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Identifying Wetland Availability and Quality For Focal Species of the Illinois Wetlands Campaign W-184-R-1

Annual Report

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ANNUAL REPORT – FY2015
Identifying Wetland Availability and Quality for Focal Species of the Illinois Wetlands Campaign
Federal Aid in Wildlife Restoration

NARRATIVE

JOB 2: Estimate Functional Quality of Wetlands for Focal Species of the Illinois Wetlands Campaign

Objectives

1) Estimate wetland habitat quality during spring, summer, and autumn for focal species of the Illinois Wetlands Campaign

2) Develop a model to predict wetland quality for focal species of the Illinois Wetlands Campaign relative to wetland and landscape characteristics.

Introduction

Although biologists recognize that wetland quality has declined over the last 200 years due to a variety of anthropogenic influences, the rate and extent of that decline is unknown (Mitsch and Gosselink 2000). Data are needed to both better describe the current level of function of extant wetlands as well as establish baseline data for estimating rate of wetland degradation in the state of Illinois relative to habitat needs for wetland-dependent wildlife. Currently, National Wetland Inventory (NWI) data provide the most comprehensive source of information that can be used to quantify wetland availability and habitat suitability for wetland wildlife. However, wildlife often require surface hydrology within specific depth ranges and at specific times of the year for wetlands to provide functional habitat. Unfortunately, NWI data does not include descriptions of water depth or seasonality of surface hydrology. Thus, NWI wetland estimates likely overestimate and amount of wetland and deepwater habitat available to wetland wildlife, especially during spring and autumn migrations.

Moreover, current wetland availability estimates in Illinois are not corrected for wetlands which have suitable hydrology and may not provide habitat of sufficient quality to be useful to many species of wetland wildlife (e.g., power plant cooling lakes, borrow pits along interstates, ponds in urban developments, etc.). A major assumption of many habitat conservation plans is that foraging habitat is most limiting during spring and autumn migration in non-breeding regions such as Illinois (e.g., Soulliere et al. 2007). Aquatic habitats with extensive disturbance or those lacking aquatic vegetation likely provide little value as foraging habitats (Stafford et al. 2010, Hagy et al. 2015) and information to describe the actual availability of wetland habitat or suitable quality for migrating wetland bird species in Illinois is lacking.

We will assess the functional quantity (i.e., relative value to focal species of the wetland area actually inundated by water to the appropriate depths) of wetlands currently assumed to be available to waterbirds and other wetland-dependent organisms during spring, summer, and autumn in Illinois. This information can then be used to develop fine-scale wetland conservation objectives for wetland-dependent organisms at different times of the year. Moreover, an index of wetland quality can be used to estimate values (e.g., foraging habitat quality, breeding habitat quality, etc.), risk of conversion to other types or drainage, and habitat availability relative to specific taxa. Understanding the current status of average wetland quality and the rate of change in wetland quality is critical for appropriate planning objectives. This study will provide estimates of current functional quality of wetlands allowing a more precise development of wetland enhancement and restoration implementation objectives.

Methods

We stratified Illinois by natural division and allocated survey effort in proportion to wetland density within natural divisions. We consolidated NWI polygons into 6 classes (Freshwater Pond, Lake, Freshwater Emergent [herbaceous only], Freshwater Scrub-Shrub/Forested, Riverine, and Other; Table 1) based on our focal species guilds in 3 different seasons (spring [1 March – 15 April] – migrating waterfowl, summer [15 May – 30 June] – breeding marsh birds, and autumn [25 July – 10 September] – migrating shorebirds). We determined our maximum sampling effort (i.e., ~80 sites/season aerial; ~50 sites/season ground) given temporal and monetary constraints and used total wetland area to determine the number of sample plots in each in each natural division with Neyman allocation. We then used the Reversed Randomized Quadrant-Recursive Raster tool in ArcMap to assign plot locations within wetland area inside each natural division, which created a more spatially-balanced sample population than simple random allocation. We also generated a second set of 80 plots using the same methodology which served as a backup sample population if a primary plot could not be sampled. We established 1-km^2 plots as sample units and obtained aerial photographs of each during the three seasons concurrent with ground surveys. We selected approximately 50 1-km^2 plots and conducted intensive ground surveys on a random ¼ of each plot (i.e., subplot; Fig. 1). Conducting ground surveys on all 1-km^2 plots was not feasible due to temporal limitations and issues obtaining landowner permission. Aerial photographs were obtained from 2,000–4,500 ft above ground level for later digitizing of inundation boundaries and habitat classification.

Our ground surveys included one survey each within the Grand Prairie, Northeastern Morainal, and Middle Mississippi River Borders natural divisions; three surveys each in the Rock River Hill Country and the Wisconsin Driftless divisions; six surveys in the Illinois / Mississippi River Sand Areas; seven surveys from the Major Water Bodies; and ten surveys in the Upper Mississippi / Illinois River Bottomlands natural division (Fig. 2). During aerial surveys in spring, an observer identified and enumerated waterfowl and other waterbirds as possible by making one or more low-altitude passes over each wetland within each 1-km^2 plot in a low-winged aircraft at speeds of approximately 240 kph (Havera 1999). We also recorded bird abundances through flush counts during ground surveys for comparison with aerial surveys. During ground surveys of subplots, observers traveled along surface inundation boundaries within or around each polygon, marked water boundaries using GPS units, and recorded surface water coverage as a percentage of each polygon using visual estimation (Fig. 3). For each NWI polygon within each subplot, observers also recorded proportion of inundated area <45 cm deep, cover of dense emergent vegetation, cover of herbaceous vegetation (e.g., moist-soil vegetation), cover of submersed and floating-leaved aquatic vegetation, and other habitat characteristics. Observers estimated the proportion of each polygon containing mudflats and under various management practices (e.g., mowing, burned, planted in food plots). Within each subplot and for each polygon, observers noted hydrological characteristics, evidence of wetland management activities, and possible wetland stressors (e.g., levees, invasive species, drainage ditches, etc.). We assessed wetland vegetation community composition and condition using a modified version of the Environmental Protection Agency's National Wetland Condition Assessment rapid assessment method (USA-RAM; Gray et al. 2012). The USA-RAM procedure uses potential stressors as indicators of wetland condition that are consistent with current EPA methods, yet inclusive of metrics indicative of wetland quality for focal wildlife species under a wide variety of modified conditions (e.g., impoundment management of hydrology).

Wetland characteristics, such as emergent vegetation type and height, can influence animal occupancy rates of wetland complexes, but associations with intrinsic and extrinsic factors are highly variable in the Midwest, perhaps because habitat is limited (Bolenbaugh et al. 2011). Thus, we considered both intrinsic and extrinsic wetland characteristics as influencing wetland quality and bird use. As intrinsic vegetation characteristics may be less important than wetland surroundings (DeLuca et al. 2004) and size (Brown and Dinsmore 1986) in site occupancy of some species (e.g., waterbirds), we used ArcMap and available imagery and land use shapefiles (e.g., Landsat 8) to characterize the landscape around each wetland. We will evaluate parameters such as wetland isolation, surrounding buffer, proximity to developed areas, and other factors using available spatial data (e.g., Landsat) or head's-up digitizing. After multiple years of data are collected and analyzed, we will model factors affecting wetland quality and occupancy by focal species.

Major Accomplishments and Findings

During spring surveys, mallards (*Anas platyrhynchos*) were the most common duck encountered and were present at 40% of plots. Canada geese (*Branta canadensis*) were the most frequently observed goose species and occurred at 28% of plots, while snow geese occurred at only 2 plots. In total, 21 species of waterbirds and waterfowl were observed during spring aerial surveys, but 35% of sites had no birds present during aerial counts. We rarely observed or heard marsh birds at plots during our summer sampling, likely because few plots contained significant areas of emergent vegetation and surveys occurred after most species migrated through Illinois (Table 2).

During spring, we surveyed 31 subplots and 62 polygons (Fig. 4, Table 3). Lake, pond, and riverine polygons were mostly covered by surface water, but only 38% of emergent and 19% of forested polygons were inundated. Furthermore, less than a third of any polygon type was inundated shallowly and accessible for foraging by dabbling ducks. Similarly, emergent vegetation (<10%) and overall vegetation (<25%) were rarely inundated in plots. During summer we surveyed 50 subplots and 105 polygons. Inundation rates were much greater than spring, with lake, pond, riverine, and other polygons greater than 90% inundated. Forested (34%) and emergent (61%) also had higher inundation rates than spring. Mean area of shallow water coverage was variable across polygon types, but generally greater in summer than spring, as was inundated vegetation area. During autumn, we surveyed 50 subplots and 100 polygons. Flooded area across polygons was quite similar to spring, but shallowly inundated area was slightly greater in autumn. Mudflats comprised less than 20% of any polygon type and were greatest in riverine and least in forested polygons. Across polygon types and seasons, approximately 60% of wetland polygons were inundated by surface water and 20% of wetland area was shallow. Mudflats were abundant in early autumn for migrating shorebirds due to extensive flooding along major rivers and in farm fields which persisted from early June through early August. We noted that overall wetland inundation and area of shallow water coverage in several of our most important wetland types for migrating ducks, such as forested and herbaceous emergent habitats, were lowest during our spring sampling period.

Aerial photos are still being georectified and processed. Inundated areas outside of NWI polygons were not included in this summary report as digitizing of aerial photographs has not yet been completed. After multiple years of data have been collected, we will model surface inundation and vegetation characteristics as a function of landscape composition, wetland type, and other factors. Following completion of data collection for our entire first field season, we will evaluate various combinations of stressors as predictors of wetland inundation rates.

Literature Cited

Bolenbaugh, J.R., D.G. Krementz, and S.E. Lehnen. 2011. Secretive marsh bird species co-occurrences and habitat associations across the Midwest, USA. Journal of Fish and Wildlife Management 2:49–60.

Brown, M., and J.J. Dinsmore. 1986. Implications of marsh size and isolation for marsh bird management. Journal of Wildlife Management 50:392–397.

DeLuca, W.V., C.E. Studds, L.L. Rockwood, and P.P. Marra. 2004. Influence of land use on the integrity of marsh bird communities of Chesapeake Bay, USA. Wetlands 24:837–847.

Gray, M.J., K.E., Edwards, H.M. Hagy, W.B. Sutton, D.A. Osborne, G.D. Upchurch, and Z. Guo. 2012. United States Department of Agriculture Natural Resources Conservation Service National Easement Assessment Project. Final Report. July 1. 532 pp. Available: http://neap.tennessee.edu/pdf/NEAP_October2012Report-Final10-8-12.pdf

Hagy, H.M., M.M. Horath, A.P. Yetter, C.S. Hine, R.V. Smith. 2015. An evaluation of temporary sanctuary from hunter disturbance on migratory waterfowl. Hydrobiologia (*In Review*).

Havera, S.P. 1999. Waterfowl of Illinois: status and management. Illinois Natural History Survey Special Publication 21.

Mitsch, W.J., and J.G. Gosselink. 2000. Wetlands. John Wiley and Sons, NY.

Soulliere, G.J., B.A. Potter, J.M. Coluccy, R.C. Gatti., C.L. Roy, D.R. Luukkonen, P.W. Brown, and M. W. Eichholz. 2007. Upper Mississippi River and Great Lakes Region Joint Venture waterfowl habitat conservation strategy. U.S. Fish and Wildlife Service, Fort Snelling, Minnesota, USA.

Stafford, J.D., M.M. Horath, A.P. Yetter, R.V. Smith, and C.S. Hine. 2010. Historical and contemporary characteristics and waterfowl use of Illinois River valley wetlands. Wetlands 30:565–576.

Figure 1. 1-km^2 plot with the sampled ¼-km^2 subplot during ground surveys (blue outline) with wetland polygons as determined by the National Wetland Inventory.

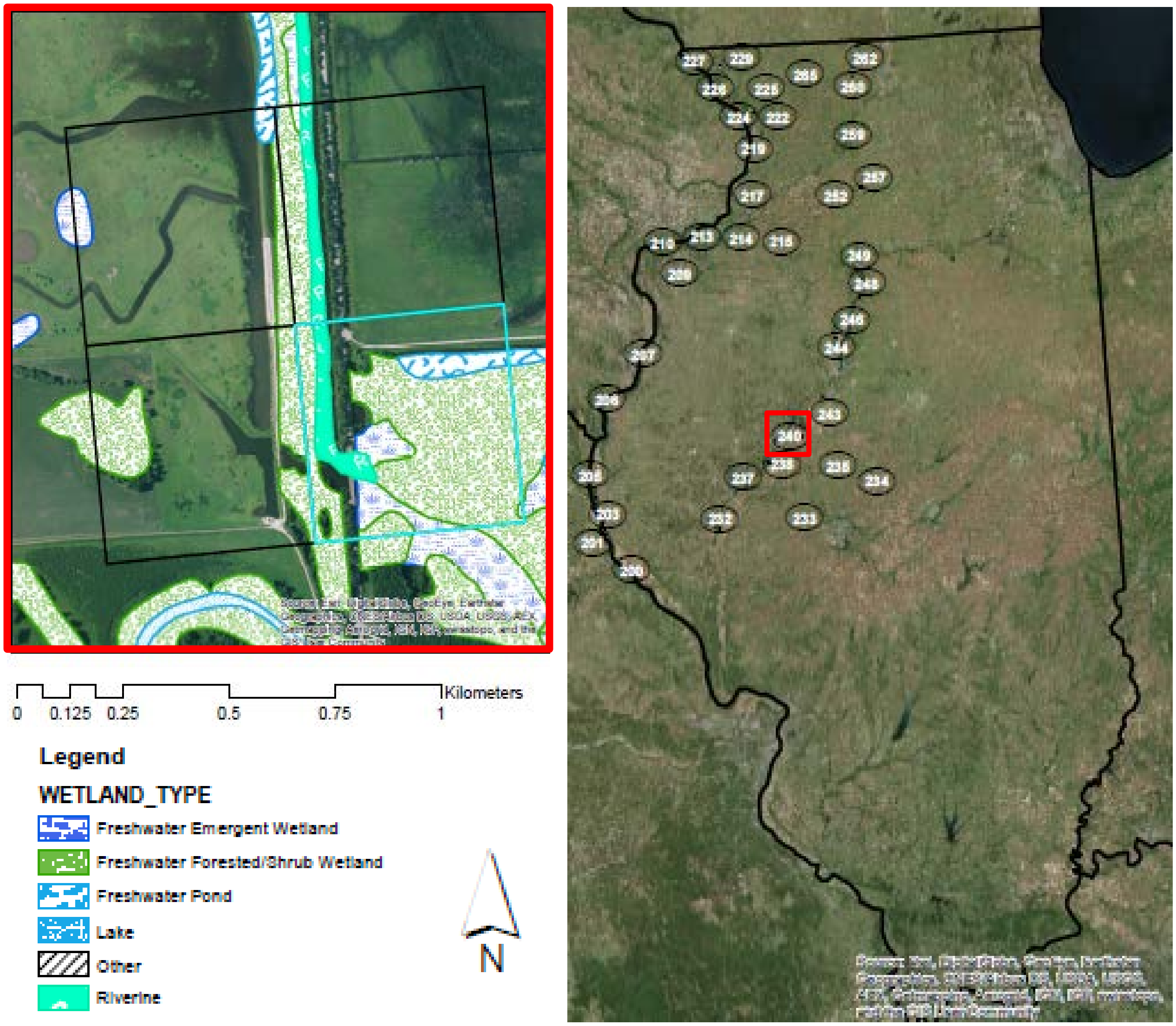

Figure 2. Natural divisions of Illinois and locations of primary sampling plots in 2015.

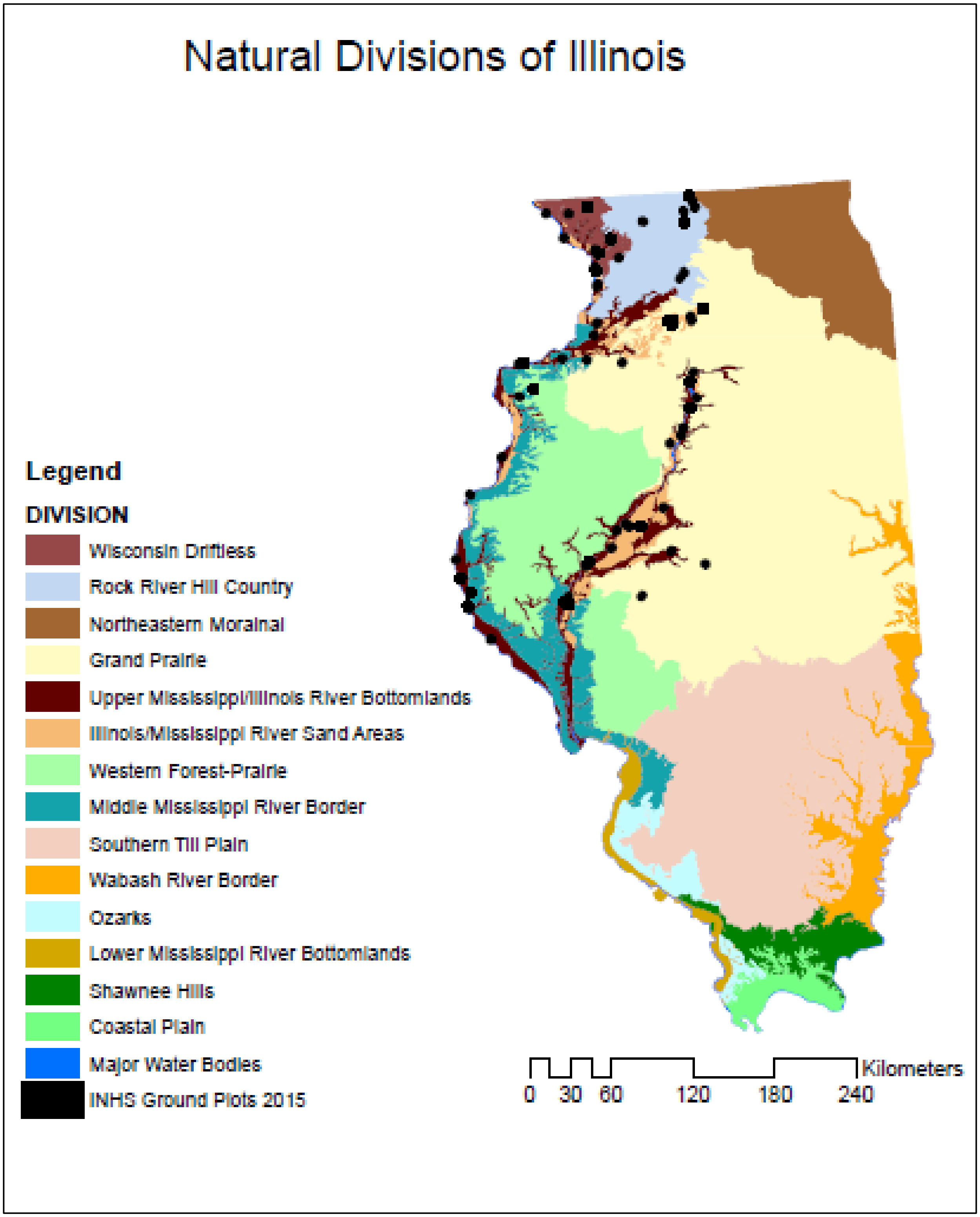

Figure 3. Example GPS tracks used to map wetland inundation within wetland polygons and ¼-km^2 subplots.

Figure 4. Total National Wetland Inventory polygon area (ha) sampled, total area inundated by surface water, and total inundated area <45 cm in depth (shallow) during three sampling seasons in central and western Illinois in 2015.

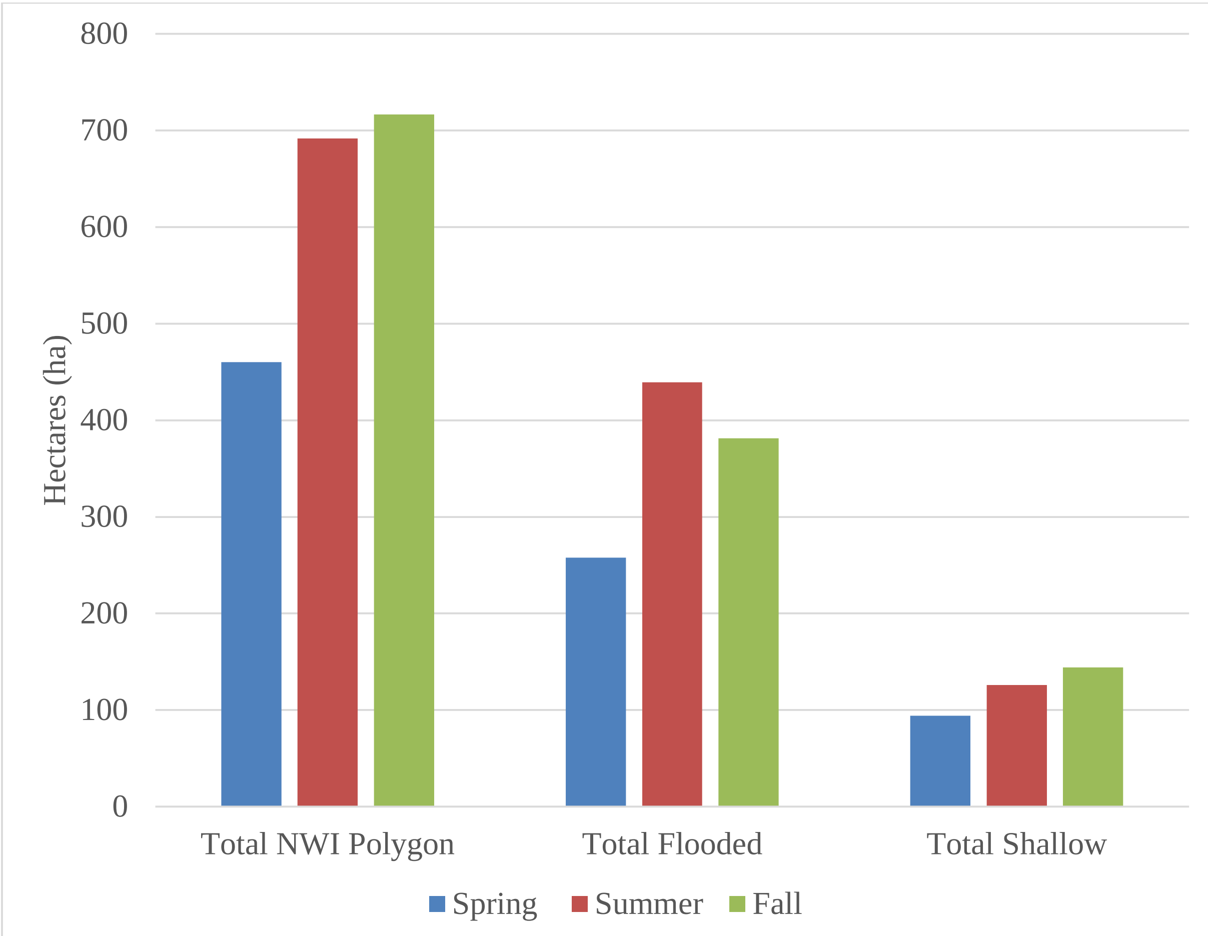

Table 1. Wetland types used in analyses. For more information, see the National Wetland Inventory Wetland Mapper (http://www.fws.gov/wetlands/data/Mapper-Wetlands-Legend.html).

Wetland Type[1]	**NWI Map Code**	**Cowardin System and Class**	**General Description**
Freshwater Forested and Shrub-shrub	PFO, PSS	Palustrine forested and/or Palustrine shrub	Forested swamp or wetland shrub bog or other wetland with 30% woody vegetation cover > 1 m in height
Freshwater Emergent	PEM	Palustrine emergent	Herbaceous march, fen, swale and wet meadow, non-woody
Freshwater Pond	PUB, PAB	Palustrine unconsolidated bottom, Palustrine aquatic bed	Pond, small wetland with open water or aquatic bed vegetation only
Riverine	R	Riverine wetland and deepwater	River or stream channel
Lake	L	Lacustrine wetland and deepwater	Lake or reservoir basin
Other Freshwater Wetland	Misc. types	Palustrine wetland	Farmed wetland, ditches, saline seep and other miscellaneous wetland

[1] Estuarine and marine wetlands omitted

Table 2. Mean and total area of polygons (n) surveyed within 50 1-km^2 plots throughout central and western Illinois during 2015.

NWI Polygon Type	**n**	**Mean Area Surveyed (ha/polygon)**	**Total Surveyed Area (ha)**
Emergent (herbaceous)	20	2.9	57.6
Forested/Scrub-shrub	38	8.5	321.8
Lake	23	10.6	244.6
Pond	7	1.5	10.8
Riverine	11	7.4	81.8
Total	99	31.0	716.8

Table 3. Mean percent (± standard deviation) of polygons (n) during each sampling season inundated by surface water, inundated by surface water to a depth of less than 45 cm which is the maximum foraging depth for dabbling ducks, inundated by surface water to a depth less than 8 cm which is the maximum foraging depth for most shorebirds, emergent vegetation within standing water, submersed- and floating leaf aquatic vegetation, and other characteristics of polygons occurring within 50 1-km^2 plots throughout central and western Illinois during 2015.

Season	NWI Polygon Type	n	Inundated	Inundated <45cm	Inundated <8cm	Emergent Vegetation	SAV/FLAV	Overall Vegetation	Mudflats
Spring	Emergent (herbaceous)	12	38.2 ±39	19.1 ±30		7.7 ±17	0.8 ±3	20.9 ±26	
	Forested/Scrub-shrub	24	19.5 ±32	9.3 ±22		1.8 ±7	0.6 ±2	8.5 ±18	
	Lake	14	98.9 ±3	32.2 ±35		2.1 ±4	15.1 ±30	18.9 ±34	
	Pond	4	60.5 ±40	32.4 ±34		1.9 ±4	0.7 ±1	23.7 ±24	
	Riverine	8	92.5 ±21	23.6 ±32		0	0	1.5 ±3	
	Total	**62**	**56.0**	**20.4**					
Summer	Emergent (herbaceous)	20	60.8 ± 41	35.1 ±37		8.2 ±20	3.9 ±6	37.1 ±37	
	Forested/Scrub-shrub	37	34.1 ±35	20.4 ±23		0	2.6 ±10	28.4 ±36	
	Lake	21	96.4 ±5	19.9 ±18		2.8 ±7	23.8 ±36	40.5 ±42	
	Pond	8	92.5 ±14	45.1 ±30		1.8 ±4	4.8 ±12	20.2 ±19	
	Riverine	17	94.1 ±17	8.9 ±14		0	0.3 ±1	4.21 ±7	
	Total	**103**	**63.4**	**18.2**					
Autumn	Emergent (herbaceous)	22	39.3 ±36	29.1 ±30	11.2 ±13				13.1 ±29
	Forested/Scrub-shrub	40	25.2 ±30	20.3 ±24	6.2 ±13				1.3 ±4
	Lake	21	88.6 ±15	27.7 ±20	6.0 ±7				13.7 ±20
	Pond	10	87.0 ±18	47.8 ±25	9.9 ±12				4.4 ±11
	Riverine	17	89.7 ±18	27.5 ±28	4.7 ±8				16.4 ±30
	Total	**110**	**53.2**	**20.1**					

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