Classification of Wetland Habitats in Oklahoma's Eastern Ecoregions
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Final Report

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TABLE OF CONTENTS

ABSTRACT

Development and implementation of a comprehensive wetland monitoring program that allows Oklahoma to assess the condition of its wetlands is a high priority. This work is a continuation of past 104(b)3 wetland development projects that provided much needed information and guidance to the State on different approaches for establishing a wetland monitoring program. Recently, the State has adopted the Hydrogeomorphic (HGM) Approach for wetland classification to better control for natural variation among wetlands which should facilitate more accurate assessments of wetland condition. The HGM approach initially characterizes wetlands into national wetland classes based on landscape position, water source, and hydrodynamics and then further reduces variability among wetlands by separating the wetlands into regional subclasses based on site-specific information and professional input. The goal of the HGM approach is to reduce natural variability to a level that facilitates the detection of functional changes due to anthropogenic impacts. To date, wetlands within three ecoregions (Central Plains Ecoregion, Cross Timbers Ecoregion, and Ouachita Mountains Ecoregion) in the state have been classified following the HGM approach. This work expanded on the previous HGM work to include the Central Irregular Plains, Arkansas Valley, and South Central Plains Ecoregions of eastern Oklahoma. Therefore, the primary goal of this project was to continue HGM characterization of wetlands to support the development of future assessment methods. We also characterized key functional attributes of each regional subclass and used a novel ranking metric to provide a gradient of reference conditions of the dominant wetland subclasses.

We initially used Geographic Information System (GIS) to reclassify National Wetland Inventory (NWI) wetlands within the study area into HGM national classes using a variety of GIS data layers and ancillary data. From this GIS classification, we were able to create a target population of all potential wetlands based on NWI polygons located in 30 counties among the three ecoregions. We then selected wetlands from our target population for assessment to determine national HGM classes and regional subclasses for each ecoregion. From our initial target population, we were able to select 875 wetlands of which we were able to gain permission to access 230 of those wetlands. We ultimately assessed 107 of those wetlands. We determined wetlands within the study area belonged to four (riverine, depressional, lacustrine fringe, and slope) of the seven HGM national classes. The dominant HGM wetland class in the study area was depressional wetland, accounting for 74% of the wetlands. We further divided the four wetland classes into 10 subclasses, with the dominant regional subclass being created depression which accounted for more than 50% of the sites in the study area. Overall, we identified 5 hydrologic functions, 4 biogeochemical functions, and 6 habitat functions that these wetlands may potentially provide. We further assessed the condition of the dominant wetland subclass (created depression) based on an evaluation of anthropogenic stressors (hydrological, physical structure, biotic structure, and buffer/landscape stressors), water quality parameters, and composition of biotic communities inhabiting the wetlands.

Forty percent of the created wetlands were either in good or excellent condition, while only five percent were considered in poor condition.

Overall, we found that the Central Irregular Plains, Arkansas Valley, and South Central Plains Ecoregions contain a wide range of wetland types. This research completes our work to characterize wetlands in most of the ecoregions in Oklahoma. However, as with previous projects, this work should be viewed as a survey of the most common wetland types present in these ecoregions, and should not be considered an exhaustive list of wetlands in these ecoregions, especially when rare wetland types are considered. Future development of the State's assessment protocols for wetland condition will be assisted by the characterization of these wetlands as well as an initial assessment of wetland condition. As the State begins to develop, refine, and calibrate assessment protocols, the baseline data from this project should be an important resource.

BACKGROUND

The goal of comprehensive wetland monitoring is a high priority in Oklahoma (Oklahoma Conservation Commission 1996). Since 1996, the Oklahoma Conservation Commission has sought a method to reliably assess wetland condition for the purpose of better enacting wetland conservation. Before a statewide assessment program can be initiated, wetlands must be located and appropriately classified. In fact, a lack of state-wide inventories of wetlands has been identified as one of the three most significant obstacles to effectively assess wetland condition (Collins et al. 2008). Furthermore, classification of wetlands is a critical element of any wetland assessment program since it facilitates reducing natural variability between sites and improves the ability to detect anthropogenic effects (USEPA 2006). Initially, wetlands in Oklahoma were classified according to the Cowardin et al. (1979) classification system, but the Cowardin system was not designed to characterize and assess wetland functions, an important component of wetland assessment and monitoring. As a result, the State adopted the Hydrogeomorphic (HGM) Approach (Brinson 1993a) for wetland classification. The HGM Approach initially groups wetlands based on landscape position, water source, and hydrodynamics. The development of regional subclasses is then usually undertaken to further group wetlands, which reduces natural variability in wetlands and improves resolution in the ability to detect functional changes in wetlands due to anthropogenic impacts. Following classification of wetlands, functions of each HGM wetland subclass are identified and reference wetlands are used to scale or measure the functional performance across a range of conditions within the subclass. Initially, the Central Great Plains and Cross Timbers Ecoregions (CA#CD-966618-01; Dvorett et al. 2012) and Ouachita Mountains Ecoregion (CA#CD-966784-01; Davis et al. 2012) were surveyed and classified according to HGM methodology. However, in order for Oklahoma to develop a statewide assessment program, other ecoregions of the state that contain diverse and underrepresented wetland classes and subclasses must be classified and inventoried. In this project, we expanded the HGM coverage of Oklahoma wetlands by focusing on the Central Irregular Plains, Arkansas Valley, and South Central Plains Ecoregions in the eastern portion of the state.

In this project, we continued to expand the HGM characterization of wetlands, with the goal of supporting a functional approach to wetland classification in the state that will enhance the resolution of other assessment methods already in use. We adapted the techniques used previously in the surveys of the Central Great Plains, Cross Timbers, and Ouachita Mountain ecoregions, and used the classifications and subclassifications thereof as a launching point to expand HGM classification into the Central Irregular Plains, Arkansas Valley, and South Central Plains ecoregions. Additionally, we further assessed the condition of the dominant wetland subclass to determine the gradient of disturbance that encompasses reference wetlands across these ecoregions. This study doubles the number of completed ecoregions in the state surveyed for HGM classification and functional attributes.

STUDY AREA

This study encompassed three ecoregions: Central Irregular Plains, Arkansas Valley, and South Central Plains (Figure 1). Collectively, these ecoregions represent the lowland areas of eastern Oklahoma. The Central Irregular Plains Ecoregion, 13,486 km^2 in area, encompasses all or parts of Craig, Ottawa, Osage, Nowata, Washington, Delaware, Rogers, Mayes, Tulsa, Creek, Wagoner, Cherokee, Okmulgee, Muskogee, and McIntosh counties. Natural plant communities in this ecoregion include tallgrass prairie assemblages, and oak and hickory groves along hills and ridges (Woods et al. 2005). Mean annual precipitation for the region ranges from 101 cm to 116 cm, increasing from northwest to southeast. Elevations range from 140 m to 315 m. The Arkansas Valley Ecoregion, which occupies 12,452 km^2, includes parts of Muskogee, McIntosh, Sequoyah, Hackell, Le Flore, Pittsburg, Hughes, Latimer, Pontotoc, Coal, and Atoka counties. Overall, this ecoregion represents a low lying area, but includes some foothills made up of Pennsylvania shale, and open coal mining has occurred in the eastern portion of the ecoregion (Woods et al. 2005). The elevation in this ecoregion ranges from 116 m to 782 m. Plant communities in this ecoregion are dominated by prairie and oak-hickory forest communities (Woods et al. 2005). Mean annual precipitation in the Arkansas Valley Ecoregion ranges from 101 cm to 147 cm, with the highest rainfall in the Ozark foothills of the western portion of the ecoregion. The South Central Plains ecoregion encompasses 6,823 km^2 and includes parts of Coal, Pushmataha, Atoka, McCurtain, Johnston, Bryan, and Choctaw counties in the southeastern corner of the state. Oak-Hickory-Pine forest and prairie plant communities occurred in the region historically, but much of the low lying area has been converted to cropland (Woods et al. 2005). Mean annual precipitation ranges from 104 cm to 132 cm, increasing gradually to the east. Elevations range from 83 m to 256 m.

HGM classifies wetlands according to seven national wetland classes: depressional, lacustrine fringe, tidal fringe, slope, riverine, mineral soil flats, and organic soil flats. HGM classification is based on water source for the wetland, hydrodynamics, and geomorphology, which have been demonstrated to influence wetland function (Brinson 1993b). Of the seven national wetland classes, riverine, depresssional, lacustrine fringe, and slope wetland classes occur in the Central Irregular Plains, Arkansas Valley, and South Central Plains Ecoregions.

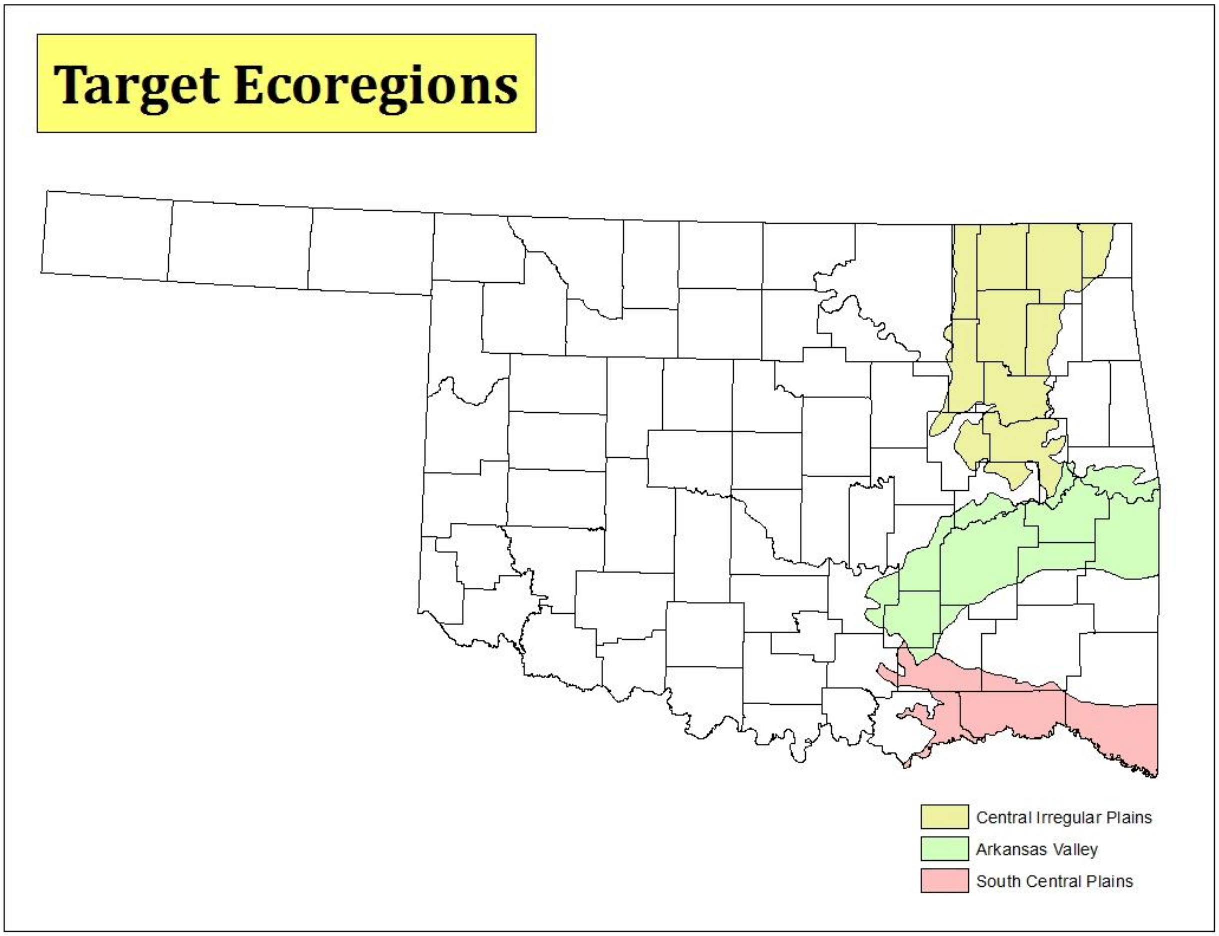

Figure 1. Location of Central Irregular Plains (yellow), Arkansas Valley (green), and South Central Plains (red) Ecoregions in eastern Oklahoma.

METHODS

GIS Classification

Initially, we used the National Wetlands Inventory (NWI) database to create our target population of wetlands within the three ecoregions. Most of the NWI wetlands in the ecoregions were mapped during the 1980's from color infrared aerial imagery at 1:58,000 scale (Dahl and Johnson 1991). We reclassified NWI polygons into HGM classes based on spatial queries of collateral data layers (using GIS based on a technique modified from previous HGM reports and Genet and Olsen (2008). Collateral data layers included Natural Resource Conservation Service (NRCS) county soil survey geographic datasets (SSURGO), national hydrography plus datasets (NHD), digital elevation models (DEM), and U.S. Geological Survey topographic maps. These collateral data layers allowed us to determine flooding frequency, drainage characteristics of soils, and location of the wetland relative to rivers and lakes which facilitated reclassification of NWI polygons based on geomorphology and hydrology.

We initially used the population of NWI polygons within each ecoregion to begin our selection of target wetlands. To restrict our target population to wetlands, we removed those polygons designated as deep water habitats (i.e., river channels and reservoirs) in NWI. These habitats are not considered wetlands in accordance with past Oklahoma HGM projects as well as the Cowardin classification system. We then designated NWI polygons to HGM classes according to the following rules. For determining riverine wetlands, we relied on NRCS's SSURGO dataset and NHD river center lines to facilitate classification of riverine wetlands. All polygons that were determined to occur on occasionally or frequently flooded soils and occurred in close proximity to rivers were considered riverine wetlands. We considered all NWI polygons that were classified as lacustrine wetlands or adjacent to NWI polygons classified as lacustrine wetlands and any wetland polygon within 20 m of any lake as belonging to the lacustrine HGM class. We defined depressional wetlands as polygons that were not classified as riverine or lacustrine (Dvorett et al. 2012). Slope wetlands were difficult to classify reliably using GIS, but using DEM data, we classified any wetland, with any part occurring on a grade greater than 5% or more as a slope. However, those wetlands were underrepresented in our target population.

We initially created a target population of 875 wetlands. Due to logistical constraints (e.g., travel time between wetlands) and difficulties with obtaining permission to access sites, we incorporated a more systematic approach, rather than a completely random approach, to select wetlands for sampling. Specifically, we systematically chose areas (typically counties) within each ecoregion that contained a large number of wetlands. We then selected wetlands from each area and contacted the landowners to obtain permission for land access. Ultimately, this approach did allow us to obtain a representative sample of wetlands from each ecoregion. We gained permission for access to wetlands by contacting landowners by phone calls. When access was not obtainable, we simply selected the next wetland within the target area. Of the 875 wetlands in the initial target population, we eventually obtained permission to visit 230 wetlands. However, due to logistical issues (e.g., gates locked, tenant later denied access), NWI errors (e.g., misidentification of wetlands), and modification and loss of wetlands since NWI mapping, we were able to survey 97 wetlands. Most of the wetlands (90%) occurred on private lands. Despite these issues, the wetlands were well-distributed throughout the three ecoregions (Figures 2 - 4).

HGM Subclass Development

We initially used previous HGM regional guidebooks (e.g., Stutheit et al. 2004, Klimas et al. 2005) for guidance on development of HGM regional subclasses, but relied on the guidebooks that occurred in nearby ecoregions (e.g., West Gulf Coastal Plain Region of Arkansas) for descriptions of subclasses. Following the initial review of previous subclasses, we then conducted field assessments of the wetlands for which we had permission for access. Field assessments focused on HGM characteristics (e.g., landscape position, water source, and hydrodynamics), wetland hydrology, landscape condition, and plant community composition. Examples of site assessment data sheets are provided in Appendices A and B. On site, we relied on hydrological indicators such as high water marks, drift lines, drainage patterns, sediment accretion, and plant adaptations to describe the hydrology (US Army Corps of Engineers 1987, Tiner 1999). Additionally, we also assessed landscape position by determining the topographic position of the wetland and its proximity to surface waters such as streams, lakes, and ponds in the lab using GIS tools. We recorded stressors for each wetland, obvious on site or in the GIS assessment, which allowed us to identify anthropogenic perturbations that occurred within the wetland or its landscape setting. We conducted field surveys of plants by creating cover maps of the vegetation communities in each wetland in which we used either handheld Trimble mapping units or aerial photography in GIS combined with information from site surveys to create the cover maps. During each survey, we noted the dominant plants in each wetland as well as less common plants. We identified plants to the appropriate species according to published descriptions (Haukos and Smith 1997; Crow and Hellquist 2000a, b). A representative specimen of each plant species was collected and pressed as a voucher specimen that is stored at Department of Natural Resource Ecology and Management at Oklahoma State University. Following guidelines described in Davis et al. (2012) and Dvorett et al. (2012), we used the field data and an iterative process for assigning HGM subclasses to wetlands. Based on this iterative process, we were able to create an initial list of preliminary subclasses. As more detailed field assessments were completed and new subclasses were developed, we reassigned wetlands to new subclasses as required. Throughout the study, we continually reviewed our list of preliminary subclasses and expanded and revised the list as additional assessments were completed. After we completed our assessments and finalized our list of subclasses, we developed a dichotomous key for HGM subclasses in the three ecoregions (Appendix C).

After we finalized our list of subclasses, we determined the range of reference conditions that occurred within the dominant HGM subclass using several attributes. Specifically, we used a stressor checklist modified from Collins et al. (2008) to assess the type and number of stressors influencing buffers surrounding the wetlands, landscape surrounding the wetland, hydrology, physical structure, and biotic structure (see Appendix D for example of the checklist). Known stressors were recorded for each site, either because they were apparent during the survey, observed via GIS, or known because of landowner communication. We also conducted additional plant surveys at each wetland to further assess wetland condition. Water samples were collected from all sites with standing water of sufficient depth to collect samples. Total phosphorus and nitrogen (nitrate, nitrite, and ammonia) components were analyzed using a Hach™ DR 5000 spectrophotometer. We also noted evidence of fauna use either via direct observation or indirect evidence (e.g., tracks, scat, feathers, etc.) to further provide insight on the condition of the wetland.

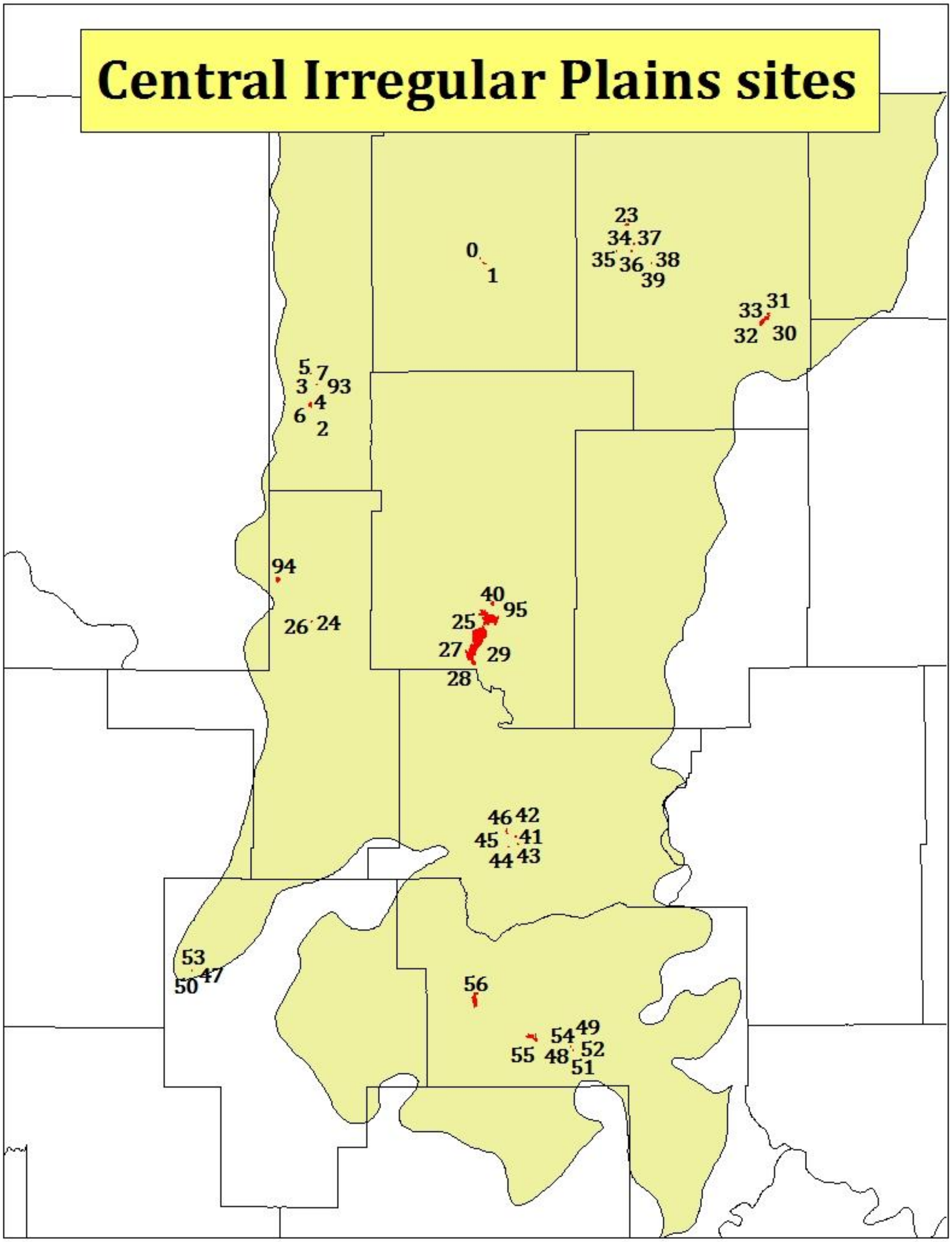

Figure 2. Location of assessed wetlands in the Central Irregular Plains Ecoregion of Oklahoma. Numerals indicate individual wetlands and red polygons indicate locations of wetlands.

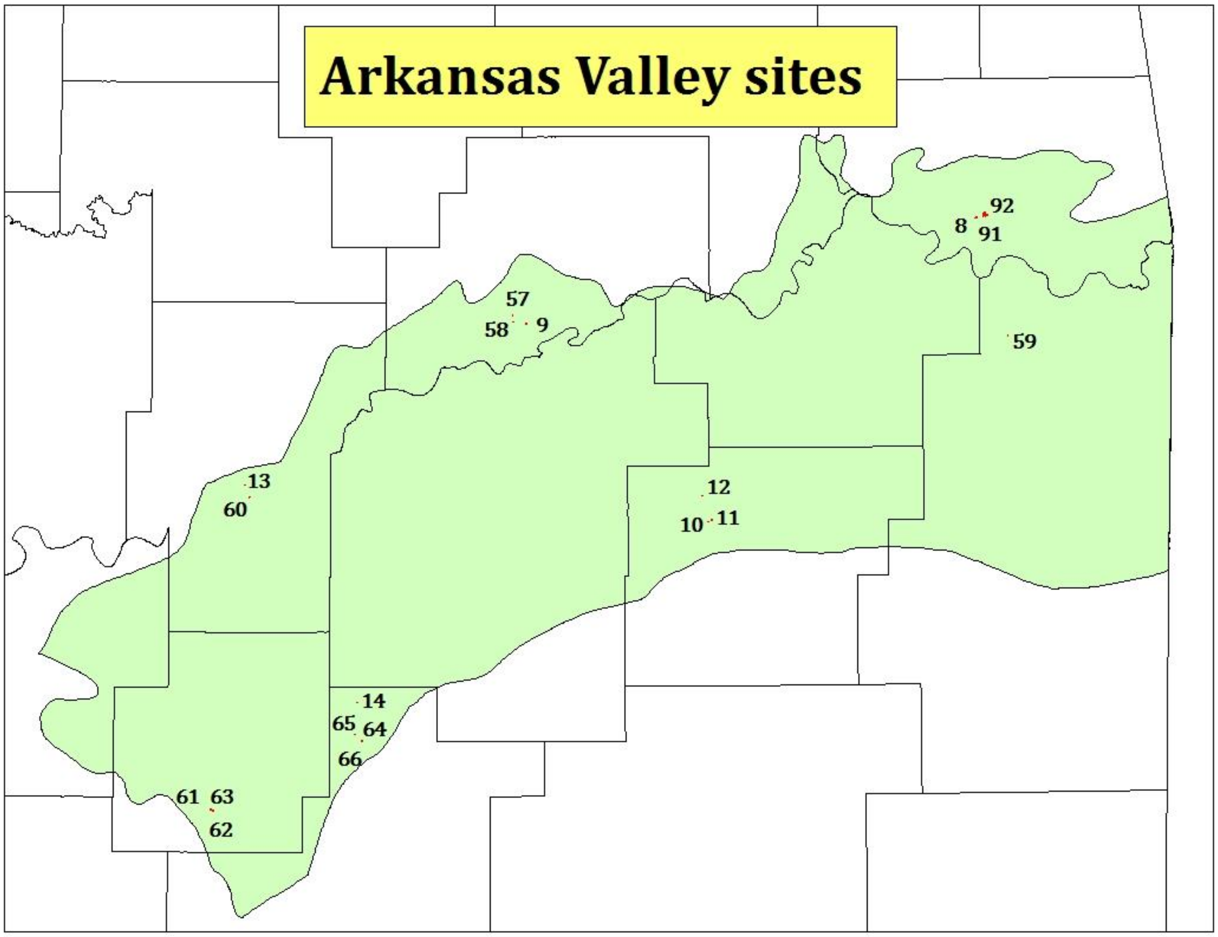

Figure 3. Location of assessed wetlands in the Arkansas Valley Ecoregion of Oklahoma. Numerals indicate individual wetlands and red polygons indicate locations of wetlands.

Identification of Functional Attributes

We consulted with regional experts to identify potential functions provided by wetlands in the three lowland ecoregions and conducted a review of the national guidebooks for wetlands (Brinson et al. 1995, Smith et al. 1995), regional guidebooks (e.g., Rainwater Basin depressional wetlands of Nebraska [Stutheit et al. 2004], forested wetlands in the West Gulf Coastal Plain Region of Arkansas [Klimas et al. 2005], riparian forests in the Ouachita Mountains and Crowley's Ridge Regions of Arkansas [Klimas et al. 2006]), and past HGM work conducted in the Cross Timbers, Central Great Plains, and Ouachita Mountains Ecoregions in Oklahoma (Dvorett 2010, Davis et al. 2012) to further expand our list of potential functions for wetlands. Based on our discussions with regional experts and our review of the literature, we identified five hydrologic functions, four biogeochemical functions, and six habitat functions (Table 1). While conducting field assessments of each wetland, we determined which functions were being provided by each wetland. Specifically, we assigned a score to each site based on how many functions each site provided.

RESULTS

Development of Subclasses

We identified wetlands within the three ecoregions belonging to four (riverine, depressional, lacustrine fringe, and slope) of the seven HGM national classes. Following field assessments, we were able to further divide the four wetland classes into 10 subclasses (Table 2). Depressional wetlands were divided into one altered depression type (created depression) that was typically human-created and four natural subclasses (open surface water depression, closed surface water depression and groundwater depression). Riverine wetlands included riparian, in-channel, and floodplain subclasses. Created depressions were considered subclasses because farm ponds and other small created impoundments take on the characteristics of wetlands (Hartzell et al. 2007, Dvorett et al. 2012). Lacustrine wetlands included two subclasses (reservoir fringe, and pond fringe). Slope was represented by one natural subclass (headwater slope).

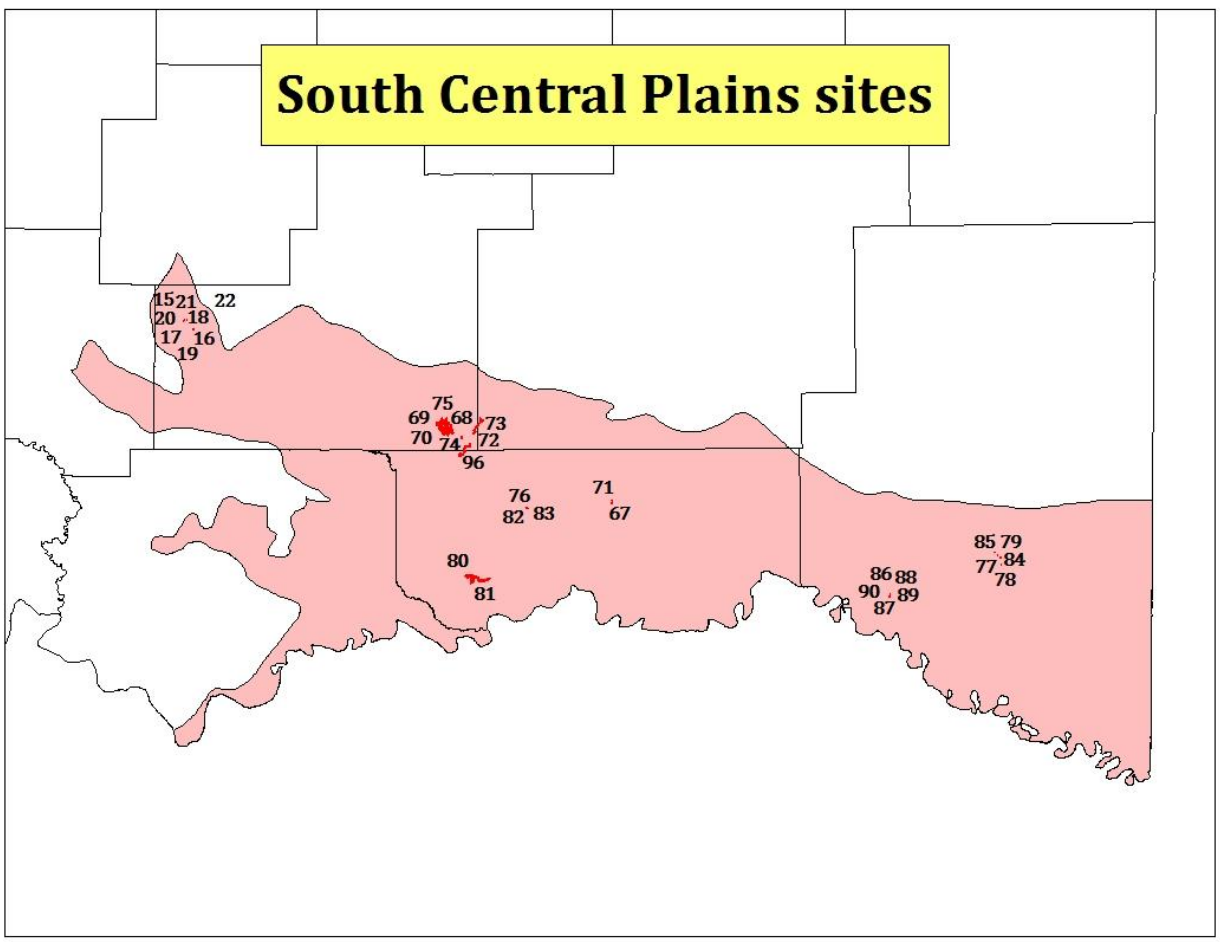

Figure 4. Location of assessed wetlands in the South Central Plains Ecoregion of Oklahoma. Numerals indicate individual wetlands and red polygons indicate locations of wetlands.

Table 1. List of potential functions provided by wetlands in the Central Irregular Plains, Arkansas Valley, and South Central Plains Ecoregions of eastern Oklahoma (adapted from Brinson et al. 1995, Smith et al. 1995, Klimas et al. 2005, 2006, Dvorett 2010, and Davis et al. 2012).

Function	Description
Hydrologic	
Dynamic surface water storage (i.e., detain floodwater and precipitation)	The capacity of wetland to detain moving water from overbank flow for a short duration.
Long-term water storage (i.e., detain floodwater and precipitation)	The capacity of a wetland to detain surface water for long durations.
Energy dissipation	Allocation of the energy of water to other forms as it moves through, into, or out of the wetland as a result of roughness associated with large woody debris, vegetation structure, micro- and macrotopography, and other obstructions.
Subsurface water storage	Capacity of a wetland to store water beneath the wetland surface.
Moderation of groundwater flow or discharge	Capacity for wetland to moderate the rate of groundwater flow or discharge from up-gradient sources.
Biogeochemical	
Nutrient cycling	Abiotic and biotic processes that convert nutrients and other elements from one form to another.
Removal of imported elements and compounds	Removal of imported nutrients, contaminants, and other elements and compounds from water inputs.
Retention of particulates	Deposition and retention of inorganic and organic particulates (>0.45 m) from the water column, primarily through physical processes.
Organic carbon export	Export of dissolved and particulate organic carbon from a wetland.
Habitat	
Maintain characteristic plant community	Maintain species composition and physical characteristics of living plant biomass.
Maintain characteristic detrital biomass	Maintain the production, accumulation and dispersal of dead plant biomass of all sizes.
Maintain spatial structure of habitat	The capacity of a wetland to support animal populations and guilds by providing heterogeneous habitats.
Maintain habitat interspersion and connectivity	The capacity of a wetland to permit aquatic organisms to enter and leave the wetland via permanent or ephemeral surface channels, overbank flow, or unconfined hyporheic gravel aquifers.
Maintain distribution and abundance of invertebrates	The capacity of a wetland to maintain characteristic density and spatial distribution of invertebrates (aquatic, semiaquatic, and terrestrial).
Maintain distribution and abundance of vertebrates	The capacity of a wetland to maintain characteristic density and spatial distribution of vertebrates (aquatic, semiaquatic, and terrestrial) that utilize wetlands for food, cover, rest, and reproduction.

Table 2. List of all HGM classes and subclasses and typical geomorphic setting for wetlands within the Central Irregular Plains, Arkansas Valley, and South Central Plains Ecoregions of eastern Oklahoma.

Class	Subclass	Typical geomorphic setting
Depressional	Created Depression	Created or altered depression or impoundment that has developed wetland-like features.
	Open Surface Water Depression	Basin with confining layer and with a water outlet.
	Closed Surface Water Depression	Closed contour basin with a confining layer.
	Groundwater Depression	Basin typically in sandy soil where the water table is close to the surface.
Riverine	In-channel	Sand and gravel bars within river or stream channel.
	Floodplain	Flat, backwater area within 5 year floodplain of river or stream.
	Riparian	Natural levee directly adjacent to river or stream.
Lacustrine	Reservoir Fringe	Lakes created by impounding high order, permanent rivers.
	Pond Fringe	Impounded basins with at least 2 m of semi-permanent water depth.
Slope	Headwater	Sloping areas fed by groundwater that are typically associated with low order streams.

The dominant HGM wetland class found in the Central Irregular Plains, Arkansas Valley, and South Central Plains Ecoregions was depressional, accounting for 74% of the wetlands assessed (Figure 5). Riverine wetlands were the next common wetland class representing 16% of the wetlands. Lacustrine and slope wetlands were uncommon in the ecoregions. Approximately 8% of visited sites were determined not to be wetlands, and no further data was recorded. These sites were misclassified sites that were incorrectly characterized in NWI or were destroyed through anthropogenic influences since originally being included in NWI. The dominant wetland subclass was created depression, which accounted for 53% of all the subclasses. Other less common subclasses included open surface water depression (6%), closed surface water depression (13%), floodplain (6%), and riparian (6%). The remaining subclasses accounted for 5% or less of the subclasses in the study sample.

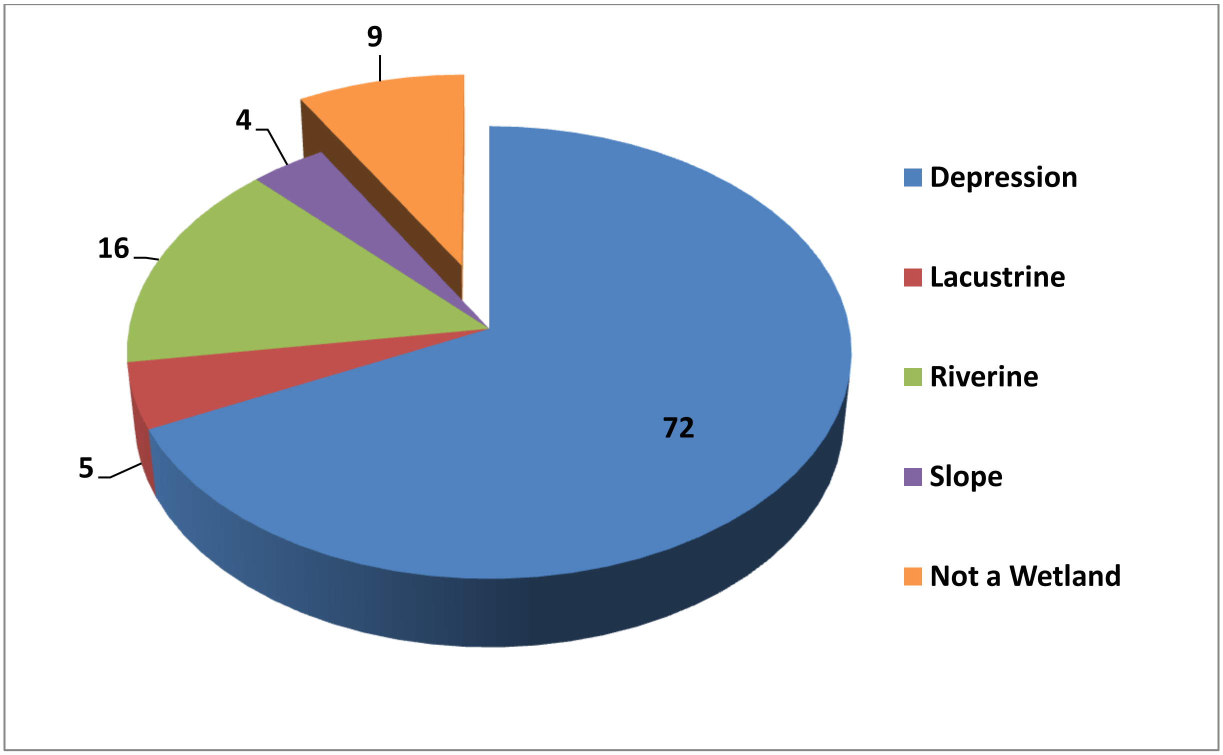

Figure 5. Total number of wetlands characterized within national HGM and misidentified by NWI or modified/destroyed since original NWI mapping for the Central Irregular Plains, Arkansas Valley, and the South Central Plains Ecoregions in eastern Oklahoma.

Assessment of Reference Conditions within Created Depression Subclass

Of the created depressions surveyed during the study, 36 had records complete enough to evaluate for reference purposes (Figure 6). These sites were evaluated using ancillary data collected from, or specific to, each site. We used three criteria (stressors, water quality, and biotic community composition) as an initial indication of wetland quality/condition. The term reference site is used here to describe sites from which other sites can be compared to evaluate anthropogenic impacts. The sites are considered the best available sites, but not considered pristine, unaltered sites because the dominant subclass, created depression, was created through anthropogenic alterations such as flow obstruction or soil excavation. Additionally, all the wetlands reviewed for reference had at least one major stressor impacting them. Furthermore, few wetlands in Oklahoma exist in an unaltered or undisturbed condition. Consequently, we typically refer to these wetlands as least altered. To assess condition, we scored each criterion individually based on the range of values among the wetlands. Values for each criterion were then assigned a score based on the terciles into which they fell. Criteria occurring in the upper one-third of any criterion was scored 1 and a value in the bottom one-third was scored -1 (Table 3). Values in the middle tercile were scored 0. We then summed the scores for an overall condition score for the reference wetlands ranging from -3 to 3.

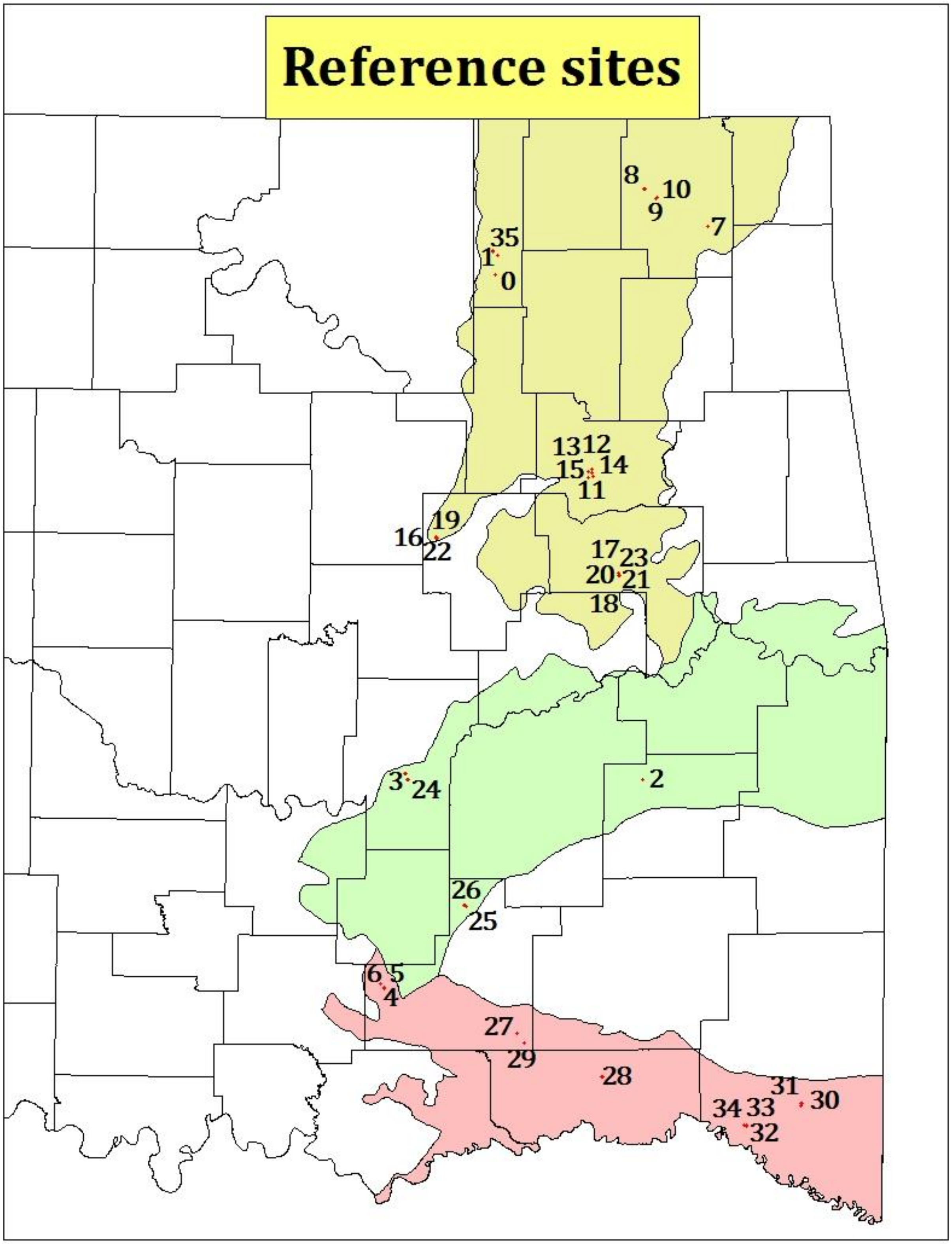

Figure 6. Locations of created depression wetlands used for assessing range reference conditions for the dominant HGM subclass in the Central Irregular Plains, Arkansas Valley, and the South Central Plains Ecoregions in eastern Oklahoma.

Based on the overall scores, we were able to provide a fairly objective assessment of wetland condition. However, our assessment of the water quality criterion was somewhat subjective as no specific water quality standards exist for Oklahoma wetlands, but high values for phosphates and nitrogenous compounds are generally considered to negatively impact wetlands or be an indicator of impacts from the surrounding landscape. This may especially be the case for wetlands that have extremely high values of phosphates and/or nitrogenous compounds. Likewise, all the stressors we assessed were considered to have a negative impact on wetland quality, so sites with a high number of stressors were scored lower. Biotic community was scored based on the number of wetland obligate and wetland facultative plant species present at a site. We also noted the occurrence of other wetland taxa present at sites during field visits, but data were sparse, and they were not included in the reference evaluation. Across the three ecoregions, we observed two created depressions with a reference score of 3 indicating an excellent condition and two with a reference score of -3 indicating poor condition (Table 3). Most of the wetlands were either in good condition, indicating relatively low disturbance or were in fair condition, indicating higher levels of degradation. Given that the development of created depressions is typically due to some type of anthropogenic alteration, it is not surprising that large number of the wetlands were in a degraded condition. However, it is encouraging that a large number of the wetlands were considered to be in a good condition. Many of those wetlands were "created" several decades ago so it could be indication that those systems are becoming more wetland-like as well as being in locations with minimal disturbance from the surrounding landscape. Further assessment of these wetlands using a more in-depth assessment procedure such as California Rapid Assessment Method, Oklahoma Rapid Assessment Method, or FACWET (Functional Assessment of Colorado Wetlands) may allow for a more clear separation of levels of degradation of these wetlands and as the State develops its wetland monitoring capabilities more intensive assessments should be encouraged when necessary.

Table 3. Relative quality of created depressional wetlands in the in Arkansas Valley, Central Irregular Plains, and South Central Plains Ecoregions of Oklahoma. Natural breaks in quality criteria are coded as Good (1), Neutral (0), or Poor (-1).

Wetland ID	Phosphate*	Nitrite*	Nitrate*	Ammonia*	Stressors	Biotic Community#	Reference Category+
AV-D-3191	0.4	0	0.06	0	2	4	Moderate
AV-D-28250	0.73	0	0.1	0.01	2	6	Good
AV-D-7861	0.91	0.017	0.62	0.27	2	3	Fair
AV-D-8048	0.43	0	0.01	0.08	1	2	Moderate
AV-D-2344	0.68	0	0	0.17	1	4	Good
CIP-D-6511	0.94	0.03	1.68	0.13	2	3	Moderate
CIP-D-51348	0.42	0	0.22	0.01	3	2	Fair
CIP-D-44193	0.63	0	0.36	0	2	6	Good
CIP-S-260	1.54	0	0.77	0	2	3	Fair
CIP-D-49661	1.56	0	0	> 3.5	3	2	Poor
CIP-D-14862	1.07	0	0.1	0.37	2	3	Moderate
CIP-D-51467	0.49	0	0.02	0.43	2	2	Fair
CIP-D-25168	0.45	0	0	0.18	1	5	Good
CIP-D-33408	0.41	0	0	0.17	1	8	Good
CIP-D-35915	1.76	0.058	0.42	2.36	3	1	Poor
CIP-D-4029	0.24	0.011	0.07	0.41	3	4	Moderate
CIP-D-38827	0.17	0.08	0.07	0.001	4	4	Moderate
CIP-D-51914	0.1	0.004	0.01	0.38	4	2	Fair
CIP-D-7063	0.07	0.002	0	0.19	1	5	Excellent
CIP-D-33547	0.49	0.17	0.05	1.67	2	4	Fair
CIP-D-59923	0.43	0	0.01	0.06	2	6	Good
CIP-D-39361	0.94	0.003	0.01	0.96	2	1	Fair
CIP-D-40889	1.08	0.092	-	0.25	2	3	Fair
CIP-D-56844	0.26	0.03	-	0.81	2	3	Good
CIP-D-13855	0.62	0	0.03	0.29	1	1	Moderate
SCP-D-23381	0.26	0.0003	0.08	0.04	1	5	Excellent
SCP-D-3918	0.49	0	0.27	0	1	3	Good
SCP-D-13264	0.38	0.01	0.64	0.01	2	6	Good
SCP-D-14920	1.06	0	2.23	0	2	5	Moderate
SCP-D-14417	0.48	0	0.04	0.83	1	5	Good
SCP-S-298	0.31	0	0.02	0.03	1	2	Good
SCP-S-12	0.98	0.02	0	0.87	1	5	Good
SCP-D-13398	0.55	0.01	0.01	0.44	1	4	Good
SCP-D-19298	0.62	0.008	0.01	1.53	3	2	Fair
SCP-D-21428	3.01	0.004	0.01	0.81	2	3	Fair
SCP-D-17400	0.21	0.45	0.02	0	3	2	Fair

***Units for all water chemistry are in mg/L. # Based on number of obligate and facultative wetland plant species. + Sites were categorized by their total score as Poor (-3), Fair (-2,-1), Moderate (0), Good (1,2), or Excellent (3).**

DESCRIPTION OF WETLAND SUBCLASSES

Class: Depression

Subclass: Created Depression

Figure 7. Example of a created depression from the Central Irregular Plains Ecoregion.

We surveyed 52 created depressions in the study areas (Figure 8). In the Central Irregular Plains and South Central Plains Ecoregions, this subclass made up over half of all wetlands surveyed. This subclass included wetlands that we determined to occur due to or created by a process other than natural topographic and hydrologic features. Most commonly this meant that the site was physically impounded, but could also mean that the site had been excavated to hold water or irrigated to maintain water levels. Impoundments were created by earthen berms, with or without overflow release or water level control devices, roads that blocked overland flow, or culverts that created bottlenecks in low order stream flow. Excavated sites were commonly created by ranchers for watering cattle, but occasionally appeared to be alterations meant to drain the adjacent areas.

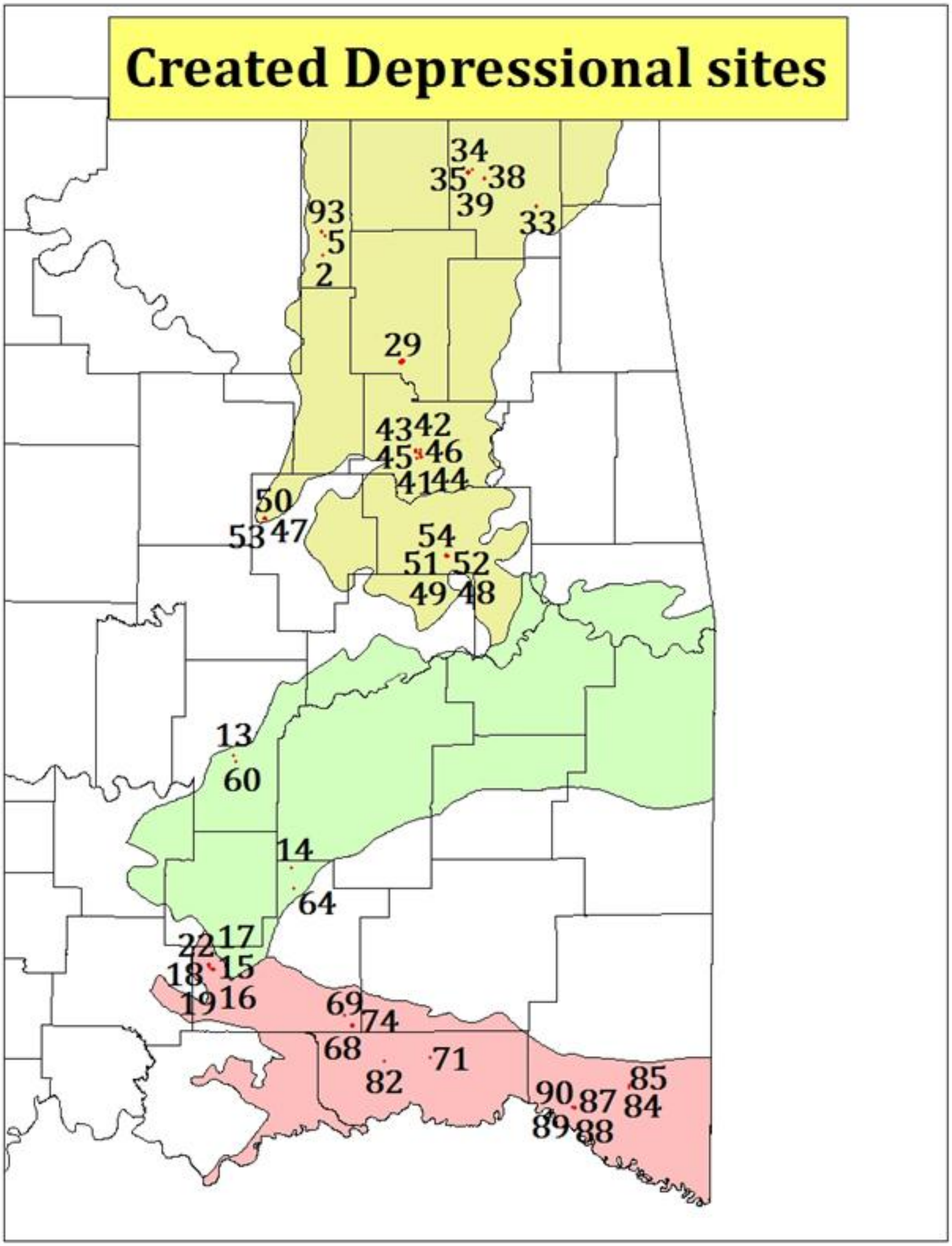

Figure 8. Locations of created depressions in the Arkansas Valley, Central Irregular Plains, and South Central Plains Ecoregions of Oklahoma. Numerals indicate individual wetlands and red polygons indicate locations of wetlands.

The dominant hydroperiod for these sites was permanent, and as they were used heavily by ranchers to provide cattle with water, we expect that this was by design. Vertical fluctuations were the most common hydrodynamic action in the subclass, but sites with overflow or water control devices could experience unidirectional flow after heavy rains. A few of these sites may have been experiencing groundwater discharge, as seeping was observed below impoundments.

The dominant function of these sites was long-term surface water retention. In particular, many of these wetlands provide watering locations for domestic livestock. Additional functions include removal of imported nutrients and contaminants, retention of organic and inorganic compounds (especially in pastures with heavy cattle grazing), nutrient cycling, and maintenance of habitat for a variety of taxa. These wetlands also may serve as "hot spots" for local aquatic biodiversity, provide watering locations for non-domestic animals, and act as stopover sites for waterfowl and shorebirds.

In general, the vegetation in these subclasses was dominated by mudflat annual plants such as smartweeds (*Polygonum* sp.) and barnyard grass (Echinochloa crus-galli) (Figure 9). Other common plants included straw-colored sedge (*Cyperus strigosus*), common spikerush (*Eleocharis palustris*), common buttonbush (*Cephalantus occidentalis*), Croton sp., annual broomweed (*Amphiachyris dracunculoides*), and redroot pigweed (*Amaranthus retroflexus*). Black willow (*Salix nigra*) was the most common tree species observed in association with these wetlands. Many of the common species (e.g., broomweed, pigweed, and cocklebur) are not wetland plants and occurred in dried wetlands or exposed mudflats along the edge of the wetlands.

Figure 9. A representative plant community found in the created depression subclass.

Subclass: Open Surface Water

Figure 10. An example of an open surface water depression late in the season in the South Central Plains Ecoregion.

We surveyed five open surface water depressions (Figure 10). Three of the sites occurred in the South Central Plains Ecoregion, and one each occurred in the other two ecoregions (Fig. 11). These wetlands are sometimes associated with intermittent streams that may traverse the wetlands and are similar in nature to riparian wetlands in that they are associated with a lotic system (albeit, a temporary lotic system), but were distinguished by having wide and deep basins forming depressions with inlets and outlets. The geomorphic location of these systems and association with intermittent streams were the basis for these systems being placed in this subclass.

The hydroperiod of these wetlands varied. Deeper basins are more likely to hold permanent water, while the shallower basins are more ephemeral in nature. Dominant water sources are precipitation and overland flow as well as overbank flow from the intermittent streams. Hydrodynamics are likely characterized by vertical fluctuations as flood events subside and are probably most common, but unidirectional flow occurs during flood events.

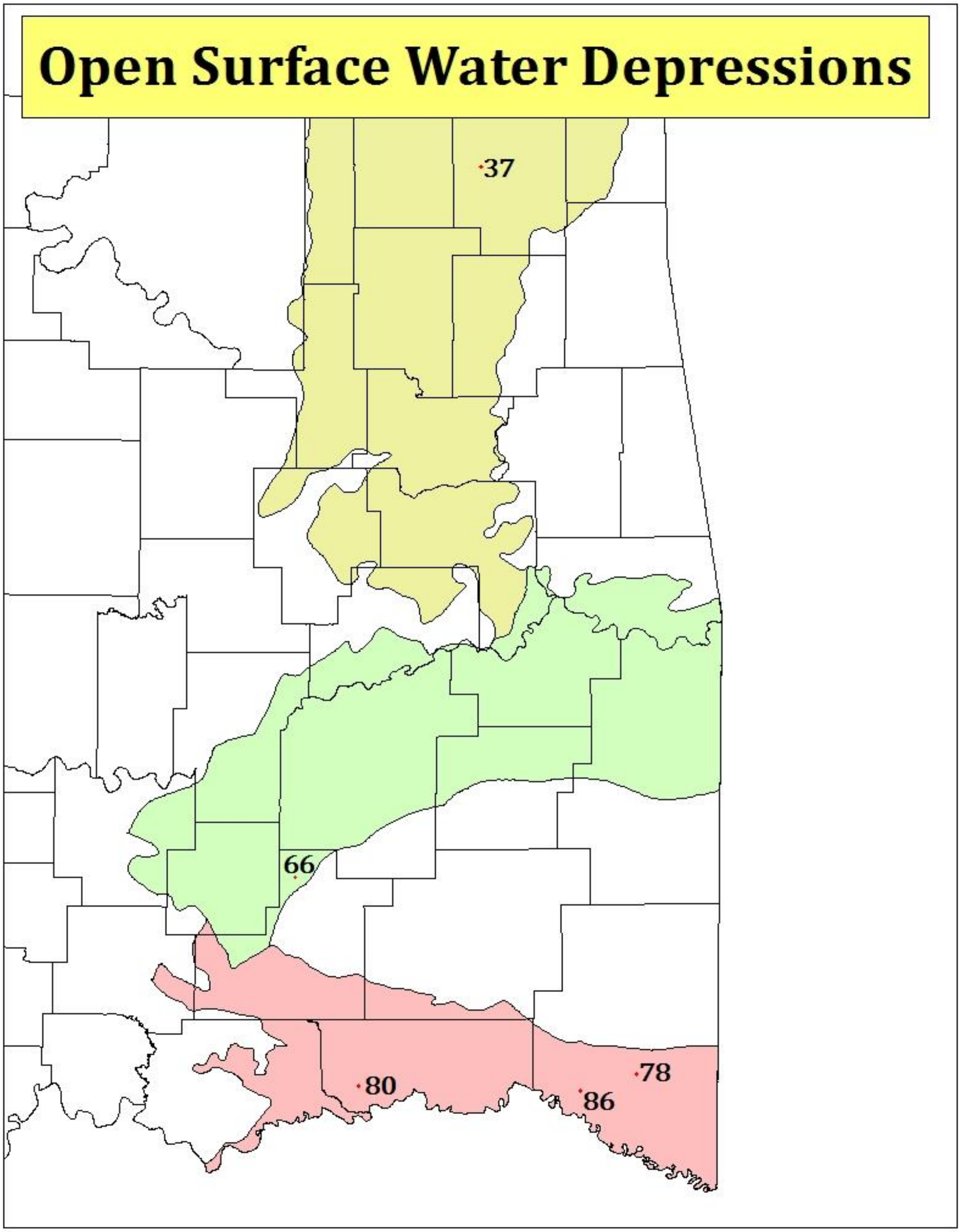

Figure 11. Locations of open surface water depressions in the Arkansas Valley, Central Irregular Plains, and South Central Plains Ecoregions of Oklahoma. Numerals indicate individual wetlands and red polygons indicate locations of wetlands.

Functions of these sites include water storage that may range from temporary storage in the shallow basins to long-term storage in the deeper basins, nutrient cyling, retention of sediment and particulates, and habitat maintenance for a wide variety of taxa. For the wetlands that remain flooded for extended periods throughout the year, the wetlands may also provide refugia for some wetland vertebrate and invertebrate taxa during dry periods. The plant communities in these wetlands were similar to the plant communities observed in the created wetlands. Straw-colored sedge, woolly croton (*Croton capitatus*), spikerushes, common buttonbush, barnyard grass, and smartweeds were common plants. For sites that maintained more permanent water, coontail (*Ceratophyllum demersum*) and pondweeds (*Potamogeton* sp.) were common. Black willow was the most frequently observed tree at these wetlands. Other trees included American sycamore (*Platanus occidentalis*) and water oak (*Quercus nigra*).

Subclass: Closed Surface Water Depression

Figure 12. An example of a closed surface water depression in the Central Irregular Plains Ecoregion.

We surveyed 14 closed surface water depression across the three ecoregions (Figures 12 and 13.). The primary difference between open and closed water features is the presence or absence of an inlet or an outlet. Closed surface water depressions have high banks or natural features creating a catchment basin. Five of these sites were remnant oxbows. These sites all occurred near a river, but were far enough from the river to not be influenced by the river, except under the most extreme flood conditions. One of the Central Irregular Plains Ecoregion sites, Little Flag Lake (Figure 14), was technically disconnected from the Verdigris River, but was also being actively managed to maintain deepwater habitat at the site. The landowner has a variance to pump water from the river, and therefore, this site was unusually full and maintained in this condition throughout the year. Another of the sites was maintained by diverting water from an irrigation well in an adjacent field.

These sites have hydroperiods that ranged from temporary to permanent (in the case of the Little Flag Lake site). The primary hydrodynamics of these wetlands is vertical fluctuations. A few of the sites contained water greater than a half meter deep, but most of the sites were dry at the time of the survey. Dominant water source for these sites were precipitation and surface flow from surrounding landscape. The primary mechanism for the existence of these sites was topography and as a result of having a high surface area to volume, these sites filled during rain events and dried quickly.

Primary functions of these sites include providing long-term water storage, short term water storage, moderation of groundwater flow and discharge, maintaining habitat for wildlife, maintaining wetland plant communities, and nutrient cycling. These sites also had the capacity to serve as breeding pools for explosive breeding amphibians such as Blanchard's cricket frogs (*Acris crepitans*) and providing stopover sites from migratory waterfowl. As many of these wetlands were dry, many of the common plant species observed were terrestrial plants that colonized the dried wetlands. Some of the more common plants included fish-on-the-pole, cocklebur, crotons, foxtail, pokeweed, and broomweed. Common wetland plants included straw-colored sedge, smartweeds, common buttonbush, and spikerushes. Common trees included black willow, American sycamore, boxelder, and water oak. Little Flag Lake was dominated by giant cutgrass (*Zizaniopsis miliacea*) along the edges of the wetland and water lotus (*Nelumbo lutea*) and pondweeds within the interior of the wetland.

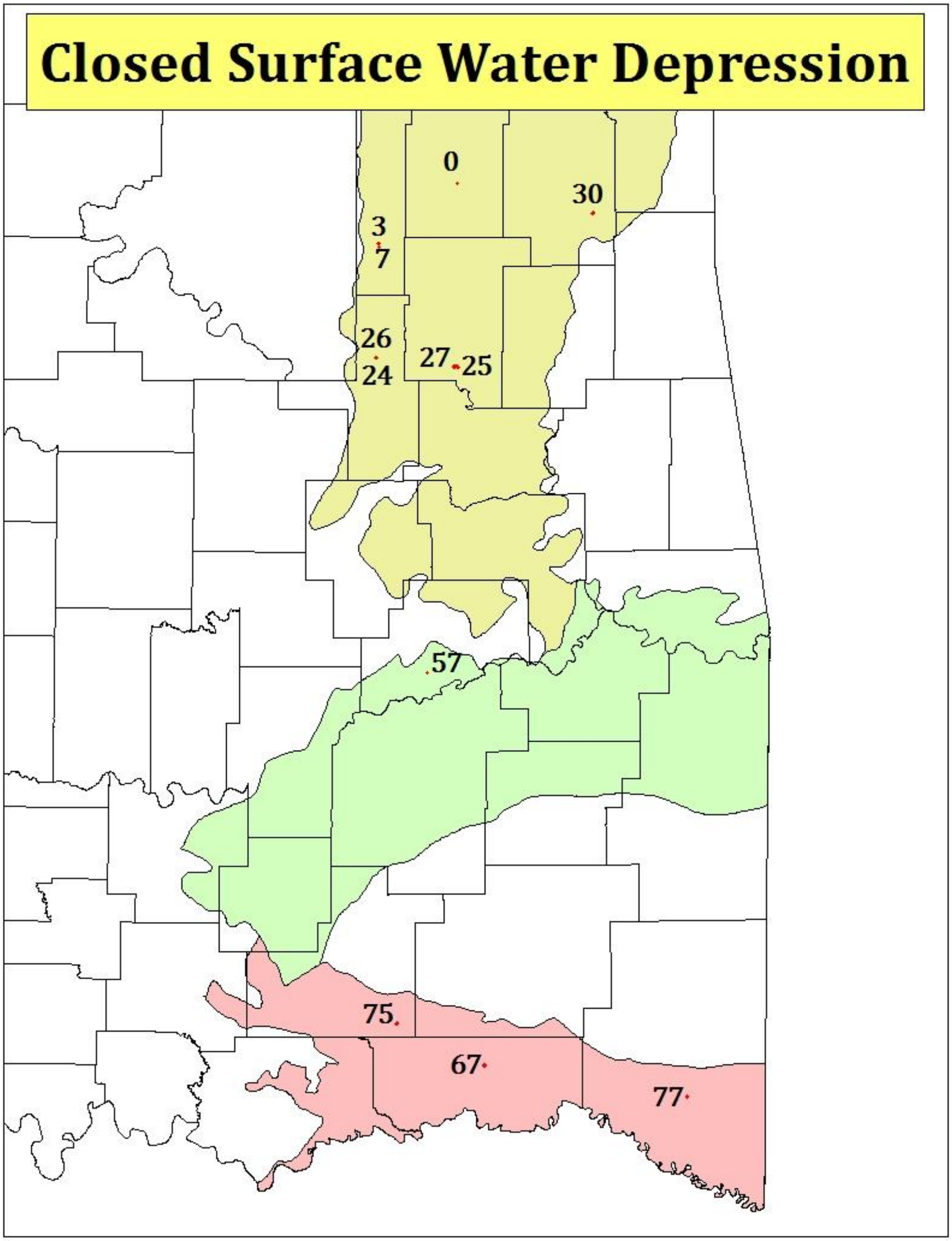

Figure 13. Locations of closed surface water depressions in the Arkansas Valley, Central Irregular Plains, and South Central Plains Ecoregions of Oklahoma. Numerals indicate individual wetlands and red polygons indicate locations of wetlands.

CLASS: Riverine

Subclass: In-channel

Figure 16. Example of an in-channel wetland in the Central Irregular Plains Ecoregion.

We observed four in channel wetlands (Figure 16), with all occurring in the Central Irregular Plains Ecoregion (Figure 17). Three of the four wetlands occurred along low-order streams, and the fourth occurred in the braided channel of the Arkansas River. The dominant hydroperiod for these wetlands is temporary. However, due to the fluctuating water levels and geographic variability, different parts of the wetlands could have different hydroperiods. Typically, the majority of the wetland basin is a temporary hydroperiod, but some portions of the wetland are also seasonal, semipermanent, or permanent depending on basin depths and proximity to stream flow. For example, the low-order streams had a temporary hydroperiod, whereas the site on the Arkansas River was permanent. Water sources for the three low-order sites were in-channel flow, surface flow, and precipitation. In addition to the water sources for the low-order sites, the site on the Arkansas River also appeared to be influenced by groundwater discharge. Dominant hydrodynamics were unidirectional and vertical fluctuations depended on stream order and time of year.

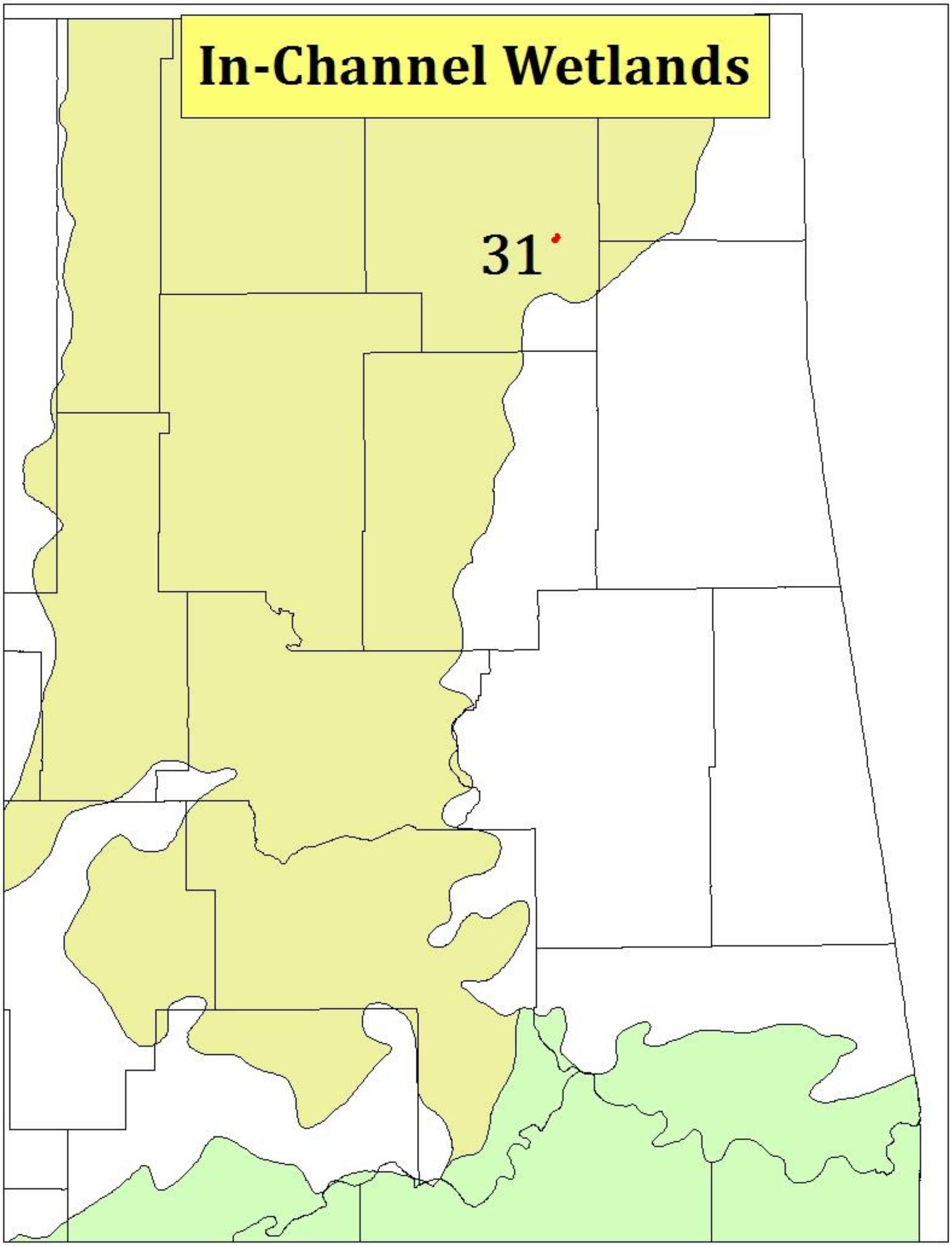

Figure 17. Locations of in-channel wetlands in the Central Irregular Plains Ecoregion.

Potential functions for these wetlands include dynamic water storage, energy dissipation, moderation of groundwater flow and discharge, nutrient cycling, long-term water storage, and maintenance of wildlife habitat and characteristic plant communities. The sites also may serve as wildlife corridors. Common plants include annual grasses (*Chasmanthium latifolium, Sorghastrum nutans,* and *Echinochloa crusgalli*) which were common along the edges of the wetland, spikerushes, and smartweeds. Boxelder, black willow, and American sycamore were frequently observed trees at these sites.

Subclass: Floodplain

Figure 18. Woody debris rafting in a floodplain wetland in the Central Irregular Plains Ecoregion.

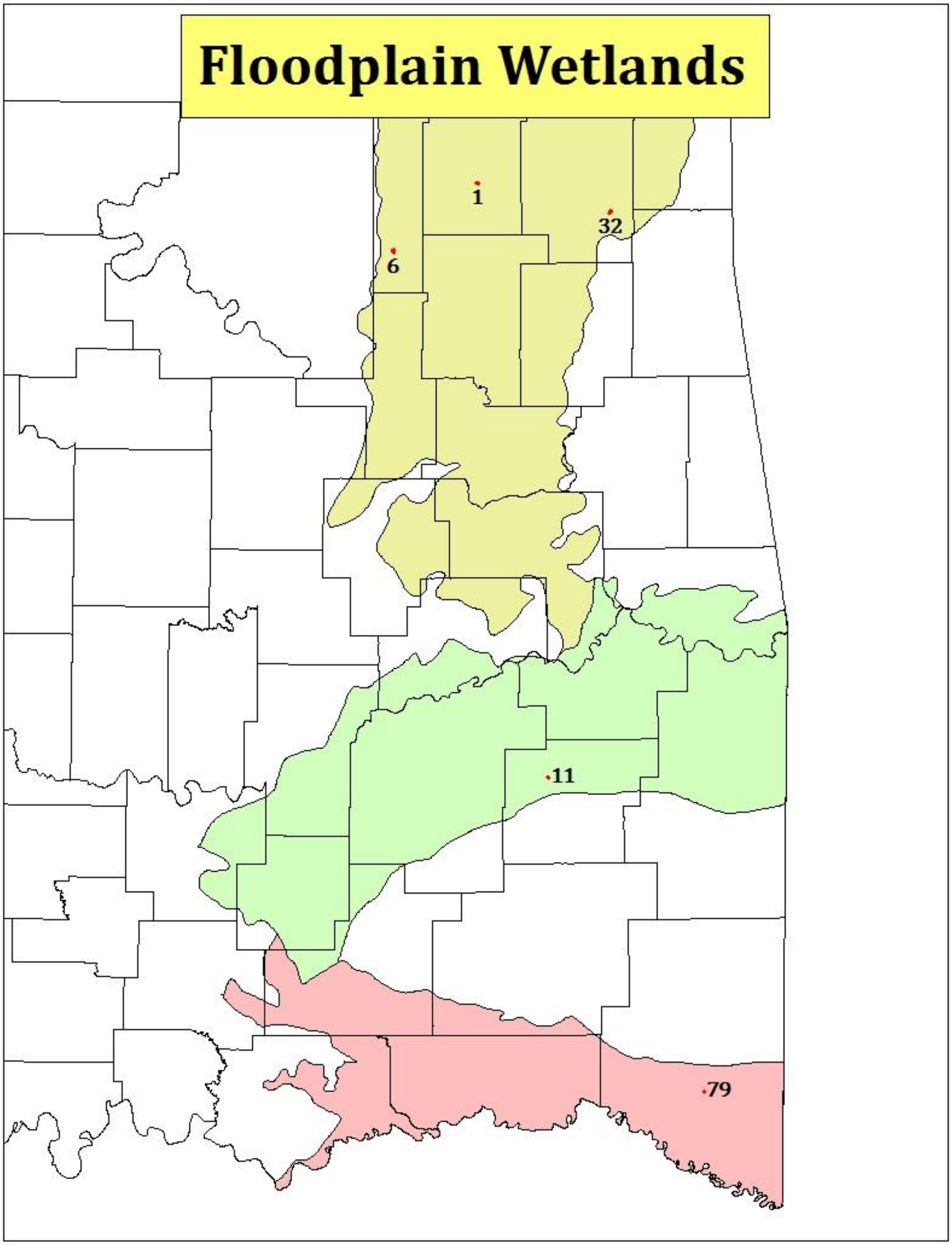

Figure 19. Locations of floodplain sites in the Arkansas Valley, Central Irregular Plains, and South Central Plains Ecoregions of Oklahoma. Numerals indicate individual wetlands and red polygons indicate locations of wetlands.

We surveyed six floodplain wetlands (Figure 18), with most of them occurring in the Central Irregular Plains Ecoregion (Figure 19). All of these sites were dry during the period when we conducted our surveys.

The dominant hydroperiod for these sites is temporary, and these sites are dependent on seasonal rains and flooding. Water sources for these sites are precipitation, surface water runoff, and overbank flow. These sites likely experienced vertical fluctuations in pools, and unidirectional flow at flood stage. Water flow into the wetland was not observed, but was evidenced by damage to upstream side of tree trunks and considerable rafting of leaves and woody debris (Figure 18). We also did not observe any evidence of groundwater influence in these wetlands, but these wetlands certainly are hydrologically-linked to the local aquifer.

Potential functions of these sites include energy dissipation, short-term and long-term water storage, wildlife habitat maintenance, carbon export, moderation of groundwater flow or discharge, and nutrient cycling. These sites also serve as wildlife corridors for many species as well as serving as refugia for plant and animal diversity in a surrounding landscape that is highly modified. Floodplain wetlands are dominated by bottomland hardwood forest. Common trees recorded in this subclass include American sycamore, black willow, green ash, eastern cottonwood, boxelder, and water oak. Common herbaceous species include fish-on-a-pole, giant river cane (*Arundinaria gigantea*),several species of rushes (*Juncus* spp.), barnyard grass, smartweeds, and flatsedges.

Subclass: Riparian

Figure 20. An example of a riparian wetland in the Arkansas Valley Ecoregion.

We surveyed seven riparian wetlands (Figure 20) in the Central Irregular Plains, Arkansas Valley, and South Costal Plains Ecoregions (Figure 21). These wetlands were located outside of the main channel of the stream or river system. They represented a gradient from the channel edge to upland edge. These wetlands mostly occurred along low-order streams.

These wetlands have temporary hydroperiods, with the exception of one site that was located along the headwaters of a small reservoir. At that site, the water level of the upstream riparian area was probably maintained by the lake water table. Dominant water sources are precipitation, surface runoff from the surrounding landscape, and overbank flow. Dominant hydrodynamics are unidirectional flow with direction of the stream, and secondarily, vertical fluctuations depending on the size and entrenchment of the stream channel. We observed no evidence of groundwater discharge or recharge at these sites.

Potential functions for riparian wetlands include dynamic water storage, energy dissipation, carbon export, particulate retention, maintenance of characteristic plant community, and providing wildlife corridors/habitat. These wetlands have dense vegetation that potentially assist with filtration, carbon export, stream bank stabilization, and slowing

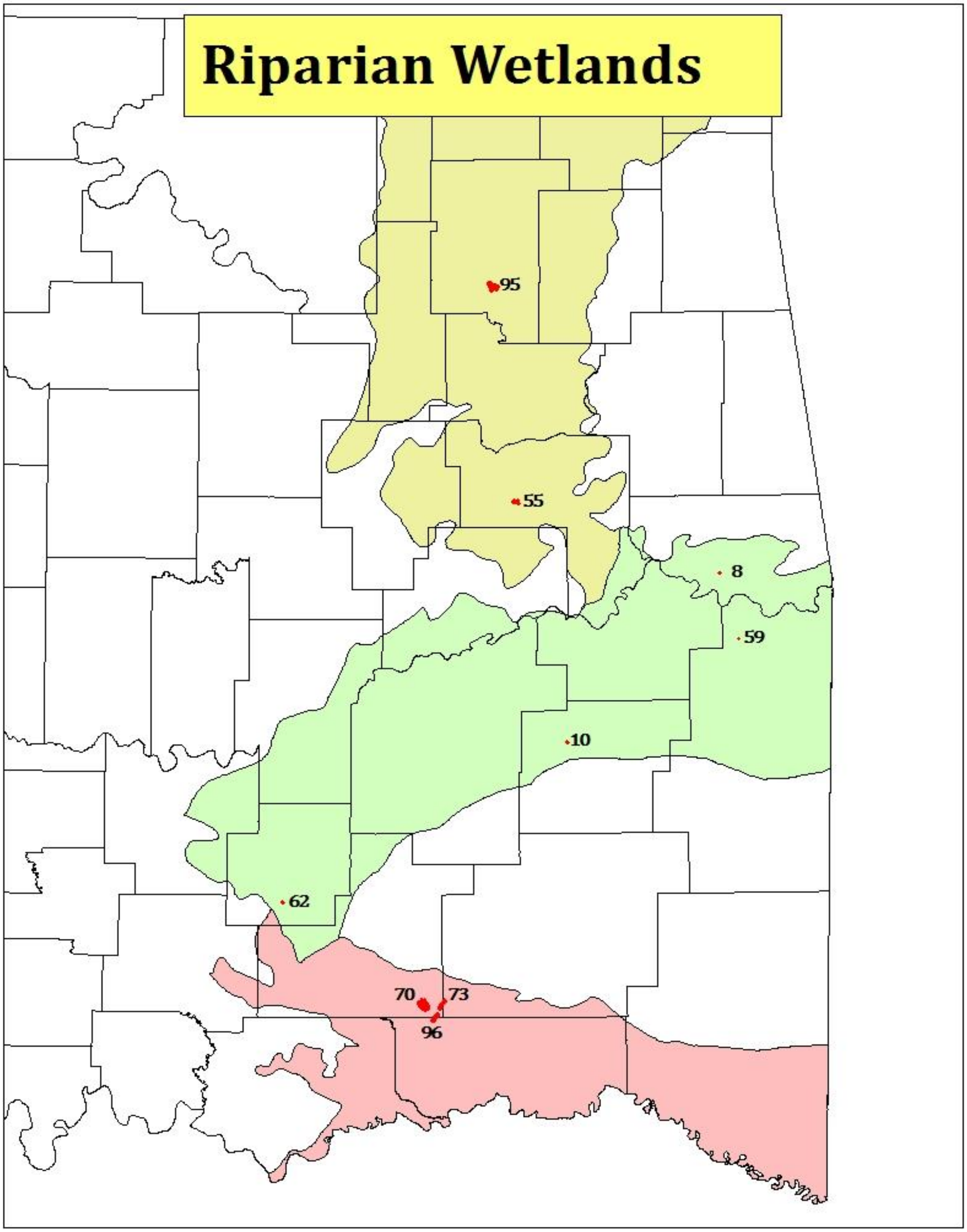

Figure 21. Locations of the riparian wetlands in the Central Irregular Plains, Arkansas Valley, and South Central Plains Ecoregions in Oklahoma. Numerals indicate individual wetlands and red polygons indicate locations of wetlands.

downstream flooding. The plant communities associated with these wetlands vary with the size of the wetland and stream channel entrenchment, but most of the sites were dominated by bottomland hardwood trees such as American sycamore, black willow, eastern cottonwood, American elm, silver maple, and water oak. Other common plant species across the ecoregions include fish-on-a-pole grass, smartweeds, common buttonbush, green briar, pigweed, cocklebur, giant cutgrass, and salt marsh aster. Because these wetlands are dry for most of the year, the majority of the plant species are terrestrial.

Class: Lacustrine Fringe

Subclass: Reservoir Fringe

Figure 22. A typical reservoir fringe wetland from the Arkansas Valley Ecoregion.

Three reservoir fringe wetlands (Figure 22) were surveyed (Figure 23). Two of the sites were located in the Arkansas Valley Ecoregion, and one was located in the Central Irregular Plains Ecoregion. The two sites in the Arkansas Valley Ecoregion were both located on Lake Eufaula (Figure 22), and although they were several miles apart they had substantial similarities.

The hydroperiods at these sites were controlled entirely by the lake level. During the initial visit to one site, large patches of emergent vegetation were visible, but during a subsequent visit, the entire wetland was submerged and inaccessible. Water levels may flucatuate from several meters to a few centimeters throughout the growing season. As such,

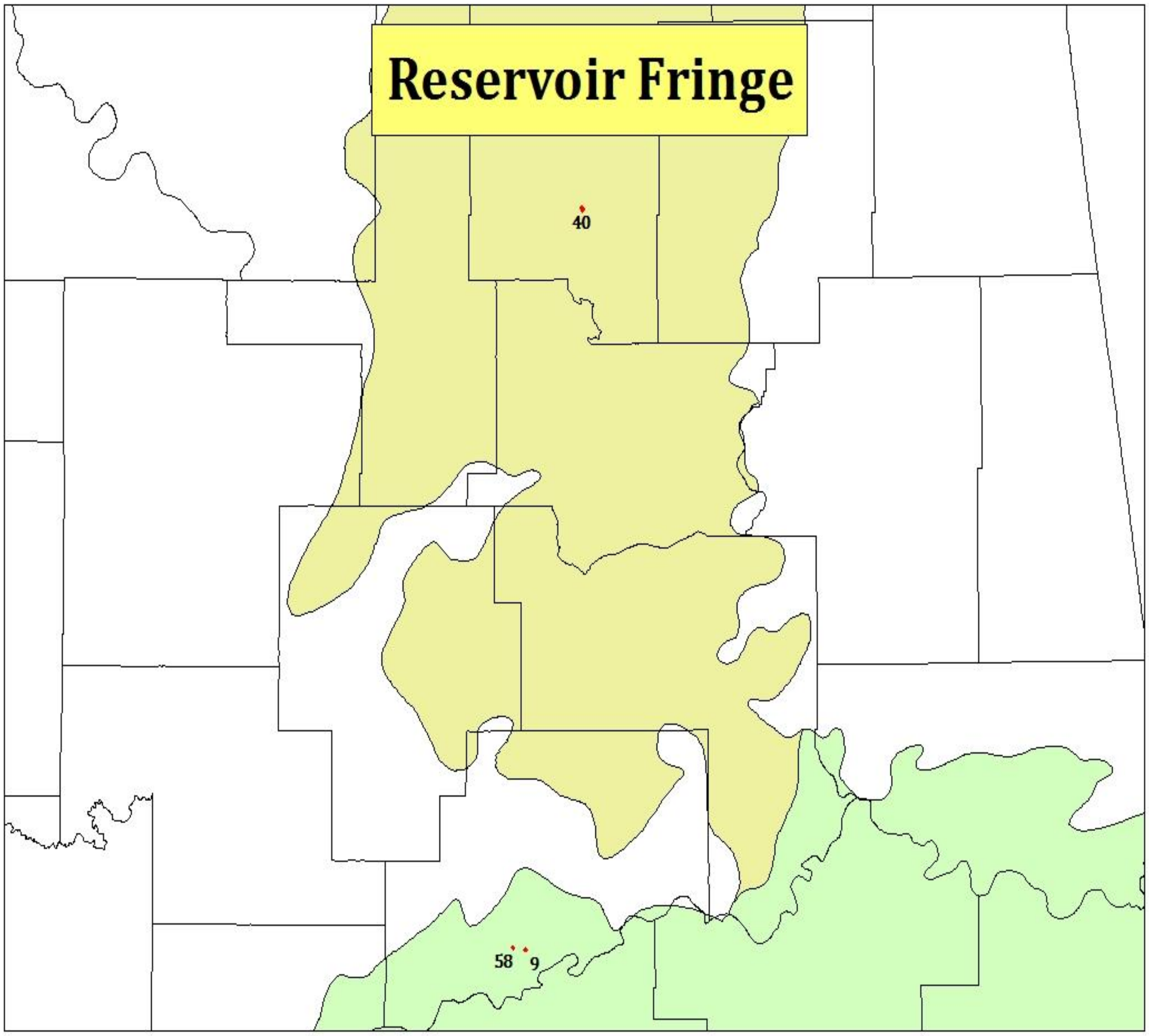

Figure 23. Locations of reservoir fringe sites in the Central Irregular Plains and Arkansas Valley Ecoregions. Numerals indicate individual wetlands and red polygons indicate locations of wetlands.

the hydroperiods of these wetlands range from temporary to semipermanent. The fluctuating water levels drive both bidirectional and vertical fluctuations in these wetlands. The dominant water source is surface flow from the lake. Precipitation played a small role in refilling of pools separated from the lake water table. Groundwater influences were not evident.

Potential functions for these sites include long-term and short-term surface water storage, dynamic water storage, nutrient cycling, carbon export, maintenance of characteristic plant communities, and maintenance of wildlife habitat. Reservoir fringe also provided spatial structure and heterogeneity in the lake, which likely may be important in providing nursery habitat for fish. These sites also provide can provide important habitat for migrant shorebirds in these ecoregions. Dominant vegetation at these sites consists of bottomland hardwood species in the canopy layer including black willow, green ash, American sycamore, silver maple, and elms. Common herbaceous plants include sedges, common buttonbush, winged loosestrife (*Lythrum alatum*), straw-colored sedge, fish-on-a-pole, barnyard grass, green briar, smartweeds, spikerushes, and arrowhead.

Subclass: Pond Fringe

Figure 24. An example of a pond fringe wetland in the Arkansas Valley Ecoregion.

Our survey of the three ecoregions in this study revealed only four pond fringe wetlands (Figure 24), with none of them occurring in the South Central Plains Ecoregion (Figure 25). In reality, these sites were often indistinguishable from Created Depressions. For the purpose of consistent classification, only sites with significant evidence of water deeper than 2 meters on a semi-permanent basis were considered for this group. Other sites, where depth or hypdroperiod was ambiguous were classified as created depressions.

Water sources were precipitation and overbank flow and potentially groundwater discharge at some sites. Dominant hydrodynamics were vertical fluctuations, as the impoundments tended to be permanent. However, one site, a small municipal reservoir for the City of Sperry, appeared to have been drained, despite the evidence suggesting the water was normally deep.

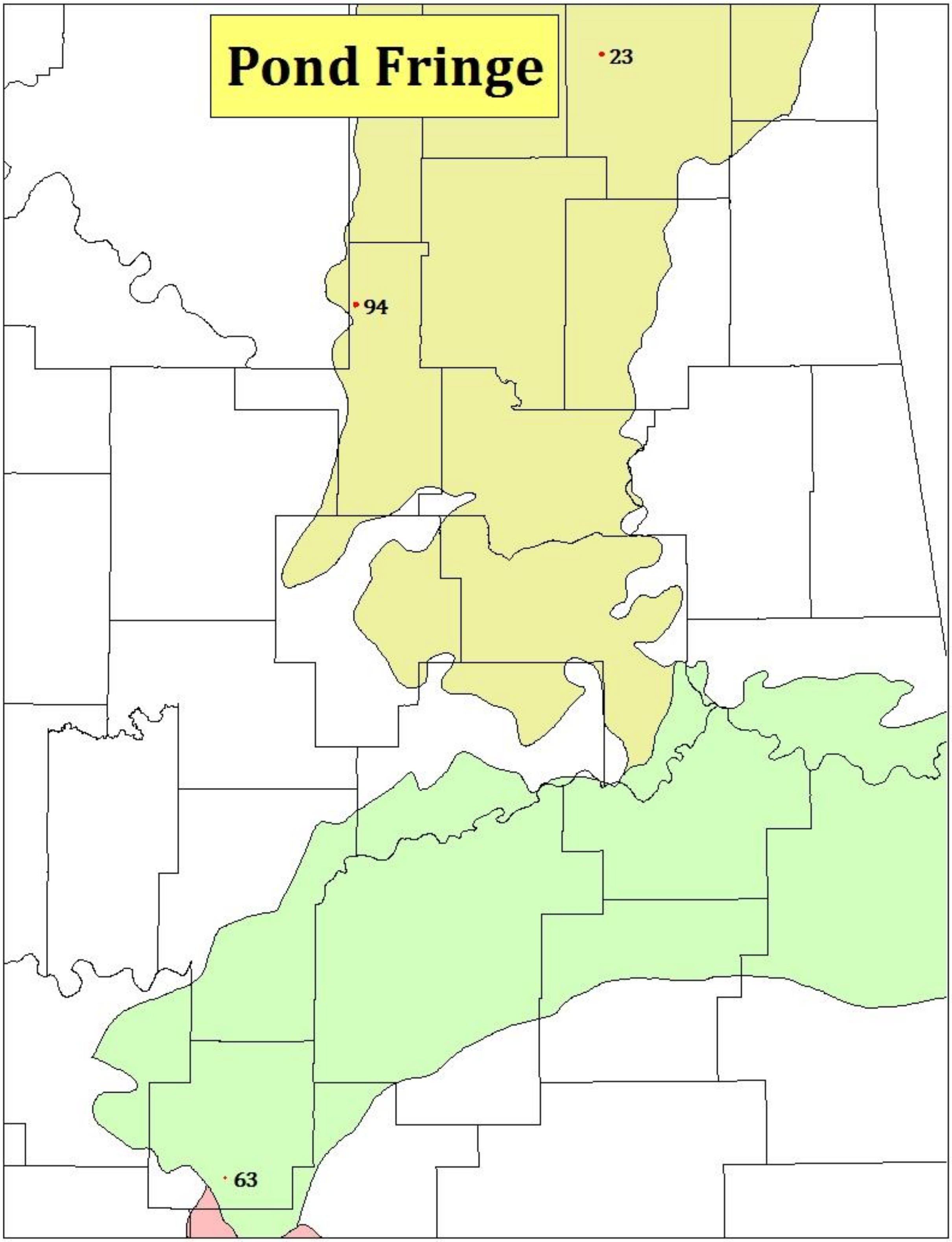

Figure 25. Locations of pond fringe wetlands in the Central Irregular Plains and Arkansas Valley Ecoregions. Numerals indicate individual wetlands and red polygons indicate locations of wetlands.

Potential functions include long term storage of surface water, nutrient cycling, organic carbon export, and maintenance of plant and animal communities. The more permanent hydroperiod for these wetlands suggest they provide consistent habitat for migrating waterfowl and other waterbirds that require deeper water. Additionally, this site may provide breeding habitat for amphibians, especially those species that require longer hydroperiods. These wetlands exhibited a distinct zonation of the plant community. Specifically, the zonation followed along a moisture/elevation gradient. In the deeper water, water lilies and cattails were common. In the more shallower areas of the wetlands, cattails were still abundant, but other species less tolerant of deeper water were more abundant. Specifically, sedges, smartweeds, barnyard grass, giant cutgrass, and flatsedges were the dominant species growing in the shallow waters along the shoreline. Common trees and shrubs included black willow, common buttonbrush, persimmon trees (*Diospyros virginiana*), and green ash.

Class: Slope

Subclass: Headwater

Figure 26. An example of a headwater slope site at Robber's Cave State Park in the Arkansas Valley Ecoregion.

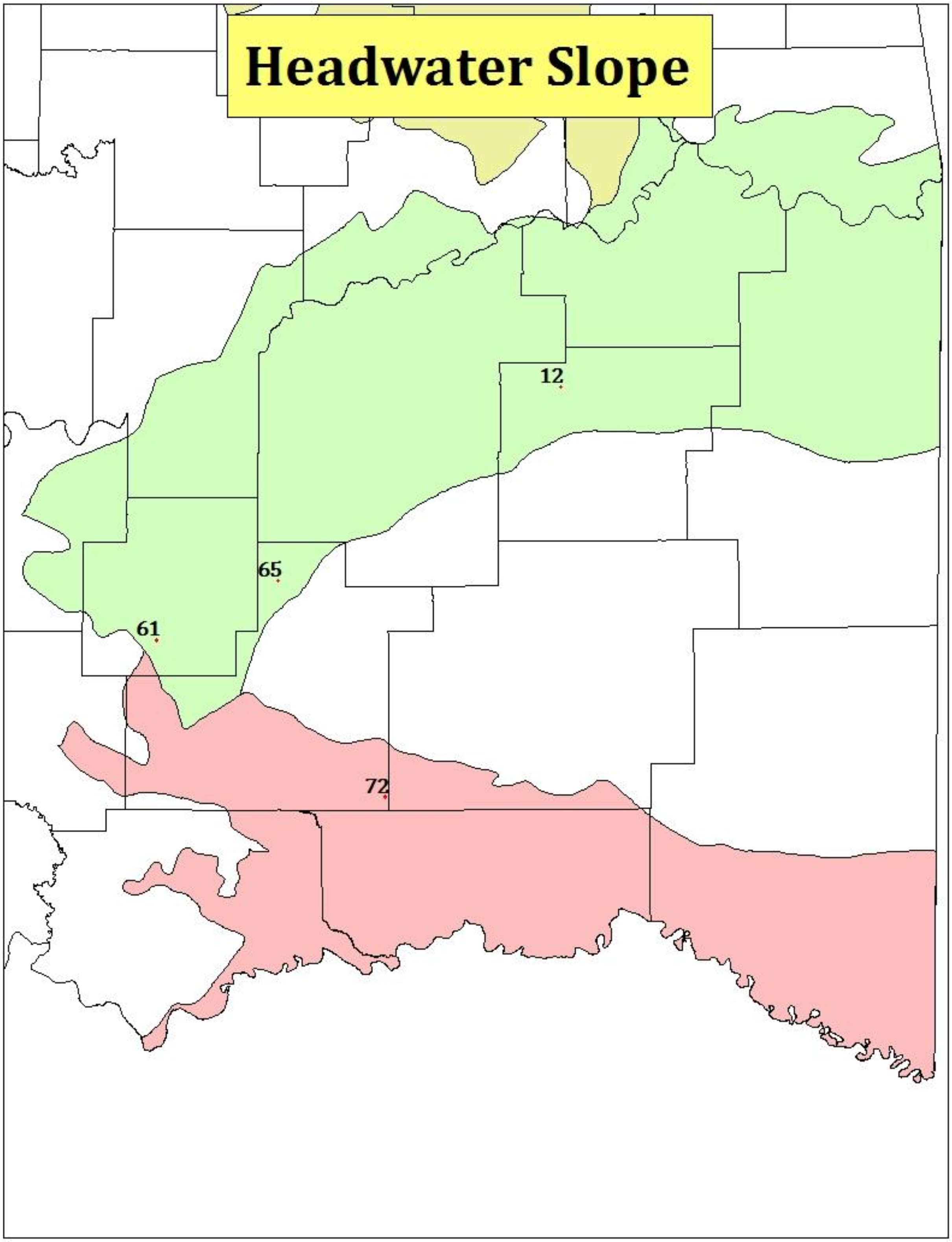

Figure 27. Locations of headwater slope sites in the Arkansas Valley and South Costal Plains Ecoregions in Oklahoma. Numerals indicate individual wetlands and red polygons indicate locations of wetlands.

We surveyed three headwater slope wetlands (Figure 26) within the Arkansas Valley Ecoregion and one within the South Central Plains Ecoregion (Figure 27). These sites were exceedingly difficult to identify using the NWI layers and ancillary GIS data. In fact, none of the sites identified as slope by frame materials were accurate, and none of the four slope sites surveyed were originally identified as such by the GIS analysis. These sites originated from groundwater seeps along a sloped surface, and sometimes exhibited no surface water. In cases where the surface water was not present, saturated soils followed a linear pattern down the slope resulting in marked differences in plant communities which were used to identify sites.

Hydroperiods varied from temporary to permanent, and were likely influenced by precipitation in most cases. The dominant hydrodynamics, in all observed cases, was unidirectional, with secondary vertical fluctuations for sites associated directly with a stream where stream stage influenced water levels. The dominant water source was groundwater, with precipitation and overland flow as secondary sources. For one site in Atoka County, the source of the water was specifically known to be a natural spring at the apex of the wetland. The land owner related that the spring had existed on the property since her family claimed it during the homestead boom, but that the spring had been disturbed by a group a surveyors doing natural gas exploration during the 1990's and the spring had temporarily disappeared, only to be rediscovered several hundred yards from its original location. The landowner's husband had since driven a piece of ceramic drain pipe directly into the source, where water could be observed pooling and running off (Figure 28).

Potential functions for these sites include subsurface water storage, dynamic water storage, moderation of groundwater flow/discharge, and maintenance of plant and animal diversity. Vegetation communities were inconsistent among sites, and the sites typically contain plants observed frequently in other wetlands in the ecoregions such as sedges, croton, fish-on-a-pole grass, smartweeds, rushes, and common buttonbush. Trees associated with headwater slopes include black willow, green ash, common persimmon, and elms.

Figure 28. Groundwater source of one of the headwater wetlands surveyed in Atoka County.

Conclusions

In a continuing effort to inventory and categorize the wetlands of Oklahoma, this study expanded the use of the HGM classification system to the Central Irregular Plains, Arkansas Valley, and South Central Plains Ecoregions. With the completion of this project, we have characterized six of the ecoregions in the state. Like the three ecoregions previously surveyed, these three ecoregions represent a broad selection of wetland types, which provide a wide array of functions. Of the seven national HGM wetland classes, four occurred within these three ecoregions. Depressional wetlands made up the vast majority of the sites surveyed, and based on our overall examination of NWI maps in GIS, it seems likely that depressions are truly the dominant wetland type throughout these ecoregions. Riverine wetlands were the second most common wetland type in the three ecoregions. However, it should be noted that despite our difficulty in gaining landowner permission in the study area, we are confident that our targeted approach of locating wetlands and gaining permission for access did allow us to provide a representative sample of wetlands in the three ecoregions that reflects the relative frequency of the various wetland classes in these ecoregions.

Within the four national classes, we were able to classify ten subclasses. Created depressions were the dominant subclass in all three ecoregions, but the second most common subclass varied across the ecoregions. In the Central Irregular Plains Ecoregion, closed surface water depressions and in-channel wetlands were also common. Riparian and slope headwaters wetlands were common in the Arkansas Valley Ecoregion, while open surface water depressions were common in the South Central Plains Ecoregion. Although each ecoregion possessed some unique qualities, the wetland types and their proportion were similar across all three ecoregions.

This study also sought to establish baseline data on the functional attributes of the wetlands in these regions. This data could be used as a launch point for developing functional assessments appropriate to each ecoregion as part of the State's Comprehensive Wetland Program Plan. Our list of functional attributes was based on the functional attributes described in the HGM assessment projects previously completed in the State, which should allow for consistency and continuity of future monitoring and assessment programs in these ecoregions and other ecoregions in the state.

As the dominant subclass, all created depressional sites with full sets of data were ranked to create a gradient of wetland conditions for use as reference sites for future studies. Lack of water at the time of sampling prevented water quality measurement for some sites, and they were therefore excluded from the reference site analysis. Rather than use a rapid assessment method developed for wetlands in other parts of the country, we used a novel system of ranks and natural breaks in the data to provide each site with a relative quality score from -3 to 3, and a category from Poor to Excellent. As such, the metric we developed provides a comparison among created depressions in the three ecoregions, but not a specifically quantified value for use comparing these sites with sites outside these ecoregions. We felt that for the purpose of evaluating additional sites within the Central Irregular Plains, Arkansas Valley, and South Central Plains Ecoregions, this would be a more valuable tool, especially because no created depression could be considered to be a pristine site by definition.

Finally, we would recommend that the methods of GIS analysis used to initially reclassify HGM classes from NWI data continue to be refined, modified, and updated. As the model was completely unable to accurately predict the locations of slope wetlands in these ecoregions, special consideration should be given to improving that aspect of the reclassification model.

Acknowledgments

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APPENDIX A

Initial Site Characterization Form

GIS Assessment:

SITE BACKGROUND
Date: ____________________
Site Name: ____________________
County: ____________________
Coordinates of centroid: ____________________ Coordinate System ____________________
Wetland Area: ____________________
NWI Wetland Type: ____________________
Contact Person for Access Permission: ____________________
Notes: ____________________

LANDSCAPE POSITION
Elevation: ____________________
Topography: ____________________
Dominant Soil Types: ____________________
LU/LC Types: ____________________
Surrounding LU/LC: ____________________
Level 3 Ecoregion: ____________________
Level 4 Ecoregion: ____________________
Other notes: ____________________
____

WATER SOURCE and HYDRODYNAMICS
Proximity to River: ____________________ Name: ____________________ Stream Order ____________________
Proximity to Lake: ____________________
Floodplain Location: ____________________
Aquifer Location: ____________________
Precipitation Range: ____________________
Avg Max: ____________________ Avg Min: ____________________
Last Rain Event: ____________________
Other Notes: ____________________
____

HGM CLASSIFICATION
Likely HGM Class: ____________________
Likely Regional Subclass: ____________________
Other Notes: ____________________
____

APPENDIX B

Initial Site Characterization Form

Field Assessment:

SITE BACKGROUND
Date:____________________ Data Recorders:____________________
Site Name: ____________________
County: ____________________
Size compared to NWI polygon:____________________

LANDSCAPE POSITION
Soil Descriptions (depth to water, perched aquifer, wetland indicators):____________________

Wetland plant communities (designate dominant plants):____________________

Description of surrounding landscape (including occurrence of buffer strips, types of vegetation communities, land-use practices, altered surface flows):____________________

WATER SOURCE AND HYDRODYNAMICS
Description of current hydrological conditions (flooded, saturated soil, or dry):____________________

Water depth:____________________
Water source (Dominant and other):____________________

Approximate hydroperiod length:____________________
Evidence of hydroperiod length:____________________

Hydrodynamics:____________________

Evidence of groundwater discharge/recharge:____________________

CONDITION AND FUNCTIONS
Description of types of alterations:____________________

Condition indicators:____________________

Condition/disturbance/overall wetland health assessment (1-5 with 1=reference standard): ____________________

List of potential functions:____________________

HGM Class:____________________ Regional Subclass:____________________

APPENDIX C

Key to HGM National Classes and Wetland Subclasses in the Central Irregular Plains, Arkansas Valley, and South Central Plains Ecoregions of Oklahoma

1. Wetland is within the 5 year floodplain of a river but not
   fringing an impounded water body ....Riverine
1. Wetland is associated with a topographic depression or
   slope 2

2. Wetland is located on a topographic slope or relatively flat
   area and has groundwater as the primary water source.
   Wetland does not occur in a basin with closed contours .... Slope
2. Wetland is located in a natural or artificial
   (dammed/excavated) topographic depression 3

3. Topographic depression has permanent water greater than 2
   meters deep .... Lacustrine Fringe
3. Topographic Depression does not contain permanent water
   greater than 2 meters deep ....Depression

DEPRESSION
1. Wetland is created by a process other than natural
   topography or hydrology, and is less than 2 meters in
   depth .... Created
1. Wetland is not created by a process other than natural
   topography or hydrology...2
2. Wetland is in a remnant river channel not regularly flooded
   by river .... Closed Surface Water
2. Wetland is not in a remnant river channel 3
3. Wetland has an inlet and/or outlet to surface flow ....Open Surface Water
3. Wetland has high bank creating a catchment basin .... Closed Surface Water

LACUSTRINE FRINGE
1. Wetland is in littoral zone of a man-made lake fed primarily
   by a permanent river ....Reservoir Fringe
1. Wetland is in littoral zone of a man-made lake fed primarily
   by an ephemeral drainage or overland flow...2
2. Wetland in greater than 2 meters in depth ....Pond Fringe
2. Wetland is less than 2 meters in depth..See DEPRESSION

RIVERINE
1. Wetland is within the bank full channel .... In-channel

1. Wetland is not within the bank full channel 2
2. Wetland occurs in riparian zone ....Riparian
2. Wetland is beyond riparian zone.. Floodplain

SLOPE

1. Wetland originates with groundwater on or at the base of a slope .... Headwater Slope

Appendix D

Stressor checklist for use in characterizing the disturbance gradient for reference wetlands. Modified from Collins et al. (2008).

HYDROLOGY ATTRIBUTE (within 50 m of wetland)	Present and likely to have negative effect on wetland	Significant negative effect on wetland
Point source discharge		
Non-point source discharge		
Flow diversion or unnatural inflows		
Dams		
Flow Obstructions (roads, bridge, etc.)		
Engineered channel (riprap, straightened)		
Groundwater extraction		
Ditch		
Actively managed hydrology		
Comments:		
PHYSICAL STRUCTURE ATTRIBUTE (within 50 m of wetland)	**Present and likely to have negative effect on wetland**	**Significant negative effect on wetland**
Sedimentation from human activity		
Grading		
Plowing/discing		
Resource extraction		
Vegetation management		
Excessive sedimentation or organic debris from watershed		
Excessive runoff from watershed		
Nutrient impaired		
Pesticides		
Bacteria/pathogens		
Trash/refuse dumping		
Comments:		
BIOTIC STRUCTURE ATTRIBUTE (within 50 m of wetland)	**Present and likely to have negative effect on wetland**	**Significant negative effect on wetland**
Mowing, grazing, excessive herbivory		

Excessive human visitation		
Habitat destruction/predation by non-native vertebrates		
Tree cutting/sapling removal		
Removal of woody debris		
Treatment of non-native and nuisance plant species		
Pesticide application		
Resource stocking/extraction		
Excessive organic debris in pools		
Lack of veg. mgmt to conserve natural resources		
Lack of treatment of invasive plants		
Comments:		

BUFFER AND LANDSCAPE CONTEXT ATTRIBUTE (within 500 m of wetland)	Present and likely to have negative effect on wetland	Significant negative effect on wetland
Urban residential		
Industrial/commercial		
Air traffic		
Dams		
Ranching		
Orchards/Nurseries		
Pine silviculture		
Commercial feedlots		
Dairies		
Passive recreation		
Active recreation		
Physical resource extraction		
Cleared lines		
Comments:		