particular interest to CWP managers and biologists. Due to a need to process the high volume of data collected in previous years, no additional site assessments were conducted in 2005. WMEP data forms are included in Appendix B.

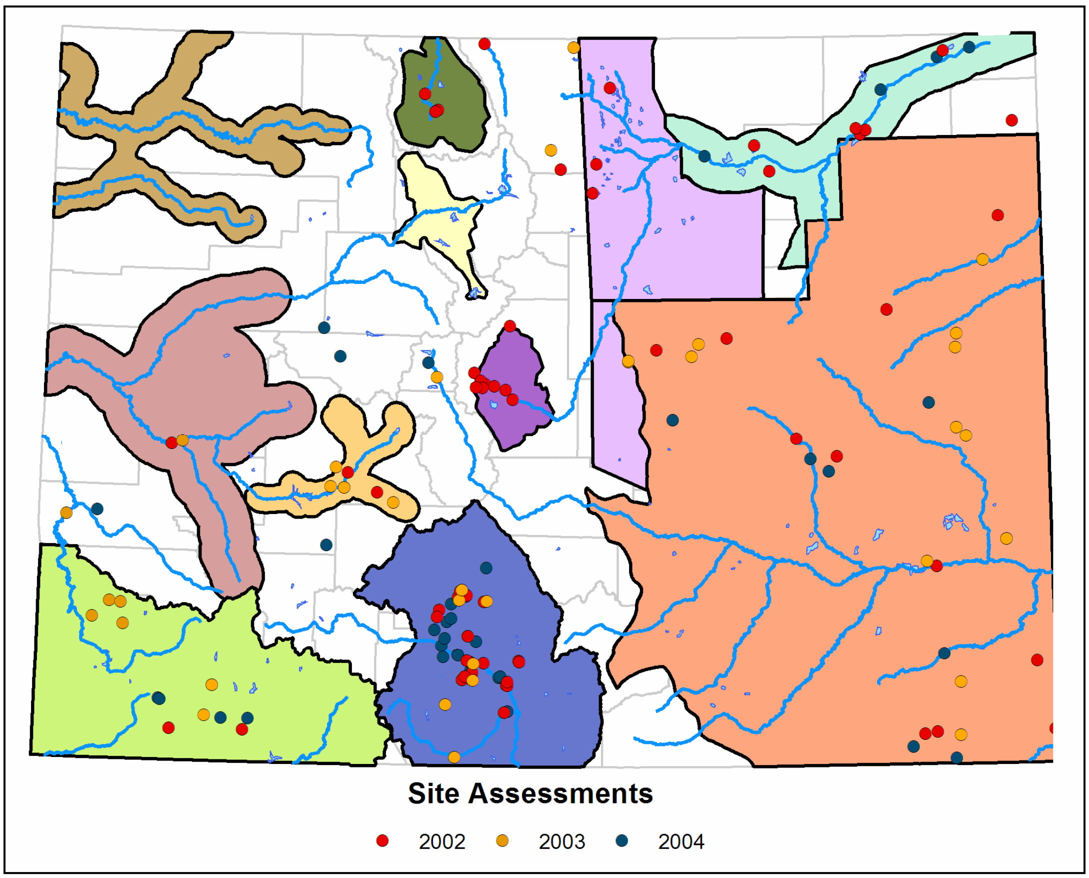


Figure 3-1. WMEP site assessment locations by year

Land Use

We characterized the type of activity present on and surrounding the project site at the time of assessment and historically, through landowner/manager interviews and observations during the site visit. Land uses included grazing, mowing, farming, disking, flooding, and haying. If known, the length and duration of each activity was recorded. We also recorded information about urbanization and fragmentation in relation to the project's location.

Hydrology

For non-riparian wetlands, we recorded hydrologic conditions including area flooded, volume flooded, and basin water:vegetation patterns observed during the site visit. The frequency, timing, and length of inundation and drawdowns were not possible to ascertain during rapid site visits, but an attempt was made to track that information through interviews with landowners and managers.

Riverine conditions were described by estimating width and depth of water in the channel at time of assessment (wetted width), width and depth of the river at bank-full condition (channel width), and width of the 100-year floodplain as indicated by riparian vegetation (flood width). These channel morphometrics provided overall descriptions of the channel at the time of the site assessment. In addition, average percent slope of the stream channel and stream sinuosity were visually estimated. Characteristics such as braiding, presence of backwaters, and presence of sandbars, cutbanks, and cliff dimensions were recorded. Channel substrate was categorized as sand/silt, gravel, cobble, or boulder.

Structures

During site visits and confirmed through interviews with managers, we recorded information regarding all structures, or site improvements, installed as part of each project, including wells, ditches, levees, water control structures, and fences. We recorded characteristics including type, placement, capacity, operable status, use, structural integrity, and condition, including vegetative cover on levees.

Newly constructed stop-log structure

Plant Community

Each wetland type or basin/unit of a project site was assessed separately unless uniform vegetation across units allowed a joint assessment. For each project, vegetation communities were described according to plant associations. Up to three dominant plant species described each association, and associations were named in order of decreasing plant dominance. We estimated the proportion of cover by each association within the entire unit. Information on location of the associations was recorded on a hand drawn map of the site. Two types of sampling measures were used to document associations; stand typing in riparian and upland areas, and modified Robel plots (Robel *et al.* 1970) in wetland areas. The number of vegetation measurements taken per association was dependent on the relative proportion of the vegetation association on the project site.

Where stand typing methodology was employed, we recorded a minimum of two characterizations per association. Stand typing entailed estimating percent cover, height, and species composition within canopy, sub-canopy, tall shrub, short shrub, and herbaceous layers. When applicable, canopy or tree-stand structure within each association was classified as either even-aged or uneven-aged, with age classes identified as mature (>38 cm diameter breast height (dbh)), medium (8-38 cm dbh) or young (<8 cm dbh). The presence of snags (standing dead trees), seedlings, or suckers was also noted. Cover class was recorded within each association for each species, using the following cover classes: less than 1%; 1-10%; 11-25%; 26-50%; 51-75%; and 76-100%. The use of cover classes reduces error and variability when using visual estimation techniques. Estimates of the relative cover of duff/litter, bare ground, and open water components of each identified association were also recorded using these classes.

WMEP ARCHIVES

Measuring vegetation using a Robel pole

For each vegetation association identified in wetlands, a minimum of three modified Robel readings were taken to describe the vegetative structure. Modified Robel readings utilize a 1–2m pole painted at 10cm intervals. A 3m rope is attached at the 1m mark on the pole and fully extended in each of the four cardinal directions. Vegetation density was estimated with a visual obstruction reading (VOR) by determining the lowest mark that could be read on the Robel pole by the observer from 3m away. Average vegetation height was visually estimated in the plane below the 3m line running from the observer to the pole. A total of four VOR and average height readings were recorded at each plot. Species composition and cover for each species was recorded. Plant names followed the national PLANTS database standard nomenclature (USDA 2002). Appendix C lists all plants identified through site assessments, including scientific names and wetland indicator status in FWS Region 5 (eastern Colorado) and Region 8 (western Colorado).

Wetland Functions

Wetland function scores and evaluation procedures were developed and implemented based on procedures adapted from the Colorado Natural Heritage Program (CNHP). Following analysis of 2003 attempts, the scope of WMEP functional assessments was narrowed and the following wetland functions were evaluated for each project assessed in 2004: shoreline stabilization, groundwater discharge, groundwater recharge, flood attenuation, removal of imported nutrients, toxicants, and sediments, and habitat diversity (Reddy and Cariveau 2004). First, the applicability of each wetland function was determined according to the features of the project site, its position in the landscape, and the nature of the function. Then, we considered a number of wetland characteristics, or cues, to determine the site's rank for each function (Table 3-1). These cues were assigned a qualitative, logic rating of high, medium, or low. Most cues reflect either a wetland's opportunity or effectiveness at performing a function; several are direct indicators of particular functions. Opportunity is the chance a wetland has to perform a specific function, while effectiveness is the capability of a wetland to perform a function due to its physical, chemical, or biological characteristics (Adamus *et al*. 1991).

In order to maximize efficiency of on-site data collection efforts, we assumed that particular data could be obtained from existing external resources. This included flow data based on existing stream gauge networks, soil profile and association data from USDA NRCS soil surveys, wetland areas from GIS shapefile polygons provided by CWP proponents, and water level stability data provided through interviews with landowners and wetland managers.

Table 3-1. Cue scores for WMEP wetland functional assessment

High (H) = 1, Medium (M) = 2, Low (L) = 3, Present (P)= 1, Absent (A) = 2, N/A = 0 points.	
Shoreline Stabilization – Riparian Sites Only	
Evidence of Erosion – Indicator	
H	Wetland is characterized by scours, headcuts, or downcuts.
M	Wetland has some scouring headcutting or downcutting.
L	Wetland has no scouring, headcutting or downcutting.
Vegetation Composition – Effectiveness	
H	Shoreline vegetation is comprised of woody vegetation or wetland vegetation is comprised of fast-rooted graminoids.
M	Shoreline vegetation is present but comprised of non-woody vegetation and non-fast-rooted graminoids.
L	Very little to no vegetation exists along shoreline.
Vegetation Cover – Effectiveness	
H	Shoreline vegetation covers >75% of erosive boundary.
M	Shoreline vegetation covers between 25% and 75% of erosive boundary.
L	Shoreline vegetation covers less than 25% of erosive boundary.
Meander Type – Effectiveness	
H	Meander is described by Rosgen classes DA, E.
M	Meander is described by Rosgen classes B,C.
L	Meander is described by Rosgen classes A, F, G.
Bank Length – Opportunity	
H	Estimated linear miles subject to bank erosion is less than 1.
M	Estimated linear miles subject to bank erosion is 1-5.
L	Estimated linear miles subject to bank erosion is greater than 5.
Water Flow -- Opportunity	
H	Water flow exceeds 20 cfs through the wetland.
M	Water flow is between 2 and 20 cfs through the wetland.
L	Water flow is less than 2 cfs through the wetland.
Flood Attenuation and Storage/Dynamic Surface Water Storage	
Wetland Area – Effectiveness	
H	Wetland area >20 acres
M	5-20 acres
L	<5 acres

Table 3-1. Cue scores for WMEP wetland functional assessment

Saturation – Opportunity	
H	Extent of wetland is usually dry or minimally saturated during periods of high runoff.
M	Extent of wetland is partially saturated during periods of high runoff.
L	Extent of wetland is flooded during periods of high runoff.
Stem Density – Effectiveness	
H	Tree stands with a high density of stems per unit area or shrub stands with > 40% cover of project site.
M	Tree stands with moderate to low density of stems per unit area or shrub stands with < 40% cover of project site or stands of tall emergent or other vigorous vegetation communities on >50% of site.
L	Trees or shrubs <10% of site, or tall emergent communities <50%, or no vegetation.
Microtopography – Effectiveness (Riparian sites only)	
H	Meanders are characteristic features of the wetland site.
M	Meanders are found in moderate to high density in strategic portions of the wetland site.
L	Few or no meanders found on project site.
Substrate – Effectiveness (Riparian sites only)	
H	Gravels, aggregates or sands
M	Silts
L	Clays
Inlet/Outlet -- Effectiveness	
H	Wetland has inlet, but no outlet, or wetland has inlet and a highly constricted outlet.
M	Wetland outlet is unobstructed or wetland is managed to shed floodwater.
L	Wetland is drained or ditched to increase outflow of water from wetland.
Groundwater Discharge	
Topographic Relief – Indicator	
P	Topographic relief characterized by a slope such that the groundwater table intercepts ground level.
A	Topographic relief characterized by a slope such that groundwater cannot intercept ground.
Water Level Stability – Effectiveness	
P	Water levels are relatively stable.
A	Water levels are not stable.
Inlet/Outlet – Effectiveness	
P	Wetland possesses an outlet but no inlet.
A	Alternate water source (inlet) identified.
Presence of Groundwater Discharge – Indicator	
P	Groundwater flow observed on site and not degraded and flowing as to expectation.
A	Groundwater flow not known on-site or degraded to <25% normal flow or not flowing as expected
Groundwater Recharge	
Water Level Stability – Effectiveness	
P	Water levels are **not** stable.
A	Water levels **are** relatively stable.
Inlet/Outlet – Effectiveness	
P	Wetland possesses an inlet but no outlet.
A	Wetland possesses an outlet.
Wetland Soils – Indicator	
P	Soils are characterized as porous, maintaining little loam or clay.
A	Soils characterized as nonporous, maintaining some loam and clay.
Habitat Diversity	
Number of Plant Associations – Effectiveness	
H	Wetlands maintains >9 associations
M	Wetland maintains 4 to 6 associations
L	Wetland maintains 3 or fewer associations

Table 3-1. Cue scores for WMEP wetland functional assessment

Nutrient and Toxicant Removal	
Gradient – Effectiveness	
H	Wetland has shallow gradient (0-5%).
M	Wetland has a slope between 6 and 10%.
L	Wetland has a slope greater than 10%.
Vegetation Type – Effectiveness	
H	Wetland maintains dense stands of perennial vegetation.
M	Wetland maintains moderately dense stands of vegetation
L	Wetland maintains no vegetation; Wetland maintains sparse annual or perennial stands of vegetation.
Water Flow– Effectiveness	
H	Less than 2 cfs flows through wetland.
M	Water flow is between 2 and 20 cfs through wetland.
L	Water flow exceeds 20 cfs through wetland.
Substrate – Effectiveness	
H	Highly organic soils, muck.
M	Soils with some organics in matrix.
L	Soils with no organics in matrix.
Inlet/Outlet – Effectiveness	
H	Wetland has inlet, but no outlet, or wetland has inlet and a highly constricted outlet.
M	Wetland outlet is unobstructed or wetland is managed to shed floodwater.
L	Wetland is drained or ditched to increase outflow of water from wetland.
Turbidity – Opportunity	
H	Water is very turbid.
M	Water is moderately turbid.
L	Water is clear

The WMEP created an initial set of basic models to calculate functional assessment results for CWP wetlands. In light of the variety of functional models available and the complexity of developing an appropriate model, the WMEP recognizes that models developed under this project are merely preliminary and provide a starting point for further refinement.

Coefficients and exponents were used to create score indices between 1 and 10. Sites were evaluated as highly functioning if they scored 0-3.33, moderately functioning if they scored 3.34-6.66, and low or poorly functioning if they scored 6.67–10. The following equations were used to calculate site functional scores:

Shoreline Stabilization:
$[(\textit{Bank Length})\ (\textit{Water Flow})(\textit{Vegetation Composition})\ (\textit{Vegetation Cover})\ (\textit{Meander Type})\ (\textit{Erosion})]^{.35}$

Nutrient and Toxicant Removal:
$[(\text{Turbidity})(\text{Wetland Slope})\ (\text{Vegetation Density})\ (\text{Water Flow})\ (\text{Substrate})\ (\text{Inlet/Outlet})]^{2.096}$

Flood Attenuation:
[(Wetland Area) (Saturation) (Stem Density) (Microtopography) (Substrate)]

Groundwater Discharge:
If (*Presence of Groundwater Discharge)* = P Then “P” Else 3(*Topography*) + 2(*Water Level*) + (*Inlet Type*)

Groundwater Recharge:
If (*Inlet/Outlet)* = P Then "P" Else $(Inlet/Outlet)^3 + 2(Water\ Level) + 3(Porosity)$

Habitat diversity was determined by enumerating the number of wetland vegetation associations found on the site.

Photosurveys

Photos were taken at multiple locations for each site assessed, to document the condition, structure, and distribution of vegetation communities, and hydrologic conditions at the time of the assessment. Prominent landmarks or boundaries were used to provide photopoints that could be relocated in the future. A GPS was used to mark each point and the aspect of each photo was recorded in order to facilitate comparisons among years. Photos of site improvements were also taken to document their condition. All photos were taken in digital format.

Data Analysis

Data collected during site assessment activities were entered into the *Evaluwet* Site Assessment database module developed by RMBO. Prior to analysis, all data were checked pursuant to the quality assurance/quality control (QAPP) plan between RMBO and the US EPA (Reddy 2003). For site assessment results, summary statistics were calculated using MS Access, MS Excel, or JMP® statistical software for Windows.

Results

In 2004 we completed assessments on 60 projects on 65 units of 40 sites (Figure 3-1, Table 3-2). Over 50% were baseline assessments (35 units on 21 sites), up from 5% in 2003. Site assessments were conducted between June 10 and October 14, 2004. The WMEP field team operated primarily in Wetlands Focus Areas in the southern half of the state; five assessments were completed outside of wetlands focus area boundaries in western Colorado.

The most common type of project assessed was enhancement (53%), followed by restoration (32%), creation (13%) and protection (2%). In terms of wetland type as characterized by hydrogeomorphic features, 50% of projects visited were riverine, 45% were depressional, and 5% were slope wetlands.

Hydrology

Riparian

Stream widths and depths varied somewhat between Wetlands Focus Areas, with average wetted width and water depth highest in the South Platte and San Luis Valley Focus Areas (Table 3-3). Sites on the western slope exhibited smaller overall channel characteristics than those in the SLV and eastward. With the exception of sites in the SLV, average water was very shallow at all sites.

Table 3-2. CWP sites/units assessed by Wetlands Focus Area, year, project type, and wetland type

	Total Sites Assessed (n)				Unit Project Type[1]				Unit Wetland Type[2]			
Wetlands Focus Area	**2002**	**2003**	**2004**	**Total**	**R**	**E**	**C**	**P**	**D**	**F**	**S**	**R**
Five Rivers	1	8	0	**9**	8	2	0	1	2	0	0	4
Front Range Urban	6	5	0	**11**	6	1	0	4	2	0	0	7
Gunnison	3	7	0	**10**	4	7	1	0	5	0	0	3
Middle Park	0	0	0	**0**	0	0	0	0	0	0	0	0
North Park	2	0	0	**2**	1	1	0	0	1	0	0	1
San Luis Valley	27	19	19	**65**	8	40	9	2	46	5	1	12
South Park	9	1	0	**10**	2	0	0	8	0	0	6	8
South Platte River	9	0	4	**13**	2	6	5	0	12	0	1	1
Prairie & Wetlands	7	12	7	**26**	12	7	5	1	17	0	1	8
Yampa/White River	3	4	0	**7**	0	1	0	0	1	0	0	0
Southwest	1	0	5	**6**	8	2	1	1	3	0	0	9
Other (None)	0	1	5	**6**	1	2	2	1	1	0	1	7
Annual Totals[3]	**68**	**57**	**40**	**165**	**52**	**69**	**23**	**18**	**90**	**5**	**10**	**60**

1. Unit Project Type: R=Restoration, E=Enhancement, C=Creation, P=Protection
2. Unit Wetland Type: D=Depressional, F=Flat, S=Slope, R=Riverine
3. Unit totals may exceed site totals when more than one unit was assessed on the site; or, unit totals may not equal site totals due to lack of clear classification in pilot assessment years.

Geomorphologic characteristics of streams and rivers showed both presence of desired habitat features and evidence of degradation (Table 3-4). Backwaters, sandbars, and cliffs were present on a number of sites, providing potential habitat for specialist avian species. Although banks were vegetated at all sites, cutbanks and bank erosion were noted on almost all sites, indicating stream downcutting and bank instability.

Table 3-3. Average stream widths and depths (m) by site and Wetlands Focus Area in 2004

Focus Area	N Sites	Average Wetted Width	Average Bank Width	Average Flood Width	Average Water Depth
Prairie & Wetland	3	5.0	41.0	186.0	0.4
San Luis Valley	3	26.3	39.3	466.0	1.3
South Platte	1	13.5	40.5	103.5	0.5
Southwest	4	3.5	4.3	20.0	0.1
Other (Western CO)	4	6.5	9.5	139.0	0.3

Table 3-4. Frequency of stream features by Wetlands Focus Area

Focus Area	N Sites	Braided Channel	Backwater	Sandbars	Cliffs	Cutbanks	Bank Erosion	Vegetated
Prairie and Wetland	3	0	1	1	2	3	3	3
San Luis Valley	4	0	4	4	1	3	2	4
Southwest	4	0	0	0	3	3	2	4
South Platte	1	0	1	1	0	1	1	1
Other (Western CO)	3	2	3	2	0	2	2	3
Total	**15**	**2**	**9**	**8**	**6**	**12**	**10**	**15**

<u>Wetland</u>

We documented five types of water:vegetation patterns in wetland basins on 21 sites (Table 3-5). Diagrams were used to describe the interspersion of surface water and vegetation (Figure 3-2).

We documented 92 structural improvements (Table 3-6) which fell into three categories: new (recently installed and documented during a baseline assessment), or operable/not operable (existing structures documented on non-baseline assessments). Stop-log structures and levees were by far the most commonly employed structural improvements for retaining water and managing water levels.

CARY ALOIA

Ringed vegetation.

Table 3-5. Water:vegetation patterns (N) on sites assessed in 2004

Pattern	Baseline	Delivered
Closed Vegetation	1	2
Island Vegetation	3	3
Ringed Vegetation	0	3
Veg Inclusion	1	1
Water Inclusion	5	7

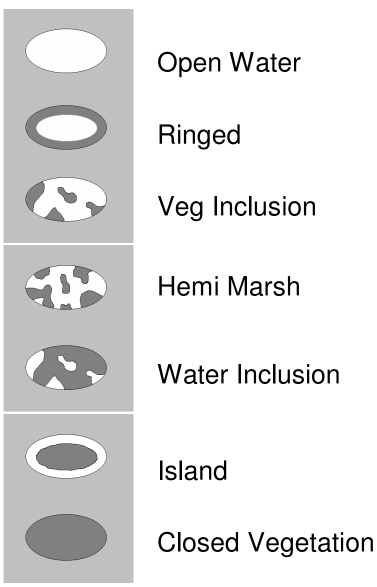


Figure 3-2. Wetland basin water: vegetation patterns

Table 3-6. Structural improvements documented during 2004 site assessments

Focus Area	Type	Condition	N
Irrigation/Inlets			
Prairie and Wetland	Solar powered well	New	1
San Luis Valley	T-box	New	2
	T-box	Not Operable	1
	Stop log box riser	New	2
	Artesian	Operable	1
	Ditch	New	2
	Pipe	New	1
South Platte	Screw gate	Operable	1
Drainage/Outlets			
Prairie and Wetland	Pipe	New	1
San Luis Valley	Ditch	New	8
	Pipe	New	5
	Stop Log	New	19
Southwest	Ditch	New	1
	Stop Log	New	1
South Platte	Pipe	New	2
	T-box	New	1
	Unknown	New	2
Levees			
Prairie and Wetland	Berm	New	1
San Luis Valley	Countour	New	30
	Countour	Operable	2
	Countour	Not Operable	2
	Barrier	Operable	1
Southwest	Ring	Operable	1
South Platte	Ring	New	2
	Contour	New	2

Vegetation

We recorded 118 vegetation associations on 63 units of 39 sites in 2004. Just over 75% associations occurred only once, and most occurred only within one habitat type. Therefore, we grouped associations by the most dominant species in the association. We recorded an average of two associations per habitat per unit (Table 3-7). For 15 of the wetland units surveyed, the entire area was occupied by only one plant association, seven (47%) of which were weed associations. In riparian areas, we documented 27 plant associations with an average of 3.7 vegetative layers per association, indicating structural heterogeneity in riparian CWP projects.

Riparian areas assessed showed a high degree of structural diversity, with multiple layers present in most cases (Table 3-8). Additionally, we found evidence for regeneration of woody species, with seedlings present in 85% of the plant associations.

Table 3-7. 2004 Plant associations observed by most dominant species or group

Frequency and Mean Cover Class

	Wetland		Riparian		Upland		Total
Association Name[1]	**N**	**MCC[2]**	**N**	**MCC**	**N**	**MCC**	**(N)**
baltic rush	15	2	2	1			**17**
cottonwood	1	1	14	3			**15**
sedge (*Carex* spp.)	9	3	3	3			**12**
greasewood					11	3	**11**
willow			11	1			**11**
salt grass	8	2					**8**
spike rush	7	2	1	1			**8**
cattail	5	2					**5**
open water	5	3					**5**
kochia	3	5			2	2	**5**
rabbitbrush					5	4	**5**
bulrush	4	4					**4**
timothy	3	3	1	2			**4**

Plant Association Summary by Habitat Type

Habitat Type	**N (units)**	**Total # Assns**	**Avg/ Site**	**SD**	**Min/ Site**	**Max/ Site**
Wetland	46	42	2.4	1.4	1	6
Riparian	19	17	2.3	1.5	1	6
Upland	23	15	1.5	1.1	1	6

1. Please see Appendix C for plant nomenclature.
2. MCC = Mean Cover Class, rounded to nearest whole number. Cover class values: 0=<5%, 1=5-10%, 2=11-20%, 3=21-50%, 4=51-75%, 5=76-100%.

Table 3-8. Presence of different-aged woody vegetation by canopy layer in riparian areas.

Layer	Layer Frequency (N)	Mature Trees	Medium Trees	Young Trees	Snags
		% Occurrence Within Layer			
Canopy	20	90	55	40	85
Subcanopy	9	0	44	67	33
Tall Shrub	17	0	12	41	12
Short Shrub	26	0	0	23	0
Lower layer	27	0	0	0	0

A total of 223 plant species or genera (some species were only identified to genus, e.g. *Carex* sp.) were documented across all sites assessed in 2004. Of the 170 plant species or genera documented in wetlands, the five most frequently encountered were sedges (*Carex* spp.), asters (*Aster* spp.), goosefoot, foxtail barley, and needle spikerush. Average percent cover of these species ranged from 6.23 to 26.2 (Figure 3-3). Non-native, invasive species were frequently documented on CWP sites. Brome, kochia, sweetclover, and Russian thistle occurred on 20% of assessed units. When invasive species occurred, mean percent cover ranged from 6-27% (Figure 3-4).

Of the 145 plant species or genera documented in riparian areas, the five most frequently recorded were grasses in the genus *Poa*, narrowleaf cottonwood, asters, willow shrubs and Wood's rose. These plants accounted for 25% of all species occurrences in riparian areas. Tamarisk, a particularly detrimental species to stream corridors and habitat quality in Colorado, was found on only one assessed site (Figure 3-4).

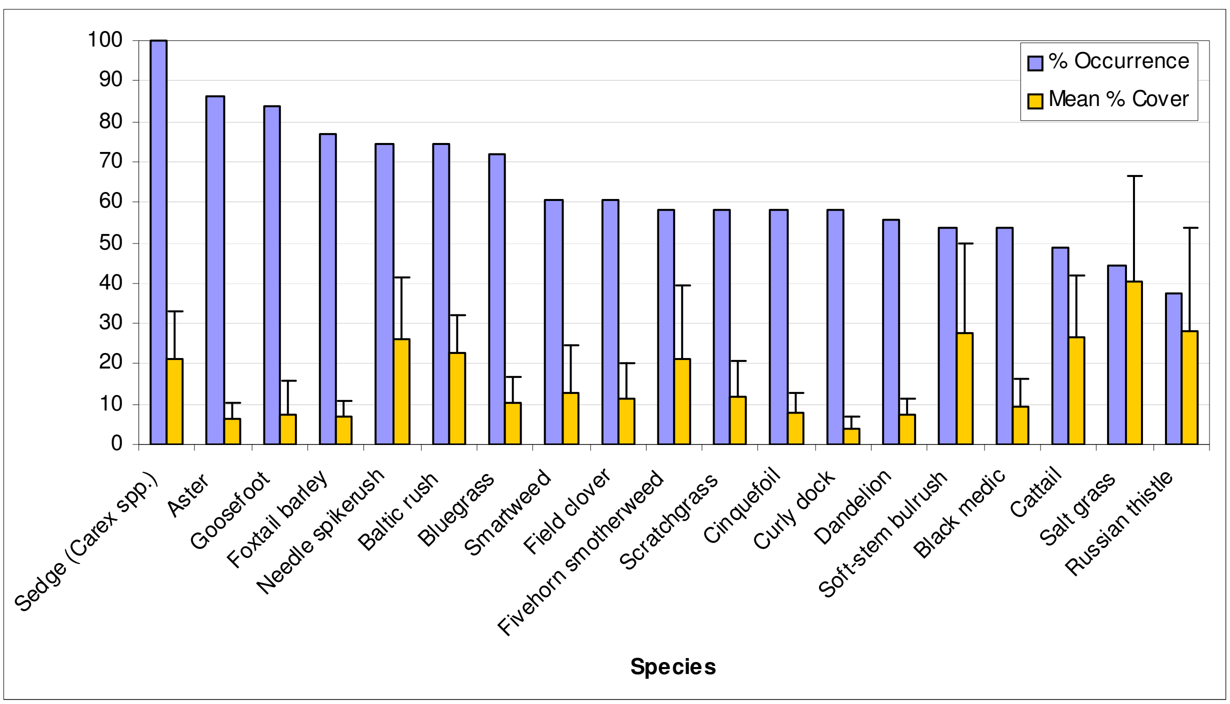


Figure 3-3. Plant species frequency and mean % cover in CWP wetland units assessed in 2004 (n=43)

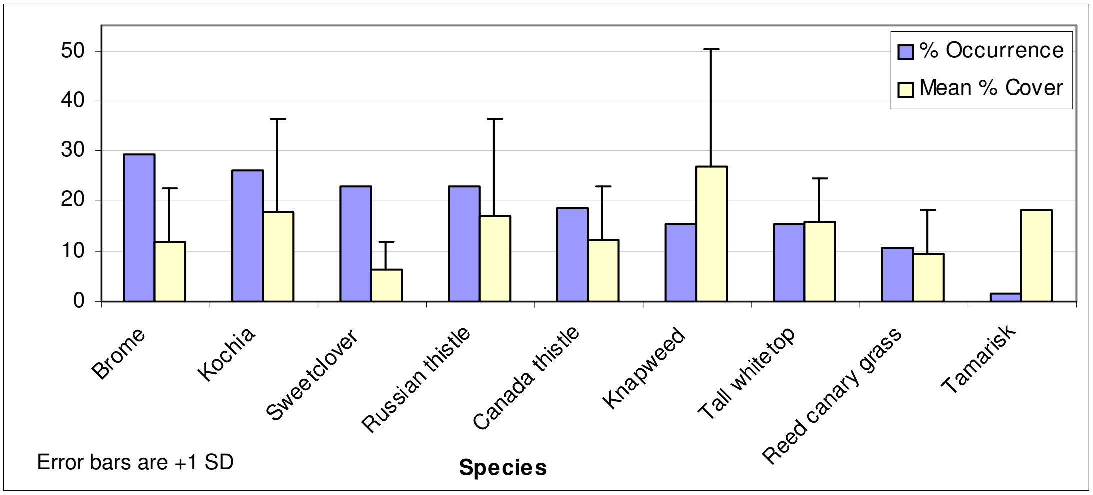


Figure 3-4. Frequency and mean % cover per unit (n=65) of invasive species

Discussion

Our site assessments in 2004 included baseline assessments of new projects and first assessments of older projects. Repeat visits will be necessary to document habitat changes resulting from project implementation. Thus we are limited in our ability to discuss the progression of CWP sites over time or to conduct an in-depth exploration of trends in the program at this point. Here we discuss topics that can begin to be addressed with the data collected at this stage of the project.

Project Types

The almost even split between depressional and riverine sites assessed in 2004 may be attributed to both the types of projects in the CWP and the Wetlands Focus Areas in which sites were assessed in 2004. Of the 165 projects assessed by the WMEP over the past three years, 55% have been depressional and 34% have been riverine, much higher than the 3% of sites classified as flat wetlands and 5% classified as slope wetlands. We believe this is a trend that will eventually show to be true program-wide, simply due to the restricted geographic distribution of flat and slope wetlands in the state. However, we cannot state this conclusively until the population of the Project Tracking database module of the WMEP is completed.

Hydrology

We observed a range of hydrologic conditions in riparian and wetland settings on CWP sites assessed in 2004. Riparian sites were generally located adjacent to streams which had low baseflow at the time of the surveys. This is an artifact of the time of year at which site assessments were conducted and the alteration that has occurred on Colorado's streams and rivers. A typical hydrograph for such streams would depict peak flow in spring during snowmelt. In the middle of the summer, due to irrigation and dry weather, western streams tend to exhibit greatly reduced baseflow. We observed a range of stream channel sizes and bank widths across the surveyed sites, but generally channel size was greatest in the San Luis Valley and Prairie & Wetlands Focus Areas.

We noted beneficial habitat features along stream channels on many of the CWP sites assessed in 2004. Backwater sloughs were found on nine sites, providing foraging, loafing, migratory, and breeding habitat for waterfowl. Cliffs were noted on six occasions, and may provide habitat for cliff-nesting species including Canyon Wren, Cliff Swallow, White-throated Swift, and Peregrine Falcon. Mud banks provide habitat for the nesting burrows of birds such as Belted Kingfisher and Bank Swallow. Sandbars may be utilized by Spotted Sandpipers and Killdeer. We also noted cutbanks and bank erosion on 67% of sites, providing evidence of channel instability on many project sites. Such channel characteristics are probably often historic and caused by off-site stream dynamics, but attention should be paid to ensure that CWP projects serve to stabilize the channel as much as possible within project areas.

On wetland sites, most of the planned and existing water:vegetation basin patterns reflected interspersion of vegetative stands among water, a desirable condition which provides both cover and foraging habitat for waterfowl, secretive marshbirds, and wading birds. Variation among observed basin patterns suggests that habitat heterogeneity exists or is planned for CWP projects, which may benefit a greater number of wildlife species than if all designs were similar.

Though the WMEP attempted to document flood schedule and planned and actual water delivery schedules for wetlands by month in 2004, the information was difficult to obtain. This information primarily existed at the planning stage, preventing a review of actual seasonal hydrologic trends. Achieving appropriate wetland hydrology on CWP sites will be an on-going challenge, as many restoration sites utilize irrigation water or are dependent upon surface water runoff, and Colorado has been experiencing an extended period of drought.

Site Improvements

A variety of structural improvements were being used for delivering and controlling water levels on project sites. Nearly all projects in the San Luis Valley featured contour levees and stop-log structures to create shallow impoundments with controllable outlets. This reflects a somewhat uniform application of restoration technique for projects in this Wetlands Focus Area.

One function of WMEP site assessments is to document the status of site improvements installed with funds from the CWP. By doing this we can provide updates to managers and landowners on the functionality of the structures, enabling timely maintenance when needed.

Projects assessed in 2004 demonstrated a high degree of structural integrity. Structural improvements were generally found to be functioning. Even for older projects the majority of structures were operable – only 3% of the 92 structures assessed were not functioning properly.

Vegetation

We found many different plant assemblages on CWP sites assessed in 2004. This was due in part to the wide variety of wetland types and geographical dispersion of project areas surveyed. Our results also reflect the protocol WMEP used to identify plant associations. WMEP originally adopted the identification scheme developed by CNHP for classifying wetland and riparian plant associations in Colorado (Carsey *et al.* 2003). However, the CNHP dichotomous key for plant associations was developed using reference wetlands, and in the first two years of the WMEP, Reddy and Cariveau (2004) found that CNHP associations rarely occurred on CWP sites.

Because wetland restoration, enhancement, and creation sites are naturally characterized by degraded, weedy, or early successional species, WMEP needed an alternate approach.

The modified CNHP naming scheme that the WMEP has adopted for restored sites has proven to be too specific, as plant associations documented on CWP sites in 2004 were rarely repeated. In future assessments we plan to employ a grosser level of categorization, to allow for tabulation of habitat types in the CWP. This classification would describe community types in a way that would allow both compilation of habitat types statewide and exploration of variation within types. Examples could include accepted descriptions incorporating hydrologic setting and vegetation attributes, such as tall emergent marsh, cottonwood gallery, shrub carr, etc. Additionally, parameters already measured at the 165 sites assessed to date will enable us to retroactively apply these more encompassing categories to our existing data, facilitating among-year comparisons.

We did find evidence of habitat diversity as expressed by the average number of plant associations per unit (1.8-2.5, based on habitat type). This suggests that most sites are providing a basic level of habitat diversity in those cases in which associations are dominated by desired species. We also found evidence of structural complexity in riparian plant associations, a desirable habitat condition.

Overall, CWP sites exhibit expected characteristics for restoration and enhancement sites; individual plant species with highest frequency documented in 2004 were a mix of desired species and habitat generalists/opportunists. A portion of the most commonly encountered wetland plants were facultative wetland and obligate wetland species. Development of wetland vegetation on restoration sites often requires several years, and without seeding, weedy, opportunistic species can easily become established.

Weeds are becoming a management concern on CWP sites. Weedy species are rarely productive habitat for wildlife. In addition, project areas should not serve as source areas for noxious weeds, given the broad range of agricultural and conservation-oriented weed control efforts in place through government agencies and private groups. CWP partners share a concern about exotic invaders, as evidenced by the goal of controlling noxious weeds in 31% of the projects with stated objectives. CWP project management plans will need to allocate effort towards weed control.

Wetland Functions

The technique tested by the WMEP provides a structure for reporting a cursory, subjective assessment of a variety of wetland functions, similar to efforts undertaken by wetland managers and many others employing rapid assessment techniques (Hruby 1999). This approach has proven to be the optimal and only way to collect functional assessment data for a statewide monitoring program such as the WMEP, which must balance the amount of data collected per project against number of projects visited. Limitations to WMEP staff size require that data collection is as efficient and brief as possible, necessitating employment of rapid assessment techniques, and thus application of logistic models to functional assessment. Mechanistic models, or those which assign actual values to ranges of detailed biological measures (i.e., sediment transport), would require that the WMEP spend much more than one day at a site gathering data. This would severely impact our ability to characterize CWP wetlands. Furthermore, functional analysis methods based on reference data in Colorado do not exist.

Development of such data sets has been advocated as one method for establishing baseline functional assessment values (Rheinhardt *et al*. 1997), but such approaches require intensive data collection to characterize a specific wetland type and geographic location and as such their application is limited (Hruby 1999). The WMEP is currently aware of only one effort focusing on depressional wetlands in one county in Colorado (J. Rocchio, pers. comm.), and a newly funded project developing landscape-level functional criteria beginning development in 2006 (B. Johnson, pers. comm.). Development of reference metrics for additional areas or wetland types in Colorado is currently beyond the scope of the WMEP, however, coordination of WMEP monitoring with these efforts would enable application of those methods to restored wetland condition in Colorado.

The WMEP has constructed logic models for assessing whether wetlands function at high, moderate, or low levels for each function evaluated (Reddy and Cariveau 2004). In 2004 we adopted an approach which incorporated combining on-site data obtained for some metrics with data obtained from existing sources for other metrics. We have found that all of our models include some variables which have not been possible to consistently evaluate, due to a lack of existing data from external sources. Specifically, we have not been able to obtain geo-referenced spatial data for project or wetland acreage, impeding our ability to calculate metrics which incorporate wetland area or stream shoreline lengths. Examples include the wetland area values for the flood attenuation function and vegetation cover and bank length metrics for the shoreline stabilization function. Further, the application of rapid, one-time visits to sites limits our ability to determine water level responses to management and precipitation events, data which contribute to estimating the groundwater discharge and recharge functions. We assumed these data would be attainable through interviews with landowners and wetland managers, however, we have found that the availability and quality of those data are dependent upon the familiarity of those individuals with the project sites. In most cases, CWP projects are not actively or closely monitored for water level fluctuations.

Due to these inconsistencies, at this time a thorough discussion of the cue scores and individual function weights for evaluating each site is not warranted. Until the WMEP can verify and validate models, an effort which has generally proven not to be feasible for many initiatives undertaking similar efforts (Brooks 1997), a thorough evaluation of metrics is premature. A variety of models do exist for assigning weights to cue scores and calculating functional assessment models. The Wetlands Evaluation Technique (Adamus *et al*. 1991) and the Evaluation for Planned Wetlands (Bartoldus *et al*. 1994), among others, maintain relatively complex calculations for scoring a wetland's functional capacity. If the WMEP can obtain required cue data in a more direct, standardized fashion, comparison with these existing methods would be worthwhile and provide valuable information on restored wetland function.

To date, the WMEP has prioritized visits to new projects in order to collect as much data as possible and thereby bolster sample sizes for revisits. This has resulted in visiting wetlands of all HGM classes and subclasses in an opportunistic fashion. If a functional assessment of CWP wetlands was to be as comprehensive as possible, we recommend selecting only sites from a certain HGM class, such as depressional wetlands, focusing monitoring efforts on that class, and direct measurement by the WMEP of all variables included in the models. One major data deficiency this effort has highlighted is the need for spatial data in GIS format for all CWP sites. The WMEP has begun to collect this information for a subset of sites, and will begin development of a GIS for CWP projects in 2006. The future application of functional assessment metrics to CWP wetland conservation sites is a topic to be discussed among CWP partners in terms of usefulness to furthering restoration goals in Colorado.

The WMEP has conducted site assessments on approximately 25% of all CWP projects to date. We plan to begin revisiting sites to conduct the second round of assessments in 2008. Upon collecting data at follow-up visits, we will be able to compare change at sites over time. We will incorporate spatial data, including site dimensions, wetland acreage, and riparian area delineations in our future monitoring.

CHAPTER 4. PASSERINE BREEDING IN RIPARIAN WETLANDS


TONY LEUKERING

Yellow Warbler

The CWP has supported over 120 riparian conservation projects to date, including protection by conservation easement, habitat enhancement through grazing management and exotic plant control, and hydrologic restoration. Many of the CWP riparian projects articulate general benefits to birds. Riparian systems in western North America provide avian habitat for a disproportionate segment of the avifauna, supporting a greater diversity of breeding birds than all other western habitats combined (Anderson and Ohmart 1977, Johnson *et al.* 1977, Johnson and Haight 1985). Colorado riparian habitat hosts a greater diversity of bird species than any other habitat (Bottorff *et al.* 1971-1984 in Kingery 1998). In northern Colorado, an estimated 82% of the avifauna breeds in riparian habitat (Knopf 1985). Riparian systems are also heavily impacted; one study estimates that 95% of riparian habitat in western North America has been lost, altered, or anthropogenically degraded (Ohmart 1994). Western riparian systems have been subjected to disturbances by extreme alteration of hydrologic regimes due to water management, agricultural use, grazing, channelization, and encroachment by woody species (Knopf *et al.* 1988a).

A diversity of riverine habitat types exist in Colorado, along large rivers including the Arkansas, Colorado, and Rio Grande and smaller streams in three physiographic regions: Central Shortgrass Prairie, Colorado Plateau, and Southern Rocky Mountains (Colorado Partners in Flight 2000).

WMEP Monitoring Objective

Our objective for this portion of the WMEP is to determine avian community responses to riparian restoration projects. Specifically, we are investigating changes in avian species richness or diversity, increased overall numbers or densities of birds, and the addition of particular species that have been lost from the site or from a portion of its range.

Several types of riparian restoration projects are common within the CWP, including grazing management, (usually through fencing of the riparian area), control of exotic weed species such as tamarisk, and direct hydrological manipulation. During Phase I of the WMEP, we selected fourteen projects with clearly stated objectives that represented each of the categories of projects described above. Selected projects were pre-project delivery or in the first year of project delivery and distributed in a variety of elevation and riparian habitat zones throughout the state. In Phase I, we piloted a number of monitoring techniques to explore the most efficient and cost-effective means for monitoring vegetative and avian responses to projects. In Phase II, we focused our attention on eight sites that best represented opportunity to track biological responses to restoration projects, eliminating those projects that mixed two or more restoration practices or did not implement practices as anticipated.

Methods

Study Design

Eight sites were monitored for avian responses to restoration in 2004, six of which were monitored again in 2005 (Table 4-1). Sites were selected to fit into a Before-After Control-Impact (BACI) study design (Green 1979). We attempted to gather avian use and vegetation information on project sites before and after restoration practices were applied, and, if available, on adjoining areas that did not undergo restoration. Three projects entailed grazing management, three hydrologic manipulation, and two exotic plant control. For photographs of riparian study sites, see Appendix D.

Table 4-1. CWP sites selected for riparian avian monitoring in 2004-2005.

Project Objective	Site Name	Habitat Type (Wetlands Focus Area)	Restoration Objective	Monitoring Objective	Project Phase in 2004
Grazing management through fencing	Tabeguache Creek	Low-elevation stream woodland (Southwest)	Enhance understory and midstory	Compare fenced to unfenced area over time	2 years after fencing
	McIntyre Springs	Mid-elevation riverine woodland (San Luis Valley)	Maintain riparian and wetland habitats	Change through time	2 years after acquisition
	Lone Mesa State Park	High elevation stream shrub carr (Southwest)	Enhance woody species density	Compare fenced to unfenced area over time	1 year after fencing
Hydrologic development / restoration	Centennial Valley SWA	Low-elevation riverine woodland (South Platte)	Enhance riparian and wetland habitats	Compare above and below site of water application	Pre-project
	Medano-Zapata Ranch	Mid-elevation stream woodland (San Luis Valley)	Enhance canopy and shrub recruitment and increase under-story density	Change through time	Pre-project
	Fourmile Creek	High elevation stream, meadow and fen (South Park)	Enhance graminoid layer and shrub recruitment	Change through time	Pre-project
Exotic plant control: tamarisk	Escalante SWA	Low-elevation riverine woodland (Five Rivers)	Restore native species dominance	Monitor effects of tamarisk removal and wetland development	2 years after tamarisk removal
	Chico Creek**	Low-elevation stream shrub carr and woodland (Prairie and Wetlands)	Enhance canopy and shrub recruitment and increase under-story density	Compare fenced to unfenced area over time and effects of tamarisk removal	1-2 years after tamarisk treatment

* Sites not monitored in 2005 are Lone Mesa State Park and Tabeguache Creek.
**Site also receives grazing management. Tamarisk was treated on one survey transect in 2002 and on the other in 2003.

Point-count Surveys

Surveys were variable-radius point counts (after Reynolds *et al.* 1980) with distance estimation for generating bird density estimates (Rosenstock *et al.* 2002). Counts at each point were for five minutes, with some counts extended for an additional five minute period. The number of survey stations per site varied from 14 to 22 according to size of the site. Counts were initiated approximately one minute after arrival at points.

Riparian habitat along Conejos River on BLM's Simpson Property, San Luis Valley; note multiple habitat layers, presence of snags, and tall whitetop groundlayer.

During the point-count period, all birds seen or heard were noted. For each bird detected during the count period, the following data were collected: point number, species, distance to observer (using a Bushnell Yardage Pro 500 laser range finder), number of individuals, detection type (visual or aural), habitat association (substrate where observed), and sex (if known). Other observations such as behaviors indicating breeding activity were recorded when appropriate. Birds flying high over the habitat (e.g., twice canopy height) and birds observed in between points are not included in abundance indices or density estimates.

Line transect Surveys

Line transect surveys were conducted on two sites with smaller stream courses. Three 1-km transects were established on each site. Observers followed the stream course and recorded all birds detected. These counts yielded tallies of birds by species.

Analytic Methods

We categorized species according to their degree of specialization to riparian habitat, following the work of Rich (2002). Rich classified 77 western riparian species as either riparian-obligate (n=35 species; greater than 90% breeding records are in riparian habitat) or riparian-dependent (n=42; 60-90% breed in riparian). We augmented his classification by designating two additional species as riparian-obligate in Colorado (Black Phoebe, Spotted Sandpiper) two additional species as riparian-dependent in Colorado (Northern Rough-winged Swallow, Brown Thrasher), based on our knowledge of these species within the state. Because our intent is also to understand the value of riparian conservation sites to wetland-dependent birds, we also classified 28 species of waterfowl, shorebirds, and other waterbirds as wetland-dependent species. Because species composition varies with both the condition of sites as well as the natural variation in the avifauna among the diversity of Colorado riparian habitats, we compare sites close to one another, using data collected in Phase I of the project in some cases.

We used distance sampling (Buckland *et al.* 2001) to derive density estimates for species with a minimum of 20 observations per site and coefficients of variation of less than 50%. This method adjusts raw counts by the detectability of particular species within variable habitats to obtain estimates of birds/area. This technique requires the following major assumptions: all birds at zero distance or close to the line or point are detected, distances are measured accurately, and species are detected at their initial location (Buckland et. al. 2001). Density estimates were derived from program DISTANCE 5.0 Beta version 4 (Thomas *et al.* 2004).

Results

A total of 289 point surveys were conducted and 13.8 km of riverine habitat was surveyed during this phase of the project. In 2004, six sites were visited twice and two sites were visited once; in 2005, four sites were visited twice and two sites were visited once (Table 4-2). All surveys were conducted without precipitation and with wind speeds of less than 12 km. All results reported will be for both years combined, unless otherwise noted.

Table 4-2. Summary of 2004 and 2005 bird survey results on CWP riparian restoration sites

Site	Year	# Survey Stations	Transect length (km)	# Surveys	Species Richness	# Birds Counted	Average Birds/Point
Centennial SWA	**2004**	14		1	33	150	10.71
	2005	14		2	41	419	13.21
Chico Creek	**2004**		3.6	2	51	317	
	2005		3.6	1	26	213	
Escalante SWA	**2004**	15		1	36	232	15.47
	2005	15		2	51	533	18.53
Fourmile Creek	**2004**		3	2	13	146	
	2005	14		1	15	101	7.21
McIntyre Springs[1]	**2004**	22		1	45	482	21.91
	2005	11,13		2	47	600	19.46
Medano-Zapata Ranch	**2004**	16		2	51	479	14.97
	2005	16		2	50	504	12.69
Lone Mesa SP[2]	**2004**	22		2	60	628	14.27
Tabeguache Creek[2]	**2004**	17		2	37	266	19

[1] Not all survey stations were visited due to flooding on site; one visit included 11 points, the other visit, 13.
[2] Sites were not visited in 2005.

Bird Abundances

A total of 5,070 birds were counted, representing 143 species. The mean number of species, or species richness, per site surveyed was 49. Species richness ranged from 17 at Fourmile Creek, where no shrub or canopy vegetation layers were present, to 65 at the Medano-Zapata site, where grassland, riparian, and pinyon-juniper habitats interface.

We detected an average of 12 birds per 5-minute point survey overall. Among sites, average numbers of birds per 5-minute point survey varied from 7 birds per point at Fourmile Creek to over 18 birds per point at Escalante SWA.

Bird Density Estimates

For data collected in 2004, we calculated bird density estimates for species with sufficient sample sizes (see Table 4-3). In accordance with the count data, the site with the highest bird density was McIntyre Springs, where the Yellow Warbler and House Wren were the two most abundant species. European Starling was also highly abundant at Medano-Zapata Ranch. In general, density estimates presented here are similar to those derived in Phase I (Reddy and Cariveau 2004). All findings are preliminary at this point; we will not report trends in bird numbers until we have a minimum of five years of data from a site. A list of all bird species documented on CWP sites can be found in Appendix E.

Table 4-3. Avian density estimates from 2004 surveys of CWP riparian restoration sites

Site	Species	D[1]	D LCL	D UCL	D CV	# birds[2]
Lone Mesa SP	Lazuli Bunting	0.63	0.38	1.05	0.26	37
	MacGillivray's Warbler	0.48	0.27	0.86	0.30	25
	Dusky Flycatcher	0.45	0.30	0.67	0.20	38
	American Robin	0.40	0.26	0.63	0.23	40
	Green-tailed Towhee	0.41	0.23	0.73	0.30	34
	Warbling Vireo	0.21	0.11	0.39	0.31	22
Medano-Zapata Ranch	European Starling	2.16	0.96	4.89	0.42	22
	House Wren	1.27	0.73	2.22	0.27	29
	Yellow Warbler	0.74	0.36	1.53	0.37	34
	Western Meadowlark	0.12	0.06	0.23	0.33	31
McIntyre Springs	Yellow Warbler	5.88	3.89	8.89	0.21	98
	House Wren	2.32	1.45	3.72	0.24	59
	Western Wood-Peewee	0.95	0.56	1.61	0.27	23
	Mourning Dove	0.64	0.39	1.03	0.24	35
	Red-winged Blackbird	0.63	0.31	1.26	0.35	23

[1] D is estimated density of birds/hectare. LCL=Lower Confidence Limit. UCL=Upper Confidence Limit.
[2] The number of birds used in the analysis.

Species Composition

Across all sites, the most common species observed was Yellow Warbler (n=355; 6.66%), followed by Western Meadowlark, Mourning Dove, Red-winged Blackbird, and House Wren. Brown-headed Cowbird and European Starling were the sixth and seventh most frequently counted species, each representing approximately 4% of the total birds counted.

Wetland and Riparian Dependent and Obligate Species

The number of wetland and riparian dependent or obligate species varied considerably among sites, from a total of eight for Fourmile Creek to 34 at McIntyre Springs (based on 2004 survey data; Figure 4-1). For comparison, a riparian project site two miles away from the Fourmile Creek restoration site yielded 17 wetland and riparian-dependent/obligate species (Reddy and Cariveau 2004).

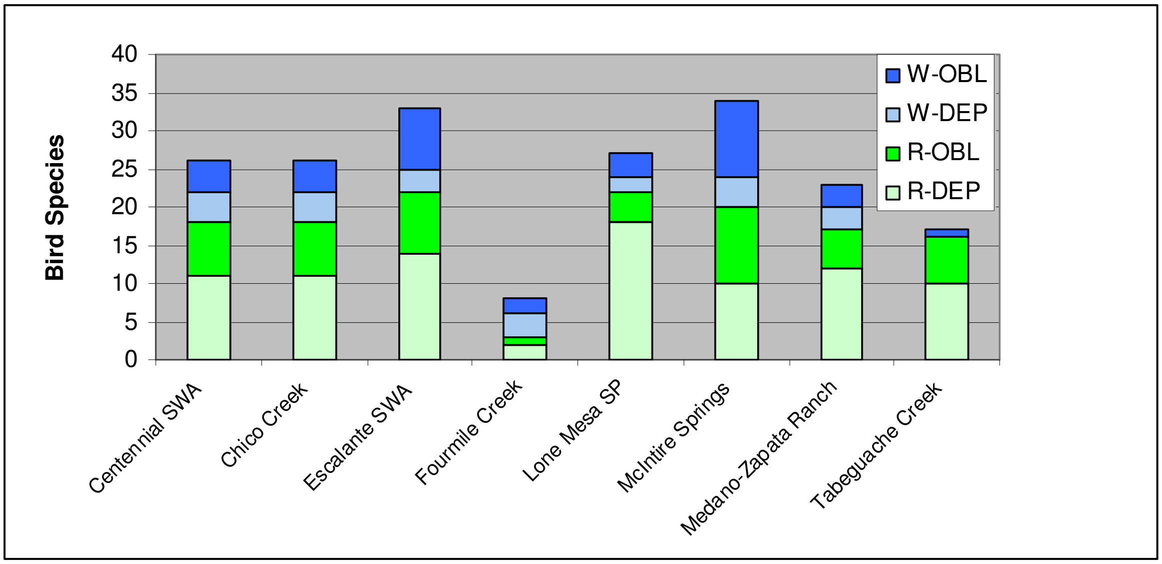


Figure 4-1. Numbers of riparian-dependent, riparian-obligate, wetland-dependent, and wetland-obligate species, by study site

Rare Species

We found high numbers of the federally threatened Southwestern Willow Flycatcher at McIntyre Springs (21 detected on surveys), as well as Western Yellow-billed Cuckoos in both 2004 and 2005. Also at McIntyre Springs, we detected three species of secretive marshbirds: American Bittern, Sora, and Pied-billed Grebe. Black-crowned Night-heron were documented at McIntyre Springs and Lone Mesa SP. At the Medano-Zapata site, Rose-breasted Grosbeak was found in both years and Summer Tanager in 2004 (very rare and accidental, respectively; Andrews and Righter 1992).

Discussion

Breeding passerine birds are responsive to changes in the vegetative structure of habitats, and therefore can be useful indicators of riparian habitat conditions (Hutto 1998; Knopf *et al.* 1988b, O'Connell *et al.* 2000; Rich 2002). In particular, studies have indicated clear avian responses to grazing management in riparian areas (Saab *et al.* 1995, Tewksbury *et al.* 2002, Krueper *et al.* 2003). Additionally, particular species may provide insight into habitat conditions on sites; for instance, Song Sparrows may indicate dense understory and Yellow-billed Cuckoos well-developed, mature

ALISON CARIVEAU

New channel construction at Fourmile Creek in South Park, August 26, 2004

canopy forest (Rich 2002). Finally, birds can serve as effective monitoring tools because they may be surveyed by the growing number of citizens interested in bird watching and conservation, and because they may be more economical to monitor than some other variables (US EPA 2002b).


TONY LEUKERING

Western Wood-Pewee

Restoration goals for riparian projects in the CWP often include a return of the hydrologic condition of a river or stream to some historic condition. Reinstatement of historic hydrologic regimes should fulfill habitat improvement needs over the long term, and is indeed a preferred solution. However, in Colorado where baseflows are reduced from groundwater depletion, in-stream flows are heavily allocated to off-river uses and permanent dams have removed natural flood pulse dynamics, true restoration of river hydrology is often difficult. In these cases, restoration objectives often focus on the vegetation component of habitat.

Because of the general positive relationship between the density and diversity of habitat layers (e.g., canopy, shrub, herbaceous) and the diversity of avian species on a site (e.g., Scott *et al.* 2003), restoration practices often target the habitat layer that is perceived to most need enhancement.

There are several major categories of bird habitat restoration needs in riparian systems:

1. Enhancement of canopy tree species, by encouraging reproduction and establishment of species primarily in the genus *Populus.*
2. Enhancement of native woody shrub species (especially *Salix* spp.), in either a system with canopy or in a shrub carr riparian system.
3. Enhancement of short woody species and herbaceous cover, often by increasing the width of riparian areas that have been impacted by channel incision and/or a lowered water table.
4. Enhancement of sand bars in plains riverine systems where trees and large shrubs were historically less abundant, to provide nesting and stopover habitat for avian species accustomed to utilizing sandy expanses.

CWP projects address the first three needs by applying practices that include hydrologic manipulations such as in-stream work, flooding, impoundments, or beaver dams; tree or shrub plantings; removal of non-native invasive plants; and grazing or browsing management. The fourth habitat need is addressed by removal of trees, shrubs, and in some cases, direct augmentation of sand bars. This work is being practiced extensively for endangered species conservation in Nebraska (e.g., USFWS 1990) but is less common in Colorado, although brush removal is pursued on a local scale on reservoirs in the Prairie and Wetlands Focus Area for Least Tern and Piping Plover habitat enhancement (Colorado Division of Wildlife unpub. data).

Among the sites we surveyed, we found high variability in the species richness and numbers of birds, with a nearly four-fold difference in the number of species hosted per project site. For instance, the restoration site at Fourmile Creek currently lacks any shrub or canopy vegetation layers and consistently reports low bird numbers, species richness, and numbers of riparian- and wetland-dependent species, even when compared to another site close by. Monitoring this site through time should present strong data indicating that ecological restoration can indeed create habitat for additional species.

Some of the CWP riparian restoration sites already present high habitat values. In particular, McIntyre Springs, a site managed by the Bureau of Land Management for wildlife benefits, provides habitat for a large population of breeding federally-threatened Southwestern Willow Flycatchers. We also recorded Western Yellow-billed Cuckoos in both 2004 and 2005, representing the only currently documented Western Yellow-billed Cuckoo individuals present for the duration of the breeding season within the San Luis Valley and western slope of Colorado (Lucero and Cariveau 2004). In the past century, these birds have suffered precipitous declines throughout their western range, and were extirpated from several states, including loss from western Colorado (Kingery *et al*. 1998). Other species of note are the waterbirds, American Bittern, Black-crowned Night-heron, Pied-billed Grebe, and Sora all also found at McIntyre Springs.

We are limited to preliminary reporting of our avian data for these projects as no project has reached an age of more than three years, with several projects still in the pre-project stage. Due to natural oscillations in bird populations and the low sample sizes generated by our small study sites, we will combine information from several seasons to establish baseline levels of avian use for the projects with several years of pre-project data. For projects where we lack several seasons of pre-project data, we will analyze the data as a time series. Again due to the variability expected in our datasets, we have set a threshold of five years of data as the minimum required to examine trends in bird abundance information. Thus, we will be able to report on bird trends in relation to restoration practices beginning in 2007. We also will analyze the bird survey data in relation to vegetation data collected in Phase I to describe bird-habitat relationships, which may be used to inform the design of future projects.

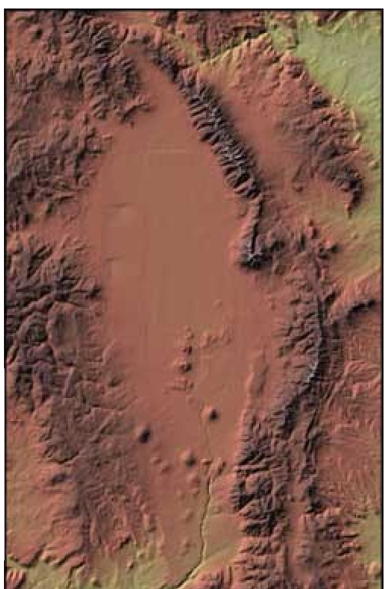
CHAPTER 5. WATERFOWL BREEDING IN THE SAN LUIS VALLEY

Improvement of habitat for waterbird breeding in the San Luis Valley (SLV) has been a major focus of CWP wetland conservation efforts. CWP projects in the SLV are primarily designed to improve wetland managers' abilities to maintain appropriate water levels and to provide vegetative structure optimal for breeding and brood rearing of waterfowl, shorebirds, and other waterbirds. Thus, CWP projects in the SLV are characterized by the enhancement and creation of shallow wetland impoundments and repair of water delivery systems. By creating flexibility to flood or draw down water levels and encouraging the establishment of beneficial vegetation cover on wetland projects, managers in the SLV can improve habitat availability and quality.


TONY LEUKERING

Northern Shoveler

The SLV is a semi-arid, high-elevation basin in south-central Colorado. Areas in the SLV have been documented as very important for breeding waterfowl in the state; historically 20-30,000 duck pairs were estimated to breed there annually (Gilbert *et al.* 1996). In addition, the SLV has been designated a national Waterbird Priority Wetland Area by the North American Waterbird Conservation Plan (Ivey and Herziger 2005). Managed wetland complexes in the SLV provide a majority of the habitat available for waterfowl breeding, as historical wetland habitat has mostly been converted to agricultural use. Common breeders include Northern Pintail, Mallard, Blue-winged and Cinnamon Teal, and Redhead, all of which are ranked moderately high to high-priority at the continental level by the North American Waterfowl Management Plan (NAWMP 2004). Large numbers of shorebirds and wading birds also breed in the SLV, many of which are of high conservation concern.


SANGRES.COM

SLV shaded relief image

Preservation of available breeding habitat for these species is a major conservation priority in the SLV. Bounded by the San Juan Mountains on the west and Sangre de Christo range to the north and east, SLV wetlands were historically fed by artesian flow, spring snowmelt, and a healthy groundwater system. However, expansion of agriculture in the SLV since the 1970s has resulted in alterations to local wetland dynamics through groundwater depletions and diversion of streams and rivers for irrigation. These activities have increased the importance of managed wetlands for breeding, migrating and wintering birds. Aggressive monotypic vegetation, invasive plants, increased surface water salinity, lowering of the water table, a decrease in artesian flow, drought, and creation of static hydrologic conditions are among the wetland management challenges faced in the SLV.

WMEP Monitoring Objective

The WMEP conducted intensive monitoring of SLV projects in spring of 2004 and 2005 (Figure 5-1). The purpose of this effort was to document habitat conditions and nest density and success by breeding waterbirds on CWP projects with such objectives.

Methods

Site Selection

The WMEP design for intensive waterbird nesting monitoring in the SLV was created in 2003 and employed a stratified random sampling design (Cochran 1977). Strata were created based on the assumption that waterbird response would differ as a result of differences in site ownership (public/private), size (small/large (>40 acres)), and juxtaposition with major wetland complexes (individual/complex (within two miles of Russell Lakes SWA, Blanca Wetlands WMA, Alamosa NWR, or Monte Vista NWR)). At the time, 71 projects were known to have waterbird nesting objectives; all were categorized according to one of the eight strata (Table 5-1).

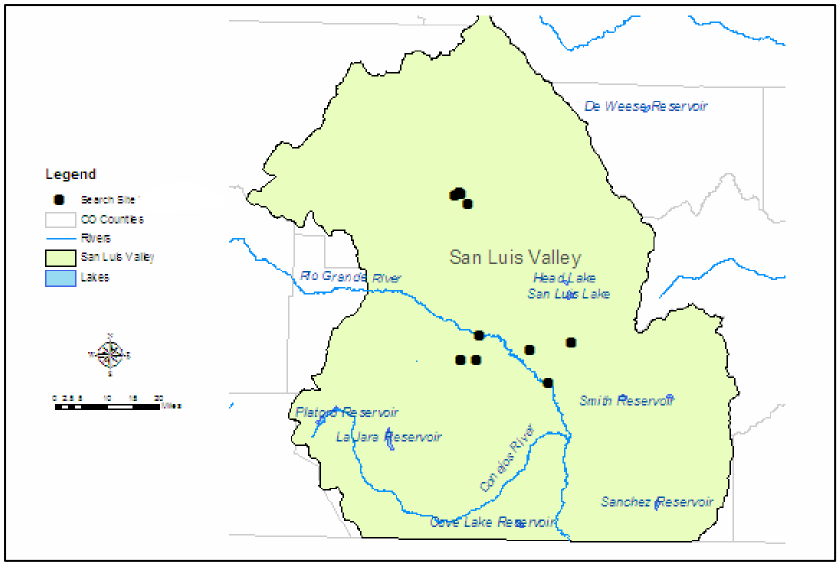


Figure 5-1. Nest Search Sites

Table 5-1. Site selection strata for waterbird nesting monitoring

Stratum	*N Projects*	*% Projects*
Large Public Complex	14	20
Large Public Individual	3	<1
Small Public Complex	2	<1
Small Public Individual	1	<1
Large Private Complex	10	14
Large Private Individual	21	30
Small Private Complex	1	<1
Small Private Individual	19	27

The Large Public Individual, Small Public Complex, Small Public Individual and Small Private Complex strata did not contain sufficient projects to allow comparison of results, and therefore were not included in the final site selection. Sites were selected for monitoring using a simple proportional sampling approach (Thompson *et al.* 1998). However, access could not be gained for some of the sites and therefore the final portfolio of sites sampled did not precisely reflect composition of the sampling pool. As bird populations fluctuate annually, sites monitored in each subsequent year were selected from the pool of sites sampled in the previous year, to strengthen evaluation of site performance by controlling for site as a variable. Sampling efforts in 2003 indicated that large sites were more likely to provide suitable habitat for nesting birds, so only large sites were monitored in 2004. Furthermore, analysis of 2003 data showed that an association between public ownership and wetland complexes and private ownership of projects away from wetland complexes confounded comparisons of ownership or proximity to other wetlands (Reddy and Cariveau 2004). Thus, in an effort to focus resources toward determining habitat quality and use by nesting birds, only large public sites were monitored in 2005. To accomplish this annual monitoring effort, the WMEP benefited from 6-8 volunteers who donated several days of search time each year. In 2005 available volunteer time was very limited, and therefore only three impoundments could be monitored. Table 5-2 summarizes sites monitored in each year of the study.

Nest Searching

Nest searches were conducted in mid- to late May and early June each year. Two search periods were required to ensure detection of early- and late-nesting species. Nest searches began at dawn and continued until noon. The entire site was searched if it was less than 40 acres in size; for larger sites a randomly selected portion of the site ranging from 25-40 acres was searched. All nests that were intact at the time of discovery were revisited to determine final nest fate.

Table 5-2. Projects monitored for waterbird breeding

Stratum	**Year Monitored**	
Project Name	**2004**	**2005**
Large Public Complex		
Alamosa NWR – Unit C2	x	x
Blanca WMA – Unit 5	x	
Monte Vista NWR – Unit 7	x	
Russell Lakes SWA – Island Lake	x	
Russell Lakes SWA – West Davey	x	x
Russell Lakes SWA – Wetherill 4	x	x
Large Private Individual		
Rio Grande I	x	
La Garita Creek I	x	

One of three searching strategies was employed based on the type of habitat present and number of individuals searching:

1. ATV Rope-Chain Drag: Used in wet meadows or shallow water with a moderate to high number of searchers. A 50m rope-chain drag (Klett *et al.* 1986) was pulled by an ATV on either end with 4-6 searchers following behind the drag. This method is very time efficient in habitats with little topographical relief and short vegetation.

2. Simple Rope-Chain Drag: Used in short emergent marshes or deeper water, with a moderate to high number of searchers. Where use of an ATV was not possible, an individual was placed on either end of the rope and the drag was performed by hand, with 4-6 searchers following behind.

3. Walk-through Search: Used when ATVs were not available, in tall emergent marshes, areas where topographical relief precluded use of a rope, or with a low number of searchers. Individuals stood roughly 10m apart and walked in a line across the project area, remaining parallel to one another and zigzagging back and forth. At the boundary of the project the end surveyor moved 10m further into the project area, the line pivoted around the end searcher, and all searchers walked back along another set of 10m-wide transects. This protocol was repeated until the whole unit was searched. As searchers walked they brushed aside vegetation with poles or meter sticks in an effort to ensure that a nest was not missed.


CARY ALOIA

Nest searching using the Walk-through Search technique

Nest Sampling

We surveyed for waterfowl, shorebird, and waterbird species known or suspected to breed in the SLV. We did not record American Coot nests, which are not targeted for management in this region. Nests were documented by a maximum of two observers to prevent undue disturbance.

When a nest was found, information pertaining to each nest site was documented by a recorder as the observer dictated details. Nest characteristics documented included species, nest status, number of eggs, incubation state, hen status, nest material, and location (Klett *et al.* 1986). Nest status when found was categorized as intact or terminated, and when possible, if the nest was terminated the cause was documented as abandoned, flooded, or destroyed. Abandoned nests showed no signs of depredation, eggs were cold, and there was no evidence of hen presence. Flooded nests were submerged or partially submerged in water. Destroyed nests were depredated, and predator type was categorized as avian, mammalian, or unknown. Evidence of avian predation included eggs punctured through one or more walls of the egg, puncture diameter commensurate in size with known local predators such as ravens, and the presence of the destroyed egg in or near the nest. Mammalian predation was determined by a portion of the eggshell destroyed, evidence of tooth marks in the eggshell, and presence of the destroyed egg in or near the nest. Predator type was unknown if the eggshell was too destroyed to find evidence of avian or mammalian depredation, or if eggs were missing (known only at follow-up nest visits). Incubation stage was determined by candling eggs to estimate the age of the eggs in days. Each nest location was recorded using GPS and marked with a low-lying stake 20m directly north of the nest. Any nest material moved was replaced to its former position. Nest markers were removed once nest fate was determined.

Teal nest

At the time of nest revisits, two people worked as a team to determine and record final nest status. Final nest fate was categorized as one of the following five possibilities (Klett *et al.* 1986):

- Successful: at least one chick hatched even if chicks are found dead at hatch sites;
- Abandoned: intact clutches deserted by the hen;
- Destroyed: one or more eggs missing or destroyed and none hatched;
- Nonviable: all eggs infertile, addled, or contain dead embryos; or
- Unknown: could not be determined whether at least one chick hatched from the clutch.

Habitat Measurements

Habitat measurements were taken at nest sites and at random locations for each habitat type within searched areas where nests were found. Cover type was documented as scrub-shrub, short emergent, tall emergent, or saltgrass. The extent (percent of total area) of each cover type observed within each searched unit was visually estimated.

Vegetative composition and structure were determined by establishing several vegetation plots. using a modified Robel method (Robel *et al.* 1970). This method employed a 2m pole marked along its length in 10cm increments with a 3m length of rope attached. The 3m length of rope formed a 28.3 m^2 circular plot within which plant species composition was recorded. The number of Robel plots sampled per habitat type was roughly proportional to the percentage of the total search area occupied by the habitat type. A minimum of five Robel plots were sampled per habitat.

Four sets of measurements were taken at the cardinal directions. Water depth was recorded at the base of the Robel pole and at the end of the 3m length of rope at each of the four measurement points. Salinity measurements were taken with an Orion Model 120 conductivity meter if water was present at the Robel pole. Plant measurements included vegetation density using the visual obstruction (VOR) method, in which the investigator identifies the lowest 1cm interval visible on the Robel pole from 3m away at 1m height. Average vegetation height along the length of rope was measured in centimeters by visually estimating the average height of vegetation located in the plane directly below the rope. For scrub-shrub communities, shrub and grass heights were not separated; the average vegetation height reflects the average of all plants observed along the line made by the rope. Plant species abundance was measured as visual estimation of percent cover for each species identified within the circular plot.

Data Summary and Analysis

Data were entered into the Waterbird Nesting module of the WMEP *Evaluwet* database and checked by an independent reviewer to ensure data accuracy in accordance with WMEP's US EPA QAPP (Reddy 2003). Results were generated by querying the Waterbird Nesting database for a variety of nest and habitat parameters. Data were then imported into JMP® statistical software for MS Windows.

For comparisons of response variables among habitats, either one-way ANOVA with the Tukey-Kramer HSD (normal data) or the Kruskal-Wallis rank sum test (non-normal data) was used to test for significance among multiple means. If significant differences ($\alpha < 0.05$) were noted in comparisons of multiple means, pairwise comparisons were made between all pairs of means. Either t-tests were used, or the data were rank-transformed and the Wilcoxon Rank Test (χ^2) was used to test for significance between pairs of means. A Pearson chi-square test was used to test apparent nest success rate by habitat.

Comparisons between response variables across habitats versus those at nest sites were conducted using t-tests for normally distributed data and Wilcoxon Rank Tests (χ^2) for non-normally distributed data. Nest density was calculated by dividing the number of nests found on a site by the acreage searched on the site.

Results

Searches

Nest searches were conducted during two search periods each year. Surveys occurred May 19-May 28 and June 2-June 11 in 2003, May 11-18 and 25 and June 7-12 in 2004, and May 17-19 and June 7-9 in 2005. All nests detected intact were revisited at least once to determine final nest fate. A summary of search efforts, including surface acres flooded by habitat type, is presented in Table 5-3.

Nests

Table 5-3. Summary of nest search efforts

Habitat Type	Sites (N)	Units (N)	Nests (N)	Random Plots (N)	Area Searched (ac)	Area Flooded (ac)
2004						
Tall Emergent	4	5	18	86	101.2	43.1
Short Emergent	6	7	38	142	198.5	95.4
Salt Grass	3	3	6	35	46.8	3.0
Scrub-shrub	3	5	12	44	26.5	0.3
Total	6	8	74	307	373.0	141.8
2005						
Tall Emergent	2	2	21	30	41.9	14.1
Short Emergent	2	3	21	81	87.2	38.8
Salt Grass	2	2	3	7	7.7	0
Scrub-shrub	2	3	2	N/A	23.6	0
Total	2	3	47	118	160.4	52.9

In 2004, 74 nests of 15 species were found on six survey sites, and in 2005, 47 nests of 11 species were identified on three survey sites. In 2004 all nests were detected in the Large Public Complex stratum; no nests were found on the privately owned sites. Species found nesting on the survey sites included one species of goose, six species of ducks, five species of waterbirds, and four species of shorebirds (Table 5-4). Teal (Cinnamon Teal and Blue-winged Teal) were the most abundant nesting waterfowl in both years and Wilson's Phalarope was the most abundant nesting shorebird in both years.

In 2004, the Island Lake unit at Russell Lakes SWA had the highest number of nests detected with a total of 23, but the highest nest density (0.53 nests/acre) was observed on the C2 Unit at Alamosa NWR. Wetherill 4 unit at Russell Lakes SWA had the highest species diversity, with nests from nine species detected. The fewest species and number of nests and lowest nest density occurred on the unit surveyed at Blanca WMA, with only one American Bittern nest found. Gadwall and the teal group were the most widely dispersed throughout the searched areas, with each found on five units. In 2005, Alamosa NWR Unit C2 had the highest number of nests detected with a total of 21, and also had the highest nest density (0.53 nests/acre). Wetherill 4 unit at Russell Lakes SWA again had the highest species diversity, with nests from seven species detected. In both years, nests were found in all habitats searched: salt grass, scrub-shrub, short emergent marsh, and tall emergent marsh.

Table 5-4. Nest densities and numbers by species on CWP waterbird breeding sites

	Total # of Nests / Species		Mean Nest Density/ Acre Across All Sites	
	2004	**2005**	**2004**	**2005**
Waterfowl				
Canada Goose	7	3	0.02	0.02
Gadwall	8	1	0.03	0.01
Mallard	8	2	0.03	0.01
Northern Pintail	3	2	0.01	0.01
Northern Shoveler	3	2	0.01	0.01
Redhead	5	6	0.02	0.03
Teal Group[1]	16	21	0.05	0.12
Unknown Duck[2]		1		0.01
Waterfowl Subtotal	50	38	0.16	0.21
Waterbirds				
American Bittern	1	1		0.01
Pied-billed Grebe	2		0.01	
Sora	2		0.01	
Virginia Rail				
White-faced Ibis		1		0.01
Waterbird Subtotal	5	2	0.02	0.01
Shorebirds				
American Avocet	3	2	0.01	0.01
Killdeer	1		0.00	
Wilson's Phalarope	10	5	0.03	0.03
Wilson's Snipe	5		0.02	
Shorebird Subtotal	19	7	0.06	0.04
TOTAL	**74**	**47**	**0.23**	**0.26**

[1] Teal group includes Blue-winged Teal (BWTE) and Cinnamon Teal (CITE).
[2] Nest was discovered during a re-visit to a different nest, hen was absent, and/or nest and egg characteristics insufficient to determine species.

Nest Success

Successful and unsuccessful nests were found at all sites (Table 5-5). We were not able to calculate nest success using the Mayfield method due to the low number of nests that were intact when detected for any given species. The Mayfield method requires that nests are intact when found, and insufficient numbers (n≥10) of nests of any species were found intact in either 2004 or 2005.

Table 5-5. Final nest fate

	Nests (N)		
	2004	2005	**TOTAL**
Successful	40	16	56
Unsuccueessful	29	23	52
Cause of Failure[1]	7(A)	2(A)	9(A)
	5(M)	9(M)	14(M)
	1(P)	2(P)	3(P)
	16(U)	10(U)	28(U)
Abandoned	0	2	2
Unknown	5	6	11

[1] A=Avian predation, M=Mammalian Predation, P=UndeterminedPredator, U=Unknown

Although we cannot estimate true nest success, we can report apparent success numbers, which may be biased high without the Mayfield correction (Mayfield 1975, Klett *et al*. 1986). In 2004, of the 74 nests found, 54% were successful, 39% were unsuccessful, and the final status of 7% of nests was undetermined. Of the nests that were not successful, 45% showed obvious signs of predation. In 2005, of the 47 nests found, 34% were successful, 49% were unsuccessful, 4% were abandoned, and the final status of 13% could not be determined. Of the nests that were unsuccessful, 44% showed obvious signs of predation.

In 2004 apparent nest success rate was highest in tall emergent habitats (72%), followed by short emergent (58%), and scrub-shrub habitats (42%). Saltgrass habitats were excluded from analysis due to low number of nests with known fate. No significant difference was observed in apparent nest success rate among habitats (n=63, χ^2=1.391, p=.4988). In 2005, only two nests each were found in saltgrass and scrub-shrub habitats, precluding those habitats from nest success summaries or analyses. Apparent nest success was essentially equivalent in short-emergent (33%) and tall-emergent habitats (35%). Again, no significant difference was observed in apparent nest success rate among habitats (n=37, χ^2=0.013, p=.9093).

Habitat Characterization

In 2004, habitat characteristics at nest sites varied among the four community types where nests were found (Figure 5-2). Mean vegetation height differed significantly at nest sites among habitat types ($F_{3,70}$=32.16; P < .0001); as would be expected, vegetation in tall emergent habitat (mean=78.9 ± 9.85cm) was significantly taller than in all other habitats. Mean visual obstruction was significantly greater in tall emergent habitats (mean=56.66) than in all three others (VOR: $F_{3,70}$=29.70, P <.0001) none of which were significantly different from one another. The same trend was observed for water depth; tall emergent communities had significantly deeper water (mean= 22.88 ± 4.69; $F_{3,69}$=17.85, P <.0001) than the other three, which did not differ significantly from one another.

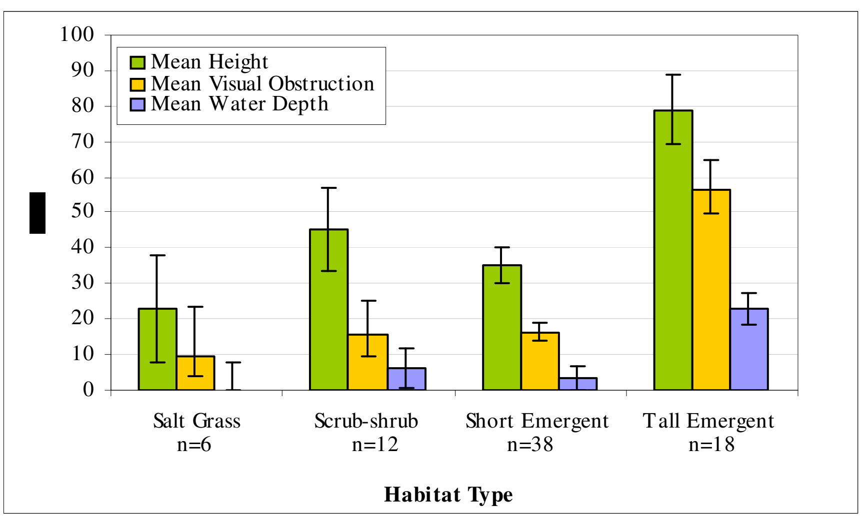


Figure 5-2. 2004 habitat parameters at nests, across all sites

In 2005, habitat characteristics at nest sites varied among the short and tall emergent community types, as expected (Figure 5-3).

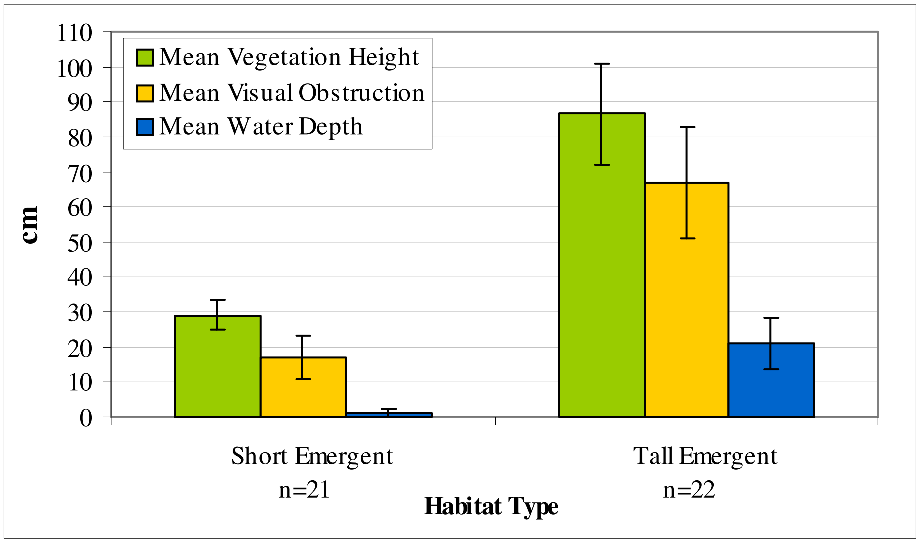


Figure 5-3. 2005 habitat parameters at nests in tall and short emergent habitats.

Too few nests (≤3) were found to meaningfully analyze nest habitat attributes in salt grass and scrub-shrub habitats in 2005. Mean vegetation height differed significantly at nest sites among habitat types (t=7.79, P<.0001); as would be expected, vegetation in tall emergent habitat (mean=86.6 ± 14.4cm) was significantly taller than in short emergent. Mean visual obstruction was significantly greater in tall emergent habitats (mean=66.9 ± 15.6cm) than in short emergent (t=6.05, P<.0001). The same trend was observed for water depth; tall emergent communities had significantly deeper water (mean= 20.8 ± 7.3cm; t=5.05, P <.0001) than short emergent. Community characteristics in each habitat where nests were found were randomly sampled after nest searches were completed. A summary of habitat attributes is presented in Table 5-6.

Table 5-6. Vegetation characteristics at nest sites and in habitats surveyed, by year

Habitat Type	Water Depth (cm)						Vegetation Height (cm)						Visual Obstruction Reading (cm)					
	Nests			Habitat			Nest			Habitat			Nest			Habitat		
	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean
2004																		
Tall Emergent	0	61.0	97.4	0	70.0	26.6	45.0	122.5	78.9	15	185	82.2	6	190	58.5	25	110	55.0
Short Emergent	0	54.0	3.3	0	49.0	9.3	12.5	87.5	35.2	5	80	33.4	0	55	18.4	5	95	17.5
Salt Grass	0	0.0	0	0	11.0	1.3	9.8	42.0	22.9	5	50	15.3	0	110	14.2	2	80	6.4
Scrub-shrub	0	39.0	6.0	0	22.0	7.6	17.5	79.5	45.3	5	110	47.6	0	142	20.4	0	150	22.2
2005																		
Tall Emergent	0	55.0	20.2	0	54.0	32.3	0	185	86.6	38	120	93	0	170	66.6	22	86	67.1
Short Emergent	0	24.0	1.29	0	57.0	13.1	7	76	29.1	1	45	56.9	0	75	17.2	0	68	15.1
Salt Grass	0	0	0	0	0	0	8	30	16.0	2	22	8.64	2	40	14.3	0	5	0.8
Scrub-shrub	0	0	0	0	0	0	5	10	18.1	5	90	70.5	2	20	5.5	N/A[1]	N/A	N/A

[1] A revised method was used to evaluate shrub communities in 2005 which does not incorporate direct density measures.

Vegetation at nest sites was typically dominated by two to three plant species, with several other species occurring infrequently and in low abundance (<10% mean cover per site). Dominant plants were considered to be those which occurred at a minimum of one-third (33%)

of nest sites for a given guild (waterfowl, waterbird, shorebird) and which accounted for a minimum of 20% cover. In 2004, a total of 42 plant species was observed at nest sites. Baltic rush was dominant at 68% of waterfowl nest sites in tall and short emergent marsh habitats. Other dominant species included salt grass and greasewood, in salt grass and scrub-shrub habitats, respectively. In 2005, a total of 34 plant species was observed at nest sites. Nest sites in tall emergent habitats were dominated by soft-stem bulrush, cattail, and Baltic rush, nest sites in short emergent habitats were dominated by Baltic rush, and nest sites in saltgrass habitats were dominated by salt grass. There was no clear dominant plant species for nest sites in scrub-shrub habitats in 2005.

While no plant species of management concern were dominant, invasive species were present at 30% of the nest sites in 2004 and at 13% of nest sites in 2005. Tall whitetop (*Lepidium latifolium*) occurred at 11% of nest sites with an average cover of 18% in 2004 and at 11% of nest sites in 2005 with an average cover of 13%. Arrowgrass (*Triglochin* sp.) occurred at 8% of nest sites with 4% average cover in 2004 and 6% of nest sites with a mean of 3% cover in 2005. Kochia (*Kochia* sp.) occurred on 5% of 2004 nest sites with an average cover of 14%, and at 4% of nest sites with an average of 10% cover in 2005. A minimum of two of these species occurred on all search sites with the exception of Blanca WMA.

Nest Site vs. Habitat Type Parameters

In 2004, in several instances nest sites differed significantly from the available habitat (Figure 5-4). Nests in short emergent habitat were found in shallower water than random plots (χ^2=11.36, p<.0008), while nests in tall emergent habitat were in deeper water than random plots (t=8.238, p<.001). In scrub-shrub habitat, nests were surrounded by more open water than random plots (χ^2=8.266, p<.0040). In contrast, in short emergent habitat, nests were surrounded by less open water than random plots (χ^2=6.21, p<.0127). Other characteristics were not found to differ (p>.05).

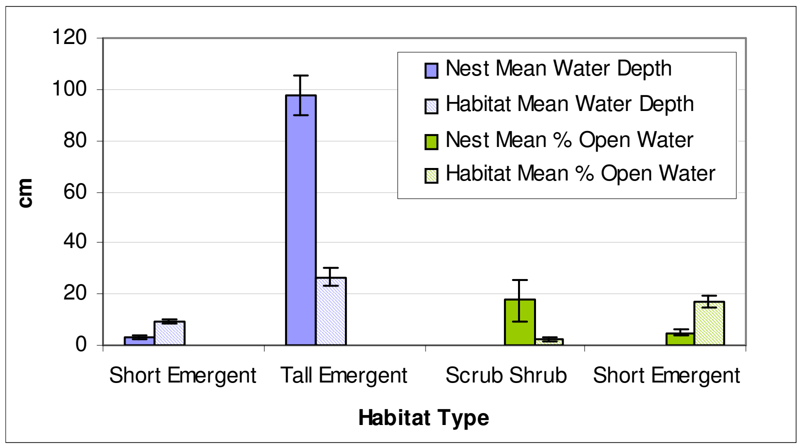


Figure 5-4. 2004 nest site parameters which differed from overall habitat

Discussion

Detailed nest site and habitat condition information provides an understanding of resource availability among these CWP sites. Nest densities observed in 2004 were similar to those of 2005. Though nesting species composition differed slightly between the two years, all species observed are known to use the SLV for breeding (Gilbert *et al.* 1996).

Nest densities monitored through this effort fall within the range of historical estimates of nesting ducks on similar sites in the SLV (Gilbert *et al.*1996), but are in the lowest quartile of that range.

Our densities for Mallard, teal species, and Gadwall are distinctly lower than those documented by Laubhan and Gammonley (2000) in a study of foraging habitat on Russell Lakes SWA, however, they conducted eight line-transect surveys in the study area in each year; a greater level of effort than the WMEP has been able to expend to date. They found densities of 0.38 nests/acre for Mallard, 0.51 nests/acre for teal, and 0.28 nests/acre for Gadwall, figures which are approximately ten times greater than our findings (Laubhan and Gammonley 2000). We believe that a prolonged drought period which extended into 2003 (Reddy and Cariveau 2004) or other larger oscillations in bird numbers may have impacted the nest densities we observed. Our preliminary results suggest that numbers of nesting birds on large public wetland complexes today may be lower than averages recorded over the past 35 years. Continued effort for several more years will strengthen our ability to draw conclusions about trends in nest densities on CWP sites.

Additionally, the fact that we detected no nests on the private sites searched may indicate that habitat factors on those sites are not desirable for nesting. We recommend continued study of these sites in the future in order to verify whether our findings are representative, and to collect sufficient habitat data to enable comparisons to the large public complex sites.

Apparent nest success was similar to other success rates for the SLV (Gilbert *et al.* 1996). Of failed nests, depredation was almost equivalent between mammalian and avian predators, but mammals accounted for almost all predation in scrub-shrub and short emergent habitats, while avian predators were predominant in tall emergent habitats. This is to be expected as scrub-shrub and short emergent habitats were shown to have very little water present and low to moderate visual obstruction by vegetation, which would facilitate nest visibility and access by mammals. In contrast, tall emergent habitats exhibited tall, denser vegetation and deeper water levels, where nest visibility and access may be easier for avian predators.

A variety of suitable habitat was available on the CWP sites searched, and guilds utilized the expected range of nesting habitat. Shorebirds selected for habitats with short vegetation and shallow (5cm) to no water, and waterbirds selected almost exclusively for dense, tall vegetation and higher water. As would also be expected based on known life-history traits (Bellrose 1980), waterfowl used all habitat types, with teal and Northern Shoveler preferring short emergent habitats, Gadwall using both scrub-shrub and short emergent, and Mallard, Canada Goose, and Redhead preferring tall emergent communities.

Habitat is aggregated on the CWP project areas, with each community type typically occurring in one or two large patches in each unit. On the sites we surveyed, a higher number of nests was observed on sites with a variety of habitat types. Observation of higher nest numbers in areas with multiple habitat types supports the recommendation that managers should consider the entire avian community and attempt to maintain habitat diversity when implementing water management plans (Laubhan and Gammonley 2000).

In addition to differences in habitat cover, dominant plant species within a given habitat type have been shown to influence nest site selection. Gilbert *et al.*'s (1996) summary of nesting ducks on the Monte Vista NWR concludes that ducks preferred the presence of baltic rush (*Juncus balticus*) for nesting over other plant species. This trend was also observed on CWP nest sites.

CWP waterfowl breeding projects on large wetland complexes in the SLV are providing habitat for nesting waterfowl, waterbirds, and shorebirds at levels commensurate with, but on the low end of historical studies. Large, public wetland-complex sites account for significant land acreage in the CWP in the SLV, but due to intensive management, are not representative of all habitat available valley-wide. A survey of all available habitat or on all CWP sites throughout the SLV would complement the nest search effort. CWP projects on privately owned sites are of particular interest, due to lack of nests on the two searched in 2004. Knowing how many sites are providing suitable habitat in a given year will help better understand the relative importance of the large, publicly owned sites that have been intensively surveyed to date.

CHAPTER 6. SECRETIVE MARSHBIRDS

Secretive marshbirds may be indicators of wetland health (Conway and Timmermans 2005), as these species depend on emergent wetland habitat for cover, forage, and nesting habitat. Populations of secretive marshbirds appear to be in decline; causes could include habitat loss or conversion, loss of the aquatic invertebrate food source due to degradation of wetland water quality, or invasion of wetlands by invasive species, affecting habitat quality (Gibbs *et al*. 1992). Knowledge of baseline numbers of secretive marshbirds and their population trends s an issue of particular interest in assessing wetland ecosystems at local and regional scales.

A national effort to monitor the status of secretive marshbirds was introduced in 2003, and protocols are in the early testing stages across the country (Conway 2003). We applied these standardized protocols to appropriate wetlands in the SLV, in a pilot effort to determine the feasibility of using secretive marshbird surveys as one component of the WMEP's wetland assessment portfolio.


TONY LEUKERING

American Bittern

WMEP Monitoring Objective

The purpose of this effort was establish long-term monitoring transects, collect species presence data, and evaluate whether future monitoring for secretive marshbirds should be officially incorporated into the WMEP.

Methods

The WMEP piloted intensive monitoring of secretive marshbirds from 2003-2005 in the San Luis Valley (SLV) where secretive marshbird habitat is extensive on CWP sites. Target species included American Bittern, Sora, Virginia Rail, and Pied-billed Grebe, wetland-dependent secretive marshbirds known to be present in the SLV. Secondary species included multiple types of wetland-associated species: Least Bittern, Green Heron, Northern Harrier, Common Moorhen, Wilson's Snipe, Forster's Tern, Black Tern, Belted Kingfisher, and Willow Flycatcher. Some of these species are generally distributed outside the SLV, and some use marsh edges or move between wetland and upland habitats; all have certain habitat requirements and therefore their presence is of interest in evaluating wetland quality.

Due to the nature of this pilot effort, sites to be monitored were selected from known CWP sites providing appropriate emergent marsh habitat. All of these wetlands fall under the Tier I site type recommended by the national protocol, as managed and protected wetland areas (Conway and Timmermans 2005). Transects were established on four sites across the SLV to obtain spatial distribution in monitoring locations. Two transects were established in 2003, one each at the Monte Vista NWR and Alamosa NWR, a third was added in 2004 at Russell Lakes SWA, and the final transect was added at the BLM's Blanca Wetlands WMA in 2005. Multiple points along each transect were monitored. Points were spaced a minimum of 200m and up to 400m apart, to maximize survey data collected within each site, but maintain independence between sampling points, by ensuring that the same individuals were not recounted at subsequent points (Conway and Timmermans 2005).

Surveys were conducted in the morning and evening in May and early June, during the marshbird breeding period. Morning surveys began 30 minutes before dawn and ended by 11:00 am and evening surveys began in the late afternoon and ended by dark. Surveys were not conducted when winds were in excess of 20mph, or in foggy or rainy conditions. At each survey point, the investigator first conducted a five-minute period of passive observation, followed immediately by broadcasting a series of pre-recorded vocalizations from a portable compact-disc player (boombox). Each recording was one minute in duration and included 30 seconds of calls followed by 30 seconds of silence. Calls of all the primary target species were used. Throughout both the passive observation and playback periods, observers recorded each individual, along with the time and method of detection (aural or visual). Distance to the bird from the observer was estimated using a Bushnell Yardage Pro 500 laser range finder.

Results

Surveys were conducted from May 22-June 6 in 2003, May 7-June 6 in 2004, and May 9-June 4 in 2005. Each transect consisted of 12 to 13 points. An attempt was made to survey all points along each transect each year, however, in some cases weather conditions precluded completion of the full transect. All target species were documented on all survey sites over the three-year period (Table 6-1). Total and average number of birds detected per point varied among sites (Table 6-2).

Table 6-1. Detections of target secretive marshbird species

	Surveys (N) / Total Points (N) per Site and Total Detections (N)			
Site/Species	**2003**	**2004**	**2005**	**Species Total/Site**
Monte Vista NWR	2 / 30	2 / 26	2 / 26	
American Bittern	5	12	4	**21**
Pied-billed Grebe	1	0	0	**1**
Sora	7	21	21	**49**
Virginia Rail	0	1	1	**2**
Subtotal	13	34	26	**73**
Alamosa NWR	2 / 25	1 / 6	3 / 20	
American Bittern	6	1	7	**14**
Pied-billed Grebe	5	0	7	**12**
Sora	10	2	13	**25**
Virginia Rail	1	1	5	**7**
Subtotal	22	4	32	**58**
Russell Lakes SWA	0	1 / 14	3 / 33	
American Bittern		6	3	**9**
Pied-billed Grebe		8	29	**37**
Sora		24	26	**50**
Virginia Rail		3	36	**39**
Subtotal		41	94	**135**
Blanca Wetlands WMA	0	0	3 / 36	
American Bittern			7	**7**
Pied-billed Grebe			22	**22**
Sora			11	**11**
Virginia Rail			20	**20**
Subtotal			60	**60**
Total by Year	**35**	**79**	**212**	**326**

Table 6-2. Individuals of target species detected per point per survey 2003-2005

	Mean	Min	Max
By Year			
2003	0.75	0	3
2004	1.71	0	5
2005	2.18	0	12
Cumulative	1.55	0	12
By Site			
Alamosa NWR	1.23	0	6
Monte Vista NWR	0.97	0	4
Russell Lakes SWA	2.92	0	12
Blanca Wetlands WMA[1]	1.69	0	8

[1] Results for Blanca represent data collected only in 2005.

In addition to the primary target species, secondary species Northern Harrier and Wilson's Snipe were documented at every site. Opportunistic documentation of other wetland species included Black-crowned Night Heron, Blue-winged Teal, Marsh Wren, Red-winged Blackbird, Snowy Egret, and White-faced Ibis. More individuals were detected using call-playback methods than through passive observation, however, the latter did contribute additional individuals to the overall tally.

Discussion

Secretive marshbird species were present at all sites, and all target species were present in the SLV in each year of the study. Data collected during these pilot years suggests that abundance varies on a site-by-site basis in the SLV. Therefore, a greater number of survey locations is desirable for the purpose of determining which sites contain high-quality wetlands.

While it may appear at first review that the number of secretive marshbirds increased on survey sites from 2003-2005, data must be interpreted as pilot only. The increase in overall detections could be due to variation in survey conditions, improvement in equipment, or differences in observers year to year. However, this pilot study does establish that between up to three species in the target group can be expected in wetlands in the SLV, and several may be present and coexist at any given wetland location. Due to the cursory nature of this monitoring effort, exact acreage surveyed and surface acreage flooded was not recorded, nor were any habitat measurements taken. These data would be needed to elucidate habitat preferences among species.

The data collected on secretive marshbird use of SLV wetlands in the CWP indicate that monitoring these species may indeed be useful for assessing wetland quality, particularly for tall emergent marsh communities. Further, these data can contribute to the countrywide effort directed at monitoring secretive marshbird populations, thereby placing Colorado wetlands in a national context. Surveys require only one day of effort each for all travel, data collection, and data entry, and thus represent an efficient method for gathering data both on wetland health and bird populations. Use of this method in the SLV would particularly benefit from adding information regarding acreage, vegetation, and hydrologic parameters of searched areas. After two to three years of collecting habitat attribute in this fashion, relationships between site species use and site characteristics could be modeled, and subsequent surveys would require only bird monitoring. Secretive marshbird surveys represent an opportunity to gather much-needed data while further developing wetland assessment methodologies.

CHAPTER 7. MIGRATION MONITORING

Hydrology and ecosystem processes have been greatly altered in the South Platte River Basin of Colorado as a result of groundwater pumping, surface flow diversion, loss of flood events, and urban development (Strange *et al*. 1999). The lower South Platte River, located between the city of Greeley, Colorado and the Nebraska border, now 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). Further, water quality along this reach of the South Platte River is the most degraded in the basin, impacted by nitrates, salinity, and sedimentation (USGS 2004). Riparian vegetation structure and composition have been altered and 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).


EMILY STEEL

Long-billed dowitchers forage in a South Platte River wetland during migration.

CDOW, Ducks Unlimited and USFWS PFW have all identified the lower South Platte River as important wetland habitat for migrating waterbirds (CDOW 1989, Ducks Unlimited 2003, USFWS 2004). Nearly 100 CWP projects on this reach of the river have focused on providing food and cover for migrating waterbird species. The WMEP initiated intensive monitoring on sites in the South Platte River Wetlands Focus Area to estimate the level of use by waterbirds and provide local wetland managers with information regarding bird response to management regimes.

In the fall of 2003, we piloted survey methods for migrating waterbirds on CWP sites. Due to difficulty obtaining access and undisturbed counts during the hunting season, we subsequently implemented surveys in the spring migration periods of 2004 and 2005; these are the data summarized in this report.

Methods

Study Site Selection

We identified five major areas of high wetland density (complexes) along the lower South Platte River (west to east): Centennial, Golden Triangle, Brush Prairie Ponds, Tamarack, and Julesburg. One to four representative sites were surveyed within each complex each year, except Julesburg was omitted in 2005. One additional site was not located within any complex, but rather between Golden Triangle and Brush Prairie Ponds. Survey sites were located on public and private lands.

Field Protocols

Surveys were conducted March through May 2004 and 2005, during peak spring migration season. Surveys were conducted three days per week within each five-day work week. In 2004, we surveyed on three randomly selected days each work week; in 2005 we surveyed each Monday, Wednesday, and Friday. Site survey order was selected at random for the first site, which was then randomly assigned a survey period: morning (first light to 10 am), noon (10 am to 3 pm), or evening (3 pm to dark). All other sites within the same complex were then assigned to the same period to maximize data collection efficiency by minimizing travel time between sites. This effectively removed those sites from the random selection pool for that day, and the next site was chosen at random from the remaining subset of sites. Sites within that complex were included, and survey period was randomly assigned from the remaining two periods. In 2004 no noon counts were conducted, as pilot information from 2003 indicated that mid-day bird use of wetlands might differ from morning or evening. However, in 2005 noon surveys were required in order to ensure all sites were visited three times per week.

Field crews of one or two observer employed three survey methods: vantage counts, walk-around flush, and walk-through flush. The survey method(s) used depended on site access allowed and time available. Vantage counts were always employed, followed by either a walk-around or walk-through flush on most surveys. Preference was given to the walk-through flush, assumed to provide the most comprehensive count. Protocols for each of the survey methods are characterized as follows:

1. *Vantage count:* Monitor used spotting scope from remote vantage point to count birds; did not flush. Used on sites with no access/restrictions in bird disturbance. For vantage counts, the spotting scope was positioned such that as many birds as possible (preferably all) could be counted from the vantage point location. On occasion, it was necessary to position the scope in several places around the wetland to ensure counting of individuals on the far side of open water areas, or in areas with dense, tall stands of vegetation. Multiple vantage location selection was left to the discretion of the observer on the day of the survey.

   When two observers were present, one person acted as 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 counted. If there was a low number of birds present (50 or fewer) in the whole wetland, the panning method was still used, but tallying by species was done all at once rather than repeated pans for each species.

2. *Walk-around flush:* Following the vantage count, the monitor walked around the wetland flushing any birds, using binoculars or direct observation to identify and count flushed birds. Observers were instructed to minimize time elapsed between vantage counts and flush counts in order to minimize entrances and exits of birds from the site during the counts. Used at sites where flush counts were permitted, but where time or site conditions were prohibitive. Generally used when field crew consisted of only one observer or in areas where dense stands of vegetation made the wetland difficult to traverse efficiently or practically.

3. *Walk-through flush:* Following the vantage count, all field crew members walked through the wetland, flushing any birds and using binoculars or direct observation to identify and count flushed individuals. Used at all sites where flush counts were permitted and feasible. Walk-through counts 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.

All species of waterfowl, shorebirds, wading birds, and other wetland dependent species such as grebes and cormorants were identified and counted. Some species which are difficult to reliably identify were classed into groups. Greater and Lesser Scaup, Greater and Lesser Yellowlegs and the three small sandpipers in the genus *Calidris* (Least, Western, and Baird's) were lumped. Teal were classified to species when identification was positive, otherwise they were contained in the unknown teal group. Most often this occurred with female Cinnamon and Blue-winged Teal. All dowitchers were assumed to be Long-billed Dowitchers, based on known very low occurrence of Short-billed Dowitchers in eastern Colorado during spring migration (T. Leukering, pers. comm.). When conditions and time allowed, the sex of identified birds was recorded.

Whenever possible, all individuals of each species were identified and counted, to the best of the observers' abilities. This was considered possible on sites with 1-200 individuals of a given species, and up to 500 birds, as a general rule. When large numbers of a given species were present (>200 individuals), grouping birds to estimate the total number of individuals was allowed. This facilitated complete counts of the wetland prior to detection of the observer(s) by the birds, which often flush once a threat is perceived. If grouping methods were used, the monitor first counted out sample groups, to familiarize him/herself with small groups in order to accomplish an accurate estimation of the total number of birds of that species on the wetland, despite grouping. Increments of 10 per species were used for counting total populations numbering from 200-500 and increments of 25 were allowed for populations exceeding 500 individuals on the wetland. Pilot data obtained from the 2003 effort suggested that populations of over 500 individuals of a given species were rare for wetlands the size of CWP sites. Birds flying high over the site but clearly en route between two distant points were not counted.

In addition to bird counts, during each survey, the flooded proportion of each impoundment was visually estimated; 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.

Data Analysis

Wetland use during migration was estimated by calculating use-days for all waterbird species detected; count data for the three counts within each week were averaged and that number was multiplied by seven. Due to the wide variation in site use for monitored sites and the fact that sites were not randomly selected, we found that the most appropriate way to depict number of birds and species detected per site was through scatter plots rather than using statistical methods.

Results

Table 7-1 presents the number of counts per site on each wetland complex. The low number of surveys at some sites reflect short durations of available habitat as determined by flooding

Table 7-1. Number of spring migration counts by year, site, and period

Complex Site (N Units Surveyed)	2004 Morning	 Evening	 Total	2005 Morning	 Noon	 Evening	 Total	Cumulative Total
Centennial								
South Platte VII (2)				9	4	10	**23**	**23**
Golden Triangle								
Jackson SWA (6)	8	9	**17**	4	14	5	**23**	**40**
No Complex								
South Platte VIII (2)				3	9	6	**18**	**18**
Brush								
Elliott SWA (9)	22	36	**58**	2	4	5	**11**	**69**
South Platte I (8)	2	9	**11**					**11**
Tamarack								
Red Lion SWA (3)	22	19	**41**	6	11	10	**27**	**68**
South Platte VI (1)	13	16	**29**	5	13	9	**27**	**56**
Tamarack SWA	11	10	**21**					**21**
Julesburg								
South Platte III (1)	1	2	**3**					**3**
South Platte IV (1)	3	4	**7**					**7**
South Platte V (1)	2	3	**5**					**5**
South Platte IX (1)				4	11	6	**21**	**21**
Total	**84**	**108**	**192**	**33**	**66**	**51**	**150**	**342**

schedule. For instance, most sites in the Julesburg complex only received water for a short period in 2004, creating opportunity for the completion of only 3 weeks of surveys on those sites. Two newly completed conservation sites were added in spring 2005 to provide an opportunity to collect data on migration use of newly completed projects. In 2005, the Julesburg complex was not visited due to distance to the sites and logistical constraints.

The number of species and total birds observed weekly varied substantially among sites, and to a lesser degree, among monitored wetland units within sites. Of the 24 units surveyed in 2004, Red Lion SWA Unit 3 consistently represented the area with highest use; approximately 200 birds were counted during each survey. Of the 23 units searched in 2005, the privately-owned South Platte IX consistently hosted the highest mean number of birds per week, with several hundred birds (approximately 500) counted per survey. In contrast, several other units averaged fewer than 100 birds per week (Table 7-2). Numbers of birds peaked in week 13 (March 21-27) in 2004 and week 15 (April 10-16) in 2005.

We documented a total of 18 species of waterfowl, 16 species of shorebirds, and 13 species of other waterbirds using migration sites in 2004 and 2005. Differences in total number of birds observed per year were not significant ($F_{1,44}$=1.685, p=.2013). In 2004, the highest species richness occurred on the privately-owned South Platte VI, in week 18 (April 26-29). Twenty species were observed, including 11 species of waterfowl, seven species of shorebirds, and three species of waterbirds. The highest species richness in 2005 was observed at South Platte IX, where 25 species were observed in week 17 (April 19-23), comprised of 16 waterfowl species, seven species of shorebirds, and two species of waterbirds. Figure 7-1 depicts weekly species richness for two sites monitored for at least five of the same weeks in each year, as an example of fluctuations in species richness over the monitoring season. Species richness generally increases toward the end of the monitoring season as later-migrating waterbirds and shorebirds arrive.

Table 7-2. Use days by site and unit in 2004 and 2005

SiteName	Unit Name	Week[1] 9	10	11	12	13	14	15	16	17	18	19	Season Total
2004													
Elliott SWA/Hamlin	Bluewing								28	0			**28**
Elliott SWA/Hamlin	Cinnamon								42	0			**42**
Elliott SWA/Hamlin	Gadwall							7	119	56	7		**189**
Elliott SWA/Hamlin	Greenwing								0	0			**0**
Elliott SWA/Hamlin	Mallard				399	567		84	203	203	434	70	**1960**
Elliott SWA/Hamlin	Pintail							0	175	49	28		**252**
Elliott SWA/Hamlin	Shoveler							119	49	238	147	154	**707**
Elliott SWA/Hamlin	Wigeon							49	84	7	21	0	**161**
Elliott SWA/Hamlin	Wood Duck								91	630	700	259	**1680**
South Platte III					252	637	0						**889**
Jackson Lake SWA	A				28	14	35	35	42	28			**182**
South Platte IV					483	511	336	973					**2303**
Red Lion SWA	2				224	854	1050	728	322	511	1470	1134	**6293**
Red Lion SWA	3				532	1218	987	1379	1274	763	1533	1372	**9058**
South Platte VI	Pond				315	630	938	1239					**3122**
Tamarack SWA	1				14	0	7						**21**
Tamarack SWA	2				14	105	56						**175**
Tamarack SWA	3				91	7	91						**189**
South Platte VI	2				7	35	0						**42**
South Platte I	Pond 1				0	0	0						**0**
South Platte I	Pond 2				21	56	0						**77**
South Platte I	Pond 3				7	35	14						**56**
South Platte I	Ponds 1-4				35	77	28						**140**
2004 Subtotal by Site					2422	4746	3542	4613	2429	2485	4340	2989	**24577**
2005													
South Platte VII	Muskrat	294	74	86	128	287	551	462	348	271			**2501**
South Platte VII	OO7	497	1390	324	646	693	334	627	341	242			**5094**
Elliott SWA/Hamlin	Bluewing						0	0	0				**0**
Elliott SWA/Hamlin	Cinnamon						7	994	58	84			**1143**
Elliott SWA/Hamlin	Gadwall						30	462	49	259			**800**
Elliott SWA/Hamlin	Greenwing						0	0	0	0			**0**
Elliott SWA/Hamlin	Mallard						9	70	236	462			**777**
Elliott SWA/Hamlin	Pintail						9	23	25	39			**96**
Elliott SWA/Hamlin	Shoveler						35	133	91	133			**392**
Elliott SWA/Hamlin	Wigeon						364	26	128	378			**896**
Elliott SWA/Hamlin	Wood Duck						159	415	1594	938			**3106**
Jackson Lake SWA	A	35	21	63	420	46	488	273	345	112			**1803**
Jackson Lake SWA	B	16	0	33	14	28	432	210	119	137			**989**
Jackson Lake SWA	C	56	58	37	79	172	98						**500**
Jackson Lake SWA	E	0	0	5	7	0	0		7				**19**
Jackson Lake SWA	F	4	0	0	14	11	21		21	32			**103**
South Platte IX	Pond		5852	3253	5789	2735	4051	2991	4190	4247			**33108**
South Platte VIII	Cell 1			0	0	2345		14	0	42			**2401**
South Platte VIII	Cell 2	6223		0	0	1708	917	728	140	21			**9737**
Red Lion SWA	1	0	0		0	0	0	25	0	163			**188**
Red Lion SWA	2	919	75	91	189	355	250	576	765	1435			**4655**
Red Lion SWA	3	714	12	9	114	222	308	443	33	42			**1897**
South Platte VI	Pond	831	826	306	2088	180	455	658	614	616			**6574**
2005 Subtotal by Site		9589	8308	4207	9488	8782	8518	9130	9104	9653			**76779**
Weekly Totals Across All Sites		**9589**	**8308**	**4207**	**11910**	**13528**	**12060**	**13743**	**11533**	**12138**	**4340**	**2989**	**101356**

[1] Week number designates calendar week of the year. Week 9 began February 29 in 2004 and February 27 in 2005.

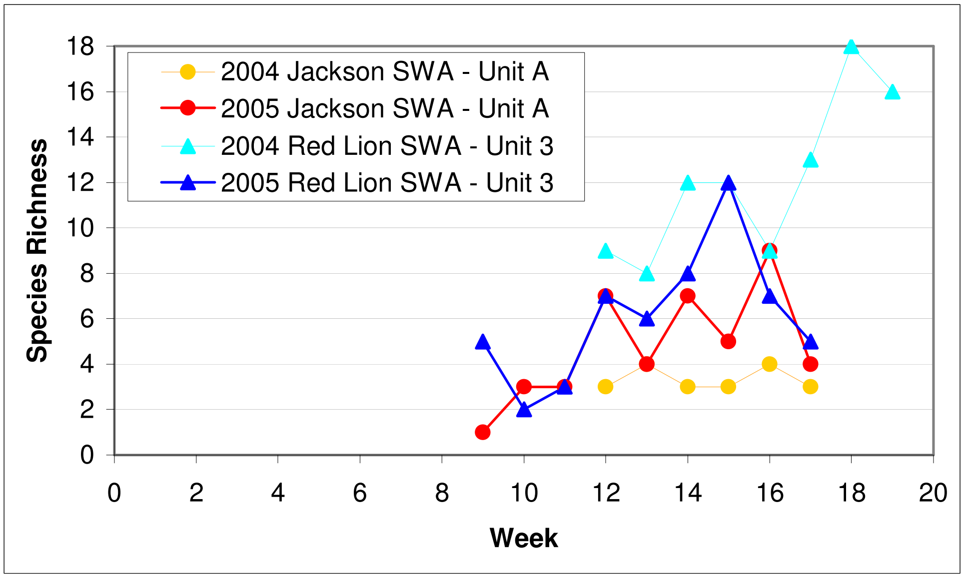


Figure 7-1. Species richness by week and by year at two CWP sites

The highest mean count per week for waterfowl species in 2004 were American Green-winged Teal and Gadwall, with peak counts in weeks 14 and 19, respectively. In 2005, Canada Goose was the highest in week 9. Wilson's Phalarope was the most abundant shorebird in both years, peaking in week 19 in 2004 and week 17 in 2005. The timing of bird migration, or chronology, is depicted for sample waterfowl and shorebird species in Figure 7-2. Full species lists for each season and project site are available upon request.

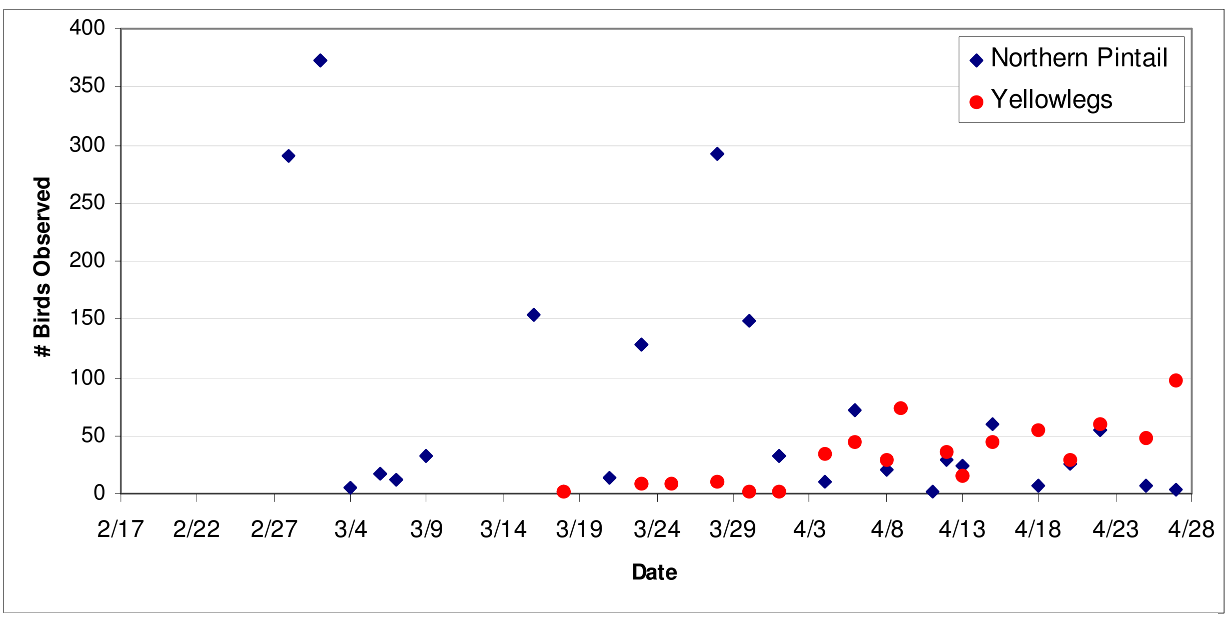


Figure 7-2. Migration chronology observed for a waterfowl species (Northern Pintail) and a shorebird species group (yellowlegs) in 2005

Discussion

Despite ecosystem alteration and degradation, the lower South Platte River continues to provide important ecological services. Wetlands along this reach provide opportunities for groundwater recharge, sediment retention, water quality improvement, and support migratory waterfowl and shorebird populations in both spring and fall. Skagen and Knopf (1993) suggest that in the plains, migrating shorebirds disperse and use wetlands opportunistically in response to highly variable wetland conditions, rather than returning to the same sites each year. This is also likely true for waterfowl, and thus highlights the importance of providing sufficient habitat at the regional scale to meet staging requirements of intermediate- and long-distance migrants.

Data collected through the WMEP's 2004 and 2005 spring migration effort have provided information on species using the lower South Platte River, species richness, migration chronology, and waterbird use-days for CWP sites. We found peak numbers of birds during the month of April, while peak species richness occurred in late April, primarily driven by greater abundance of shorebirds later in the monitoring period. We estimated waterbird use-days for each weekly survey period, by species, which are particularly important inputs for conservation planning efforts. The Playa Lakes Joint Venture (PLJV) has set habitat conservation goals for species in this region based on projected use-day information for various habitats (Sullivan 2005), and the WMEP data represents the first concrete data set that can be applied to refining the PLJV's target numbers.


TONY LEUKERING
Marbled godwits and other shorebirds

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 varied considerably among wetland units surveyed, with season totals of zero birds to over 33,000. Bird use data varied even when units were located adjacent to one another, suggesting that habitat conditions vary among sites. Combining bird use data with flooding regimes and vegetation information should assist managers in determining factors important for providing high quality spring migration habitat. Because basic information on wetland acreages, habitat types, and water depths throughout the spring migration period were lacking, we were unable to explore those relationships here. However, in 2006, in combination with bird surveys, we collected data regarding habitat extent, wetland acres, and weekly water depths across sites. We also continued surveys through the month of May to ensure that we captured the peak of shorebird migration.

The ecological importance, widely-acknowledged impacts, and potential future water insecurity in the lower South Platte River watershed have made it a high priority for conservation. This project leads to a better understanding of wetland condition in this highly manipulated and biologically important system. The WMEP's migration monitoring effort has yielded much-needed information for CWP projects along the lower South Platte River, and our data are available to those planning large-scale conservation efforts in this region. Additional years of data collection will be required to determine the robustness of the patterns we observed and to learn more about potential causal factors.

CHAPTER 8. 5-YEAR MONITORING OVERVIEW

The WMEP has successfully initiated a long-term monitoring program for wetland conservation projects in the CWP, informing the adaptive management process and enabling data-based program assessment by administrators, funders, and resource professionals. This exemplary project fulfills information needs often articulated by conservation partners but rarely implemented. Activities completed in 2004 and 2005 enable a comprehensive, evaluative review of WMEP monitoring protocols and CWP projects. A brief synopsis of major findings to date is presented below.

Project Tracking

At the inception of the WMEP, no centralized data repository existed for projects funded in whole or in part by the CWP. Gathering and standardizing this basic project information was an unexpected challenge. Entities participating in the CWP collect varied site information at differing levels of complexity and completeness, and often these data reside on paper in offices scattered throughout the state.

Creating and populating a database has required a significant investment of effort and time on the part of the WMEP. However, the Project Tracking database was absolutely necessary in its own right as a clearinghouse for CWP information, and has resulted in data which provides context for both ecological and programmatic characterizations of the CWP.

Any monitoring effort attempting to summarize and track information for a regional or statewide program with several hundred projects should spend its first year developing a database, determining data of interest to stakeholders, gathering the data, populating the database, and summarizing the program.

Site Assessments

One of the most valuable outcomes of the WMEP has been the development and field testing of site assessment protocols. The WMEP has visited sufficient numbers of sites to incorporate Colorado's wetland variability in our assessment methodologies, an undertaking which required two field seasons.

We have completed a total of 165 assessments, representing nearly 20% of all known projects. Thirty-three of these have been baseline assessments (data collected prior to or closely following project completion), creating the opportunity to revisit these sites in 5 or 10 years to document changes due to project activities. This component of the WMEP distinguishes this large-scale monitoring project from many others which are lacking baseline data.

We have found a variety of wetland vegetation associations to be present on CWP sites, and also that many sites are becoming impacted by noxious weeds, invasive species, and monotypic stand-forming species. We have also found that riparian areas assessed contain both important habitat features and evidence of degradation. This information can be related back to managers, facilitating adaptive management of these and future projects.

Our ability to evaluate wetland functions for this many projects has been limited by the lack of readily available data from external sources. While we have tracked project locations in this effort, spatially georeferenced site maps are not available for many sites, and creating site maps for all projects assessed was beyond the current project scope or funding levels. However, we believe the project would be greatly enhanced by the availability of better spatial data for projects. We have identified the lack of a GIS for the CWP as a significant deficit to estimating wetland attributes, and recommend creation of a GIS along with future monitoring efforts.

At this point, we have collected sufficient data to provide CWP partners and Wetlands Focus Areas with reports tailored to their projects, which we plan to compile and distribute by December 2006. Additionally, as the WMEP was designed to collect detailed information at the site level, we plan to develop project portfolios to provide specific feedback to managers and landowners. Creation and dissemination of these documents will provide the final link in the CWP framework needed to complete the adaptive management cycle. By enabling informed management based on monitoring data, the CWP will be one of only a few programs of its scope implementing this approach.

Riparian Breeding

Monitoring of riparian birds on restoration projects has yielded a number of findings. Riparian areas in Colorado are very diverse; we documented over 162 species, but only 73 within any one site. This means that for projects to serve as replicates, they will need to take place within similar elevational zones and coercions within the state.

Multiple visits per season and longer point-count survey periods (10 minute) have generated better sample sizes than the more common single 5-minute survey protocol. Two to three visits per season, depending on the size of the site, is sufficient to generate density estimates for some of the more common species. Density estimates enable tracking of trends in bird densities over time, despite changes in vegetation structure.

We found large variation in the numbers of individuals and species among sites, with highly degraded sites showing lower bird use. We found that classifying the dependence of various bird species on riparian and wetland habitats and reporting the use by these species refines our ability to describe habitat values of project areas. Some sites already show great value as avian habitat, hosting threatened and at-risk species.

The most important contributions of this effort have yet to be reaped, in the comparison of project areas with different habitat treatments and in the trends of species composition and bird numbers through time. With sustained funding at sufficient levels, we will be able to determine avian responses to restoration practices, which will be a significant contribution to project managers as well as the scientific community.

Waterfowl Nesting

Publicly-owned wetland complexes supported the majority of waterfowl, shorebird, and waterbird nests. The habitat quality at these sites may be attributed in part to the active management they receive, an effort also funded by the CWP. In 2003, searching of 11 private sites yielded the discovery of only 10 nests. Nest searching techniques and habitat characterization worked very well on wetlands surveyed, however low overall sample sizes limited our ability to estimate nest survival rates and demonstrated that many more wetlands should be monitored annually to elucidate trends related to wetland size, habitat condition, or ownership. In the future, continued waterbird nesting monitoring should involve a greater number of searchers surveying many more sites.

The waterfowl nesting intensive monitoring effort has demonstrated lower densities of nesting waterfowl on project sites than was historically documented in Colorado's San Luis Valley. Anecdotal evidence from other, concurrent monitoring efforts on National Wildlife Refuges in the SLV from 2003-2005 indicates that this trend may be due to external, rather than proximate factors. The WMEP has been able to works closely with biologists at the CDOW, NWRs, and Ducks Unlimited (nest site wetland managers) to share data from monitoring efforts. A comparison of WMEP data with data from NWRs is warranted, as well as examination of nesting trends elsewhere in the flyway, if those data are available.

Migration Monitoring

Bird monitoring along the lower South Platte River has demonstrated that waterfowl, shorebirds, wading birds, and other wetland-dependent species use CWP projects heavily during spring migration. Birds are able to locate newly-completed projects, as evidenced by direct observations of several hundred individuals of a variety of species using wetlands which have just received water for the first time. Additionally, birds have been documented using the same sites in more than one year, demonstrating that the presence of the wetlands is valuable over the longer term.

Migration monitoring protocols have proved to provide a thorough account of the total number of birds using a site, as well as detect secretive species. This monitoring effort would also benefit from an increased number of surveyors and monitoring sites, to better examine trends in use across the entire lower South Platte Region.

WMEP Overview

Wetland conservation monitoring programs have historically reported acreage conserved, usually tallying efforts by land cover or wetland type. This approach has left administrators and other conservation partners wondering how to relate acres to ecological benefits. Through well-developed partnerships, Colorado has successfully implemented an innovative venture to monitor the biological effects of its statewide wetlands program. Attention has been brought to the WMEP, among other similar programs, in a recent nationwide interest in effectiveness monitoring.

The WMEP explores how suites of projects function relative to stated biological objectives. The empirical data also can be used to depict the concrete contributions conservation projects provide biological communities. This information allows conservation planners to understand how various types of habitat projects impact long-term wetland conservation goals and provides program administrators data to substantiate the contributions of their programs.

Over the course of the WMEP's development, we have discovered components vital to a successful large-scale monitoring program. These practical "lessons learned" should apply to others establishing monitoring programs of similar scope:

1. *Monitoring should begin at the outset of the program*. In the case of the CWP, wetland conservation activities began five years before the WMEP started. Opportunities were lost to document baseline conditions on several hundred projects completed during that timeframe.

2. *Data management must be a top priority*. Creating a central database is key to coordinating information for large-scale initiatives. Sufficient resources should be allocated for data management, and database development should precede or coincide with the establishment of the monitoring effort.

   When the WMEP started, no centralized records were available for the breadth of CWP projects implemented by various partners, hampering the ability of WMEP staff to summarize the program as a whole or track the progress or outcomes of projects post-funding. Acquiring information from partners and retroactively populating a massive project tracking database has required substantial effort. This task is complicated by the fact that CWP partners and committees in wetland focus areas have varied information needs. We have learned that a database for this type of large-scale project must be able to provide meaningful and accurate project data to diverse individual partners. It should be both a repository for biological data gathered on project sites and a tool that can generate information useful to both managers at the project level and administrators at the program level.

3. *Standard definitions should be adopted for the terms restoration, enhancement, creation, and protection*. Each partner or agency involved in the CWP has its own internal description of these activities, and these often quite different definitions made summarizing program-wide efforts difficult. We found it necessary to define these terms for the WMEP based on the peer-reviewed and gray literature. The standard definitions we now use allow the WMEP data to be relevant to other wetland professionals and resource managers in state, regional, or federal programs, as the WMEP definitions align with those commonly used in the profession.

4. *Partners should be trained in the articulation of project objectives*. Clear and specific project objectives are necessary for characterizing the success of projects and providing feedback for adaptive management. The WMEP needs to understand the objectives of the projects it examines if it is to perform any kind of evaluation procedure. However, when we attempted to track project objectives through project proposals and interviews, we found that many proponents had a difficult time articulating specific and measurable objectives for their projects. Clear articulation of specific conservation objectives will improve project quality and understanding of project performance and strengthen the entire program.

5. *At the beginning of the study, monitoring programs should identify the range of wetland types and conditions to be assessed; this identification should guide the development of protocols and selection of study resources*. We found that many of the wetlands in the CWP are heavily managed and exhibit plant communities characteristic of heavily disturbed areas. We therefore had to modify substantially the vegetation classification tools and wetland functional descriptors previously developed by conservation partners for more pristine wetlands. In addition, the size and type of the wetlands a monitoring program intends to study will inform the selection of approaches for describing site conditions. For instance, we developed different metrics and field forms for riparian and depressional wetlands.

6. *Monitoring funding remains limited and broad partnerships are vital to programmatic success*. Monitoring wetland conservation projects requires long timeframes. Ecological responses often occur slowly, and external factors such as climate (i.e., hydrology) affect project conditions differently from year to year. In contrast, most funding is provided in

annual increments, challenging efforts to establish long-term monitoring programs. In addition, the costs of large-scale programmatic monitoring efforts are substantial.

RMBO and the WMEP have succeeded only with the generous support of multiple funding partners: US EPA, CDOW, the Colorado Governor's Office of Energy and Conservation, USFWS, the Playa Lakes Joint Venture, and the Intermountain West Joint Venture. Maintaining a broad, diverse pool of financial support can help ensure funding continuity over the long term. Also, monitoring efforts should be flexible enough to reduce or expand their scope of work in response to available funds.

In conclusion, RMBO and CWP partners have developed an extremely effective monitoring and evaluation program for wetlands conservation projects in Colorado. The data we have collected through the WMEP are of value to the broad constituents of the CWP, and we hope that through continued funding support, the WMEP can maintain its activities throughout the life of the CWP.

LITERATURE CITED

Adamus, P., L. Stockwell, E. Clairain, Jr., M.E. Morrow, L.P. Rozas, and R.D. Smith. 1991. Wetland Evaluation Technique (WET), Volume I: Literature Review and Evaluation Rationale. Wetlands Research Program Technical Report WRP-DE-2, Waterways Experiment Station, NTIS, Springfield, VA.

Anderson, B.W. and R.D. Ohmart. 1977. Vegetation structure and bird use in the lower Colorado River valley. Pp 23-34 in R.R. Johnson and D.A. Jones: Importance, preservation, and management of riparian habitat: a symposium. USFS General Technical Report, RM-GTR-43.

Andrews, R. and R. Righter. 1992. Colorado Birds: a reference to their distribution and habitat. Denver Museum of Natural History, Denver, Colorado.

Aronson, J.C., R.V. O'Neill, and R.W. Hoekstra. 1984. Interlevel relations in ecological research and management: Some working principles from hierarchy theory. USDA Forest Service General Tech Report RM-110. Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO.

Bartoldus, C.C., E.W. Garbisch, and M.L. Kraus. 1994. Evaluation for Planned Wetlands. Environmental Concern, Inc., St. Michaels, MD.

Bellrose, F.C. 1980. Ducks, Geese, and Swans of North America. Stackpole Books, Harrisburg, PA.

Bottoroff, R.N., N. Hurley, F. Justice, J. Justice, R. Kelley, H.E. Kingery, U. Kingery, D. Stotz, and J. Trainor. 1971-1984. *In* Van Velzen W.T. Breeding bird censuses. American Birds 25:966, 26:980, 27:996, 28:1036, 29:1125, 31:71, 32:83, 33:81, 34:73, 35:87, 37:84, 38:98.

Brooks, R.P. 1997. Improving habitat suitability index models. Wildlife Society Bulletin 25:163-167.

Buckland, S.T., D.R. Anderson, K.P. Burnham, J.L. Laake, D.L. Borchers, and L. Thomas. 2001. Introduction to Distance Sampling. Oxford University Press, New York.

Cairns, J. Jr. 1990. The prediction, validation, monitoring and mitigation of anthropogenic effects on natural systems. Environmental Auditor 2:19-25.

Cairns, J. Jr. 1991. The status of the theoretical and applied science of restoration ecology. The Environmental Professional 13:186-194.

Carsey, K., G. Kittel, K. Decker, D.J. Cooper, and D. Culver. 2003. Field Guide to the Wetland and Riparian Plant Associations of Colorado. Colorado Natural Heritage Program, Fort Collins, CO.

Cochran, W.G. 1977. Sampling Techniques. 3rd ed. John Wiley, New York.

Colorado Division of Wildlife. 1989. Statewide Waterfowl Conservation Plan. Colorado Division of Wildlife, Denver, CO.

Colorado Partners in Flight. 2000. Partners in Flight Land Bird Conservation Plan Version 1.0. Colorado Partners in Flight, Estes Park, CO.

Conway, C.J. 2003. Standardized North American marshbird monitoring protocols. Arizona Cooperative Fish and Wildlife Research Unit, Geological Survey, U.S. Department of the Interior, Tuscon, AZ.

Conway, C.J. and S.T.A. Timmermans. 2005. Progress Toward Developing Field Protocols for a North American Marshbird Monitoring Program. USDA Forest Service General Technical Report #PSW-GTR-191.

Cooper, D.J. 1998. "Classification of Colorado's Wetlands for Use in HGM Functional Assessment: A First Approximation." In Characterization and Functional Assessment of Reference Wetlands in Colorado. Report submitted to Colorado Department of Natural Resources, EPA Region 8, Colorado Geologic Survey, Colorado School of Mines, and Colorado State University.

Ducks Unlimited. 2003. Colorado Conservation Plan: A strategy for protecting Colorado's Critical Wetland Corridors, 2003-2012 Plan Summary. Ducks Unlimited, Inc., Great Plains Region, Bismarck, ND.

Gibbs, J.P., S. Melvin, and F.A. Reid. 1992. American Bittern. In: A. Poole, P. Stettenheim, and F. Gill, editors. The Birds of North America, No. 18, The Academy of Natural Sciences, Philadelphia, PA.

Gilbert, D.W., D.R. Anderson, J.K. Ringelman, and M.R. Szymczak. 1996. Response of nesting ducks to habitat and management on the Monte Vista National Wildlife Refuge, Colorado. Wildlife Monographs. No. 131. The Wildlife Society.

Green, R.H.1979. Sampling Design and Statistical Methods for Environmental Biologists. Wiley, Chichester.

Hammer, D.A. 1997. Creating Freshwater Wetlands, 2nd ed. Lewis Publishers, Inc., Boca Raton, FL.

Hruby, T. 1999. Assessments of Wetland Functions: What They Are and What They Are Not. Environmental Management 23:75-85.

Hutto, R.L. 1998. Using landbirds as an indicator species group. Pp 75-91 in J.M. Marzluff and R. Sallabanks: Avian Conservation: research and management. Island Press, Covelo, CA.

Ivey, G.L., and C.P. Herziger. 2005. Intermountain West Waterbird Conservation Plan—A plan associated with the Waterbird Conservation for the Americas initiative. Version 1.0. Published by U.S. Fish and Wildlife Service Pacific Region, Portland, Oregon.

Kentula, M.E., R.P. Brooks, S.E. Gwin, C.C. Holland, A.D. Sherman, and J.C. Sifneos. 1993. An Approach to Improving Decision Making in Wetland Restoration and Creation. C.K. Smoley, Boca Raton, FL.

Johnson, R.R. and L.T. Haight. 1985. Avian use of exroriparian ecosystems in the North American warm deserts. Pp 156-160 in R.R. Johnson, C.D. Ziebell, D.R. Patton, P.F. Follitott, and R.H. Hamre: Riparian ecosystems and their management: reconciling conflicting uses. USDA, USFS, General Technical Report RM-GTR-120.

Johnson, R.R., L.T. Haight, and J.M. Simpson. 1977. Endangered species vs. endangered habitats: a concept. Pp 68-74 in R.R. Johnson and D.A. Jones: Importance, preservation, and management of riparian habitat: a symposium. U.S.F.S. General Technical Report, RM-GTR-43.

Jordan, W.R. III, R.L. Peters III, and E.B. Allen. 1988. Ecological restoration as a strategy for conserving biological diversity. Environmental Management 12:55-72.

Kauffman, J.B., R.L. Bescheta, N. Otting, and D. Lytjen. 1997. An ecological perspective of riparian and stream restoration in the Western United States. Fisheries 22:12-24.

Kingery, H. (ed). 1998. Colorado Breeding Bird Atlas. Colorado Breeding Bird Atlas Partnership, Denver, CO.

Klett, A.T., H.F. Duebbert, C.A. Faanes, and K.F. Higgins. 1986. Techniques for studying nest success of ducks in upland habitats in the Prairie Pothole Region. U.S. Fish and Wildlife Service, Resource Publication 158. Jamestown, ND: Northern Prairie Wildlife Research Center Online. http://www.npwrc.usgs.gov/resource/tools/nest/nest.htm, (Version 16JUL97).

Knopf, F.L. 1985. Significance of riparian vegetation to breeding birds across an altitudinal cline. Pp 105-111 in R.R. Johnson, C.D. Ziebell, D.R. Patton, P.F. Follitott, and R.H. Hamre: Riparian ecosystems and their management: reconciling conflicting uses. USDA, USFS, General Technical Report RM-GTR-120.

Knopf, F.L. 1986. Changing landscapes and the cosmopolitanism of the eastern Colorado avifauna. Wildlife Society Bulletin 14:132-142.

Knopf, F.L., R.R. Johnson, T. Rich, F.B. Samson, and R.C. Szaro. 1988a. Conservation of riparian ecosystems in the United States. Wilson Bulletin 100: 272-284.

Knopf, F.L., J.A. Sedgewick, and R.W. Cannon. 1988b. Guild structure of a riparian avifauna relative to seasonal cattle grazing. Journal of Wildlife Management 52: 280-289.

Krueper, D., J. Bart, and T.D. Rich. 2003. Response of vegetation and breeding birds to the removal of cattle on the San Pedro River, Arizona. Conservation Biology 17:607-615.

Laubhan, M.K. and J.H. Gammonley. 2000. Density and foraging habitat selection of waterbirds breeding in the San Luis Valley of Colorado. Journal of Wildlife Management 64: 808-819.

Leukering, T, and R Levad. 2000. Monitoring Colorado's Birds: Protocols. Rocky Mountain Bird Observatory, Brighton, Colorado.

Lewis, R.R. III. 1990. Wetlands restoration/creation/enhancement terminology: Suggestions for standardization. Pages 417-422 in J.A. Kusler and M.E. Kentula (eds.), Wetland Creation and Restoration: The Status of the Science. Island Press, Washington, DC.

Lucero, J. and A.B. Cariveau. 2004. Yellow-billed Cuckoos in Southern Colorado. Colorado Birds 38: 67-68.

Mayfield, H.F. 1975. Suggestions for calculating nest success. Wilson Bulletin 87:456-466.

Middleton, B. 1999. Wetland Restoration, Flood Pulsing, and Disturbance Dynamics. John Wiley & Sons, Inc., New York, NY.

Mitsch, W.J. and J.G. Gosselink. 2000. Wetlands, 3rd edition. John Wiley & Sons, Inc., New York, NY.

Natural Resources Conservation Service. 2005. United States Department of Agriculture, NRCS Conservation Practice Standard, Wetland Restoration, Code 657. http://www.nrcs.usda.gov/technical/Standards/nhcp.html

National Research Council. 1992. Restoration of Aquatic Ecosystems: Science, Technology, and Public Policy. National Academy Press, Washington DC.

National Oceanic and Atmospheric Administration. 2004. Coastal Ecosystem Restoration: Adaptive Management. NOAA Coastal Service Center. www.csc.noaa.gov/coastal/management/management.htm.

North American Waterfowl Management Plan, Plan Committee. 2004. North American Waterfowl Management Plan 2004. Implementation Framework: Strengthening the Biological Foundation. Canadian Wildlife Service, U.S. Fish and Wildlife Service, Secretaria de Medio Ambiente y Recursos Naturales, 106 pp.

O'Connell, T.J., L.E. Jackson, and R.P. Brooks. 2000. Bird guilds as indicators of ecological condition in the central Appalachians. Ecological Applications 10:1706-1721.

Ohmart, R.D. 1994. The effects of human-induced changes on the avifauna of western riparian habitats. Studies in Avian Biology 15:273-285.

Reddy, M.A. 2003. Developing Statewide Monitoring and Assessment Tools & Strategies: Evaluation of Wetland Conservation Sites in Colorado, Quality Assurance Project Plan. Rocky Mountain Bird Observatory, Brighton, CO.

Reddy, M., A. B. Cariveau, J. Gammonley, A. Chappell, and D. Culver. 2003. "The Colorado Wetlands Program Monitoring and Evaluation Project Final Report." Rocky Mountain Bird Observatory, Brighton, CO.

Reddy, M.A. and A.B. Cariveau. 2004. The Colorado Wetlands Program Monitoring and Evaluation 2002-2003 Report. Rocky Mountain Bird Observatory, Brighton, Colorado.

Reynolds, R.T., J.M. Scott, and R.A. Nussbaum. 1980. A variable circular-plot method for estimating bird numbers. Condor 82:309-313.

Rheinhardt, R.D., M.M. Brinson, and P.M. Farley. 1997. Applying Wetland Reference Data to Functional Assessment, Mitigation, and Restoration. Wetlands 17:195-215.

Rich, T. 2002. Using breeding land birds in the assessment of western riparian systems. Wildlife Society Bulletin 30:1128-1139.

Robel, R.J., J.N. Briggs, A.D. Dayton, and L.C. Hulbert. 1970. Relationships between visual obstruction measurements and weight of grassland vegetation. Journal of Range Management 23:295-297.

Rosenstock, S.S., D.R. Anderson, K.M. Geisen, T. Leukering, and M.F. Carter. 2002. Landbird counting techniques: current practices and an alternative. Auk 199:46-53.

Saab, V.A., C.E. Bock, T.D. Rich, and D.S. Dobkin. 1995. Livestock grazing effects in western North America. Pp 311-353 in T.E. Martin and D.M. Finch: Ecology and management of Neotropical migratory birds. Oxford University Press, New York.

Sangres.com. 2005. The San Luis Valley of Southern Colorado. http://Sangres.com/places.slv, September 12, 2005.

Scott, M.L., S.K. Skagen, and M. F. Merigliano. 2003. Relating Geomorphic Change and Grazing to Avian Communities in Riparian Forests. Conservation Biology 17:284-296.

Skagen, S. and F. Knopf. 1993. Toward Conservation of Midcontinental Shorebird Migrations. Conservation Biology 7:533-541.

Steel, E. and A.B. Cariveau. 2005. Colorado Wetlands Program 2004 Monitoring and Evaluation Report. Rocky Mountain Bird Observatory, Brighton, Colorado.

Strange, E.L., K.D. Fausch, and A.P. Covich. 1999. Sustaining Ecosystem Services in Human-Dominated Watersheds: Biohydrology and Ecosystem Processes in the South Platte River Basin. Environmental Management 24:39-54.

Streever, W. (ed.). 1999. An International Perspective on Wetland Rehabilitation. Kluwer Academic Publishers, Dordrecht, Netherlands.

Sullivan, B. 2005. Waterfowl Conservation Strategy for the Playa Lakes Joint Venture. PLJV Waterfowl Team, Denver, CO.

Tewksbury, J.J., A.E. Black, N. Nur, V.A. Saab, D.B. Logan, and D.S. Dobkin. 2002. Effects of anthropogenic fragmentation and livestock grazing on western riparian bird communities. Studies in Avian Biology 25: 158-202.

Thomas, L., J.L. Laake, S. Strindberg, F.F.C. Marques, S.T. Buckland, D.L. Borchers, D.R. Anderson, K.P. Burnham, S.L. Hedley, J.H. Pollard, and J.R.B. Bishop. 2004. Distance 4.1. Release 2. Research Unit for Wildlife Population Assessment, University of St. Andrews, UK. http://www.ruwpa.st-and.ac.uk/distance/

Thompson, W.L., G.C. White, and C. Gowan. 1998. Monitoring Vertebrate Populations. Academic Press, Inc., San Diego, CA.

U.S. Department of Agriculture. 2002. The PLANTS Database, Version 3.5. http://plants.usda.gov. National Plant Data Center, Baton Rouge, LA 70874-4490 USA.

U. S. Environmental Protection Agency. 1990. "Wetlands: Meeting the President's Challenge." Washington, DC.

U.S. Environmental Protection Agency. 2001. EPA Requirements for Quality Assurance Project Plans. Office of Environmental Information. Washington, D.C., EPA/240/B-01/003.

U.S. Environmental Protection Agency. 2002a. Methods for Evaluating Wetland Condition: Introduction to Wetland Biological Assessment. Office of Water, United States Environmental Protection Agency, Washington, D.C. EPA-822-R-02-014.

U.S. Environmental Protection Agency. 2002b. Methods for Evaluating Wetland Condition: Biological Assessment Methods for Birds. Office of Water, United States Environmental Protection Agency, Washington, D.C. EPA-822-R-02-023.

U.S. Environmental Protection Agency. 2004. Review of Rapid Assessment Methods for Assessing Wetland Condition. Environmental Monitoring and Assessment Program. National Health and Environmental Effects Laboratory. Office of Research and Development. U.S. EPA. Research Triangle Park, NC.
.
U.S. Fish and Wildlife Service. 1990. Recovery plan for the interior population of the least tern (*Sterna antillarum*). USFWS: Twin Cities, MN.

U.S. Fish and Wildlife Service. 2004. Colorado Partners for Fish and Wildlife Program home page, http://coloradopartners.fws.gov, accessed May 2004.

U. S. Geological Survey. 2004. Colorado Water Resources, South Platte River Basin National Water-Quality Assessment Program. http://co.water.usgs.gov/nawqa/splt/index.html, accessed November 22, 2005.

U.S. Geological Survey. 2005. National Water Summary on Wetland Resources, United States Geological Survey Water Supply Paper 2425. http://water.usgs.gov/nwsum/WSP2425/state_highlights_summary.html

APPENDIX A

PROJECT TRACKING DATABASE USER MANUAL

Colorado Wetland Partnership Wetlands Monitoring and Evaluation Project Project Tracking Database Documentation

November 14, 2005

Michele Shimomura
Information Manager
970.482.1707
michele.shimomura@rmbo.org

Emily Steel
WMEP Leader
970.482.1707
emily.steel@rmbo.org

Rocky Mountain Bird Observatory
14500 Lark Bunting Lane
Brighton, CO 80603
303.659.4348
www.rmbo.org

Table of Contents

I. Database Information

The Colorado Wetland Partnership (CWP) Wetlands Monitoring and Evaluation Project (WMEP) Project Tracking Database is a 2003 Microsoft Access database. This report documents the data as it is in the Access database.

The master database is stored and updated by the Rocky Mountain Bird Observatory (RMBO).

II. Database Structure

The database is relational in structure with 22 tables:

1. Sites
2. Junction_SiteContact
3. Contacts
4. ContactAddress
5. ContactPhone
6. Units
7. LandTypes
8. WetlandProtocols
9. Junction_ProjectsUnits
10. Projects
11. Project Type
12. Type
13. Project Status Date
14. Status
15. Objectives
16. Objective Attribute
17. Attribute
18. Objective Date
19. Objective Status
20. Contract
21. Project Partners
22. ProjectApplicationFences

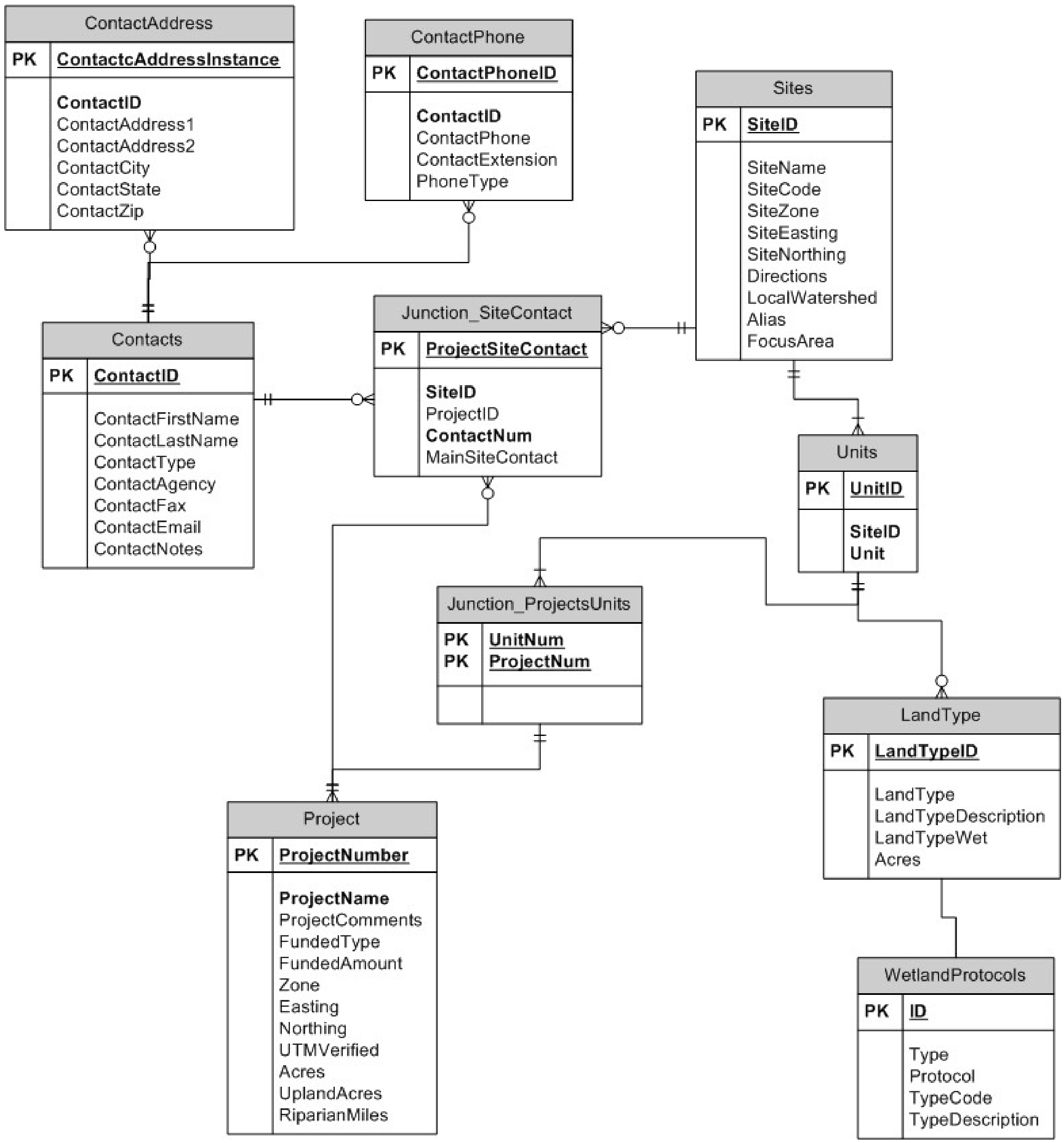
III. Definitions

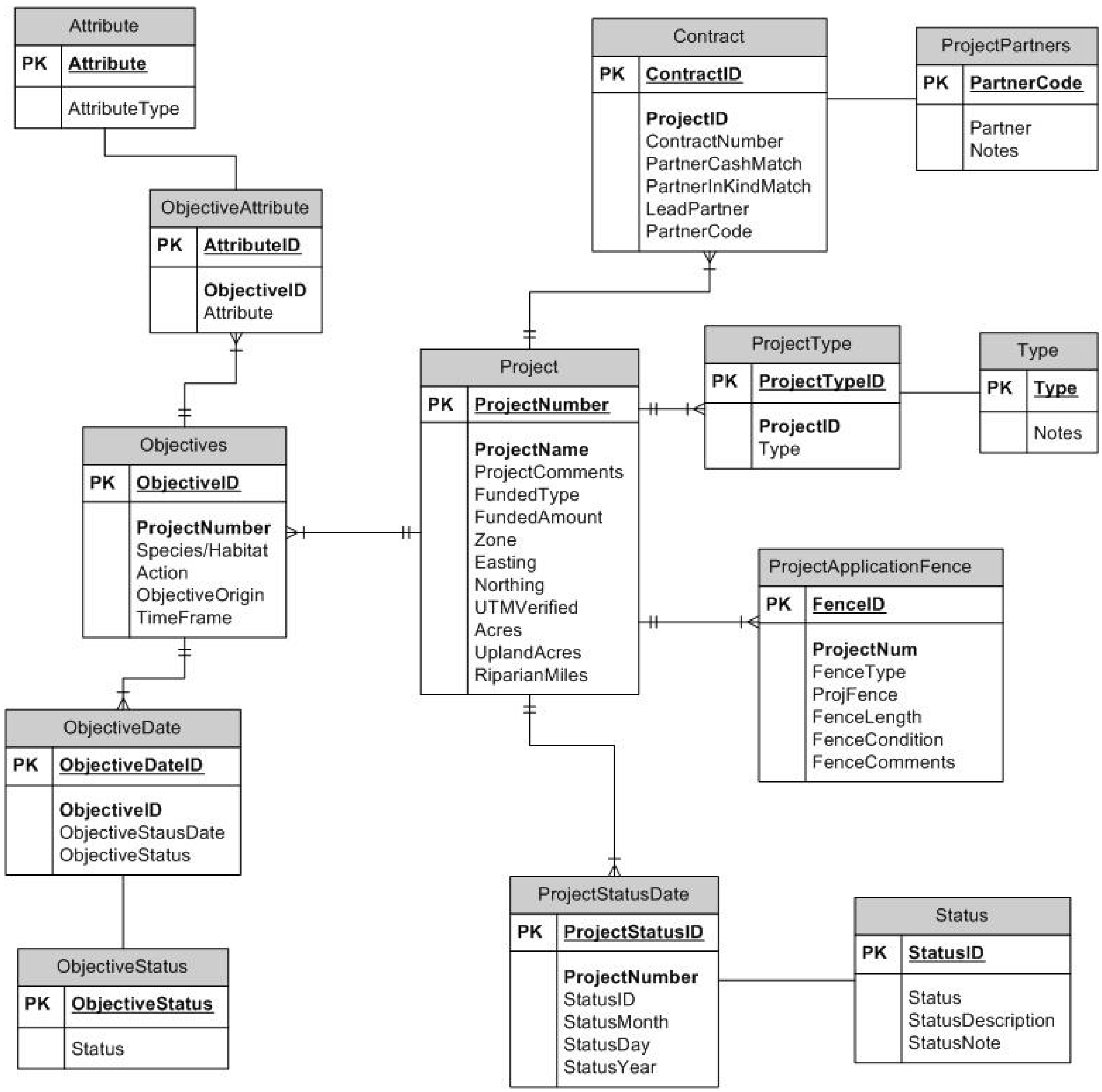
Definitions of certain terms are important for the user to understand when navigating the database.

Projects, Sites, Units
The WMEP distinguishes among three strata when categorizing a project: site, unit, and project. A site is greater than or equal to a unit in terms of area. A site may contain one or more units, and one or more projects. A unit may be a sub-area of a site (such as basin X1 on the WMEP National Wildlife Refuge), or can occupy an entire site, such as a 3-acre basin on a privately owned site. Projects occur within units on sites. A project may span more than one unit within a site, or even more than one site. Conversely, multiple projects may occur within any given site or unit.

The project is the fundamental level at which an action is taken under the CWP, and therefore all tracking information is tied to this stratum.

IV. Entity Relationship Diagram




Attribute
PK Attribute
AttributeType
ObjectiveAttribute
PK AttributeID
ObjectiveID
Attribute
Objectives
PK ObjectiveID
ProjectNumber
Species/Habitat
Action
ObjectiveOrigin
TimeFrame
ObjectiveDate
PK ObjectiveDateID
ObjectiveID
ObjectiveStausDate
ObjectiveStatus
ObjectiveStatus
PK ObjectiveStatus
Status
Contract
PK ContractID
ProjectID
ContractNumber
PartnerCashMatch
PartnerInKindMatch
LeadPartner
PartnerCode
ProjectPartners
PK PartnerCode
Partner
Notes
Project
PK ProjectNumber
ProjectName
ProjectComments
FundedType
FundedAmount
Zone
Easting
Northing
UTMVerified
Acres
UplandAcres
RiparianMiles
ProjectType
PK ProjectTypeID
ProjectID
Type
Type
PK Type
Notes
ProjectApplicationFence
PK FenceID
ProjectNum
FenceType
ProjFence
FenceLength
FenceCondition
FenceComments
ProjectStatusDate
PK ProjectStatusID
ProjectNumber
StatusID
StatusMonth
StatusDay
StatusYear
Status
PK StatusID
Status
StatusDescription
StatusNote

V. Data Dictionary

Each attribute for each table is described below. Attribute name, a qualitative description of the data content, and the data type are included. In the data type category, primary keys are denoted as PK, foreign keys are denoted as FK, and the number of characters allowed in a text string is denoted in parentheses.

1. Sites Table

Attribute	Description	Data Type
SiteID	Unique numeric code identifying the site. Primary, auto-numbered key.	PK - Long Integer
SiteName	Common name of the site.	Text (50)
SiteCode	Unique three-digit alpha code identifying the site.	Text (3)
SiteZone	UTM zone (12 or 13).	Long Integer
SiteEasting	Six-digit numeric code indicating UTM Easting.	Long Integer
SiteNorthing	Seven-digit numeric code indicating UTM Northing.	Long Integer
Directions	Driving directions to site as well as project area(s) within site and any notes regarding locked gates, seasonal accessibility, etc.	Memo
Local Watershed	Name of local watershed/drainage basin in which site lies.	Text (50)
Alias	Watershed Name and number to be used as alternate name; secondarily a ranch name or other known site name may be used provided it protects the identity of the landowner.	Text (50)
FocusArea	Focus area name (enter N/A if the site is not in a focus area).	Text (50)

2. Junction_SiteContact Table

Attribute	Description	Data Type
ProjectSiteContactID	Primary, auto-numbered key.	PK - Long Integer
SiteID	Foreign key to Site Table.	Long Integer
ContactNum	Foreign key to Contact Table.	FK - Long Integer
MainSiteContact	Is this the main contact for this site?	Yes/No
ProjectID	Foreign key to Projects Table.	FK - Long Integer

3. Contacts Table

Attribute	Description	Data Type
ContactID	Primary, auto-numbered key. Unique identifier for each contact person.	PK - Long Integer
ContactFirstName	First name of contact.	Text (40)
ContactLastName	Last name of contact.	Text (40)
ContactType	Specify landowner, land manager, etc.	Text (40)
ContactAgency	Name of agency with which contact is associated, or NA.	Text (50)
ContactFax	Fax number of contact, or NA.	Text (30)
ContactEmail	Email address of contact, or NA.	Text (40)
ContactNotes	Additional phone numbers, notification requirements and other comments.	Memo

4. ContactAddress Table

Attribute	Description	Data Type
ContactAddressInstance	Primary, auto-numbered key.	PK - Long Integer
ContactID	Foreign key to Contact table.	FK - Long Integer
ContactAddress1	Primary street address.	Text (50)
ContactAddress2	Secondary address (suite, P.O. Box).	Text (50)
ContactCity	City.	Text (35)
ContactState	2-digit state name.	Text (2)
ContactZip	Zip code.	Long Integer

5. ContactPhone Table

Attribute	Description	Data Type
ContactPhoneID	Primary, auto-numbered key.	PK - Long Integer
ContactID	Foreign key to Contact table.	FK - Long Integer
ContactPhone	Telephone number, including area code.	Text (20)
PhoneExtension	Extension number.	Integer
PhoneType	Phone number type (Home, Office, Cell, Other, Not Specified).	Text (25)

6. Units Table

Attribute	Description	Data Type
UnitID	Primary, auto-numbered key. Unique identifier for each site-unit combination.	PK - Long Integer
SiteID	Foreign key to Site table.	FK - Long Integer
Unit	Name of unit within site.	Text (50)

7. LandTypes Table

Attribute	Description	Data Type
LandTypeID	Primary, auto-numbered key.	PK - Long Integer
LandType	Name of Land Type: Look up to HGM, add other types to HGM table (e.g. Cowardin) when available.	Long Integer
LandTypeDescription	Comments on Wetland Type.	Memo
LandTypeWet	Is this considered wetland?	Yes/No
Acres	Number of acres in this land type.	Long Integer
UnitID	Foreign key to Unit table.	FK - Long Integer

8. WetlandProtocols Table

Attribute	Description	Data Type
ID	Primary, auto-numbered key.	PK - Long Integer
Type	Depressional, flat, slope, riverine.	Text (50)
Protocol	Cowardin, HGM, etc.	Text (50)
TypeCode	Code used to describe the type.	Text (50)
TypeDescription	Details about this wetland type.	Memo

9. Junction_ProjectsUnits Table

Attribute	Description	Data Type
ProjectNum	Foreign key to Projects table.	FK - Long Integer
UnitNum	Foreign key to Units table.	FK - Long Integer

10. Projects Table

Attribute	Description	Data Type
ProjectNumber	Primary, auto-numbered key.	PK - Long Integer
ProjectName	Name assigned to project by WP or WEA.	Text (50)
ProjectComments	Comments regarding project work, etc.	Memo
FundedType	Wetlands Partnership funding agent the project was funded through (Wetlands Initiative, Waterfowl Stamp, NAWCA, GOCO Base, Other.	Text (50)
FundedAmount	Wetlands Program funding amount.	Currency
TrackingNumber	Tracking Number assigned all WP projects applied for under the WFP.	Text (50)
Zone	UTM zone.	Long Integer
Easting	UTM easting; six-digits.	Long Integer
Northing	UTM northing; seven-digits.	Long Integer
UTMVerified	Has the UTM been verified by RMBO?	Yes/No
Acres	The number of acres in the project.	Long Integer

11. Project Type Table

Attribute	Description	Data Type
ProjectTypeID	Primary, auto-numbered key.	PK - Long Integer
ProjectID	Foreign key to Projects table. Numeric code identifying which project the type belongs to.	FK - Long Integer
Type	Project type (Restoration, Enhancement, Creation, Purchase-Easement, Purchase-Feetitle).	Text (50)

12. Type Table

Attribute	Description	Data Type
Type	Project type (Restoration, Enhancement, Creation, Purchase-Easement, Purchase-Feetitle).	Text (40)
Notes	Description of project types.	Memo

13. ProjectStatusDate Table

Attribute	Description	Data Type
ProjectStatusID	Primary, auto-numbered key.	PK - Long Integer
ProjectNumber	Foreign key to Projects table.	FK - Long Integer
Statusid	Name of milestones in life of project (Prelliminary Application, Final Application, No Application, Unfunded NAWCA, Funded, Contracted, Transfer, Expected Delivery, Actual Delivery, Expired, Closed).	Long Integer
StatusMonth	Month (if known) that milestone was achieved.	Byte
StatusDay	Day (if known) that milestone was achieved.	Byte
StatusYear	Year that milestone was achieved.	Integer

14. Status Table

Attribute	Description	Data Type
StatusID	Primary, auto-numbered key. Unique numeric code identifying each of the status ranks.	PK - Long Integer
Status	Status of project.	Text (30)
ProjectDescription	Description of status, decision-rule to place a project in one rank or another.	Memo
StatusNote	Whether this status is typically tracked by the WMEP, and if so, how.	Memo

15. Objectives Table

Attribute	Description	Data Type
ObjectiveID	Primary, auto-numbered key.	PK - Long Integer
ProjectNumber	Foreign key to Projects table.	FK - Long Integer
Species/Habitat	Identifies what will be monitored.	Text (255)
Action	Measurable response for objective: An increase, decrease, or maintenance of some parameter for the identified element and event.	Text (150)
Objective Origin	Source of stated objective (e.g. application, interview, WMEP, WEA, background documents).	Text (150)
TimeFrame	Number of years from the delivery date that the objective is expected to be obtained, as stated by the objective origin.	Long Integer

16. Objective Attribute Table

Attribute	Description	Data Type
AttributeID	Primary, auto-numbered key.	PK - Long Integer
ObjectiveID	Foreign key to Objectives table.	FK - Long Integer
Attribute	Attribute type, lookup to attribute list .	Long Integer

17. Attribute Table

Attribute	Description	Data Type
Attribute	Primary, auto-numbered key.	PK - Long Integer
AttributeType	Aspect of the species or indicator (e.g., size, density, cover).	Text (50)

18. ObjectiveDate Table

Attribute	Description	Data Type
ObjectiveDateID	Primary, auto-numbered key.	PK - Long Integer
ObjectiveID	Foreign key to Objectives table.	FK - Long Integer
ObjectiveStatusDate	Date that objective changed status.	Date/Time
ObjectiveStatus	Current status, lookup field from status table.	Long Integer

19. ObjectiveStatus Table

Attribute	Description	Data Type
ObjectiveStatus	Primary, auto-numbered key.	PK - Long Integer
Status	Active/Inactive.	Text (50)

20. Contract Table

Attribute	Description	Data Type
ContractID	Primary, auto-numbered key.	PK - Long Integer
PartnerCode	Foreign key to Partners table.	FK - Long Integer
ContractNumber	Contract or agreement number of the project: alphanumeric identifiers (not subcontractors).	Text (50)
PartnerCashMatch	The amount of cash the partner is contributing to the project.	Currency
PartnerInKindMatch	The amount of in-kind match the partner is contributing to the project.	Currency
LeadPartner	Is the partner the lead WP Partner delivering the project?	Yes/No
ProjectID	The project funded by this contract: foreign key to Project table.	FK - Long Integer

21. Project Partners Table

Attribute	Description	Data Type
PartnerCode	Primary, auto-numbered key.	PK - Long Integer
Partner	Partner's name.	Text (50)
Notes	Notes about partners.	Memo

22. ProjectApplicationFences Table

Attribute	Description	Data Type
ProjectNum	Foreign key to Projects table. Numeric code identifying the assessment under which this fence was evaluated.	FK - Long Integer
FenceID	Primary, auto-numbered key.	PK - Long Integer
FenceType	The type of fence found.	Text (50)
ProjFence	Is the identified fence part of a Wetlands Partnership project?	Yes/No
FenceLength	Estimated total length, in feet, of this fence.	Integer
FenceCondition	Describe the general condition of this fence.	Memo
FenceComments	Comments regarding this fence.	Memo

APPENDIX B

WMEP SITE ASSESSMENT DATA SHEETS

WMEP SITE ASSESSMENT: SITE DESCRIPTION

New Site Projects					
Name:	Project Type:	Wetland Type:	Delivery Date:	Notes:	Units:

New Units

Site Location
Verify UTM: Zone 12 13 __ __ __ __ __ __ mE __ __ __ __ __ __ __ mN
New/Amended Site Directions:

New Site Contacts			
Name:		Phone:	
Type:		Other:	
Agency:		Note:	

Landscape Description
Generally, use the "horizon" rule and describe the landscape out to the horizon. When this is impossible or impracticable use a 2 mile/5mile/10mile rule and describe: 1.) Location: County, Valley, Mountain Range, etc; 2.) Watershed: location in USGS Watershed; 3.) Major habitat types/ecosystems: Shrub steppe, shortgrass prairie, canyonland, agland, etc; 4.) Wetland systems, complexes in landscape: numbers, types, distances, health; 5.) Human activities: Roads, subdivisions, etc; 6.) Wildlife/Bird descriptions: Major sites of importance, migration corridors, stopover points, etc.
Describe Fragmentation:
Describe Urbanization:
Agricultural Impacts:
Miles to Feedlot: ☐ 0-5 miles ☐ 6-10 miles ☐ >10 miles ☐ N/A
Landscape Description Notes:

SITE:_________DATE:__________________OBSERVERS_________________________ **P. ____ of _____**

WMEP SITE ASSESSMENT: BASIN DESCRIPTION & MORPHOMETRICS

Flood Description and Schedule

Flood Stage	Acres	$\bar{X}$ Depth	Edge (*l:d*)	j	f	m	a	m	j	j	a	s	o	n	d	Notes
100 %																
75 %																
50 %																
25 %																
0 %	n/a	n/a	n/a													
Unknown																

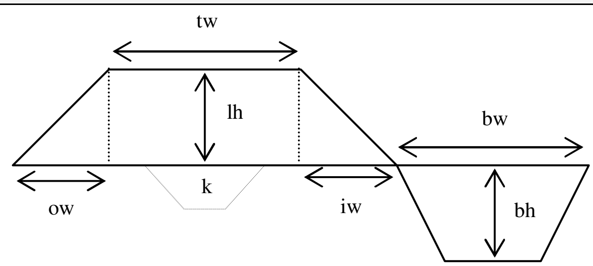
Irrigation/Inlet

Source	Type	Max Flow	$\bar{X}$ Flow	Inlet	Indpndent	o	u	d	Condition	Photo #
				☐ o ☐ p	☐ y ☐ n					
				☐ o ☐ p	☐ y ☐ n					
				☐ o ☐ p	☐ y ☐ n					
				☐ o ☐ p	☐ y ☐ n					

Drainage/Outlet

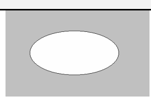
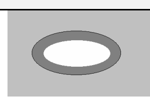
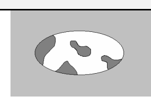
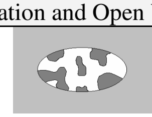
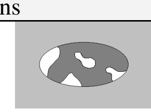
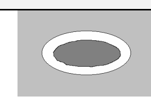
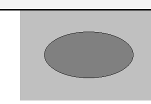
Type	Interval	Full down	Outlet	Indpndent	o	u	d	Condition	Photo #
		☐y ☐n	☐ o ☐ p	☐ y ☐ n					
		☐y ☐n	☐ o ☐ p	☐ y ☐ n					
		☐y ☐n	☐ o ☐ p	☐ y ☐ n					
		☐y ☐n	☐ o ☐ p	☐ y ☐ n					

Levee



Type:						
l:		Condition:		Condition:		Condition:
tw						
ow:						
iw:		Vegetation:		Vegetation:		Vegetation:
lh:						
bw:						
bh:		Spillway: ☐y ☐n		Spillway: ☐y ☐n		Spillway: ☐y ☐n
k:	☐y ☐n	Contour: ☐y ☐n		Contour: ☐y ☐n		Contour: ☐y ☐n

Basin Vegetation and Open Water Patterns

						
Open Water	**Ringed Vegetation**	**Veg Inclusion**	**Hemi-Marsh**	**Water Inclusion**	**Island Vegetation**	**Closed Vegetation**
j f m a m j j a s o d	j f m a m j j a s o n d	j f m a m j j a s o n d	j f m a m j j a s o n d	j f m a m j j a s o n d	j f m a m j j a s o n d	j f m a m j j a s o n d

Notes:

SITE:________UNIT:__________/_________/____________DATE:_________ OBSERVERS______. P. ____ of ___.

WMEP SITE ASSESSMENT: RIVERINE DESCRIPTION

1.)			Waypoint #:		
Wetted Width :	m	Actual Water Depth:	m	Rosgen Type:	(a-g)
Bankfull Width:	m	Bankfull MeanWater Depth :	m	Channel Slope:	%
Floodplain Width :	m	Bankfull Max Water Depth :	m	Sinuosity:	☐ L ☐ M ☐ H
Backwaters: ☐ Present ☐ Absent		Supporting emergent vegetation: ☐ Y ☐ N		BraidedChannel: ☐ Y ☐ N	
Bridges: ☐ Present ☐ Absent		Channel: ☐ sand/silt ☐ gravel ☐ cobble ☐ boulder		Sandbars: ☐ Present ☐ Absent	
Cliffs: ☐Absent ☐ 3-79m ☐ ≥ 79m		Cut-banks: ☐ Present ☐Absent		Bank Erosion: ☐Degrading ☐Stable	
Notes:					
2.)			Waypoint #:		
Wetted Width :	m	Actual Water Depth:	m	Rosgen Type:	(a-g)
Bankfull Width:	m	Bankfull MeanWater Depth :	m	Channel Slope:	%
Floodplain Width :	m	Bankfull Max Water Depth :	m	Sinuosity:	☐ L ☐ M ☐ H
Backwaters: ☐ Present ☐ Absent		Supporting emergent vegetation: ☐ Y ☐ N		BraidedChannel: ☐ Y ☐ N	
Bridges: ☐ Present ☐ Absent		Channel: ☐ sand/silt ☐ gravel ☐ cobble ☐ boulder		Sandbars: ☐ Present ☐ Absent	
Cliffs: ☐Absent ☐ 3-79m ☐ ≥ 79m		Cut-banks: ☐ Present ☐Absent		Bank Erosion: ☐Degrading ☐Stable	
Notes:					
3.)			Waypoint #:		
Wetted Width :	m	Actual Water Depth:	m	Rosgen Type:	(a-g)
Bankfull Width:	m	Bankfull MeanWater Depth :	m	Channel Slope:	%
Floodplain Width :	m	Bankfull Max Water Depth :	m	Sinuosity:	☐ L ☐ M ☐ H
Backwaters: ☐ Present ☐ Absent		Supporting emergent vegetation: ☐ Y ☐ N		BraidedChannel: ☐ Y ☐ N	
Bridges: ☐ Present ☐ Absent		Channel: ☐ sand/silt ☐ gravel ☐ cobble ☐ boulder		Sandbars: ☐ Present ☐ Absent	
Cliffs: ☐Absent ☐ 3-79m ☐ ≥ 79m		Cut-banks: ☐ Present ☐Absent		Bank Erosion: ☐Degrading ☐Stable	
Notes:					
4.)			Waypoint #:		
Wetted Width :	m	Actual Water Depth:	m	Rosgen Type:	(a-g)
Bankfull Width:	m	Bankfull MeanWater Depth :	m	Channel Slope:	%
Floodplain Width :	m	Bankfull Max Water Depth :	m	Sinuosity:	☐ L ☐ M ☐ H
Backwaters: ☐ Present ☐ Absent		Supporting emergent vegetation: ☐ Y ☐ N		BraidedChannel: ☐ Y ☐ N	
Bridges: ☐ Present ☐ Absent		Channel: ☐ sand/silt ☐ gravel ☐ cobble ☐ boulder		Sandbars: ☐ Present ☐ Absent	
Cliffs: ☐Absent ☐ 3-79m ☐ ≥ 79m		Cut-banks: ☐ Present ☐Absent		Bank Erosion: ☐Degrading ☐Stable	
Notes:					

SITE:_________UNIT:________/_____/____DATE:_________OBSERVERS_________. P. ____ of _____.

WMEP SITE ASSESSMENT: STAND TYPE ASSESSMENT

Association:	Cover Class	Dist	% Slope	Ht.	Species 1 % Cover	Species 2 % Cover	Species 3 % Cover	Mature	Med	Young	Snags	Seedl./ Sucker
1.												
1.) Canopy								☐	☐	☐	☐	☐
2.) Subcanopy								☐	☐	☐	☐	☐
3.) Tall Shrub								☐	☐	☐	☐	☐
4.) Short Shrub								☐	☐	☐	☐	☐
5.) Lower Layer								☐	☐	☐	☐	☐
2.												
1.) Canopy								☐	☐	☐	☐	☐
2.) Subcanopy								☐	☐	☐	☐	☐
3.) Tall Shrub								☐	☐	☐	☐	☐
4.) Short Shrub								☐	☐	☐	☐	☐
5.) Lower Layer								☐	☐	☐	☐	☐
3.												
1.) Canopy								☐	☐	☐	☐	☐
2.) Subcanopy								☐	☐	☐	☐	☐
3.) Tall Shrub								☐	☐	☐	☐	☐
4.) Short Shrub								☐	☐	☐	☐	☐
5.) Lower Layer								☐	☐	☐	☐	☐
4.												
1.) Canopy								☐	☐	☐	☐	☐
2.) Subcanopy								☐	☐	☐	☐	☐
3.) Tall Shrub								☐	☐	☐	☐	☐
4.) Short Shrub								☐	☐	☐	☐	☐
5.) Lower Layer								☐	☐	☐	☐	☐
5.												
1.) Canopy								☐	☐	☐	☐	☐
2.) Subcanopy								☐	☐	☐	☐	☐
3.) Tall Shrub								☐	☐	☐	☐	☐
4.) Short Shrub								☐	☐	☐	☐	☐
5.) Lower Layer								☐	☐	☐	☐	☐
Cover Classes: A=0-25%;B=26-50%;C=51-75%;D=76-100%								*>38 cm*	*8 - 38 cm*	*<8 cm*		

SITE:_________UNIT:________/________/________DATE:_______________OBSERVERS____________. P. ____ of _____.

WMEP SITE ASSESSMENT: WETLAND VEGETATION

Robel Measurements

Page __ of __.

Site: Unit: Date: / / 2005

Community Name:________________

Investigator(s):

	P	N	E	S	W
VOR	X				
VH	X				
WD					

	P	N	E	S	W
VOR	X				
VH	X				
WD					

	P	N	E	S	W
VOR	X				
VH	X				
WD					

	P	N	E	S	W
VOR	X				
VH	X				
WD					

	P	N	E	S	W
VOR	X				
VH	X				
WD					

	P	N	E	S	W
VOR	X				
VH	X				
WD					

	P	N	E	S	W
VOR	X				
VH	X				
WD					

	P	N	E	S	W
VOR	X				
VH	X				
WD					

	P	N	E	S	W
VOR	X				
VH	X				
WD					

	P	N	E	S	W
VOR	X				
VH	X				
WD					

	P	N	E	S	W
VOR	X				
VH	X				
WD					

	P	N	E	S	W
VOR	X				
VH	X				
WD					

	P	N	E	S	W
VOR	X				
VH	X				
WD					

	P	N	E	S	W
VOR	X				
VH	X				
WD					

	P	N	E	S	W
VOR	X				
VH	X				
WD					

WMEP SITE ASSESSMENT: INTERVIEW QUESTIONS

SITE DESCRIPTION

Characterize the river prior to project delivery. Describe the flood characteristics on the site/unit. How often/How big?

How have the surrounding land uses changed since the project was delivered?

MANAGEMENT/HISTORY

Describe the management history of the projet site. What sort of disturbance regimes have been used to maintain or prevent certain vegetation communities?

Describe the grazing regime on the project site both historically and presently. Determine intensity and timing of grazing?

Are there any special management provisions on the site/unit? Describe closures, restriction or other activities designed to maintain or improve the quality of the wetland.

FUNCTIONS/VALUES

Describe the water quality on site before and after project delivery? Has an appreciable change in water quality been noted due to project?

What types of recreation have been made available on project site?

What types of education/outreach opportunities have been made available on project site?

HYDROLOGY

Describe the source or sources of water for this wetland project (Ditches, wells, precipitation, etc.)?

What are the frequency, timing, and duration of flooding for this wetland project: How variable is this schedule? Is it tied to irrigation season?

On average, how many acres are flooded at what depths? (i.e. percent of basin at full pool at depth intervals)?

VEGETATION

Describe the site/unit vegetation prior to delivery?

How has the vegetation community on the site/unit changed since the project was delivered?

Have you achieved the vegetation community composition needed to meet objectives?

IMPROVEMENTS (Primarily for developed/managed wetlands)

Describe the quality of the irrigation system. Do they work as they are supposed to? Are any components in need of repair?

Rate the performance of the irrigation system. Does it allow you to meet project objectives?

Describe the quality of the drainage system. Do improvements work as they are supposed to?

Rate the performance of the drainage system. Do improvements allow you to meet project objectives?

WILDLIFE/BIRD USE

Describe bird use observed on the wetland project site before and after project delivery. Any unique or important species now present?

Describe other wildlife use observed on the wetland project site before and after project delivery. Any unique or important species?

Are you satisfied with the wildlife response to the project?

APPENDIX C

PLANT SPECIES DOCUMENTED ON CWP SITES IN 2004

LIST OF ALL PLANT SPECIES DOCUMENTED DURING SITE ASSESSMENTS IN 2004

Scientific Name	Common Name	USDA PLANTS Symbol	Regional Wetland Indicator Status	
			Region 5	Region 8
Abutilon abutilon		ABAB3		
Achillea sp.	Yarrow	ACHIL		
Achillea millefolium	Common yarrow	ACMI2	FACU	FACU
Achnatherum hymenoides	Indian ricegrass	ACHY		
Agropyron sp.	Wheatgrass	AGROP2		
Agropyron spicatum		AGSP	UPL	UPL
Agrostis gigantea	Redtop	AGGI2	NI	NI
Amaranthus sp.	Pigweed	AMARA		
Ambrosia sp.	Ragweed	AMBRO		
Apocynum sp.	Dogbane	APOCY		
Arctium minus	Lesser burdock	ARMI2		
Artemesia frigida	Prairie sagewort	ARFR4		
Artemisia sp.	Sagebrush	ARTEM		
Artemisia biennis	Biennial wormwood	ARBI2	FACU-	FACW
Artemisia franserioides	Ragweed sagebrush	ARFR3		
Asclepias sp.	Milkweed	ASCLE		
Aster sp.	Aster	ASTER		
Astragalus sp.	Milkvetch	ASTRA		
Atriplex canescens	Fourwing saltbush	ATCA2	FACU-	UPL
Bassia hyssopifolia	Fivehorn smotherweed	BAHY	FACW	FACW
Beckmannia syzigachne	American sloughgrass	BESY	OBL	OBL
Betula nigra	River birch	BENI		
Bidens sp.	Beggarticks	BIDEN		
Bouteloua curtipendula	Sideoats grama	BOCU		
Bouteloua gracilis	Blue grama	BOGR2		
Brassica sp.	Mustard	BRASS2		
Bromus sp.	Brome	BROMU		
Buchloe sp.	Buffalograss	BUCHL		
Calamagrostis sp.	Reedgrass	CALAM		
Calamagrostis expansa		CAEX11		
Caltha sp.	Marsh marigold	CALTH		
Capsella bursa-pastoris	Shepherd's purse	CABU2	FACU	FACU
Cardaria draba	Hoary cress	CADR		
Carex sp.	Sedge	CAREX		
Carex praegracilis	Clustered field sedge	CAPR5	FACW	FACW
Carex utriculata	Northwest Territory sedge	CAUT		
Centaurea sp.	Knapweed	CENTA		
Chenopodium	Goosefoot	CHENO		
Chrysothamnus nauseosus		CHNA2		
Cirsium sp.	Thistle	CIRSI		
Cirsium arvense	Canada thistle	CIAR4	FACU	FACU
Cirsium tioganum var. coloradense	Colorado thistle	CITIC		
Clematis ligusticifolia	Western white clematis	CLLI2	FACU	FACU
Cleome multicaulis	Slender spiderflower	CLMU	NI	
Cleome serrulata	Rocky Mountain beeplant	CLSE	FACU	FACU
Conioselinum scopulorum	Rocky Mountain hemlockparsley	COSC2	FACW	

Scientific Name	Common Name	USDA PLANTS Symbol	Regional Wetland Indicator Status	
			Region 5	Region 8
Conium maculatum	Poison hemlock	COMA2	FACW	FACW
Convolvulus arvensis	Field bindweed	COAR4		
Conyza canadensis	Canadian horseweed	COCA5	FACU-	UPL
Cornus sp.	Dogwood	CORNU		
Crataegus sp.	Hawthorn	CRATA		
Dactylis glomerata	Orchardgrass	DAGL	FACU	FACU
Dasiphora floribunda	Shrubby cinquefoil	DAFL3		
Delphinium sonnei		DESO		NI
Deschampsia caespitosa	Tufted hairgrass	DECA18		FACW
Descurainia sophia	Herb sophia	DESO2		
Dimorphocarpa	Spectaclepod	DIMOR		
Distichlis stricta		DIST3		
Echinochloa crus-galli	Barnyardgrass	ECCR	FACW	FACW
Echinocloa sp.	Millet	ECHI		
Elaeagnus angustifolia	Russian olive	ELAN	FAC	FAC
Eleocharis sp.	Spikerush	ELEOC		
Eleocharis acicularis	Needle spikerush	ELAC	OBL	OBL
Elyhordeum sp.	Barley	ELYHO		
Elyleymus hirtiflorus	Canadian wildrye	ELH14		
Elymus sp.	Wildrye	ELYMU		
Elymus canadensis	Canada wildrye	ELCA4	FACU	FACU
Elymus repens	Quackgrass	ELRE4		
Ephedra viridus	Mormon tea	EPVI		
Epilobium sp.	Willowherb	EPILO		
Equisetum sp.	Horsetail	EQUIS		
Equisetum arvense	Field horsetail	EQAR	FAC	FAC+
Ericameria nauseosa ssp. nauseosa var. nauseosa	Rubber rabbitbrush	ERNAN5		
Erigeron sp.	Fleabane	ERIGE2		
Erodium cicutarium	Redstem stork's bill	ERCI6		
Ferocactus sp.	Barrel cactus	FEROC		
Festuca sp.	Fescue	FESTU		
Fragaria sp.	Strawberry	FRAGA		
Gentiana sp.	Gentian	GENTI		
Geranium sp.	Geranium	GERAN		
Glaux maritima	Sea milkwort	GLMA	OBL	OBL
Glycyrrhiza	Licorice	GLYCY		
Glycyrrhiza lepidota	American licorice	GLLE3	FACU	FAC-
Grindelia squarrosa	Curlycup gumweed	GRSQ	FACU-	FACU
Halogeton sp.	Saltlover	HALOG		
Helianthus sp.	Sunflower	HELIA3		
Hieracium cynoglossoides	Houndstongue hawkweed	HICY		
Hordeum jubatum	Foxtail barley	HOJU	FACW	FAC*
Hordeum jubatum ssp. jubatum	Foxtail barley	HOJUJ		
Ipomoea sp.	Morning-glory	IPOMO		
Iris missouriensis	Rocky Mountain iris	IRMI	OBL	OBL*
Iva axillaris	Povertyweed	IVAX	FAC	FACW
Juncus sp.	Rush	JUNCU		
Juncus balticus	Baltic rush	JUBA	OBL	FACW
Juncus bufonius	Toad rush	JUBU	OBL	OBL
Juncus nevadensis	Sierra rush	JUNE		FACW

Scientific Name	Common Name	USDA PLANTS Symbol	Regional Wetland Indicator Status	
			Region 5	Region 8
Juncus parviflora	Smallflowered woodrush	LUPA4		
Juniperus sp.	Juniper/Cedar	JUNIP		
Kochia scoparia	Mexican-fireweed	KOSC		
Krascheninnikovia lanata	Winterfat	KRLA2		
Lepidium campestre	Field pepperweed	LECA5		
Lepidium latifolium	Broadleaved pepperweed	LELA2	FACW	FAC
Leptochloa panicea	Mucronate sprangeltop	LEPAB		
Lichen sp.	Lichen	2Lichn		
Linaria vulgaris	Butter and eggs	LIVU2		
Lolium perenne ssp. multiflorum	Italian ryegrass	LOPEM2		
Lupinus sp.	Lupine	LUPIN		
Lygodesmia juncea	Rush skeletonplant	LYJU		
Maianthemum stellatum	Starry false lily of the valley	MAST4		
Matricaria sp.	Mayweed	MATRI		
Medicago sp.	Alfalfa	MEDIC		
Medicago lupulina	Black medick	MELU	FAC	FAC
Melilotus alba	White sweetclover	MEAL12		
Melilotus officinalis	Yellow sweetclover	MEOF	FACU	FACU
Mentha sp.	Mint	MENTH		
Microthlaspi sp.	Pennycress	MICRO18		
Mimulus sp.	Monkeyflower	MIMUL		
Monroa squarrosa	False buffalograss	MOSQ		
Muhlenbergia asperifolia	Scratchgrass	MUAS	FACW	FACW
Nuttallia nuda		NUNU		
Onagraceae	Evening primrose family	ONAG		
Opuntia imbricata	Tree cholla	OPIM		
Opuntia polyacantha	Plains pricklypear	OPPO		
Orthocarpus cuspidatus ssp.copelandii	Copeland's owl clover	ORCUC		
Oxytropis sp.	Locoweed	OXYTR		
Panicum sp.	Panicgrass	PANIC		
Panicum dichotomiflorum	Fall panicgrass	PADI	FAC	FACW
Panicum miliaceum	Broomcorn millet	PAMI2		
Pascopyrum smithii	Western wheatgrass	PASM		
Pedicularis groenlandica	Elephanthead lousewort	PEGR2		OBL
Phalaris arundinacea	Reed canarygrass	PHAR3	FACW+	OBL
Phleum sp.	Timothy	PHLEU		
Phleum pratense	Timothy	PHPR3	FACU	FACU
Pinus aristata	Bristlecone Pine	PIAR		
Plagiobothrys sp.	Popcornflower	PLAGI		
Plantago sp.	Plantain	PLANT		
Plantago lanceolata	Narrowleaf plantain	PLLA	FAC	FACU
Poa sp.	Bluegrass	POA		
Polygala sp.	Polygala	POLYG		
Polygonum sp.	Knotweed	POLYG4		
Polygonum tenue var. microspermum		POTEM		
Polypogon sp.	Rabbitsfoot grass	POLYP2		
Polypogon monspeliensis	Annual rabbitsfoot grass	POMO5	OBL	FACW+
Populus angustifolia	Narrowleaf cottonwood	POAN3	FACW	FAC*
Populus deltoides	Eastern cottonwood	PODE3	FAC	FACW*
Populus tremuloides	Quaking aspen	POTR5		
Portulaca sp.	Purslane	PORTU		

Scientific Name	Common Name	USDA PLANTS Symbol	Regional Wetland Indicator Status	
			Region 5	Region 8
Potamogeton sp.	Pondweed	POTAM		
Potentilla sp.	Cinquefoil	POTEN		
Primula sp.	Primrose	PRIMU		
Prunus sp.	Plum	PRUNU		
Prunus virginiana	Chokecherry	PRVI	FACU	FACU
Puccinellia airoides		PUAI	OBL	OBL
Puccinellia nuttalliana	Nuttall's alkaligrass	PUNU2	OBL	OBL
Quercus sp.	Oak	QUERC		
Quercus gambelii	Gambel oak	QUGA		
Ranunculus sp.	Buttercup	RANUN		
Rhodiola integrifolia	Ledge stonecrop	RHIN11		
Ribes sp.	Currant	RIBES		
Rosa woodsii	Woods' rose	ROWO	FACU	FAC-
Rudbeckia sp.	Coneflower	RUDBE		
Rumex sp.	Dock	RUMEX		
Rumex crispus	Curly dock	RUCR	FACW	FACW
Rumex maritimus	Golden dock	RUMA4	FACW	FACW
Sabicea sp.	Woodvine	SABIC		
Sagittaria sp.	Arrowhead	SAGIT		
Salix sp.	Willow	SALIX		
Salix interior	Sandbar willow	SAIN3		
Salsola sp.	Russian thistle	SALSO		
Salsola collina	Slender Russian thistle	SACO8		
Salsola iberica		SAIB		
Sarcobatus sp.	Greasewood	SARCO		
Sarcobatus vermiculatus	Greasewood	SAVE4	FACU	FACU*
Saxifraga cespitosa		SACE4		
Schoenoplectus sp.	Bulrush	SCHOE6		
Schoenoplectus pungens	Common threesquare	SCPU10		
Schoenoplectus pungens var. longispicatus	Common threesquare	SCPUL4		
Schoenoplectus tabernaemontani	Softstem bulrush	SCTA2		
Sisymbrium irio	London rocket	SIIR		
Sisyrinchium sp.	Blue-eyed grass	SISYR		
Solanum sp.	Nightshade	SOLAN		
Solanum rostratum	Buffalobur nightshade	SORO		
Solanum triflorum	Cutleaf nightshade	SOTR		
Solidago sp.	Goldenrod	SOLID		
Sonchus sp.	Sowthistle	SONCH		
Sorghum halepense	Johnsongrass	SOHA	FACU	FACU+
Sparganium sp.	Bur-reed	SPARG		
Spartina sp.	Cordgrass	SPART		
Spartina gracilis	Alkali cordgrass	SPGR	FACW	FACW
Sphaerophysa salsula	Alkali swainsonpea	SPSA3		FAC
Sporobolus airoides	Alkali sacaton	SPAI	FAC	FAC
Sporobolus cryptandrus	Sand dropseed	SPCR	FACU-	FACU-
Symphoricarpos occidentalis	Western snowberry	SYOC		
Tamarix ramosissima	Saltcedar	TARA	FACW	FACW
Taraxacum officinale	Common dandelion	TAOF	FACU	
Thlaspi sp.	Pennycress	THLAS		
Tragopogon dubius	Yellow salsify	TRDU		

Scientific Name	Common Name	USDA PLANTS Symbol	Regional Wetland Indicator Status	
			Region 5	Region 8
Tragopogon porrifolius	Salsify	TRPO		
Trautvetteria caroliniensis	Carolina bugbane	TRCA		FAC
Tribulus terrestris	Puncturevine	TRTE		
Trifolium sp.	Clover	TRIFO		
Trifolium campestre	Field clover	trca5		
Triglochin sp.	Arrowgrass	TRIGL		
Triticum sp.	Wheat	TRITI		
Typha sp.	Cattail	TYPHA		
Urtica sp.	Nettle	URTIC		
Verbascum thapsus	Common mullein	VETH		
Verbena bracteata	Bigbract verbena	VEBR	FACU	FACU
Xanthium sp.	Cocklebur	XANTH2		
Yucca sp.	Yucca	YUCCA		

APPENDIX D

REPRESENTATIVE PHOTOS OF CWP PROJECTS

*Note: Photo records from all photo points established during site assessments are on file and available from RMBO upon request. Photos taken on sites owned by private landowners will be shared following approval from landowner.

CWP wetland project to restore and enhance shallowly flooded wetlands through the use of contour levees and grazing exclusion on private land; San Luis Valley Focus Area.

CWP playa wetland restoration project grazing exclusion on private land; San Luis Valley Wetlands Focus Area.

CWP wetland water delivery project in a riparian backwater slough;
Rio Grande State Wildlife Area in the San Luis Valley Wetlands Focus Area.

CWP playa enhancement project to exclude grazing through fence construction (fence not pictured); private land in the Prairie and Wetlands Wetlands Focus Area.

CWP riparian enhancement project to exclude grazing through fence construction (fence not pictured); private land in the Prairie and Wetlands Wetlands Focus Area.

CWP riparian project on private land; South Platte River Wetlands Focus Area.

CWP riparian restoration project involving removal of sediment, re-lining the streambed with gravel and cobble, removal of an in-stream structure, and construction of a fence to exclude grazing; private land in the Southwest Wetlands Focus Area.

CWP wetland project incorporating rest rotation grazing and construction of contour levees and water control structures on private land; San Luis Valley Wetland Focus Area.

Riparian habitat at the Medano-Zapata Ranch restoration project in the San Luis Valley Wetlands Focus Area, entailing rehabilitation of a former golf course; note the absence of a shrub layer. July 21, 2004.

Riparian habitat along Chico Creek, in the Prairie and Wetlands Wetlands Focus Area, showing tamarisk treated with a foliar herbicide. May 21, 2005.

Riparian habitat along Plateau Creek at Lone Mesa State Park indicating cut banks. Top: June 19, 2004. bottom: June 21, 2003.

APPENDIX E

BIRD SPECIES DOCUMENTED ON CWP SITES IN 2004 AND 2005

LIST OF BIRD SPECIES DOCUMENTED ON CWP SITES IN 2004 AND 2005

Common Name	Species Code	Genus	Species
American Avocet	AMAV	*Recurvirostra*	*americana*
American Bittern	AMBI	*Botaurus*	*lentiginosus*
American Coot	AMCO	*Fulica*	*americana*
American Crow	AMCR	*Corvus*	*brachyrhynchos*
American Goldfinch	AMGO	*Carduelis*	*tristis*
American Green-winged Teal	AGWT	*Anas*	*crecca*
American Kestrel	AMKE	*Falco*	*sparverius*
American Robin	AMRO	*Turdus*	*migratorius*
American Wigeon	AMWI	*Anas*	*americana*
American White Pelican	AWPE	*Pelecanus*	*erythrorhynchos*
Ash-throated Flycatcher	ATFL	*Myiarchus*	*cinerascens*
Bank Swallow	BANS	*Riparia*	*riparia*
Barn Swallow	BARS	*Hirundo*	*rustica*
Baird’s Sandpiper	BASA	*Calidris*	*bairdii*
Bewick’s Wren	BEWR	*Thryomanes*	*bewickii*
Black Phoebe	BLPH	*Sayornis*	*nigricans*
Black-billed Magpie	BBMA	*Pica*	*hudsonia*
Black-capped Chicadee	BCCH	*Poecile*	*atricapillus*
Black-chinned Hummingbird	BCHU	*Archilochus*	*alexandri*
Black-crowned Night Heron	BCHN	*Nycticorax*	*nycticorax*
Black-headed Grosbeak	BHGR	*Pheucticus*	*melanocephalus*
Black-necked Stilt	BNST	*Himantopus*	*mexicana*
Black-throated Gray Warbler	BTYW	*Dendroica*	*nigrescens*
Blue Grosbeak	BLGR	*Passerina*	*caerulea*
Blue Jay	BLJA	*Cyanocitta*	*cristata*
Blue-gray Gnatcatcher	BGGN	*Polioptila*	*caerulea*
Blue-winged Teal	BWTE	*Anas*	*discors*
Brewer’s Blackbird	BRBL	*Euphagus*	*cyanocephalus*
Brewer’s Sparrow	BRSP	*Spizella*	*breweri*
Broad-tailed Hummingbird	BTLH	*Selasphorus*	*platycercus*
Brown Thrasher	BRTH	*Toxostoma*	*rufum*
Brown-headed Cowbird	BHCO	*Molothrus*	*ater*
Bullock’s Oriole	BUOR	*Icterus*	*bullockii*
Bufflehead	BUFF	*Bucephala*	*albeola*
Canada Goose	CAGO	*Branta*	*canadensis*
Canvasback	CANV	*Aythya*	*valisineria*
Canyon Wren	CANW	*Catherpes*	*mexicanus*
Cassin’s Finch	CASP	*Aimophila*	*cassinii*
Chipping Sparrow	CHSP	*Spizella*	*passerina*
Cinnamon Teal	CITE	*Anas*	*cyanoptera*
Clark’s Nutcracker	CLNU	*Nucifraga*	*columbiana*
Cliff Swallow	CLSW	*Petrochelidon*	*pyrrhonota*
Common Grackle	COGR	*Quiscalus*	*quiscula*
Common Goldeneye	COGO	*Bucephala*	*clangula*
Common Nighthawk	CONI	*Chordeiles*	*minor*
Common Merganser	COME	*Mergus*	*merganser*
Common Raven	CORA	*Corvus*	*corax*
Common Yellowthroat	COYE	*Geothlypis*	*trichas*
Cooper’s Hawk	COHA	*Accipiter*	*cooperii*
Cordilleran Flycatcher	COFL	*Empidonax*	*occidentalis*

Common Name	Species Code	Genus	Species
Double-crested Cormorant	DCCO	*Phalacrocorax*	*auritus*
Downy Woodpecker	DOWO	*Picoides*	*pubescens*
Dusky Flycatcher	DUFL	*Empidonax*	*oberholseri*
Eared Grebe	EAGR	*Podiceps*	*nigricollis*
Eastern Kingbird	EAKI	*Tyrannus*	*tyrannus*
European Starling	EUST	*Sturnus*	*vulgaris*
Franklin's Gull	FRGU	*Larus*	*pipixcan*
Fox Sparrow	FOSP	*Passerella*	*iliaca*
Gadwall	GADW	*Anas*	*strepera*
Grace's Warbler	GRWA	*Dendroica*	*graciae*
Grasshopper Sparrow	GRSP	*Ammodramus*	*savannarum*
Gray Catbird	GRCA	*Dumetella*	*carolinensis*
Gray Flycatcher	GRFL	*Empidonax*	*wrightii*
Gray Jay	GRAJ	*Perisoreus*	*canadensis*
Great Blue Heron	GBHE	*Ardea*	*herodias*
Great Horned Owl	GHOW	*Bubo*	*virginianus*
Greater Yellowlegs	GRYE	*Tringa*	*melanoleuca*
Green-tailed Towhee	GTTO	*Pipilo*	*chlorurus*
Hairy Woodpecker	HAWO	*Picoides*	*villosus*
Hermit Thrush	HETH	*Catharus*	*guttatus*
Hooded Merganser	HOME	*Lophodytes*	*cucullatus*
Hooded Warbler	HOWA	*Wilsonia*	*citrina*
Horned Lark	HOLA	*Eremophila*	*alpestris*
House Finch	HOFI	*Carpodacus*	*mexicanus*
House Wren	HOWR	*Troglodytes*	*aedon*
Killdeer	KILL	*Charadrius*	*vociferus*
Lark Bunting	LARB	*Calamospiza*	*melanocorys*
Lark Sparrow	LASP	*Chondestes*	*grammacus*
Least Sandpiper	LESA	*Calidris*	*minutilla*
Lesser Goldfinch	LEGO	*Carduelis*	*psaltria*
Lesser Scaup	LESC	*Aythya*	*affinis*
Lesser Snow Goose	LSGO	*Chen*	*caerulescens*
Lesser Yellowlegs	LEYE	*Tringa*	*flavipes*
Lewis's Woodpecker	LEWO	*Melanerpes*	*lewis*
Lincoln's Sparrow	LISP	*Melospiza*	*lincolnii*
Long-billed Dowitcher	LBDO	*Limnodromus*	*scolopaceus*
Loggerhead Shrike	LOSH	*Lanius*	*ludovicianus*
MacGillivray's Warbler	MGWA	*Oporornis*	*tolmiei*
Mallard	MALL	*Anas*	*platyrhynchos*
Marbled Godwit	MAGO	*Limosa*	*fedoa*
Merlin	MERL	*Falco*	*columbarius*
Mountain Bluebird	MOBL	*Sialia*	*currucoides*
Mountain Chickadee	MOCH	*Poecile*	*gambeli*
Mountain Plover	MOUP	*Charadrius*	*montanus*
Mourning Dove	MODO	*Zenaida*	*macroura*
Northern Flicker	NOFL	*Colaptes*	*auratus*
Northern Harrier	NOHA	*Circus*	*cyaneus*
Northern Mockingbird	NOMO	*Mimus*	*polyglottos*
Northern Pintail	NOPI	*Anas*	*acuta*
Northern Rough-winged Swallow	NRWS	*Stelgidopteryx*	*serripennis*
Northern Shoveler	NSHO	*Anas*	*clypeata*
Olive-sided Flycatcher	OSFL	*Contopus*	*cooperi*
Orange-crowned Warbler	OCWA	*Vermivora*	*celata*

Common Name	Species Code	Genus	Species
Orchard Oriole	OROR	*Icterus*	*spurius*
Pied-billed Grebe	PBGR	*Podilymbus*	*podiceps*
Pine Siskin	PISI	*Carduelis*	*pinus*
Plumbeous Vireo	PLVI	*Vireo*	*plumbeus*
Pygmy Nuthatch	PYNU	*Sitta*	*pygmaea*
Red Crossbill	RECR	*Loxia*	*curvirostra*
Red-breasted Nuthatch	RBNU	*Sitta*	*canadensis*
Red-naped Sapsucker	RNSA	*Sphyrapicus*	*nuchalis*
Red-necked Phalarope	RNPH	*Palaropus*	*lobatus*
Red-tailed Hawk	RTHA	*Buteo*	*jamaicensis*
Red-winged Blackbird	RWBL	*Agelaius*	*phoeniceus*
Redhead	REDH	*Aythya*	*americana*
Ring-billed Gull	RBGU	*Larus*	*delawarensis*
Ring-necked Pheasant	RINP	*Phasianus*	*colchicus*
Ring-necked Duck	RNDU	*Aythya*	*collaris*
Rock Wren	ROWR	*Salpinctes*	*obsoletus*
Rose-breasted Grosbeak	RBGR	*Pheucticus*	*ludovicianus*
Ross's Goose	ROGO	*Chen*	*rossii*
Rough-legged Hawk	RLHA	*Buteo*	*jamaicensis*
Ruddy Duck	RUDU	*Oxyura*	*jamaicensis*
Sandhill Crane	SACR	*Grus*	*canadensis*
Savannah Sparrow	SAVS	*Passerculus*	*sandwichensis*
Say's Phoebe	SAPH	*Sayornis*	*saya*
Semipalmated Plover	SEPL	*Charadrius*	*semipalmatus*
Sharp-shinned Hawk	SSHA	*Accipiter*	*striatus*
Short-billed Dowitcher	SBDO	*Limnodromus*	*griseus*
Solitary Sandpiper	SOSA	*Tringa*	*solitaria*
Song Sparrow	SOSP	*Melospiza*	*melodia*
Sora	SORA	*Porzana*	*carolina*
Spotted Sandpiper	SPSA	*Actitis*	*macularia*
Spotted Towhee	SPTO	*Pipilo*	*maculatus*
Steller's Jay	STJA	*Cyanocitta*	*stelleri*
Stilt Sandpiper	STSA	*Calidris*	*himantopus*
Summer Tanager	SUTA	*Piranga*	*rubra*
Swainson's Hawk	SWHA	*Buteo*	*swainsoni*
Swainson's Thrush	SWTH	*Catharus*	*ustulatus*
Townsend's Solitaire	TOSO	*Myadestes*	*townsendi*
Tree Swallow	TRES	*Tachycineta*	*bicolor*
Turkey Vulture	TUVU	*Cathartes*	*aura*
Upland Sandpiper	UPSA	*Bartramia*	*longicauda*
Vesper Sparrow	VESP	*Pooecetes*	*gramineus*
Violet-green Swallow	VGSW	*Tachycineta*	*thalassina*
Virginia Rail	VIRA	*Rallus*	*limicola*
Virginia's Warbler	VIWA	*Vermivora*	*virginiae*
Warbling Vireo	WAVI	*Vireo*	*gilvus*
Western Bluebird	WEBL	*Sialia*	*mexicana*
Western Grebe	WEGR	*Aechmophorus*	*occidentalis*
Western Kingbird	WEKI	*Tyrannus*	*verticalis*
Western Meadowlark	WEME	*Sturnella*	*neglecta*
Western Scrub-jay	WESJ	*Aphelocoma*	*californica*
Western Tanager	WETA	*Piranga*	*ludoviciana*
Western Wood-Pewee	WEWP	*Contopus*	*sordidulus*
White-breasted Nuthatch	WBNU	*Sitta*	*carolinensis*

Common Name	Species Code	Genus	Species
White-crowned Sparrow	WCSP	*Zonotrichia*	*leucophrys*
White-faced Ibis	WFIB	*Plegadis*	*chihi*
White-throated Swift	WTSW	*Aeronautes*	*saxatalis*
Williamson’s Sapsucker	WISA	*Sphyrapicus*	*thyroideus*
Willet	WILL	*Catoptrophorus*	*semipalmatus*
Willow Flycatcher	WIFL	*Empidonax*	*traillii*
Wilson's Phalarope	WIPH	*Phalaropus*	*tricolor*
Wilson's Snipe	WISN	*Gallinago*	*delicata*
Wilson’s Warbler	WIWA	*Wilsonia*	*pusilla*
Wood Duck	WODU	*Aix*	*sponsa*
Yellow Warbler	YWAR	*Dendroica*	*petechia*
Yellow-billed Cuckoo	YBCU	*Coccyzus*	*americanus*
Yellow-breasted Chat	YBCH	*Icteria*	*virens*
Yellow-headed Blackbird	YHBL	*Xanthocephalus*	*xanthocephalus*
Yellow-rumped Warbler	YRWA	*Dendroica*	*coronata*