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PROJECT TITLE: Abundance and habitat requirements of wetland-dependent birds in northeastern Illinois.

Principle Investigator
Dr. Charles R. Paine
Max McGraw Wildlife Foundation
P.O. Box 9
Dundee IL 60118
Office: (847) 428-6331
Fax: (847) 741-8157
CRPaine@aol.com

Graduate Student
Mr. Nathaniel J. Stricker
Max McGraw Wildlife Foundation
P.O. Box 9
Dundee IL 60118
Office: (847) 428-6331

Introduction

Prior to settlement, Illinois marshes supported approximately 40 species of breeding birds. Since that time, more than 90% of Illinois' wetlands have been lost and about half of Illinois' marsh-dependent bird species are now on the state's threatened, endangered, or watch lists. The greatest remaining concentrations of emergent wetlands and wetland-dependent birds in Illinois are located within the Chicago region, and many wetland species are restricted to the area. The region also supports 70% of the state's human population, and is experiencing rapid urban development with resultant loss and degradation of wetland habitats. There is an urgent need to identify, preserve, and enhance habitat conditions that support healthy (self-sustaining) populations of wetland birds in northeastern Illinois if we are to maintain a diverse wetland bird community in the region. Unfortunately the information needed to accomplish this task is largely unavailable.

Relatively little is known about the population status and habitat needs of wetland-dependent birds (non-waterfowl) at both continental and regional scales due to the difficulty of working in dense wetland habitats and the secretive nature of many wetland species. Wetland-dependent birds are poorly sampled in the Breeding Bird Survey and other national bird surveys, and population information is either lacking or suggests population declines in many species including rails, bitterns, and grebes. Information on habitat requirements of wetland birds is also limited. The few large-scale studies of habitat requirements of wetland birds at the marsh and landscape levels (e.g., Brown and Dinsmore 1986, Craig and Beal 1992, Gibbs et al. 1991) indicate that marsh size, isolation, and within-wetland habitat diversity all affect wetland bird diversity. Large wetlands, with high within-wetland habitat diversity, and in a landscape with high wetland densities, support the greatest diversity of wetland birds. However, little information is available on how small a wetland is too small to support specific species, how degraded is too degraded, or how isolated is too isolated. Nor do we have any real idea of how land use (i.e., housing developments, roads, agriculture) adjacent to wetlands affects bird populations. In order to preserve wetland bird populations we need a better understanding of how landscape, marsh, and within-marsh habitat conditions interact to yield individual marshes that will attract and support wetland species. We must also understand these factors to identify what combinations of large and small, high and low quality, and isolated vs. clustered wetlands will form landscape mosaics capable of supporting healthy regional populations of wetland birds.

In response to this need, the Max McGraw Wildlife Foundation, in cooperation with the Illinois Department of Natural Resources, U.S. Fish and Wildlife Service, and Chicago Wilderness, initiated a three-year wetland bird project, with fieldwork to begin in the spring of 1998. Mr. Nathaniel J. Stricker, who has been involved in the Max McGraw Wildlife Foundation's wetland bird research since 1996, will be beginning a Ph.D. program at Ohio State this fall, under the direction of Dr. Robert J. Gates (formerly at SIU). N.J.S. will be adapting a portion of the wetland bird project as his dissertation topic.

Activities to date have emphasized random selection of marshes from potentially suitable wetlands identified in the National Wetlands Inventory, and collection of abundance, nesting productivity, and habitat information on study wetlands. Abundance and productivity fieldwork was delayed this spring due to problems in obtaining GIS software (Geographic Information System), which pushed back the process of selecting field sites and obtaining permission work on the sites. As a result, not all of the 90 field sites planned for the study were surveyed this year. Field activities for the year are still underway, but to date, over 400 nests have been located and monitored. Preliminary results of abundance and productivity work will be reported this fall after data collection is completed and results entered into the computer. Below, we report on the study site selection process, which is now complete.

Objectives

1) Estimate size and health of wetland-dependent bird populations across northeastern Illinois.

   Methods:
   a) random selection of study marshes across NE Illinois (N=90).
   b) point count surveys including playbacks of recorded calls of secretive species once every 3 weeks.
   c) nest location and monitoring at a sub-sample of marshes.

2) Evaluate effects of wetland size, vegetative structure within a wetland, wetland isolation, landscape-level wetland density, urbanization, and other surrounding landscape characteristics on abundance and nesting productivity of wetland birds.

   Methods:
   a) marsh selection stratified by wetland size (5 classes) and landscape level wetland density/isolation (3 classes), and urbanization (3 classes).
   b) habitat and land use characteristics measured at multiple spatial scales from nest through landscape.

3) Improve survey methods for wetland dependent birds through tests of the biases associated with playback surveys, and through comparisons of the results of two different survey methods (point count surveys and nest searching).

Methods

Marsh Selection Process

<u>Wetland basin identification</u>

Digital National Wetland Inventory (NWI) maps were obtained from the NWI internet site for the 24 northeastern Illinois 7.5 minute quadrangles selected as the study region and for the 16 Illinois quadrangles surrounding the main study area (Figure 1). NWI maps were converted from Digital Line Graphs (DLG) to ArcView shapefiles. To identify wetland basins, we merged adjacent wetland polygons (sharing a common border) with a NWI system classification of Palustrine or Lacustrine (see Cowardin et. al 1979 for a description of the NWI wetland classification system). Polygons with a system classification of Riverine were excluded. The preceding operation created a GIS layer containing single polygons for each wetland basin rather than multiple polygons representing different wetland habitat types within a basin. We then performed a spatial join between the original NWI polygon data and the basin polygons to attach a basin identification code to each habitat polygon in the original NWI data (Figure 2). The original NWI data plus basin identification code, basin center coordinates, and polygon areas were then exported to a Microsoft Access relational database for further processing.

Definition of suitable wetland bird habitat

We identified the range of NWI classes most likely to provide suitable wetland bird habitat by examining the NWI classifications of northeastern Illinois marshes known to have supported populations of wetland birds (data from Heidorn et al. 1991, Paine 1997). We defined potentially suitable study wetlands as basins that contained at least some area of palustrine emergent vegetation (NWI class EM) with a water regime of seasonal, semi-permanent, or intermittently exposed (NWI water regime modifier C, F, or G, Table 1). Areas identified as being a combination of emergent vegetation and scrub shrub or forested wetland habitats (Class = EM/SS or EM/FO) were not considered suitable habitat. However, areas identified as being a combination of emergent vegetation and open water or aquatic bed habitats (Class = EM/AB or EM/OW), with any of the water regimes specified above, were considered suitable.

Wetland size and available wetland bird habitat

Because wetland basins could contain several different habitat types, not all of which were suitable for wetland birds, the total area of a basin was not a good measure of wetland bird habitat availability. For that reason, we calculated suitable habitat area (SHA) for each basin as the sum of all areas of emergent vegetation (EM, EM/AB, or EM/OW with water regimes specified above), plus a proportion of the area of open water and aquatic bed habitat (OW and AB). Open water and aquatic bed habitat can be important for wetland birds. The greatest diversity of wetland birds typically occur when the water to emergent vegetation ratio is about 1:1, suggesting that the presence of open water increases the area of suitable habitat, up to a point. Exactly what that point is, is uncertain. We used a 3:1 ratio of water to vegetation as a threshold level above which increases in the area of water were not considered to increase the area of suitable habitat. Thus SHA could be no more than 4 times the area of emergent vegetation no matter how large the area of open water and aquatic bed habitat contained within a basin.

Landscape-level wetland density

For each basin identified as containing suitable wetland bird habitat, we calculated a measure of the surrounding landscape-level wetland density (WD) as the sum of SHA for all wetland basins whose center coordinates fell within a 5-km radius circle of the center coordinates of the target basin. NWI data from the 16 Illinois quadrangles surrounding the main study area were used to calculate WD for basins located close to the border of the main study area (Figure 1). NWI data were not available for the Wisconsin quadrangles located just to the north of the main study area and no adjustment was made to compensate for this lack in the calculation of WD for basins less than 5 km from the border.

Wetland size, landscape-level wetland density, and urbanization classification

We assigned each wetland containing at least 0.5 ha of suitable habitat to one of five wetland size classes based on the value of SHA: SHA >0.5 and ≤ 1.0 ha. = very small, >1.0 and ≤ 5.0, ha = small, >5.0 and ≤ 10.0 ha = medium, >10.0 and ≤ 20.0 ha = large, and >20.0 ha = very large. Wetlands were assigned to one of three landscape-level wetland density classes based on the value of WD: WD ≤ 250 ha = low, >250 and ≤500 ha = medium, >500 ha = high. Wetlands were also assigned to one of three landscape-level urbanization classes based the level of urbanization within the 7.5 minute quadrangle containing the wetland (Figure 3).

Wetland selection process and field checks

We selected potential study wetlands for further habitat evaluation in a stratified random manor from within the 45 different habitat classes resulting from all possible combinations of the five size, three density, and three urbanization classes. A 9-digit random number was assigned to each basin identified in the previous steps as containing potentially suitable wetland bird habitat. Basins were then sorted by random number within size, density, and urbanization classes and assigned ranks based on the sort order. The two highest ranked marshes within each of the 45 size-density-urbanization classes were selected as potential study sites.

The NWI classifications we identified as potentially suitable for wetland birds covered a broad range of wetland conditions, not all of which provide good marshbird habitat. It was therefore necessary to field check each selected wetland to determine if it truly provided suitable habitat. If a field check determined that a wetland was suitable, it was accepted as a study marsh. If it was rejected, the next highest ranked marsh within the same habitat class was field checked until two suitable marshes had been accepted for each of the 45 habitat classes for a total of 90 study wetlands.

We used a GPS (Global Positioning System) unit in combination with topographic and NWI maps to locate selected wetlands in the field. Using NWI and topographic maps, we identified a vantage point along a nearby road likely to provide a good view of the selected wetland. If the initial vantage point did not allow a clear enough view of the wetland to assess habitat characteristics, we drove around the road network surrounding the wetland, using the GPS unit as a guide, to find a better view. If the wetland could not be seen from the road, we sometimes checked a wetland on foot if the distance to the wetland were relatively short (100-200 m), and it was possible to get closer on foot without trespassing. Four different individuals made initial wetland checks, but all wetlands deemed potentially suitable were double-checked by both authors before being accepted as study sites.

Criteria for acceptance of wetlands

To be accepted for inclusion in the study, a wetland had to provide at least grossly suitable habitat for marshbirds. Our purpose was not to identify bird communities found in a broad array of wetland types, but rather to test effects of wetland size, landscape-level wetland density, and within-wetland habitat conditions within a restricted range of wetland types favored by marshbirds. The greatest diversity of wetland birds has been found in marshes that have an approximately 50:50 ratio of open water to emergent vegetation, the so-called "hemi-marsh" condition (Weller and Spatcher 1965, Heidorn et al. 1991). Marshes dominated by open water, with little or no emergent vegetation, and closed marshes composed of dense stands of emergent vegetation (particularly cattail, *Typha sp.*) support fewer species of marshbirds. The presence of standing water within a wetland basin is thought to be particularly important (e.g., Manci and Rusch 1988). Dry stands of emergent vegetation appear to support few wetland birds. We developed a set of rules, based on these general principles, to evaluate the suitability of potential study wetlands during field checks (Table 2).

Unfilled habitat categories and substitutions

The study area did not contain enough suitable marshes in every habitat class to provide two suitable marshes in all 45 size x density x urbanization-categories. When this occurred, it was necessary to substitute wetlands in other habitat categories to fill all cells in the study design. We used a hierarchical system outlined in Table 3 to determine what habitat classes to substitute for design-cells containing fewer than two marshes. Whenever possible, we held size and density classes constant and substituted a wetland with a different urbanization class. If no suitable wetland could be found in the size and density classes called for in the sampling design, we held size and urbanization constant and substituted a wetland in a different wetland density class. Finally, as a last resort, we held size constant and substituted wetlands with different urbanization and density classes. In no case did we substitute a wetland in a different size class.

Results

Basin identification and habitat classification

NWI data for the 24-quadrangle study area contained 20,126 polygons of wetland and deepwater habitats (Table 4). Our basin identification process identified 14,855 individual basins. Of those, 2,763 contained 0.5 ha or more of potentially suitable wetland bird habitat (SHA). Basins averaged 5.8 ± 29.2 ha (± SD) of potentially suitable habitat (SHA, range 0.5 to 1307 ha). Small and very small wetlands were most common, making up almost 80% of the 2,763 basin (Table 4). Landscape-level wetland density averaged 433.4 ± 292.1 ha of potentially suitable habitat (SHA) within a 5-km radius of individual basins (range 10 to 2400 ha). Wetlands surrounded by a moderate density of other wetlands were most common, but a substantial number of sites with low and high landscape-level wetland densities were present in the study area (Table 4.). The largest numbers of wetland basins were found in the quadrangles classified as moderately urban, but low and high urbanization quadrangles also contained large numbers of potential study sites (Table 4). Only one of the 45 habitat class combinations (size x density x urbanization) contained no wetlands, but an additional 12 categories contained fewer than 10 wetlands (Table 5).

Wetland selection process

Between 1 March and 1 July 1998, we field checked 1,071 wetland basins to determine whether they met the criteria in Table 3 for inclusion in the study. Of the 1,071 wetlands checked, access was insufficient to evaluate habitat at 162 sites (15.1%), 780 sites (72.8%) did not provided suitable habitat, 42 (3.9%) were considered possibly suitable but were ultimately rejected, and 87 (8.1%) were classified as suitable. Of the 87 marshes considered suitable, 85 were assigned to habitat classes and included in the study (Figure 4, Table 6, Appendix A). The two remaining suitable marshes were in habitat categories that had already been filled, and they were not included as study sites. Five marshes are still needed to complete the full suite of 90 study marshes. They will be selected this fall.

Most of the size x density x urbanization cells in the study design were filled with wetlands of the correct habitat class (n=64/85, 75%), but in some cases it was necessary to substitute a marsh that did not exactly match habitat classes called for in the study design. In most of the 21 cases where a substitution was needed, a marsh with a different urbanization class was substituted (15/85, 18%). In three cases (3%), marshes in a different landscape-level wetland density class were substituted. Marshes in different urbanization and density classes were substituted in an additional three cases (3%).

Discussion

The study site selection process took longer than expected due to the large number of unsuitable wetlands that it was necessary to eliminate through field checks, but overall, the process went well. Two problems did occur, but their impacts on the validity of the process should be minimal. Lack of NWI data from quadrangles just north of the main study area in Wisconsin resulted in the underestimation of landscape-level wetland density for sites < 5 km from the northern border of the 24-quadrangle study area. We estimate that lack of NWI data from Wisconsin probably resulted in the mis-assignment of landscape-level wetland density class in 78 of the 2,763 potential study basins. The other problem with the process was the lack of sufficient numbers of suitable wetlands to fill all cells in the study design with marshes of the correct habitat class. In most cases, we were able to resolve this problem by substituting a site with a different urbanization class, while retaining the correct density and size classes. Adjustments to the urbanization stratification scheme are least likely to impact the validity of the sampling design, as urbanization was not included in the design to test specific effects of urbanization. Rather, it was included to balance effects of urbanization across all levels of wetland size and density. Wetland density in the study area is correlated with urbanization. Density tends to be low in rural areas dominated by agriculture, high in moderately urban areas with a mix of rural and suburban habitats, and low in highly urbanized regions of the study area. If site selection were not stratified by urbanization, effects of size and wetland density would be confounded with urbanization effects. Our substitution protocol should maintain a balanced design with respect to urbanization.

Prospectus

Results from the season's abundance and productivity surveys will be reported this fall as the data are compiled and analyzed. We also plan to conduct field checks to evaluate habitat suitability on the 250 medium, large, and very large wetlands in the study area that were not visited during the marsh selection process.

Literature Cited

Brown, M. W., and J. J. Dinsmore. 1986. Implications of marsh size and isolation for marsh bird management. *J. Wildl. Manage.* 50(3): 392-97.

Cowardin, L.M., F.C. Golet, E.T. LaRoe. 1979. Classification of wetland and deepwater habitats of the United States. U.S. Fish & Wildlife Service. Biological services program; FWS/OBS-79/31.

Craig, R. J., and K. G. Beal. 1992. The influence of habitat variables on marsh bird communities of the Connecticut River estuary. *Wilson Bull.* 104(2): 295-311.

Gibbs, J. P., J. R. Longcore, D. G. McAuley, and J. K. Ringelman. 1991. *Use of wetland habitats by selected nongame waterbirds in Maine*, U.S. Fish Wildl. Serv. Fish Wildl. Res. 9. 57 pp.

Heidorn, R. R., W. D. Glass, D. R. Ludwig, and M. A. R. Cole. 1991. Northeastern Illinois wetland survey for endangered and threatened birds, a summary of field data: 1980-1989. Illinois Dept. of Conservation, Division of Natural Heritage, Natural Heritage General Technical Report #1, 157 pp.

Manci, K. M., and D. H. Rusch. 1988. Indices to distribution and abundance of some inconspicuous waterbirds on Horicon Marsh. *J. Field Ornithol.* 59(1): 67-75.

Paine, C.R. 1997. Abundance and nesting productivity of wetland-dependent birds in northeastern Illinois. Phase I. Methods of monitoring abundance and productivity. Final Project Report, Max McGraw Wildlife Foundation. Submitted to U.S. FWS Webless Migratory Game Bird Research Program (FWS Agreement 14-48-0009-95-1276), 78 pp.

Weller, M. W., and C. S. Spatcher. 1965. Role of habitat in the distribution and abundance of marsh birds. Agric. Home Econ. Exp. Stat. Spec. Rep. No. 43, Iowa State Univ., Ames, IA.

Table 1. Inventory and classification of wetland and deepwater habitats identified by the National Wetland Inventory (NWI) within the 24-quadrangle main study area in northeastern Illinois. Wetland types shaded in dark gray were considered primary marshbird-breeding habitats. Presence of at least some primary marshbird habitat was required for a basin to be considered as a study site. Presence of habitats shaded in light gray within a basin was not sufficient for a wetland to be considered suitable, but when present in basins containing primary habitat type, light gray shaded habitats were included in calculations of wetland size. All habitats classified as Palustrine or Lacustrine were used to identify wetland basins, but Riverine habitat was not.

NWI Wetland classification (Cowardin et al. 1979)				Number of habitat blocks (polygons)
System (abreviation)	Class (abreviation)	Water regime (abreviation)		
Lacustrine (L)	Aquatic bed (AB)	Permanently flooded (H)	-------------------------	18
		Intermittently exposed (G)	-------------------------	5
	Open water (OW)	Permanently flooded (H)	-------------------------	191
		Intermittently exposed (G)	-------------------------	15
	Unconsolidated bottom (UB)	Permanently flooded (H)	-------------------------	16
		Intermittently exposed	-------------------------	2
	Unconsolidated shore (US)	Intermittently flooded (J)	-------------------------	22
		Seasonally flooded (C)	-------------------------	1
Palustrine (P)	Aquatic bed (AB)	Semi-permanently flooded (F)	-------------------------	488
		Intermittently exposed (G)	-------------------------	38
		Permanently flooded (H)	-------------------------	22
		Artificially flooded (K)	-------------------------	2
		Seasonally flooded (C)	-------------------------	1
	[illegible]	[illegible]		[illegible]
		[illegible]		[illegible]
		Temporarily flooded (A)	-------------------------	1492
		Saturated (B)	-------------------------	212
		[illegible]		[illegible]
		Artificially flooded (K)	-------------------------	5
		Intermittently flooded (J)	-------------------------	1
	Forested (FO)	Seasonally flooded (C)	-------------------------	1361
		Temporarily flooded (A)	-------------------------	409
		Saturated (B)	-------------------------	11
		Semi-permanently flooded (F)	-------------------------	10
	Open water (OW)	Permanently flooded (H)	-------------------------	2392
		Intermittently exposed (G)	-------------------------	2129
		Semi-permanently flooded (F)	-------------------------	969
		Artificially flooded (K)	-------------------------	46
	Scrub shrub (SS)	Seasonally flooded (C)	-------------------------	514
		Temporarily flooded (A)	-------------------------	85
		Saturated (B)	-------------------------	20
		Semi-permanently flooded (F)	-------------------------	18
	Unconsolidated bottom (UB)	Intermittently exposed (G)	-------------------------	715
		Semi-permanently flooded (F)	-------------------------	160
		Permanently flooded (H)	-------------------------	22
		Artificially flooded (K)	-------------------------	15
	Unconsolidated shore (US)	Seasonally flooded (C)	-------------------------	12
			-------------------------	0
Riverine (R)	Open water (OW)	Permanently flooded (H)	-------------------------	99
	Unconsolidated bottom (UB)	Permanently flooded (H)	-------------------------	2
		Total		20,126

Table 2. Criteria used to accept or exclude potential study wetland during field checks.

Step	Criteria	Result	Action
1.0	Access to the basin sufficient to evaluate gross habitat characteristics.	NO	EXCLUDE - no access
		YES	Step 2
2.0	Basin contains emergent vegetation.	NO	EXCLUDE - unsuitable
		YES	Step 3
3.0	Emergent vegetation zone has been invaded by substantial numbers of shrubs or trees (1/3 or more of shrub/tree cover).	NO	Step 4
		YES	EXCLUDE - unsuitable
4.0	The basin is likely to maintain standing water through the breeding season within at least a portion (1/3 or more) of the emergent vegetation zone.		
	Negative indicators		
	Grass intermixed with emergents over much of emergent vegetation zone.	YES	EXCLUDE - unsuitable
	Dense cattail stands with no openings of any kind.	YES	EXCLUDE - unsuitable
	Positive indicators		
	Open water present	YES	Step 5
	Interspersion of water and vegetation present	YES	Step 5
5.0	Actual areas of emergent vegetation and water are close to the calculated SHA value (still within the assigned size class).	NO	EXCLUDE – incorrect size
		YES	POSSIBLY SUITABLE
6.0	Second check of POSSIBLY SUITABLE wetlands by CRP & NJS		
	Agree the marsh is suitable	YES	ACCEPT MARSH
		NO	EXCLUDE

Table 3. Criteria used to select substitute habitat classes when no suitable marsh in the size x landscape-level wetland density x urbanization class called for in the study design was available.

Step	Criteria	Result	Action
1.0	A suitable wetland in the habitat class called for in the sampling design is available.	YES	Use correct habitat class.
		NO	2
2.0	Suitable site available in an alternate **Urbanization** class holding **Size** and **Density** classes constant.	YES	3
		NO	4
3.1	Correct **Urbanization** class High or Low.		Substitute **Urbanization** class Medium if available or High/Low if not.
3.2	Correct **Urbanization** class Medium.		Randomly select **Urbanization** class High or Low as a substitute if both are available. Substitute the available **Urbanization** class if both are not available.
4.0	Suitable site available in an alternate **Density** class holding **Size** and **Urbanization** classes constant.	YES	5
		NO	6
5.1	Correct **Density** class High or Low.	YES	Substitute **Density** class Medium if available or High/Low if not.
5.2	Correct **Density** class Medium.	YES	Randomly select **Density** class High or Low as a substitute if both are available. Substitute the available **Density** class if both are not available.
6.0	Suitable site available in an alternate **Density** and **Urbanization** combination holding **Size** class constant.	YES	Choose alternate **Urbanization** and **Density** classes using rules at levels 3 & 5 to determine which classes to substitute.
		NO	Never occurred.

Table 4. Number of northeastern Illinois wetland basins in each wetland size, landscape-level wetland density, and quadrangle urbanization class.

Variable Type	Habitat Class: Very small	Small/Low	Medium	Large/High	Very Large	Total basins
Area of suitable habitat[1]	853	1325	281	171	133	2763
Landscape-level wetland density[2]	-----	653	1289	821	-----	2763
Quadrangle urbanization[3]	-----	889	1248	626	-----	2763

1. Area of suitable habitat was defined as very small (area of suitable wetland bird habitat within a basin >0.5 and ≤ 1.0 ha), small (>1.0 and ≤ 5.0 ha), medium (>5.0 and ≤ 10.0 ha), large (>10.0 and ≤ 20.0 ha), and very large (>20.0 ha).

2. Landscape-level wetland density was classified as low (≤250 ha of suitable wetland bird habitat within a 5-km radius of the target wetland), medium (>250 and ≤500 ha) and High (>500 ha).

3. Urbanization classes (low, medium, high) were assigned based on the degree of urbanization within the 7.5 minute quadrangle containing the wetland. Quadrangle urbanization was based on a subjective estimation of road and population density within the quadrangle.

Table 5. Number of wetland basins within the 24-quadrangle main study area in each of 45 wetland size, landscape-level wetland density, and quadrangle urbanization class combinations.

Habitat class[1]			
Area of suitable habitat within basin	Landscape-level wetland density	Quadrangle urbanization	Number of wetland basins
Very Small	Low	Low	110
Very Small	Low	Medium	12
Very Small	Low	High	105
Very Small	Medium	Low	156
Very Small	Medium	Medium	136
Very Small	Medium	High	93
Very Small	High	Low	20
Very Small	High	Medium	214
Very Small	High	High	7
Small	Low	Low	143
Small	Low	Medium	27
Small	Low	High	154
Small	Medium	Low	258
Small	Medium	Medium	238
Small	Medium	High	157
Small	High	Low	32
Small	High	Medium	309
Small	High	High	7
Medium	Low	Low	24
Medium	Low	Medium	5
Medium	Low	High	23
Medium	Medium	Low	63
Medium	Medium	Medium	39
Medium	Medium	High	25
Medium	High	Low	8
Medium	High	Medium	90
Medium	High	High	4
Large	Low	Low	12
Large	Low	Medium	5
Large	Low	High	15
Large	Medium	Low	23
Large	Medium	Medium	28
Large	Medium	High	17
Large	High	Low	5
Large	High	Medium	64
Large	High	High	2
Very Large	High	Low	3
Very Large	High	Medium	56
Very Large	High	High	---
Very Large	Low	Low	7
Very Large	Low	Medium	1
Very Large	Low	High	10
Very Large	Medium	Low	25
Very Large	Medium	Medium	24
Very Large	Medium	High	7

1. Size class was defined as very small (the area of suitable wetland bird habitat within a basin >0.5 and ≤ 1.0 ha), small (>1.0 and ≤ 5.0 ha), medium (>5.0 and ≤ 10.0 ha), large (>10.0 and ≤ 20.0 ha), and very large (>20.0 ha). Landscape-level wetland density was classified as low (≤250 ha of suitable wetland bird habitat within a 5-km radius of the target wetland), medium (>250 and ≤500 ha), and High (>500 ha).

Table 6. Location, name, size, and habitat characteristics of northeastern Illinois wetland bird project study marshes.

County	Marsh ID	Qaudrangle (7.5 minute)	Marsh name	Marsh coordinates[1] (UTMs) X	Y	Area of[2] suitable habitat (ha)	Correct habitat class[3] Size	Density	Urbanization	Substitute habitat class[3] Size	Density	Urbanization
Cook	BA0256	Barrington	Spring Lake	399866	4666698	108.0	V Large	Medium	Medium	------------	Low	Low
Cook	BA0709	Barrington	Goose Lake	402169	4665289	28.3	V Large	Medium	Medium	------------	------------	------------
Cook	LK0253	Lake Zurich	Baker's Lake	407484	4665789	47.6	V Large	High	Medium	------------	------------	High
Cook	LK0318	Lake Zurich		414153	4665893	1.6	Small	Low	Medium	------------	------------	------------
Cook	LK0320	Lake Zurich		414325	4665753	2.9	Small	Low	Medium	------------	------------	------------
Cook	LK1600	Lake Zurich	Wilke Marsh	416716	4664005	6.5	Medium	Low	Medium	------------	------------	------------
Cook	PA1055	Palatine	On Ned Brown forest preserve	415250	4651016	6.5	Medium	Medium	High	------------	------------	------------
Cook	PA1083	Palatine		414408	4651693	18.3	Large	Medium	High	------------	------------	Low
Cook	PA1295	Palatine		410080	4659083	10.1	Large	Medium	High	------------	------------	Low
Cook	PA1428	Palatine		412984	4663500	10.8	Large	Low	High	------------	------------	------------
Cook	RI1483	Richmond	Glacial Park Marsh	391010	4697119	7.1	Medium	Medium	Low	------------	------------	------------
Cook	ST0022	Streamwood	Crab Tree Nature Center Marsh	404143	4663158	6.1	Medium	High	High	------------	------------	------------
Cook	ST0153	Streamwood	Wichman Rd Marsh	400613	4661093	1.1	Small	Medium	High	------------	------------	------------
Cook	ST0175	Streamwood	Palatine Marsh	406586	4662694	21.5	V Large	Medium	High	------------	Low	------------
Cook	ST1553	Streamwood	Hoosier Grove Park Marsh	400818	4652036	10.2	Large	Low	High	------------	------------	------------
Cook	ST1637	Streamwood		404931	4654773	0.8	V Small	Low	High	------------	------------	------------
Cook	ST1785	Streamwood		398388	4657939	0.7	V Small	Low	High	------------	------------	------------
Cook	ST1790	Streamwood		400297	4658112	1.1	Small	Low	High	------------	------------	------------
Cook	ST1817	Streamwood	On Poplar Creek FP	399709	4659853	5.8	Medium	Low	High	------------	------------	------------
Cook	ST1912	Streamwood	Willow Creek Church Marsh	405897	4660541	10.9	Large	Medium	High	------------	------------	------------
Kane	CR0759	Crystal Lake	Huntley Rd Marsh	388879	4664658	12.5	Large	Medium	High	------------	------------	------------
Kane	EL1154	Elgin		395463	4653750	2.6	Small	Low	High	------------	------------	------------
Kane	EL1451	Elgin		386829	4661366	17.1	Large	Medium	High	------------	Low	Low
Kane	HA0173	Hampshire		374521	4660969	0.9	V Small	Low	Low	------------	------------	------------
Kane	HA0178	Hampshire		373281	4659828	0.6	V Small	Low	Low	------------	------------	Medium
Kane	HU0861	Huntley		384829	4664836	22.9	V Large	High	Low	------------	------------	------------
Kane	PI0893	Pingree Grove	Muirhead Rd Marsh	382814	4654201	5.6	Medium	Low	Low	------------	------------	------------
Kane	PI0944	Pingree Grove		385674	4655283	2.6	Small	Medium	Low	------------	------------	------------
Kane	PI1019	Pingree Grove	Kane County trying to buy	382048	4658076	30.8	V Large	Medium	Low	------------	------------	------------
Lake	BA0652	Barrington	Wagner Fen	403986	4675184	47.2	V Large	High	Medium	------------	Low	------------
Lake	FO1107	Fox lake		402793	4697518	15.6	Large	High	Medium	------------	------------	------------
Lake	FO1180	Fox lake		407024	4699331	0.9	V Small	High	Medium	------------	------------	Low
Lake	FO1181	Fox lake		407362	4699761	1.1	Small	High	Medium	------------	------------	Low
Lake	GR1419	Grayslake	Cedar Lake Rd Marsh	409176	4688124	19.8	Large	High	Medium	------------	------------	------------
Lake	GR1432	Grayslake		410089	4690236	1.5	Small	High	Medium	------------	------------	------------
Lake	GR1456	Grayslake	Avon Cemetery Marsh	413874	4691508	8.6	Medium	High	Medium	------------	------------	------------
Lake	GR1555	Grayslake		415978	4689668	7.3	Medium	High	Medium	------------	------------	Low
Lake	GR1571	Grayslake		411823	4689310	18.3	Large	High	Medium	------------	------------	High
Lake	GR1704	Grayslake		407720	4686088	0.6	V Small	High	Medium	------------	------------	------------
Lake	GR1773	Grayslake		408086	4682598	0.9	V Small	High	Medium	------------	------------	------------
Lake	GR1849	Grayslake		416911	4682508	23.7	V Large	Low	Medium	------------	------------	------------
Lake	GR1989	Grayslake	Broberg Marsh	408105	4680008	38.8	V Large	High	Medium	------------	------------	Low
Lake	GR1996	Grayslake		409484	4679762	1.9	Small	High	Medium	------------	------------	High

1. Center coordinates of wetland basin in UTM's, grid 16 T (Universal Transverse Mercator system).

2. Suitable habitat area was calculated as the sum of all NWI polygons within a basin with a classification of PEM with a water regime of C, G, or F, plus a proportion of the area of the open water and aquatic bed habitats (the area of open water and aquatic bed habitat included in the calculation was limited to a value no more three times the size of the emergent vegetation area).

3. We classified habitat by categorizing wetlands by size (5 classes), density of suitable wetland habitats in the area surrounding a basin (3 classes), and urbanization of the quadrangle containing a wetland (3 classes). The study area did not contain enough suitable wetlands in each of the 45 habitat classes resulting from the combination of size x density x urbanization classes to fill all cells in the design. It was necessary to substitute wetlands in different habitat classes to fill all cells. Correct habitat class columns list the desired values specified in the design. Substitute habitat class columns list any deviation from the correct values specified in design (blanks indicate use of the correct class).

Table 6 (cont.). Location, name, size, and habitat characteristics of northeastern Illinois wetland bird project study marshes.

County	Marsh ID	Quadrangle (7.5 minute)	Marsh name	Marsh coordinates[1] (UTMs) X	Y	Area of[2] suitable habitat (ha)	Correct habitat class[3] Size	Density	Urbanization	Substitute habitat class[3] Size	Density	Urbanization
Lake	LI0914	Libertyville		424592	4679138	0.6	V Small	Low	High	-------------	-------------	High
Lake	LI1158	Libertyville		419313	4686219	0.9	V Small	Medium	High	-------------	-------------	-------------
Lake	LI1166	Libertyville	Almond Marsh	418941	4686677	37.4	V Large	Medium	High	-------------	-------------	-------------
Lake	LI1168	Libertyville		418267	4687490	1.0	V Small	Medium	High	-------------	-------------	-------------
Lake	LI1173	Libertyville	at Almond Marsh FP	418932	4687333	1.1	Small	Medium	High	-------------	-------------	-------------
Lake	LI1296	Libertyville		419339	4691355	5.1	Medium	High	High	-------------	-------------	-------------
Lake	LI1298	Libertyville		419578	4691491	0.6	V Small	High	High	-------------	-------------	-------------
Lake	LK0444	Lake Zurich	Cuba Marsh	408842	4669004	12.6	Large	Medium	Medium	-------------	-------------	-------------
Lake	LK0446	Lake Zurich	Labyrinth/Railroad	408015	4669032	69.8	V Large	High	Medium	-------------	-------------	High
Lake	LK0482	Lake Zurich	Deer Park Marsh	409187	4669326	6.4	Medium	Medium	Medium	-------------	-------------	-------------
Lake	LK0525	Lake Zurich		414290	4668301	0.9	V Small	Medium	Medium	-------------	-------------	-------------
Lake	LK0551	Lake Zurich		416073	4667862	6.9	Medium	Low	Medium	-------------	-------------	-------------
Lake	LK0646	Lake Zurich		410609	4672527	1.0	Small	High	Medium	-------------	-------------	High
Lake	LK0739	Lake Zurich		414430	4671444	21.4	V Large	Medium	Medium	-------------	-------------	-------------
Lake	LK0816	Lake Zurich		411156	4674035	8.0	Medium	Medium	Medium	-------------	-------------	-------------
Lake	LK0910	Lake Zurich	Fairfield Rd Marsh, South	410692	4676984	0.9	V Small	High	Medium	-------------	-------------	Low
Lake	WC0335	Wauconda		404490	4684587	9.9	Medium	High	Medium	-------------	-------------	-------------
Lake	WC0488	Wauconda	Volo Bog	402379	4689156	37.1	V Large	Medium	Medium	-------------	Low	High
Lake	WC0521	Wauconda	YMCA Camp Duncan	405443	4687240	5.0	Small	High	Medium	-------------	-------------	-------------
Lake	WC0684	Wauconda		407269	4690201	23.0	V Large	High	Medium	-------------	-------------	-------------
Lake	WD0128	Wadsworth		419445	4692147	14.1	Large	High	Low	-------------	-------------	-------------
Lake	WD1498	Wadsworth		427838	4692711	3.5	Small	Low	Low	-------------	-------------	-------------
Lake	WH1993	Wheeling		423005	4669733	8.3	Medium	Low	High	-------------	-------------	-------------
McHenry	BA0503	Barrington		400661	4671722	0.7	V Small	Medium	Medium	-------------	-------------	-------------
McHenry	BA0692	Barrington		397675	4676804	22.2	V Large	High	Medium	-------------	-------------	-------------
McHenry	BA1112	Barrington	Lion Park Marsh	396715	4675265	19.3	Large	Low	Medium	-------------	-------------	-------------
McHenry	CR0782	Crystal Lake		387497	4668554	7.2	Medium	Medium	High	-------------	-------------	-------------
McHenry	CR0904	Crystal Lake	Exner Marsh	387029	4670935	26.0	V Large	Medium	High	-------------	-------------	-------------
McHenry	FO1113	Fox lake		401215	4701208	0.7	V Small	High	Medium	-------------	-------------	High
McHenry	HU0450	Huntley		382134	4668689	2.3	Small	Medium	Low	-------------	-------------	-------------
McHenry	HU0780	Huntley		383514	4677427	7.4	Medium	High	Low	-------------	-------------	-------------
McHenry	HV1418	Harvard		367739	4694529	0.7	V Small	Low	Low	-------------	-------------	-------------
McHenry	MN0276	Marengo North		375915	4687233	0.6	V Small	Medium	Low	-------------	-------------	-------------
McHenry	MN0304	Marengo North		374734	4689400	9.3	Medium	Medium	Low	-------------	-------------	-------------
McHenry	MN0319	Marengo North	Owned by Boy Scouts NW, Il Nat. Inventory site	373332	4689818	5.5	Medium	Low	Low	-------------	-------------	-------------
McHenry	PI1187	Pingree Grove		385778	4662883	47.0	V Large	High	Low	-------------	-------------	-------------
McHenry	RI1018	Richmond		396773	4691923	28.9	V Large	Low	Low	-------------	-------------	-------------
McHenry	RI1237	Richmond	Elizabeth Lake	394619	4704938	149.2	V Large	Medium	Low	-------------	-------------	-------------
McHenry	WC0265	Wauconda		400929	4682826	10.8	Large	High	Medium	-------------	-------------	Low
McHenry	WC0305	Wauconda	Black Tern	397709	4684272	26.5	V Large	High	Medium	-------------	-------------	-------------
McHenry	WO0981	Woodstock	Country Club Rd Marsh (Dufield Pond)	382757	4685018	18.1	Large	Medium	Medium	-------------	Low	-------------
McHenry	WO1018	Woodstock		376415	4689322	19.7	Large	Medium	Medium	-------------	-------------	-------------

1. Center coordinates of wetland basin in UTM's grid 16 T (Universal Transverse Mercator system).
2. Suitable habitat was calculated as the sum of all NWI polygons within a basin with a classification of PEM with a water regime of C, G, or F, plus a proportion of the area of the open water and aquatic bed habitats (the area of open water and aquatic bed habitat included in the calculation was limited to a value no more three times the size of the emergent vegetation area).
3. We classified habitat by categorizing wetlands by size (5 classes), density of suitable wetland habitats in the area surrounding a basin (3 classes), and urbanization of the quadrangle containing a wetland (3 classes). The study area did not contain enough suitable wetlands in each of the 45 habitat classes resulting from the combination of size x density x urbanization classes to fill all cells in the design. It was necessary to substitute wetlands in different habitat classes to fill all cells. Correct habitat class columns list the desired values specified in the design. Substitute habitat class columns list any deviation from the correct values specified in design (blanks indicate use of the correct class).

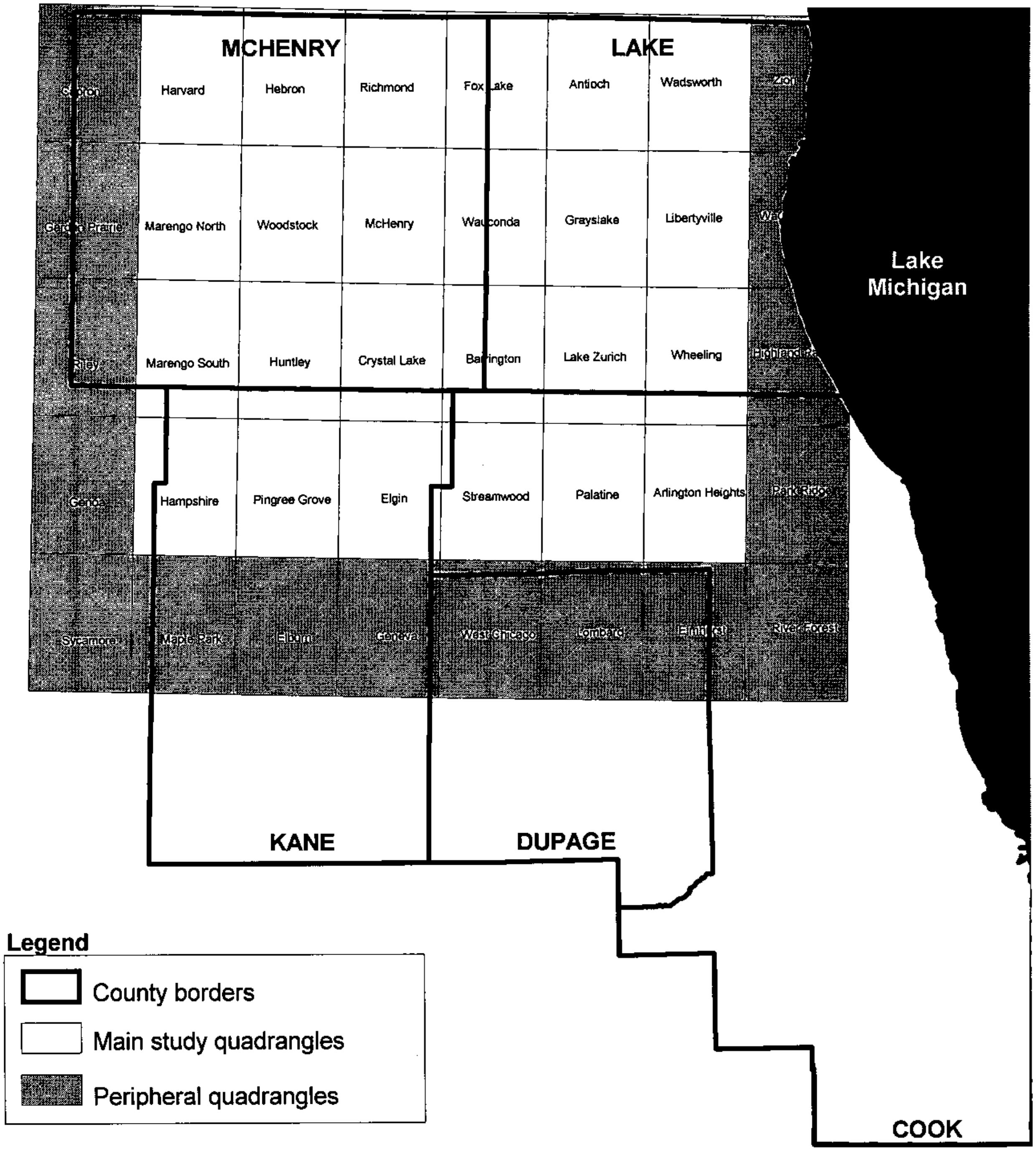


Figure 1. Northeastern Illinois Wetland Bird Project main study quadrangles (7.5') from which study marshes were selected, and surrounding quadrangles used in landscape-level habitat assessments of the area surrounding potential study marshes.

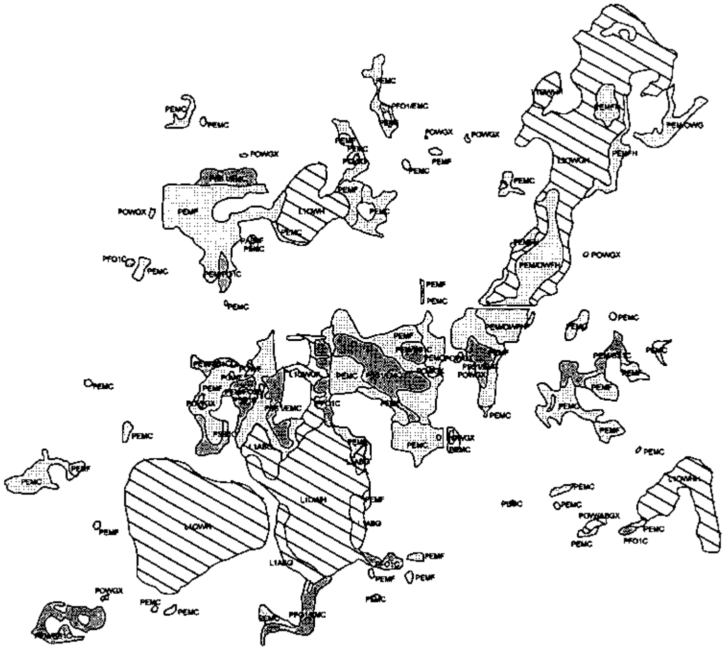


Figure 2a. Orignal digital National Wetlands Inventory (NWI) data with areas (polygons) defined by differences in wetland classification (i.e., emergent vegetation versus open water). Further proccessing of NWI data was needed to identify adjacent wetland habitats that formed basins.

The common borders of adjacent wetland polygons were dissolved to form polygons representing wetland basins.

Figure 2b. Processed NWI data with polygons representing wetland basins.

Basin polygons were linked to the original NWI habitat data using a spatial join.

Figure 2c. Basins were classified by within-wetland habitat characterestics taken from the original NWI data. Basin containing no suitable wetland bird habitat (at least some emergent vegetation) were eliminated from further consideration.

Legend

- Emergent Vegetation (EM)
- Forested (FO) or Shrub Shrub (SS)
- Open Water (OW) or Aquatic Bed (AB)
- Basin Bounderies

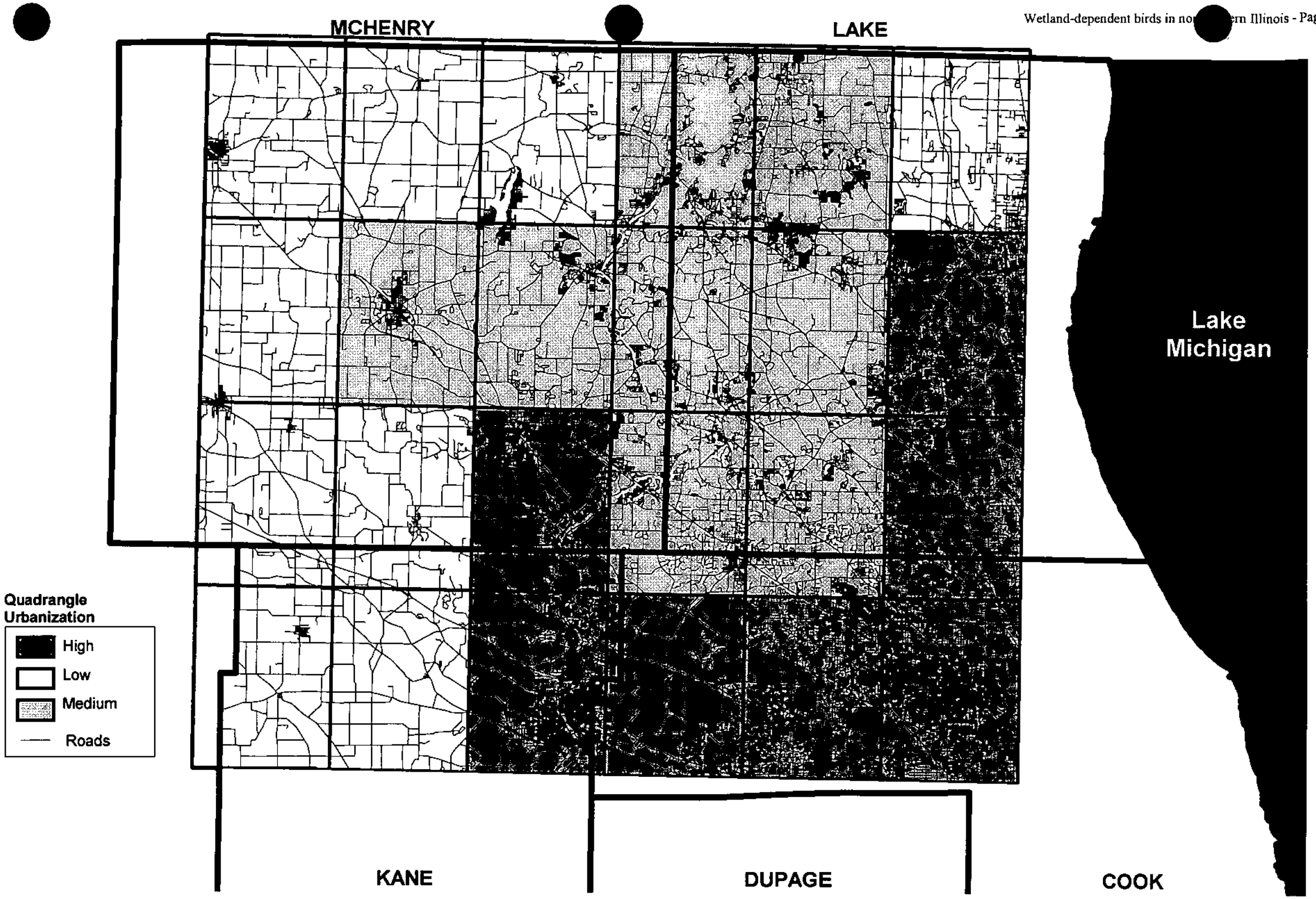


Figure 3. Urbanization classes assigned to northeastern Illinois wetland bird study 7.5 minute quadrangles.

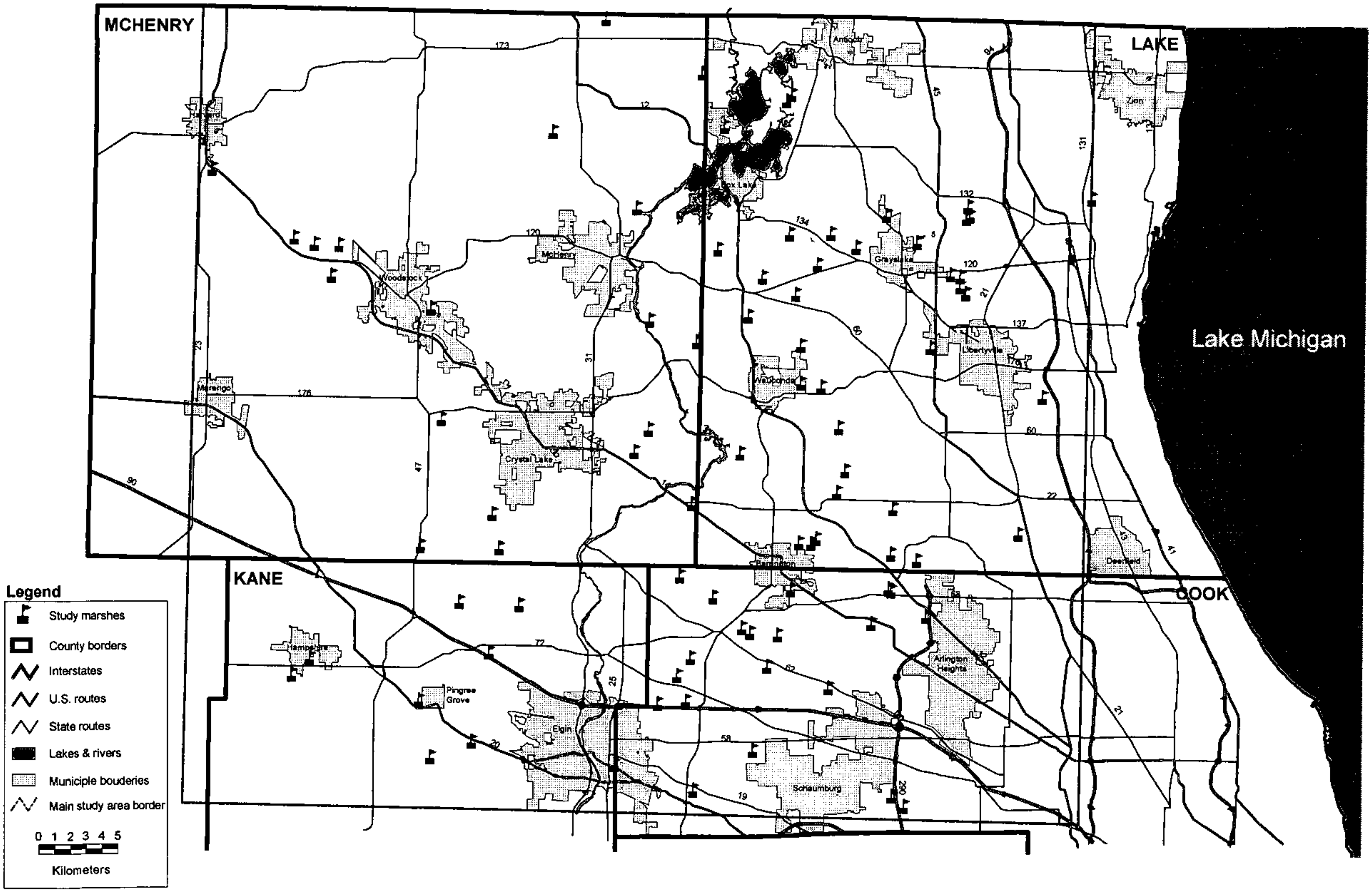
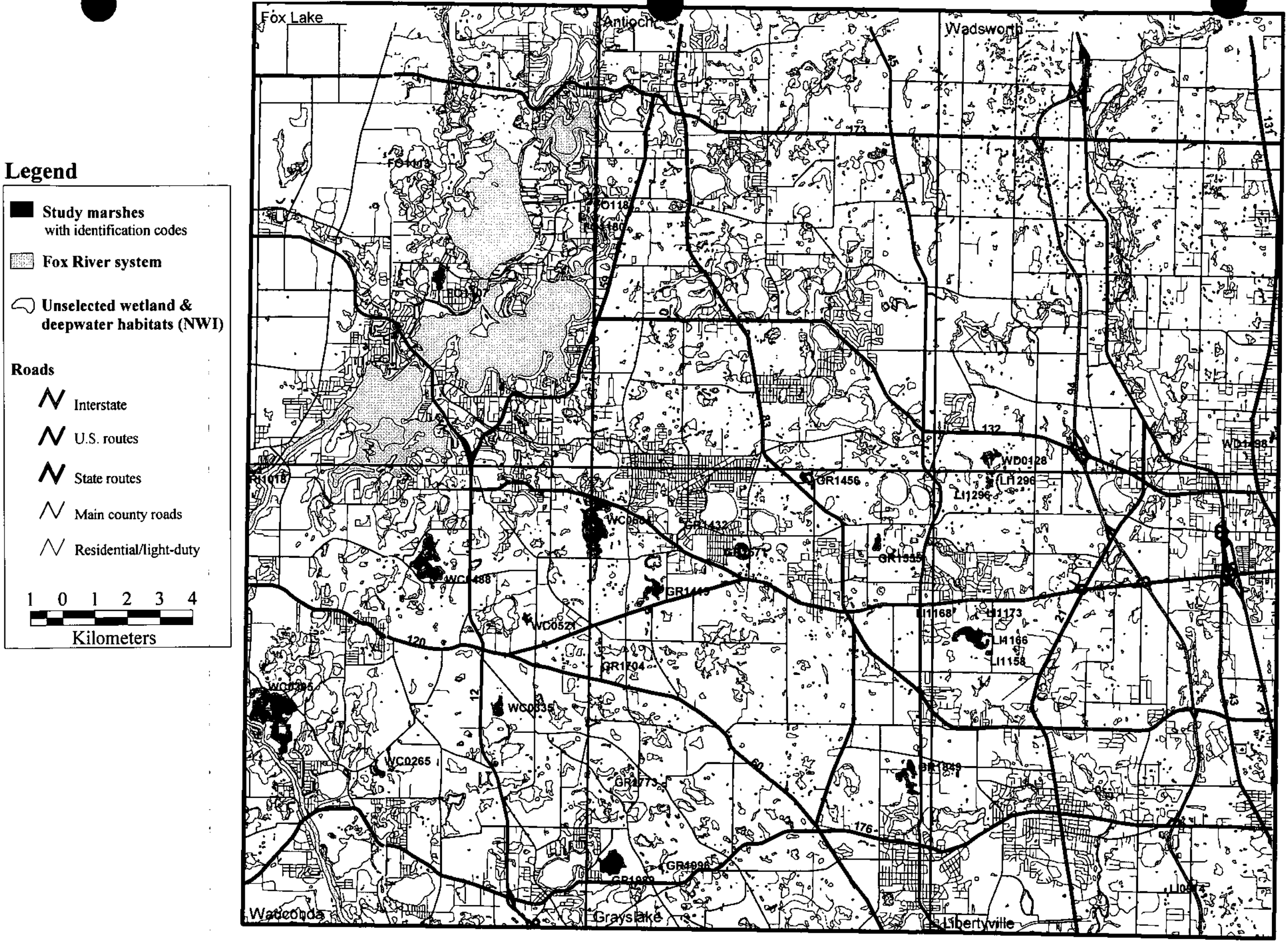
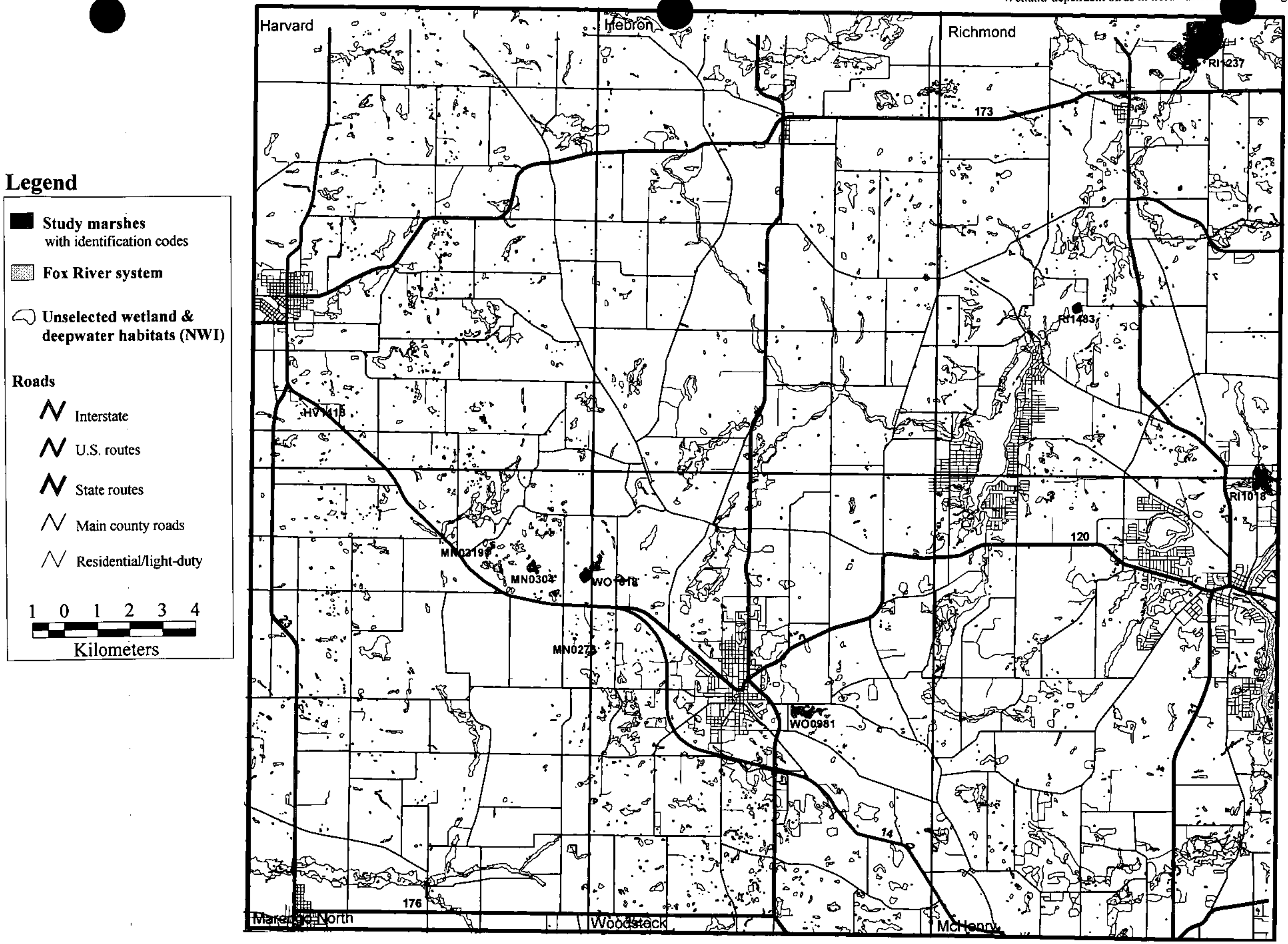


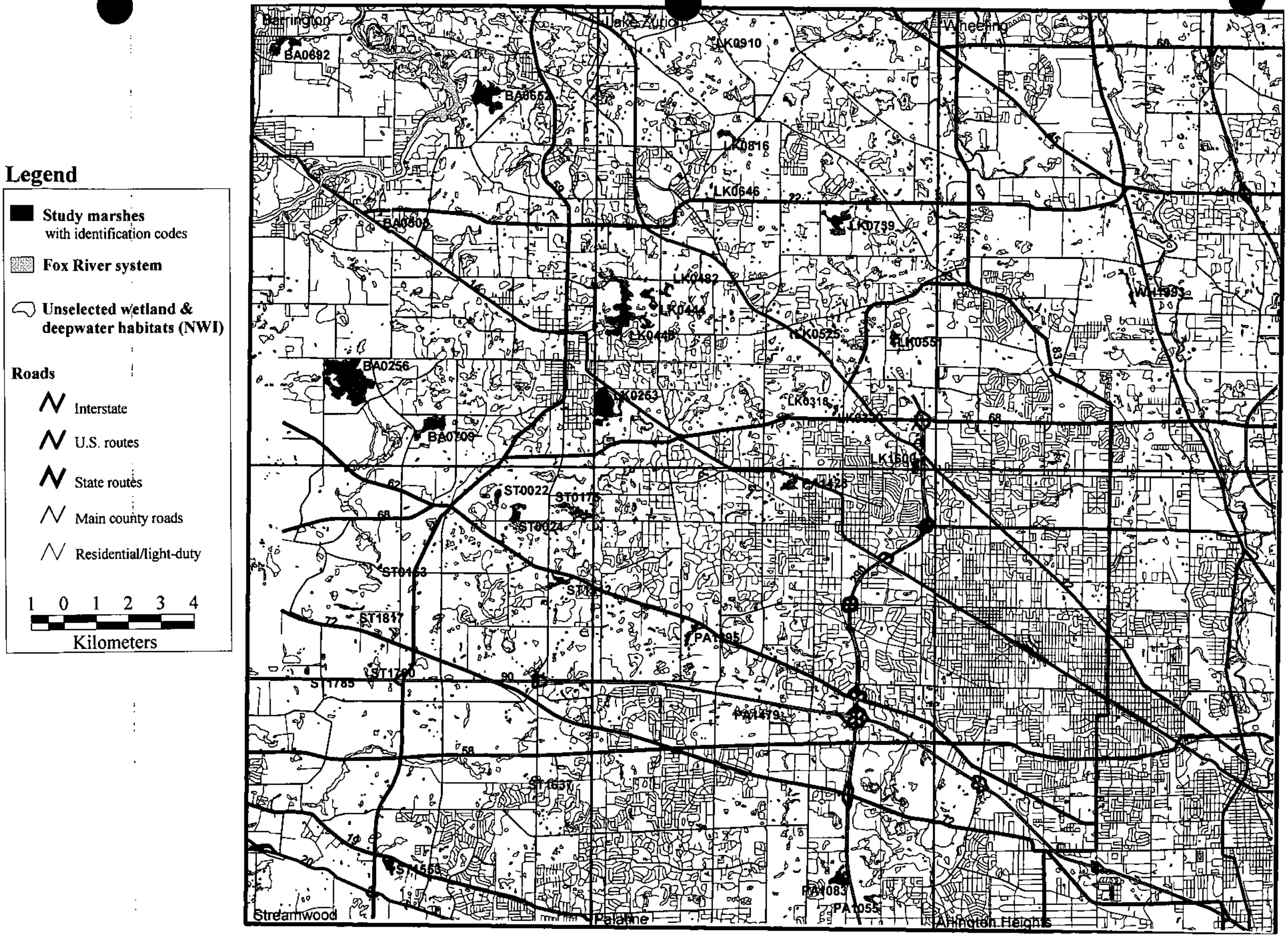
Figure 4. Location of northeastern Illinois wetland bird project study marshes.



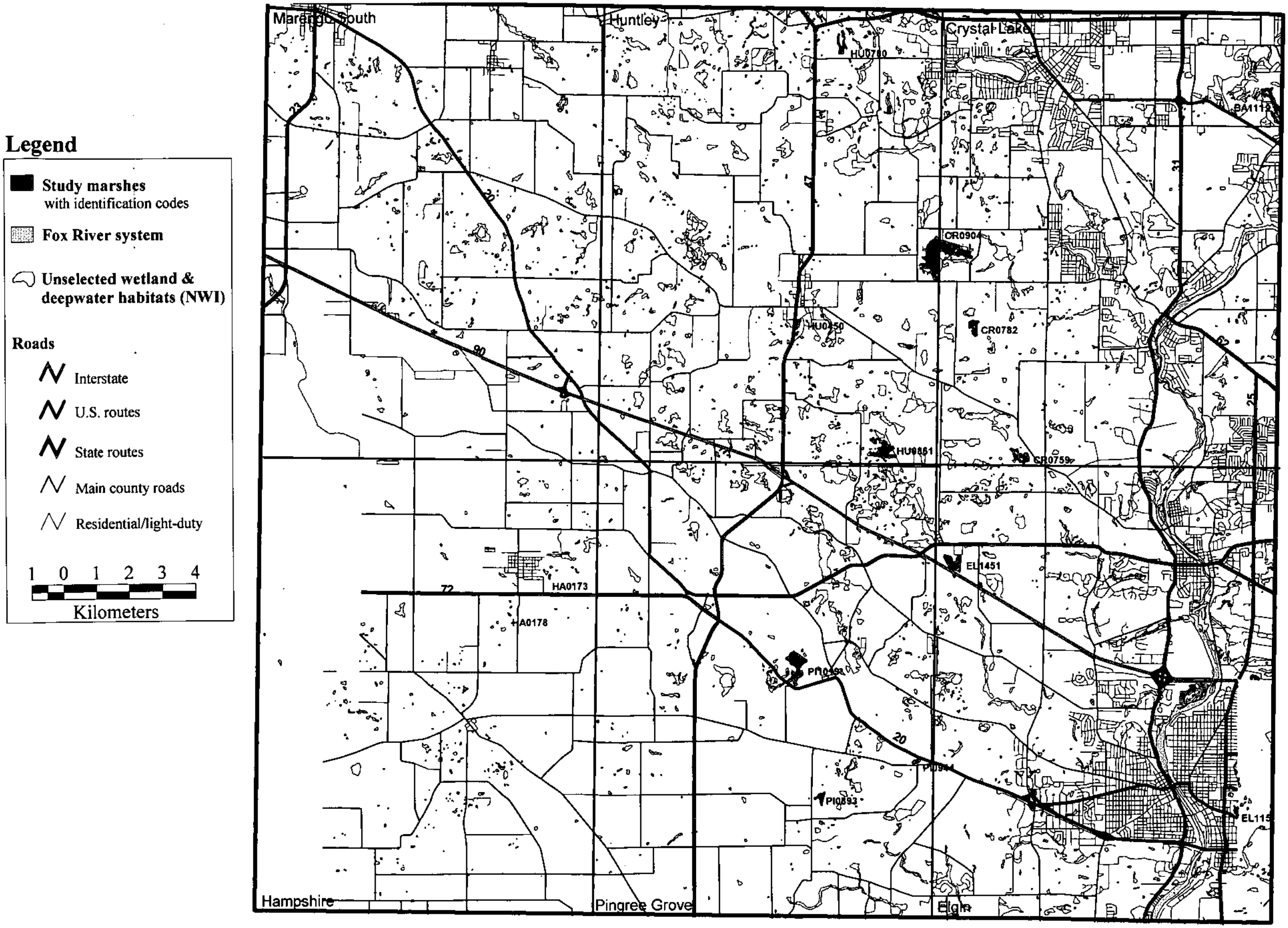
Appendix 1b. Northeastern Illinois wetland and deepwater habitats identified in the National Wetland Inventory (NWI) with northeastern Illinois wetland bird project study marshes identified by shading and labeled with identification codes (northeast quadrangles: Fox Lake, Antioch, Wadworth, Libertyville, Grayslake, and Wauconda).



Appendix 1a. Northeastern Illinois wetland and deepwater habitats identified in the National Wetland Inventory (NWI) with northeastern Illinois wetland bird project study marshes identified by shading and labeled with identification codes (northwest quadrangles: Harvard, Hebron, Richmond, McHenry, Woodstock, and Marengo North).



Appendix 1c. Northeastern Illinois wetland and deepwater habitats identified in the National Wetland Inventory (NWI) with northeastern Illinois wetland bird project study marshes identified by shading and labeled with identification codes (southeast quadrangles: Barrington, Lake Zurich, Wheeling, Arlington Heights, Palatine, and Streamwood).



Appendix 1d. Northeastern Illinois wetland and deepwater habitats identified in the National Wetland Inventory (NWI) with northeastern Illinois wetland bird project study marshes identified by shading and labeled with identification codes (southwest quadrangles: Hampshire, Pingree Grove, Elgin, Cyrstal Lake, Huntley, and Marengo South).