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Measuring outcomes of wetland restoration, enhancement, and creation in Idaho—Assessing potential functions, values, and condition in a watershed context




Franklin Wetland Mitigation (left); Jewel Wetland (right)

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ABSTRACT

A wetland restoration monitoring and assessment program framework was developed for Idaho. The project goal was to assess outcomes of substantial governmental and private investment in wetland restoration, enhancement and creation. The functions, values, condition, and vegetation at restored, enhanced, and created wetlands on private and state lands across Idaho were retrospectively evaluated. Assessment was conducted at multiple spatial scales and intensities. Potential functions and values (ecosystem services) were rapidly assessed using the Oregon Rapid Wetland Assessment Protocol. Vegetation samples were analyzed using Floristic Quality Assessment indices from Washington State. We compared vegetation of restored, enhanced, and created wetlands with reference wetlands that occurred in similar hydrogeomorphic environments determined at the HUC 12 level. HUC 12s were classified using cluster analysis according to spatially derived hydrologic, geologic, soils, and climate data into watershed ecological groups. A primary outcome of this project was that stakeholders are better informed about how restoration benefits watershed processes, functions, and services. Managers learned tools to monitor and assess restoration effectiveness. Project planners were informed of the values derived from functioning wetland restoration, enhancement, and creation projects.

KEYWORDS

assessment, condition, creation, ecosystem services, enhancement, Floristic Quality Assessment (FQA), functions, habitat, Idaho, landscape, monitoring, Oregon Rapid Wetland Assessment Protocol (ORWAP), restoration, riparian, stressors, watershed, wetland, Wetland Ecosystem Services Protocol for the United States (WESPUS), wetland profile, values, vegetation

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INTRODUCTION

Wetland and riparian habitats provide functions and values greatly disproportionate to the small land area they occupy in the Intermountain West. These habitats form a critical link between terrestrial and aquatic ecosystems (Hansen et al. 1995). With naturally functioning hydrology, appropriate vegetative composition and structure, and minimal stressors these habitats function to (Adamus et al. 1991, Brinson 1993, Hansen et al. 1995, Smith 1995, Novitzki et al. 1996):

- stabilize stream banks
- capture and transform sediment, toxics, and other pollutants
- maintain proper water chemistry and nutrient cycling for aquatic ecosystems
- shade water and maintain proper temperatures for aquatic organisms
- supply woody debris and other organic matter creating diverse and complex aquatic habitat
- retain floodwaters
- recharge groundwater
- support stream base flows
- promote floodplain development and terrestrial ecosystem formation
- provide primary habitats for diverse biota, including numerous at-risk species

Values derived from functioning wetland and riparian habitats can be assigned substantial monetary value (National Research Council 1995, Novitzki et al. 1996). Values can include aesthetics, cultural, historical, archeological, educational, research, open space, recreation, wastewater treatment, water quality protection, and water supply.

From 1780 to 1980, approximately 56% (156,200 ha [386,000 ac]) of Idaho's wetlands were lost to drainage, dredging, filling, leveling, flooding, and other anthropogenic alterations (Dahl 1990). Areas of Idaho have experienced even greater wetland losses, mainly due to drainage for agriculture. While wetland and riparian habitats with high ecological integrity and function still exist, the functions of many have been degraded by hydrologic alteration, pollution, land uses, and other impacts (Quigley et al. 1999). In turn, products of these functions valued by society have been diminished in quantity and quality. Certain land uses and improper management clearly cause direct and indirect effects on these habitats. These do not always result in total habitat loss, but can cause shifts in type and changes in function. Human-caused impacts to wetlands can be magnified by processes including mass earth movement, wildfire, extended drought, and climate change.

Due to strengthened wetland regulations, policies, conservation (USFWS 1990, 1991), and especially restoration-related projects, the rate of wetland loss has decreased during the last 25 years (Dahl 2000, 2006, 2011). During the last 40 years, hundreds of wetland and riparian restoration and enhancement projects have been completed throughout Idaho. Cumulatively, tens of millions of dollars have been spent and a variety of partners and communities are vested in outcomes. The number of restoration-related projects has increased in the last 10 to 15 years in response to rising interest, ecologic and sociologic need, and funding opportunities, especially on privately owned and state-managed land.

Maintaining and restoring the functional characteristics of wetland and riparian habitats are now high priorities for public land management agencies and private landowners. At least 16 public-private partnership programs fund restoration-related projects in Idaho. These include 6 federal agency programs (e.g., U. S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Farm Bill Conservation Programs, North American Wetlands Conservation Act (NAWCA)), several state programs (e.g., IDFG's Habitat Improvement Program (HIP), Idaho Department of Environmental Quality's (IDEQ) Nonpoint Source Management Clean Water Act Section 319 Grants), and non-governmental (NGO) foundation programs. These programs have successfully increased the acreage of wetlands in Idaho. For example, during the last 7 years, IDFG's HIP has enhanced or created nearly 40 wetlands, totaling over 350 acres, and contributed match funding to larger projects. The NRCS Wetland Reserve Program (WRP) has affected over 8,500 acres in Idaho, with more than 50 projects since 1992. In recent years, Ducks Unlimited, a NGO very active in Idaho wetland restoration, has worked on about 40 restoration and conservation projects, improving approximately 28,000 acres, requiring an investment of over 12 million dollars (Ducks Unlimited 2012). The majority of projects have occurred on private lands.

Objectives for most programs are to restore the ecological condition, integrity, processes and/or functions of wetlands so that habitat features necessary for fish, wildlife, and waterfowl are optimized and water quality and other beneficial ecosystem services to communities improved. However, relatively few resources have been expended to evaluate how well objectives have been met. Monitoring is often lacking or limited to short periods (e.g., < 5 years, implementation phase) and sometimes includes only qualitative or limited quantitative observations (Wall 2011). Some programs do not, or only minimally, fund monitoring and evaluation. Few programs require monitoring progress toward quantifiable biological objectives. Data from pre-implementation and/or control reference sites is often lacking (Ruiz-Jaen and Aide 2005, Bernhardt et al. 2007). Evaluation of post-restoration ecological processes or function is infrequent. The National River Restoration Science Synthesis found that only 10% of restoration projects in their nationwide database included monitoring and evaluation (Palmer and Allan 2006, Bernhardt et al. 2007). In Idaho, less than 20% of 132 habitat and riparian restoration projects completed between 1970 and 2007 were monitored (Rumps et al. 2007). When re-evaluated, many projects were found to be functioning below success standards or not meeting design criteria (Davis and Muhlberg 2002, Porej 2003, Ambrose et al. 2006, Rumps et al. 2007, De Steven et al. 2010). In a global assessment of restored wetlands, recovery of ecological function and structure was very slow, even over long time periods, or wetland succession moved on trajectories away from reference conditions (Moreno-Mateos et al. 2012). Post-restoration evaluation is critical for understanding these processes.

Reference-based performance standards, or quantitative success criteria, are important for determining if restoration objectives are met (Ruiz-Jaen and Aide 2005, Bernhardt et al. 2007). Only about 10% of riparian restoration projects reviewed in the Pacific Northwest had quantitative performance standards (Wall 2011). While not the only measure of project success, they can be used as "targets." However, wetlands often have spatial, temporal, and compositional variation in their trajectories of ecological succession after restoration, enhancement, and creation (Grayson et al. 1999, Zedler and Callaway 1999, Matthews and Spyreas 2010, Moreno-Mateos et al. 2012). Restored riparian areas are also dynamic and have a range of vegetative structure and composition, due to the combined effects of natural disturbance, hydrology, and geomorphic evolution of watersheds (Hansen et al. 1995, Weixelman et al. 1996, Walford et al. 2001). A holistic approach to evaluating wetland restoration is needed (Ruiz-Jaen and Aide 2005, Bernhardt et al. 2007). The landscape and watershed context of both restored and reference sites needs to be considered when determining realistic success criteria (Matthews et al. 2009, Moreno-Mateos et al. 2012). Restoration evaluation should include assessment of vegetation succession and wetland functions (Grayson et al. 1999, Zedler and Callaway 1999, Adamus 2010, Matthews and Spyreas 2010).

Recently, agencies responsible for funding and planning restoration projects have promoted effectiveness monitoring and retrospective assessment of restored, enhanced, and created wetland and riparian habitats to ascertain their functions and values, condition, and (where possible) success in meeting performance standards. This includes assessment of composition, condition, function of compensatory wetland mitigation projects in Ohio (Porej 2003), California (Ambrose et al. 2006), and Alaska (Ehlert 2010). The effectiveness of riparian restoration projects funded by the USDA's Conservation Reserve Enhancement Program has been monitored in Washington (Smith 2011). The ecological characteristics and functions of wetlands restored under the NRCS's Wetland Reserve Program were recently evaluated in the southeastern U. S. (De Steven and Gramling 2012). State and county agencies, ranging from Alaska (Davis and Muhlberg 2002) to Wisconsin (Hapner 2006), have developed programs for evaluating wetland and riparian restoration projects. The Oregon Watershed Enhancement Board (Oregon Department of State Lands) recently assessed the function and condition of wetlands restored and enhanced for improving salmon habitat and watershed condition (Adamus 2010).

The goal of this project was to retrospectively assess the outcomes of wetland restoration, enhancement and creation on state and private land in Idaho. Specific objectives were to:

1. characterize the wetland functions and values potentially supported by restored, enhanced, and created wetlands, and to describe the ecologic condition / integrity of these wetlands;

2. analyze the effectiveness of different restoration, enhancement, and creation project types and objectives in supporting wetland functions and values;
3. compare and contrast vegetation composition of these wetlands with that of hydrogeomorphically equivalent reference wetlands identified from prior inventories;
4. determine the best methods for rapidly assessing the functions, values, and condition of restored, enhanced, and created wetlands in Idaho;
5. work with citizens in collection of assessment data, educating participants about functions and values provided by wetland restoration;
6. inform stakeholders of the benefits of past projects and needs for additional projects;
7. inform planners of the value of long-term monitoring and give them assessment tools;
8. inform landowners and managers of the condition of their restored wetlands, and to provide management recommendations to help sustain desired processes, functions, and values.

The design of this project was similar to approaches used by Ambrose et al. (2006), Hapner (2006) (an Environmental Protection Agency (EPA) Wetland Program Development Grant (WPDG) funded project), Matthews et al. 2009, Adamus 2010 (also EPA WPDG funded), Ehlert (2010), O2 Planning and Design (2011), and De Steven and Gramling (2012). Budget and time constraints did not allow us to estimate the function and condition of reference wetlands (as in Adamus 2010).

This EPA WPDG funded project is an integral part of a broader Idaho wetland program. It directly addresses Idaho Wetland Conservation Strategy objectives pertaining to wetland restoration, builds on prior WPDG work, and demonstrates use of landscape-scale, rapid assessment, and vegetation analysis methods in a state wetland monitoring and assessment program (US EPA 2006). IDFG developed and applied a Landscape-scale Assessment Tool (Murphy and Schmidt 2010, Murphy et al. 2012) and has also conducted inventory of ecologically significant wetlands across Idaho (e.g., IDFG 2007). These inventories and application of the Tool resulted in a preliminary reference wetland network for Idaho. Spatial information and data from these reference sites are useful for comparing traits of restored, enhanced, and created wetlands. The Tool can be used to assess the condition of the landscape in which wetland restoration has occurred. Results give insights into both the sustainability of wetland restoration sites and the influence of watershed condition at a landscape-scale. This project also incorporates other EPA-sponsored products, including the Oregon Wetland Assessment Protocol (ORWAP) for rapid functional assessment (Adamus et al. 2010a, 2010b), floristic quality assessment methods created for Washington vegetation (Rocchio and Crawford 2013), and methods for hydrogeomorphic wetland profiling (Johnson 2005).

STUDY AREAS

Sample site determination

A list of potential restored, enhanced, and created wetland assessment sites on state and private land was developed in collaboration with governmental agencies, including IDFG regional biologists, Idaho Transportation Department (ITD), NRCS, U. S. Fish and Wildlife Service (USFWS), and non-governmental partners (Ducks Unlimited, Palouse-Clearwater Environmental Institute, Teton Regional Land Trust, The Nature Conservancy, and Trout Unlimited). The goal was to sample at least 30 restored, enhanced, and created wetlands. Projects were considered if they:

- occurred on state or private land;
- had minimal post-implementation quantitative monitoring or evaluation;
- were $\geq$ 4 years post-implementation;
- were well-distributed across Idaho's 10 Omernik Level 3 Ecoregions and representative of the diversity of wetland habitats and project types.

Potential sample sites were reviewed. Project history (e.g., objectives, implementation date, partners, plans, etc.) and environmental information (e.g., location, pre- and post-implementation monitoring and evaluation data) for each project obtained where possible. Aerial imagery was used to characterize the size, spatial distribution, and extent of hydrogeomorphic and Cowardin classes in each restored wetland. Once the list of potential restored, enhanced, and created wetland for assessment was finalized, partners provided crucial assistance in identifying landowners willing to grant permission to sample their wetlands.

Restored, enhanced, and created wetlands assessment sites

Thirty-five restored, enhanced, and created wetlands were assessed during 2010 and 2011 (Table 1). One wetland, Deyo Reservoir, was assessed prior to an enhancement project implemented in 2012. Assessed wetlands represented 7 of Idaho's 10 Omernik Level 3 Ecoregions, although sites tended to be clustered in areas where state and private land restoration projects were most common (e.g., Palouse River basin of the Columbia Plateau; Lower Boise River and Teton basins of the Snake River Plain) (see maps in Appendix 1). Wetlands were often clustered in agricultural or urban areas near population centers with a concentration of NGOs (e.g., Palouse-Clearwater Environmental Institute, Teton Regional Land Trust) and governmental agencies present that actively promote wetland restoration, enhancement, and creation. These factors, combined with opportunities to access private land, constrained the geographic distribution of assessment sites.

Twenty of the assessed wetlands had restoration as their primary goal. Enhancement was the primary goal of 6 projects assessed, while 9 of the assessed wetlands were created (Table 1). Approximately 50% of the assessed wetlands were best categorized in the depressional HGM class, with slope and riverine classes characterizing a roughly equal proportion of the remaining sites. Twenty projects were implemented 5 or more years before this assessment. Nine wetlands had undergone phases of restoration or enhancement completed 2 to 3 years prior to the assessment. A wide range of project types were represented, including fish and wildlife habitat improvement, compensatory mitigation, and irrigation and stormwater treatment.

Table 1. Information about restored, enhanced, and created wetlands assessed during this project.

Assessment Date	Assessment Site Name	Key Partners (not a complete list; doesn't include landowners)	Number of Known Partners	Omernik Level III Ecoregion	HUC4 SUBBASIN NAME	Project Goal (primary goal is listed first)	HGM Class (primary class is listed first)	Year of Project Completion	Project Type
10/29/2010	Alta Harris Ranch Side Channel -	Trout Unlimited; IDEQ; IDFG	8	Snake River Plain	LOWER BOISE	restoration / enhancement	riverine / depressional	2007	Fish and Wildlife Habitat
10/19/2010	Bailie Sundown Ranch South - Teton	Teton Regional Land Trust; USFWS	3	Snake River Plain	TETON	restoration / enhancement	slope / depressional	2005	Wetland Habitat NAWCA Grant
7/20/2011	Ball Creek TNC Preserve Wetland	The Nature Conservancy; Ducks Unlimited; USFWS	3	Northern Rockies	LOWER KOOTENAI	restoration	depressional	2006	Wetland Habitat NAWCA Grant
7/19/2011	Bismark Meadows Wetland	Ducks Unlimited; NRCS	3	Northern Rockies	PRIEST	restoration / enhancement	slope	2004	Wetland Reserve Program
9/14/2011	Carol Ryrie Brink Nature Park	Palouse-Clearwater Environmental Institute; IDEQ	5	Columbia Plateau	PALOUSE	restoration	riverine / slope	1996	Watershed Restoration S. 319 Grant
9/22/2010	Chapman Wetland	NRCS; USFWS; Clearwater Soil and Water Conservation District; IDFG	6	Northern Rockies	CLEARWATER	restoration / enhancement	depressional	2003	Wetland Reserve Program
9/29/2010	Chester Wetlands - Sand Creek WMA	Ducks Unlimited; USFWS; IDFG	3	Snake River Plain	LOWER HENRYS	enhancement / restoration	depressional	2007	Wetland Habitat NAWCA Grant
9/15/2011	College of Southern Idaho Wetland - Perrine Coulee	College of Southern Idaho; Twin Falls Canal Company	2+	Snake River Plain	UPPER SNAKE-ROCK	creation / enhancement	slope / depressional	2007	Stormwater and Irrigation Return Water Treatment
10/19/2010	Cooke Warm Creek Ranch	Teton Regional Land Trust; Ducks Unlimited; USFWS	4	Snake River Plain	TETON	restoration / enhancement	slope / riverine / depressional	2003	Wetland Habitat NAWCA Grant
7/15/2011	Deyo Reservoir	IDFG	1+	Northern Rockies	CLEARWATER	restoration / enhancement	riverine / slope	2012	Fish and Wildlife Habitat
11/5/2010	Eagle Island Wetland Mitigation	ITD	1+	Snake River Plain	LOWER BOISE	restoration	depressional	~ 2000	Mitigation
11/5/2010	Fivemile - Victory Wetland	Ada County Highway District; NRCS	5	Snake River Plain	LOWER BOISE	creation / enhancement	depressional / slope	~ 1997	Stormwater and Irrigation Return Water Treatment
9/1/2011	Franklin Wetland Mitigation	ITD	1+	Central Basin and Range	MIDDLE BEAR	restoration	depressional / riverine	2006	Mitigation
9/30/2010	Garden Creek - Conant Valley Ranch	Trout Unlimited; NRCS; IDEQ; IDFG	16+	Middle Rockies	PALISADES	restoration / enhancement	riverine / depressional	2005	Fish and Wildlife Habitat

Table 1 continued.

Assessment Date	Assessment Site Name	Key Partners (not a complete list; doesn't include landowners)	Number of Known Partners	Omernik Level III Ecoregion	HUC4 SUBBASIN NAME	Project Goal (primary goal is listed first)	HGM Class (primary class is listed first)	Year of Project Completion	Project Type
9/27/2011	Genesee - Cow Creek Wetland Mitigation	ITD	1+	Columbia Plateau	PALOUSE	restoration	riverine / slope	2005	Mitigation
10/15/2010	Glenn Wetland	NRCS; USFWS; IDEQ; IDFG	7	Snake River Plain	LOWER BOISE	restoration	depressional	2005	Wetland Reserve Program
7/18/2011	Hauser Lake	NRCS; IDFG	3	Northern Rockies	UPPER SPOKANE	restoration / enhancement	depressional	2008	Wetland Reserve Program
11/5/2010	Hyatt Hidden Lakes Reserve	City of Boise; Ada County Highway District; EPA	5	Snake River Plain	LOWER BOISE	creation / enhancement	depressional / slope	2008	Stormwater and Irrigation Return Water Treatment
7/29/2010	Jewel Wetland	NRCS	2+	Snake River Plain	MIDDLE SNAKE-PAYETTE	restoration / creation	depressional	2005	Wetland Reserve Program
9/21/2010	Kaler Easement - Telcher Creek Wetland	IDFG	2	Columbia Plateau	LOWER SALMON	enhancement	depressional	1992 - 2004	Fish and Wildlife Habitat
10/21/2010	Klausman Lazy K Ranch	Teton Regional Land Trust; NRCS; USFWS; IDFG	5+	Snake River Plain	TETON	restoration / enhancement	slope / depressional	2002	Fish and Wildlife Habitat
9/2/2011	Lloyd Wetland	A & B Irrigation District; USBOR	2+	Snake River Plain	LAKE WALCOTT	creation	depressional	1992 - 2003	Stormwater and Irrigation Return Water Treatment
11/3/2010	LQ Drain	Twin Falls Canal Company; IDEQ; IDFG	3	Snake River Plain	UPPER SNAKE-ROCK	creation / enhancement	depressional	1993 - 2003	Stormwater and Irrigation Return Water Treatment
8/18/2011	Price Road - McCammon Wetland Mitigation	ITD	1+	Northern Basin and Range	PORTNEUF	restoration	depressional	2008	Mitigation
9/29/2010	Rainey Creek	Trout Unlimited; NRCS; USBOR; USFWS; IDEQ; IDFG	14+	Middle Rockies	PALISADES	restoration / enhancement	depressional / riverine	2006	Fish and Wildlife Habitat
9/24/2010	Round Valley Creek	National Oceanic and Atmospheric Administration; USFWS; IDFG; numerous schools	12+	Idaho Batholith	LITTLE SALMON	restoration / enhancement	riverine / depressional / slope	2008	Fish and Wildlife Habitat

Table 1 continued.

Assessment Date	Assessment Site Name	Key Partners (not a complete list; doesn't include landowners)	Number of Known Partners	Omernik Level III Ecoregion	HUC4 SUBBASIN NAME	Project Goal (primary goal is listed first)	HGM Class (primary class is listed first)	Year of Project Completion	Project Type
8/31/2011	Sacajawea Park - Portneuf River	City of Pocatello; Idaho State University; NRCS; several schools and community organizations	9+	Snake River Plain	PORTNEUF	creation / enhancement	slope / depressional / riverine	2008	Stormwater and Irrigation Return Water Treatment
9/20/2011	South Fork Palouse River	Palouse-Clearwater Environmental Institute; University of Idaho; Moscow; IDEQ	7+	Columbia Plateau	PALOUSE	restoration	riverine	2004	Watershed Restoration S. 319 Grant
10/14/2011	Spring Cove Ranch	Ducks Unlimited; IDFG	3	Snake River Plain	UPPER SNAKE-ROCK	creation / enhancement	depressional	1992 - 2003	Stormwater and Irrigation Return Water Treatment
9/11/2011	Streets Wetland	Palouse-Clearwater Environmental Institute; IDEQ	3+	Columbia Plateau	PALOUSE	restoration / enhancement	riverine / slope / depressional	2003	Watershed Restoration S. 319 Grant
10/6/2010	Succor Creek Wetland	NRCS; USFWS; IDFG	4	Snake River Plain	MIDDLE SNAKE-SUCCOR	restoration / enhancement	depressional	~ 2008	Wetland Reserve Program
9/22/2011	Threemile Creek	Palouse-Clearwater Environmental Institute; IDEQ	5+	Columbia Plateau	SOUTH FORK CLEARWATER	restoration	riverine / slope	2007	Watershed Restoration S. 319 Grant
10/20/2010	Vest Sundown River Ranch North - Teton River	Teton Regional Land Trust; Ducks Unlimited; USFWS	4	Snake River Plain	TETON	enhancement	slope / depressional / riverine	2005	Wetland Habitat NAWCA Grant
10/4/2011	Worley - North Fork Rock Creek Wetland Mitigation	ITD	1+	Columbia Plateau	HANGMAN	restoration	riverine / depressional	~ 2001	Mitigation
10/8/2010	Wrightman Wetland	NRCS; USFWS	3	Snake River Plain	WEISER	restoration / enhancement	slope / depressional	~ 2007	Wetland Reserve Program

IDEQ = Idaho Department of Environmental Quality, primarily Cleanwater Act S. 319 grant funding

IDFG = Idaho Department of Fish and Game, primarily technical assistance, volunteer coordination, and Habitat Improvement Program funding

IDT = Idaho Transportation Department, primarily wetland mitigation projects

EPA = U. S. Environmental Protection Agency

NRCS = Natural Resources Conservation Service, primarily Wetland Reserve Program projects

USFWS = U. S. Fish and Wildlife Service, primarily North American Wetlands Conservation Act (NAWCA) grant funding and/or Partners for Fish and Wildlife Program support

USBOR = U. S. Bureau of Reclamation

METHODS

Rapid assessment of potential wetland functions and values

Wetland functions and values are not always correlated with wetland condition (Adamus et al. 2010a, Adamus 2011). Some degraded wetlands, or those undergoing rapid ecological changes (typical of relatively recently restored, enhanced, and created wetlands) can have high capability for supporting numerous important functions and values (Hruby 2004).

A modified version of the Oregon Rapid Wetland Assessment Protocol (ORWAP) (Adamus et al. 2010a) was used to assess the potential functions and values of restored, enhanced, and created wetlands. This method also addresses wetland stressors and integrity. It allows for comparisons between all wetland types. It is logic-based, incorporating wetland ecologic principles of hydrology, biogeochemistry, ecology, and hydrogeomorphic (HGM) assessment (Adamus et al. 2010a). ORWAP was modified by its developers to eliminate questions in the assessment checklists that were specific to Oregon. The modified version is called the Wetland Ecosystem Services Protocol for the United States (WESPUS) (Adamus 2011). Although this was the first known broad application of this method in Idaho, its applicability has been tested across a wide variety of wetland types (including restored wetlands) both within Oregon (Adamus 2010, Adamus et al. 2010a) and elsewhere (e.g., in Alaska by Ehlert 2010, in Alberta, Canada, by O2 Planning and Design 2011). One of ORWAP's original design purposes was to be a tool for evaluating success of wetland restoration and enhancement projects (Adamus et al. 2010a).

ORWAP / WESPUS was chosen over similar methods, including the Wetland Rating System for Eastern Washington (Hruby 2004) and Montana Department of Transportation Wetland Assessment Method (Berglund and McEldowney 2008), because of its thoroughness and transparency in detailing the assumptions and algorithms used in models that score wetland functions and values for a site. It is a rapid method (3 to 6 hours to assess a typical wetland) that is repeatable and relatively easily applied by wetland specialists and field ecologists (Adamus et al. 2010a). Minimal field equipment is required.

The ORWAP / WESPUS protocol is applied in several key steps. First, the assessment area (AA) is determined, typically by the combined examination of aerial imagery and field visits. This may include an entire wetland or a portion of it, the extent of which is determined by criteria explained in the user's manual (Adamus et al. 2010a, Adamus 2011). Typically undissected wetlands less than 50 ac are treated as one assessment area. For this project, the AA equaled the entire portion of the wetland influenced by restoration, enhancement, or creation activities. If the wetland was dissected hydrologically, such as by a water control structure or constructed dike, then the AA was equal to the project extent within the divided area.

The models incorporate 140 indicators observable during the entire assessment. Questions about the quality and/or quantity of these indicators are answered during the next two steps--an office-based component (recorded on the Cover Page and Office Form) and the field assessment (recorded on the Field Forms) (Adamus et al. 2010a, Adamus 2011). Although not required, it is recommended that the office component be completed before the field assessment. The Office Form includes an extensive list of questions about the wetland and its surrounding landscape answered by inspecting aerial imagery, maps, soils, and other information available online. The ORWAP / WESPUS manual explains how to properly answer each question on the form.

The Field Forms are completed during site visits. In addition to forms, the ORWAP / WESPUS manual, aerial imagery, topographic maps, and any other site information (e.g., project descriptions, wetland delineations, plant lists, floras and field guides, etc.) are needed to define the AA and assist with answering questions (Adamus et al. 2010a, Adamus 2011). A shovel or small soil probe is required for soil determination. The best time of year to perform the assessments are during the wettest and driest times of the year. Because we had time for only one visit, we performed the majority of our assessments nearest to the driest period of the year. High familiarity with the manual and/or training is required before attempting the field assessment. In the field, the observer first walks around the entire AA, making notes of hydrologic characteristics (including inlets and outlets), the range of water depths, area of cover types and open water, non-native plant cover, evidence of wildlife and fish, and other wetland features. A short description of the wetland AA and field observations are helpful.

After the office and field assessments are completed, answers from all forms are entered into the ORWAP / WESPUS Calculator, a macro-enhanced MS Excel spreadsheet with all model algorithms programmed to yield assessment scores for functions and values (Adamus et al. 2010b, Adamus 2011). Ecologic condition (or integrity), sensitivity, and stressors are also scored. The primary outputs of the assessment are values (ranging from 0 to 10) for the following functions and values:

- water storage and delay
- sediment retention and stabilization
- phosphorus retention
- nitrate removal and retention
- thermoregulation
- carbon sequestration
- organic matter export
- aquatic invertebrate habitat
- anadromous fish habitat
- non-anadromous fish habitat
- amphibian and reptile habitat
- waterbird feeding habitat
- waterbird nesting habitat
- songbird, raptor, and mammal habitat
- pollinator habitat
- native plant diversity

Wetland values, or ecosystem services, reflect the importance or worth (sometimes monetarily) of functions to society. Determining the value of wetland functions is a complex task because not all wetlands perform the same functions nor do they perform them equally well (Hruby 2004). Variability in values results from landscape and watershed factors, including land use, human impacts, and natural gradients of climate, topography, soils, geology, and vegetation. The ORWAP / WESPUS protocol estimates the value of a wetland function according to the opportunity and relative importance that a particular wetland has in providing that function. Opportunity and importance are based on the wetland's significance, placement in the landscape, and watershed condition (Adamus et al. 2010a, Adamus 2011). The protocol considers land uses in both the contributing upslope watershed and in downstream areas from a wetland when estimating a function's value. For example, a large wetland complex in a completely urbanized watershed may have a higher value to society for providing water and sediment storage functions than a smaller, isolated wetland in a completely undeveloped setting. Values alone, however, should not be used to judge whether or not development that negatively impacts a wetland function should occur.

Rapid assessment of wetland condition

The condition of restored, enhanced, and created wetlands was rapidly assessed using three methods. The first was the "Idaho Landscape-scale Wetland Assessment Tool," a statewide, raster-based GIS analysis (described in **Vegetation** section below) (Murphy et al. 2012). The second was the "Idaho Wetland Condition Rapid Assessment Method" (Idaho RAM) (described in Murphy and Schmidt 2010). This method was modeled after the Penn State land use and stressor checklists (Brooks et al. 2004). Other rapid assessment methods were incorporated into Idaho RAM, including Apfelbeck and Farris (2005), Faber-Langendoen et al. (2006), Collins et al. (2007), and Idaho Department of Fish and Game (2007). Idaho RAM is based on field observation of disturbance and stress indicators. It consists of both land use and stressor checklists. The third method was ORWAP / WESPUS, which includes observable indicators of stress in its checklists.

In the field, Idaho RAM is applied by first identifying the wetland assessment area (AA). For this survey, the AA equaled the entire portion of the wetland influenced by restoration, enhancement, or creation activities. The Land-use Checklist is applied by estimating the percent of the AA and percent of the 100 m buffer occupied by each land-use on the checklist and marking the appropriate box on a spreadsheet. The Stressor Checklist is applied by marking the presence of each stressor on the checklist that is observed in the AA and in the surrounding 50 m wide buffer. Impervious surfaces and noxious/highly invasive weed species are recorded by estimating the percent cover rather than only presence. After completing the field checklists, results are checked by viewing the AA and buffer zones on NAIP (aerial) imagery.

In the Idaho RAM, the number of stressors on the rapid field assessment checklist observed in the field is inversely and linearly related to the condition ranking of the wetland. High stressor scores (on a scale of 1 to 5) mean that a greater number of indicators of stress and impairments to wetland condition were observed. Wetland condition is scored on a scale of 1 to 5 (quintiles, with

5 representing the top 20% and least disturbed condition). The highest ranks (on a scale of 1 to 5) represent the lowest stressor levels and least disturbed condition. The number of stressors recorded using ORWAP / WESPUS is not assumed to have a linear relationship to overall estimation of condition or stress on a wetland. The ORWAP/ WESPUS method uses a complex model to estimate wetland stress. It incorporates distance to stressors, proportion of the wetland impacted by stressors, and weighs stressors in different ways (Adamus et al. 2010a, Adamus 2011). Stress is scored on a scale of 0 to 10 (with 10 representing the highest stressor levels). ORWAP/ WESPUS uses a different model to estimate condition, focusing on primarily on hydrologic, vegetation, and biologic indicators. Condition is scored on a scale of 0 to 10 (with 10 representing the least disturbed condition). ORWAP/ WESPUS estimates wetland sensitivity based on a complex model incorporating hydrologic, vegetation, wetland size, and watershed context factors. The higher the score, the less resistant and resilient (i.e., more sensitive) the wetland is human or natural stressors (Adamus et al. 2010a, Adamus 2011).

Vegetation—Comparing restored, enhanced, and created wetlands to reference wetlands
Key drivers in the function and formation of wetland and riparian ecosystems include climate, hydrology, geology, and soils (Brinson 1993, Smith 1995). Climate influences the temperature of soils, precipitation timing and amount, snowpack depth, and pattern of melting (Hansen et al. 1995, Weixelman et al. 1996). Resultant hydrologic regimes determine stream flow and groundwater patterns and volume. Climate and hydrology, in turn, act upon bedrock lithology. Differential erosion and weathering rates create a variety of soil parent materials and sediment transport regimes that determine soil types. Underlying geologic structure, topography, and elevation combined with past glaciations affect drainage patterns, valley shapes, and valley sizes. These factors ultimately determine settings for wetland and riparian ecosystem formation (Weixelman et al. 1996, Walford et al. 2001).

Wetland and riparian ecosystems occurring in similar landscape or watershed settings reflect similar climatic, hydrologic, geologic, and soil influences (Winters et al. 2006). As a result, they typically have common emergent properties, including vegetation and functions (Brinson 1993, Johnson 2005). This allows for the profiling, or characterization of watersheds according to the abundance and diversity of specific hydrologic and geomorphic settings present (Spivey and Ainslie 2004, Johnson 2005, Winters et al. 2006, Lemly et al. 2011). Applied to landscape-scale assessment, monitoring, and restoration, a watershed's profile can be compared to that of reference watersheds having the same profile (Tiner 2002, Johnson 2005, Winters et al. 2006). Making comparisons between watersheds first requires classification of watersheds into similar ecological groups based on environmental characteristics (Johnson 2005 Winters et al. 2006, Lemly et al. 2011). Classification of watersheds can be based on multivariate analysis of spatially-derived attributes (Johnson 2005, Winters et al. 2006, Lemly et al. 2011).

Reference watersheds are widely used in monitoring and evaluating wetland and riparian condition and restoration progress (Harris 1999, Tiner 2002, Johnson 2005). The description of reference characteristics is accomplished by analyzing ecological integrity and placing watersheds in condition classes (Tiner 2002, Johnson 2005). Ideally, a network of reference watersheds will span the gradient from undisturbed to highly disturbed. To inform restoration and management planning, vegetation plot data can be used to describe the structure and composition of functional habitat groups in restored and reference watersheds (Harris 1999). The purpose of these tasks was to identify reference wetland and riparian vegetation plots in watersheds having environmental settings similar to those of assessed restored, enhanced, and created wetlands.

Watershed profiling—Classification of HUC 12 / watershed ecological groups: The widely used hierarchical classification of watersheds mapped by the U. S. Geological Survey (Seaber et al. 1987) was chosen for classification of ecological groups and assessment of reference condition. This classification aggregates watersheds or parts of watersheds into coded hydrologic units. As in similar watershed-scale analyses (Johnson 2005, Winters et al. 2006, Lemly et al. 2011), twelve-digit (6^{th} level) hydrologic units (HUC 12s) were used. For this analysis, we classified all HUC 12s within the state of Idaho.

Multivariate analysis techniques performed in PC-ORD version 4.25 (McCune and Mefford 1999, McCune and Grace 2002) were used to classify and ordinate HUC 12s into ecological groups according to their mapped soil, climatic, hydrologic, and geomorphic characteristics (Johnson 2005, Winters et al. 2006, Lemly et al. 2011). The following factors were assumed to represent the hydrologic and geomorphic settings for each HUC 12:

- aspect (north, 315 - 45 degrees)
- elevation (classified)
- heat load (classes)
- lithologic units (Quigley et al. 1999)
- precipitation (DAYMET) (mean annual classified)
- slope (classified)
- soil units (STATSGO)
- stream order (by segment)
- temperature (DAYMET) (mean annual classified)
- topographic positions (classes)
- HUC 12 area (relativized 0 - 100)

GIS analysis of available spatial layers for the above factors was used to calculate the percent of each HUC 12 represented by each factor. This ensured that no factor was weighted in the multivariate analysis more heavily than another. To reduce noise in the dataset, any factors occurring in only one HUC 12 were dropped.

Potential groups were derived by hierarchical, polythetic, agglomerative cluster analysis using Relative Sorenson (Bray-Curtis) distance measure and the flexible beta linkage method (flexible beta = -0.250, to minimize chaining) (PC-ORD v. 4.25, McCune and Mefford 1999). Watershed ecological groups were identified by subjectively "pruning" the dendrogram at the point where maximum information (indicated by longer limbs on the dendrogram) was captured by the fewest number of groups. Relationships between groups were examined by Bray-Curtis ordination (PC-ORD v. 4.25, McCune and Mefford 1999). Bray-Curtis ordination used a Relative Sorenson distance measure and endpoints were selected using variance-regression. Results are in shown in Figure 1.

Landscape-scale condition assessment of restored, enhanced, and created wetlands and reference wetlands: Landscape-scale, or "Level 1," wetland assessment is defined as the use of a geographic information system (GIS) and remote sensing to understand the characteristics of wetlands across landscapes or watersheds of interest. Typical assessment indicators include wetland area, land use, land cover, and human disturbance (US EPA 2006). These indicators are often incorporated into a GIS model used to estimate condition. These methods have been widely applied, at the national (Comer and Hak 2012) and state level, including Colorado (Lemly et al. 2011), Delaware and Maryland (Tiner 2002 and 2005; Weller et al. 2007), Minnesota (Sands 2002), Montana (Daumiller 2003, Vance 2009), North Dakota (Mita et al. 2007), Ohio (Fennessy et al. 2007), Pennsylvania (Brooks et al. 2002 and 2004; Hychka et al. 2007; Wardrop et al. 2007), and South Dakota (Troelstrup and Stueven 2007). Most of these landscape-scale analyses use a limited, but relatively similar list of spatial layer inputs to calculate metrics for their condition analyses.

Regardless of methods used, landscape-scale assessment is a relatively low-effort method that maximizes the quantity, quality, and consistency of riparian and wetland data gathered over broad geographic areas (Hychka et al. 2007, Wardrop et al. 2007, Weller et al. 2007, Vance 2009). It can be a cost-effective way to stretch limited assessment dollars. Similar landscape-scale assessment projects in Idaho (Murphy and Schmidt 2010, Murphy et al. 2012), used spatial analysis to estimate the relative condition of watersheds, wetlands, and riparian habitats throughout Idaho. We applied results from Murphy et al. (2012) to estimate the condition of restored, enhanced, and created wetland assessment areas and reference wetlands.

Idaho's landscape-scale wetland assessment tool (Murphy et al. 2012) is a raster-based landscape integrity model analogous to those for Montana (Vance 2009), Colorado (Lemly et al. 2011), and nationally (Faber-Langendoen et al. 2006, Comer and Hak 2012). This project builds off many prior landscape-scale assessments which used reference wetland approaches to determine which GIS calculated metrics best predict wetland condition (Hychka et al. 2007, Mita et al. 2007, Troelstrup and Stueven 2007, Wardrop et al. 2007, Weller et al. 2007, Vance 2009, Murphy and Schmidt 2010). Several spatial layers were downloaded from the statewide geospatial data clearinghouse, the Interactive Numeric and Spatial Information Data Engine for Idaho (INSIDE) (http://inside.uidaho.edu/index.html), but most were obtained from state and federal agencies. Complete methods are found in Murphy et al. (2012).

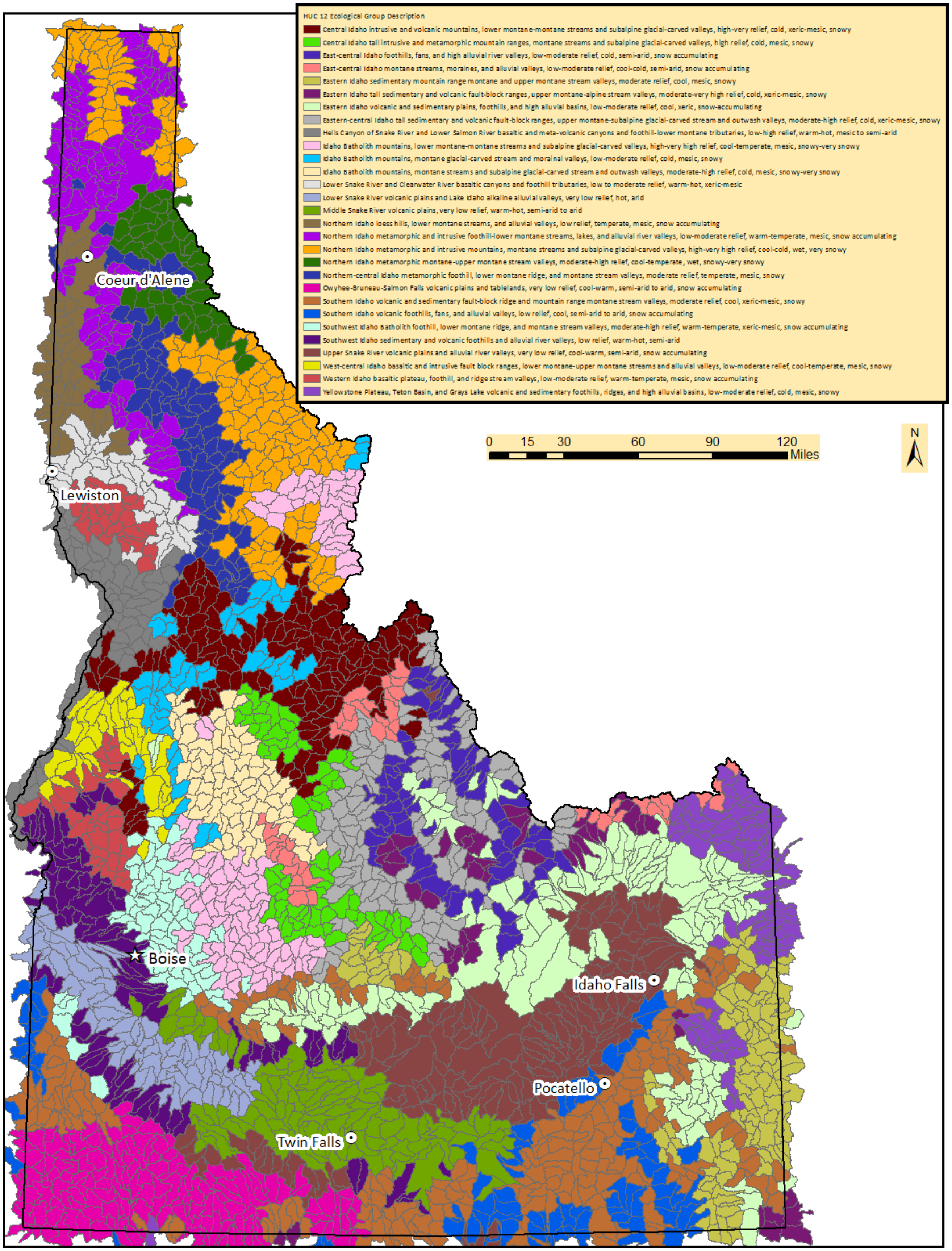

Figure 1. Watershed ecological groups for Idaho classified at the HUC 12 level.

Spatial analysis in GIS was used to calculate the presence of human land use and activity (i.e., stressor) metrics for every 30 m^2 pixel across Idaho (Murphy et al. 2012). A single raster layer that indicated a disturbance value for that pixel was produced using an inverse weighted distance model based on the assumption that ecological condition will be poorer in areas of the landscape with the most cumulative human activities and disturbances (Faber-Langendoen et al. 2006, Vance 2009, Lemly et al. 2011, Comer and Hak 2012). Because not all land uses or stressors impact wetlands the same way, a weighting scheme for each land use or stressor was determined (as in Rocchio and Crawford 2009, Vance 2009, Comer and Hak 2012). The condition value for each pixel was then calculated based on all input rasters, weights, and distance.

Pixels potentially supporting wetland and riparian habitat were extracted from the landscape integrity model layer using the layer of potential wetland and riparian habitat distribution (Murphy et al. 2012). The disturbance value of each wetland and riparian pixel was then ranked relative to all others in Idaho using methods analogous to Stoddard et al. (2005), Fennessy et al. (2007), Mita et al. (2007), Troelstrup and Stueven (2007), and Lemly et al. (2011). The scale was an arbitrary ranking based on expert judgment and examination of the disturbance value distribution. Five condition categories based on the value range in the landscape integrity model were used:

1 = minimally disturbed (top 1% of wetlands, values 0 – 141); wetlands with absence or near absence of human disturbances; zero to few stressors present; land use almost completely not human-created; equivalent to reference condition; conservation priority;

2 = lightly disturbed (2 - 5%, values 142 – 703); wetland deviates from the minimally disturbed class based on existing landscape impacts; few stressors present; majority of land use is not human-created; these are the best wetlands in areas where some human impacts are present; ecosystem processes and functions are within natural ranges of variation found in the reference condition, but threats exist; usually reference condition; conservation priority;

3 = moderately disturbed (6 - 15%, values 704 – 2,108); several stressors present; land use roughly split between human-created and non-human-created; ecosystem processes and functions are impaired and somewhat outside the range of variation found in the reference condition, but are still intact; ecosystem processes are restorable; sometimes the best remaining wetlands in watersheds with many human impacts; conservation and/or restoration priority;

4 = severely disturbed (16 - 40%, values 2,109 – 5,625); numerous stressors present; land use is majority human-created; ecosystem processes and functions are severely altered or disrupted and outside the range of variation found in the reference condition; ecosystem processes are restorable, but may require large investments of energy and money to succeed; potential restoration priority;

5 = completely disturbed (bottom 41 - 100%, values 5,626 – 14,055); many stressors present; land use is nearly completely human-created; ecosystem processes and functions are disrupted and outside the range of variation in the reference condition; ecosystem processes are very difficult or not feasible to restore.

Reference wetland determination: Vegetation and wetland site databases housed at IDFG were queried to identify reference wetland vegetation plots. We utilized the IDFG Wetland and Riparian Vegetation Plot Database which includes stand and location data for almost 1,992 plots and community observations sampled throughout Idaho from 1993 to 2012. The IDCDC Conservation Site Database contains spatial and associated ecological information on over 700 sites in Idaho, about two-thirds of which include wetland and/or riparian components. Sites are ranked by 4 factors: richness, rarity, condition, and viability. Class I sites are the most outstanding, irreplaceable wetlands of highest conservation priority. Class II sites provide valuable habitat and other functions, but impacts may be more noticeable. Most of the information in both databases was collected during WPDG-funded inventories conducted between 1995 and 2007 across Idaho.

The condition of all vegetation plots and sites was estimated using the landscape-scale wetland assessment tool (see above). Plot data were then filtered through a series of screens to determine which belonged to the least disturbed reference condition class. A vegetation plot was assigned to the least disturbed reference wetland class if it was:

- located in the same HUC 12 / watershed group as an assessed restored, enhanced, or created wetland, and,
- minimally or lightly disturbed, predicted by landscape-scale wetland assessment tool, and/or,
- sampled within a Class I and Class II wetland conservation site, or,
- moderately disturbed and represented an ecological habitat (see description below under *Vegetation classification and characterization*) that was underrepresented in a particular HUC 12 / watershed group by plots that met the first three criteria.

After analysis, 157 vegetation plots passed the above screens and were used to represent reference wetlands. Distribution of these plots across Idaho’s 29 HUC 12 / watershed ecological groups is shown in Figure 2.

Vegetation Field Sampling: Eighty-five vegetation plots were sampled in representative habitats at assessed restored, enhanced, and created wetlands and riparian areas. Assessment areas and plots were located in 12 of the 29 HUC 12 / watershed ecological groups in Idaho (Figure 3).

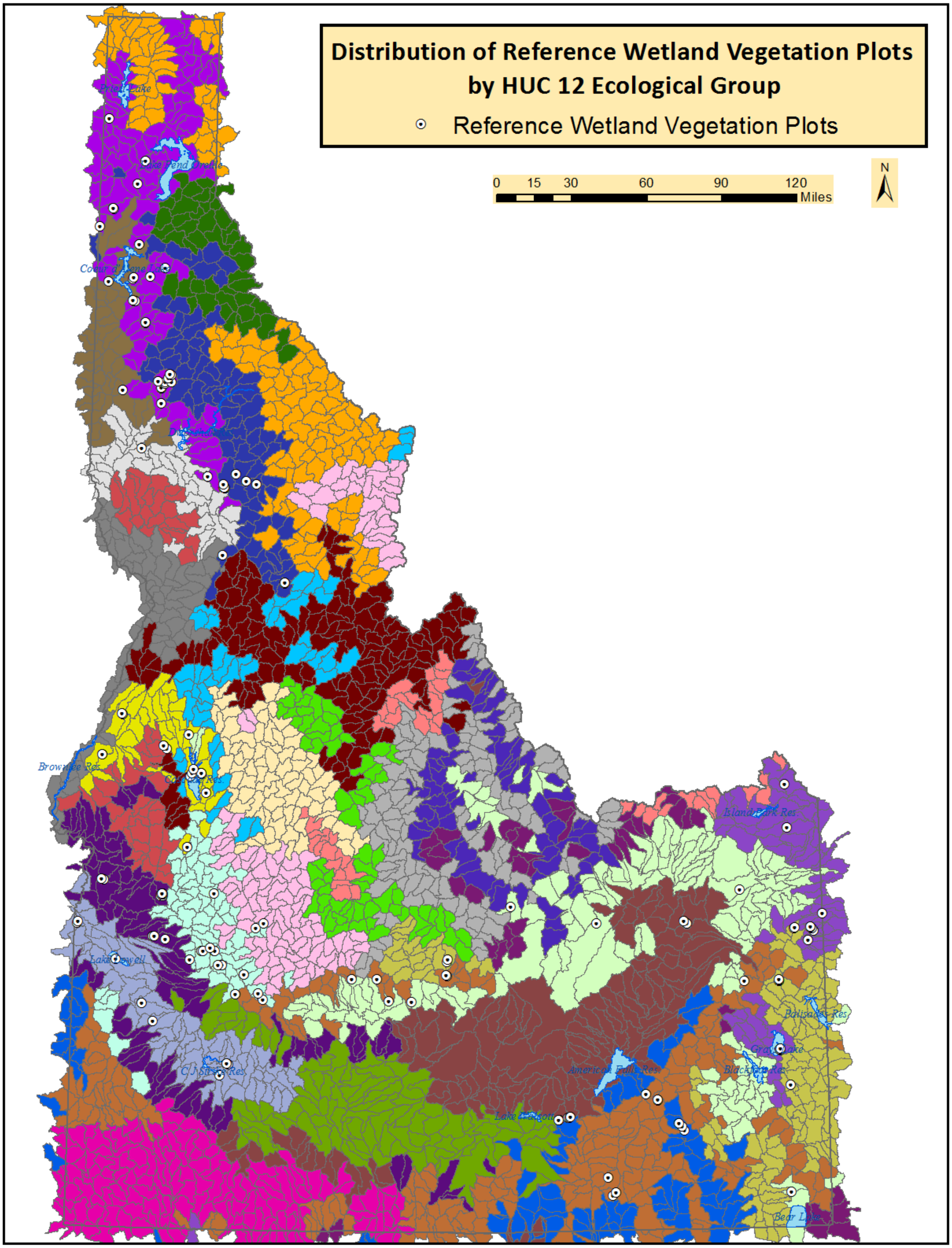

Figure 2. Distribution of reference wetland vegetation plots by watershed ecological group.

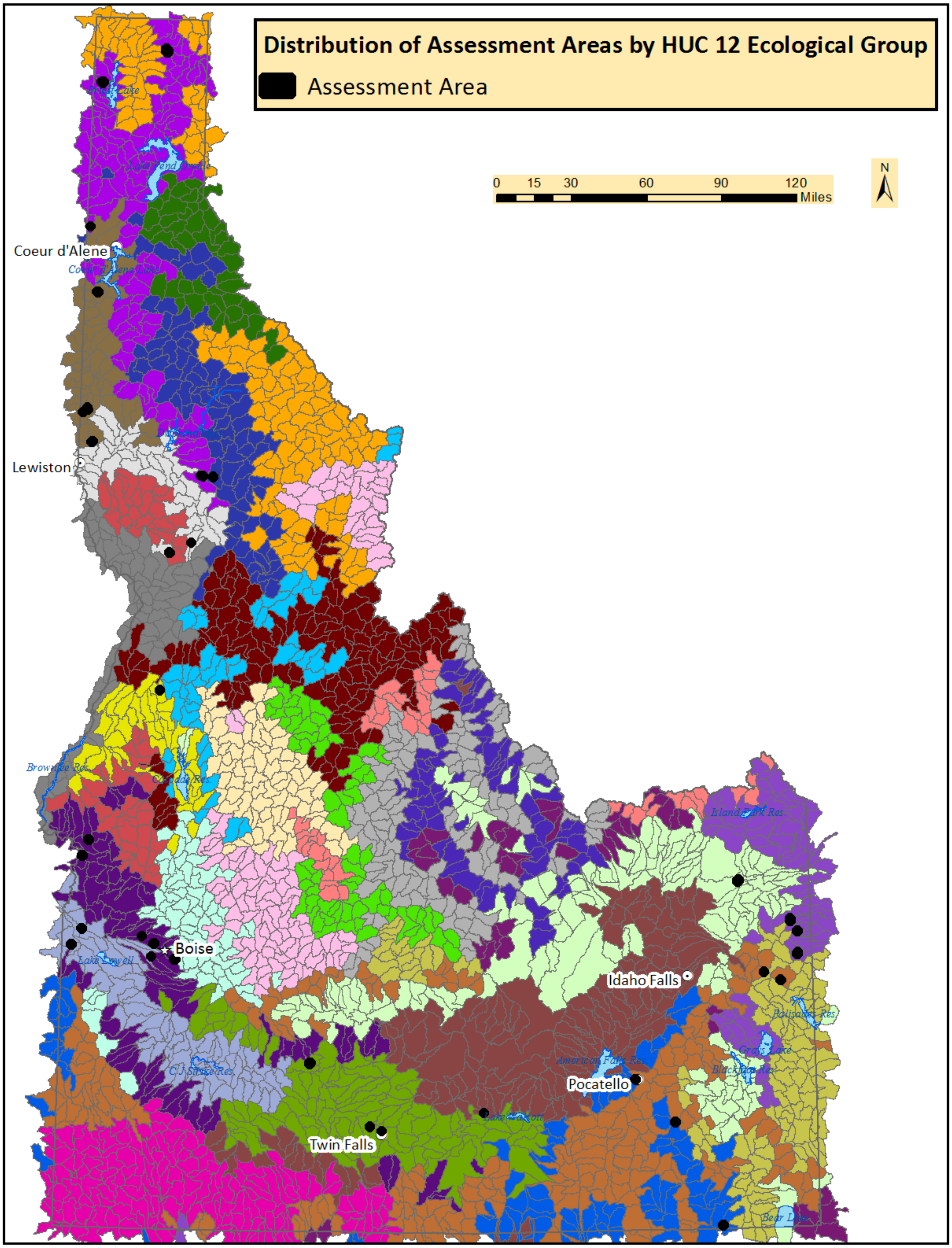

Figure 3. Distribution of assessed restored, enhanced, and created wetlands by watershed group.

Attempts were made to sample vegetation in as many different habitats as time allowed. Plots were placed in the middle of relatively homogeneous stands of wetland or riparian vegetation at least twice the plot size, so as to avoid ecotones. Stands were located without preconceived bias and prior placement within an existing classification scheme. Vegetation was sampled on 20 x 5 m plots in stands with trees and on 10 x 5 m plots in shrubby or herbaceous stands. Standard methods similar to Bourgeron et al. (1992), Jankovsky-Jones et al. (2001), and Murphy et al. (2011) were used. Occasionally, plot dimensions were altered to fit narrow valley bottoms, but the 100 or 50 m^2 area was maintained. At each plot, vegetation data were recorded, including:

- canopy cover of each species; cover of ground surface features, including non-vascular plants, downed wood, etc.
- height of strata; diameters at breast height of all trees and snags rooted in plot

Hydrologic, geomorphic, and other environmental data were recorded at each plot or cluster of closely situated plots, including:

- plot location, general site description, and disturbance history (e.g., natural processes, roads, recreation sites, recent livestock use, logging, mining, hydrologic alteration, etc.)
- valley landform variables (e.g., slope, aspect, valley shape, width, gradient, etc.), geomorphic substrate, and adjacent vegetation
- fluvial surfaces (height above bankfull) and wetland microtopography
- floodplain connectivity; beaver activity

Vascular plant species were identified using Hitchcock and Cronquist (1973). Nomenclature followed PLANTS Database (NRCS 2012).

Vegetation classification and characterization: To accommodate the range of variability inherent in wetland and riparian plant communities, vegetation plots from restored, enhanced, and created wetlands and reference wetlands were classified into broad functional groups (Harris 1999). Plots were assigned to ecological habitats based on their composition and environmental settings. Habitats were analogous to riparian/wetland complexes (Winward 2000), ecological types (Weixelman et al. 1996), and Cowardin classes (Cowardin 1979). This level of classification reduced complexity in the dataset and increased the numbers of samples per unit. The ecological habitat is a broad enough classification to capture variability found in watersheds, but still reflects specific environmental settings, processes, and structure. The following habitats were used:

- Alkaline Wetland
- Fen
- Forested Wetland
- Mesic Meadow
- Scrub-Shrub Wetland
- Short Emergent Marsh

- Tall Emergent Marsh
- Wet Meadow

All vegetation plots were then categorized by the HUC12 / watershed ecological group in which they were located. Vegetation composition (cover and constancy) was then summarized by HUC 12 / watershed group and by ecological habitat for restored, enhanced, and created wetland plots and for reference wetland plots. "Keystone" species, or those that are most characteristic of an ecologic habitat, met the following criteria:

- Highly characteristic = 100% constancy and ≥ 5% cover, or
- Highly characteristic = 50 - 99% constancy and > 10% cover, or
- Moderately characteristic = 50 - 99% constancy and 2 - 9% cover, or
- Moderately characteristic = 25 - 49% constancy and > 5% cover

Floristic Quality Assessment

Floristic Quality Assessment (FQA) is a scientifically rigorous and widely applied method for estimating the relative condition of a plant community. Indices built on FQAs are holistic, integrating numerous metrics including those typically used in vegetation analysis (e.g., species richness, % non-native species), and sensitive indicators of ecological condition (Rocchio and Crawford 2013). Originally used to assess condition of prairies and other communities in the midwestern and eastern United States, they have recently been developed and applied in the west, including Montana (Jones 2005), Colorado (Rocchio 2007), and Washington (Rocchio and Crawford 2013). FQA indices are useful for monitoring the progress of wetland restoration, determining performance standards for mitigation sites, and describing condition of reference sites (Hapner 2006, Matthews et al. 2009, De Steven and Gramling 2012).

We decided to apply FQA indices developed by Rocchio and Crawford (2013) for eastern Washington to estimate the condition of vegetation sampled at restored, enhanced, and created wetlands in Idaho. We utilized the FQA calculators created by Rocchio and Crawford (2013) for the Columbia Basin and eastern Washington mountains. The flora and ecology of eastern Washington wetland and riparian habitats is very similar to that of Idaho wetlands. This is the first known wide application of this method in Idaho.

FQA is based on the proportion of conservative plant species present in a plant community (Rocchio and Crawford 2013). The most conservative species are those with a high likelihood of, or only, occurring in communities undisturbed (or minimally degraded) by human land uses or induced stressors (e.g., non-native plant invasion). Some conservative species are highly restricted to habitats with unique environmental conditions, such as fens or alkaline wetlands. Less conservative species tend to be generalists that thrive in a wide variety of environmental settings with more frequent and/or a higher magnitude of disturbance (including natural (e.g., floodplain) and human-caused disturbance) (Rocchio and Crawford 2013). A large proportion of conservative species in a site's flora indicates a high level of ecological integrity.

Each native plant species in a regional flora is assigned a coefficient of conservatism value (C-value) of 0 to 10; non-native species are typically not assigned a C-value. Assignments are made by an expert panel of botanists and plant ecologists. Rocchio and Crawford (2013) define species with C-values of 0 to 3 as the least conservative ("ruderal" or early seral species) typically found in human-disturbed habitats. Plant species with C-values of 4 to 6 are found in (and often dominate) habitats moderately disturbed by human activities (e.g., wet meadows grazed by livestock, but not overgrazed), but also tend to include species common on naturally disturbed floodplains. Species with C-values of 7 to 8 are typically found in intact habitats only minimally degraded by human land uses. They are good indicators of functioning ecosystems. C-values of 9 to 10 are assigned to species restricted to specific, undisturbed environments. The C-value is the key variable used in FQA indices.

To perform any FQA, a species list is compiled for the plant community or ecological habitat sampled in the field. The C-values of the species in that list are then used to calculate the Floristic Quality Assessment Index (FQAI) (sometimes adjusted for inclusion of non-native species) and other metrics, including mean C-values for different groupings of species and percent of flora with C-values > 7 (e.g., intolerant of disturbance) (Rocchio and Crawford 2013). For this project we used the calculators provided by Rocchio and Crawford (2013) to analyze the floristic quality of each of the 85 plots sampled at restored, enhanced, and created wetlands (Eastern Washington Floristic Quality Assessment Index Calculator - Columbia Basin for semi-arid foothill, canyon, and plains sites within the Columbia Basin and Eastern Washington Floristic Quality Assessment Index Calculator - Mountains for montane and lower montane sites). We also analyzed the floristic quality of each of the 157 reference plots. Eighty-three percent of the unique 785 plant taxa documented from both restored and reference wetlands in Idaho had been assigned a C-value by Rocchio and Crawford (2013) and included in their calculators. The majority of taxa not assigned a C-value were plants identified only to genus. Only 32 species (4% of the total taxa documented) were unique to Idaho.

RESULTS

Potential functions of restored, enhanced, and created wetlands

Wetland restoration projects obtained levels of habitat functions, and some water quality and ecological functions (nitrate removal and retention, thermoregulation, carbon sequestration, organic matter export), roughly equal to or greater than enhanced wetlands (Figure 4). Assessed enhancement projects provided higher potential water storage and delay, sediment retention and stabilization, and phosphorus retention functions than created or restored wetlands. In contrast, enhanced wetlands lagged behind created and restored wetlands for most habitat functions (pollinator, songbird, raptor, mammal, and waterbird). Created wetlands provided notably lower levels of water storage and delay and fish habitat than enhancement and restoration projects.

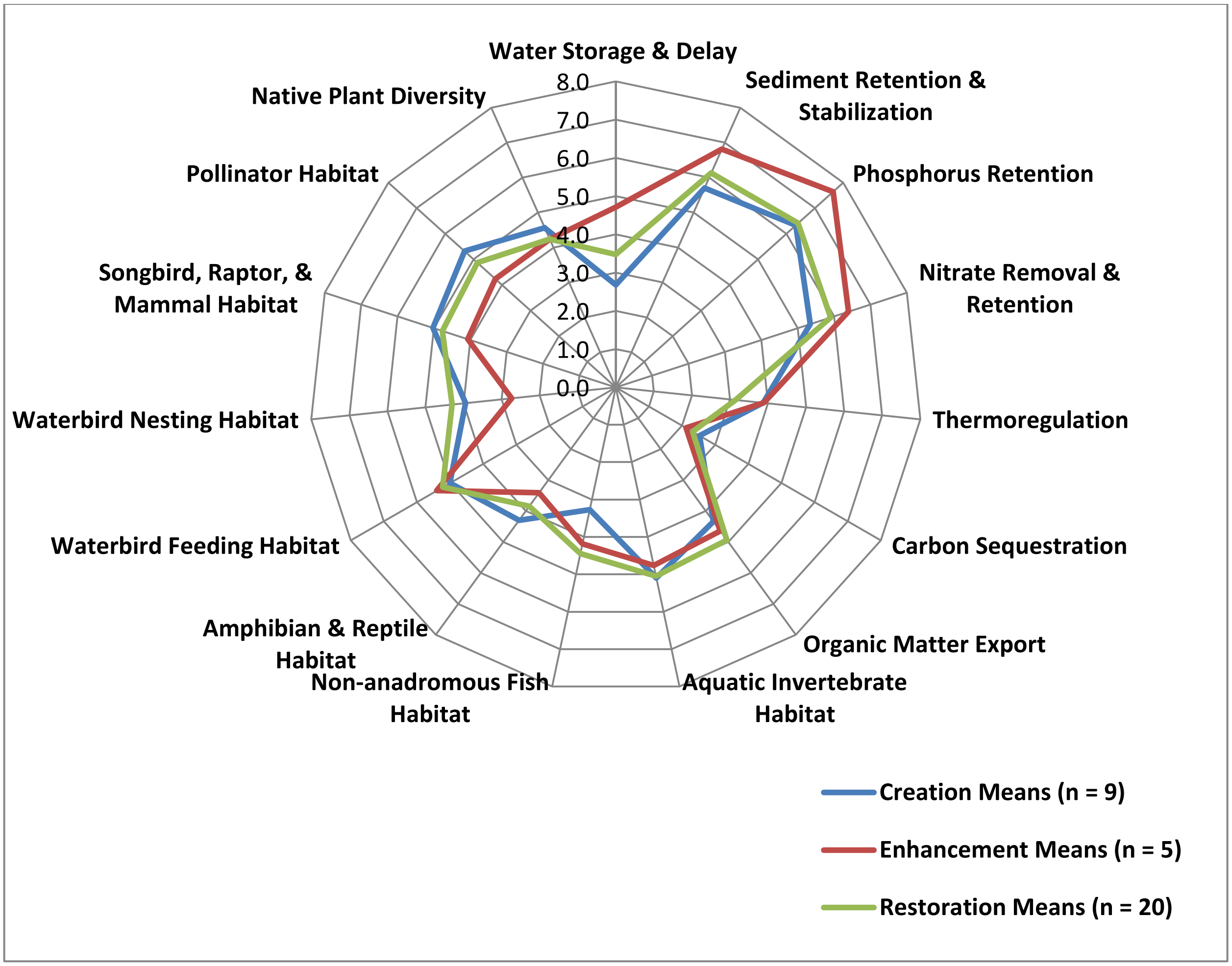

Figure 4. Potential functions by project goal (restoration, enhancement, or creation).

As expected from design of ORWAP's models, HGM class clearly influenced the resulting potential functions. Restored, enhanced, and created depressional wetlands provided relatively high levels of potential water storage and delay and sediment retention and stabilization functions while riverine wetlands supported moderately high levels of organic matter export (Figure 5). Riverine and slope wetlands had much higher thermoregulation function than depressional wetlands. Slope wetlands also provided high phosphorus retention function and had the highest levels of pollinator habitat and native plant diversity. Depressional wetlands excelled in their support of waterbird nesting and feeding habitat. Restored and enhanced riverine wetlands seemed to underperform in their support of habitat for pollinators, amphibians, reptiles, fish, and aquatic invertebrates relative to what might be expected from fully functioning riverine wetlands.

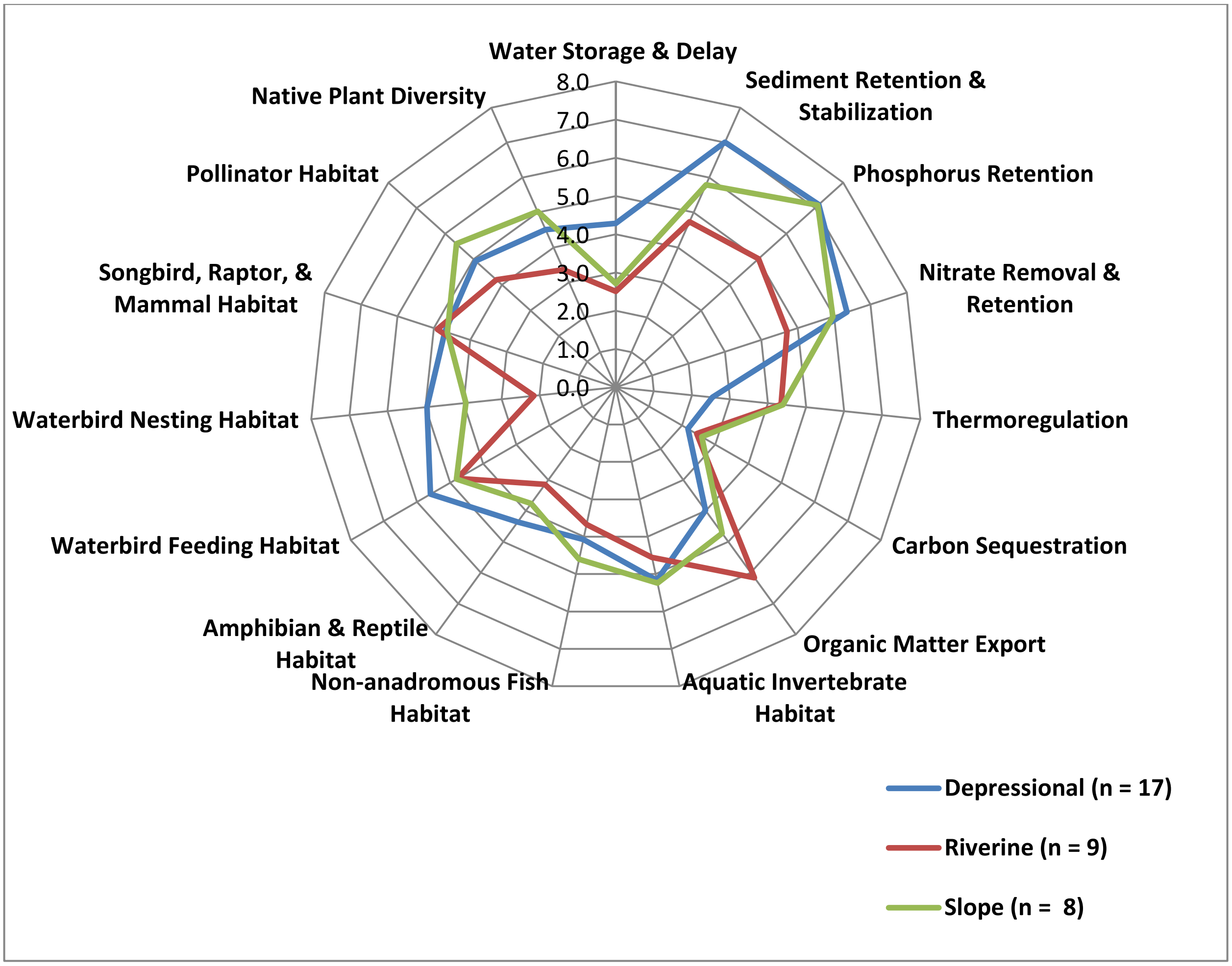

Figure 5. Potential functions by HGM class.

As a result of rapid ecological succession of restored, enhanced, and created wetlands, levels of potential functions vary over relatively short periods of time. Wetland project age influenced the levels of potential water quality functions (Figure 6). Projects > 10 years since completion supported much higher phosphorus retention and water storage and delay functions than younger projects. However, projects < 5 years since completion were able to obtain levels of sediment retention and stabilization and nitrate removal and retention functions equal to the oldest projects. Potential habitat functions of < 5 year-old projects were about equal to (or for waterbird nesting, greater than) older projects. Five to 10 year-old projects had much higher levels of organic matter export and thermoregulation functions than either younger or older projects. These projects lagged behind younger or older projects for water storage and delay, sediment retention and stabilization, and nitrate removal and retention.

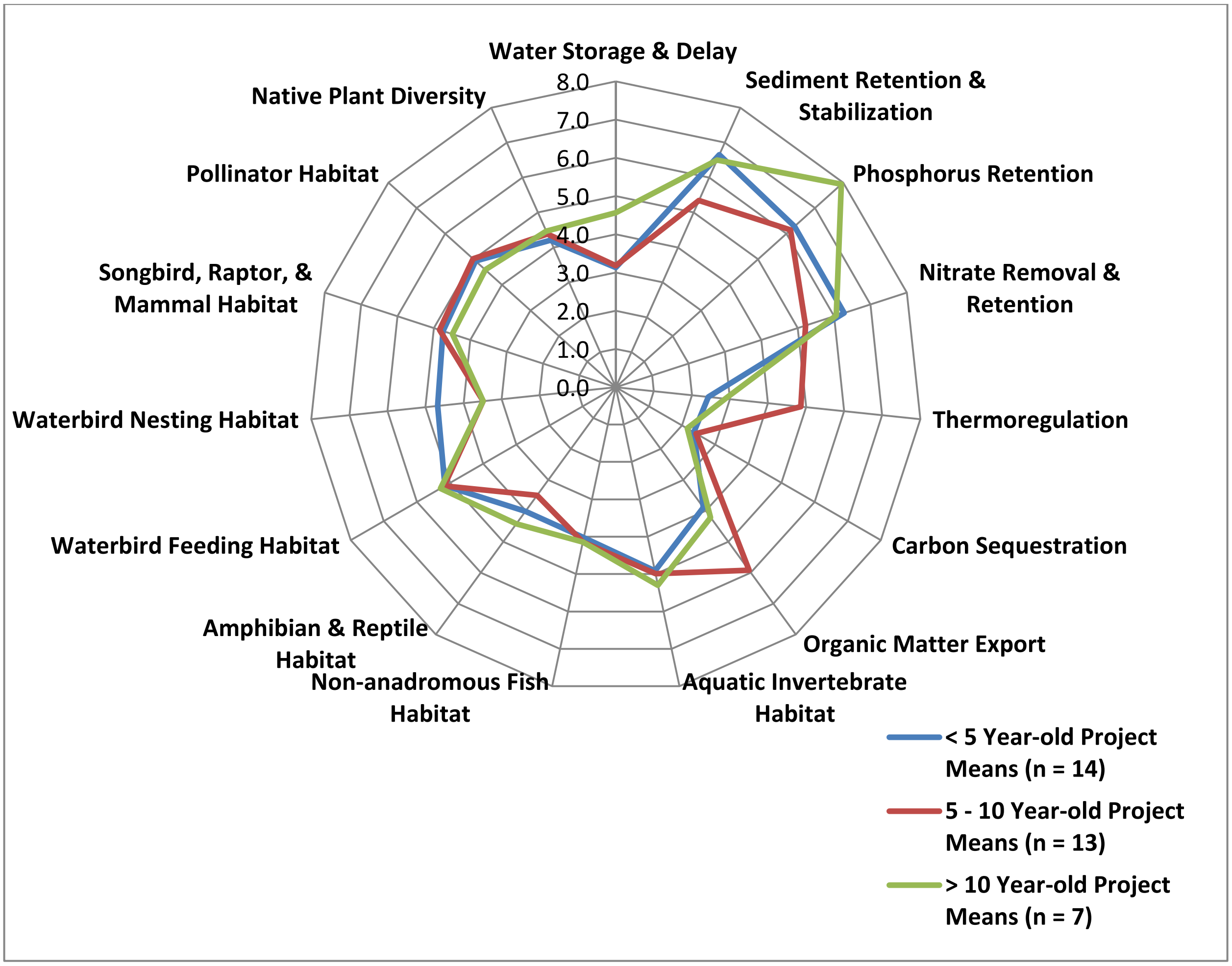

Figure 6. Potential functions by project age since implementation.

Different restored, enhanced, and created wetland project types provided diverse and varying potential functions, sometimes at high estimated levels. Functions were sometimes "value-added" relative to the original primary objective of the project. For example, fish, wildlife, and waterfowl (NAWCA-funded) habitat projects had relatively high potential pollinator habitat and native plant diversity functions (Figure 7). In addition to exceptional habitat functions, NAWCA-funded projects also supported moderate to high water quality functions (e.g., sediment retention and stabilization, phosphorus retention, and nitrate removal and retention). Stormwater and irrigation return water treatment projects provided moderate levels of waterbird feeding and aquatic invertebrate habitat. Mitigation and WRP projects provided the highest support for sediment retention and stabilization, phosphorus retention, and nitrate removal and retention. Mitigation projects also led others for support of water storage and delay and waterbird feeding habitat functions. NAWCA and general fish and wildlife habitat projects successfully met their primary objectives by potentially providing moderate to high levels of habitat functions for waterbird nesting and feeding, as well as habitat for pollinators, songbirds, raptors, mammals, amphibians, reptiles, and aquatic invertebrates.

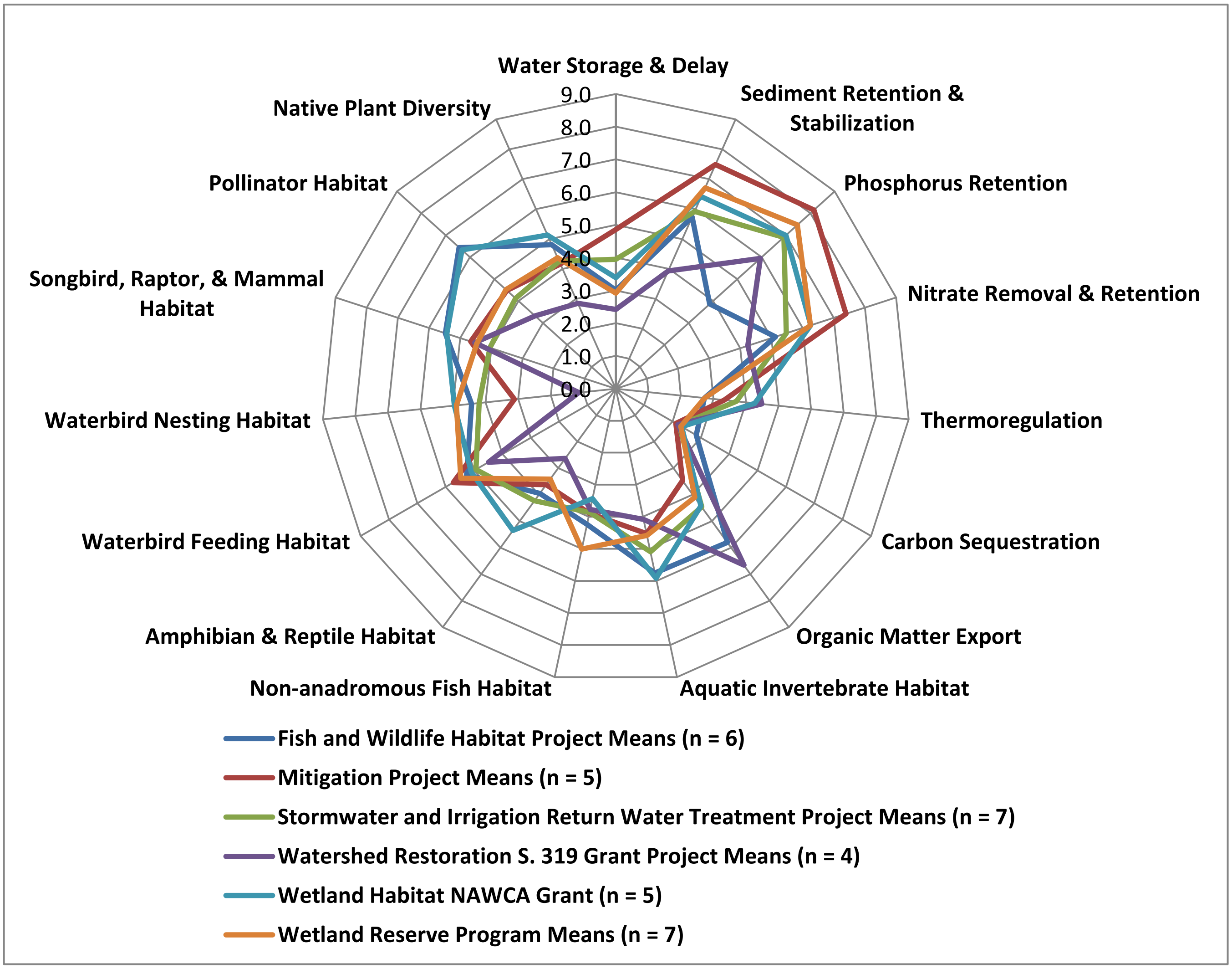

Figure 7. Potential functions by project type.

Some assessed restored, enhanced, or created wetland project types had not developed levels of potential functions that indicated the primary project objective had been achieved. Stormwater and irrigation return water treatment projects and watershed restoration Clean Water Act S. 319 projects supported water quality functions for which they were designed at relatively low levels (Figure 7). Watershed restoration S. 319 projects also lagged behind all other types in supporting native plant diversity, pollinator habitat, and waterbird nesting and feeding. Although water quality function support was not a primary objective, fish and wildlife habitat projects did not support high levels of water storage and delay, phosphorus retention, and nitrate removal and retention. In general, potential water storage and delay, thermoregulation, and carbon sequestration functions were low to moderate for all project types.

The specific habitat restored, enhanced, or created influenced the type and level of resulting functions, but usually not as much as expected. Deepwater marsh and open water habitat projects created for waterfowl obtained relatively high levels of waterbird nesting and feeding habitat functions for which they were designed (Figure 8). However, projects targeting seasonally flooded marsh and wet meadow habitat and urban stormwater treatment also achieved nearly the same levels for these functions. Irrigation return water treatment projects supported sediment retention and stabilization, phosphorus retention, and nitrate removal and retention functions at levels expected for the project's purpose. However, deepwater marsh and open water, riparian and stream, and seasonally flooded marsh and wet meadow habitat projects also achieved similar water quality function levels. These project types also supported relatively high and similar levels of native plant diversity, and pollinator, songbird, raptor, and mammal habitat functions. All project types supported sediment retention and stabilization and organic matter export and aquatic invertebrate habitat functions at similar, relatively high levels.

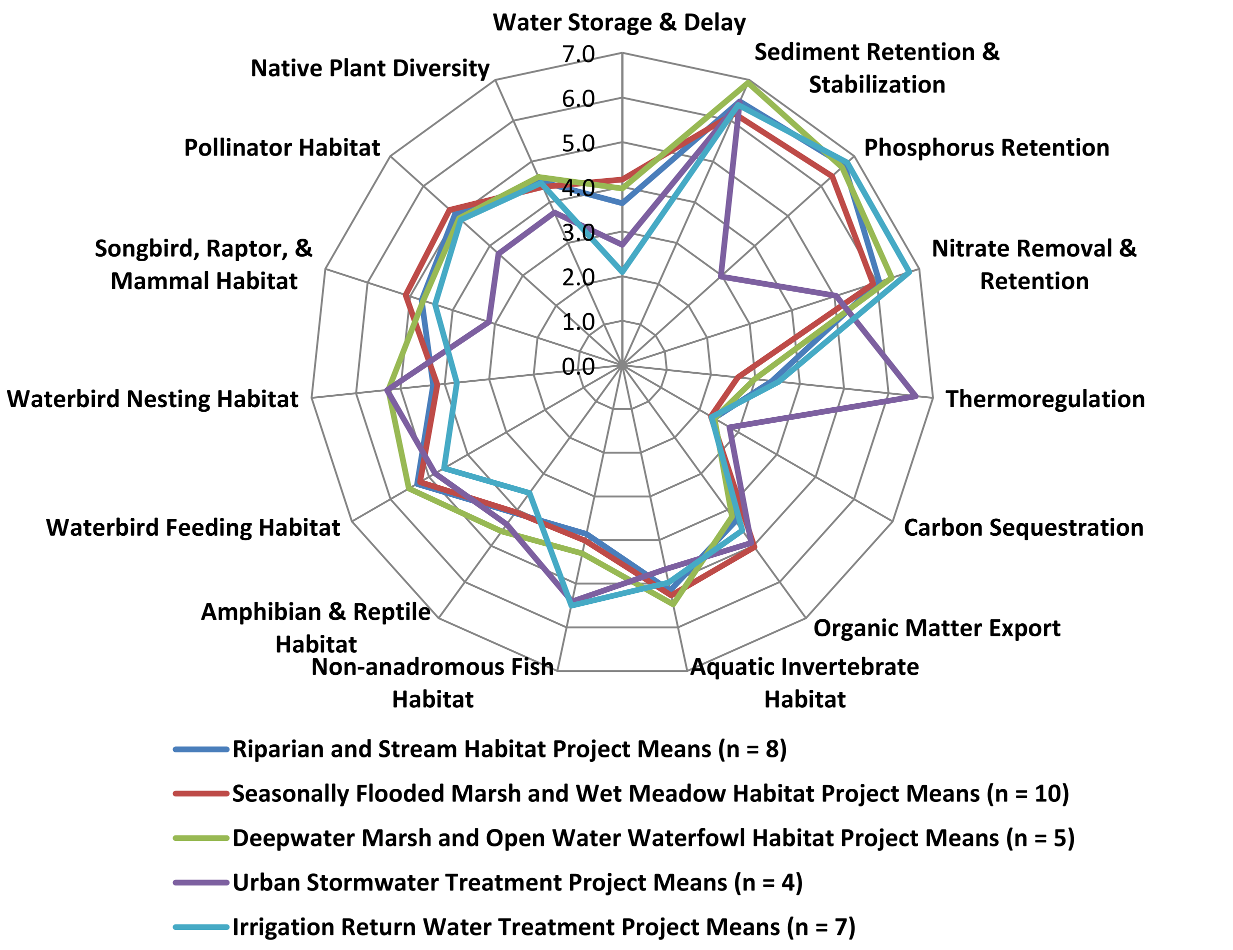

Figure 8. Potential functions by primary project objective (e.g., specific habitat or function)

Urban stormwater and irrigation return water treatment wetlands varied the most in the levels of different potential functions supported. Urban stormwater treatment wetlands provided thermoregulation function, as well as amphibian and fish habitat at moderately high levels (Figure

8). However, these projects supported phosphorus retention, water storage and delay, native plant diversity, and habitat for pollinators, songbirds, raptors, and mammals at only low levels. Except for fish habitat support, irrigation return water treatment projects produced lower potential habitat functions than other project types. Irrigation return water treatment projects also had low support of water storage and delay function.

Values of functions supported by restored, enhanced, and created wetlands

The value of a function is dependent on the opportunity of the wetland to provide it. Opportunity is, in-part, determined by the wetland's location in the watershed. As a result the value of a function may be relatively high compared to the level of function potentially provided. Different project goals resulted in varying values for functions supported by assessed wetlands. Enhancement projects exceled in supporting sediment retention and stabilization and phosphorus retention functions, and these functions were also highly valued (Figure 9). Waterbird nesting and feeding habitat functions had relatively high value in creation projects, while enhancement projects provided high value amphibian and reptile habitat functions. The value of these habitat functions far exceeded the potential support of these functions in created and enhanced wetlands, indicating the importance of these projects (at least where assessed) on the landscape.

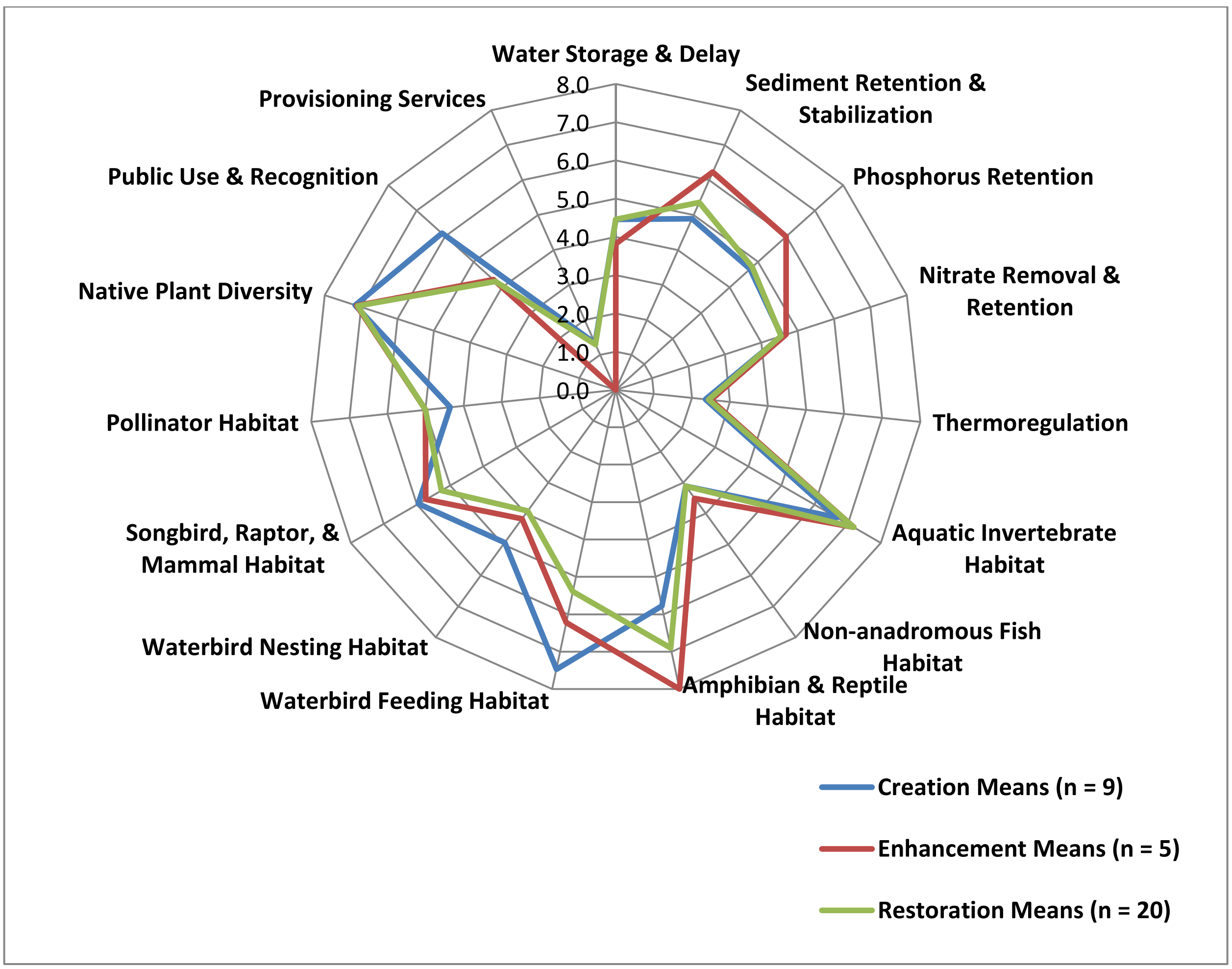

Figure 9. Values of functions by project goal (restoration, enhancement, or creation).

The value of water quality improvement functions (e.g., sediment retention and stabilization, phosphorus retention, nitrate removal and retention, and thermoregulation) far exceeded the potential to support these functions in riverine wetlands (Figure 10). In contrast, the value of water quality functions was lower for depressional and slope wetlands, indicating that (for the wetlands assessed) these HGM classes were located in sites with less opportunity to perform these functions. For example, depressional wetlands were often located in highly degraded and fragmented agricultural landscapes. Slope wetlands tended to occur in slightly less disturbed landscapes, but were sampled in an area rich with wetlands (e.g., Teton Basin) where the value of functions from an individual wetland was muted.

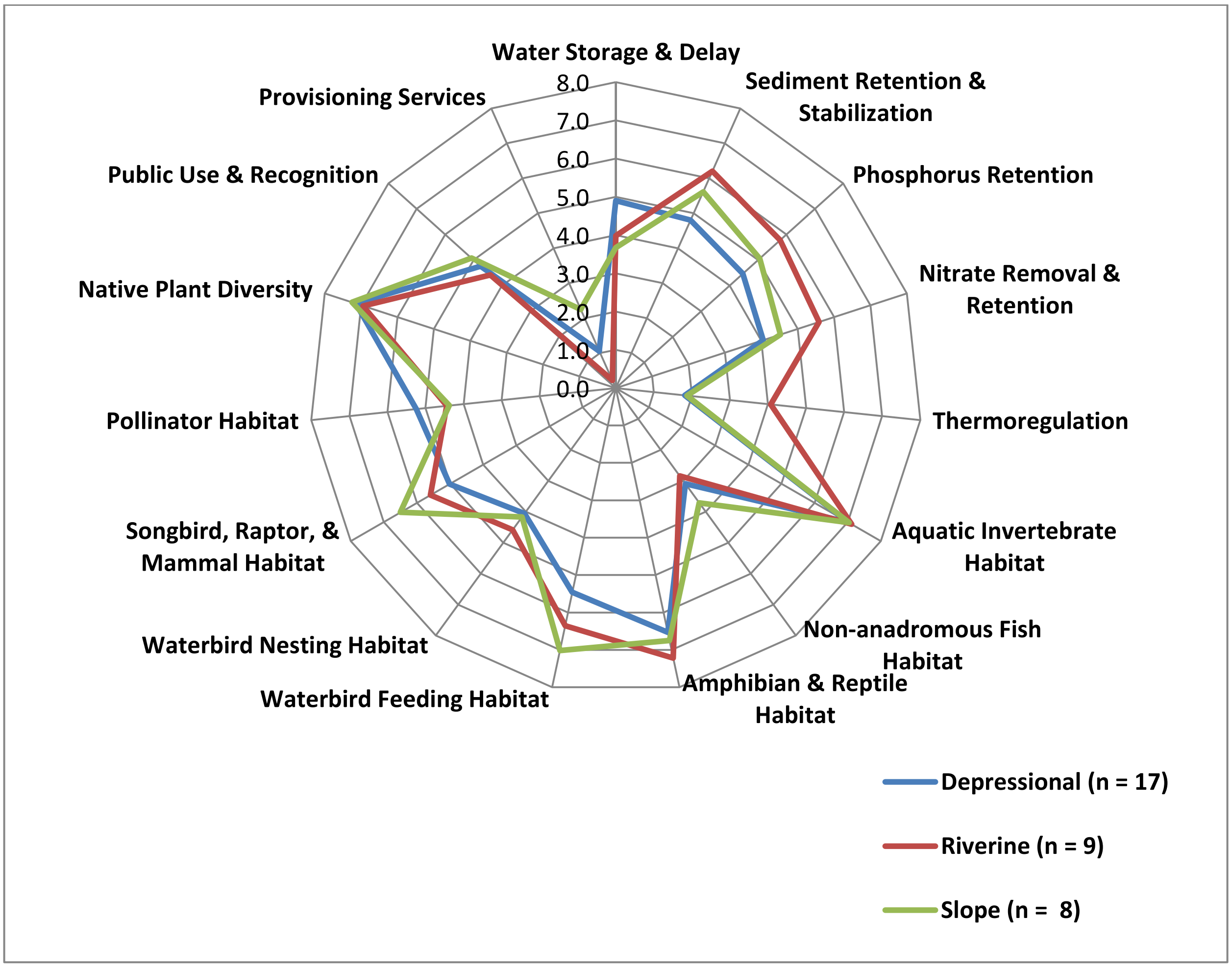

Figure 10. Values of functions by HGM class.

The value of water quality improvement functions and several habitat functions in 5 to 10-year old projects was higher than in either younger or older projects (Figure 11). In projects < 5 years since completion, the value of water storage and delay function was much higher than older project types. Although watershed context is the primary driver in value determination, project age could indicate how placement of projects on the landscape and objectives may be changing. It is possible that projects > 10-years since completion may have been placed in the most disturbed and fragmented agricultural landscapes with less consideration of if pollinators, bird, mammals, and amphibians can actually utilize restored, enhanced, and created habitat.

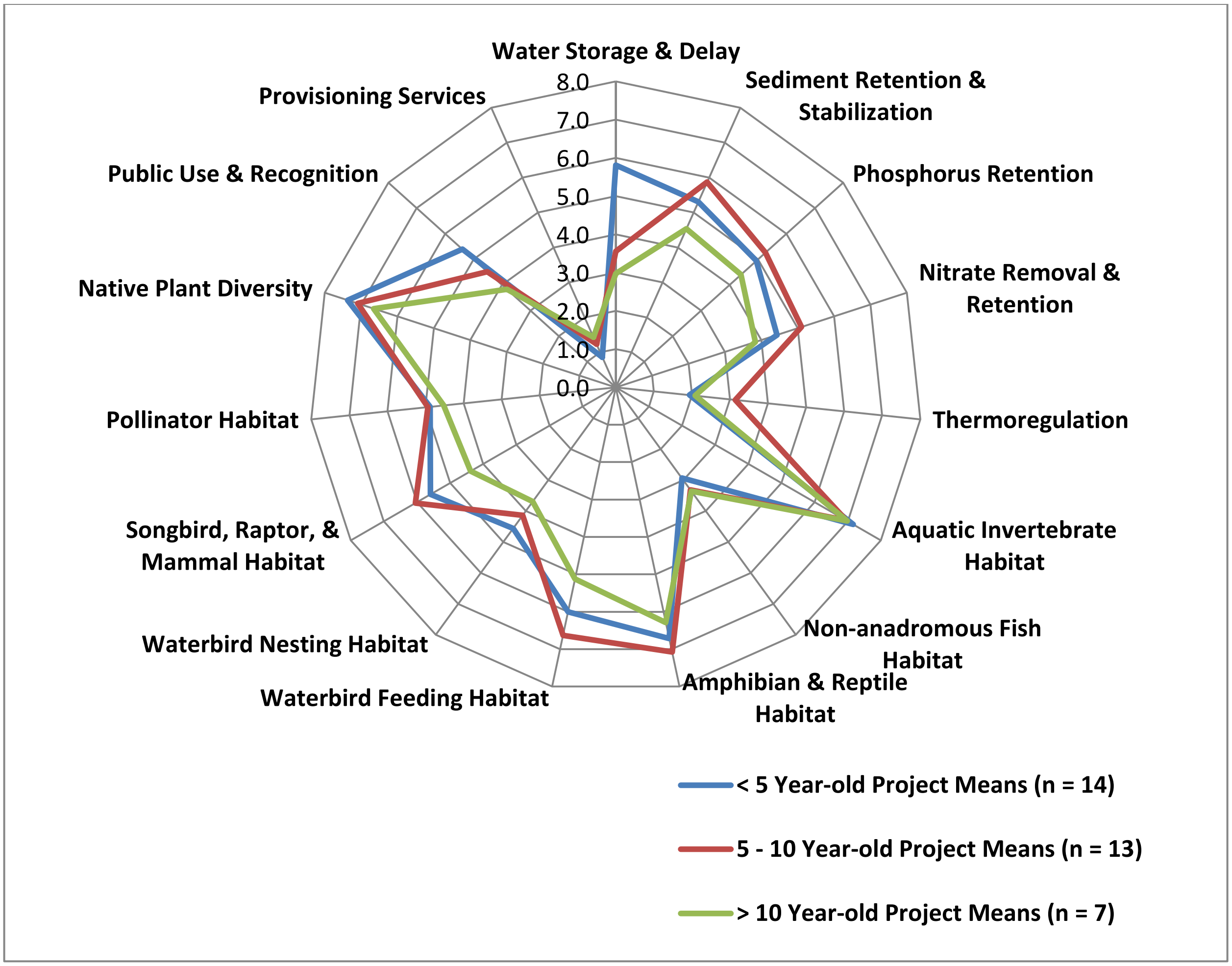

Figure 11. Values of functions by project age since implementation.

Some project types generated highly valued functions that likely met or exceeded the initial investment of resources. The value of water quality improvement functions (e.g., sediment retention and stabilization, phosphorus retention, nitrate removal and retention, and thermoregulation) in Clean Water Act S. 319 Grant-funded watershed restoration projects was high (Figure 12). Although not as high as in S. 319 projects, fish and wildlife habitat projects supported moderately highly valued water quality support functions. Mitigation projects also supported functions with high value, especially water storage and delay, sediment retention and stabilization, phosphorus retention, nitrate removal and retention, aquatic invertebrate habitat, and amphibian and reptile habitat. For example, the Franklin Wetland Mitigation site supported northern leopard frogs (*Rana pipiens*), an at-risk species in Idaho. Wetland habitat NAWCA-funded projects similarly resulted in highly valued bird, mammal, and waterbird habitat functions. The values of water quality support functions supported by stormwater and irrigation return water treatment projects were not as highly valued as expected.

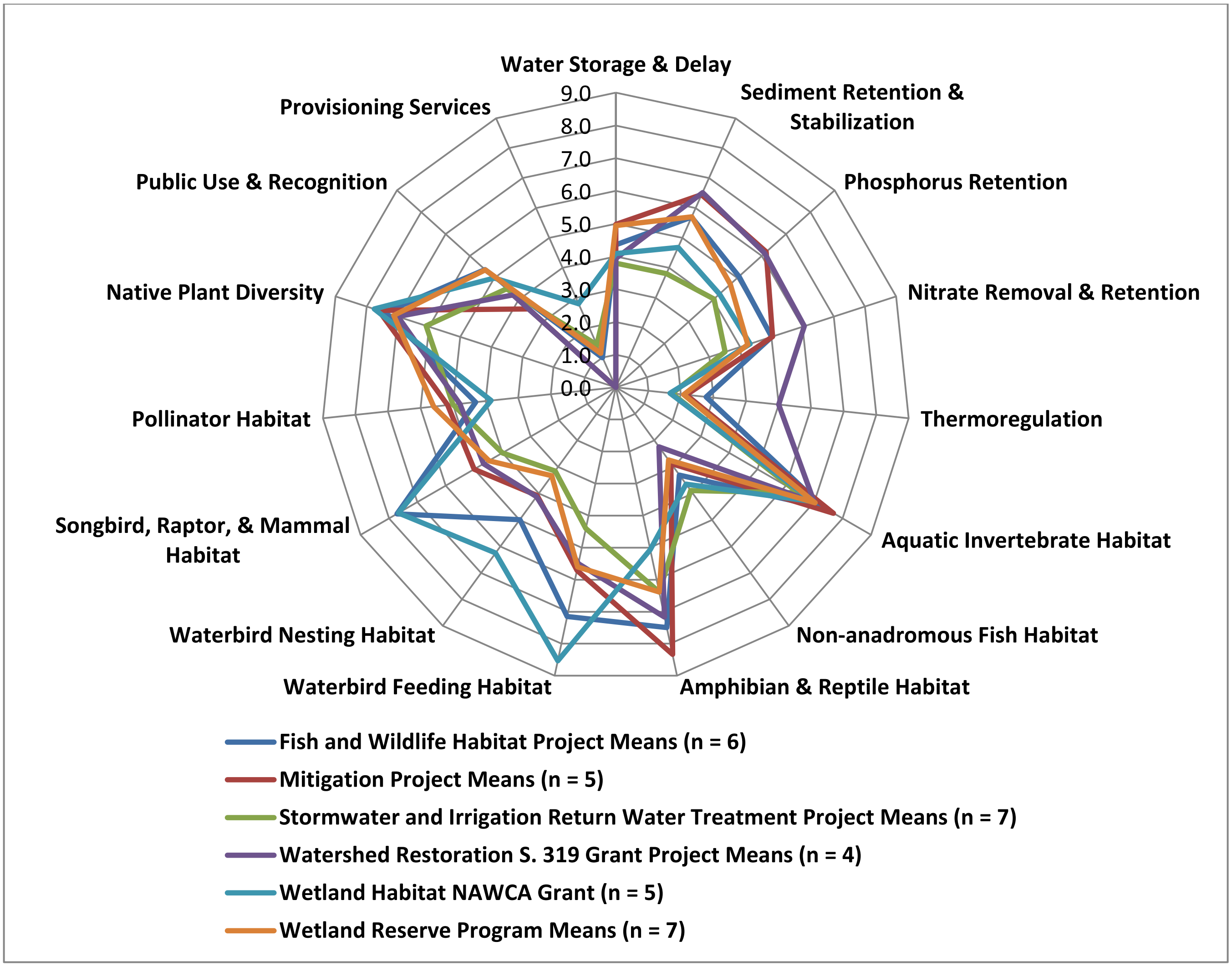

Figure 12. Values of functions by project type.

Assigning values to functions can also highlight results unexpected from original project objectives. Although designed to restore sediment retention and stabilization and thermoregulation functions, riparian and stream habitat projects also supported moderately highly valued phosphorus retention and nitrate removal and retention functions (Figure 13). Urban stormwater treatment projects resulted in valuable amphibian, reptile, and aquatic invertebrate functions in landscapes where habitats for these taxa are in short supply. Spring Cove Ranch, an irrigation return water treatment wetland, supported a population of rare northern leopard frog. Seasonally flooded marsh and wet meadow habitat projects had the highest value for public use and recognition (e.g., education) of any project objective. Similarly, the value of native plant diversity and bird and mammal habitat functions in these marsh and meadow complexes was high, indicating that where these types of wetlands occurred there were significant benefits to both wildlife and humans. Restoring, enhancing, and creating seasonally flooded marsh and wet meadow habitat may be challenging, but the results are likely worth the investment.

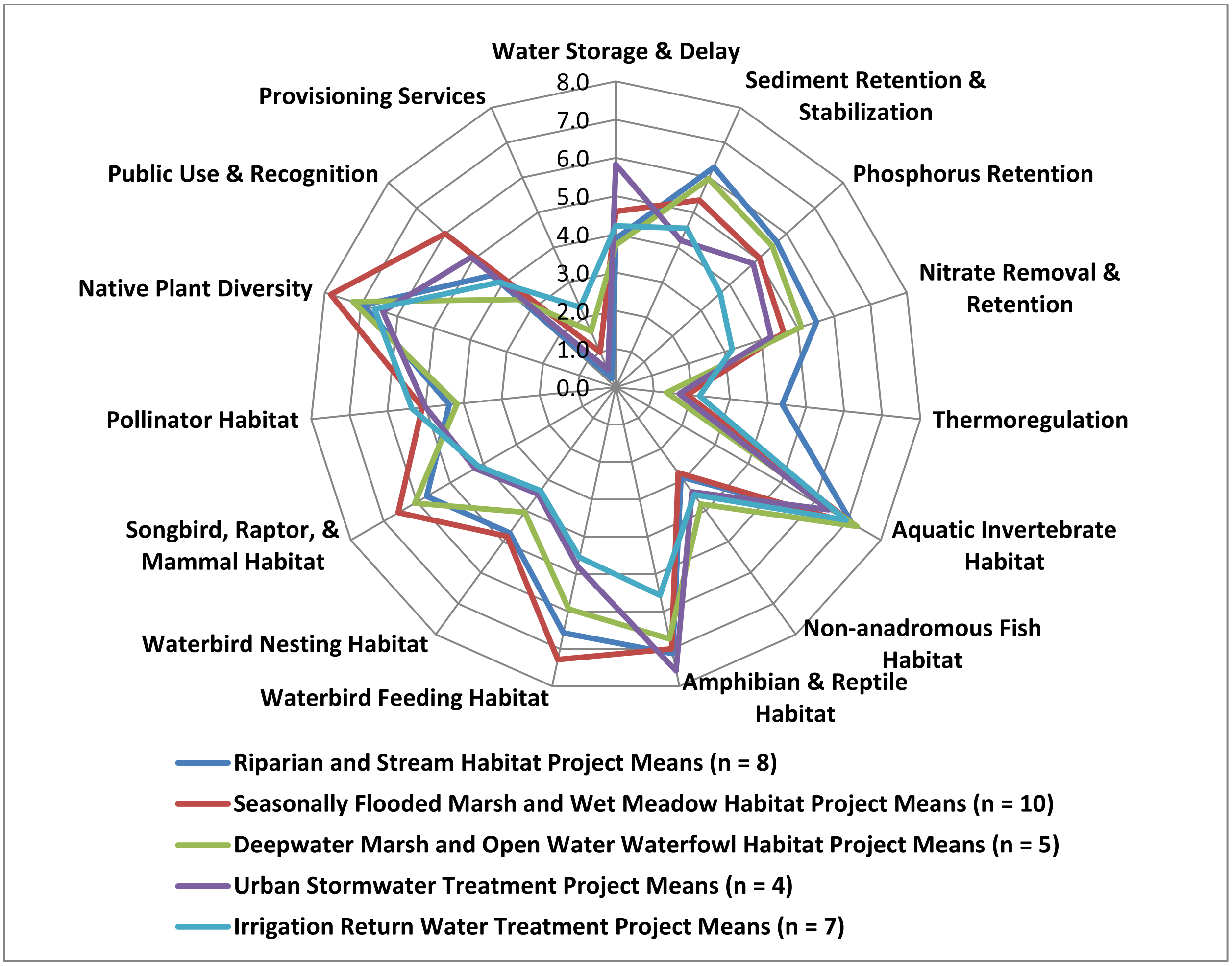

Figure 13. Values of functions by primary project objective (e.g., specific habitat or function).

Landscape-scale condition of restored, enhanced, and created wetlands

Overall, restored, enhanced, and created wetland projects in this survey were located in landscapes where restoration was needed and environmental constraints not so excessive that success was severely hampered. The vast majority of assessed wetland projects were located in moderately to severely disturbed settings predicted by our GIS landscape-scale assessment tool. Fifty-one percent of surveyed wetlands occurred in moderately disturbed settings, compared to 29% in severely disturbed landscape settings and 20% in minimally or lightly disturbed settings (Table 2). Moderately disturbed landscape settings were characterized by irrigated crop or hay agricultural production, with associated canals, roads, and houses adjacent. Severely disturbed settings had relatively high levels of urban housing density, associated streets, manipulated hydrology (e.g., stormwater management systems), and, occasionally, intensive agriculture. Minimally disturbed restored wetland settings occurred in areas of less intensive agriculture (e.g., hay fields and livestock grazing pasture), surrounded by natural areas or low density rural housing. No assessed wetlands occurred in completely disturbed settings (e.g., industrial areas). Although ecological integrity and function may be negatively impacted by human development, the proximity of 80% of surveyed restored, enhanced, and created wetland projects to urban and agricultural areas is noteworthy. This demonstrates compatibility of these projects with societal priorities. Many restoration projects used proximity to human development to their benefit by educating the public about the values of wetland functions, especially wildlife habitat, water quality, and recreation. This often results in increased community volunteer involvement, a broader partner base, and increased funding.

Wetland site-scale rapid assessment of condition

Results of field condition assessment were very similar to the landscape-scale wetland assessment. Based on the checklist of stressor indicators and land uses observed within and adjacent to wetlands (Idaho RAM), 48% percent of restored, enhanced, and created wetlands assessed were moderately disturbed, 29% severely disturbed, and 23% minimally or lightly disturbed (Table 2). This result is not unexpected because the process of restoration and creation often results in unavoidable disturbances and purposeful hydrologic modification. Stressors not detected by GIS analysis were present at several wetlands, most commonly noxious and invasive species (plants, bullfrogs, carp), recreation use (in urban areas), hydrologic modifications (ditches, dikes, culverts, water control structures, etc. not mapped as canals in GIS layers, many of which were the result of restoration activities), or, less frequently, livestock grazing. Non-native plant populations in restored sites may be due to colonization of bare soil patches resulting from disturbance during the restoration process. In other cases, non-native species populations may reflect expansion or persistence of weed populations present prior to restoration, enhancement, or creation project implementation (often the case with reed canarygrass, *Phalaris arundinacea*).

At 31% of the wetlands assessed, the cumulative impacts of adjacent land uses included in the GIS landscape-scale analysis did not result in an equivalent amount of stressors observed within the wetland. This situation occurred for various reasons. In several cases it appeared that maps of land use used in the landscape assessment tool were out of date (due to recent management changes) or mistakenly mapped. For example, land adjacent to a wetland was labeled intensive crop agriculture in GIS when in reality it was uncultivated grassland. Alternatively, a wide uncultivated buffer was established around the restored, enhanced, or created wetland that did not exist prior to the project. Either or both scenarios were the case for at least 7 wetlands.

Table 2. Ecological condition of restored, enhanced, and created wetlands assessed during this project.

Assessment Date	Assessment Site Name	Project Goal	HGM Class	Year Project Completed	Project Type	Specific Restoration, Enhancement, or Creation Objective	Phase I Landscape Tool Condition*	Phase II Landscape Tool Condition	Idaho Rapid Assessment Method Condition
10/29/2010	Alta Harris Ranch Side Channel - Boise River	restoration / enhancement	riverine / depressional	2007	Fish and Wildlife Habitat	riparian and stream habitat	severely	severely (moderately)	severely
10/19/2010	Bailie Sundown Ranch South - Teton River	restoration / enhancement	slope / depressional	2005	Wetland Habitat NAWCA Grant	seasonally flooded marsh and wet meadow habitat		minimally (moderately)	moderately (severely)
7/20/2011	Ball Creek TNC Preserve Wetland	restoration	depressional	2006	Wetland Habitat NAWCA Grant	seasonally flooded marsh and wet meadow habitat	moderately - severely	moderately	moderately
7/19/2011	Bismark Meadows Wetland	restoration / enhancement	slope	2004	Wetland Reserve Program	seasonally flooded marsh and wet meadow habitat	severely - moderately	minimally	minimally (moderately)
9/14/2011	Carol Ryrie Brink Nature Park	restoration	riverine / slope	1996	Watershed Restoration S. 319 Grant	riparian and stream habitat		severely	lightly (moderately)
9/22/2010	Chapman Wetland	restoration / enhancement	depressional	2003	Wetland Reserve Program	seasonally flooded marsh and wet meadow habitat		minimally (moderately)	moderately
9/29/2010	Chester Wetlands - Sand Creek WMA	enhancement / restoration	depressional	2007	Wetland Habitat NAWCA Grant	seasonally flooded marsh and wet meadow habitat		moderately	lightly (moderately)
9/15/2011	College of Southern Idaho Wetland - Perrine Coulee	creation / enhancement	slope / depressional	2007	Stormwater and Irrigation Return Water Treatment	urban stormwater treatment		moderately (severely)	severely
10/19/2010	Cooke Warm Creek Ranch	restoration / enhancement	slope / riverine / depressional	2003	Wetland Habitat NAWCA Grant	deepwater marsh and open water waterfowl habitat		moderately	severely
7/15/2011	Deyo Reservoir	restoration / enhancement	riverine / slope	2012	Fish and Wildlife Habitat	waterfowl and terrestrial wildlife habitat		minimally (lightly)	moderately
11/5/2010	Eagle Island Wetland Mitigation	restoration	depressional	~ 2000	Mitigation	seasonally flooded marsh and wet meadow habitat	severely	moderately	lightly (moderately)
11/5/2010	Fivemile - Victory Wetland	creation / enhancement	depressional / slope	~ 1997	Stormwater and Irrigation Return Water Treatment	urban stormwater treatment		severely	severely
9/1/2011	Franklin Wetland Mitigation	restoration	depressional / riverine	2006	Mitigation	deepwater marsh and open water waterfowl habitat		severely	severely
9/30/2010	Garden Creek - Conant Valley Ranch	restoration / enhancement	riverine / depressional	2005	Fish and Wildlife Habitat	riparian and stream habitat		minimally	severely

Table 2 continued.

Assessment Date	Assessment Site Name	Project Goal	HGM Class	Year Project Completed	Project Type	Specific Restoration, Enhancement, or Creation Objective	Phase I Landscape Tool Condition*	Phase II Landscape Tool Condition	Idaho Rapid Assessment Method Condition
9/27/2011	Genesee - Cow Creek Wetland Mitigation	restoration	riverine / slope	2005	Mitigation	riparian and stream habitat		moderately (severely)	lightly (moderately)
10/15/2010	Glenn Wetland	restoration	depressional	2005	Wetland Reserve Program	irrigation return water treatment	moderately	moderately (severely)	severely
7/18/2011	Hauser Lake	restoration / enhancement	depressional	2008	Wetland Reserve Program	deepwater marsh and open water waterfowl habitat	severely	moderately (minimally)	lightly (moderately)
11/5/2010	Hyatt Hidden Lakes Reserve	creation / enhancement	depressional / slope	2008	Stormwater and Irrigation Return Water Treatment	urban stormwater treatment	moderately	severely (moderately)	moderately (severely)
7/29/2010	Jewel Wetland	restoration / creation	depressional	2005	Wetland Reserve Program	irrigation return water treatment	moderately	moderately (severely)	moderately
9/21/2010	Kaler Easement - Telcher Creek Wetland	enhancement	depressional	1992 - 2004	Fish and Wildlife Habitat	seasonally flooded marsh and wet meadow habitat		moderately (severely)	lightly (moderately)
10/21/2010	Klausman Lazy K Ranch	restoration / enhancement	slope / depressional	2002	Fish and Wildlife Habitat	seasonally flooded marsh and wet meadow habitat		moderately	moderately
9/2/2011	Lloyd Wetland	creation	depressional	1992 - 2003	Stormwater and Irrigation Return Water Treatment	irrigation return water treatment		moderately (lightly)	minimally (moderately)
11/3/2010	LQ Drain	creation / enhancement	depressional	1993 - 2003	Stormwater and Irrigation Return Water Treatment	irrigation return water treatment		moderately (severely)	severely (completely)
8/18/2011	Price Road - McCammon Wetland Mitigation	restoration	depressional	2008	Mitigation	deepwater marsh and open water waterfowl habitat		moderately	moderately
9/29/2010	Rainey Creek	restoration / enhancement	depressional / riverine	2006	Fish and Wildlife Habitat	seasonally flooded marsh and wet meadow habitat		moderately	moderately
9/24/2010	Round Valley Creek	restoration / enhancement	riverine / depressional / slope	2008	Fish and Wildlife Habitat	riparian and stream habitat		minimally	moderately (severely)
8/31/2011	Sacajawea Park - Portneuf River	creation / enhancement	slope / depressional / riverine	2008	Stormwater and Irrigation Return Water Treatment	urban stormwater treatment		severely	severely
9/20/2011	South Fork Palouse River	restoration	riverine	2004	Watershed Restoration S. 319 Grant	riparian and stream habitat		severely	moderately

Table 2 continued.

Assessment Date	Assessment Site Name	Project Goal	HGM Class	Year Project Completed	Project Type	Specific Restoration, Enhancement, or Creation Objective	Phase I Landscape Tool Condition*	Phase II Landscape Tool Condition	Idaho Rapid Assessment Method Condition
10/14/2011	Spring Cove Ranch	creation / enhancement	depressional	1992 - 2003	Stormwater and Irrigation Return Water Treatment	irrigation return water treatment		moderately	moderately
9/11/2011	Streets Wetland	restoration / enhancement	riverine / slope / depressional	2003	Watershed Restoration S. 319 Grant	seasonally flooded marsh and wet meadow habitat		severely	moderately
10/6/2010	Succor Creek Wetland	restoration / enhancement	depressional	~ 2008	Wetland Reserve Program	irrigation return water treatment	moderately	moderately	severely
9/22/2011	Threemile Creek	restoration	riverine / slope	2007	Watershed Restoration S. 319 Grant	riparian and stream habitat		severely (moderately)	moderately
10/20/2010	Vest Sundown River Ranch North - Teton River	enhancement	slope / depressional / riverine	2005	Wetland Habitat NAWCA Grant	deepwater marsh and open water waterfowl habitat		minimally (lightly)	moderately
10/4/2011	Worley - North Fork Rock Creek Wetland Mitigation	restoration	riverine / depressional	~ 2001	Mitigation	riparian and stream habitat		moderately (severely)	moderately
10/8/2010	Wrightman Wetland	restoration / enhancement	slope / depressional	~ 2007	Wetland Reserve Program	irrigation return water treatment	moderately - severely	severely (moderately)	moderately (severely)

* = Murphy and Schmidt 2010

Wetland condition and stress by project goal, HGM class, type, and objective

In the Idaho RAM, the highest ranks (on a scale of 1 to 5) represent the **highest stressor levels,** but the **least disturbed condition**. Similarly, the number of stressors recorded using ORWAP / WESPUS is scored on a scale of 0 to 10 (with 10 representing the **highest stressor levels**). Condition is scored on a scale of 0 to 10 (with 10 representing the **least disturbed condition**). Wetland sensitivity is also scored on a scale of 0 to 10, where the higher the score the **more sensitive** a wetland is to human or natural stressors (Adamus et al. 2010a, Adamus 2011).

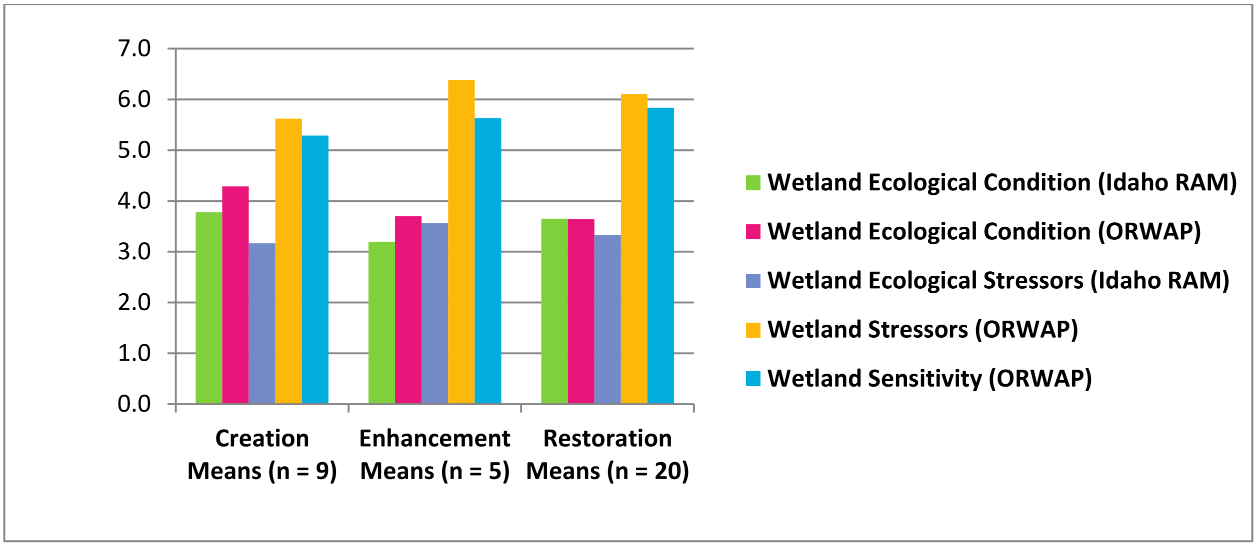

Figure 14. Condition by project goal (restoration, enhancement, or creation).

Wetland stress and relative condition of wetlands determined in the field by Idaho RAM were mostly similar between restored, enhanced, and created wetlands (Figure 14). The condition of enhanced wetlands was slightly worse, and the level of stressors slightly higher, than restored and created wetlands. The ORWAP / WESPUS method also showed enhanced wetlands having slightly higher levels of stress than other wetland project goal types in the survey. Created wetlands were in slightly better ecological condition than enhanced and restored wetlands when assessed using ORWAP. Across all project goal types, condition values were indicative of moderate disturbance. Restoration projects were more sensitive to stress than enhanced or created wetlands, but only slightly so. Overall, differences between restored, enhanced, and created wetlands were likely within the margin of error for using these assessment methods (Adamus et al. 2010a).

The Idaho RAM was not as sensitive as ORWAP / WESPUS in detecting apparent condition differences between various restored, enhanced, and created wetland HGM classes. Condition and stressors were similar between depressional, riverine, and slope wetlands using Idaho RAM (Figure 15). Using ORWAP / WESPUS slope wetlands had noticeably higher ecological condition than depressional or riverine wetlands. Stress to wetlands did not differ greatly between depressional, riverine, and slope HGM types. Slope wetlands were notably the most sensitive to stress, followed by depressional wetlands. This may have been due to the inclusion of enhanced fens in this HGM class.

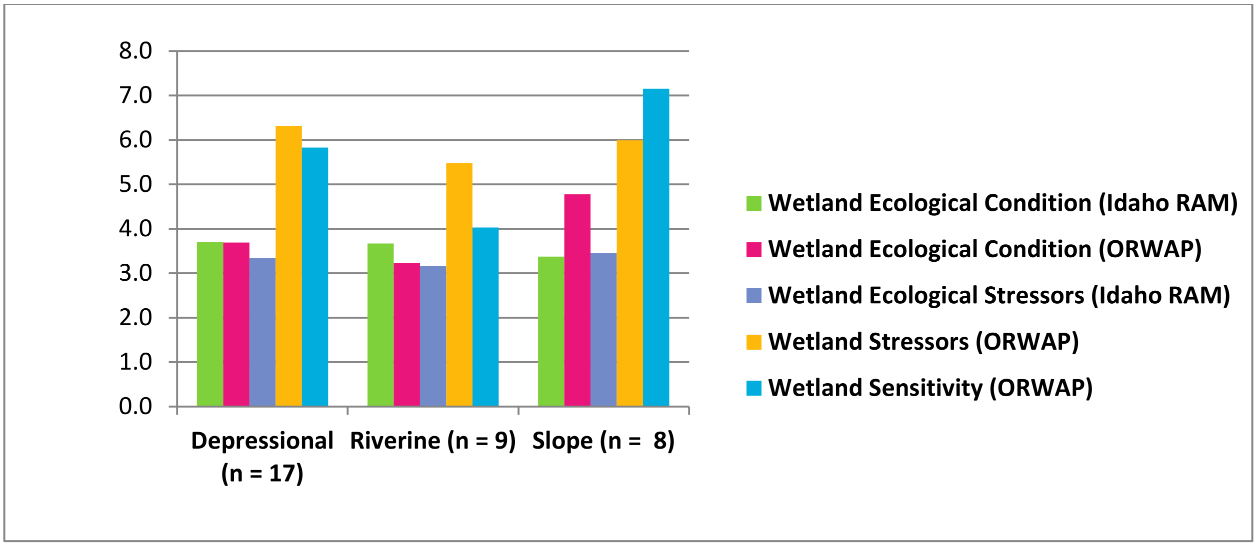

Figure 15. Condition by HGM class.

Wetland condition estimated using Idaho RAM increased over time since project completion, and the number of stressors recorded in > 10 year-old projects was slightly less than those < 5 years since completion (Figure 16). ORWAP / WESPUS produced somewhat different results. Condition was best for projects 5 - 10 years since completion, and unlike Idaho RAM results, > 10 year-old projects had the poorest condition level. However, differences in condition were minimal between the oldest and youngest project age classes. According to results of both methods, wetland stress was highest for < 5 year-old projects. Projects > 10 years since implementation were the most sensitive to disturbance, but not dramatically different from younger projects. ORWAP / WESPUS results illustrate how ecologic condition can change relatively rapidly after implementation (due to both natural succession and human-related factors), emphasizing the need for stewardship assessments and adaptive management after 5 years. For example, the trajectory of some projects toward undesired states (e.g., dominance by non-native invasive species) may not be clear until 5 to 10 years after project completion.

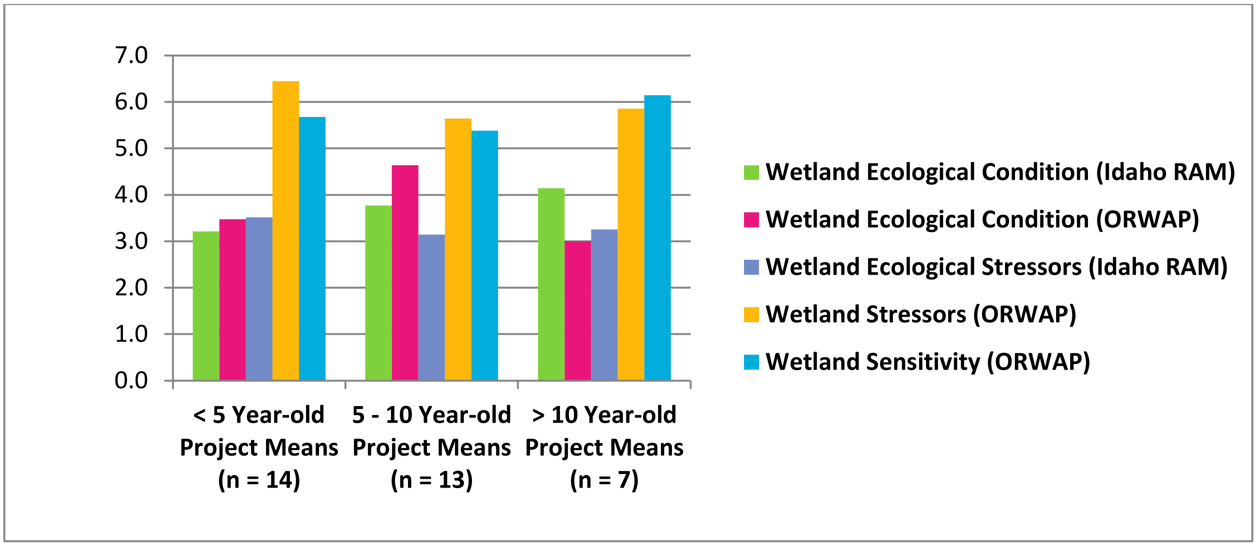

Figure 16. Condition by project age since implementation.

Condition and stressor levels by project type varied. NAWCA projects, followed by fish and wildlife habitat projects were clearly in the best ecological condition according to ORWAP / WESPUS (Figure 17). Idaho RAM results differed, showing watershed restoration S. 319 projects, followed by mitigation projects, in the best ecological condition. The average number of stressors for S. 319 projects was the lowest of all types according to the Idaho RAM. Using ORWAP / WESPUS, S. 319 projects were in the poorest ecological condition of all types. Stormwater and irrigation return water treatment projects were in the worst condition using Idaho RAM and second to worst condition using ORWAP / WESPUS. The amount of stress to these water treatment wetlands was the highest of all project types according to results of both methods. The ecological condition of mitigation wetlands was relatively low, and stress levels high, using the ORWAP / WESPUS method. However, mitigation wetlands performed a wide variety of functions at relatively high levels. With the Idaho RAM, mitigation wetlands assessed as having notably better ecologic condition than shown by ORWAP / WESPUS results. Mitigation, WRP, and NAWCA projects were clearly more sensitive to stressors than other project types.

The condition of seasonally flooded marsh and wet meadow habitat projects was very good, based on both Idaho RAM and ORWAP / WESPUS results (Figure 18). Deepwater marsh and open water waterfowl habitat projects were in the best ecologic condition according to ORWAP / WESPUS, although stress levels were relatively high. These projects were also the most sensitive to stressors, followed by seasonally flooded marsh and wet meadow wetlands. The condition of riparian and stream habitat projects was moderate. The ecologic condition of urban stormwater treatment projects was clearly the poorest, followed by irrigation return water treatment projects, as shown by both methods. Stressors to these wetlands were correspondingly high.

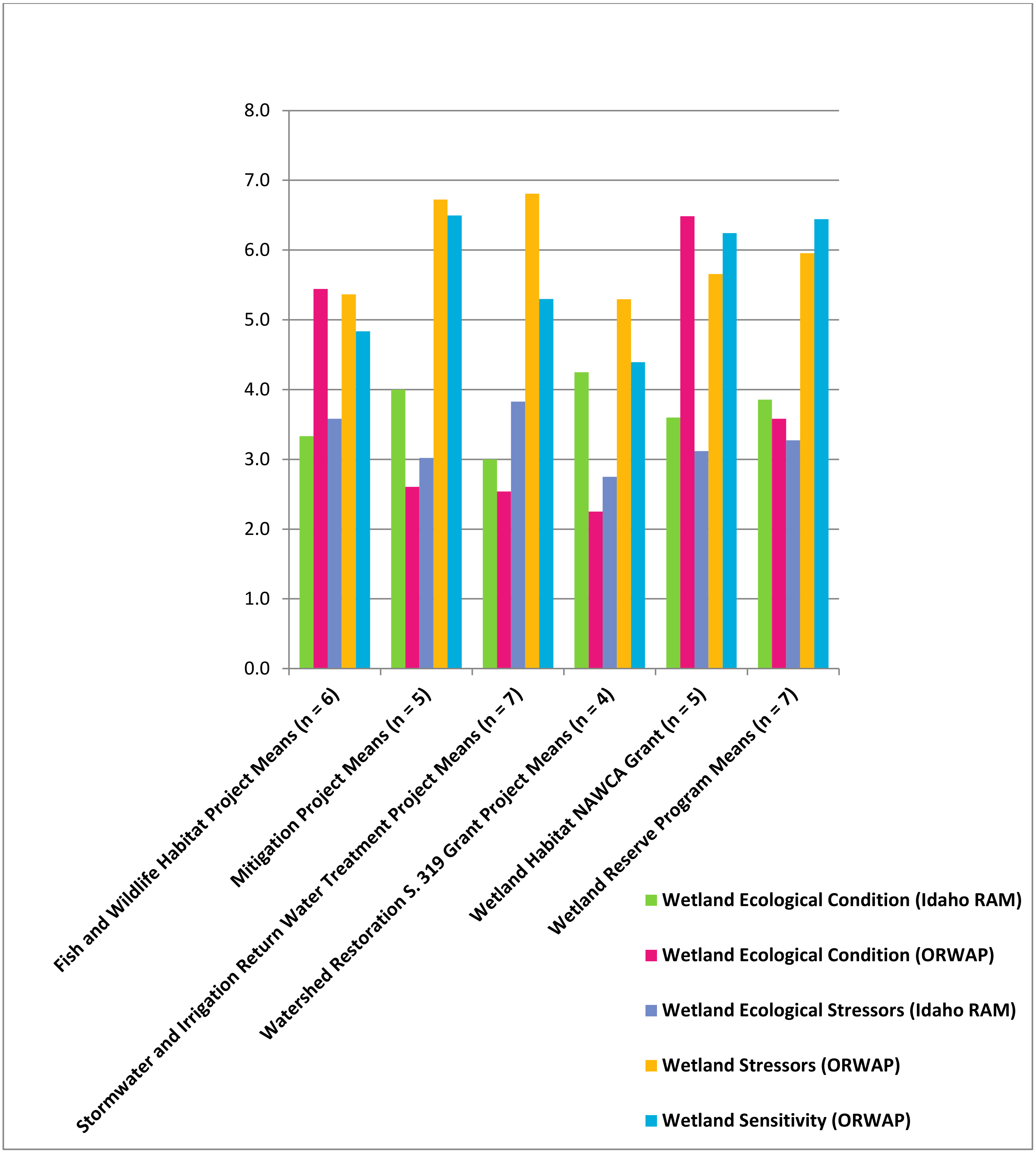

Figure 17. Condition by project type.

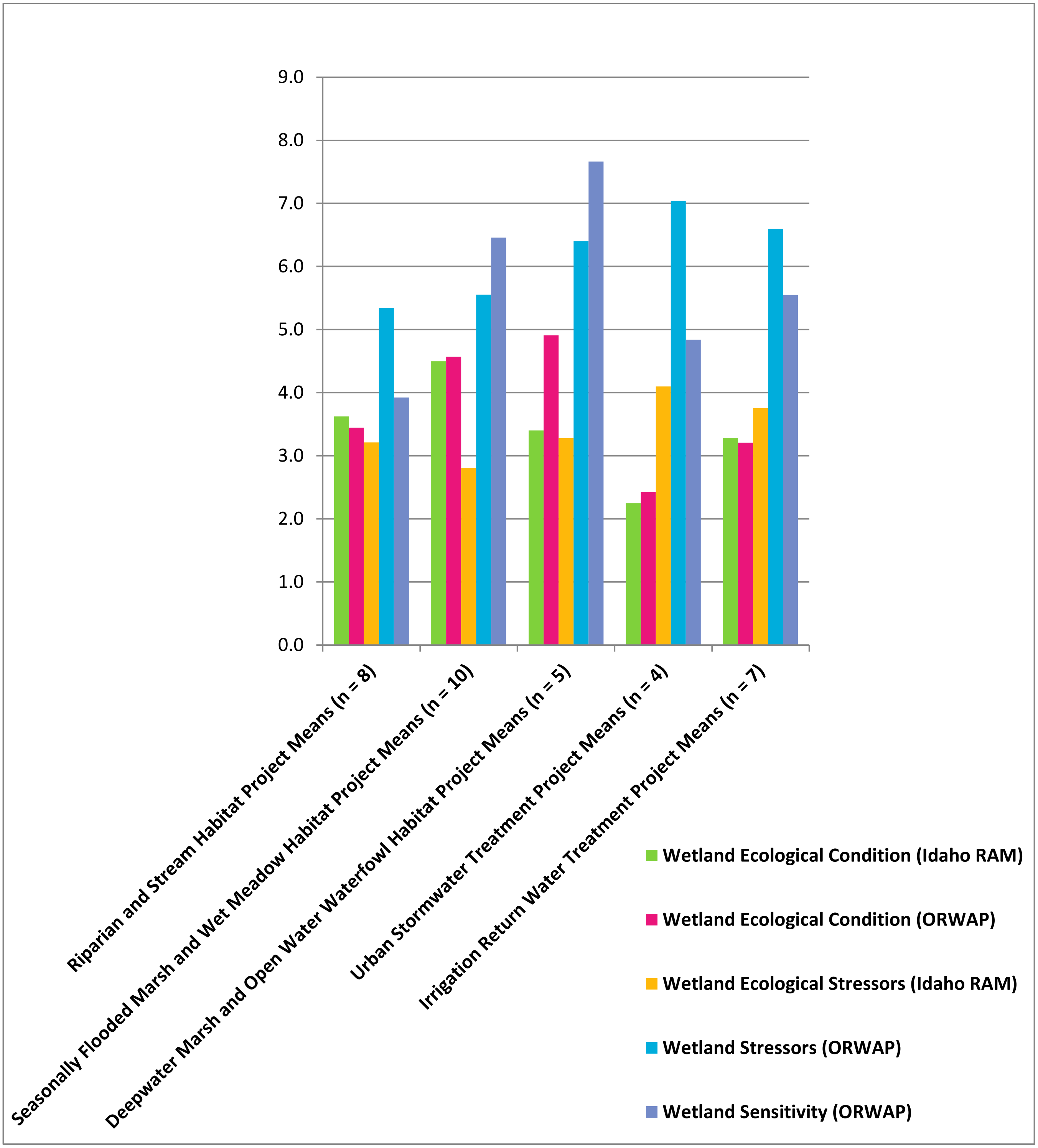

Figure 18. Condition by primary project objective (e.g., specific habitat or function).

Vegetation of restored, enhanced, and created wetlands and reference wetlands

Based on analysis of plot data, vegetation succession in restored, enhanced, and created wetlands was not predictable. This indicated the presence of multiple successional trajectories for the same ecological habitat, depending on watershed and local factors. Plant species composition was highly variable, with a relatively low percentage of species shared between restored, enhanced, and created wetlands and reference wetlands, regardless of watershed group. The spreadsheet in Appendix 2 summarizes all vegetation plot data. As expected, variability was also relatively high between the same ecological habitats in different watershed ecological groups. Across all plots there were 760 unique plant taxa documented, of which 353 were recorded in restored, enhanced, and created wetland plots and 662 in reference wetlands. The most frequently sampled species in restored, enhanced, and created wetland plots were (in decreasing order):

1. common spikerush (*Eleocharis palustris*)
2. Baltic rush (*Juncus balticus*)
3. reed canarygrass (*Phalaris arundinacea*)*
4. cattail (*Typha latifolia*)
5. Canada thistle (*Cirsium arvense*)*
6. wild mint (*Mentha arvensis*)
7. Kentucky bluegrass (*Poa pratensis*)*
8. curly dock (*Rumex crispus*)*
9. hardstem bulrush (*Schoenoplectus acutus*)
10. fringed willowherb (*Epilobium ciliatum*)
11. woolly sedge (*Carex pellita*)
12. bull thistle (*Cirsium vulgare*)*

*= non-native species

The large volume of vegetation data is more easily interpreted when reduced to the most characteristic native "keystone" species in each ecological habitat (Table 3). In reference wetlands, across all watershed groups, scrub-shrub wetlands usually had the highest diversity of native keystone species, followed by tall emergent marshes. Restored, enhanced, and created scrub-shrub and short emergent marsh wetlands were often lacking a large percentage of keystone species found in reference wetlands (cells highlighted red in Table 3). Restored, enhanced, and created wetlands in the Middle Snake River Plain, Palouse, and Southeast Basin watershed ecological groups shared the least keystone species with reference wetlands in several habitat types. Projects in the Upper Snake River Plain and Yellowstone Plateau shared a higher percentage of keystone species with reference wetlands.

Floristic Quality Assessment

<u>Floristic quality by watershed ecological group</u>: Overall, the mean C value, FQAI, and adjusted FQAI of reference and restored, enhanced, and created wetland vegetation were highest in watersheds of North Panhandle Valleys, North-central Foothills, and the Yellowstone Region (Figure 19). The North Panhandle Valleys and Yellowstone Region also had the highest percentages of their flora that were intolerant of disturbance (C-values $\geq$ 7) (Figure 20). These areas support a large diversity of wetland habitats, including fens. The overall floristic quality in restored, enhanced, and created wetland vegetation in these watersheds was noticeably better than other areas of the state, as shown by mean C-values > 3.

Table 3. Keystone species by ecological habitat and watershed group for restored, enhanced, and created wetlands ("Restoration Plots") and reference wetlands.

Watershed Group	Ecological Habitat	ScientificName	Common Name	% Constancy Restoration Plots	Min % Cover Restoration Plots	Max % Cover Restoration Plots	Mean % Cover Restoration Plots	% Constancy Reference Plots	Min % Cover Reference Plots	Max % Cover Reference Plots	Mean % Cover Reference Plots
Boise-Payette River Valleys	Alkaline Wetland	Distichlis spicata	inland saltgrass	100.0	60.0	60.0	60.0	100.0	1.0	90.0	52.8
Boise-Payette River Valleys	Alkaline Wetland	Eleocharis rostellata	beaked spikerush					50.0	0.1	85.0	42.6
Boise-Payette River Valleys	Alkaline Wetland	Sarcobatus vermiculatus	greasewood					50.0	20.0	33.0	26.5
Boise-Payette River Valleys	Alkaline Wetland	Suaeda calceoliformis	Pursh seepweed					75.0	1.0	16.0	8.0
Boise-Payette River Valleys	Alkaline Wetland	Schoenoplectus pungens	common threesquare	100.0	10.0	10.0	10.0				
Boise-Payette River Valleys	Forested Wetland	Populus balsamifera ssp. trichocarpa	black cottonwood	100.0	0.1	70.0	31.0	100.0	1.0	65.0	41.4
Boise-Payette River Valleys	Forested Wetland	Euthamia occidentalis	western goldentop	50.0	0.1	15.0	7.6	60.0	5.0	30.0	21.7
Boise-Payette River Valleys	Forested Wetland	Maianthemum racemosum ssp. amplexicaule	feathery false lily of the valley					60.0	0.1	34.0	21.4
Boise-Payette River Valleys	Forested Wetland	Carex pellita	woolly sedge	50.0	9.0	15.0	12.0	40.0	3.0	30.0	16.5
Boise-Payette River Valleys	Forested Wetland	Salix lutea	yellow willow	25.0	3.0	3.0	3.0	60.0	3.0	30.0	13.5
Boise-Payette River Valleys	Forested Wetland	Salix lucida ssp. caudata	greenleaf willow	25.0	1.0	1.0	1.0	60.0	0.1	35.0	13.0
Boise-Payette River Valleys	Forested Wetland	Ribes aureum	golden currant	25.0	1.0	1.0	1.0	80.0	1.0	30.0	11.1
Boise-Payette River Valleys	Forested Wetland	Solidago gigantea	giant goldenrod					60.0	0.1	30.0	11.0
Boise-Payette River Valleys	Forested Wetland	Rosa woodsii	Woods' rose					80.0	1.0	30.0	10.6
Boise-Payette River Valleys	Forested Wetland	Salix exigua	narrowleaf willow	50.0	4.0	20.0	12.0	60.0	0.1	6.5	2.2
Boise-Payette River Valleys	Forested Wetland	Alnus incana	gray alder	50.0	3.0	60.0	31.5				
Boise-Payette River Valleys	Tall Emergent Marsh	Eleocharis palustris	common spikerush	50.0	2.0	5.0	3.0	50.0	50.0	50.0	50.0
Boise-Payette River Valleys	Tall Emergent Marsh	Polygonum amphibium var. emersum	longroot smartweed					50.0	3.0	75.0	39.0
Boise-Payette River Valleys	Tall Emergent Marsh	Schoenoplectus americanus	chairmaker's bulrush	16.7	0.1	0.1	0.1	50.0	20.0	40.0	30.0
Boise-Payette River Valleys	Tall Emergent Marsh	Berula erecta	cutleaf waterparsnip					50.0	20.0	40.0	30.0
Boise-Payette River Valleys	Tall Emergent Marsh	Carex pellita	woolly sedge	16.7	0.1	0.1	0.1	50.0	20.0	30.0	25.0
Boise-Payette River Valleys	Tall Emergent Marsh	Panicum capillare	witchgrass	16.7	0.1	0.1	0.1	50.0	0.1	40.0	20.1
Boise-Payette River Valleys	Tall Emergent Marsh	Schoenoplectus tabernaemontani	softstem bulrush	50.0	0.1	30.0	13.4	50.0	0.1	1.0	0.6
Boise-Payette River Valleys	Tall Emergent Marsh	Typha latifolia	broadleaf cattail	100.0	4.0	90.0	52.3	50.0	0.1	0.1	0.1
Boise-Payette River Valleys	Tall Emergent Marsh	Schoenoplectus acutus	hardstem bulrush	100.0	0.1	90.0	16.9				

Table 3 continued.

Watershed Group	Ecological Habitat	ScientificName	Common Name	% Constancy Restoration Plots	Min % Cover Restoration Plots	Max % Cover Restoration Plots	Mean % Cover Restoration Plots	% Constancy Reference Plots	Min % Cover Reference Plots	Max % Cover Reference Plots	Mean % Cover Reference Plots
Boise-Payette River Valleys	Wet Meadow	Carex praegracilis	clustered field sedge					66.7	0.1	60.0	27.8
Boise-Payette River Valleys	Wet Meadow	Eleocharis palustris	common spikerush					50.0	1.0	70.0	24.7
Boise-Payette River Valleys	Wet Meadow	Juncus balticus	Baltic rush	100.0	40.0	40.0	40.0	66.7	3.0	70.0	21.5
Boise-Payette River Valleys	Wet Meadow	Carex vulpinoidea	fox sedge	100.0	20.0	20.0	20.0	66.7	0.1	65.0	18.9
Boise-Payette River Valleys	Wet Meadow	Schoenoplectus americanus	chairmaker's bulrush					50.0	2.0	30.0	17.3
Boise-Payette River Valleys	Wet Meadow	Carex pellita	woolly sedge	100.0	6.0	6.0	6.0	83.3	0.5	40.0	12.9
Boise-Payette River Valleys	Wet Meadow	Carex nebrascensis	Nebraska sedge	100.0	5.0	5.0	5.0	33.3	0.1	4.0	2.1
Boise-Payette River Valleys	Wet Meadow	Schoenoplectus acutus	hardstem bulrush	100.0	15.0	15.0	15.0				
Lower Snake River Valley	Alkaline Wetland	Distichlis spicata	inland saltgrass					100.0	1.0	100.0	52.7
Lower Snake River Valley	Alkaline Wetland	Eleocharis rostellata	beaked spikerush	50.0	60.0	60.0	60.0	33.3	0.1	85.0	42.6
Lower Snake River Valley	Alkaline Wetland	Schoenoplectus americanus	chairmaker's bulrush	50.0	20.0	20.0	20.0	50.0	1.0	60.0	21.5
Lower Snake River Valley	Alkaline Wetland	Puccinellia lemmonii	Lemmon's alkaligrass	50.0	60.0	60.0	60.0				
Lower Snake River Valley	Alkaline Wetland	Puccinellia nuttalliana	Nuttall's alkaligrass	50.0	30.0	30.0	30.0				
Lower Snake River Valley	Alkaline Wetland	Schoenoplectus pungens	common threesquare	100.0	1.0	30.0	15.5				
Lower Snake River Valley	Alkaline Wetland	Juncus articulatus	jointleaf rush	50.0	10.0	10.0	10.0				
Lower Snake River Valley	Tall Emergent Marsh	Berula erecta	cutleaf waterparsnip					50.0	20.0	40.0	30.0
Lower Snake River Valley	Tall Emergent Marsh	Panicum capillare	witchgrass					50.0	0.1	40.0	20.1
Lower Snake River Valley	Tall Emergent Marsh	Typha latifolia	broadleaf cattail	100.0	30.0	70.0	50.0	25.0	0.1	0.1	0.1
Lower Snake River Valley	Tall Emergent Marsh	Paspalum distichum	knotgrass	50.0	10.0	10.0	10.0	25.0	0.1	0.1	0.1
Lower Snake River Valley	Tall Emergent Marsh	Eleocharis acicularis	needle spikerush	50.0	20.0	20.0	20.0				
Middle Snake River Plain	Mesic Meadow	Juncus balticus	Baltic rush					100.0	1.0	65.0	42.8
Middle Snake River Plain	Mesic Meadow	Hordeum brachyantherum	meadow barley					66.7	0.5	55.0	27.8
Middle Snake River Plain	Mesic Meadow	Muhlenbergia asperifolia	scratchgrass					100.0	0.1	15.0	5.9
Middle Snake River Plain	Mesic Meadow	Carex pellita	woolly sedge	100.0	50.0	50.0	50.0				
Middle Snake River Plain	Scrub-Shrub Wetland	Salix exigua	narrowleaf willow	100.0	80.0	80.0	80.0	33.3	60.0	60.0	60.0
Middle Snake River Plain	Scrub-Shrub Wetland	Prunus virginiana	chokecherry					66.7	20.0	80.0	50.0
Middle Snake River Plain	Scrub-Shrub Wetland	Rosa woodsii	Woods' rose					66.7	10.0	40.0	25.0
Middle Snake River Plain	Short Emergent Marsh	Eleocharis palustris	common spikerush	100.0	70.0	70.0	70.0	50.0	70.0	70.0	70.0
Middle Snake River Plain	Short Emergent Marsh	Carex nebrascensis	Nebraska sedge					50.0	70.0	70.0	70.0
Middle Snake River Plain	Short Emergent Marsh	Carex praegracilis	clustered field sedge					50.0	12.5	12.5	12.5
Middle Snake River Plain	Tall Emergent Marsh	Typha latifolia	broadleaf cattail	100.0	2.0	90.0	37.8	33.3	80.0	80.0	80.0
Middle Snake River Plain	Tall Emergent Marsh	Schoenoplectus acutus	hardstem bulrush	62.5	0.1	90.0	36.8	66.7	3.0	60.0	31.5
Middle Snake River Plain	Tall Emergent Marsh	Stuckenia pectinatus	sago pondweed	50.0	1.0	50.0	22.8				

Table 3 continued.

Watershed Group	Ecological Habitat	ScientificName	Common Name	% Constancy Restoration Plots	Min % Cover Restoration Plots	Max % Cover Restoration Plots	Mean % Cover Restoration Plots	% Constancy Reference Plots	Min % Cover Reference Plots	Max % Cover Reference Plots	Mean % Cover Reference Plots
North Panhandle Valleys	Fen	Scirpus microcarpus	panicled bulrush	100.0	0.1	90.0	45.1	12.5	40.0	40.0	40.0
North Panhandle Valleys	Fen	Carex utriculata	Northwest Territory sedge	100.0	0.1	40.0	20.1	62.5	1.0	80.0	19.0
North Panhandle Valleys	Fen	Spiraea douglasii	rose spirea	100.0	7.0	70.0	38.5	50.0	1.0	60.0	17.3
North Panhandle Valleys	Fen	Drosera rotundifolia	roundleaf sundew					50.0	0.1	10.0	4.5
North Panhandle Valleys	Fen	Salix geyeriana	Geyer's willow	50.0	60.0	60.0	60.0				
North Panhandle Valleys	Tall Emergent Marsh	Carex lasiocarpa	woollyfruit sedge					50.0	60.0	60.0	60.0
North Panhandle Valleys	Tall Emergent Marsh	Schoenoplectus acutus	hardstem bulrush					50.0	60.0	60.0	60.0
North Panhandle Valleys	Tall Emergent Marsh	Sagittaria cuneata	arumleaf arrowhead					50.0	30.0	30.0	30.0
North Panhandle Valleys	Tall Emergent Marsh	Alisma gramineum	narrowleaf water plantain					50.0	10.0	10.0	10.0
North Panhandle Valleys	Tall Emergent Marsh	Dulichium arundinaceum	threeway sedge					50.0	10.0	10.0	10.0
North Panhandle Valleys	Tall Emergent Marsh	Schoenoplectus tabernaemontani	softstem bulrush	66.7	0.1	30.0	15.1				
North-central Foothills	Short Emergent Marsh	Eleocharis palustris	common spikerush	100.0	3.0	25.0	14.0	14.3	70.0	70.0	70.0
North-central Foothills	Short Emergent Marsh	Carex aquatilis	water sedge					57.1	5.0	98.0	40.8
North-central Foothills	Short Emergent Marsh	Sparganium angustifolium	narrowleaf bur-reed	100.0	4.0	40.0	22.0	42.9	0.1	60.0	20.4
North-central Foothills	Short Emergent Marsh	Eleocharis acicularis	needle spikerush	100.0	20.0	25.0	22.5	14.3	4.0	4.0	4.0
North-central Foothills	Short Emergent Marsh	Gnaphalium palustre	western marsh cudweed	50.0	10.0	10.0	10.0	28.6	0.1	5.0	2.6
Palouse	Forested Wetland	Populus balsamifera ssp. trichocarpa	black cottonwood					87.5	0.1	85.0	40.0
Palouse	Forested Wetland	Physocarpus capitatus	Pacific ninebark					50.0	0.1	50.0	15.0
Palouse	Scrub-Shrub Wetland	Alnus incana	gray alder					75.0	5.0	75.0	35.8
Palouse	Scrub-Shrub Wetland	Athyrium filix-femina	common ladyfern					62.5	1.0	80.0	31.2
Palouse	Scrub-Shrub Wetland	Crataegus douglasii var. douglasii	black hawthorn					50.0	1.0	80.0	30.3
Palouse	Scrub-Shrub Wetland	Salix drummondiana	Drummond's willow	50.0	20.0	20.0	20.0	12.5	30.0	30.0	30.0
Palouse	Scrub-Shrub Wetland	Eleocharis palustris	common spikerush	50.0	80.0	80.0	80.0				
Palouse	Scrub-Shrub Wetland	Salix prolixa	MacKenzie's willow	50.0	30.0	30.0	30.0				
Palouse	Tall Emergent Marsh	Schoenoplectus acutus	hardstem bulrush	100.0	6.0	10.0	8.0	100.0	60.0	60.0	60.0
Palouse	Tall Emergent Marsh	Typha latifolia	broadleaf cattail	100.0	20.0	70.0	45.0	50.0	25.0	25.0	25.0
Palouse	Tall Emergent Marsh	Eleocharis palustris	common spikerush	100.0	5.0	20.0	12.5				
Palouse	Wet Meadow	Carex aquatilis	water sedge					75.0	0.1	70.0	37.5
Palouse	Wet Meadow	Deschampsia caespitosa	tufted hairgrass					50.0	0.1	40.0	23.8
Palouse	Wet Meadow	Potentilla gracilis	slender cinquefoil					62.5	0.1	50.0	11.2

Table 3 continued.

Watershed Group	Ecological Habitat	ScientificName	Common Name	% Constancy Restoration Plots	Min % Cover Restoration Plots	Max % Cover Restoration Plots	Mean % Cover Restoration Plots	% Constancy Reference Plots	Min % Cover Reference Plots	Max % Cover Reference Plots	Mean % Cover Reference Plots
Southeast Basins	Forested Wetland	Acer negundo var. violaceum	boxelder	100.0	30.0	30.0	30.0	100.0	50.0	50.0	50.0
Southeast Basins	Forested Wetland	Cornus sericea	redosier dogwood					100.0	30.0	30.0	30.0
Southeast Basins	Forested Wetland	Bidens vulgata	big devils beggartick	100.0	10.0	10.0	10.0				
Southeast Basins	Scrub-Shrub Wetland	Cornus sericea	redosier dogwood					100.0	50.0	50.0	50.0
Southeast Basins	Scrub-Shrub Wetland	Crataegus douglasii	black hawthorn					100.0	20.0	20.0	20.0
Southeast Basins	Scrub-Shrub Wetland	Salix lutea	yellow willow	100.0	0.1	0.1	0.1	100.0	10.0	10.0	10.0
Southeast Basins	Scrub-Shrub Wetland	Betula occidentalis	water birch					100.0	10.0	10.0	10.0
Southeast Basins	Scrub-Shrub Wetland	Salix exigua	narrowleaf willow	100.0	80.0	80.0	80.0				
Southeast Basins	Scrub-Shrub Wetland	Polygonum amphibium	water knotweed	100.0	10.0	10.0	10.0				
Southeast Basins	Scrub-Shrub Wetland	Eleocharis erythropoda	bald spikerush	100.0	5.0	5.0	5.0				
Southeast Basins	Short Emergent Marsh	Carex nebrascensis	Nebraska sedge					100.0	5.0	70.0	37.5
Southeast Basins	Short Emergent Marsh	Juncus balticus	Baltic rush					100.0	10.0	60.0	35.0
Southeast Basins	Short Emergent Marsh	Deschampsia caespitosa	tufted hairgrass					100.0	3.0	5.0	4.0
Southeast Basins	Short Emergent Marsh	Alisma gramineum	narrowleaf water plantain	100.0	30.0	30.0	30.0				
Southeast Basins	Short Emergent Marsh	Eleocharis palustris	common spikerush	100.0	30.0	30.0	30.0				
Southeast Basins	Short Emergent Marsh	Chenopodium salinum	Rocky Mountain goosefoot	100.0	10.0	10.0	10.0				
Southeast Basins	Short Emergent Marsh	Eleocharis erythropoda	bald spikerush	100.0	5.0	5.0	5.0				
Southeast Basins	Tall Emergent Marsh	Typha latifolia	broadleaf cattail	66.7	10.0	60.0	35.0	25.0	98.0	98.0	98.0
Southeast Basins	Tall Emergent Marsh	Schoenoplectus acutus	hardstem bulrush					75.0	60.0	98.0	85.3
Southeast Basins	Tall Emergent Marsh	Triglochin maritimum	seaside arrowgrass					50.0	20.0	20.0	20.0
Southeast Basins	Tall Emergent Marsh	Polygonum amphibium	water knotweed	100.0	7.0	30.0	17.3				
Southeast Basins	Tall Emergent Marsh	Eleocharis palustris	common spikerush	100.0	6.0	10.0	8.0				
Southeast Basins	Wet Meadow	Hordeum brachyantherum	meadow barley					100.0	1.0	70.0	35.5
Southeast Basins	Wet Meadow	Carex nebrascensis	Nebraska sedge					50.0	20.0	20.0	20.0
Southeast Basins	Wet Meadow	Rumex maritimus	golden dock	100.0	0.1	20.0	10.1				
Southeast Basins	Wet Meadow	Panicum capillare	witchgrass	100.0	0.1	10.0	5.1				

Watershed Group	Ecological Habitat	ScientificName	Common Name	% Constancy Restoration Plots	Min % Cover Restoration Plots	Max % Cover Restoration Plots	Mean % Cover Restoration Plots	% Constancy Reference Plots	Min % Cover Reference Plots	Max % Cover Reference Plots	Mean % Cover Reference Plots
Southeast Mountains	Scrub-Shrub Wetland	Alnus incana	gray alder					50.0	30.0	70.0	46.7
Southeast Mountains	Scrub-Shrub Wetland	Cornus sericea	redosier dogwood	100.0	10.0	10.0	10.0	66.7	0.1	60.0	30.0
Southeast Mountains	Scrub-Shrub Wetland	Populus balsamifera ssp. trichocarpa	black cottonwood					50.0	1.0	50.0	18.0
Southeast Mountains	Scrub-Shrub Wetland	Maianthemum stellatum	starry false lily of the vally					66.7	3.0	30.0	12.0
Southeast Mountains	Scrub-Shrub Wetland	Solidago canadensis	Canada goldenrod	100.0	7.0	7.0	7.0	33.3	5.0	5.0	5.0
Southeast Mountains	Scrub-Shrub Wetland	Hordeum brachyantherum	meadow barley	100.0	10.0	10.0	10.0	16.7	1.0	1.0	1.0
Southeast Mountains	Scrub-Shrub Wetland	Eleocharis palustris	common spikerush	100.0	15.0	15.0	15.0	16.7	0.1	0.1	0.1
Southeast Mountains	Scrub-Shrub Wetland	Typha latifolia	broadleaf cattail	100.0	8.0	8.0	8.0	16.7	0.1	0.1	0.1
Southeast Mountains	Scrub-Shrub Wetland	Symphyotrichum	aster	100.0	5.0	5.0	5.0	16.7	0.1	0.1	0.1
Southeast Mountains	Scrub-Shrub Wetland	Alisma triviale	northern water plantain	100.0	10.0	10.0	10.0				
Southeast Mountains	Scrub-Shrub Wetland	Salix melanopsis	dusky willow	100.0	7.0	7.0	7.0				
Southeast Mountains	Short Emergent Marsh	Schoenoplectus pungens	common threesquare					100.0	50.0	98.0	74.0
Southeast Mountains	Short Emergent Marsh	Juncus balticus	Baltic rush					50.0	40.0	40.0	40.0
Southeast Mountains	Short Emergent Marsh	Triglochin palustre	marsh arrowgrass					50.0	30.0	30.0	30.0
Southeast Mountains	Short Emergent Marsh	Ceratophyllum demersum	coon's tail					50.0	10.0	10.0	10.0
Southeast Mountains	Short Emergent Marsh	Alisma triviale	northern water plantain	50.0	30.0	30.0	30.0				
Southeast Mountains	Short Emergent Marsh	Eleocharis palustris	common spikerush	100.0	20.0	30.0	25.0				
Southeast Mountains	Short Emergent Marsh	Symphyotrichum	aster	50.0	20.0	20.0	20.0				
Southeast Mountains	Short Emergent Marsh	Gnaphalium palustre	western marsh cudweed	50.0	15.0	15.0	15.0				
Southeast Mountains	Short Emergent Marsh	Mentha arvensis	wild mint	50.0	15.0	15.0	15.0				
Southeast Mountains	Wet Meadow	Juncus balticus	Baltic rush	100.0	5.0	5.0	5.0	100.0	20.0	98.0	72.0
Southeast Mountains	Wet Meadow	Carex nebrascensis	Nebraska sedge	100.0	1.0	1.0	1.0	100.0	1.0	50.0	18.0
Southwest Foothills	Scrub-Shrub Wetland	Betula occidentalis	water birch					50.0	0.1	90.0	49.0
Southwest Foothills	Scrub-Shrub Wetland	Cornus sericea ssp. sericea	redosier dogwood	100.0	1.0	1.0	1.0	78.6	0.1	80.0	38.9
Southwest Foothills	Scrub-Shrub Wetland	Salix lucida ssp. caudata	greenleaf willow	100.0	30.0	30.0	30.0	57.1	0.1	70.0	28.5
Southwest Foothills	Scrub-Shrub Wetland	Alnus incana	gray alder					50.0	0.1	60.0	19.0
Southwest Foothills	Scrub-Shrub Wetland	Salix lutea	yellow willow	100.0	3.0	3.0	3.0	64.3	0.1	40.0	17.5
Southwest Foothills	Scrub-Shrub Wetland	Carex pellita	woolly sedge	100.0	30.0	30.0	30.0	14.3	2.0	30.0	16.0
Southwest Foothills	Scrub-Shrub Wetland	Rosa woodsii	Woods' rose					64.3	0.1	50.0	10.0
Southwest Foothills	Scrub-Shrub Wetland	Epilobium ciliatum	fringed willowherb	100.0	10.0	10.0	10.0	7.1	1.0	1.0	1.0
Southwest Foothills	Scrub-Shrub Wetland	Veronica anagallis-aquatica	water speedwell	100.0	15.0	15.0	15.0	28.6	0.1	2.0	0.8
Southwest Foothills	Scrub-Shrub Wetland	Conyza canadensis	Canadian horseweed	100.0	8.0	8.0	8.0	7.1	0.1	0.1	0.1
Southwest Foothills	Scrub-Shrub Wetland	Polygonum lapathifolium	curlytop knotweed	100.0	20.0	20.0	20.0				
Southwest Foothills	Scrub-Shrub Wetland	Artemisia dracunculus	tarragon	100.0	5.0	5.0	5.0				
Southwest Foothills	Scrub-Shrub Wetland	Leymus triticoides	beardless wildrye	100.0	5.0	5.0	5.0				

Table 3 continued.

Watershed Group	Ecological Habitat	ScientificName	Common Name	% Constancy Restoration Plots	Min % Cover Restoration Plots	Max % Cover Restoration Plots	Mean % Cover Restoration Plots	% Constancy Reference Plots	Min % Cover Reference Plots	Max % Cover Reference Plots	Mean % Cover Reference Plots
Southwest Foothills	Tall Emergent Marsh	Typha latifolia	broadleaf cattail	100.0	50.0	50.0	50.0	100.0	90.0	90.0	90.0
Southwest Foothills	Tall Emergent Marsh	Carex utriculata	Northwest Territory sedge					100.0	40.0	40.0	40.0
Southwest Foothills	Tall Emergent Marsh	Scirpus microcarpus	panicled bulrush	100.0	3.0	3.0	3.0	50.0	25.0	25.0	25.0
Southwest Foothills	Tall Emergent Marsh	Lemna minor	common duckweed	100.0	5.0	5.0	5.0	50.0	20.0	20.0	20.0
Southwest Foothills	Tall Emergent Marsh	Carex pellita	woolly sedge	100.0	15.0	15.0	15.0				
Southwest Foothills	Tall Emergent Marsh	Schoenoplectus acutus	hardstem bulrush	100.0	15.0	15.0	15.0				
Southwest Foothills	Tall Emergent Marsh	Cornus sericea	redosier dogwood	100.0	10.0	10.0	10.0				
Southwest Foothills	Tall Emergent Marsh	Leymus triticoides	beardless wildrye	100.0	5.0	5.0	5.0				
Upper Snake River Plain	Scrub-Shrub Wetland	Salix exigua	narrowleaf willow	100.0	90.0	90.0	90.0	50.0	40.0	60.0	50.0
Upper Snake River Plain	Scrub-Shrub Wetland	Salix lucida ssp. caudata	greenleaf willow					75.0	5.0	30.0	18.3
Upper Snake River Plain	Scrub-Shrub Wetland	Salix lutea	yellow willow					75.0	2.0	40.0	17.3
Upper Snake River Plain	Scrub-Shrub Wetland	Eleocharis palustris	common spikerush	100.0	0.1	0.1	0.1	50.0	3.0	20.0	11.5
Upper Snake River Plain	Tall Emergent Marsh	Typha latifolia	broadleaf cattail	50.0	0.1	0.1	0.1	50.0	1.0	80.0	40.5
Upper Snake River Plain	Tall Emergent Marsh	Schoenoplectus maritimus	cosmopolitan bulrush	50.0	80.0	80.0	80.0	50.0	0.1	70.0	35.1
Upper Snake River Plain	Tall Emergent Marsh	Schoenoplectus acutus	hardstem bulrush	50.0	80.0	80.0	80.0	50.0	3.0	60.0	31.5
West-central Foothills	Tall Emergent Marsh	Schoenoplectus acutus	hardstem bulrush	100.0	20.0	20.0	20.0	50.0	60.0	60.0	60.0
West-central Foothills	Tall Emergent Marsh	Typha latifolia	broadleaf cattail					100.0	25.0	50.0	37.5
West-central Foothills	Tall Emergent Marsh	Carex pellita	woolly sedge					50.0	30.0	30.0	30.0
West-central Foothills	Tall Emergent Marsh	Myriophyllum sibiricum	shortspike watermilfoil					50.0	15.0	15.0	15.0
West-central Foothills	Tall Emergent Marsh	Potamogeton natans	floating pondweed					50.0	15.0	15.0	15.0
West-central Foothills	Wet Meadow	Scirpus microcarpus	panicled bulrush	100.0	50.0	50.0	50.0	10.0	2.0	90.0	46.0
West-central Foothills	Wet Meadow	Carex nebrascensis	Nebraska sedge	100.0	2.0	2.0	2.0	65.0	0.1	80.0	23.5
West-central Foothills	Wet Meadow	Juncus balticus	Baltic rush	100.0	0.1	0.1	0.1	55.0	1.0	60.0	15.5
West-central Foothills	Wet Meadow	Potentilla gracilis	slender cinquefoil					50.0	0.1	30.0	11.0
Yellowstone Plateau Region	Fen	Carex simulata	analogue sedge	100.0	20.0	70.0	50.0	100.0	3.0	60.0	37.7
Yellowstone Plateau Region	Fen	Juncus nodosus	knotted rush	33.3	30.0	30.0	30.0	66.7	15.0	20.0	17.5
Yellowstone Plateau Region	Fen	Dasiphora floribunda	shrubby cinquefoil	33.3	1.0	1.0	1.0	66.7	0.1	20.0	10.1
Yellowstone Plateau Region	Fen	Carex utriculata	Northwest Territory sedge	100.0	0.1	20.0	7.0	33.3	3.0	3.0	3.0
Yellowstone Plateau Region	Fen	Carex nebrascensis	Nebraska sedge	100.0	10.0	30.0	23.3	66.7	1.0	3.0	2.0
Yellowstone Plateau Region	Fen	Salix geyeriana	Geyer's willow	66.7	15.0	20.0	17.5	66.7	0.1	0.1	0.1

Table 3 continued.

Watershed Group	Ecological Habitat	ScientificName	Common Name	% Constancy Restoration Plots	Min % Cover Restoration Plots	Max % Cover Restoration Plots	Mean % Cover Restoration Plots	% Constancy Reference Plots	Min % Cover Reference Plots	Max % Cover Reference Plots	Mean % Cover Reference Plots
Yellowstone Plateau Region	Mesic Meadow	Muhlenbergia richardsonis	mat muhly	50.0	5.0	5.0	5.0	33.3	60.0	60.0	60.0
Yellowstone Plateau Region	Mesic Meadow	Dasiphora floribunda	shrubby cinquefoil	50.0	25.0	25.0	25.0	66.7	30.0	30.0	30.0
Yellowstone Plateau Region	Mesic Meadow	Juncus balticus	Baltic rush	100.0	1.0	50.0	25.5	100.0	0.1	20.0	7.7
Yellowstone Plateau Region	Mesic Meadow	Deschampsia caespitosa	tufted hairgrass	100.0	1.0	20.0	10.5	100.0	0.1	15.0	6.0
Yellowstone Plateau Region	Mesic Meadow	Carex praegracilis	clustered field sedge	100.0	30.0	60.0	45.0				
Yellowstone Plateau Region	Mesic Meadow	Symphyotrichum spathulatum var. spathulatum	western mountain aster	50.0	15.0	15.0	15.0				
Yellowstone Plateau Region	Mesic Meadow	Potentilla diversifolia	varileaf cinquefoil	50.0	5.0	5.0	5.0				
Yellowstone Plateau Region	Scrub-Shrub Wetland	Salix boothii	Booth's willow	100.0	1.0	1.0	1.0	80.0	3.0	50.0	24.5
Yellowstone Plateau Region	Scrub-Shrub Wetland	Salix geyeriana	Geyer's willow	100.0	10.0	10.0	10.0	80.0	5.0	30.0	18.8
Yellowstone Plateau Region	Scrub-Shrub Wetland	Carex utriculata	Northwest Territory sedge	100.0	2.0	2.0	2.0	100.0	1.0	30.0	9.8
Yellowstone Plateau Region	Scrub-Shrub Wetland	Juncus balticus	Baltic rush	100.0	20.0	20.0	20.0	40.0	1.0	5.0	3.0
Yellowstone Plateau Region	Scrub-Shrub Wetland	Geum macrophyllum	largeleaf avens	100.0	20.0	20.0	20.0	60.0	0.1	3.0	1.1
Yellowstone Plateau Region	Scrub-Shrub Wetland	Dasiphora floribunda	shrubby cinquefoil	100.0	10.0	10.0	10.0	20.0	0.1	0.1	0.1
Yellowstone Plateau Region	Scrub-Shrub Wetland	Deschampsia caespitosa	tufted hairgrass	100.0	10.0	10.0	10.0	20.0	0.1	0.1	0.1
Yellowstone Plateau Region	Scrub-Shrub Wetland	Carex praegracilis	clustered field sedge	100.0	7.0	7.0	7.0	40.0	0.1	0.1	0.1
Yellowstone Plateau Region	Scrub-Shrub Wetland	Potentilla	cinquefoil	100.0	20.0	20.0	20.0				
Yellowstone Plateau Region	Scrub-Shrub Wetland	Symphyotrichum spathulatum var. spathulatum	western mountain aster	100.0	20.0	20.0	20.0				
Yellowstone Plateau Region	Scrub-Shrub Wetland	Carex nebrascensis	Nebraska sedge	100.0	15.0	15.0	15.0				
Yellowstone Plateau Region	Scrub-Shrub Wetland	Carex pellita	woolly sedge	100.0	15.0	15.0	15.0				
Yellowstone Plateau Region	Scrub-Shrub Wetland	Muhlenbergia richardsonis	mat muhly	100.0	10.0	10.0	10.0				
Yellowstone Plateau Region	Scrub-Shrub Wetland	Juncus	rush	100.0	7.0	7.0	7.0				
Yellowstone Plateau Region	Short Emergent Marsh	Schoenoplectus pungens	common threesquare					50.0	50.0	98.0	74.0
Yellowstone Plateau Region	Short Emergent Marsh	Juncus balticus	Baltic rush	60.0	5.0	20.0	11.7	25.0	40.0	40.0	40.0
Yellowstone Plateau Region	Short Emergent Marsh	Triglochin maritimum	seaside arrowgrass					50.0	1.0	20.0	10.5
Yellowstone Plateau Region	Short Emergent Marsh	Eleocharis palustris	common spikerush	80.0	4.0	70.0	35.3	25.0	0.1	0.1	0.1
Yellowstone Plateau Region	Short Emergent Marsh	Carex utriculata	Northwest Territory sedge	60.0	2.0	70.0	44.0				
Yellowstone Plateau Region	Short Emergent Marsh	Typha latifolia	broadleaf cattail	60.0	0.1	30.0	10.4				
Yellowstone Plateau Region	Short Emergent Marsh	Myriophyllum sibiricum	shortspike watermilfoil	100.0	0.1	15.0	7.6				

Table 3 continued.

Watershed Group	Ecological Habitat	ScientificName	Common Name	% Constancy Restoration Plots	Min % Cover Restoration Plots	Max % Cover Restoration Plots	Mean % Cover Restoration Plots	% Constancy Reference Plots	Min % Cover Reference Plots	Max % Cover Reference Plots	Mean % Cover Reference Plots
Yellowstone Plateau Region	Tall Emergent Marsh	Schoenoplectus acutus	hardstem bulrush	50.0	80.0	80.0	80.0	66.7	98.0	98.0	98.0
Yellowstone Plateau Region	Tall Emergent Marsh	Triglochin maritimum	seaside arrowgrass					66.7	20.0	20.0	20.0
Yellowstone Plateau Region	Tall Emergent Marsh	Schoenoplectus tabernaemontani	softstem bulrush	50.0	70.0	70.0	70.0				
Yellowstone Plateau Region	Tall Emergent Marsh	Potamogeton	pondweed	100.0	0.1	20.0	10.1				
Yellowstone Plateau Region	Tall Emergent Marsh	Eleocharis palustris	common spikerush	100.0	4.0	15.0	9.5				
Yellowstone Plateau Region	Tall Emergent Marsh	Juncus balticus	Baltic rush	100.0	1.0	10.0	5.5				
Yellowstone Plateau Region	Tall Emergent Marsh	Myriophyllum sibiricum	shortspike watermilfoil	100.0	0.1	10.0	5.1				
Yellowstone Plateau Region	Wet Meadow	Juncus balticus	Baltic rush	100.0	1.0	80.0	28.0	100.0	10.0	70.0	40.0
Yellowstone Plateau Region	Wet Meadow	Deschampsia caespitosa	tufted hairgrass	66.7	0.1	3.0	1.6	100.0	0.1	20.0	10.1
Yellowstone Plateau Region	Wet Meadow	Trifolium longipes	longstalk clover					50.0	10.0	10.0	10.0
Yellowstone Plateau Region	Wet Meadow	Carex nebrascensis	Nebraska sedge	100.0	1.0	80.0	43.7	50.0	0.1	0.1	0.1

Green = Highly characteristic = 100% constancy and $\geq$ 5% cover

Green = Highly characteristic = 50 - 99% constancy and > 10% cover, or

Blue = Moderately characterisitic = 50 - 99% constancy and 2 - 9% cover, or

Blue = Moderately characterisitic = 25 - 49% constancy and > 5% cover

Red = Highly characteristic species not present where expected

Yellow = Highly characterisitic species present in minor amounts

In contrast, restored, enhanced, and created wetlands in other watersheds supported relatively few species that were intolerant of disturbance (Figure 20). FQAI metrics in restored, enhanced, and created wetlands were similar to reference wetlands in the Boise-Payette River Valleys, Lower Snake River Valley, and North-central Foothills. However, the floristic quality of reference wetlands in the Boise-Payette River Valleys and Lower Snake River Valley (and Middle Snake River Plain) was noticeably lower than in other watershed groups. The reference standard for floristic quality was lower for these areas (e.g., high quality reference sites were difficult or impossible to find) and, thus, it was easier for restored, enhanced, and created wetlands to meet the standard.

Mean values for C value, FQAI, and adjusted FQAI for restored, enhanced, and created wetlands was always less than reference wetlands in all other watersheds; the deficit most notable in the Palouse, Southeast Mountains, Southwest Foothills, Upper Snake River Plain, and West-central Foothills (Figure 19). Although reference wetlands in the Palouse were geographically proximate and had similar elevations to restored, enhanced, and created sites, they likely represented wetter habitats that reflected local climate gradients and topography. Similar differences between reference wetlands and project sites existed in Southeast Mountains, Southwest Foothills, and West-central Foothills groups. The primary reason was that most restored, enhanced, and created project sites were located in agricultural and urbanized lower watershed areas, where reference wetlands were located in less developed middle or upper portions of watersheds.

Mean native species richness and percentage of the flora comprised of non-native species varied due to local environmental factors, disturbance, nearness of propagule sources, chance establishment of species, and species traits (e.g., resilience after disturbance). Mean native species richness of restored, enhanced, and created wetlands was approximately the same as reference wetlands in watersheds of the Boise-Payette River Valleys, Lower Snake River Valley, North Panhandle Valleys, North-central Foothills, Southwest Foothills, and Yellowstone Region (Figure 19). Mean native species richness of restored, enhanced, and created wetlands exceeded reference wetlands in watersheds of the Southeast Basins and Southeast Mountains, but notably lagged behind reference wetlands in the Middle Snake River Plain, Palouse, Upper Snake River Plain, and West-central Foothills. With a few exceptions, the percent of non-native species in the flora was noticeably higher (often nearly twice as high, typically 40 to > 50%) in restored, enhanced, and created wetlands than in reference wetlands (Figure 20). Restored, enhanced, and created wetlands in watersheds of the Boise-Payette River Valleys, North-central Foothills, and Yellowstone Region had slightly lower percentages of their flora consisting of non-native species than reference wetlands. The latter two watershed groupings (along with North Panhandle Valleys) had much lower percentages of non-native species (approximately 15 to 20%).

Likely due to management goals (Adamus 2010), the percentage of the flora comprised of hydrophytic species varied but was often higher in restored, enhanced, and created wetlands than in reference wetlands. Over 75% of the flora was hydrophytic in watersheds of the North Panhandle Valleys, North-central Foothills, and Yellowstone Region, and 50 to 60% hydrophytic in the Boise-Payette River Valleys, Lower Snake River Valley, Middle Snake River Plain, and Southeast Basins (Figure 20). In these watershed groups, restored, enhanced, and created vegetation indicated presence of depressional and slope wetlands. Riverine wetlands were more commonly restored or enhanced in the other watersheds where floras had < 50% hydrophytic species.

Floristic quality by habitat: The mean C-values of habitat types in restored, enhanced, and created wetland habitats were always less than mean C-values of reference habitats (Figure 21). Only fen habitats had mean C-values > 3. Almost 20% of the flora of enhanced and restored fens were species intolerant of disturbance (C-value ≥ 7), compared to 30% of the flora in reference fens (Figure 22). Alkaline wetlands and tall emergent marshes were the only restored, enhanced, and created wetland habitats having more than 3% of their flora comprised of species with C-values ≥ 7. Restored, enhanced, and created alkaline wetlands, forested wetlands, and scrub-shrub wetlands had mean C-values ≤ 2 (Figure 21). Except for alkaline wetlands and fens, the FQAI of restored, enhanced, and created habitats was less than that of reference habitats (although mesic meadow and short emergent marsh habitats were nearly similar). Restored, enhanced, and created forested wetlands, scrub-shrub wetlands, and wet meadows had notably lower mean FQAI and adjusted FQAI values. Forested and scrub-shrub habitats in reference wetlands had the highest native species richness, indicating the complexity of these habitats and potential challenge of restoring vegetation to pre-disturbance quality.

Native species richness was higher in all reference wetland habitat types than in restored, enhanced, and created habitats, except for alkaline wetlands, fens, and short emergent marshes (Figure 21). Alteration of ecologic processes in alkaline wetland and fen habitats resulting from restoration and enhancement may open niches for additional native species. Fens and short emergent marshes were the only restored, enhanced, and/or created habitat types having lower percentages of their flora comprised of non-native species than comparable reference wetland habitats (Figure 22). The percentage of non-native species much higher (over 12% greater) in restored, enhanced, and created alkaline wetlands, forested wetlands, scrub-shrub wetlands, and wet meadows than in the same reference wetland habitats. The percent non-native species exceeded 40% in these habitats.

The percentage of the flora consisting of hydrophytic species was typically higher in restored, enhanced, and created wetland habitats than in reference habitats, or percentages were similar. Over 70% of the flora was hydrophytic in reference and restored, enhanced, and created fens, short emergent marshes, and tall emergent marshes, compared to < 45% in alkaline wetlands, forested wetlands, mesic meadows, and scrub-shrub wetlands (Figure 22). Only restored, enhanced, and created wet meadows noticeably lagged behind comparable reference habitats.

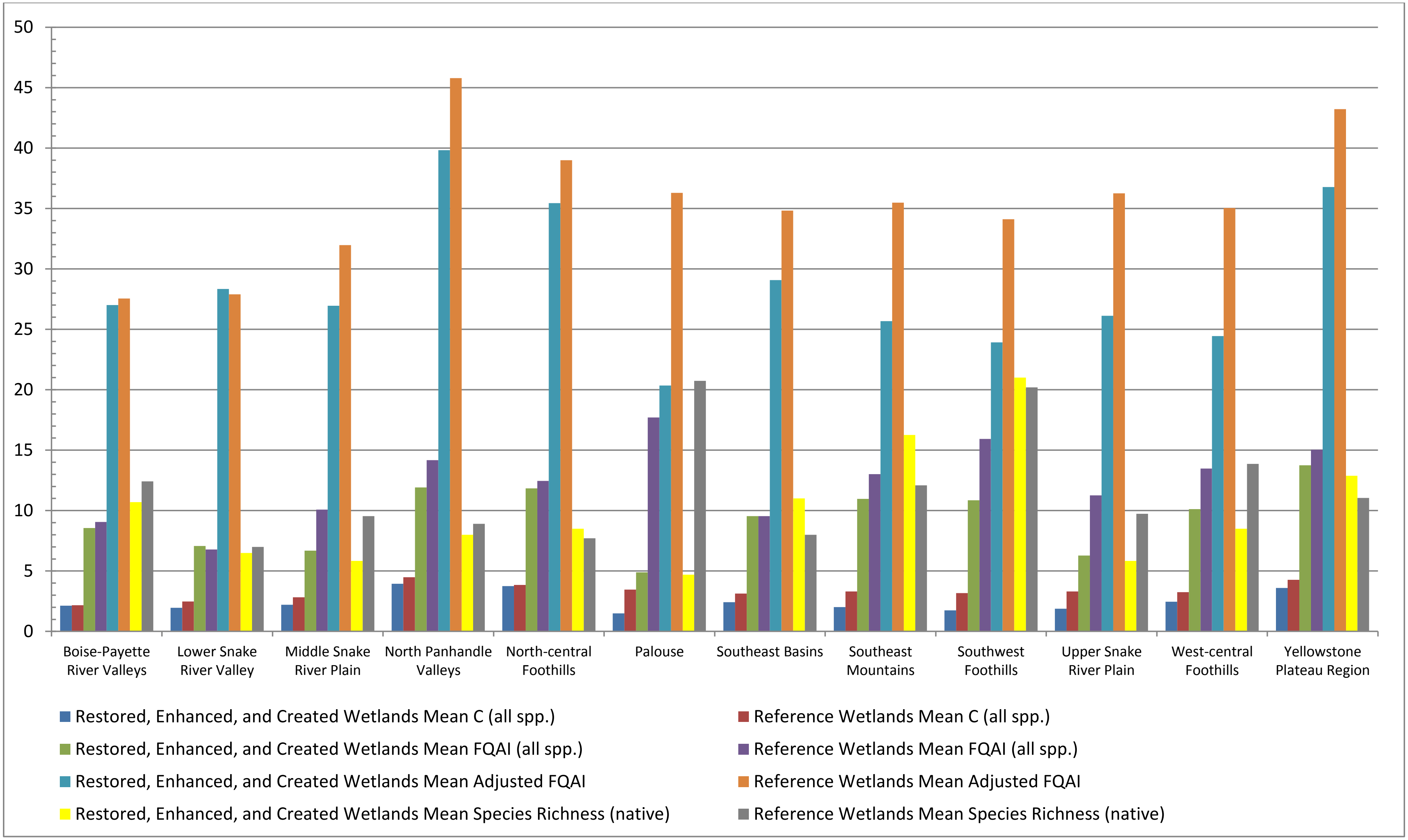

Figure 19. Floristic quality of restored, enhanced, and created wetlands and reference wetlands by watershed ecological group.

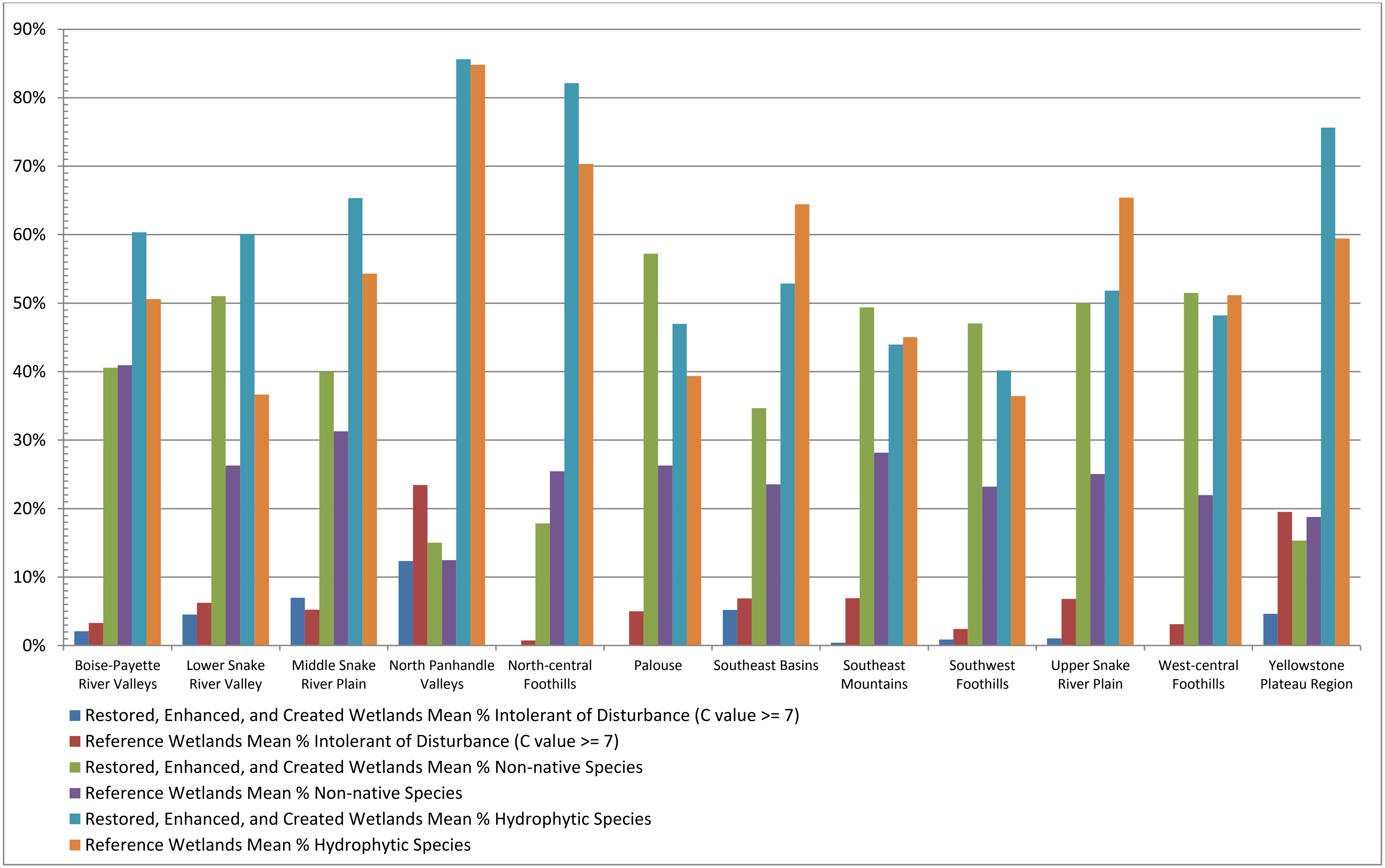

Figure 20. Floristic quality and vegetation of restored, enhanced, and created wetlands and reference wetlands by watershed ecological group.

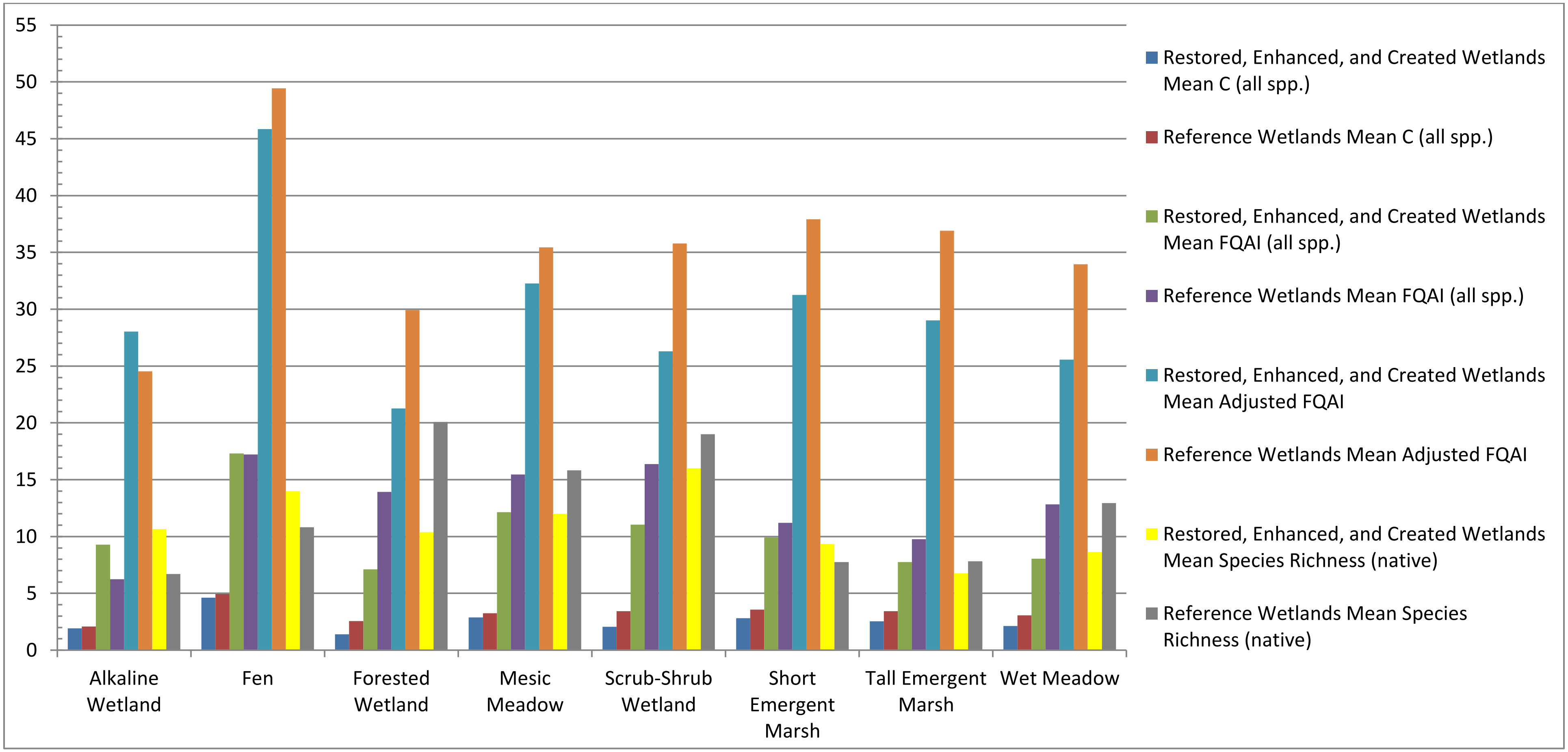

Figure 21. Floristic quality of restored, enhanced, and created wetlands and reference wetlands by ecological habitat.

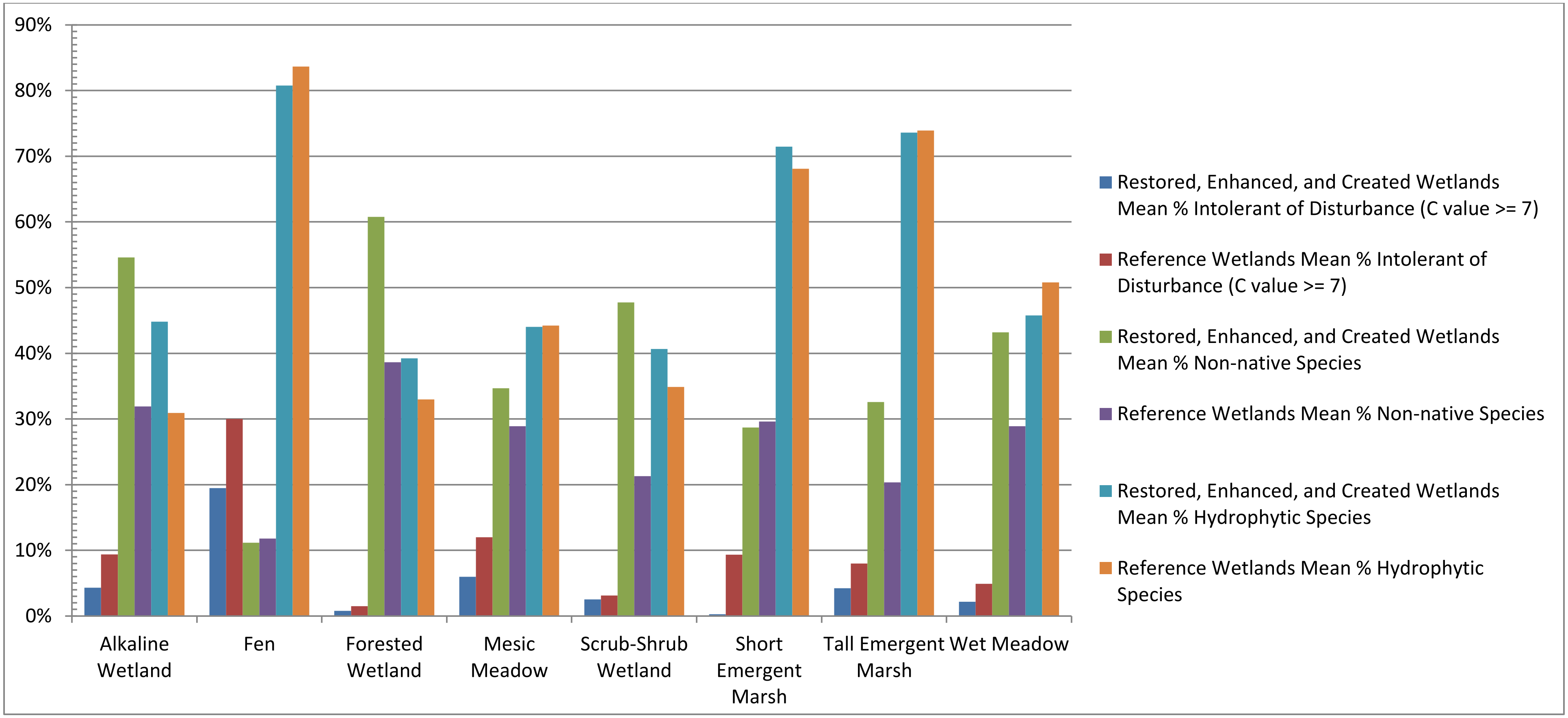

Figure 22. Floristic quality and vegetation of restored, enhanced, and created wetlands and reference wetlands by ecological habitat.

Floristic quality by project goal, HGM class, type, and objective: Floristic quality was highest in wetland enhancement projects, where large-scale disturbances typical of restoration and creation projects were lacking or minimized. Enhanced wetlands had the highest mean FQAI and adjusted FQAI values, slightly higher than those of restored wetlands (Figure 23). Mean C-values were similar between restored and enhanced wetlands (C-values 2.7 and 3.1), compared to created wetlands which had a mean C-value of only 1.9. None of these project goal types had more than 5% of their flora consisting of species intolerant of disturbance (C-value $\geq$ 7) (Figure 24). Species richness was nearly the same for enhancement and restoration projects, but slightly lower in creation projects. The percentage of the flora comprised of non-native species was lowest in enhanced wetlands (~ 26%), compared to restoration and creation projects ($\geq$ 35%). The percentage of hydrophytic species followed a similar pattern, with enhanced wetlands having 74% hydrophytes, followed by restored (62%) and created wetlands (56%).

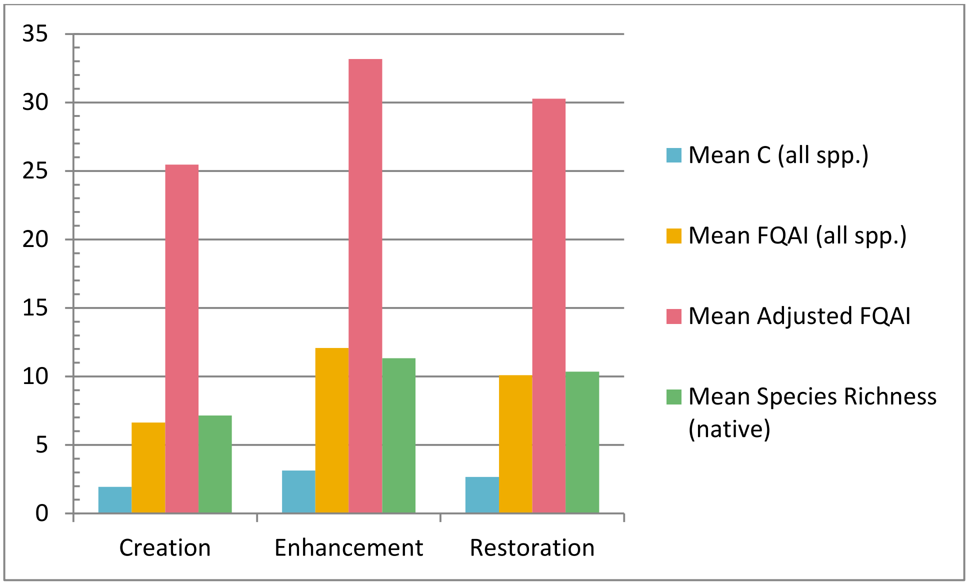

Figure 23. Floristic quality by project goal (restoration, enhancement, or creation).

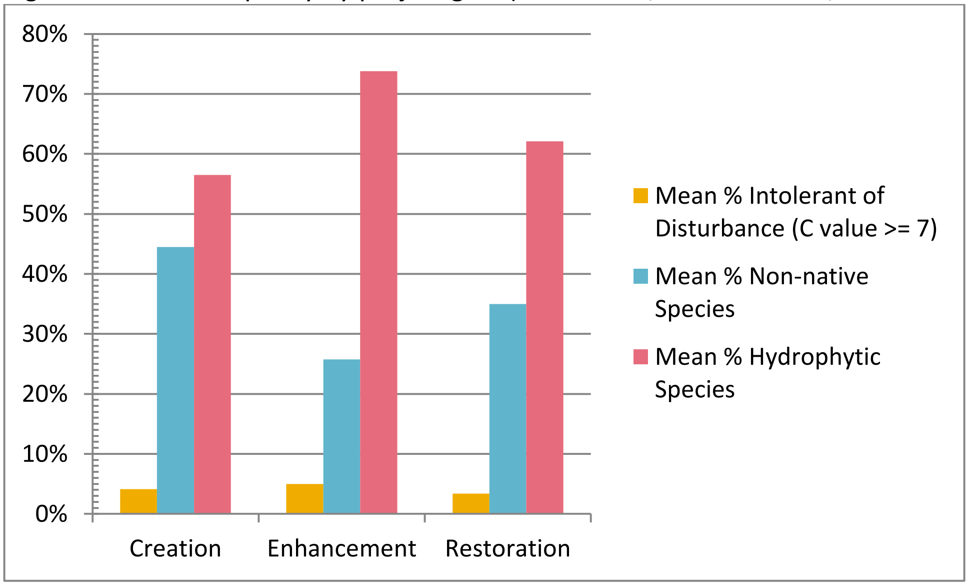

Figure 24. Floristic quality and vegetation by project goal.

Restored, enhanced, and created slope wetlands had the much higher level of floristic quality (as measured by all metrics) than depressional and riverine wetlands (Figure 25). The mean C-value for slope wetlands was 4.1, compared to 2.4 for depressional and 1.8 for riverine wetlands. Mean native species richness was the highest of any HGM class, and the percentage of non-native species the lowest (Figure 26). The percentage of the flora consisting of hydrophytic species was slightly higher in slope wetlands than depressional wetlands, but both exceeded 60%. Hydrologic stability (e.g., groundwater-fed versus flood prone) and site history of assessed slope wetlands explain these results. Several slope wetlands were enhanced fens where overall soil disturbance was minimal (primarily hydrologic modification). In contrast, riverine wetlands were more prone to flood-related disturbance and some projects involved significant earth movement (e.g., channel reconstruction). Depressional wetlands were primarily influenced by natural and human-managed hydrologic fluctuation that periodically exposes soil to non-native species colonization.

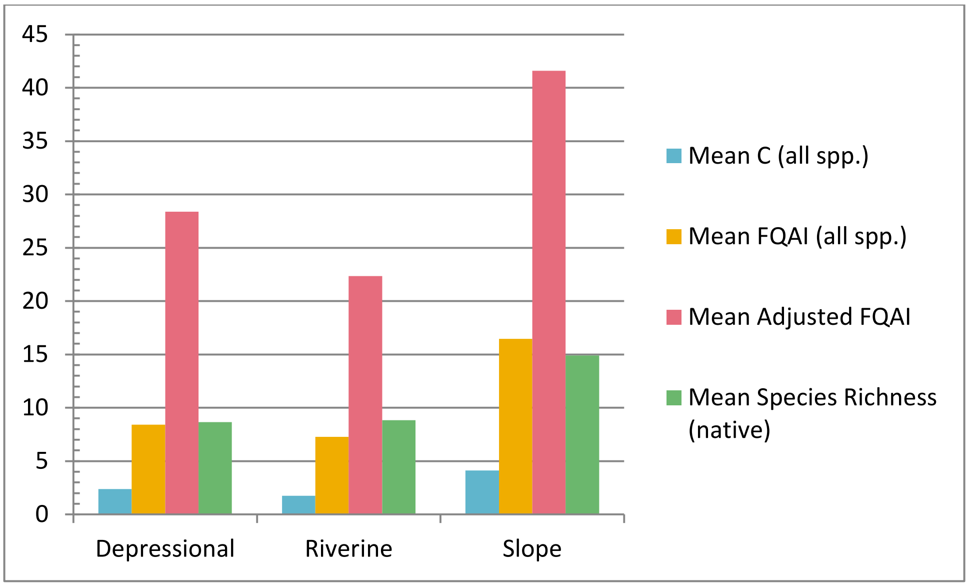

Figure 25. Floristic quality by HGM class.

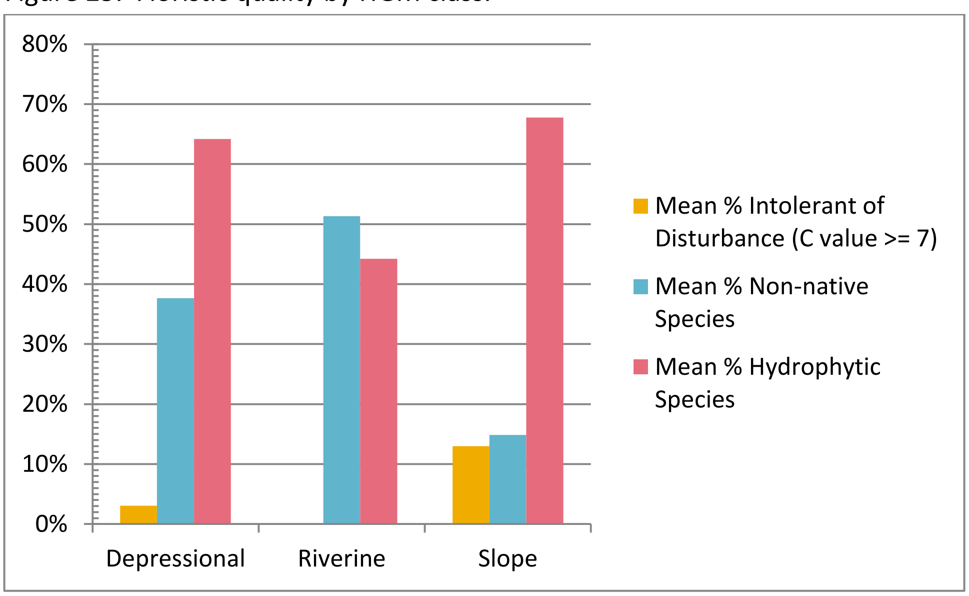

Figure 26. Floristic quality and vegetation by HGM class.

Five to 10 year-old restoration, enhancement, and creation projects had better floristic quality than younger or older projects (Figure 27). Less than 5 year-old projects had similar floristic quality (measured by mean C-value and adjusted FQAI) as those > 10 years-old. Succession in these wetlands can result in rapid vegetation change. Native species richness was highest in < 5 year-old projects, where plants that colonized disturbed sites were still competing for dominance. These were early seral species, as indicated by the low percentage of species intolerant of disturbance (C-value ≥ 7) (Figure 28). The percentage of non-native species in the flora of young projects was also high (42%). After 10 years, native species richness declined, as woody vegetation and competitive rhizomatous species suited to the new environment shaded and suppressed early seral species. The percentage of non-native species in 5 to 10 year-old projects was lower than older projects. Early seral native species were out-competed by rhizomatous non-native species, such as Canada thistle (*Cirsium arvense*) or reed canarygrass (*Phalaris arundinacea*).

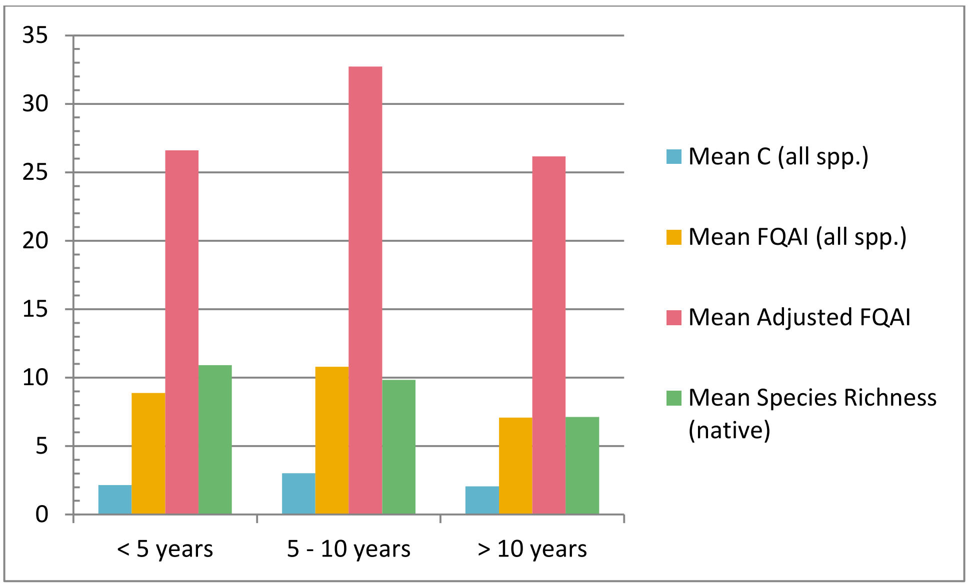

Figure 27. Floristic quality by project age since implementation.

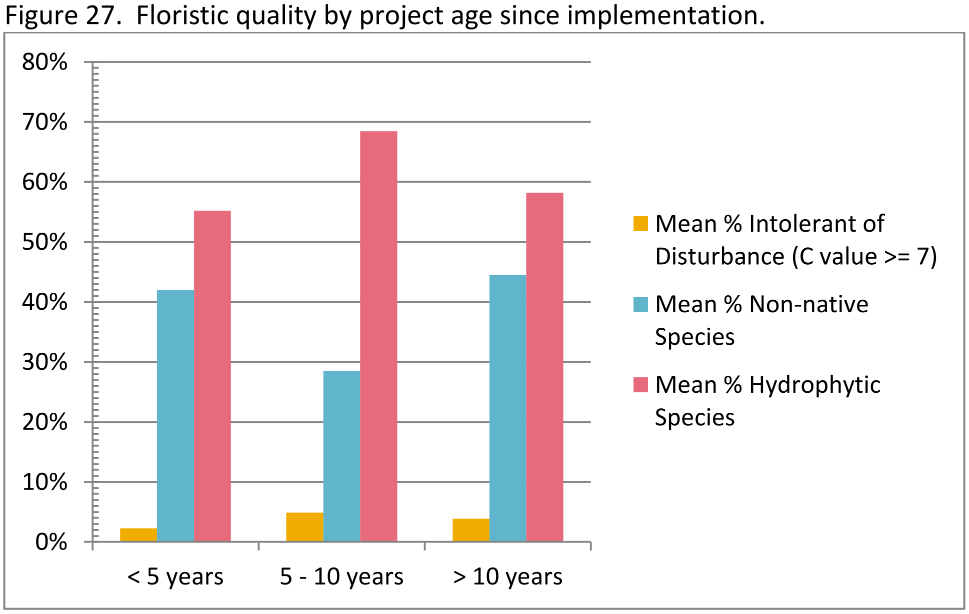

Figure 28. Floristic quality and vegetation by project age since implementation.

Floristic quality (mean C-value, FQAI, and adjusted FQAI) of NAWCA-grant funded wetland habitat projects was better than any other project type, although only slightly better than the vegetation of WRP projects (Figure 29). The floristic quality of fish and wildlife habitat projects (e.g., HIP-funded projects) was also relatively good. The percentage of the flora consisting of hydrophytic species was highest, and the percentage of non-native species lowest, in these project types (Figure 30). WRP projects had the highest percentage of their flora comprised of species intolerant of disturbance. Significant resources are often invested in post-construction planting of mitigation sites. This likely bumped up native species richness, but it had less benefit for lifting floristic quality. Stormwater and irrigation return water treatment projects and Clean Water Act S. 319-funded watershed restoration projects lagged behind. They had notably lower mean C-values (< 2) and 45 to 60% of their flora consisting of non-native species (Figure 30). They also had the lowest native species richness. Maximizing floristic quality is not a primary objective of most water treatment projects. S. 319 projects do aim to improve overall vegetation quality, but may suffer from a lack of resources necessary to effectively suppress invasive species, such as reed canary grass (*Phalaris arundinacea*), before and after restoration.

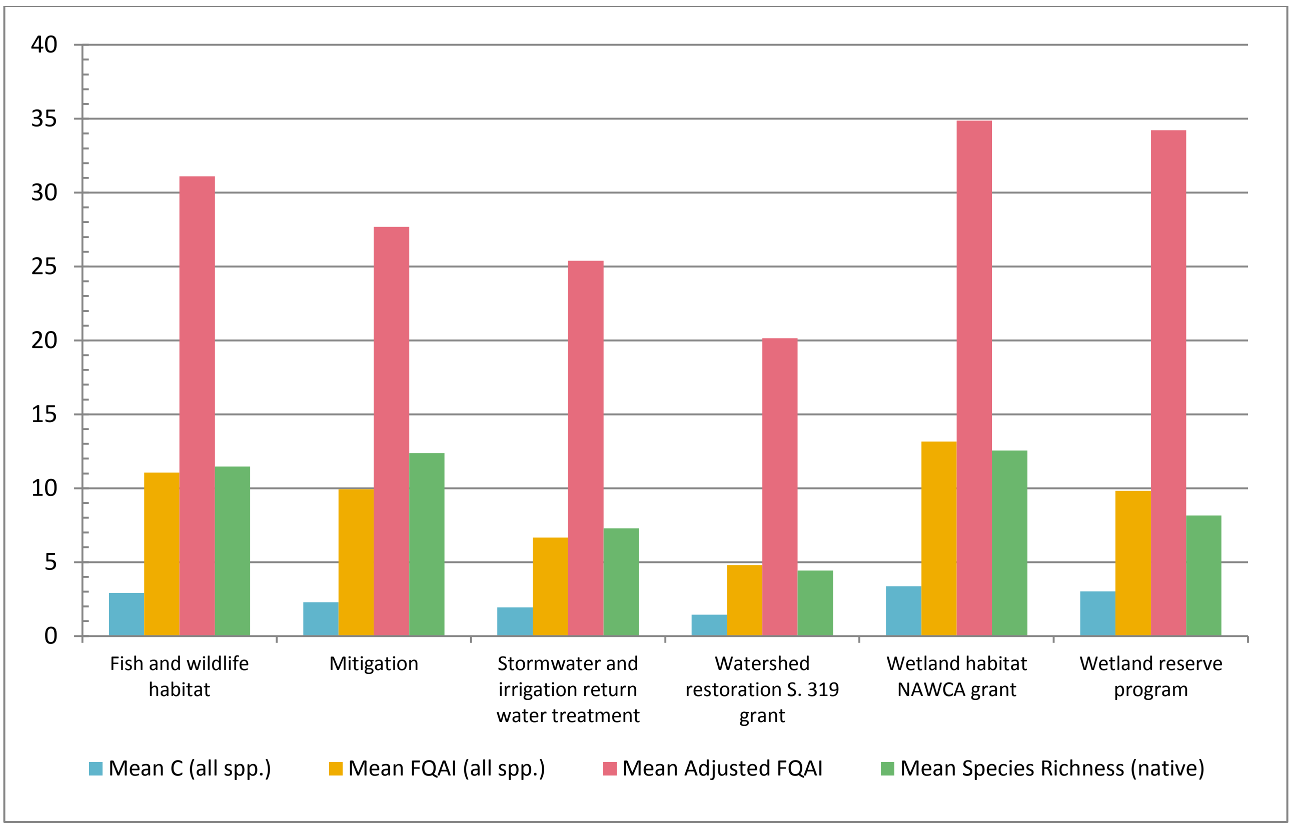

Figure 29. Floristic quality by project type.

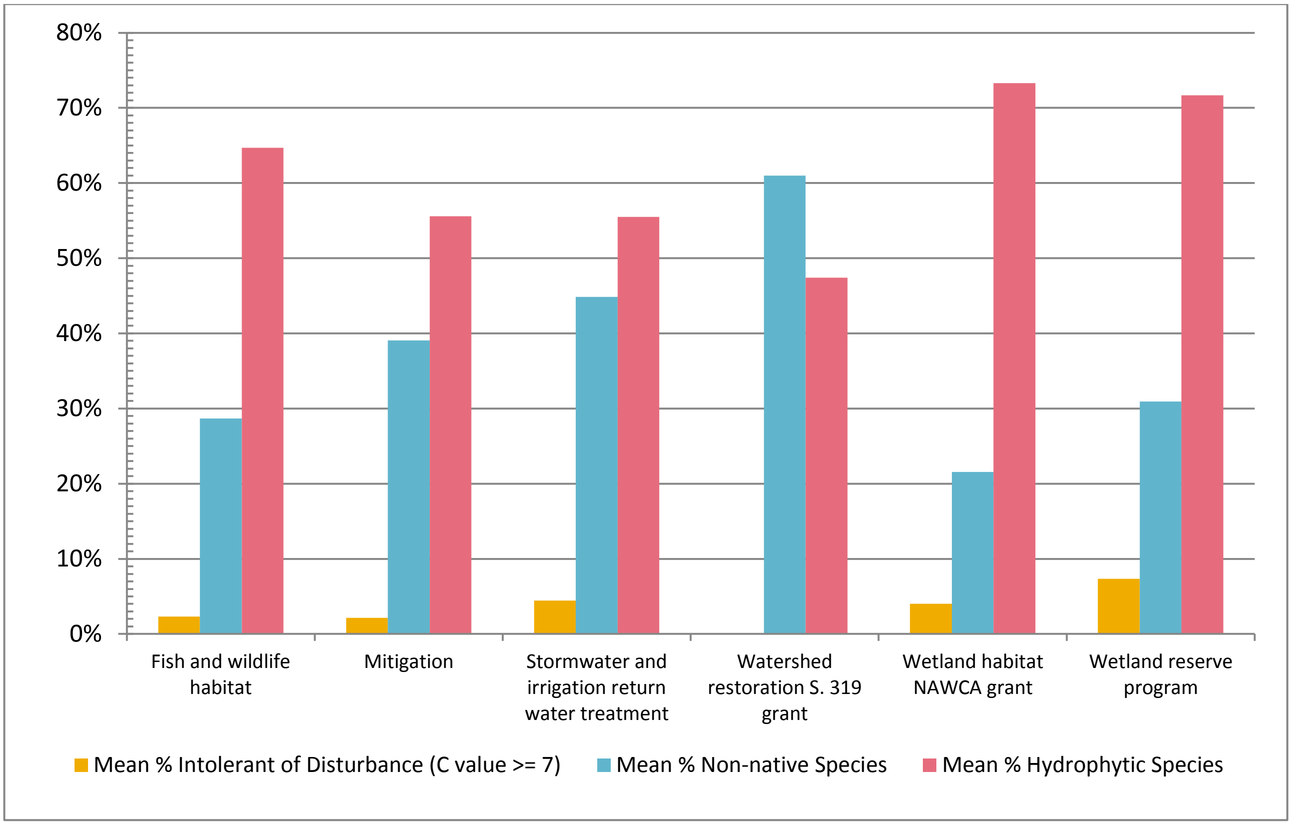

Figure 30. Floristic quality and vegetation by project type.

Deepwater marsh and open water waterfowl habitat projects had slightly higher mean FQAI and adjusted FQAI values than seasonally flooded marsh and wet meadow projects, but mean C-values were the same (Figure 31). The percentage of non-native species in the flora was lowest in projects having these two objectives (Figure 32). Somewhat surprisingly, native species richness was highest in deepwater marsh and open water waterfowl habitat projects, despite sites typically being dominated by dense patches of cattail (*Typha latifolia*) and/or hardstem bulrush (*Schoenoplectus acutus*). During drawdown periods, exposed mudflats between these cattail and bulrush patches can be colonized by a variety of terrestrial and aquatic native species. Urban stormwater treatment projects and riparian and stream habitat projects had the lowest floristic quality values (e.g., mean C-values < 2) and the highest percentages of non-native species (over 50%). Riparian and stream habitat projects were often annually disturbed by floodplain processes, and some involved channel reconstruction. Chronic and/or large-scale disturbance negatively influenced floristic quality. The low percentage (42%) of hydrophytic species in riparian and stream habitat project floras may indicate that these projects are resulting in relatively narrow floodplains that abruptly transition to upland habitats.

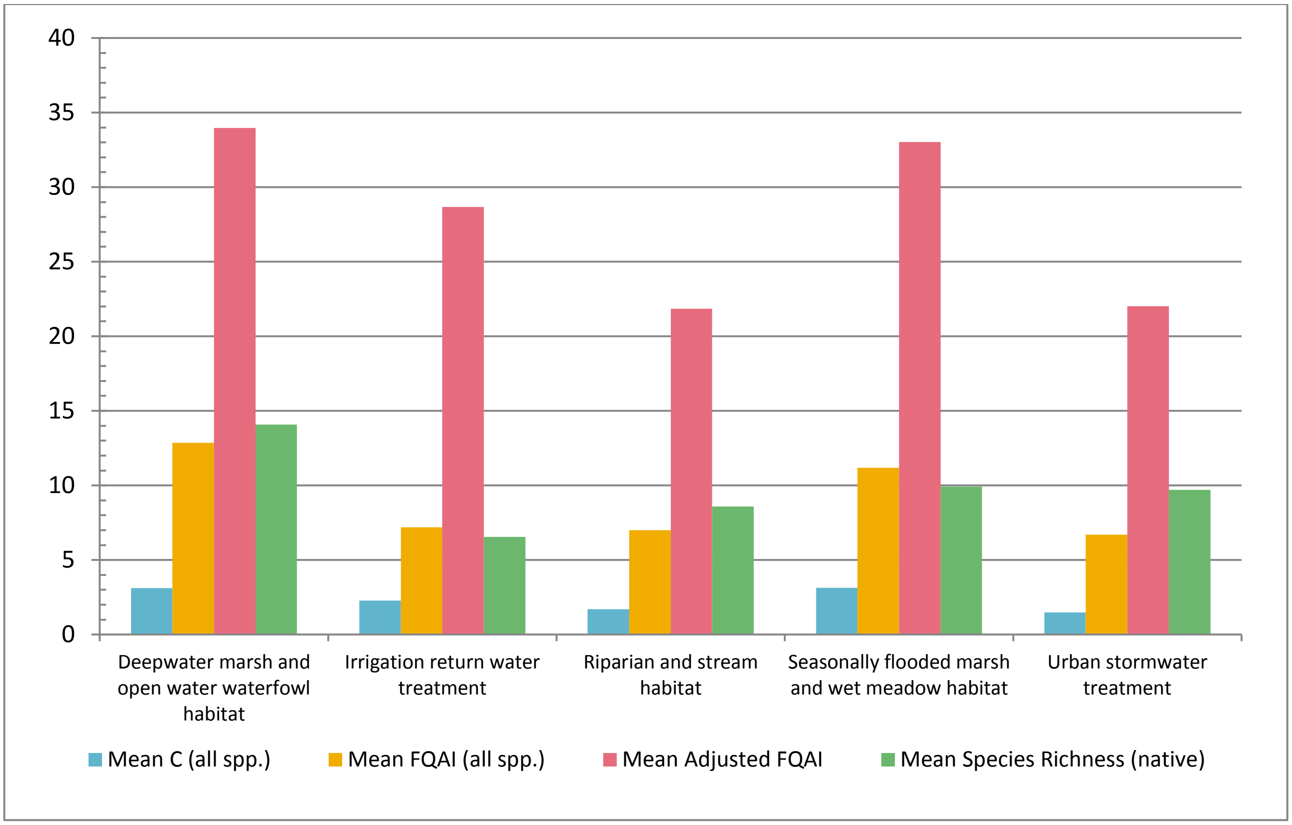

Figure 31. Floristic quality by primary project objective (e.g., specific habitat or function).

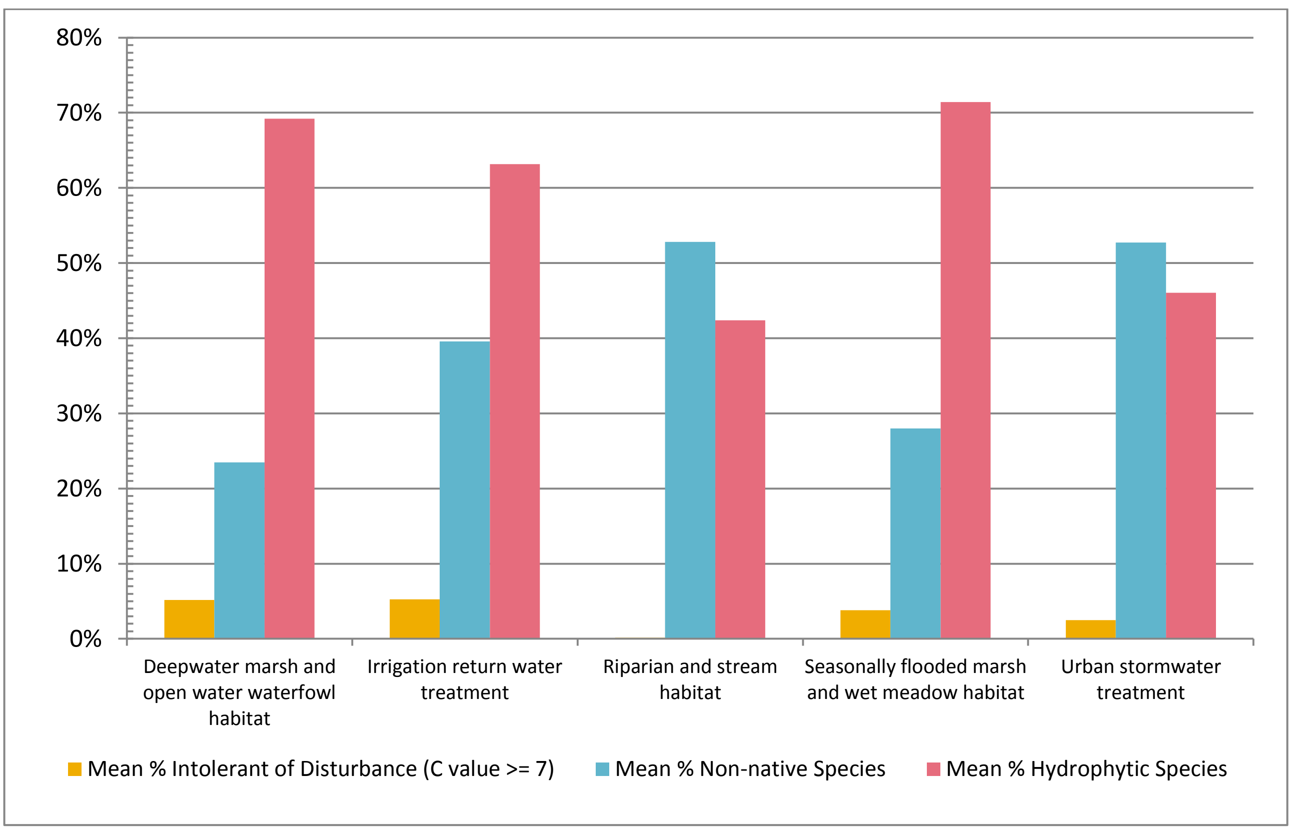

Figure 32. Floristic quality and vegetation by primary project objective.

DISCUSSION

Functions and values of restored, enhanced, and created wetlands—constraints and benefits

There is legitimate concern that restored wetlands do not attain, or sustain, levels of function comparable to pre-disturbance conditions, even after long time frames (over 20 years) (Zedler and Callaway 1999, Moreno-Mateos et al. 2012). One implication is that compensatory mitigation projects may fail to replace wetland functions lost to development. For example, the majority of compensatory mitigation wetlands assessed in California had sub-optimal levels of condition and function for most rapidly assessed metrics (Ambrose et al. 2006). Many California mitigation wetlands failed to meet or exceed the condition and function of reference wetlands. About a third of mitigation wetlands in Ohio failed to fully compensate for losses (Porej 2003). However, various studies show that restored, enhanced, and created wetlands (including mitigation sites) do support valuable functions, sometimes at substantial levels. For example, enhanced wetlands assessed in the Willamette Valley of Oregon using ORWAP provided water storage and delay function at levels higher than reference wetlands (Adamus 2010). Except for pollinator habitat and plant diversity, restored and enhanced wetlands in the Willamette Valley supported functions at levels statistically equal to functions of reference wetlands. Over 85% of WRP wetlands assessed in the southeast U. S. were shown to support important hydrologic and habitat functions (De Steven and Gramling 2012). Although we did not compare our ORWAP / WESPUS assessment results with reference sites, functions supported by restored, enhanced, and created wetlands in Idaho provided levels of water quality support functions similar to a wide variety of wetlands assessed using ORWAP in Oregon (Adamus et al. 2010a).

Some project types assessed in Idaho generated values for functions indicating a high return on investment. For example, the value of water quality improvement functions in Clean Water Act S. 319 Grant funded watershed restoration projects was high, despite these being relatively low-budget, community volunteer-driven projects. Although not as high as in S. 319 projects, fish and wildlife habitat projects supported moderately highly valued water quality support functions. This illustrates an added benefit from habitat projects to the communities where they are located. Fish and wildlife habitat restoration projects tend to be funded by hunter and angler supported small-grants, but they can yield relatively high-value wildlife habitat functions. Mitigation projects also supported functions with high value in the watersheds where they were located, especially water storage and delay, water quality support, and habitat. Landowners and watershed managers should recognize the value-added functions of placing mitigation sites on lands under their jurisdiction. Wetland habitat NAWCA funded projects similarly resulted in highly valued wildlife habitat functions, indicating an efficient expenditure of grant dollars.

Restored, enhanced, and created wetlands sometimes fail to maximize their functional and ecosystem service provision potentials due to constraints on ecological processes (De Steven et al. 2010, Moreno-Mateos et al. 2012). In Ohio, mitigation projects placed in degraded landscapes were limited in their ability to perform desired functions (Porej 2003). Surrounding landscape condition also influences succession of vegetation in restored wetlands (Matthews et al. 2009). Values are also tied to watershed context and landscape condition (Adamus et al. 2010a). For example, the values of water quality support functions supported by stormwater and irrigation return water treatment projects assessed in Idaho were not as high as expected. This may be due to their placement in intensively developed urban and agricultural landscapes where the value of their benefits, compared to the overall demand in a watershed, is relatively low.

To increase the values of restored functions, watershed and landscape factors should be considered in planning future projects. For example, urban wetland restoration is constrained by ongoing, large-scale human disturbances, ranging from pulses of excessive toxic pollution to persistent recreational use (Grayson et al. 1999). Real world application of these lessons is difficult. In their review of river restoration projects Bernhardt et al. (2007) found that project site location was primarily based on land opportunity and ecological factors, not watershed planning or landscape-scale management goals. This was likely the case for the vast majority of projects we assessed in Idaho.

Succession and floristic quality of restored, enhanced, and created wetlands

Restored wetlands > 5 years-old after project completion do not necessarily follow predictable or desirable successional trajectories toward undisturbed reference wetlands (Zedler and Callaway 1999, Matthews and Spyreas 2010). Instead, community composition at restored wetlands can converge toward that of disturbed reference sites (Matthews and Spyreas 2010). Reasons for this include non-native species dominance, isolation from native plant propagules, and depauperate seed banks (Seabloom and van der Valk 2003, Matthews and Spyreas 2010). Except for wetlands with simpler structure (e.g., some cattail (*Typha*) marshes), expected ecosystem properties may not emerge (e.g., soil characteristics) in timeframes less than 15 years (Zedler and Callaway 1999). Spatial patterns of habitats developing in restored wetlands may converge with natural wetlands at a faster rate than community composition (Seabloom and van der Valk 2003). Plant communities of restored, enhanced, and created wetlands sampled during this project were nearly always dissimilar from vegetation of reference wetlands, even at older project sites.

Matthews and Spyreas (2010) found that species composition was initially similar between < 5 year-old Illinois mitigation projects, but plant community successional trajectories soon diverged. Non-native species were the primary drivers of succession at < 5 year-old restored wetlands; some of which were frequently documented at our assessed sites, especially barnyard grass (*Echinochloa crus-galli*), reed canarygrass (*Phalaris arundinacea*), and less frequently, narrowleaf cattail (*Typha angustifolia*). Importantly, the relative cover of reed canarygrass at restored wetlands increased at a higher rate 5 years after project completion, indicating a trajectory toward low integrity reference sites rather than high integrity sites (Matthews and Spyreas 2010). In

Oregon, Adamus (2010) found no difference in non-native species prevalence between enhanced and reference wetlands, but restored wetlands did have higher abundance non-native species than reference sites. This result was concurrent with our results. In depressional mitigation wetlands of the southeast U. S., hydroperiod was a key driver of ecosystem development (De Steven et al. 2010). In some cases, vegetation targets were not reached because the necessary hydroperiod was not restored or maintained, often resulting in non-native species invasion.

Floristic quality of restored, enhanced, and created wetlands changes rapidly in response to the interplay of local environmental factors (e.g., hydrology, soils, solar radiation), species traits, and successional processes. We observed a peak in floristic quality 5 to 10 years after project completion. In Wisconsin, floristic quality stabilized after 5 years, but improved after 10 years woody vegetation matured and suppressed shade intolerant species, including reed canarygrass (*Phalaris arundinacea*) (Hapner 2006). However, vegetation succession in restored wetlands is complex. In their FQA of restored wetlands in Illinois, Matthews et al. (2009) found that landscape condition influenced species composition more than local factors, but local variables (e.g., hydrology, soil fertility, location in watershed) were slightly more important determinants of overall plant community types and mean C-values. However, mean C-values appeared limited by landscape condition. For example, wetlands in urban and agricultural landscapes had higher levels of non-native species than those surrounded by natural habitat.

Brewer and Menzel (2008) recommend that a net increase in the abundance and frequency of species that indicate habitats of interest or conservation concern may be better metric of project success than comparing community similarity to a specific reference site. This approach is useful where minimally disturbed reference sites are rare on the landscape (e.g., in southwest and south-central Idaho). Their approach is analogous to the FQA method we applied. In addition, reference wetlands in urban and agricultural landscapes may be undergoing rapid degradation, thus making them moving targets less useful for evaluating restoration progress (Grayson et al. 1999). Without knowledge of the spatial and temporal variability present in flora or fauna monitored as an indicator of restoration success, misleading conclusions can result (Grayson et al. 1999).

Our results align with other studies (e.g., Matthews and Spyreas 2010) in showing that vegetation composition at restored wetlands is variable and difficult to predict. However, planting large numbers of native species in restored wetlands can increase similarity to minimally disturbed reference wetlands and mute variability (Matthews and Spyreas 2010). This practice can increase floristic quality and may help in suppressing (but not eliminating) reed canary grass (*Phalaris arundinacea*) (Hapner 2006). However, divergence toward alternative restoration targets should be expected, especially where invasive species are present. Their presence may become a significant constraint on meeting a restoration target. The objective of a restoration project will influence whether or not reference targets can ever be met. For example, an urban stormwater treatment wetland is built for a specific function, not an ecologic end point (Grayson et al. 1999). While monitoring plant community succession is useful for indicating short-term trajectories and identifying constraints, a combined approach that also includes assessment of plant community spatial patterns (Seabloom and van der Valk 2003), broader habitat measures (Brewer and Menzel 2008), and restored ecosystem functions (Grayson et al. 1999, Zedler and Callaway 1999, Matthews and Spyreas 2010) is recommended.

Evaluating project "success"

"Success" of any wetland or riparian restoration, enhancement, or creation activity implies that condition and function improved after project completion compared to before the project. To determine success there should be (1) a clearly defined project goal or expected outcome, (2) success criteria, and (3) monitoring and assessment, ideally with a comparison to an appropriate reference site (Bernhardt et al. 2007). Bernhardt et al. (2007) found that only 10% of restoration projects in their review used all 3 of these elements in determining project success. Our review was not designed to judge success of an individual project, but rather to show how assessment of potential wetland functions and values and analysis of vegetation condition can be used to inform project evaluation and monitoring.

About 65 to 80% of the most the most ecologically successful projects had a high percent of public involvement and/or an advisory committee, compared to 40 to 50% of all projects in the review (Bernhardt et al. 2007). These restoration projects also had slightly higher numbers of funders and partners, but a significantly higher median cost ($400,000 to $580,000 compared to $150,000 for all projects). These projects are also more likely to have followed a thorough planning process, including having clearly defined goals and objectives, success criteria, and quantitative monitoring and evaluation.

We were unable to obtain enough background information about each of the restoration, enhancement, and creation projects we assessed to completely document planning and evaluation process (e.g., specific objectives, success criteria, monitoring, etc.), funding, number of partners, and public involvement. Of the project types assessed, those most likely to have followed an ecological restoration planning model (e.g., specific objectives, success criteria, quantitative monitoring and evaluation) were also likely the best funded. These were mitigation, wetland habitat (NAWCA Grant), and at least some stormwater and irrigation return water treatment projects. Mitigation projects are required to have quantifiable performance standards, or success criteria. WRP and watershed restoration (S. 319 Grant) projects are often designed with specific objectives (e.g., water quality or habitat improvement) and sometimes evaluated for success, but monitoring is not always quantitative and funding levels not as high. However, S. 319 projects in our survey made up for low funding levels by maximizing community involvement, especially volunteers used in project implementation. Fish and wildlife habitat projects are the least likely to follow an ecological planning model, but often include much landowner and public involvement.

Levels of planning, evaluation, financial, and community investment sometimes correlate with the levels of potential functions performed by different restoration, enhancement, and creation project types. Intentional design and engineering is important for increasing the level of certain functions supported by created and restored wetlands (Hapner 2006). For example, mitigation projects, followed by NAWCA and WRP projects, supported most water quality improvement functions at higher levels than other project types. NAWCA and WRP projects were also near the top for supporting a broad range of habitat functions. Application of ecological restoration planning process, monitoring, and science, combined with necessary financial resources, likely improve the outcomes of these project types. In the case of S. 319 funded projects, where most functions are not supported at high levels, community-based restoration does not wholly compensate for the lack of funding (and hence a narrower range of scientific and technical resources available).

Recommendations for planning, evaluation, and stewardship of restoration, enhancement, and creation projects

Tools for monitoring and assessment of restoration, enhancement, and creation projects: Monitoring plant community succession in restored, enhanced, and created wetlands is useful for indicating short-term progress and identifying problems (e.g., invasive species, poor survival of planted material). However, evaluation of restoration outcomes and success should be holistic and also include assessment of functions and values (Grayson et al. 1999, Zedler and Callaway 1999, Matthews and Spyreas 2010). One objective of this project was to demonstrate application of monitoring and assessment tools in evaluating restoration outcomes. Based on their ease of use and meaningful outputs, ORWAP / WESPUS (Adamus et al. 2010a, Adamus 2011) and eastern Washington FQA indices (Rocchio and Crawford 2013) proved to be useful methods for rapidly assessing outcomes of wetland restoration, enhancement, and creation in Idaho. Idaho's Landscape-scale Wetland Assessment Tool, Idaho RAM, and watershed (HUC 12) ecological group classification were also useful for estimating watershed and site-scale condition, and identifying reference wetlands. Practitioners of restoration in Idaho are encouraged to apply some, or all, of these tools in planning, implementing, monitoring, and assessing their projects.

There is a need to conduct additional field testing of these tools in Idaho. For example, ORWAP / WESPUS should be used to assess potential functions and values of reference wetlands. ORWAP / WESPUS should also be tested for its power to detect site level effects of restoration in Before-After-Control-Impact studies. Four wetlands assessed during this project (Deyo Reservoir, Hyatt Hidden Lakes Reserve, LQ Drain, and Spring Cove Ranch) had new phases of restoration, enhancement, and/or creation implemented in 2012, after our assessments in 2010 or 2011. This gives us the opportunity to reassess these sites to test the power of ORWAP / WESPUS to detect changes due to management.

Uses of watershed profiles and reference vegetation in project planning: Results of this project can be used to inform the design of ecological restoration and monitoring projects. The most characteristic "keystone" plant species for each ecological habitat in a watershed ecological group can be considered integral to restoration of the wetland ecosystem. These keystone species should be considered when developing planting lists for restoration projects. Maximizing the diversity and abundance of these species in a restoration planting can sometimes buffer invasive species competition (Hapner 2006, Matthews and Spyreas 2010). Keystone species lists can also be used to plan seed or plant material collection and propagation projects for watershed ecological groups and habitats. The cover and constancy of characteristic species in minimally or lightly disturbed reference wetlands (or moderately disturbed when minimally impacted reference conditions do not exist) can be compared to cover and constancy of species in restored wetlands in the same ecological group to monitor succession. Alternatively, the composition of any habitat documented during a watershed assessment can be compared to that of a reference habitat described for that watershed to determine if restoration might be necessary (Harris 1999).

Caution should be used when using reference vegetation to determine success criteria. Our results demonstrate that vegetation composition and floristic quality of restored, enhanced, and created wetlands is rarely equal to that of reference wetlands, especially in short term monitoring time frames. It is also important to remember that historic natural conditions may not reflect future ecosystem conditions due to the influence of climate change on hydrology and other environmental factors. The surrounding landscape and watershed context should also be a factor in determining realistic success criteria (Matthews et al. 2009, Moreno-Mateos et al. 2012).

Invasive species: The presence of invasive, perennial non-native species is a significant challenge to raising floristic quality at restored, enhanced, and created wetlands. These species have the ability to out-compete native species, even in less disturbed sites. Reed canarygrass (*Phalaris arundinacea*) was the most frequently sampled non-native species at restored and enhanced wetlands in both Idaho and Oregon (Adamus 2010). It is an invasive species at wetland projects in many other regions, especially the midwestern U. S. (Hapner 2006, Matthews and Spyreas 2010). Efforts to prevent establishment of reed canarygrass and other invasive species, and to reduce cover of these species after implementation, are recommended for any project.

The following **highly invasive** species were abundant in vegetation plots sampled during this project and should be targeted for control and prevention in existing and future wetland restoration, enhancement, and creation projects:

Trees
silver maple (*Acer saccharinum*)
Russian olive (*Elaeagnus angustifolia*)
green ash (*Fraxinus pennsylvanica*)
white willow (*Salix alba*)
crack willow (*Salix fragilis*)

Shrubs and Vines
desert false indigo (*Amorpha fruticosa*)
Himalayan blackberry (*Rubus discolor*)
climbing nightshade (*Solanum dulcamara*)

Grasses and Grass-likes
'Garrison' creeping meadow foxtail (*Alopecurus arundinaceus*)
quackgrass (*Elymus repens*)
reed canarygrass (*Phalaris arundinacea*)
narrowleaf cattail (*Typha angustifolia*)

Forbs
lesser burdock (*Arctium minus*)
Canada thistle (*Cirsium arvense*)
paleyellow iris (*Iris pseudacorus*)
purple loosestrife (*Lythrum salicaria*)
broadleaved pepperweed (*Lepidium latifolium*)
creeping buttercup (*Ranunculus repens*)
perennial sowthistle (*Sonchus arvensis*)

<u>*Planning restoration, enhancement, and creation projects to maximize functions and values*</u>: Results of our assessment indicate that higher investments of time and money in planning, monitoring, evaluation, stewardship, and engagement of local communities and landowners sometimes (but not always) correlates with higher levels of potential functions performed by restored, enhanced, and created wetlands. Quality objective-driven design and engineering is important for increasing the level of desired functions (Hapner 2006), but watershed and landscape context needs to be considered in any project plan (Matthews et al. 2009). ORWAP / WESPUS can be used to illuminate hypothetical outcomes of a project's design before implementation. For any restoration project, of any scale, there should be clearly defined goals and expected outcomes, success criteria (preferably quantifiable, but realistic), a monitoring and assessment plan (that is actually implemented), and, ideally, comparison to an appropriate reference site (Bernhardt et al. 2007).

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LITERATURE CITED

Adamus, P. R., L. T. Stockwell, E. J. 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. Prepared for US Army Corps of Engineers.

Adamus, P. R. 2010. Ecological condition and functions of enhanced, restored, and reference wetlands in the Willamette Valley, Oregon. Report to Oregon Watershed Enhancement Board and Oregon Department of State Lands, Salem, OR. 31 pp. plus appendices

Adamus, P., J. Morlan, and K. Verble. 2010a. Manual for the Oregon Rapid Wetland Assessment Protocol (ORWAP). Version 2.0.2. Oregon Department of State Lands, Salem, OR.

Adamus, P., J. Morlan, and K. Verble. 2010b. Oregon Rapid Wetland Assessment Protocol (ORWAP): calculator spreadsheet, databases, and data forms. Oregon Department of State Lands, Salem, OR.

Adamus, P. R. 2011. Manual for the Wetland Ecosystem Services Protocol for the United States (WESPUS). www.oregonstate.edu/~adamusp/WESPUS.

Ambrose, R. F., J. C. Callaway, and S. F. Lee. 2006. An evaluation of compensatory mitigation projects permitted under Clean Water Act Section 401 by the California State Water Quality Control Board, 1991-2002. Prepared for California State Water Resources Control Board, Los Angeles, CA.

Apfelbeck, R. and E. Farris. 2005. Montana wetland rapid assessment method guidebook (V.2.0—Final Draft). Prepared by Montana Department of Environmental Quality—Planning, Prevention, and Assistance Division, Water Quality Planning Bureau, Wetland Section, Helena, MT.

Berglund, J. and R. McEldowney. 2008. MDT Montana wetland assessment method. Prepared for Montana Department of Transportation. Post, Buckley, Schuh & Jernigan, Helena, MT. 42 pp.

Bernhardt, E. S., E. B. Sudduth, M. A. Palmer, J. D. Allan, J. L. Meyer, G. Alexander, J. Follastad-Shah, B. Hassett, R. Jenkinson, R. Lave, J. Rumps, and L. Pagano. 2007. Restoring rivers one reach at a time: Results from a survey of U. S. river restoration practitioners. Restoration Ecology 15(3):482-493.

Bourgeron, P. S., R. L. DeVelice, L. D. Engelking, G. Jones, and E. Muldavin. 1991. WHTF site and community survey manual. Version 92B. Western Heritage Task Force, Boulder, CO. 24 pp.

Brewer, J. S., and T. Menzel. 2009. A method for evaluating outcomes of restoration when no reference sites exist. Restoration Ecology 17(1):4-11.

Brinson, M. M. 1993. Hydrogeomorphic classification for wetlands. Technical Report WRP-DE-4. US Army Corps of Engineers, Waterways Experiment Station, Vicksburg, MS.

Brooks, R. P., D. H. Wardrop, C. A. Cole, and K. Reisinger. 2002. Using reference wetlands for integrating wetland inventory, assessment, and restoration for watersheds *in* Watershed-based wetland planning and evaluation. A collection of papers from the Wetland Millennium Event (August 6-12, 2000; Quebec City, Quebec, Canada). Tiner, R. W. (compiler). Distributed by the Association of State Wetland Managers, Inc., Berne, NY. 141 pp.

Brooks, R. P., D. H. Wardrop, and J. A. Bishop. 2004. Assessing wetland condition on a watershed basis in the Mid-Atlantic region using some synoptic land-cover maps. Environmental Monitoring and Assessment 94:9-24.

Collins, J. N., E. D. Stein, M. Sutula, R. Clark, A. E. Fetscher, L. Grenier, C. Grosso, and A. Wiskind. 2007. California Rapid Assessment Method (CRAM) for wetlands (Version 5.0.1). 151 pp.

Comer, P. J. and J. Hak. 2012. Landscape condition in the conterminous United States. Spatial model summary. NatureServe, Boulder, CO.

Cowardin, L. M., V. Carter, F. C. Golet, and E. T. LaRoe. 1979. Classification of wetlands and deepwater habitats of the United States. US Department of the Interior, Fish and Wildlife Service, Office of Biological Services, Washington, DC. 103 pp.

Dahl, T. E. 1990. Wetland losses in the United States, 1780s to 1980s. US Department of the Interior, Fish and Wildlife Service, Washington, DC. 21 pp.

Dahl, T. E. 2000. Status and trends of wetlands in the conterminous United States 1986 to 1997. US Department of the Interior, Fish and Wildlife Service, Washington, DC. 82 pp.

Dahl, T. E. 2006. Status and trends of wetlands in the conterminous United States 1998 to 2004. US Department of the Interior, Fish and Wildlife Service, Washington, DC. 112 pp.

Dahl, T. E. 2011. Status and trends of wetlands in the conterminous United States 2004 to 2009. US Department of the Interior, Fish and Wildlife Service, Washington, DC**.** 108 pp.

Davis, J. C. and G. A. Muhlberg. 2002. The evaluation of wetland and riparian restoration projects. Alaska Department of Fish and Game, Habitat and Restoration Division, Anchorage, AK. 14 pp. plus appendices.

Daumiller, G. 2003. GIS Landscape assessment tool: watershed characterization for factors that have an impact on wetlands. Montana Wetland Monitoring and Assessment Meeting, Missoula. Natural Resource Information System, Montana State Library, Helena, MT. http://deq.mt.gov/wqinfo/Wetlands/NRISwshedAssess.pdf

De Steven, D., R. R. Sharitz, and C. D. Barton. 2010. Ecological outcomes and evaluation of success in passively restored Southeastern depressional wetlands. Wetlands 30:1129-1140.

De Steven, D. and J. M. Gramling. 2012. Diverse characteristics of wetlands restored under the Wetlands Reserve Program in the southeastern United States. Wetlands 32:593-604.

Ducks Unlimited. 2012. Idaho conservation projects. http://www.ducks.org/idaho/idaho-projects/

Ehlert, H. 2010. Evaluation of wetland assessment methods and credit-debit systems for in-lieu fee mitigation of coastal aquatic resources in southeast Alaska. Prepared for Southeast Alaska Land Trust and US Fish and Wildlife Service, Juneau Field Office. CH2M HILL, Seattle, WA.

Faber-Langendoen, D., J. Rocchio, M. Schafale, C. Nordman, M. Pyne, J. Teague, T. Foti, and P. Comer. 2006. Ecological integrity assessment and performance Measures for wetland mitigation (Final Report). NatureServe, Arlington, VA.

Fennessy, M. S., J. J. Mack, E. Deimeke, M. T. Sullivan, J. Bishop, M. Cohen, M. Micacchion and M. Knapp. 2007. Assessment of wetlands in the Cuyahoga River watershed of northeast Ohio. Ohio EPA Technical Report WET/2007-4. Ohio Environmental Protection Agency, Division of Surface Water, Wetland Ecology Group, Columbus, OH.

Grayson, J. E., M. G. Chapman, and A. J. Underwood. 1999. The assessment of restoration of habitat in urban wetlands. Landscape and Urban Planning 43:227-236.

Hansen, P. L., R. D. Pfister, K. Boggs, B. J.Cook, J. Joy, and D. Hinckley. 1995. Classification and management of Montana's riparian and wetland sites. Miscellaneous publication No. 54. Montana Forest and Conservation Experiment Station, School of Forestry, University of Montana, Missoula, MT.

Hapner, J. A. 2006. Development of methods to assess and monitor small wetlands restored on private lands. Prepared for US Environmental Protection Agencey, Region 5, Wetland Program Development Grant. Ozaukee County Planning, Resources, and Land Management Department, Port Washington, WI.

Harris, R. R. 1999. Defining reference conditions for restoration of riparian plant communities: Examples from California, USA. Environmental Management 24(1):55-63.

Hitchcock, C. L. and A. Cronquist. 1973. Flora of the Pacific Northwest. University of Washington Press, Seattle, WA. 730 pp.

Hruby, T. 2004. Washington State wetland rating system for eastern Washington – Revised. Publication # 04-06-15. Washington State Department of Ecology, Olympia, WA.

Hychka, K. C., D. H. Wardrop, R. P. Brooks. 2007. Enhancing a landscape assessment with intensive data: A case study in the upper Juniata watershed. Wetlands 27(3):446-461.

Idaho Department of Fish and Game. 2007. Wetland conservation strategy for the South Fork and Middle Fork Clearwater subbasins, Idaho. Prepared for US Environmental Protection Agency, Region 10, Wetland Program Development Grant. Idaho Department of Fish and Game, Conservation Data Center, Boise, ID. 115 pp. plus appendices.

Jankovsky-Jones, M., C. Murphy, and C. Coulter. 2001. Riparian and wetland plant associations of southwestern Idaho with a focus on the Bureau of Land Management's Lower Snake River District. Miscellaneous Report BLM/ID/ST-01/001+1730. US Department of Interior, Bureau of Land Management, Boise, ID. 191 pp. plus appendices.

Johnson, J. B. 2005. Hydrogeomorphic wetland profiling: An approach to landscape and cumulative impacts analysis. EPA/620/R-05/001. US Environmental Protection Agency, Washington, D. C.

Jones, W. M. 2005. A vegetation index of biotic integrity for small-order streams in southwestern Montana and a floristic quality assessment for western Montana wetlands. Report to the Montana Department of Environmental Quality and U.S. Environmental Protection Agency, Montana Natural Heritage Program, Helena, MT. 29 pp. plus appendices.

Lemly, J., L. Gilligan, and M. Fink. 2011. Statewide strategies to improve effectiveness in protecting and restoring Colorado's wetland resource including the Rio Grande Headwaters pilot wetland condition assessment. Prepared for Colorado Parks and Wildlife Wetland Wildlife Conservation Program and US Environmental Protection Agency, Region 8. Colorado Natural Heritage Program, Colorado State University, Fort Collins, CO. 83 pp. plus appendices.

Matthews, J. W., A. L. Peralta, D. N. Flanagan, P. M. Baldwin, A. Soni, A. D. Kent, and A. G. Endress. 2009. Relative influence of landscape vs. local factors on plant community assembly in restored wetlands. Ecological Applications 19(8):2108-2123.

Matthews, J. W., and G. Spyreas. 2010. Convergence and divergence in plant community trajectories as a framework for monitoring wetland restoration progress. Journal of Applied Ecology 47:1128-1136.

McCune, B., and J. B. Grace. 2002. Analysis of ecological communities. MjM Software Design, Gleneden Beach, OR. 300 pp.

McCune, B., and M. J. Mefford. 1999. PC-ORD. Multivariate analysis of ecological data, version 4. MjM Software Design, Gleneden Beach, OR. 237 pp.

Mita, D., E. DeKeyser, D. Kirby, and G. Easson. 2007. Developing a wetland condition prediction model using landscape structure variability. Wetlands 27(4):1124-1133.

Moreno-Mateos, D., M. E. Power, F. A. Comı´n, and R. Yockteng. 2012. Structural and functional loss in restored wetland ecosystems. PLoS Biol 10(1):e1001247.

Murphy, C. and A. Schmidt. 2010. Development of a landscape-scale wetland condition assessment tool for Idaho. Prepared for US Environmental Protection Agency, Region 10, Wetland Program Development Grant. Idaho Department of Fish and Game, Wildlife Bureau, Habitat Section and Information Systems Bureau, Idaho Fish and Wildlife Information System, Boise, ID. 60 pp. plus appendices.

Murphy, C., J. Miller, and L. Harloe. 2011. Wetland and riparian plant associations of West-central Idaho. Prepared for U.S. Department of Agriculture Forest Service, Boise and Payette National Forests. Idaho Department of Fish and Game, Wildlife Bureau, Habitat Section and Idaho Natural Heritage Program, Boise, ID.

Murphy, C., J. Miller, and A. Schmidt. 2012. Idaho's landscape-scale wetland condition assessment tool—Methods and applications in conservation and restoration planning. Prepared for US Environmental Protection Agency, Region 10, Wetland Program Development Grant. Idaho Department of Fish and Game, Wildlife Bureau, Habitat Section and Wildlife Diversity Program, and Information Systems Bureau, Idaho Fish and Wildlife Information System, Boise, ID. 60 pp. plus appendices.

National Research Council. 1995. Wetlands: Characteristics and boundaries. National Research Council, Committee on Characterization of Wetlands. National Academy Press, Washington, D. C. 227 pp. plus appendices.

National Resources Conservation Service. 2012. The PLANTS Database. US Department of Agriculture, National Resources Conservation Service, National Plant Data Team, Greensboro, NC. http://plants.usda.gov

Novitzki, R. P., R. D. Smith, and J. D. Fretwell. 1996. Wetland functions, values, and assessment. In: National water summary on wetland resources—selected articles. US Geological Survey Water-Supply Paper 2425. US Geological Survey.

O2 Planning and Design Inc. 2011. Ecosystem services approach pilot on wetlands—Wetland Ecosystem Services Protocol for the United States (WESPUS) site assessments. Prepared for Alberta Environment and Sustainable Resource Development, Ecosystem Services Pilot Project, Edmonton, AB. 38 pp.

Palmer, M. A. and J. D. Allan. 2006. Policy recommendations to enhance effectiveness of river restoration. National Academy of Science: Issues in Science and Technology.

Porej, D. 2003. An inventory of Ohio wetland compensatory mitigation. Prepared for US Environmental Protection Agency. State of Ohio Wetland Ecology Group, Division of Surface Water, Columbus, OH. 25 pp.

Ruiz-Jaen, M. C. and T. M. Aide. 2005. Restoration success: How is it being measured? Restoration Ecology 13(3): 569–577.

Rumps, J. M., S. L. Katz, K. Barnas, M. D. Morehead, R. Jenkinson, S. R. Clayton, and P. Goodwin. 2007. Stream restoration in the Pacific Northwest: Analysis of interviews with project managers. Restoration Ecology 15(3):506-515.

Quigley, T. M., R. A. Gravenmier, S. J. Arbelbide, H. Bigler-Cole, R. T. Graham, R. W. Haynes. 1999. The Interior Columbia Basin Ecosystem Management Project: scientific assessment. CD-ROM. US Department of Agriculture, Forest Service, Pacific Northwest Research Station, Portland, OR.

Rocchio, F. J. 2007. Floristic Quality Assessment Indices of Colorado Plant Communities. Unpublished report prepared for Colorado Department of Natural Resources, and U.S. Environmental Protection Agency, Region VIII. Colorado Natural Heritage Program, Colorado State University, Fort Collins, CO.

Rocchio, F. J. and R. C. Crawford. 2009. Monitoring desired ecological conditions on Washington State Wildlife Areas using an Ecological Integrity Assessment framework. Natural Heritage Report 2009-13. Washington Natural Heritage Program, Washington Department of Natural Resources, Olympia, WA. 97 pp.

Rocchio, F. J. and R. C. Crawford. 2013. Floristic quality assessment for Washington vegetation. Natural Heritage Report 2013-03. Prepared for US Environmental Protection Agency. Washington Department of Natural Resources, Washington Natural Heritage Program, Olympia, WA. 49 pp.

Sands, W. P. 2002. Wetland assessment and restoration potential in the Norwood Young America watershed. Saint Mary's University, Department of Resource Analysis, Winona, MN, and Minnesota Board of Water and Soil Resources, St. Paul, MN.

Seaber, P. R., F. P Kapinos, and G. L. Knapp. 1987. Hydrologic unit maps. US Geological Survey Water-Supply Paper 2294, US Department of the Interior, Geological Survey, Denver, CO.

Seabloom, E. W., and A. G. van der Valk. 2003. The development of vegetative zonation patterns in restored prairie pothole wetlands. Journal of Applied Ecology 40:92-100

Smith, D. R., Ammann, A., Bartoldus, C., and Brinson, M. M. 1995. An approach for assessing wetland functions using hydrogeomorphic classification, reference wetlands, and functional indices. Technical Report WRP-DE-9. US Army Engineer Waterways Experiment Station, Vicksburg, MS.

Smith, C. 2011. 2010 implementation and effectiveness monitoring results for the Washington Conservation Reserve Enhancement Program (CREP). Washington State Conservation Commission, Olympia, WA. 26 pp.

Spivey, M. L. and B. Ainslie. 2004. Landscape profiling and better wetland restoration: How HGM can help. 2004 ESRI Federal User Conference. US Environmental Protection Agency, Region 4.

Stoddard, J. L., D. V. Peck, S. G. Paulsen, J. Van Sickle, C. P. Hawkins, A. T. Herlihy, R. M. Hughes, P. R. Kaufmann, D. P. Larsen, G. Lomnicky, A. R. Olsen, S. A. Peterson, P. L. Ringold, and T. R. Whittier. 2005. An ecological assessment of Western streams and rivers. EPA 620/R-05/005. US Environmental Protection Agency, Washington, DC.

Tiner, R. W. 2002. Remotely-sensed natural habitat integrity indices for assessing the general ecological condition of watersheds *in* Watershed-based wetland planning and evaluation. A collection of papers from the Wetland Millennium Event (August 6-12, 2000; Quebec City, Quebec, Canada). Tiner, R. W. (compiler). Distributed by the Association of State Wetland Managers, Inc., Berne, NY. 141 pp.

Tiner, R. 2005. Assessing cumulative loss of wetland functions in the Nanticoke River Watershed using enhanced national wetland inventory data. Wetlands 25(2):405-419.

Troelstrup, Jr., N. H. and G. Stueven. 2007. Reference site selection for monitoring and assessment of intermittent streams in South Dakota—First annual progress report to EPA. South Dakota State University, Brookings, SD.

US Environmental Protection Agency. 2006. Elements of a state water monitoring and assessment program for wetlands. Wetland Division, Office of Wetlands, Oceans and Watersheds. US Environmental Protection Agency, Washington D.C. www.epa.gov/owow/wetlands/monitor/#elements

US Fish and Wildlife Service. 1990. Regional wetlands concept plan: Emergency Wetlands Resources Act. US Department of the Interior, Fish and Wildlife Service, Portland, OR.

US Fish and Wildlife Service. 1991. National wetlands priority conservation plan. US Department of the Interior, Fish and Wildlife Service. 56 pp. plus appendices.

Vance, L. K. 2009. Assessing wetland condition with GIS: A landscape integrity model for Montana. A report to the Montana Department of Environmental Quality and the Environmental Protection Agency. Montana Natural Heritage Program, Helena, MT. 23 pp. plus appendices.

Walford, G., G. Jones, W. Fertig, S. Mellman-Brown, and K. Houston. 2001. Riparian and wetland plant community types of the Shoshone National Forest. RMRS-GTR-85. US Department of Agriculture, Forest Service, Rocky Mountain Research Station. 122 pp.

Wall, S. M. 2011. Efficacy of riparian vegetation projects in the Inland Pacific Northwest. M. S. Professional Paper, University of Montana, Missoula, MT. 41 pp.

Wardrop, D. H., M. E. Kentula, S. F. Jensen, D. L. Stevens Jr., and K. C. Hychka. 2007. Assessment of wetlands in the Upper Juniata watershed in Pennsylvania, USA using the hydrogeomorphic approach. Wetlands 27(3):432–445.

Weixelman, D. A., D. C. Zamudio, and K. A. Zamudio. 1996. Central Nevada riparian field guide. US Department of Agriculture, Forest Service, Toiyabe National Forest, Sparks, NV.

Weller, D. E., M. N. Snyder, D. F. Whigham, A. D Jacobs, and T. E. Jordan. 2007. Landscape indicators of wetland condition in the Nanticoke River watershed, Maryland and Delaware, USA. Wetlands 27(3):498-514.

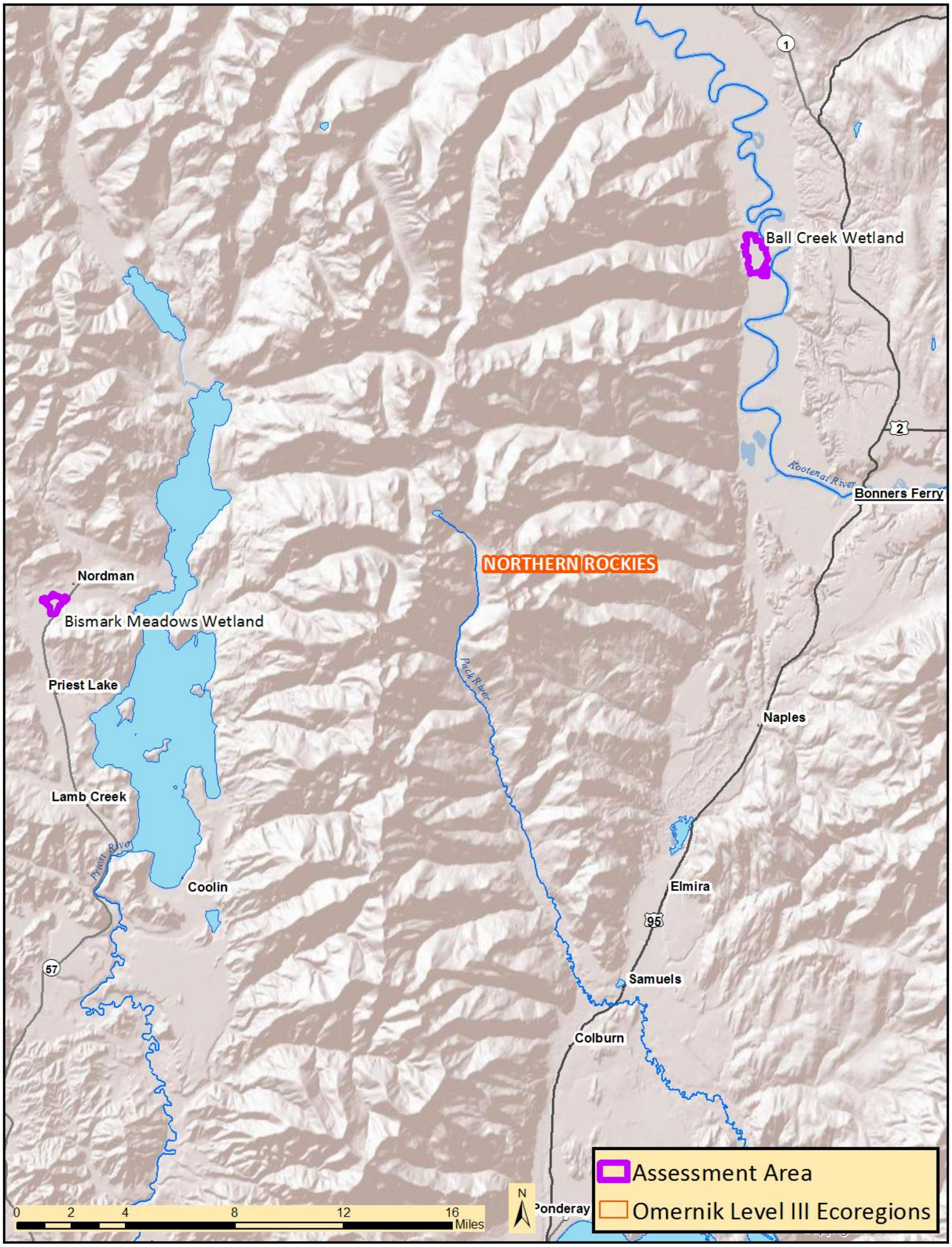
Winters, D. S., B. Bohn, D. J. Cooper, G. Eaglin, J. D. Hamerlinck, C. Hirsch, N. L. Poff, C. M. Quimby, F. J. Rahel, P. Rau, D. Scaife, D. M. Staley, E. E. Wohl, and M. Welker. 2006. Conceptual framework and protocols for conducting multiple scale aquatic, riparian, and wetland ecological assessments for the USDA Forest Service – Rocky Mountain Region. US Department of Agriculture, Forest Service, Rocky Mountain Region, Golden, CO. 135 pp.

Winward, A. H. 2000. Monitoring the vegetation resources in riparian areas. RMRS-GTR-47. US Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fort Collins, CO.

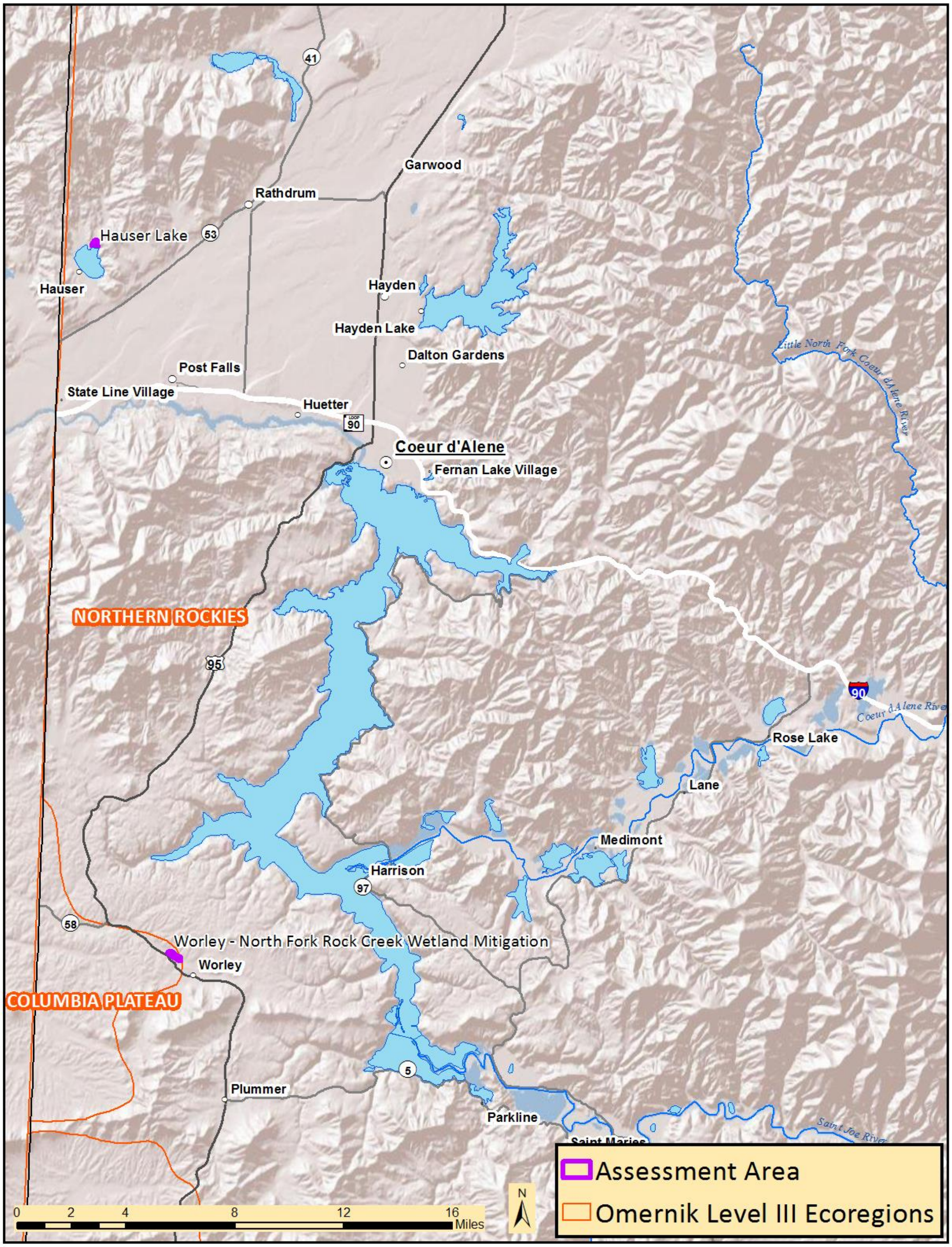
Zedler, J.B. and J. C. Callaway. 1999. Tracking wetland restoration: Do mitigation sites follow desired trajectories? Restoration Ecology 7(1):69-73.

APPENDIX 1

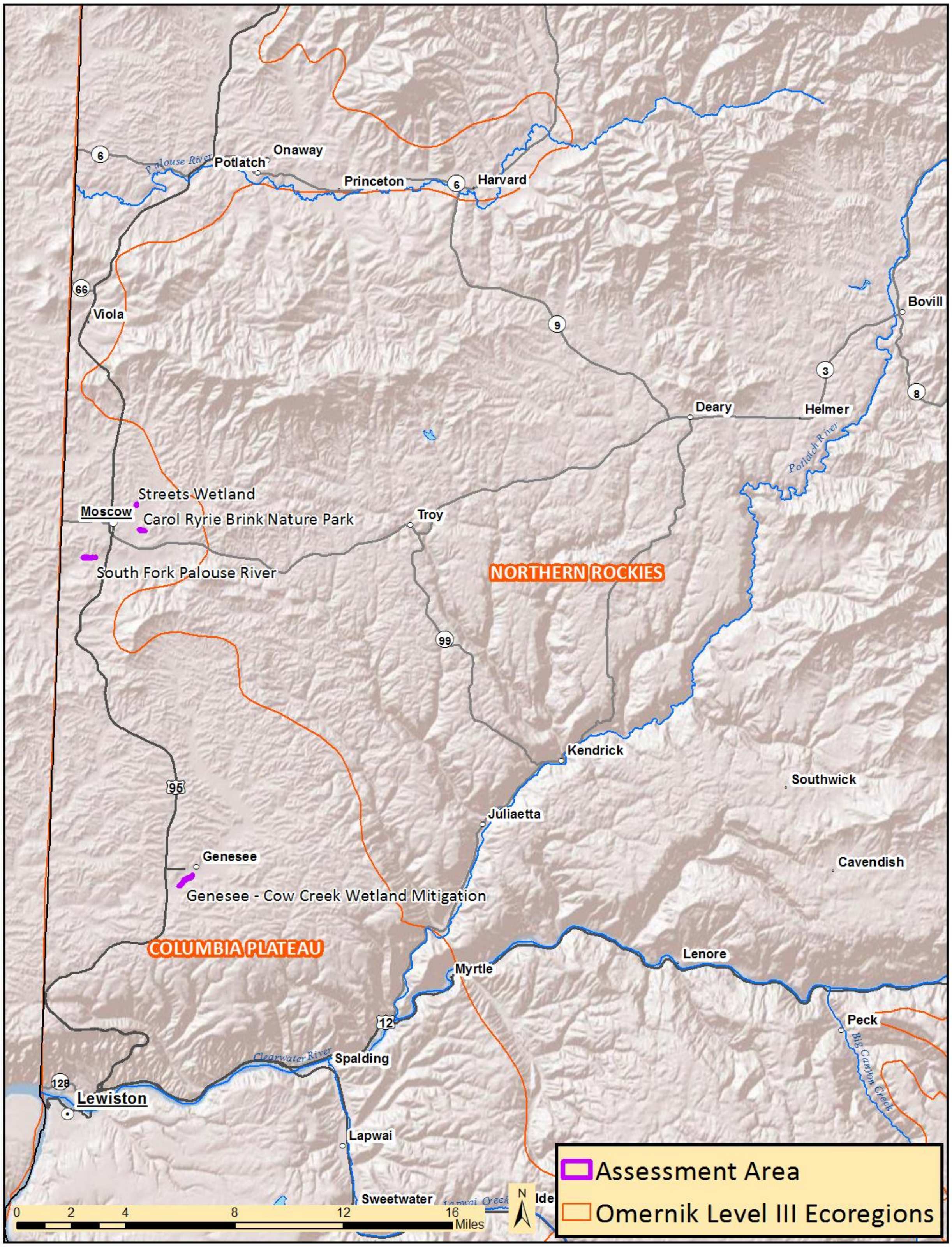
Locations of assessed restored, enhanced, and created wetlands

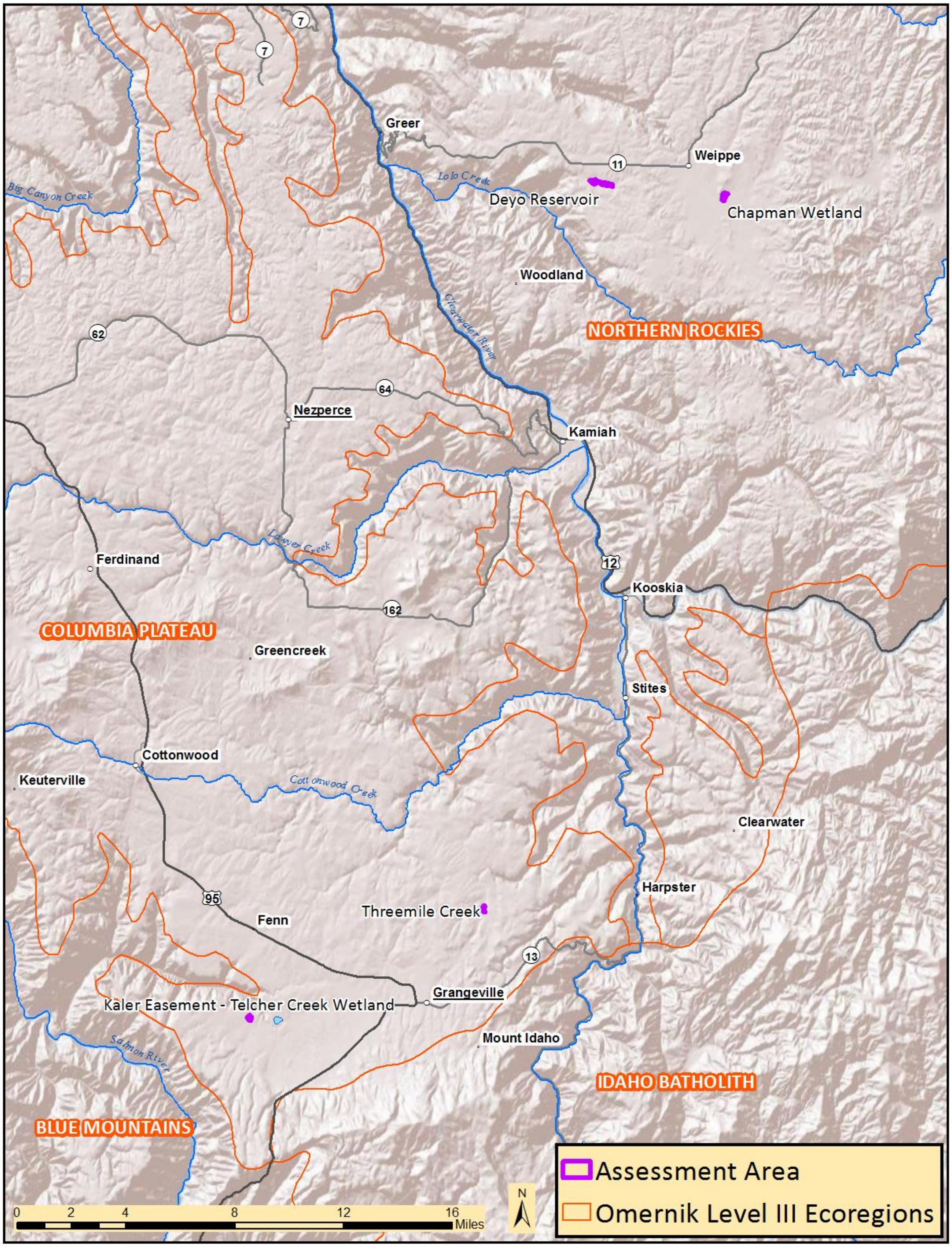


Ball Creek Wetland
Bonners Ferry
Kootenai River
NORTHERN ROCKIES
Nordman
Bismark Meadows Wetland
Priest Lake
Lamb Creek
Priest River
Coolin
Pack River
Naples
Elmira
Samuels
Colburn
Ponderay
1
2
57
95
0 2 4 8 12 16 Miles
N
Assessment Area
Omernik Level III Ecoregions

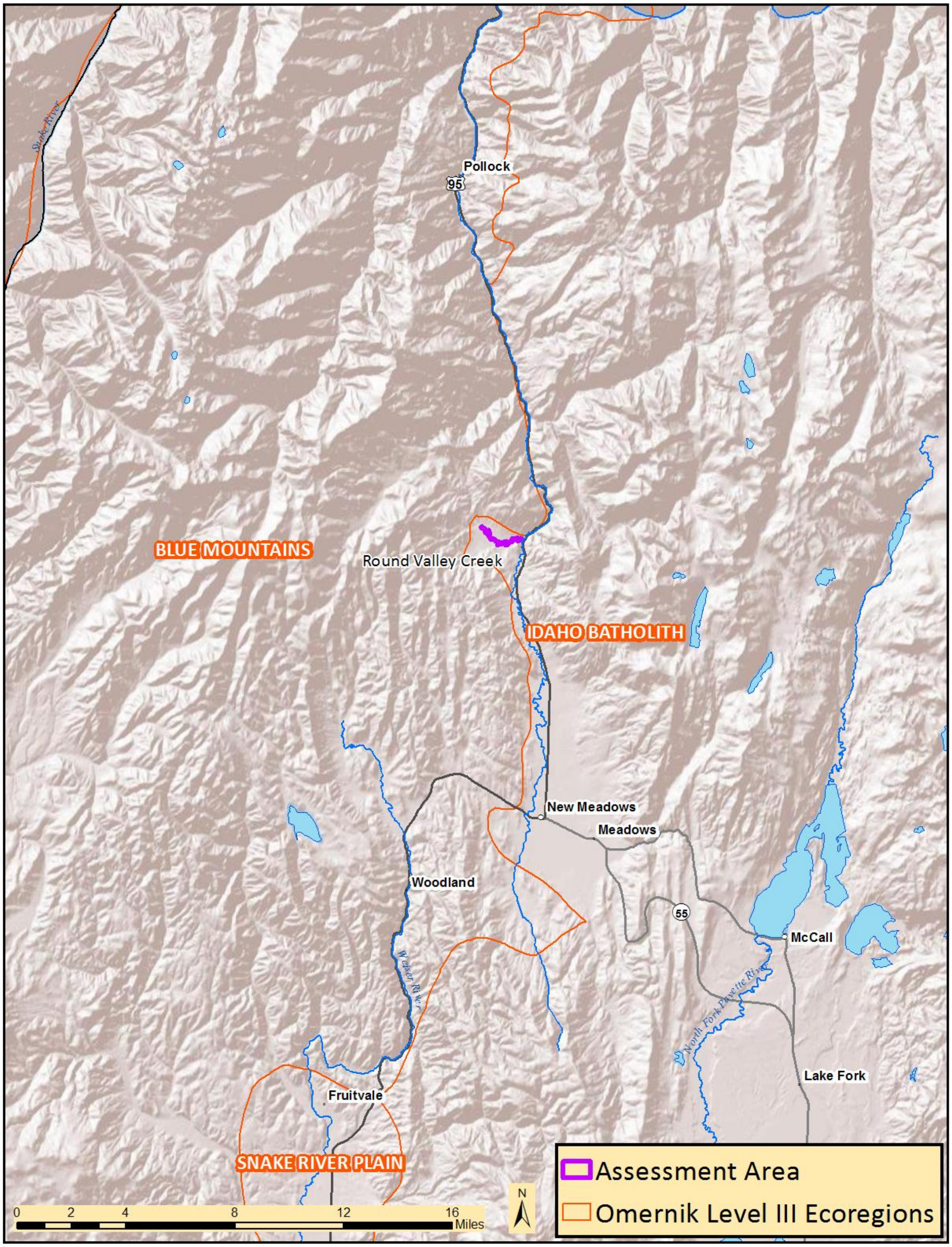


Garwood
Rathdrum
Hauser Lake
Hauser
Hayden
Hayden Lake
Dalton Gardens
Post Falls
State Line Village
Huetter
Coeur d'Alene
Fernan Lake Village
Little North Fork Coeur d'Alene River
NORTHERN ROCKIES
Coeur d'Alene River
Rose Lake
Lane
Medimont
Harrison
Worley - North Fork Rock Creek Wetland Mitigation
Worley
COLUMBIA PLATEAU
Plummer
Parkline
Saint Maries
Saint Joe River
Assessment Area
Omernik Level III Ecoregions
0 2 4 8 12 16 Miles
N

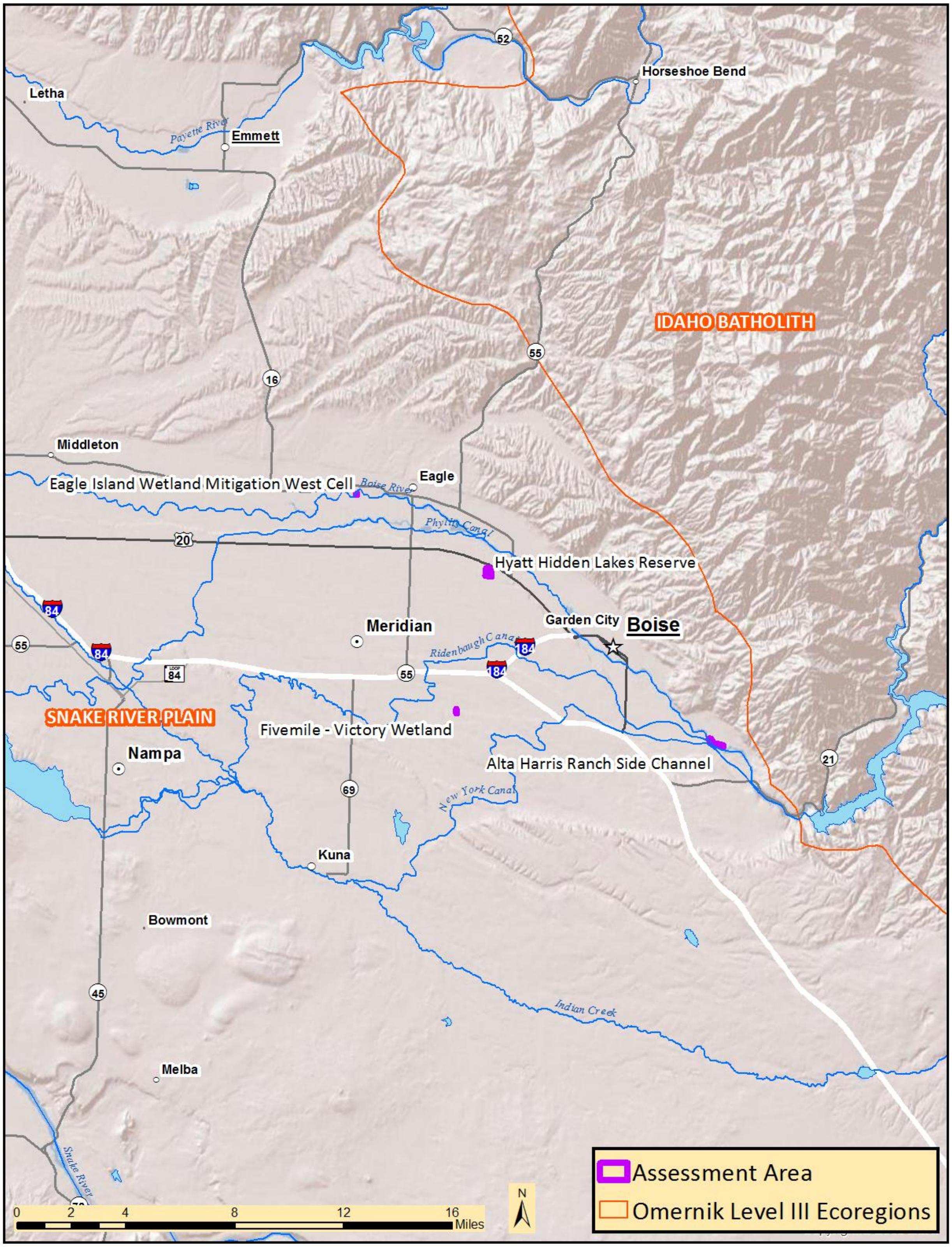

Onaway
Potlatch
Palouse River
Princeton
Harvard
Viola
Bovill
Deary
Helmer
Potlatch River
Streets Wetland
Moscow
Carol Ryrie Brink Nature Park
Troy
South Fork Palouse River
NORTHERN ROCKIES
Kendrick
Southwick
Juliaetta
Genesee
Cavendish
Genesee - Cow Creek Wetland Mitigation
COLUMBIA PLATEAU
Lenore
Myrtle
Peck
Clearwater River
Spalding
Big Canyon Creek
Lewiston
Lapwai
Sweetwater
Lapwai Creek
0 2 4 8 12 16
Miles
N
Assessment Area
Omernik Level III Ecoregions



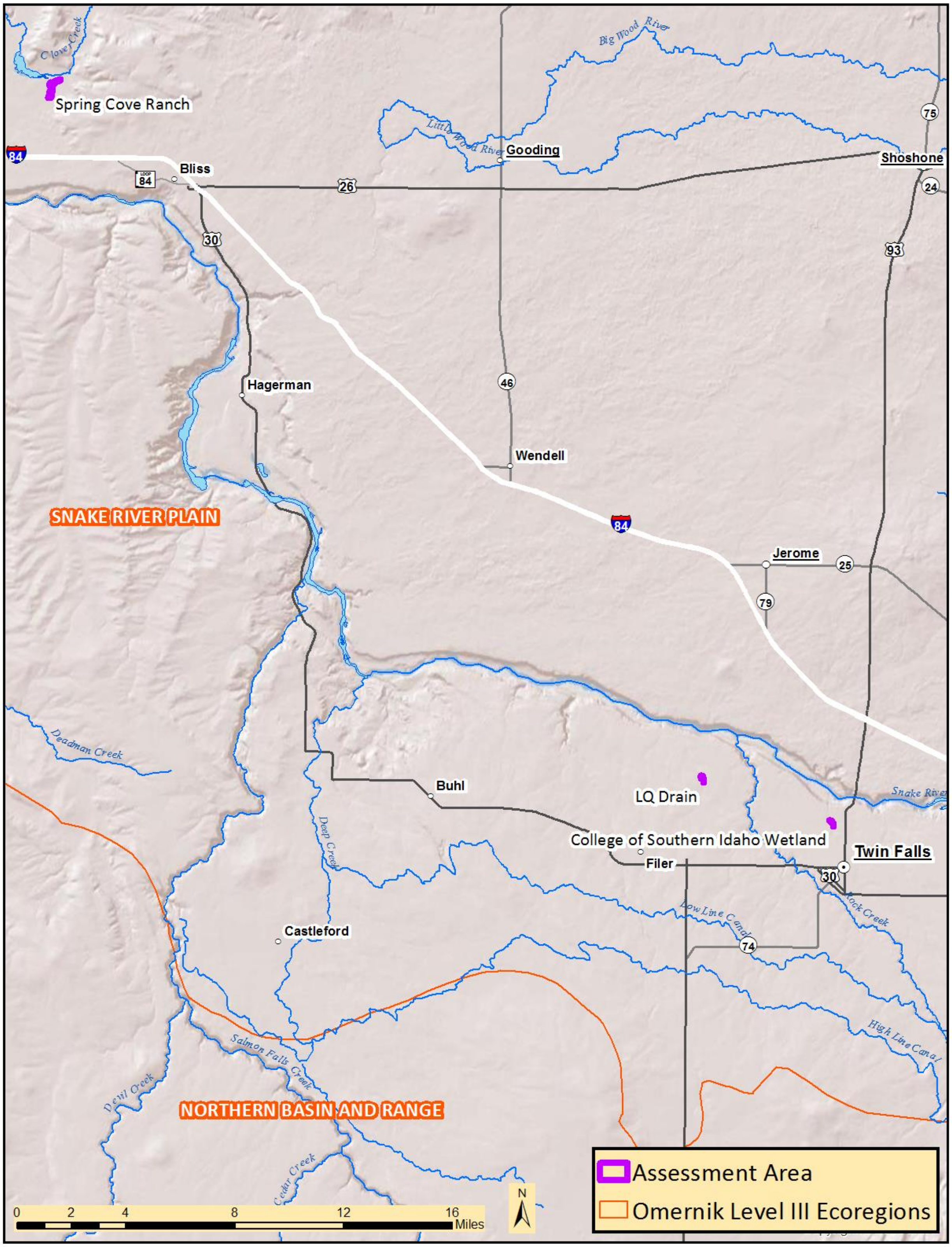
Greer
Weippe
Lolo Creek
Big Canyon Creek
Deyo Reservoir
Chapman Wetland
Woodland
Clearwater River
NORTHERN ROCKIES
Nezperce
Kamiah
Lawyer Creek
Ferdinand
Kooskia
COLUMBIA PLATEAU
Greencreek
Stites
Cottonwood
Keuterville
Cottonwood Creek
Clearwater
Harpster
Fenn
Threemile Creek
Grangeville
Kaler Easement - Telcher Creek Wetland
Salmon River
Mount Idaho
IDAHO BATHOLITH
BLUE MOUNTAINS
Assessment Area
Omernik Level III Ecoregions
0 2 4 8 12 16
Miles
N


Pollock
95
Snake River
BLUE MOUNTAINS
Round Valley Creek
IDAHO BATHOLITH
New Meadows
Meadows
Woodland
55
McCall
Weiser River
North Fork Payette River
Lake Fork
Fruitvale
SNAKE RIVER PLAIN
0 2 4 8 12 16 Miles
N
Assessment Area
Omernik Level III Ecoregions

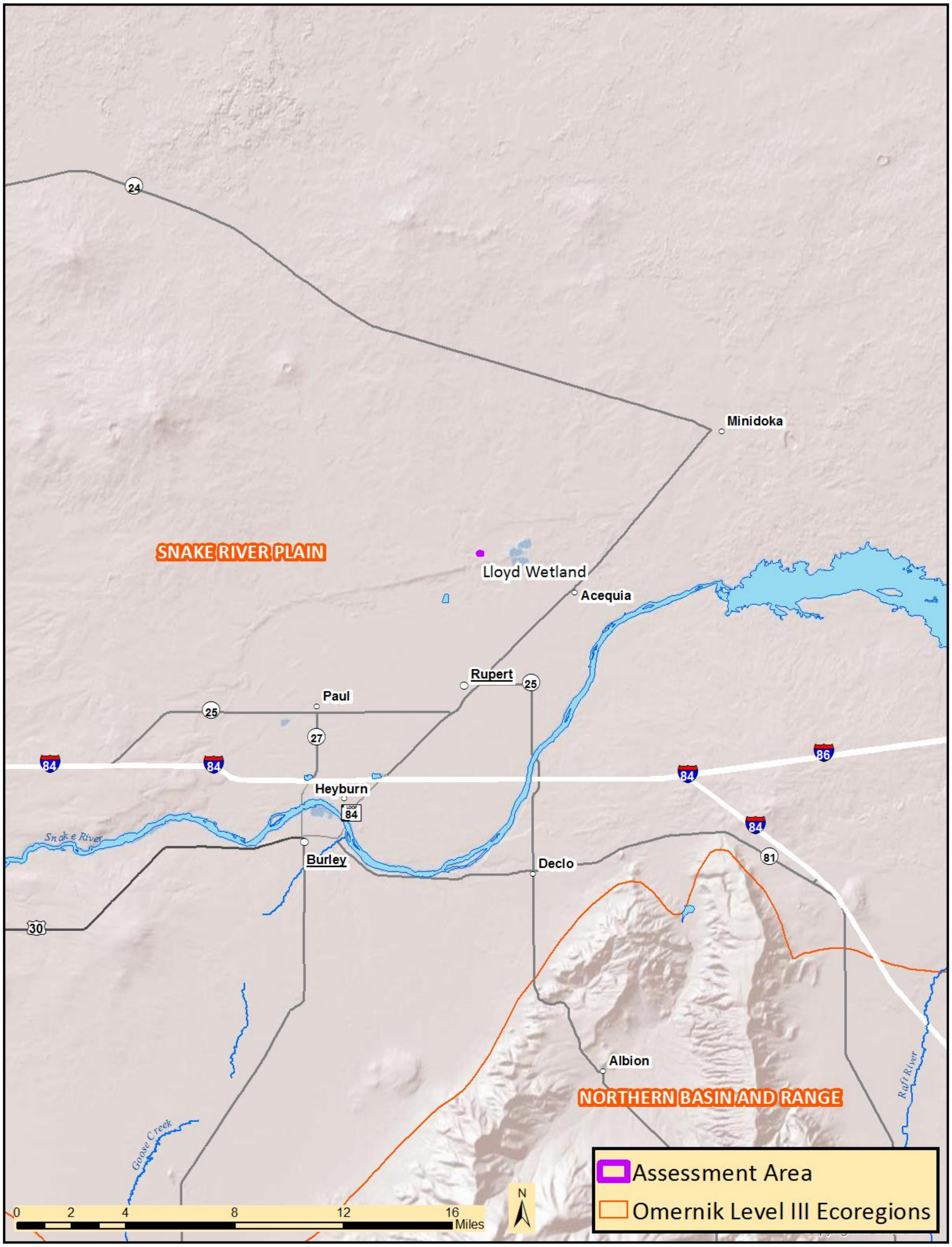
Weiser
Weiser River
Wrightman Wetland
Jewel Wetland
Payette
Big Willow Creek
Fruitland
New Plymouth
SNAKE RIVER PLAIN
Letha
Payette River
Emmett
Parma
Boise River
Notus
Glenn Wetland
Middleton
Star
Eagle
Wilder
Greenleaf
Eagle Island Wetland Mitigation West Cell
Caldwell
Eagle Island Wetland Mitigation East Cell
Snake River
Indian Creek
Succor Creek Wetland
Homedale
Assessment Area
Omernik Level III Ecoregions
0 2 4 8 12 16 Miles
N



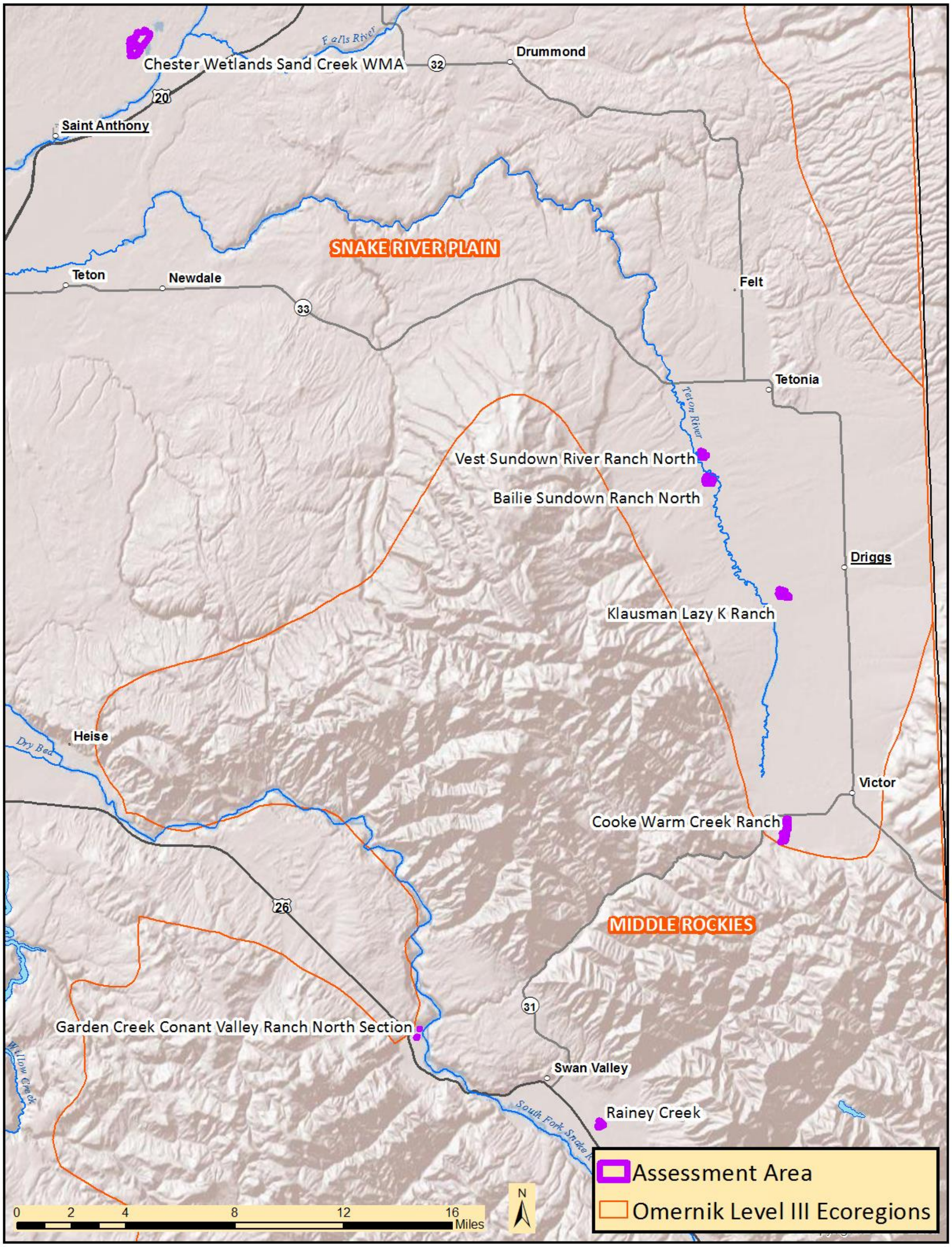
Letha
Emmett
Payette River
Horseshoe Bend
IDAHO BATHOLITH
Middleton
Eagle
Eagle Island Wetland Mitigation West Cell
Boise River
Phyllis Canal
Hyatt Hidden Lakes Reserve
Garden City
Boise
Meridian
Ridenbaugh Canal
SNAKE RIVER PLAIN
Nampa
Fivemile - Victory Wetland
Alta Harris Ranch Side Channel
New York Canal
Kuna
Bowmont
Indian Creek
Melba
Snake River
Assessment Area
Omernik Level III Ecoregions
0 2 4 8 12 16 Miles
N



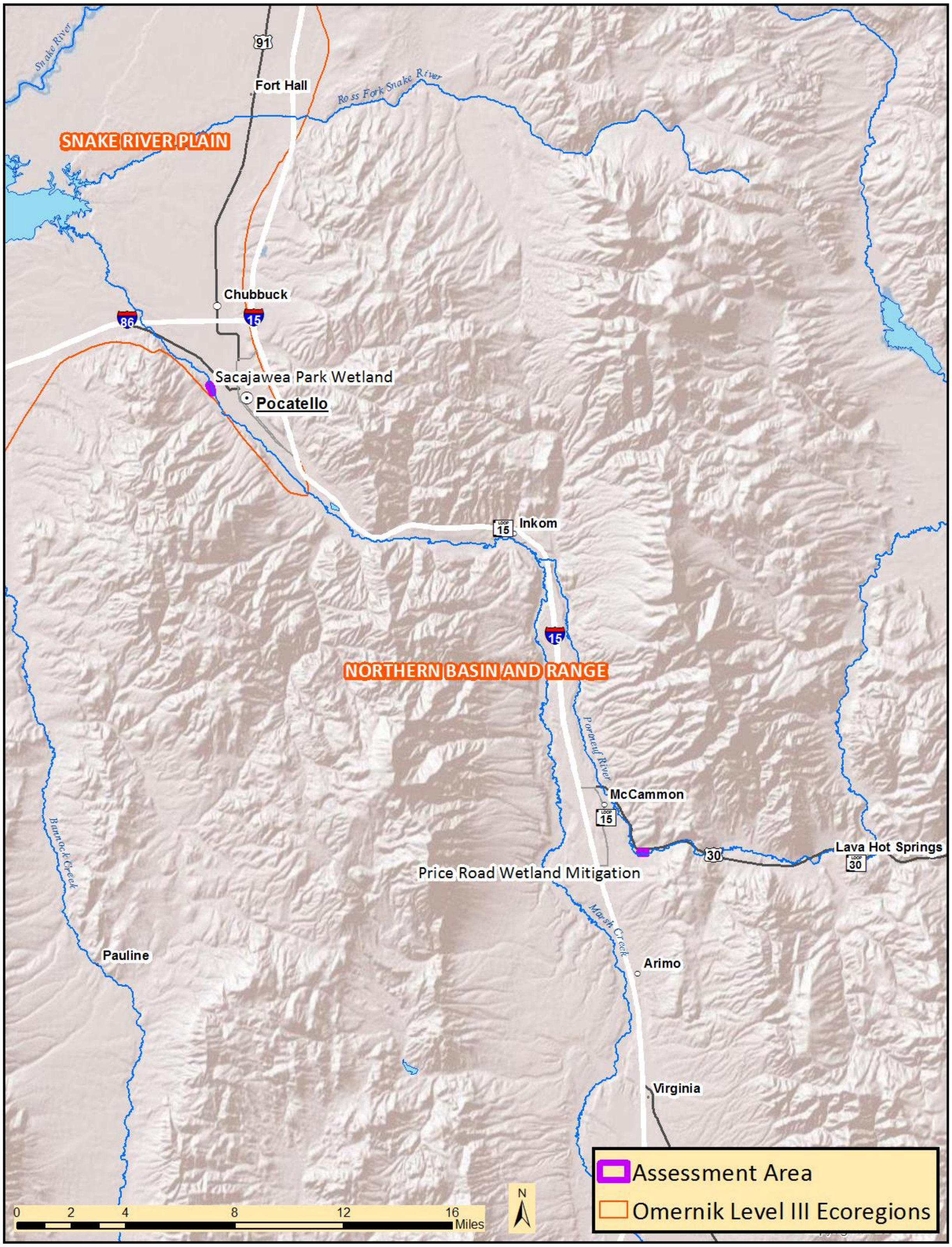
Spring Cove Ranch
Clover Creek
Big Wood River
Little Wood River
Gooding
Shoshone
Bliss
Hagerman
Wendell
Jerome
SNAKE RIVER PLAIN
Deadman Creek
Buhl
LQ Drain
College of Southern Idaho Wetland
Filer
Twin Falls
Snake River
Deep Creek
Low Line Canal
Rock Creek
Castleford
High Line Canal
Salmon Falls Creek
Devil Creek
NORTHERN BASIN AND RANGE
Cedar Creek
Assessment Area
Omernik Level III Ecoregions
0
2
4
8
12
16
Miles
N

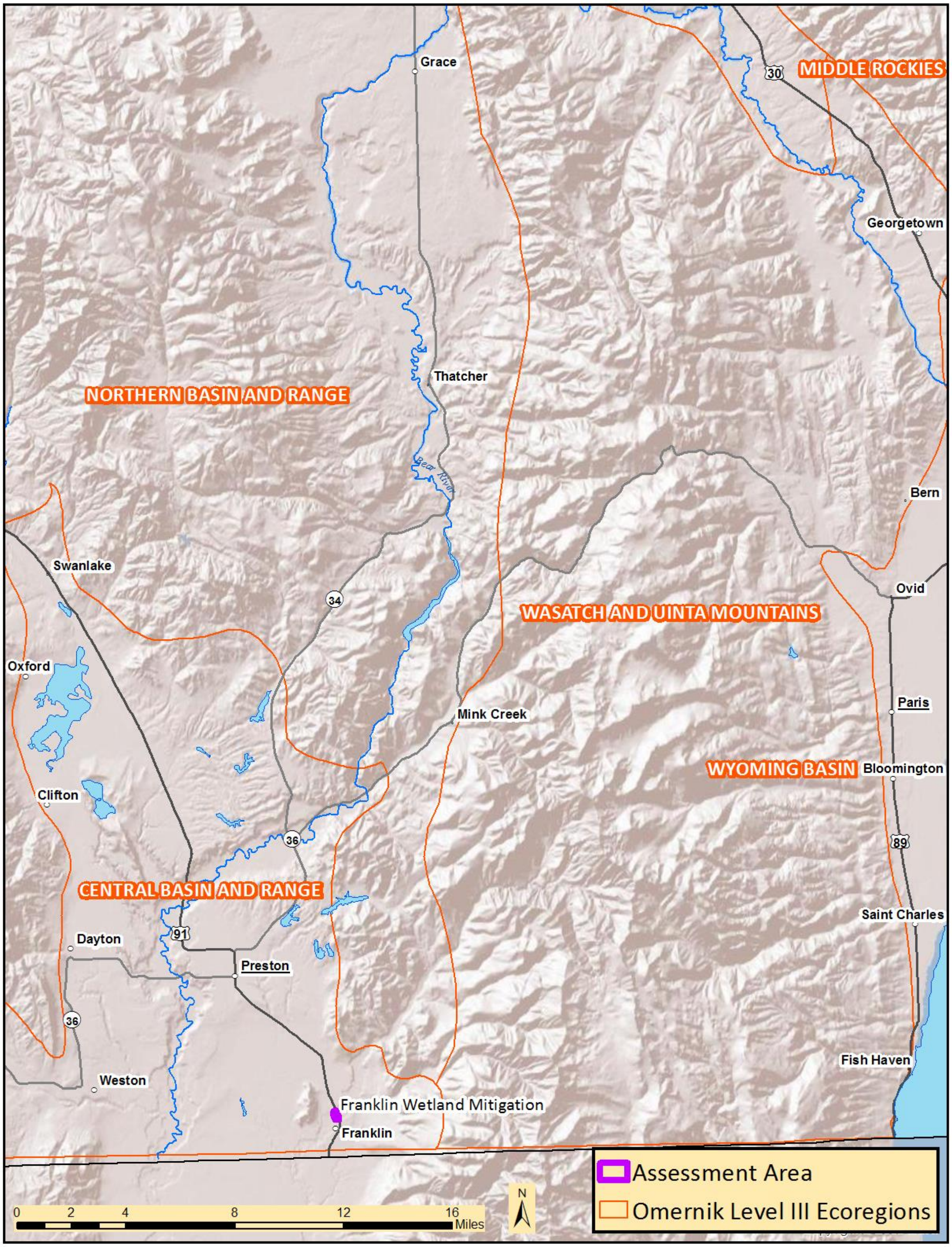


24
Minidoka
SNAKE RIVER PLAIN
Lloyd Wetland
Acequia
Rupert
25
Paul
25
27
84
84
84
86
Heyburn
84
Snake River
Burley
Declo
84
81
30
Albion
NORTHERN BASIN AND RANGE
Raft River
Goose Creek
Assessment Area
Omernik Level III Ecoregions
0 2 4 8 12 16 Miles
N



Chester Wetlands Sand Creek WMA
Falls River
Drummond
32
20
Saint Anthony
SNAKE RIVER PLAIN
Teton
Newdale
33
Felt
Tetonia
Teton River
Vest Sundown River Ranch North
Bailie Sundown Ranch North
Driggs
Klausman Lazy K Ranch
Heise
Dry Bed
Victor
Cooke Warm Creek Ranch
26
MIDDLE ROCKIES
31
Garden Creek Conant Valley Ranch North Section
Swan Valley
Willow Creek
South Fork Snake R
Rainey Creek
Assessment Area
Omernik Level III Ecoregions
0
2
4
8
12
16
Miles
N


Snake River
Fort Hall
Ross Fork Snake River
SNAKE RIVER PLAIN
Chubbuck
Sacajawea Park Wetland
Pocatello
Inkom
NORTHERN BASIN AND RANGE
Portneuf River
McCammon
Lava Hot Springs
Price Road Wetland Mitigation
Bannock Creek
Marsh Creek
Pauline
Arimo
Virginia
Assessment Area
Omernik Level III Ecoregions
0 2 4 8 12 16 Miles
N



Grace
MIDDLE ROCKIES
30
Georgetown
Thatcher
NORTHERN BASIN AND RANGE
Bear River
Bern
Swanlake
Ovid
34
WASATCH AND UINTA MOUNTAINS
Oxford
Paris
Mink Creek
WYOMING BASIN
Bloomington
Clifton
36
89
CENTRAL BASIN AND RANGE
Saint Charles
91
Dayton
Preston
36
Fish Haven
Weston
Franklin Wetland Mitigation
Franklin
Assessment Area
Omernik Level III Ecoregions
0
2
4
8
12
16
Miles
N

APPENDIX 2

Vegetation of assessed restored, enhanced, and created wetlands and reference wetlands

Separate MS Excel Spreadsheet Available Upon Request

APPENDIX 3

ORWAP / WESPUS Scores and Photos of Assessed Wetlands

Separate MS Excel Spreadsheets and Photo Files Available Upon Request