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Illinois Waterfowl Surveys and Investigations W-43-R-62

Annual Progress Report

Period: 1 July 2014 – 30 June 2015

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ANNUAL REPORT – FY2015
Illinois Waterfowl Surveys and Investigations
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EXECUTIVE SUMMARY

Objectives

1) Inventory abundance and distribution of waterfowl and other waterbirds (a minimum of 10 species and guilds) during autumn migration at a minimum of 40 sites along the Illinois and central Mississippi rivers
2) Investigate the ecology of canvasback and lesser scaup during spring migration in the central Illinois River valley (IRV) and Pool 19 of the Mississippi River
3) Estimate waterfowl and other waterbird population sizes (a minimum of 10 species and guilds) during autumn migration using an aerial quadrat survey in the IRV for comparison with aerial inventories (Objective 1)
4) Determine breeding bird use of a minimum of 10 moist-soil wetlands managed for waterfowl during summer in central Illinois
5) Investigate the breeding ecology of sandhill cranes during spring and summer in northeastern Illinois
6) Distribute our findings to site managers and biologists, make recommendations for future management, and draw conclusions relevant to regional conservation planning during the project period as appropriate and requested.

Methods

We scheduled 17 flights of the Illinois and Mississippi rivers from early September 2014 to early January 2015 during which we inventoried 18–23 areas in each river valley. One observer conducted all inventories from a single-engine, fixed-wing aircraft flying at an altitude of <450 ft and 150–160 mph (Havera 1999). We computed waterfowl use-day (Stafford et al. 2007) and peak abundance estimates for the Illinois River valley (IRV) and central Mississippi River valley (CMRV) and made comparisons between the current waterfowl abundance and the most recent 5-year average. Concurrently from mid-October through early January, we surveyed 60 1-mi^2 quadrats within the La Grange and Peoria pools of the IRV to generate total population size for comparison with aerial inventories. We generated detection probabilities by comparing ground counts of fixed survey areas with aerial observer counts and tested a downward facing fuselage-mounted camera for future use in counting waterbirds.

We investigated behavior, food abundance, foraging site selection, and distribution of lesser scaup (*Aythya affinis*) and canvasbacks (*A. valisineria*) in the IRV and Pool 19 of the Mississippi River during spring 2015 to provide data critical to effectively allocating conservation efforts and to help guide habitat restoration and conservation planning at state and regional levels. We aerially estimated diving duck and merganser abundance by species along the IRV and Pool 19 five times using inventory-style aerial surveys (Havera 1999). Additionally, we completed 5 aerial line transect surveys of Pool 19, and La Grange and Peoria

pools of the IRV during spring. We used Program DISTANCE to generate detection probabilities and populations sizes by species and survey date for comparison to concurrent inventory estimates (Buckland et.al. 2001). We visited concentrations of lesser scaup and canvasbacks, identified by aerial surveys and located incidentally, and quantified behavior using scan surveys and food abundances using standard core and sweep sample collection and processing methods at feeding and random locations (Anteau and Afton 2008, Hagy and Kaminski 2012). We experimentally collected lesser scaup and canvasbacks and analyzed blood metabolites to infer foraging habitat quality. Additionally, we captured and banded diving ducks and estimated apparent stopover duration.

We flew 9 complete (50 1-mi2 grids) and 4 partial (<50 1-mi2 grid) quadrat surveys of the Illinois River valley from Hennepin, IL to Meredosia, IL. We flew quadrat surveys during weeks when traditional aerial waterfowl inventories were conducted (Objective 1). We collected photos from an aircraft-fuselage mounted camera during quadrat surveys to estimate detection probability and estimate waterbird abundance. Additionally, we used ground observers to verify waterbird abundance, determine species composition, and monitor waterbird behavior and disturbance during grid flights.

We estimated breeding bird use of dewatered moist-soil wetlands during summers 2014–2015, including estimating bird density, nest density, and nest survival. We conducted point counts and searched known-size areas for nests every two–three weeks. Nests were revisited weekly until destroyed, abandoned, or hatched. Density and detection probability were estimated using Program Distance and distance methods.

We investigated the reproductive success of sandhill cranes (*Grus canadensis tabida*) by estimating the survival of nests and fledglings in northeastern Illinois. Nests were located via aerial surveys and monitored until the eggs hatched. Young were radio-tagged and subsequently monitored to determine the fate of these individuals. We radio-tagged both juveniles and adults and monitored them during the breeding season every 2–3 days using vehicle-mounted radio receivers. After the breeding season, automated telemetry receiving units (a.k.a. automated receiving units or "ARUs"; JDJC Corporation) positioned in the EP migration route at Chain O'Lakes State Park in Illinois and at a primary migratory stopover site at Jasper-Pulaski State Fish and Wildlife Area in Indiana were used to record the movements of radio-marked juvenile and adult cranes. Data were used to construct known fate models in Program MARK (v.7.0) to estimate nest productivity and fledging success. In addition, simple multi-state models were also constructed in Program MARK (v.7.0) to evaluate age- and status-dependent survival.

Major Accomplishments and Findings

All four scheduled flights were completed in September to document the distribution of early-migrating blue-winged and American green-winged teal (scientific names presented in Table 1). We completed 16 of 17 scheduled flights of the Illinois and Mississippi rivers. Peak abundance of total ducks was lesser in both the IRV and CMRV in 2014 than 2013. In the IRV, peak abundance of total ducks for 2014 occurred on November 5, 2014 (562,800) and ranked 34th out of 66 years of monitoring. Peak abundance of total ducks in the CMRV occurred on November 25th (522,130) and ranked 35th out of 66 years. Total duck use-day estimates were

reduced by the early freeze in mid-November along both rivers and ranked 51st on the Illinois and 29th on the Mississippi River since surveys began in 1948.

We posted aerial survey data weekly on the Forbes Biological Station web page (www.bellrose.org) for public outreach to the waterfowl hunting and bird watching communities. Additionally, we reported general observations of waterfowl and habitat conditions following each flight in a blog that was posted weekly on the Forbes Biological Station web page (www.bellrose.org) and on social media (http://www.facebook.com/forbesbiologicalstation) and reached over 100,000 Facebook users in 2014. Aerial survey data was also used by the Mallard Migration Observation Network to generate the Mallard Migration Status map posted online by the Missouri Department of Conservation (http://huntfish.mdc.mo.gov/hunting-trapping/species/waterfowl/waterfowl-reports-prospects/mallard-migration).

Detection probability of waterfowl was 100.1% (SE = 22%) during traditional and quadrat surveys (range = 115.1% – 50.7% across guilds). Use of aerial photos to generate detection probability proved inconsistent across species and guilds. On average, 13.1% (SE = 4%) of waterfowl were disturbed by aerial surveys and 5.6% (SE = 3%) of waterfowl abandoned the survey site completely. We identified highly variable error rates in site-based estimates from quadrat surveys. Errors ranged from -2,376.4% (Senachwine) to 63.7% (Jack Lake) for total waterbirds. When we combined all locations in the IRV, error between the two survey types for population size within the entire study area ranged from -498.6% for ruddy ducks (*Oxyura jamaicensis*) to 92.4% for lesser scaup. In most cases, aerial quadrat surveys produced higher abundance estimates than traditional inventory surveys. We found quadrat surveys were more parsimonious during early time periods, with total ducks and waterbirds displaying errors of -8.6% and 5.6%, respectively. However, between-survey error increased during later time periods for both ducks (-152.5%) and total waterbirds (-155.8%) due to increasingly non-random distributions as ice cover increased.

We counted 1,315,905 diving ducks and mergansers during spring 2015 on the Illinois River and Pool 19 of the Mississippi River during traditional-style aerial surveys. In spring 2015 along the Illinois River, peak numbers (151,450) of diving ducks and mergansers were observed on March 18th, which was similar chronologically to 2013 (March 22nd) and 2014 (March 17th); however, peak estimates were >50% reduced from springs 2014 (312,100 ducks) and 2013 (340,885 ducks). Peak numbers (2015; 352,690 diving ducks and mergansers) on Pool 19 were similar in size to spring 2013 (344,285) but were 50% greater than the peak in spring 2014 (235,225). Unlike the Illinois River, peak diving duck abundance on Pool 19 has varied by nearly 3 weeks from 2013 (March 8th), 2014 (March 17th), and 2015 (March 27th). Overall, 2015 estimates of total diving duck density on Pool 19 were 5% greater in transect surveys than inventories and densities ranged from 4.2 ducks/ha on 20 March to 16.2 ducks/ha on 27 March as lesser scaup numbers were peaking on both the transect surveys and inventories (CV range = 27–30% for total ducks). Detection probability exceeded 50% in all surveys with coefficients of variation <7% (range = 0.54–0.71).

Across species, male (41%) and female (43%) diving ducks spent similar proportions of time feeding and this was consistently the dominant activity across years. Total food biomass at foraging locations of diving ducks was similar across years of our study and was probably limited in most locations considering foraging thresholds and costs of foraging for diving ducks

($\overline{x}$ = 369.2 kg/ha, SE = 26.7, range = 332.1–501.4 kg/ha). Food density at random locations was similar to foraging locations. Diving ducks showed no indication of foraging patch selection based on densities of total food biomass, seed and tuber biomass, benthic invertebrate biomass, or nektonic biomass. When the data for both the Illinois and Mississippi Rivers were combined, less than half of the feeding locations had greater total food availability than random sites for both lesser scaup (0.45) and canvasbacks (0.49). We collected and analyzed food habits of 262 lesser scaup and 41 canvasbacks in the Illinois and upper Mississippi river valleys. Generally, animal material was observed more frequently and at a greater percent aggregate mass than plant foods in both lesser scaup and canvasback. Notable food items of lesser scaup included dreissenid mussels, chironomids, sphaerid clams, amphipods, pondweed seeds, and millet seeds. Canvasbacks consumed principally animal matter, with mayflies, sphaerid clams, millets seeds, and wild celery tubers as the most common taxa.

A negative mean index of daily lipid dynamics (DLD), indicating foraging habitat quality, was observed in all regions and appeared to vary by region and location. Coarsely, DLD values and food biomass were greater in the central IRV than the Illinois and Mississippi River confluence or Pool 19, but the relationship between DLD and overall food density was inconsistent among wetlands.

We banded 7,535 lesser scaup and 44 canvasbacks during springs 2012–2015. Anecdotally, we noticed the proportion of juvenile and female scaup increased throughout spring migration each year. We recaptured 1,917 previously banded scaup at our trap locations in spring 2015. We estimated that apparent stopover duration of recaptured lesser scaup during spring 2015 was 38% longer than spring 2014; however, apparent time spent during their stay was brief at 9.8 days.

We surveyed ten moist-soil wetlands in 2014 and 13 moist-soil wetlands and five grasslands (control sites) in 2015 for breeding birds. Across both years, we surveyed approximately 1,157 ha and observed 3,503 individual birds. Tree swallows (*Tachycineta bicolor*), red-winged blackbirds (*Agelaius phoeniceus*), and dickcissels (*Spiza americana*) were the most common species of birds observed, composing approximately 66.5% of all observations during both years. We observed a total of 78 species within the 100-m radius of survey points during 2014–2015, and several endangered and threatened birds and species of conservation concern were detected during surveys, including the common gallinule (*Gallinula galaeta*), Forster's tern (*Sterna forsteri*), northern harrier (*Circus cyaneus*), peregrine falcon (*Falco peregrinus)*, Bell's vireo (*Vireo bellii*), bobolink (*Dolichonyx oryzivorous*), dickcissel, grasshopper sparrow (*Ammodramus savannarum*), pied-billed grebe (*Podilymbus podiceps*), prothonotary warbler (*Protonotaria citrea*), red-headed woodpecker (*Melanerpes erythrocephalus*), sedge wren (*Cistothorus platensis*), and willow flycatcher (*Empidonax traillii*). Avian density in moist-soil wetlands (n = 237) and grasslands (n = 43) was 11.2 birds/ha (SE = 0.9) and 12.9 birds/ha (SE = 1.4), respectively, suggesting a slightly higher avian density in grasslands. During 2014, we observed 17 nests, three of which (17.6%) successfully hatched chicks and one (5.9%) failed. Nest failure was likely caused by flooding. During 2015, we observed 26 nests, four of which (15%) successfully fledged chicks, 16 (62%) failed, and six (23%) were empty for each visit. Extreme flooding in 2015 caused failure of many nests early in the season, either due to the heavy rainfall or being completely submerged by water. We

estimated daily nest survival (0.888) using the Mayfield method. In 2015, 18 of the total nests (69% of total) were found in grasslands, and eight (31%) were found in moist-soil wetlands.

Nineteen percent of 240 nests of sandhill cranes located and monitored throughout central Wisconsin and southeastern Wisconsin/northeastern Illinois study regions were successful in fledging at least one bird (mean brood size at fledging = 1.2) during 2011–2015. Individual survivorship from hatching to fledging was 27% (n = 482 young from 341 broods). Top-ranked models revealed study region – a proxy for crane population density – explained most variation observed in reproductive success. Specifically, nests in the core breeding region of central Wisconsin were 10% more likely to fledge young than those at the peripheries of the breeding range in southeastern Wisconsin/northeastern Illinois. One hundred and twenty-eight hatch-year birds and 66 adults were equipped VHF transmitters attached to leg bands to facilitate the acquisition of data on post-fledging vital rates. Juvenile survival (i.e., survivorship post-fledging to 1 year old adult) was 65% (n = 170). Annual survival of adult birds was 94% (n = 124) and was not well correlated with breeding status or study region. Survivorship from egg to three (earliest breeding age), four (average breeding age), and five years of age was 9%, 8.5% and 8%, respectively.

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NARRATIVE

JOB 118: AERIAL INVENTORIES OF WATERFOWL IN ILLINOS

Objectives:
1) Inventory waterfowl and American coots along the Illinois and central Mississippi rivers during fall migration using light aircraft.
2) Compute use-days and peak abundances for observed species.
3) Provide general inference regarding the distribution of waterfowl in space and time.
4) Compare these data to recent and long-term averages.
5) Summarize and distribute these data.

Introduction

The Illinois and Mississippi river valleys are major migration and wintering areas for nearly 30 species of waterfowl in the Mississippi Flyway. Additionally, these regions provide significant recreational opportunities (e.g., hunting and bird watching). Data from aerial inventories are used to direct waterfowl management, habitat acquisition, ecological research, and for public outreach. There are many important private, state, and federal waterfowl areas and refuges within these river floodplains, such as the Mark Twain National Wildlife Refuge (NWR), the Illinois River National Wildlife and Fish Refuges, and Keokuk Pool. The Illinois Natural History Survey (INHS), with support from the Illinois Department of Natural Resources (IDNR) and the Federal Aid to Wildlife Restoration Fund through the U.S. Fish and Wildlife Service (USFWS), has conducted aerial inventories of waterfowl along the Illinois and Mississippi rivers since 1948 (flown each year but 2001). This undertaking represents the longest known inventory of waterfowl, preceding even the USFWS breeding waterfowl counts and mid-winter inventories established in 1955. Therefore, 66 years of data exist on fall-migrating waterfowl for these critical ecoregions, collected by only 4 observers.

Aerial inventory data are frequently requested and used by federal and state agencies for regulatory decisions, evaluation of management or enhancement projects, and conservation prioritization. Specifically, the IDNR relies on these inventories to guide the establishment of hunting season dates, zones, and other regulations and to prioritize wetland habitat acquisitions. Previously, this database has been used by the Mississippi Flyway Technical Section and Council to monitor abundance and distribution of migrating waterfowl, especially canvasbacks, mallards, and northern pintails. Requests for inventory information are received annually from

state, federal, and private-sector employees to be used for projects such as Environmental Management Programs, scientific publications, theses and dissertations, formal presentations, and newspaper and magazine articles. Further, the long-term nature of this dataset makes it particularly unique and valuable; therefore, it was essential that the fall inventory database continue to be summarized and maintained for future analyses. We monitored waterfowl in Illinois to maintain this long-term dataset, evaluated spatial and temporal variation in abundance and distribution of waterfowl, and presented these data concisely to aid waterfowl and wetland management decisions in this region.

Methods

The INHS began aerial inventories of waterfowl during fall migration in the Illinois and Mississippi river floodplains in 1948. Initially, these flights were conducted weekly from 1–21 September to mid-December, and the winter inventory in early January was added in 1955. More recently, 4 flights were made in September and weekly flights from the second week of October through the first week of January to better overlap with important migration periods of waterbirds in our study region. We used fixed-wing aircraft to conduct aerial inventories of waterfowl and other waterbirds present at selected sites along the Illinois (Hennepin to Grafton, IL) and central Mississippi river valleys (Grafton to near New Boston, IL) during fall and early winter (Fig. 1; Havera 1999). One observer conducted all inventories from a single-engine, fixed-wing aircraft flying at an altitude of <450 ft and 150–160 mph (Havera 1999, Stafford et al. 2007).

We recorded the number and species composition of waterfowl at each site, and survey methods mirrored previous years to maintain consistency with past inventories (Table 1; Havera 1999). During each flight, we inventoried 18–23 areas in each river valley that typically host the majority of waterfowl in the region (Horath and Havera 2002). We computed waterfowl use-day (Stafford et al. 2007) and peak abundance estimates for the Illinois River valley (IRV) and central Mississippi River valley (CMRV) and made comparisons between the current waterfowl abundance and the most recent 5-year average. We also noted river water levels and resulting foraging habitat quality for waterfowl during September flights (Fig. 2).

Results

We provided weekly summaries of waterbird abundance to the IDNR, USFWS, and other parties of interest (Appendix 1). We posted aerial survey data weekly on the Forbes Biological Station web page (www.bellrose.org) for public outreach to the waterfowl hunting and bird watching communities. Additionally, INHS observer, Aaron Yetter, reported general

observations of waterfowl and habitat conditions following each flight in a blog that was posted weekly on the Forbes Biological Station web page (www.bellrose.org) and on social media (http://www.facebook.com/forbesbiologicalstation). Between September and December 2014, the blog reached over 100,000 Facebook users compared to 18,000 users reached in 2013. Aerial survey data was also used by the Mallard Migration Observation Network to generate the Mallard Migration Status map posted online by the Missouri Department of Conservation (http://huntfish.mdc.mo.gov/hunting-trapping/species/waterfowl/waterfowl-reports-prospects/mallard-migration). This information was also used to help prepare the Illinois Waterfowl Hunting Season report that is presented to the Mississippi Flyway Technical Section and Council at their annual winter meeting.

Waterfowl Abundances and Species Comparisons

Peak abundance of total ducks was lower in both the IRV and CMRV in 2014 than 2013 (Table 2, Appendix 1). In the IRV, peak abundance of total ducks for 2014 occurred on 5 November (562,800; Fig. 3); this estimate was 36% below the 2013 peak (876,255) but 43% above the most recent 5-year average of 393,683 (2009–2013; hereafter, 5-year average). Total duck abundance peaked in the CMRV on 25 November (522,130) at levels 26% below 2013 (709,375) but 18% above the 5-year average (440,891) (Fig. 4; Table 2). The peak abundance of total ducks for the two river systems combined (954,165) was 20% below the peak in 2013 (1,197,865) but 21% above the 5-year average (790,297; Table 2).

In the IRV, peak abundances for all species of dabbling ducks were below numbers counted in 2013 (-27 to -61%) and dabbling ducks combined (406,210) were 46% below estimates from 2013 (757,405), yet 21% above the 5-year average (336,997; Table 2). In the CMRV, excepting American wigeon (+27%), 2014 peak abundances for all dabbling ducks were lower (-4 to -84%) than numbers counted in 2013. Total dabbling ducks in the CMRV were 11% lower in 2014 (444,170) than 2013 (498,030), yet 26% above the 5-yr average (353,201; Table 2).

Diving duck abundance in the IRV peaked on 5 November 2014 at 156,580 (32% greater than 2013 [118,830]; 150% above the 5-year average [62,699]). Excepting ring-necked ducks (-54%) and canvasbacks (-1%), peak abundances for all species of diving ducks in the IRV were above numbers counted in 2013 (72 to 3,047%). Total diving ducks in the CMRV were 33% lower in 2014 (198,540) than 2013 (296,655) but 46% above the 5-year average (136,039). In the CMRV, diving duck abundance peaked on 25 November in 2014 at 198,540 (33% lower than 2013 [296,655]; 46% greater than the 5-year average [136,039]). Excepting canvasbacks (-41%)

and buffleheads (-46%), peak abundances for all species of diving ducks in the CMRV were higher than numbers counted in 2013 (4 to 88%; Table 2).

Waterfowl Use-Days

Use-day estimates for total ducks were lower in the IRV and CMRV in 2014 than 2013 (15,704,225 [-47%] and 21,708,815 [-13%], respectively; Table 3; Fig. 5). In the IRV, estimated use-days for all dabbling duck species were lower in 2014 than 2013. In the CMRV, excepting mallard, estimated use-days for all dabbling duck species were lower in 2014 than 2013.

Total diving duck use-day estimates in the IRV were 23% lower in 2014 than 2013 (1,790,905 and 2,333,978, respectively; Table 3). Use-day estimates for lesser scaup (+1,280%), redhead (+111%), common goldeneye (+839%), and bufflehead (+11%) exceeded use-days in 2013; however, use-day estimates for the 3 remaining diving duck species were less (8 to 63%) in the IRV in 2014 than 2013. In the CMRV, with the exception of canvasback (-10%), ruddy duck (-28%), and bufflehead (-76%), estimated use-days for the remaining diving duck species were greater in 2014 than 2013. Nevertheless, total diving duck use-days in the CMRV decreased by 4% from 2014 to 2013 (5,617,623 and 5,823,610, respectively).

Discussion

Summer and fall 2014 were characterized by frequent rains which caused fluctuating water levels along the Illinois River valley (IRV; Fig. 2; U.S. Army Corps of Engineers, unpublished data) and the confluence region of the Illinois and Mississippi rivers near Grafton, IL. Rain events in mid-August led to high river levels which destroyed much of the waterfowl foods at many refuges and duck clubs along both rivers resulting in below average waterfowl food resources for fall migrating ducks. Notable exceptions where good to excellent foraging habitat conditions occurred included Dardenne, Cuivre, and Port Louisa on the Mississippi River and Hennepin & Hopper, Douglas Lake, Banner Marsh, Emiquon, Cuba Island, Big Prairie, and Spunky Bottoms along the Illinois River. Additionally, beds of submersed aquatic vegetation at Pool 19, a key migratory stopover habitat for diving ducks (Aythyini), of the Mississippi River were considered below average. Consequently, our estimate of duck food in the Illinois and Mississippi river valleys was below average for fall 2014.

Inclement weather caused extensive ice coverage across the northern and central United States shortly after Veteran's Day and pushed many ducks out of our study region. We noted that fall 2014 had the earliest freeze up (i.e., > 90% ice at survey locations) since we began monitoring ice conditions during inventories in 2002. As a consequence of the early freeze date

and below average duck food availability, peak abundance estimates of ducks ranked 34th in the IRV (562,800 total ducks) and 35th in the CMRV (522,130 total ducks) out of the 66 years we have been monitoring waterfowl along these rivers (Fig. 6). Subsequent use-day estimates ranked 51st in the IRV (15,704,225) and 29th in the CMRV (21,708,815) out of the 66 years (Fig. 5).

Ducks persisted longer in the CMRV than the IRV despite freezing temperatures and iced-up conditions on many refuges. The 2014 peak abundance of total ducks (25 November) in the CMRV was similar chronologically to the peaks in 2013 (29 November) and 2011 (30 November) but 2 weeks earlier than fall 2012 (12 December). Peak counts of waterfowl in the IRV over the last 4 years have varied chronologically from 5 November (2014), 8 November (2013), and 15 November (2011) to 12 December (2012).

Table 1. Avian species encountered during fall 2014 and spring 2015 aerial inventories of the Illinois and central Mississippi rivers.

Common Name/Species Group	Scientific Name[a]	Abbreviation
Dabbling ducks		
Mallard	*Anas platyrhynchos*	MALL
American black duck	*Anas rubripes*	ABDU
Northern pintail	*Anas acuta*	NOPI
Blue-winged teal	*Anas discors*	BWTE
American green-winged teal	*Anas crecca*	AGWT
American wigeon	*Anas americana*	AMWI
Gadwall	*Anas strepera*	GADW
Northern shoveler	*Anas clypeata*	NSHO
Diving ducks		
Lesser scaup	*Aythya affinis*	LESC
Ring-necked duck	*Aythya collaris*	RNDU
Canvasback	*Aythya valisineria*	CANV
Redhead	*Aythya americana*	REDH
Ruddy duck	*Oxyura jamaicensis*	RUDU
Common goldeneye	*Bucephala clangula*	COGO
Bufflehead	*Bucephala albeola*	BUFF
Mergansers		
Common merganser	*Mergus merganser*	COME
Red-breasted merganser	*Mergus serrator*	RBME
Hooded merganser	*Lophodytes cucullatus*	HOME
Geese		
Greater white-fronted goose	*Anser albifrons*	GWFG
Canada goose	*Branta canadensis*	CAGO
Snow goose	*Chen caerulescens*	LSGO
American coot	*Fulica americana*	AMCO
American white pelican	*Pelecanus erythrorhynchos*	AWPE

[a] According to the American Ornithologists' Union Check-list, 2006.

Table 2. Peak abundance estimates of various species of waterfowl during falls 2013 and 2014, the average for 2009─2013 and the percent change (Δ) between 2014 and periods of interest.

Species and Regions	2013	2014	2009─2013 Average	% Δ from 2013	% Δ from 2009─2013
Mallard					
Illinois River	329,590	157,850	216,363	-52	-27
Central Mississippi River	374,120	359,710	276,451	-4	30
Illinois & Mississippi Rivers	735,580	503,760	481,197	-32	5
American black duck					
Illinois River	1,505	1,070	1,481	-29	-28
Central Mississippi River	625	100	754	-84	-87
Illinois & Mississippi Rivers	1,340	1,120	1,864	-16	-40
Northern pintail					
Illinois River	141,840	55,385	48,841	-61	13
Central Mississippi River	98,950	83,200	56,417	-16	47
Illinois & Mississippi Rivers	207,085	138,585	96,505	-33	44
Blue-winged teal					
Illinois River	24,455	17,750	28,370	-27	-37
Central Mississippi River	4,920	1,240	4,892	-75	-75
Illinois & Mississippi Rivers	28,110	18,990	33,167	-32	-43
American green-winged teal					
Illinois River	179,620	76,375	51,799	-57	47
Central Mississippi River	79,120	54,960	37,187	-31	48
Illinois & Mississippi Rivers	189,485	130,640	85,431	-31	53
American wigeon					
Illinois River	14,160	7,280	5,705	-49	28
Central Mississippi River	3,350	4,270	3,564	27	20
Illinois & Mississippi Rivers	14,160	11,550	8,151	-18	42
Gadwall					
Illinois River	146,300	107,490	51,589	-27	108
Central Mississippi River	79,970	58,705	35,980	-27	63
Illinois & Mississippi Rivers	189,080	166,195	85,369	-12	95
Northern shoveler					
Illinois River	49,060	35,900	23,584	-27	52
Central Mississippi River	21,545	12,535	9,150	-42	37
Illinois & Mississippi Rivers	57,070	48,435	29,026	-15	67
Dabbling ducks					
Illinois River	757,405	406,210	336,997	-46	21
Central Mississippi River	498,030	444,170	353,201	-11	26
Illinois & Mississippi Rivers	1,034,510	668,005	630,578	-35	6

Table 2. Continued.

Species and Regions	2013	2014	2009–2013 Average	% Δ from 2013	% Δ from 2009–2013
Lesser scaup					
Illinois River	1,530	48,155	13,268	3047	263
Central Mississippi River	38,200	71,650	39,334	88	82
Illinois & Mississippi Rivers	39,730	119,805	51,940	202	131
Ring-necked duck					
Illinois River	88,610	40,810	23,545	-54	73
Central Mississippi River	34,200	35,400	27,911	4	27
Illinois & Mississippi Rivers	81,400	76,210	50,528	-6	51
Canvasback					
Illinois River	6,635	6,555	3,735	-1	76
Central Mississippi River	261,550	153,775	90,293	-41	70
Illinois & Mississippi Rivers	262,100	156,350	91,919	-40	70
Redhead					
Illinois River	255	1,030	473	304	118
Central Mississippi River	10	3,400	977	33,900	248
Illinois & Mississippi Rivers	255	3,400	1,116	1233	205
Ruddy duck					
Illinois River	34,920	60,030	25,863	72	132
Central Mississippi River	15,465	16,630	18,660	8	-11
Illinois & Mississippi Rivers	50,385	76,660	41,132	52	86
Common goldeneye					
Illinois River	1,255	5,045	2,416	302	109
Central Mississippi River	11,620	20,970	12,358	80	70
Illinois & Mississippi Rivers	11,620	26,015	13,945	124	87
Bufflehead					
Illinois River	660	1,360	1,520	106	-11
Central Mississippi River	6,410	3,465	4,577	-46	-24
Illinois & Mississippi Rivers	6,420	4,825	5,680	-25	-15
Diving ducks					
Illinois River	118,830	156,580	62,699	32	150
Central Mississippi River	296,655	198,540	136,039	-33	46
Illinois & Mississippi Rivers	298,590	286,615	174,064	-4	65
Total mergansers					
Illinois River	2,225	2,645	2,632	19	0
Central Mississippi River	3,155	12,665	13,434	301	-6
Illinois & Mississippi Rivers	4,250	14,065	15,375	231	-9

Table 2. Continued.

Species and Regions	2013	2014	2009–2013 Average	% Δ from 2013	% Δ from 2009–2013
Total ducks					
Illinois River	876,255	562,800	393,683	-36	43
Central Mississippi River	709,375	522,130	440,891	-26	18
Illinois & Mississippi Rivers	1,197,865	954,165	790,297	-20	21
Greater white-fronted goose					
Illinois River	1,100	2,855	4,406	160	-35
Central Mississippi River	550	8,615	3,590	1466	140
Illinois & Mississippi Rivers	1,550	11,470	7,739	640	48
Canada goose					
Illinois River	16,170	7,160	15,690	-56	-54
Central Mississippi River	6,360	8,335	10,333	31	-19
Illinois & Mississippi Rivers	16,870	13,210	24,863	-22	-47
Lesser snow goose					
Illinois River	0	3,505	4,429	–	-21
Central Mississippi River	2,500	9,015	7,453	261	21
Illinois & Mississippi Rivers	2,500	9,025	10,629	261	-15
American coot					
Illinois River	212,905	163,680	130,956	-23	25
Central Mississippi River	49,340	53,440	29,887	8	79
Illinois & Mississippi Rivers	262,245	195,375	151,338	-25	29

Table 3. Use-day estimates of waterfowl during falls 2013 and 2014, the average for 2009–2013 and the percent change (Δ) between 2014 and periods of interest.

Species and Regions	2013	2014	2009–2013 Average	% Δ from 2013	% Δ from 2009–2013
Mallard					
Illinois River	10,676,513	6,301,230	7,684,582	-41	-18
Central Mississippi River	10,528,393	11,722,595	6,352,025	11	85
Illinois & Mississippi Rivers	21,204,905	18,023,825	14,036,606	-15	28
American black duck					
Illinois River	33,220	29,260	40,967	-12	-29
Central Mississippi River	8,100	2,073	9,039	-74	-77
Illinois & Mississippi Rivers	41,320	31,333	50,006	-24	-37
Northern pintail					
Illinois River	3,862,698	1,860,220	2,331,131	-52	-20
Central Mississippi River	3,462,965	1,853,958	2,236,140	-46	-17
Illinois & Mississippi Rivers	7,325,663	3,714,178	4,567,271	-49	-19
Blue-winged teal					
Illinois River	937,703	340,633	758,443	-64	-55
Central Mississippi River	181,415	33,943	128,955	-81	-74
Illinois & Mississippi Rivers	1,119,118	374,575	887,398	-67	-58
American green-winged teal					
Illinois River	5,409,538	2,903,393	2,856,381	-46	2
Central Mississippi River	2,528,633	1,271,893	1,688,038	-50	-25
Illinois & Mississippi Rivers	7,938,170	4,175,285	4,544,419	-47	-8
American wigeon					
Illinois River	391,258	204,503	204,423	-48	0
Central Mississippi River	63,010	47,320	90,766	-25	-48
Illinois & Mississippi Rivers	454,268	251,823	295,189	-45	-15
Gadwall					
Illinois River	4,068,695	1,396,795	2,075,817	-66	-33
Central Mississippi River	1,786,513	815,203	1,256,030	-54	-35
Illinois & Mississippi Rivers	5,855,208	2,211,998	3,331,846	-62	-34
Northern shoveler					
Illinois River	1,952,150	837,693	1,022,271	-57	-18
Central Mississippi River	560,148	208,613	352,813	-63	-41
Illinois & Mississippi Rivers	2,512,298	1,046,305	1,375,084	-58	-24
Dabbling ducks					
Illinois River	27,331,773	13,873,725	16,974,012	-49	-18
Central Mississippi River	19,119,175	15,955,595	12,513,456	-17	28
Illinois & Mississippi Rivers	46,450,948	29,829,320	29,487,468	-36	1

Table 3. Continued.

Species and Regions	2013	2014	2009–2013 Average	% Δ from 2013	% Δ from 2009–2013
Lesser scaup					
Illinois River	29,655	409,373	83,393	1,280	391
Central Mississippi River	811,408	810,795	700,630	0	16
Illinois & Mississippi Rivers	841,063	1,220,168	784,023	45	56
Ring-necked duck					
Illinois River	1,474,685	552,785	837,149	-63	-34
Central Mississippi River	762,128	798,060	776,035	5	3
Illinois & Mississippi Rivers	2,236,813	1,350,845	1,613,183	-40	-16
Canvasback					
Illinois River	132,813	96,160	76,725	-28	25
Central Mississippi River	3,439,535	3,091,018	1,493,507	-10	107
Illinois & Mississippi Rivers	3,572,348	3,187,178	1,570,232	-11	103
Redhead					
Illinois River	3,728	7,855	4,504	111	74
Central Mississippi River	115	40,885	3,612	35,452	1,032
Illinois & Mississippi Rivers	3,843	48,740	8,115	1,168	501
Ruddy duck					
Illinois River	673,673	620,045	626,289	-8	-1
Central Mississippi River	463,043	334,895	507,810	-28	-34
Illinois & Mississippi Rivers	1,136,715	954,940	1,134,099	-16	-16
Common goldeneye					
Illinois River	10,038	94,280	13,014	839	624
Central Mississippi River	155,840	510,523	126,522	228	304
Illinois & Mississippi Rivers	165,878	604,803	139,536	265	333
Bufflehead					
Illinois River	9,388	10,408	24,541	11	-58
Central Mississippi River	129,835	31,448	95,250	-76	-67
Illinois & Mississippi Rivers	139,223	41,855	119,790	-70	-65
Diving ducks					
Illinois River	2,333,978	1,790,905	1,665,613	-23	8
Central Mississippi River	5,823,610	5,617,623	3,715,705	-4	51
Illinois & Mississippi Rivers	8,157,588	7,408,528	5,381,318	-9	38
Total mergansers					
Illinois River	15,848	39,595	18,013	150	120
Central Mississippi River	61,708	135,598	56,317	120	141
Illinois & Mississippi Rivers	77,555	175,193	74,329	126	136

Table 3. Continued.

Species and Regions	2013	2014	2009–2013 Average	% Δ from 2013	% Δ from 2009–2013
Total ducks					
Illinois River	29,681,598	15,704,225	18,657,637	-47	-16
Central Mississippi River	25,004,493	21,708,815	16,285,478	-13	33
Illinois & Mississippi Rivers	54,686,090	37,413,040	34,943,115	-32	7
Greater white-fronted goose					
Illinois River	22,245	26,230	32,851	18	-20
Central Mississippi River	17,610	50,985	28,032	190	82
Illinois & Mississippi Rivers	39,855	77,215	60,883	94	27
Canada goose					
Illinois River	392,115	283,433	299,109	-28	-5
Central Mississippi River	333,725	324,570	324,040	-3	0
Illinois & Mississippi Rivers	725,840	608,003	623,149	-16	-2
Lesser snow goose					
Illinois River	0	10,643	20,654	–	-48
Central Mississippi River	28,693	57,270	83,025	100	-31
Illinois & Mississippi Rivers	28,693	67,913	103,678	137	-34
American coot					
Illinois River	7,542,938	5,785,280	4,969,490	-23	16
Central Mississippi River	1,148,915	1,083,860	1,016,335	-6	7
Illinois & Mississippi Rivers	8,691,853	6,869,140	5,985,824	-21	15

Figure 1. Locations in the Illinois and central Mississippi river valleys aerially inventoried for waterfowl by the Illinois Natural History Survey, fall 2014.

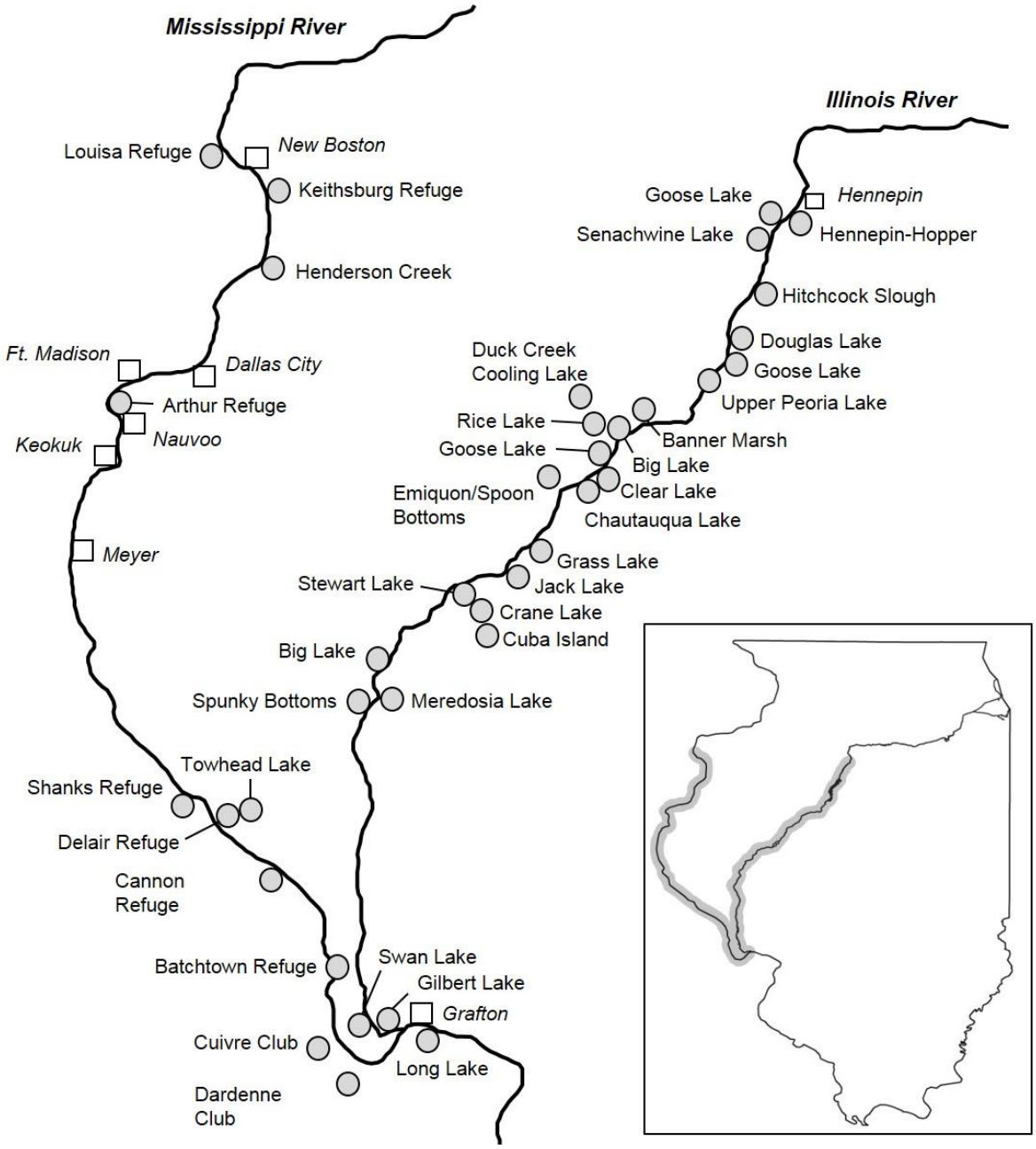

Figure 2. Water levels of the Illinois River during the 2014 growing season and fall waterfowl migration.

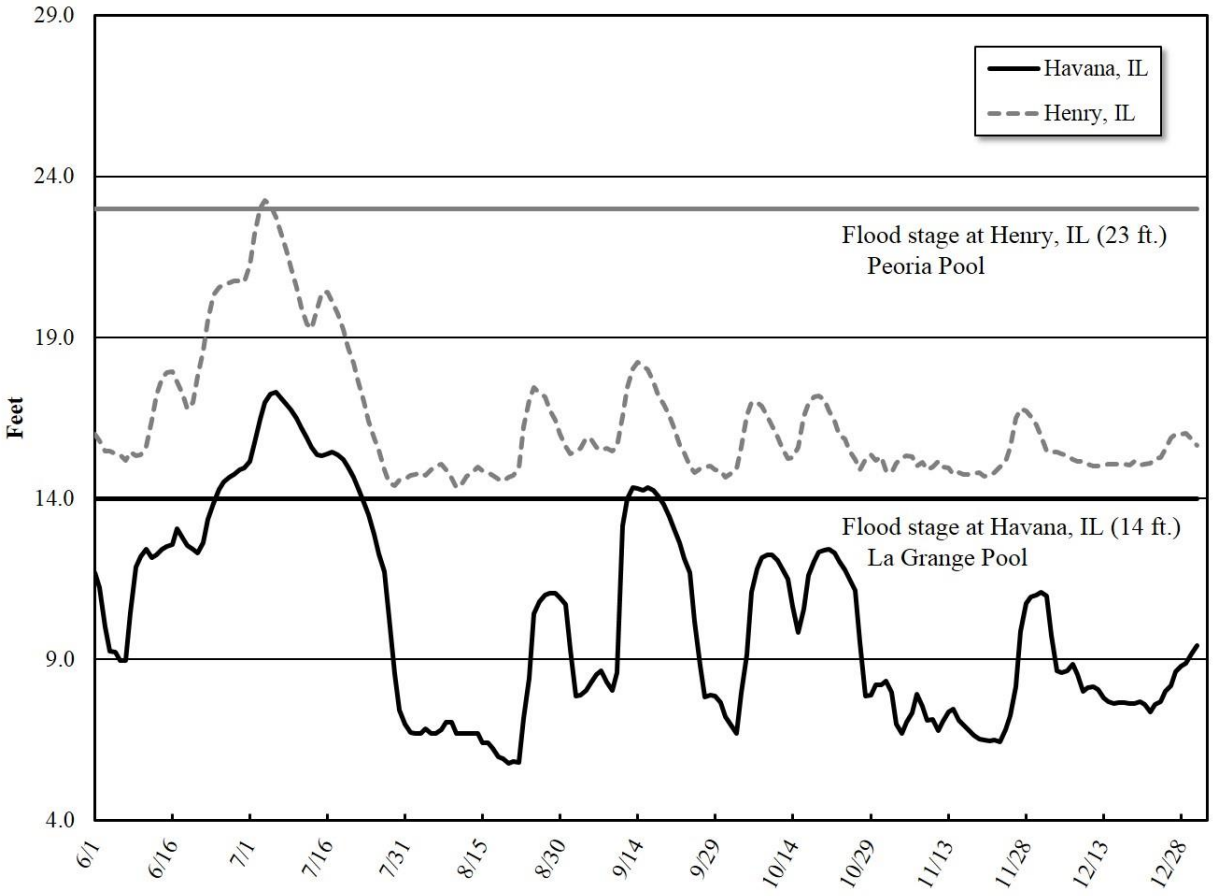

Figure 3. Estimated abundance of dabbling ducks, diving ducks, and total ducks observed during fall 2014 in the Illinois River valley

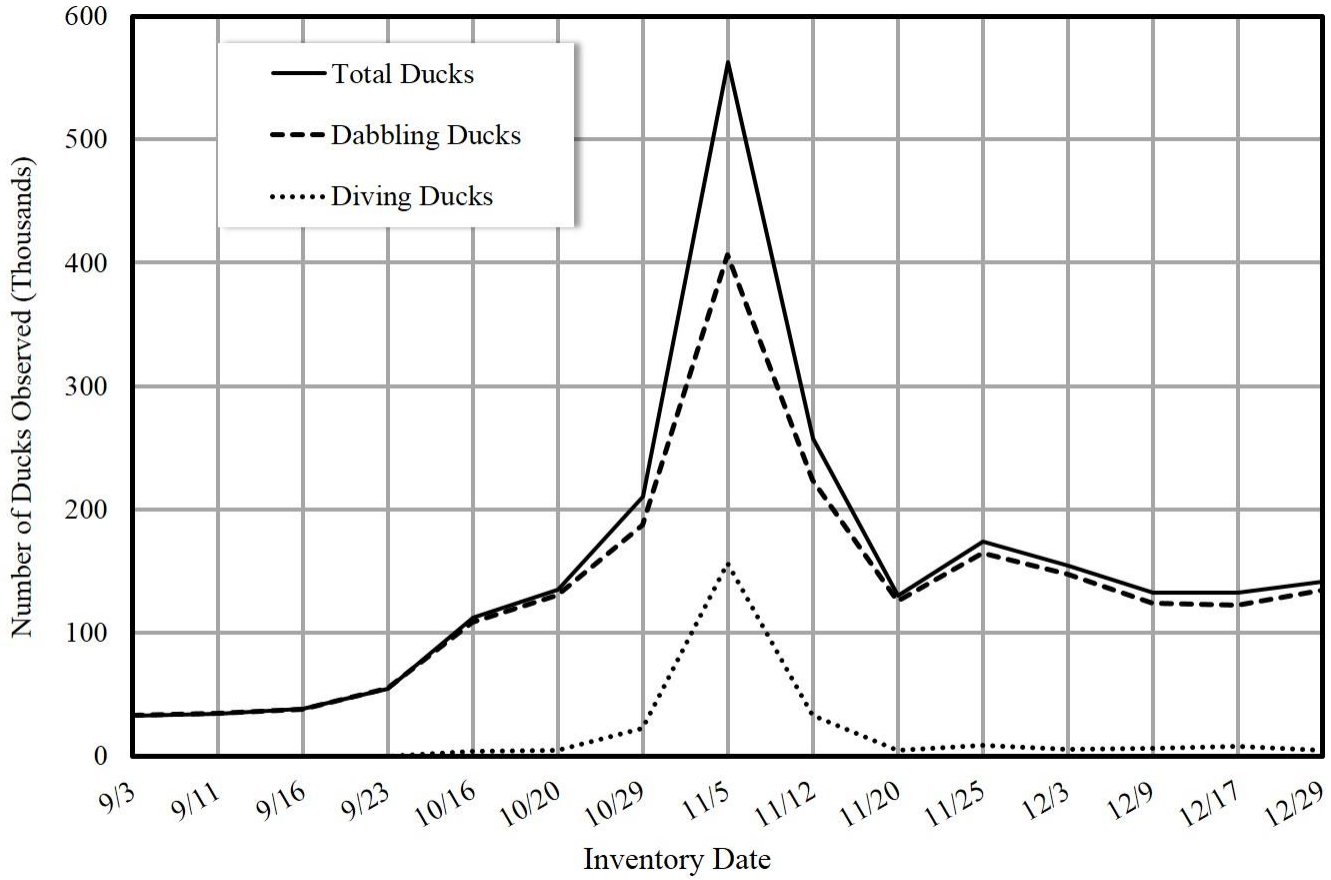

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Figure 4. Estimated abundance of dabbling ducks, diving ducks, and total ducks observed during fall 2014 in the central Mississippi River valley.

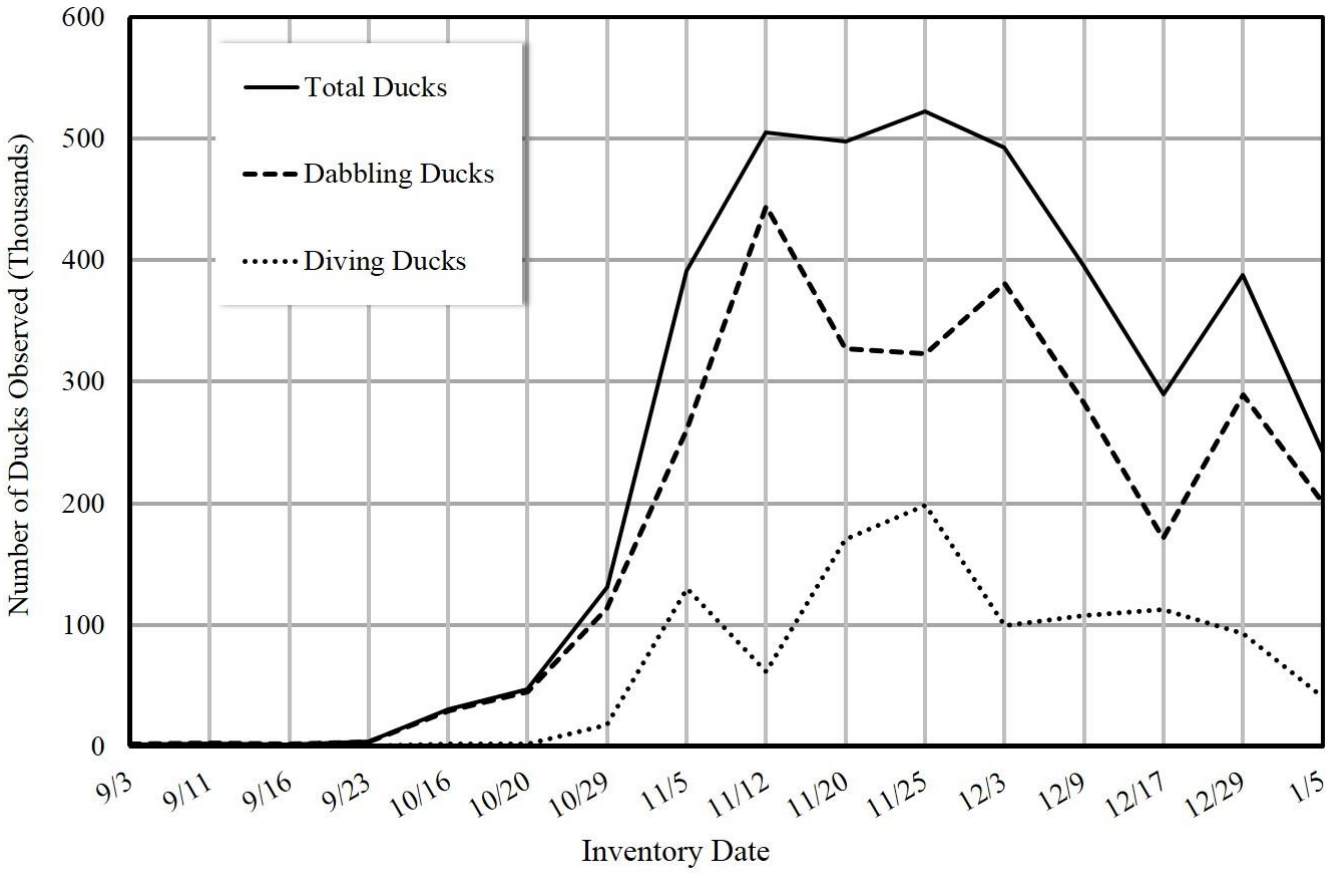


Figure 5. Total duck use-day estimates observed during falls 1948–2014 in the Illinois River valley and central Mississippi River valley.

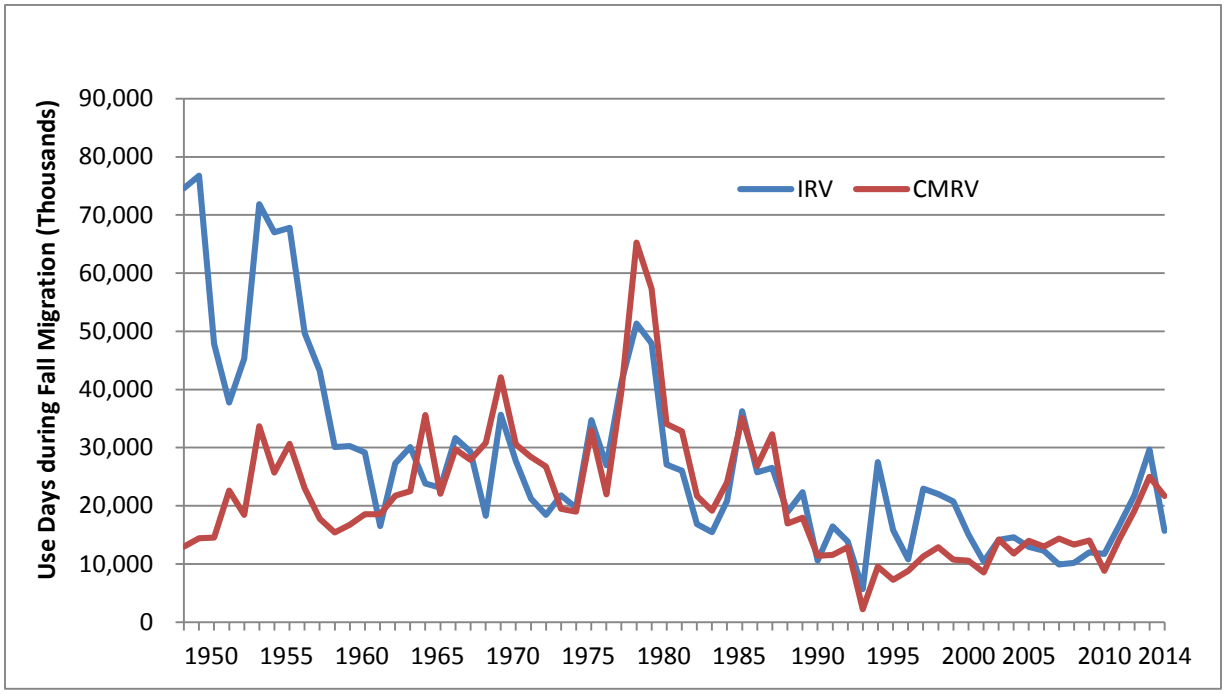
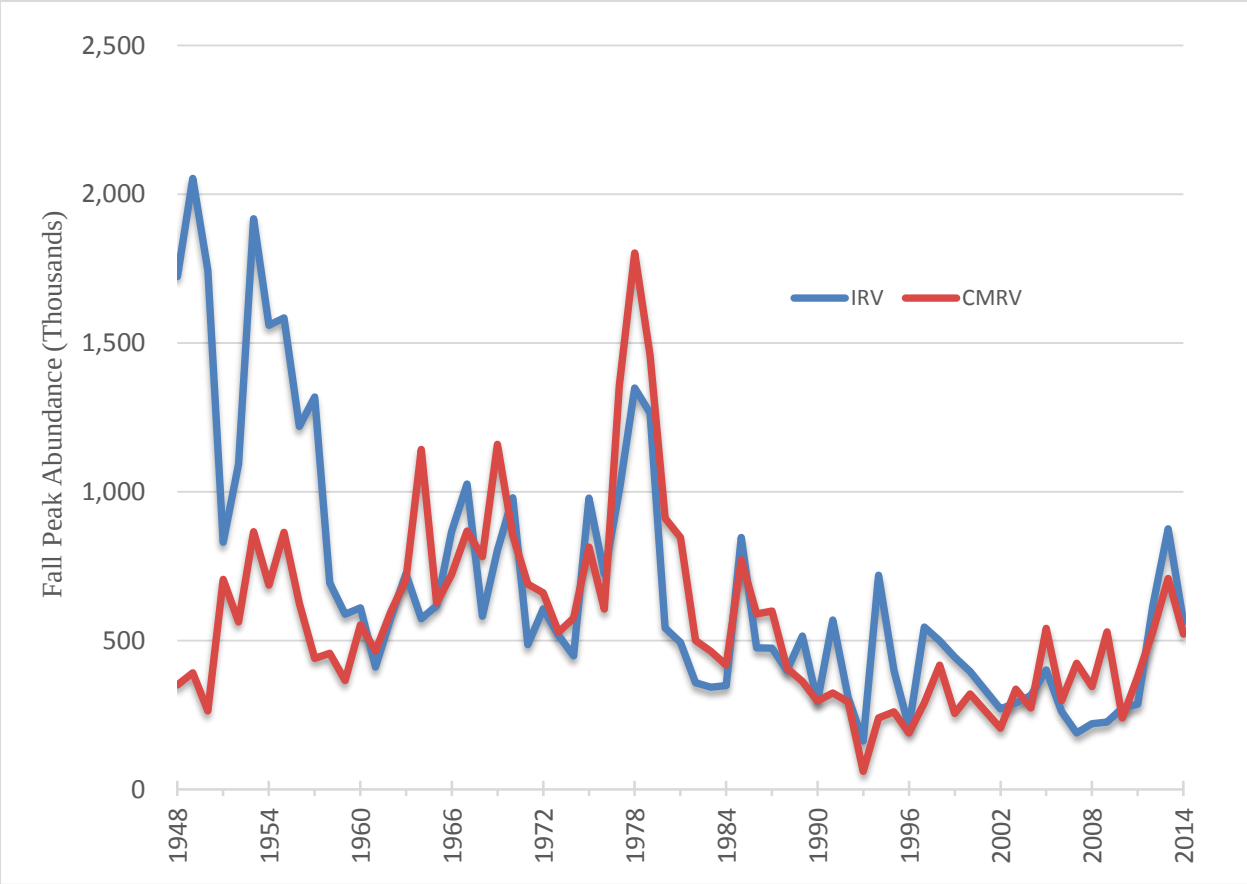


Figure 6. Peak abundance of total ducks observed during falls 1948–2014 in the Illinois River valley and central Mississippi River valley.



JOB 119: ECOLOGY OF SPRING-MIGRATING CANVASBACKS AND LESSER SCAUP IN THE CENTRAL ILLINOIS AND MISSISSIPPI RIVER VALLEYS

Objectives:

1) Aerially estimate abundance of lesser scaup and canvasbacks during spring migration in the Illinois River and Pool 19 of the Mississippi River of Illinois.

2) Document distribution of lesser scaup and canvasbacks among and within wetlands of both river systems.

3) Evaluate spring habitat composition and quality (e.g., forage abundance) within wetlands where concentrations of lesser scaup and canvasbacks occur (i.e., as determined by Objective 2).

4) Investigate and quantify behavior of lesser scaup and canvasbacks to estimate the functional response of these species to variation in habitat.

5) Experimentally collect up to 250 lesser scaup to assess diets and blood metabolites (i.e., in conjunction with Objectives 3–4).

6) Leg-band up to 1,000 lesser scaup and 500 canvasbacks along the Illinois River.

Introduction

Millions of waterbirds rely on Illinois wetlands during fall and spring migration. Historically, diving ducks were abundant during both seasons. For example, 710,275 lesser scaup were recorded on the upper Illinois River on 20 November 1949. However, fall abundance of diving ducks in the Illinois River valley (IRV) declined precipitously in the 1950s and have not recovered; peak abundance of lesser scaup during falls 1993–1996 averaged only 4,465 (Havera 1999). The central Mississippi River, specifically Pool 19, is also a critical area for migrating diving ducks, but peak abundances during fall have declined in this region from about 480,000 during 1978–1982 to 51,300 during 1993–1996 (Havera 1999).

Interestingly, diving ducks are more abundant in these systems during spring than fall. For example, INHS personnel counted nearly 12,500 lesser scaup at Emiquon Preserve in the IRV on 10 March 2007 and 350,000 lesser scaup and 20,000 canvasbacks on Pool 19 of the Mississippi River on 24 March 2008. Thus, wetlands of both rivers systems provided important stopover habitats during spring, a critically important time in the annual cycle of waterfowl. Because diving ducks rely on nutrients acquired during spring migration for breeding, the quality of wetlands in Illinois likely influences population dynamics of these species (Anteau and Afton

2004).

Lesser scaup and canvasbacks are two diving ducks considered in greatest need of conservation under the Illinois Wildlife Action Plan. Continental populations of both species have decreased significantly over the last 30–40 years, although lesser scaup breeding populations seem to have recently stabilized. The canvasback population reached a low of 373,000 in 1978 and concern remains over the future status of this species. Similarly, the continental breeding population of scaup was estimated at 8.0 million in 1972, but only 3.2 million in 2006. The "Spring Condition Hypothesis" may explain the lesser scaup decline, which indicates that foraging habitats in the midcontinent have declined in quality (e.g., abundance of food; Anteau and Afton 2004). If inadequate forage exists for lesser scaup during spring, these birds may delay, forgo, or risk reduced reproductive potential during the breeding season.

Both species are relatively abundant in Illinois during spring, but the contribution of the state's wetlands to reproduction and population ecology is largely unknown. Detailed information on spring abundance, distribution, habitat associations and selection, food use, and behavior are lacking or antiquated. Therefore, we investigated these factors to provide data critical to effectively allocating conservation efforts and help guide habitat restoration and conservation planning at state and regional levels.

Methods

Aerial Surveys

We aerially estimated diving duck abundance within the IRV and Pool 19 of the Mississippi River weekly during spring migration 2012–2015. Inventories included bottomland lakes and wetlands along the Illinois River (Hennepin to Meredosia, IL) and Pool 19 of the Mississippi River following spring ice-out and upon arrival of early migrant diving ducks (Havera 1999:187). We documented diving ducks and mergansers by species and abundance. One observer conducted all inventories from a single-engine, fixed-wing aircraft flying at an altitude of <450 ft and 150–160 mph (Havera 1999). We used aerial inventory data of lesser scaup and canvasbacks to identify focal areas to satisfy Objectives 2–4.

Additionally, we completed 5 aerial line transect surveys of Pool 19 each year during springs 2013–2015. In spring 2013, we orientated 140 transects perpendicular to the river, but results were inconsistent and this approach was logistically difficult for observers. Thus, in springs 2014–2015, we oriented 6 transects parallel to the river in two different survey strata: 1) Pool 19 dam near Keokuk, IA northward to the bridge connecting Fort Madison, IA to Niota, IL

(Dam) and 2) the Fort Madison bridge to the Pool 18 dam near Burlington, IA (Burlington; Fig. 7). We choose stratum boundaries based on logistical aerial survey considerations, habitat similarity, historical bird distributions, and results from 2013 transect surveys. We placed the first and second transects along the east and west shorelines of Pool 19 in the dam stratum. We placed the third and fourth transects along the centerline of the Pool 19 dam stratum. Transects five and six were placed along the east and west shorelines of the Burlington stratum.

We completed five aerial line transect surveys of La Grange Pool, IRV during spring 2015 for comparison with inventory style surveys. We randomly placed five north-south transects within the 100-yr floodplain from Pekin, IL to Meredosia, IL (Fig. 8). Distance between transects varied with the width of the Illinois River floodplain which varied from ~3 km near Pekin to >13 km near Beardstown, IL.

During transect surveys of La Grange Pool in the IRV and Pool 19 of the Mississippi River, a single observer covered half of the transect area (right side) during each trip along each transect due to decreased visibility from the left side of the plane. The aerial observer identified clusters of birds, estimated the number of birds in each cluster, estimated species composition, and used markings on the window and wing of the airplane to assign clusters into one of five distance intervals along one side of each transect (i.e., 50-m intervals from 70–320 m). All transects were flown at an elevation of 91 m above the water surface. We used Program DISTANCE to generate detection probabilities and population sizes by species and survey date (Buckland et.al. 2001). Parameter estimates were derived from the robust model with the greatest Akaike's Information Criteria adjusted for small samples size (Shirkey 2012). Following transect surveys along the Mississippi River, we resampled the complete area of Pool 19 using an inventory-style survey (Havera 1999) for comparison with transect survey data. We completed transect surveys of La Grange Pool the day following the inventory style survey, weather permitting.

Behavior and Food Sampling

We visited concentrations of lesser scaup and canvasbacks, identified by aerial surveys and located incidentally, and quantified behavior and food abundances at feeding and random locations. We used modified scan sampling whereby we located individual flocks (i.e., aggregations of ≥50 individuals) of lesser scaup and canvasbacks and quantified instantaneous behavior, species, and sex using 5–10 individual scans of each flock with a 5-minute waiting period between scans. Following scan surveys, we collected vertical sweep-net and benthic-core samples (Hagy et al. 2012*b*) from foraging locations of ducks and random locations within study

wetlands. Vertical sweep net samples consisted of only a vertical sweep through the water column. All seeds, tubers, and invertebrates were removed from samples or subsamples by hand, dried at 60ºC, weighed by taxon, and extrapolated to kg(dry)/ha using standard protocols and correcting for diet and processing bias (Hagy et al. 2011, Hagy and Kaminski 2012*a*).

The number of each recorded behavior (feed, rest, other, social, motion, alert) was divided by the total number of behaviors observed in each flock to determine the proportion of time devoted to each behavior. Behavioral scan samples were then paired with their corresponding food availability data. A one-way ANOVA was used (PROC GLM; SAS 9.3, SAS Institute, Inc. 2010) to examine among-year differences in total food availability. In addition, a one-way ANOVA (PROC GLM) was used to examine differences in the proportion of time spent feeding between the sexes of lesser scaup and canvasback . Regression (PROC REG) was used to examine relationships between foraging effort (i.e. the proportion of time spent feeding) and food availability of benthic food, nektonic food, seeds, and total food biomass for lesser scaup and canvasback in the Illinois and Mississippi Rivers. Food availability data were natural logarithm-transformed to normalize distribution of residuals. The proportion of samples where feeding site food availability was greater than random site food availability, indicating foraging patch selection by food density, was calculated for both species (lesser scaup and canvasback) and both rivers (Illinois and Mississippi).

Diet and Metabolite Sampling

We experimentally collected lesser scaup from foraging flocks as identified by concurrent aerial and ground surveys. We obtained blood samples and upper digestive tracts (i.e., proventriculus and esophagus) from lesser scaup to measure blood-plasma metabolites (e.g., triglyceride [TRIG], β-hydroxybutyrate [BOHB]) and evaluate food use and selection (Anteau and Afton 2008*b*, 2011). We attempted to collect birds making multiple foraging dives to increase the likelihood of finding food in the digestive tract. We harvested ducks with a shotgun from shore or sneak boats, collected blood within 5 min of harvest, obtained morphological measurements, necropsied carcasses to obtain digestive tracts and other tissues for later analysis, and preserved samples on ice or in liquid nitrogen until they could be transferred to long-term cold storage. Immediately after collection, we used a cardiac puncture technique to obtain approximately 1 mL of blood for metabolite assays (Anteau and Afton 2008*c*, 2011). We incorporated assay estimates of BOHB and TRIG into a predictive equation developed by Anteau and Afton (2008*b*) to infer daily lipid dynamics (hereafter, DLDs), an estimate of the rate and direction of recent lipid change that can be used to index foraging habitat quality.

We sampled food availability at collection sites and at random throughout wetlands within 3 days of harvest. We collected and processed food availability samples as previously described for behavioral observations. Proventriculi and esophagi of diving ducks were thawed in the laboratory and all food items identified and enumerated by species (seeds) or family (invertebrates), oven-dried for ≤24 hr at approximately 60°C, and weighed. We present food use as percent occurrence and aggregate percentage dry mass (Swanson et al. 1974). We verified assumptions for analyses and examined differences in DLDs among regions and wetlands using one–way analyses of variance (PROC GLM; SAS 9.3, SAS Institute, Inc. 2010). We performed simple linear regression (PROC REG; SAS 9.3, SAS Institute, Inc. 2010) to test for relationships between DLDs and benthic invertebrates, nektonic invertebrates, seeds, and overall food resources collected randomly throughout wetlands.

Banding

We captured and banded lesser scaup and canvasbacks along the Illinois River using baited swim-in traps with captures occurring from early March through mid-April (Anteau and Afton 2008*b,c*, Yetter et al. 2012). For each bird captured, we recorded species and sex, obtained morphological measurements, and attached an incoloy leg band. Moreover, we monitored recaptures using swim-in traps to coarsely estimate apparent stopover duration in the Illinois River valley calculating a simple mean of days elapsed between initial capture and date of last capture.

Results

Aerial Inventory Surveys

We counted 1,315,905 diving ducks and mergansers during spring 2015 on the Illinois River and Pool 19 of the Mississippi River. This estimate was 41% larger than ducks encountered (935,780) during spring 2014, but was 40% below diving ducks and mergansers numbers (2,184,795) counted in spring 2013 (Appendix 2). We excluded comparisons of spring diving duck counts in 2012 because only 3 flights were completed on each river in spring 2012 due to wind and weather. In spring 2015 along the Illinois River, peak numbers (151,450) of diving ducks and mergansers were observed on March 18th, which was similar chronologically to 2013 (March 22nd) and 2014 (March 17th); however peak estimates were >50% reduced from springs 2014 (312,100 ducks) and 2013 (339,935 ducks). Peak numbers (2015; 352,690 diving ducks and mergansers) on Pool 19 were similar in size to spring 2013 (344,285) but were 50% greater than the peak in spring 2014 (235,225). Unlike the Illinois River, peak diving duck abundance on Pool 19 has varied by nearly 3 weeks from 2013 (March 8th), 2014 (March 17th),

and 2015 (March 27th). In particular, peak abundances of lesser scaup decreased in 2015 in the IRV by 44,415 ducks from spring 2014; likewise, ring-necked ducks (-57%) and canvasback (-86%) declined sharply but ruddy ducks increased substantially (126%) when compared with 2014 peak numbers (Table 4). Total diving ducks on Pool 19 in 2015 increased 49% from 2014 peak numbers, and the majority of that increase was due to a 95% increase in peak lesser scaup abundance on the Pool from 2014 (Table 4). Notably, Chautauqua NWR and Emiquon Preserve accounted for 24.7% of the total diving duck use days in 2015 (Table 5). Unlike 2014 when Spunky Bottoms (i.e., Merwin Preserve) hosted 7.2% of the total diving duck use days in the IRV, Spunky Bottoms held <1% of the diving duck use days in spring 2015 (Table 5). Greater than 88% of the diving duck and merganser use days estimated from Pool 19 were observed below Fort Madison, IA. The stretch of Pool 19 above Burlington, IA appeared to be of little value to spring diving ducks and mergansers during springs 2014 and 2015 (Table 6). Riverine habitats of Pool 19 above Fort Madison, IA supported far fewer ducks during spring than areas below Fort Madison during both 2014 and 2015 (Table 6). Total use days along the IRV were drastically reduced (-48%) to estimates observed during 2014; however, use-day estimates from Pool 19 were elevated (+33%) in spring 2015 compared with 2014 (Tables 5, 6).

Aerial Transect Surveys

Overall, 2015 estimates of total diving duck density on Pool 19 were 5% greater in transect surveys than inventories and densities ranged from 4.2 ducks/ha on 20 March to 16.2 ducks/ha on 27 March as lesser scaup numbers were peaking on both the transect surveys and inventories (Tables 7, 8). Coefficient of variation was consistent across surveys, but greater than 15% threshold typically sought by researchers (range = 27–30% for total ducks). For species that were relatively uncommon or observed at relatively low densities (e.g., redhead, bufflehead), transect surveys tended to underestimate population size. Conversely, for common and abundant species (e.g., canvasback), aerial transects tended to overestimate population size relative to aerial inventories, with the exception of lesser scaup in 2015 (Table 7). Detection probability exceeded 50% in all surveys with coefficients of variation <7% (range = 0.54–0.71; Table 8).

In contrast to Pool 19, transect surveys of La Grange Pool during spring 2015 underestimated diving duck abundance by 46% relative to aerial inventories, and weekly differences between survey methods demonstrated transect surveys estimated 43–73% of diving duck abundance when compared to inventory methods (Table 9). Coefficient of variation ranged from 15–24% and averaged 21%. Lesser scaup were the most numerous diving duck observed during spring transect surveys and represented 26–63% of diving ducks populations using La

Grange Pool of the IRV (Table 10). Detection probability of waterbirds ranged from 49–83% during the weekly surveys.

Behavior

Across species, male (41%) and female (43%) diving ducks spent similar proportions of time feeding and this was consistently the dominant activity across years (Fig. 10). Canvasback and lesser scaup spent more than 90% of their time engaged in three activities, including foraging (46.2%, 44.2%, respectively), resting, (23.4%, 26.2%, respectively) and in motion (21.4%, 22.1%, respectively; Table 11). Interestingly, both lesser scaup and canvasbacks spent the greatest percentage of their time foraging over the 4-yr interval during spring 2015 when food availability was least (304.5 kg/ha) and benthic invertebrates (43.2 kg/ha) were scarce (Tables 11, 12).

Food Density

Total food biomass at foraging locations of diving ducks was similar across years of our study and was probably limited in most locations considering foraging thresholds and costs of foraging for diving ducks (x = 369.2 kg/ha, SE = 26.7, range = 332.1–501.4 kg/ha; Table 12). Nektonic invertebrates composed an average of 3.5% of the total food density and likely contributed little to food availability for spring-migrating diving ducks. In 2012 and 2013, benthic invertebrates comprised most food density (57–89%) followed by seeds and tubers (10–43%). However, in 2014 and 2015 when food selection and experimental collection activities occurred, benthic invertebrates composed a minority (14–16%) of food density compared to seeds and tubers (74–83%). Food densities at random locations were similar to foraging sites (Table 13).

Patch Selection

Total food biomass did not differ by year ($F_{3, 179} = 0.69$, $P = 0.561$), so years were combined for all subsequent analyses (Fig. 9). In addition, males and females did not differ in the proportion of time spent feeding ($F_{1, 380} = 0.53$, $P = 0.469$; Fig. 10), so they were combined for further analysis. Foraging effort across species did not vary with total food biomass ($F_{1, 181}=0.11$, $P = 0.742$), seed biomass ($F_{1, 168} = 0.23$, $P = 0.631$), or benthic invertebrate biomass ($F_{1, 181} = 0.08$, $P = 0.771$; Figs 11–13). In contrast, foraging effort was positively related to nektonic biomass ($F_{1,176} = 10.97$, $P = 0.001$; $\beta = 0.02$), but variance explained was low ($R^2 = 0.06$; Fig 14). Approximately half of the locations where both lesser scaup (0.53) and canvasbacks (0.55) fed in the Illinois River had greater total food availability than random sites indicating no evidence for patch selection based on food density (Table 14). These proportions were lower in the

Mississippi River with 0.19 of the lesser scaup feeding locations having greater total food availability than random sites, while this number was doubled for canvasbacks (0.38). When the data for both the Illinois and Mississippi Rivers were combined, less than half of the feeding locations had greater total food availability than random sites for both lesser scaup (0.45) and canvasbacks (0.49).

Diet and Metabolite Sampling

We collected and analyzed food habits of 262 lesser scaup and 41 canvasbacks in the Illinois and upper Mississippi river valleys. We limited diet analyses to birds observed foraging and having sufficient food in the esophagus for inference (>0.1 g / bird and >10 items). Generally, animal material was observed more frequently and at a greater percent aggregate mass than plant foods (Table 15). Similar trends were observed in both lesser scaup (Table 16) and canvasback (Table 17) diets, where invertebrates occurred more frequently (82% and 80%, respectively) and at a greater aggregate percent biomass (66% and 57% respectively) than plant material. Notable food items of lesser scaup included dreissenid mussels, chironomids, sphaerid clams, amphipods, pondweed seeds, and millet seeds. Canvasbacks consumed principally animal matter, with mayflies, sphaerid clams, millets seeds, and wild celery tubers as the most common taxa.

We observed a negative mean index of DLD for diving ducks in all regions, and DLDs differed by region ($F_{2,299}$ = 11.07, P < .001) and location ($F_{28,273}$ = 2.85, P < .001; Table 18). Lesser scaup had a negative mean DLD in all regions of our study area (Table 19). Canvasbacks collected in the central IRV had a positive mean index of DLD, while birds collected near the Illinois and Mississippi River confluence and at Pool 19 of the Mississippi River had a negative mean DLD (Table 20). Extensive variation was associated with food densities and metabolite values between wetlands. Coarsely, DLD values and food biomass were greater in the central IRV than the Illinois and Mississippi River confluence or Pool 19, but the relationship between DLD and overall food density was inconsistent among wetlands ($F_{1,26}$ = 3.52, P = .0720, R^2 = 0.12). Similarly, DLDs were not related to nektonic invertebrates ($F_{1,26}$ = 0.45, P = 0.5082, R^2 = 0.02), benthic invertebrates ($F_{1,26}$ = 0.25, P = .6227, R^2 = 0.01), or seeds ($F_{1,26}$ = 3.58, P = .0697, R^2 = 0.12).

Banding

We banded 7,535 lesser scaup and 44 canvasbacks during springs 2012–2015 (Table 21). Although we caught more canvasbacks (n = 21) during spring 2015 than in prior years (range: 3–12), canvasbacks failed to use baited sites and were seldom caught in traps. Even when groups

of canvasbacks were specifically targeted, canvasbacks typically abandoned trap sites after deployment of swim-in traps. Conversely, lesser scaup were abundant and readily used baited sites and entered swim-in traps. Anecdotally, we noticed the proportion of apparent juvenile scaup increased as spring progressed each year. Likewise, we observed the proportion of captured female scaup increased throughout spring migration each year as indicated by declining sex ratios (male:female; Fig. 15). Similar to springs 2012–2014, the majority (88%) of banded lesser scaup were male during spring 2015; likewise, only 33% of captured canvasbacks were female. The overall sex ratio of banded scaup was 6.6 males per female. We recaptured 1,917 previously banded scaup at our trap locations in spring 2015. We estimated that apparent stopover duration of recaptured lesser scaup during spring 2015 was 38% longer than spring 2014; however, apparent time spent during their stay was brief at 9.8 days.

As of mid-November 2015, we have received 164 recoveries (2%) of lesser scaup extending from the Northwest Territories to the Gulf Coast (Fig. 16). Most scaup were recovered by hunters throughout the Mississippi Flyway (77%), but others were recovered in the Central (11%) and Atlantic (10%) flyways. Most recoveries were reported from Louisiana (24%), followed by Illinois (20%) and North Dakota (7%).

Discussion

Diving Duck Abundance

Both the Illinois River and Pool 19 of the Mississippi River were major spring-migration stopover locations for diving ducks in Illinois. However, use of Pool 19 by lesser scaup and canvasbacks was 3 to 7 times greater than use of the Illinois River. Interestingly, ruddy duck and ring-necked ducks accrued more use of the Illinois River than Pool 19. Ruddy and ring-necked ducks accumulated 3.9 times more used days on the Illinois River (1,048,623) than Pool 19 (268,546). Both rivers were important to spring diving ducks; however, the wetland habitats associated with these systems may have been used differentially by diving duck species. Relatively few diving ducks used the portion of Pool 19 above Dallas City, IL and use of Pool 19 above Burlington, IA was negligible.

Line Transect Surveys

Parallel transect surveys of diving ducks on the Illinois and Mississippi rivers were feasible during spring 2015, and population estimates were similar between the traditional inventory methodology and line transect surveys. Differences (27–57%) between survey methods were more pronounced along the Illinois River; however, coefficients of variation ranged from 15–24%. Inventory and transects methods produced similar estimates of bird

abundance along Pool 19 with an average difference of only 5% during spring 2015. Additionally, CVs from transect surveys on Pool 19 were consistently between 27–30% and only slightly higher than CVs on the Illinois River. Further evaluation of transect surveys along both rivers is warranted during spring. We suggest a line transect approach to monitor waterfowl abundance along the Illinois and Mississippi rivers during fall may yield similar results; however, the non-random distribution of ducks in both river systems during fall will likely require different sampling schemes and methods from those used during spring surveys. We suggest further evaluation of a line transect method or quadrat-based method for surveying spring-migrating waterbirds in the IRV.

Functional Response and Patch Selection

Overall food availability at feeding locations appeared to have little to no effect on the amount of foraging effort expended by lesser scaup and canvasbacks in this study. There appeared to be limited evidence that ducks consistently selected foraging locations with greater food density than random locations within each river system (Smith et al. 2012). For benthic biomass, seeds, and total biomass, there was no relationship between foraging effort and food availability; however, there was a very weak, positive, relationship between nektonic biomass and foraging effort, but the effect size was small. In other words, as nektonic biomass increased, lesser scaup and canvasbacks spent more time feeding. There was no evidence that foraging patch selection or functional response was related to food densities. As diving ducks must engage in foraging dives to sample underwater resources, our data indicate that ducks are naïve to food densities when engaging in forage densities. Conspecific attraction or other mechanisms are apparently responsible for foraging site selection. Alternatively, habitat and food availability may be restricted to the point where diving ducks must feed opportunistically and selective sampling would be detrimental to overall fitness.

Alternatively, food availability may not be a strong limiting factor for these birds at the densities encountered. Lesser scaup and canvasbacks may be more limited by their intake rate rather than food availability, provided food densities are sufficiently high (Holling type II response; Holling 1959). As long as food densities are above a certain threshold, individuals may be more limited by the number of dives they can make per minute and the amount of time they can stay underwater per dive.

Diet, Food Density, and Wetland Quality

Both lesser scaup and canvasbacks consumed a variety of plant and animal foods, including showing selection tendencies for several taxa of each. Both species selected millet

seeds and sphaerid snails. Faithful to previous studies, canvasbacks selected tubers and scaup selected amphipods. However, no single diet item was dominant in either species and inter-individual variation suggests that both species were generalists by choice or necessity.

Overall, forage density was relatively low and similar to previous studies in the region during spring (Straub et al 2012). Random and foraging site food densities were similar, further indicating an opportunistic foraging strategy as opposed to optimal patch selection based on food density. Recently, evidence has mounted that foraging thresholds exist near 200 kg/ha for dabbling ducks. If energy acquisition costs are greater in diving ducks than dabbling ducks, foraging thresholds (e.g., critical food density) should also be greater. Given mean food densities < 340 kg/ha in 3 of 4 years, forage densities in most locations used by diving ducks during spring may be near or below an energetic profitability level.

Further evidence of ducks existing at a negative energy balance include mean negative DLD indices. Mean DLD values were below zero for most wetlands and regions indicating that birds existed in a negative energy balance while foraging in habitats sampled (Anteau and Afton 2011). Spring foraging habitat quality for diving ducks may have negative effects on condition of diving ducks stopping during migration.

Anecdotally, locations with positive DLD index values tended to be those which contained extensive moist-soil vegetation during the previous fall and were either hunted extensively or were not flooded until spring. A possible management approach to increase forage habitat value for spring-migrating diving ducks may be to flood unit in spring instead of fall. Further research should focus on cooperative management of wetland complexes for hunting activities during fall and provision of high-quality habitat for spring-migrating waterfowl.

Table 4. Peak abundances of diving ducks and mergansers observed and percent change (Δ) from spring 2014 to 2015 along the Illinois River and Pool 19 of the Mississippi River in Illinois.

Species and Regions		2014	2015	Δ
Lesser scaup	Illinois River	124,710	83,295	-33
	Pool 19	128,545	250,520	95
Ring-necked duck	Illinois River	93,750	40,470	-57
	Pool 19	7,200	3,500	-51
Canvasback	Illinois River	73,680	10,420	-86
	Pool 19	94,670	79,420	-16
Redhead	Illinois River	2,555	845	-67
	Pool 19	450	1,350	200
Ruddy duck	Illinois River	12,400	28,080	126
	Pool 19	8,060	15,650	94
Common goldeneye	Illinois River	2,380	3,445	45
	Pool 19	3,675	9,070	147
Bufflehead	Illinois River	2,275	2,385	5
	Pool 19	1,765	6,910	292
Total diving ducks	Illinois River	312,100	151,450	-51
	Pool 19	235,225	350,740	49
Common merganser	Illinois River	3,850	6,705	74
	Pool 19	2,360	4,170	77
Hooded merganser	Illinois River	30	70	133
	Pool 19	10	0	0

Table 5. Diving duck and merganser (Mergini) use-day estimates in the Illinois River valley from aerial inventories during spring 2015 and spring 2014, for comparison.

Location	BUFF	CANV	COGO	COME	HOME	LESC	REDH	RNDU	RUDU	2015 Total	%[a]	2014 Total
Turner	0	113	0	415	0	11,125	70	3,570	510	15,803	0.6	7,108
Depue, Spring	0	1,200	470	5,993	0	6,523	0	350	175	14,710	0.5	19,590
Coleman	0	0	350	1,115	0	3,995	0	16,700	0	22,160	0.8	111,875
Bureau Ponds	0	350	0	1,950	0	2,350	1,400	35,000	0	41,050	1.4	31,670
Goose (Putnam)	98	30,650	2,700	1,958	33	21,730	0	53,700	0	110,868	3.9	85,873
Senachwine	0	740	398	65	0	15,050	700	2,100	5,230	24,283	0.8	109,558
Hennepin/Hopper	3,793	52,075	40	1,328	0	125,450	0	33,950	26,750	243,385	8.5	254,860
Swan	0	1,750	900	1,150	0	17,800	700	36,500	0	58,800	2.1	72,910
Sawmill	0	40	350	65	0	4,430	0	3,250	1,060	9,195	0.3	12,350
Billsbach	0	1,915	550	400	0	27,020	200	14,465	1,025	45,575	1.6	52,445
Weis	65	228	0	100	0	4,885	0	650	950	6,878	0.2	80,175
Sparland	0	400	400	200	0	7,603	0	0	12,485	21,088	0.7	47,113
Wightman	0	0	0	35	0	12,025	0	5,665	0	17,725	0.6	8,540
Sawyer	0	0	35	55	0	2,100	0	0	195	2,385	0.1	12,650
Hitchcock	65	0	0	85	0	6,840	0	4,450	0	11,440	0.4	32,540
Babbs	0	160	0	0	0	24,050	0	0	17,500	41,710	1.5	70,665
Meadow	685	70	0	130	0	2,630	0	0	1,465	4,980	0.2	32,678
Douglas	650	11,475	400	1,500	0	39,350	200	183,050	2,600	239,225	8.4	80,775
Goose (Woodford)	700	2,000	1,200	4,305	0	65,450	400	7,000	11,025	92,080	3.2	211,828
Upper Peoria	65	1,130	4,800	885	0	78,295	0	0	23,020	108,195	3.8	114,255
Lower Peoria	128	1,800	1,000	0	0	24,580	0	0	7,635	35,143	1.2	35,315
Pekin	33	40	0	65	0	1,230	0	0	80	1,448	0.1	222,190
Powerton	163	1,675	35	130	0	15,735	400	200	765	19,103	0.7	0
Spring	163	400	600	1,300	0	480	105	400	1,625	5,073	0.2	2,090
Spring Bottoms	70	200	100	0	0	750	325	23,300	0	24,745	0.9	11,938
Goose (Fulton)	0	0	435	150	0	475	0	4,700	325	6,085	0.2	323,050
Rice	1,300	1,333	0	3,250	0	15,785	345	5,500	2,620	30,133	1.1	33,580
Big (Fulton)	0	400	400	0	65	13,770	550	700	3,355	19,240	0.7	246,543
Banner Marsh	0	0	35	303	140	5,968	0	0	138	6,583	0.2	1,245

Table 5. Continued

Location	BUFF	CANV	COGO	COME	HOME	LESC	REDH	RNDU	RUDU	2015 Total	%[a]	2014 Total
Duck Creek	0	0	0	6,405	0	0	0	35	0	6,440	0.2	3,960
Clear	83	3,520	0	1,070	138	80,930	0	848	55,195	141,783	5.0	158,418
Chautauqua	14,515	10,240	550	1,530	0	218,100	1,775	26,650	74,450	347,810	12.2	208,055
Quiver Creek	0	0	0	0	0	400	95	1,750	95	2,340	0.1	69,150
Quiver	0	0	0	33	0	1,030	20	0	3,800	4,883	0.2	42,965
Spoon River Btms	0	0	0	0	0	0	0	0	0	0	0.0	1,708
Emiquon Preserve	27,350	20,115	2,000	4,993	65	184,720	4,208	35,200	78,725	357,375	12.5	358,353
Emiquon NWR	0	0	0	0	0	400	0	800	0	1,200	0.0	296,035
Matanza	65	0	0	33	0	17,425	65	0	1,900	19,488	0.7	4,840
Bath Lake	0	390	0	75	0	2,445	0	3,500	1,370	7,780	0.3	250,925
Moscow	2,300	1,875	0	690	0	8,000	0	3,400	3,850	20,115	0.7	52,753
Jack	1,048	0	0	520	0	20,000	0	700	6,300	28,568	1.0	47,878
Grass	70	0	0	800	0	74,985	0	7,555	12,900	96,310	3.4	98,160
Anderson	2,598	3,550	163	850	0	37,075	400	5,700	3,200	53,535	1.9	96,840
Snicarte	0	800	0	0	0	135	0	0	80	1,015	0.0	166,375
Ingram	1,578	0	0	0	0	24,400	70	0	3,025	29,073	1.0	36,895
Chain	700	4,700	0	40	0	42,820	0	4,200	29,660	82,120	2.9	28,420
Stewart	40	3,490	800	1,040	200	64,075	0	800	22,190	92,635	3.2	82,135
Crane	65	690	0	1,980	0	4,650	0	1,900	4,325	13,610	0.5	114,405
Cuba Island	650	2,050	0	65	0	34,950	0	48,725	650	87,090	3.0	167,910
Sanganois	0	455	75	870	0	14,600	175	3,250	950	20,375	0.7	46,753
Treadway	398	2,050	0	0	0	13,675	0	600	2,850	19,573	0.7	79,275
Muscooten	0	0	0	0	0	0	0	0	0	0	0.0	4,370
Big (Brown)	70	70	0	0	0	14,550	0	7,800	5,800	28,290	1.0	179,973
Meredosia	650	2,125	0	1,450	0	69,550	0	10,100	9,000	92,875	3.3	151,825
Smith	160	0	0	400	0	8,195	0	800	3,213	12,768	0.4	2,373
Spunky Bottoms	135	1,600	0	0	0	650	0	8,350	700	11,435	0.4	392,000
Total Illinois River	60,448	167,863	18,785	49,773	640	1,495,233	12,203	607,863	444,760	2,857,565		5,468,150

[a] Percent of total use-days from each site relative to the overall total use-days in 2015.

Table 6. Use-day estimates of diving ducks on Pool 19 of the Mississippi River from aerial inventories during spring 2015 and spring 2014, for comparison.

Location	BUFF	CANV	COGO	COME	HOME	LESC	REDH	RNDU	RUDU	2015 Total	%[a]	2014 Total
Keokuk–Nauvoo	35,050	788,571	17,100	6,525	0	3,126,562	12,100	32,000	196,671	4,214,578	65.4	1,723,328
Arthur Refuge	950	0	0	0	0	950	0	0	0	1,900	0.0	121,925
Nauvoo–Ft. Madison	59,550	327,300	75,610	29,538	0	931,972	500	10,250	26,800	1,461,520	22.7	1,585,333
Ft. Madison–Dallas City	4,935	23,175	4,925	7,150	0	405,651	0	0	2,825	448,661	7.0	514,170
Dallas City–Burlington	2,150	26,810	1,100	2,200	0	252,681	0	0	0	284,941	4.4	673,203
Turkey Slough	1,350	4,350	1,800	3,150	0	25,500	0	0	0	36,150	0.6	185,285
Burlington–Dam 18	0	0	0	0	0	0	0	0	0	0	0.0	32,640
Total Pool 19	103,985	1,170,206	100,535	48,563	0	4,743,316	12,600	42,250	226,296	6,447,751		4,835,883

[a] Percent of total use-days from each site relative to the overall total use-days in 2015.

Table 7. Total abundance (N) by species and survey date with coefficients of variation (CV) and percent differences (Δ) between total population sizes estimated during parallel transect surveys with Program Distance compared to inventory surveys at Pool 19 of the Mississippi River during spring 2015.

Survey Date	BUFF		CANV		COGO		COME		LESC		REDH		RNDU		RUDU		TOTAL	
	N	CV	N	CV	N	CV	N	CV	N	CV	N	CV	N	CV	N	CV	N	CV
Transects																		
12-Mar-15	118	104%	145,350	47%	22,967	67%	33,151	52%	43,794	40%	0	0%	5,974	80%	35,895	143%	272,580	30%
20-Mar-15	192	108%	36,145	41%	3,498	60%	678	37%	32,180	35%	43	106%	11,036	120%	1,862	45%	85,635	27%
27-Mar-15	2,121	24%	135,980	50%	10,463	106%	1,066	38%	177,960	32%	0	0%	0	0%	1,407	68%	328,990	27%
1-Apr-15	3,470	35%	285	82%	2,727	142%	105	48%	229,340	30%	0	0%	52	104%	3,463	55%	242,300	28%
Inventories																		
12-Mar-15	30		79,420		9,070		4,170		35,320		600		800		100		129,510	
20-Mar-15	500		32,440		1,650		615		108,370		200		3,500		1,200		148,475	
27-Mar-15	5,565		74,435		6,660		1,950		250,520		1,350		2,000		10,210		352,690	
1-Apr-15	6,910		8,750		300		1,200		224,430		0		0		15,650		257,240	
Difference	-55%		62%		124%		341%		-22%		-98%		171%		57%		5%	

Table 8. Density (total diving ducks/ha) and detection probability (p) by and survey date of total diving ducks and mergansers (Mergini) with upper (UCL) and lower (LCL) 95% confidence intervals from parallel transect surveys at Pool 19 of the Mississippi River during spring 2015.

Survey Date	Density			Detection Probability			
	$\overline{x}$	LCL	UCL	p	LCL	UCL	CV
12-Mar-15	13.4	6.8	26.5	0.66	0.57	0.75	6.95
20-Mar-15	4.2	2.3	7.6	0.71	0.64	0.80	5.65
27-Mar-15	16.2	8.9	29.3	0.54	0.48	0.60	5.64
1-Apr-15	11.9	4.8	29.8	0.59	0.53	0.66	5.59

Table 9. Comparison of waterfowl abundance estimates obtained from traditional aerial inventories and concurrent aerial line transects along the lower Illinois River from Pekin to Meredosia, IL during spring 2015.

Date	Inventory	Transect	CV	Difference
18-Mar-15	151,450	65,308	23%	57%
26-Mar-15	106,760	78,216	15%	27%
31-Mar-15	70,560	50,186	24%	29%
14-Apr-15	36,225	16,432	24%	55%

Table 10. Total abundance (N) by species and survey date with lower (LCL) and upper confidence limits (UCL) with detection probability (*p*) estimated during parallel line transect surveys with Program Distance along the Illinois River during spring 2015.

Species	18-Mar-15			26-Mar-15			31-Mar-15			14-Apr-15		
	N	LCL	UCL	N	LCL	UCL	N	LCL	UCL	N	LCL	UCL
AGWT	3,337	1,124	9,910	13,486	7,948	22,880	7,412	4,006	13,713	7,957	5,154	12,285
BWTE	238	47	1,221	12,474	6,735	23,105	---	---	---	519	159	1,692
GADW	5,482	3,643	8,249	15,171	10,415	22,100	11,435	8,277	15,799	2,768	1,603	4,777
MALL	17,400	10,667	28,381	52,931	37,213	75,289	13,764	10,045	18,861	2,595	1,230	5,472
NOPI	715	312	1,641	674	130	3,488	---	---	---	---	---	---
NOSH	2,622	1,515	4,538	14,834	9,355	23,521	9,317	6,168	14,075	6,054	4,401	8,328
Dabbling Ducks	29,794	18,768	47,298	97,096	75,766	124,432	41,928	32,648	53,848	19,892	14,450	27,382
BUFF	1,430	727	2,814	337	67	1,703	6,353	3,083	13,089	173	33	894
CANV	2,860	1,294	6,324	1,011	462	2,216	424	137	1,305	---	---	---
COGO	238	46	1,238	674	130	3,500	---	---	---	---	---	---
COME	2,145	1,065	4,323	1,349	552	3,292	847	280	2,560	---	---	---
HOOD	---	---	---	337	65	1,744	---	---	---	---	---	---
LESC	38,375	25,277	58,258	45,177	35,868	56,902	31,764	15,642	64,500	4,324	1,580	11,836
RNDU	11,203	6,729	18,650	5,057	2,407	10,624	2,118	1,756	2,554	346	113	1,058
RUDU	9,057	5,394	15,209	12,137	7,545	19,523	8,682	4,558	16,537	11,589	7,304	18,388
Diving Ducks	65,308	42,218	101,028	78,216	58,898	103,872	50,186	31,514	79,924	16,432	10,382	26,008

Table 10. Continued.

Species	18-Mar-15			26-Mar-15			31-Mar-15			14-Apr-15		
	N	LCL	UCL	N	LCL	UCL	N	LCL	UCL	N	LCL	UCL
CAGO	11,441	4,650	28,149	16,183	7,072	37,030	10,376	4,341	24,802	4,843	3,487	6,728
GWFG	477	151	1,502	337	67	1,703	424	139	1,287	346	115	1,044
LSGO	477	151	1,504	674	219	2,077	847	350	2,049	173	34	873
Geese	12,394	5,460	28,138	17,194	7,684	38,476	11,646	5,122	26,484	5,362	3,756	7,656
AMCO	9,534	4,101	22,163	17,868	9,976	32,005	14,823	9,276	23,687	33,730	26,520	42,900
DCCO	2,145	1,147	4,012	2,023	614	6,669	2,753	1,426	5,314	1,730	866	3,454
SWAN	3,099	948	10,133	3,034	1,246	7,390	1,059	210	5,346	2,595	778	8,651
AWPE	---	---	---	1,011	309	3,311	2,753	1,717	4,413	7,957	6,015	10,525
Other Waterbirds	14,778	8,156	26,776	23,936	14,020	40,870	21,388	16,862	27,128	46,012	38,298	55,276
Total	122,270	81,279	183,950	216,780	169,690	276,950	125,150	92,117	170,030	87,698	69,784	110,210
p	0.83	0.83333	0.83333	0.49	0.44825	0.5354	0.55	0.4905	0.60944	0.72	0.67911	0.76735

Table 11. Mean ($\bar{x}$ and standard error) proportion of time spent in each behavior where canvasback (*Aythya valisineria*) and lesser scaup (*A. affinis*) were observed foraging and proportional behavior was quantified during 2012–2015 in the Illinois and Central Mississippi River valleys of Illinois.

Species/Year	Feed		Rest		Other		Social		Motion		Alert	
	$\bar{x}$	SE	$\bar{x}$	SE	$\bar{x}$	SE	$\bar{x}$	SE	$\bar{x}$	SE	$\bar{x}$	SE
Canvasback	**46.2%**	**0.5%**	**23.4%**	**0.4%**	**6.6%**	**0.1%**	**1.1%**	**0.2%**	**21.4%**	**0.7%**	**1.1%**	**0.2%**
2012	50.3%	6.5%	24.0%	5.5%	7.9%	1.2%	1.0%	0.3%	16.8%	3.3%	0.0%	0.0%
2013	38.7%	5.2%	31.9%	4.9%	7.2%	0.7%	1.0%	0.3%	20.9%	4.0%	0.3%	0.1%
2014	37.2%	5.1%	29.2%	5.9%	8.1%	1.0%	2.2%	1.1%	20.7%	2.7%	2.7%	1.0%
2015	58.6%	7.2%	8.7%	4.0%	3.5%	0.6%	0.3%	0.2%	27.3%	5.7%	1.6%	0.6%
Lesser Scaup	**44.2%**	**0.2%**	**26.2%**	**0.4%**	**6.0%**	**0.1%**	**0.7%**	**0.1%**	**22.1%**	**0.1%**	**0.9%**	**0.1%**
2012	35.4%	4.0%	38.0%	3.8%	8.6%	0.8%	0.7%	0.2%	16.9%	1.7%	0.6%	0.1%
2013	36.5%	3.7%	34.7%	3.6%	5.4%	0.5%	0.4%	0.1%	22.7%	2.1%	0.3%	0.1%
2014	39.7%	3.4%	20.7%	2.5%	5.1%	0.6%	1.0%	0.2%	31.3%	2.3%	2.2%	0.6%
2015	65.1%	2.9%	11.2%	2.2%	4.8%	0.6%	0.9%	0.4%	17.6%	2.0%	0.4%	0.1%

Table 12. Mean ($\bar{x}$ and standard error) biomass (kg/ha) and proportion of total food biomass by food type at locations where diving ducks were observed foraging and proportional behavior was quantified during 2012–2015 in the Illinois and central Mississippi river valleys.

Year	Benthic Invertebrate		Nektonic Invertebrate		Seeds & Tubers		Total	
	$\bar{x}$	SE	$\bar{x}$	SE	$\bar{x}$	SE	$\bar{x}$	SE
Food Density	**171.6**	**36.7**	**11.1**	**2.4**	**186.8**	**9.7**	**369.2**	**26.7**
2012	303.0	168.2	0.6	0.1	34.6	14.3	338.6	168.4
2013	285.9	91.4	2.6	0.8	212.9	52.7	501.4	98.3
2014	54.3	12.5	2.1	0.5	275.7	52	332.1	53.4
2015	43.2	17	38.9	10.1	224.0	54	304.5	57.1
Proportion	**44.3%**		**3.5%**		**52.3%**		--	
2012	89.5%		0.2%		10.2%		--	
2013	57.0%		0.5%		42.5%		--	
2014	16.4%		0.6%		83.0%		--	
2015	14.2%		12.8%		73.6%		--	

Table 13. Biomass of food at random locations across lakes, wetlands, and pools where lesser scaup (LESC; *Aythya affinis*) and canvasback (CANV; *A. valisineria*) were observed foraging by food type (benthic invertebrate, nektonic invertebrate, seed and tuber, and total) within the Illinois and Mississippi rivers during springs 2012–2015.

Year	Benthic Invertebrate		Nektonic Invertebrate		Seeds & Tubers		Total	
	$\bar{x}$	SE	$\bar{x}$	SE	$\bar{x}$	SE	$\bar{x}$	SE
Food Density	**155.2**	**43.0**	**8.6**	**4.7**	**158.6**	**18.4**	**329.1**	**45.9**
2012	197.7	65.9	2.3	1.5	63.0	17.7	263.0	66.2
2013	109.4	23.3	1.7	0.4	143.0	26.8	287.7	53.7
2014	216.2	126.2	0.3	0.1	275.5	44.4	492.0	127.6
2015	71.4	18.0	33.8	20.7	109.8	32.8	212.3	37.9
Proportion	**47.1**		**2.6**		**48.2**		--	
2012	75.2		0.9		24.0		--	
2013	38.0		0.6		49.7		--	
2014	43.9		0.1		56.0		--	
2015	33.6		15.9		51.7		--	

Table 14. Proportion of feeding sites with greater food density than random sampling sites for lesser scaup (LESC; *Aythya affinis*) and canvasback (CANV; *A. valisineria*) by food type (benthic invertebrate, nektonic invertebrate, seed and tuber, and total) within the Illinois and Mississippi Rivers during springs 2012–2015.

Location	Species	*n*	Benthos	Nekton	Seeds	Total
Illinois River	LESC	92	42%	55%	46%	53%
	CANV	31	42%	52%	52%	55%
Mississippi River	LESC	27	26%	56%	30%	19%
	CANV	16	44%	38%	38%	38%
Illinois & Mississippi Rivers	LESC	119	47%	55%	42%	45%
	CANV	47	43%	47%	47%	49%

Table 15. Number of spring-migrating diving ducks (*Aythya affinis*, n = 262; and *A. valisineria*, n = 41) consuming individual food items (percent occurrence) and mean biomass per individual (aggregate biomass) of common food items during springs 2014–2015 in the Illinois and upper Mississippi rivers.

Taxa	Percent Occurrence	Aggregate Percent
Total Animal	81.6	59.0
Amphipoda	25.0	1.0
Bivalvia	42.0	30.0
Diptera	36.0	4.0
Ephemeridae	14.0	7.0
Gastropoda	44.0	11.0
Corixidae	6.0	0.0
Insecta Parts	5.0	1.0
Isopoda	13.0	3.0
Odonata	9.0	1.0
Oligochaeta	3.0	1.0
Total Plant	65.8	41.0
Amaranthus spp.	17.0	0.0
Cyperus spp.	27.0	0.0
Echinochloa spp.	18.0	9.0
Leersia oryzoides	15.0	3.0
Polygonum spp.	18.0	1.0
Potamogeton spp.	18.0	1.0
Vallisneria americana	4.0	2.0
Tubers	5.0	25.0

Table 16. Number of spring-migrating lesser scaup (*Aythya affinis*, n = 262) consuming individual food items (percent occurrence) and mean biomass per individual (aggregate biomass) of common food items with mean food availability (kg/ha) and rankings of dominant items during springs 2014–2015 in the Illinois and upper Mississippi rivers.

Taxa	Percent Occurrence	Aggregate Percent	Aggregate Rank	Food Availability	Availability Rank
Dreissena polymorpha	21.0	13.0	1	39.89	2
Chironomidae	37.0	11.0	2	11.21	7
Potamogeton spp.	19.0	10.0	3	27.62	4
Sphaeriidae	27.0	8.0	4	4.55	14
Echinochloa spp.	18.0	8.0	4	38.8	3
Physiidae	29.0	7.0	5	0.72	34
Polygonum spp.	19.0	6.0	6	20.2	5
Amphipoda	30.0	5.0	7	0.09	60
Leersia oryzoides	17.0	5.0	8	3.4	19
Isopoda	15.0	4.0	9	0.36	44
Lymnaeidae	7.0	3.0	10	0.26	50
Oligochaeta	3.0	3.0			
Cyperus spp.	30.0	3.0			
Quadrula	4.0	2.0			
Hydrobiidae	9.0	2.0			
Planorbidae	17.0	2.0			
Ephemeridae	9.0	1.0			
Valvatidae	7.0	1.0			
Viviparidae	10.0	1.0			
Corixidae	7.0	1.0			
Insecta Parts	6.0	1.0			
Odonata	11.0	1.0			
Amaranthus spp.	19.0	1.0			
Vallisneria americana tubers	2.0	1.0			
Cyperus escuelentus tubers	1.0	0.0			
Vallisneria americana	1.0	0.0			
Total animal	82.0	66.0			
Total plant	68.0	34.0			

Table 17. Number of spring-migrating canvasbacks (*Aythya valisineria*, n = 41) consuming individual food items (percent occurrence) and mean biomass per individual (aggregate biomass) of common food items with mean food availability (kg/ha) and rankings of dominant items during springs 2014–2015 in the Illinois and upper Mississippi rivers.

Taxa	Percent Occurrence	Aggregate Percent	Aggregate Rank	Food Availability	Availability Rank
Ephemeridae	44.0%	25.0%	1	2.09	22
Vallisneria americana tubers	20.0%	17.0%	2	6.22	12
Sphaeriidae	32.0%	16.0%	3	4.55	14
Echinochloa spp.	15.0%	10.0%	4	38.8	3
Potamogeton spp.	12.0%	7.0%	5	27.62	4
Chironomidae	34.0%	6.0%	6	11.21	7
Quadrula	12.0%	5.0%	7	1.19	28
Cyperus spp.	15.0%	4.0%	8	3.43	18
Dreissena polymorpha	12.0%	3.0%	9	39.89	2
Cyperus escuelentus tubers	2.0%	2.0%	10	10.2	9
Leersia oryzoides	5.0%	2.0%			
Amphipoda	2.0%	1.0%			
Physiidae	5.0%	1.0%			
Vallisneria americana	2.0%	1.0%			
Hydrobiidae	2.0%	0.0%			
Lamnaeidae	2.0%	0.0%			
Planorbidae	10.0%	0.0%			
Valvatidae	2.0%	0.0%			
Viviparidae	10.0%	0.0%			
Corixidae	2.0%	0.0%			
Insecta Parts	5.0%	0.0%			
Isopoda	2.0%	0.0%			
Odonata	0.0%	0.0%			
Oligochaeta	2.0%	0.0%			
Amaranthus spp.	7.0%	0.0%			
Polygonum spp.	7.0%	0.0%			
Total animal	80.0%	57.0%			
Total plant	56.0%	43.0%			

Table 18. Sampling locations of lesser scaup (*Aythya affinis*) and canvasbacks (*A. valisineria*) during springs 2014–2015 along with an index of foraging habitat quality (daily lipid dynamics; DLD), number of samples collected, and densities (kg/ha[dry]) of seeds and tubers (plant), invertebrates, and combined (overall) that are typically consumed by diving ducks.

Location	DLD	n	Benthos	Nekton	Seeds	Overall
Central Illinois River	**-7.3**	**201**	**102.7**	**18.7**	**228.1**	**349.5**
Anderson Lake SFWA	-6.1	9	30.0	4.6	426.5	461.1
Babb's Slough	-2.2	7	103.7	3.5	7.4	114.7
Bath Lake	-11.1	11	213.9	0.8	381.2	595.9
Big Lake	1.3	7	219.8	7.9	82.7	310.4
Billsbach	-27.2	1	129.6	99.4	2.3	231.3
Chain Lake	10.2	23	8.0	1.0	93.3	102.3
Chautauqua NWR	-14.5	30	250.2	7.3	97.2	354.7
Clear Lake	-23.4	2	9.5	2.4	14.4	26.2
Emiquon NWR-Wilder Unit	38.2	3	24.4	3.0	710.5	737.9
Emiquon Preserve	-10.2	35	62.8	30.8	272.4	364.7
Lower Peoria Lake	-9.3	11	211.5	0.0	290.2	501.7
Meredosia Lake	-10.0	4	54.1	2.3	22.6	79.0
Merwin Preserve	3.2	1	9.9	0.2	449.9	460.0
Moscow Bay	17.4	5	337.9	63.2	258.0	659.1
Otter Lake/Cuba Island	-19.4	3	103.2	0.2	721.7	825.1
Quiver Creek	-10.3	14	134.5	20.2	151.6	306.2
Hennepin and Hopper Lakes	-5.9	17	34.4	37.2	251.5	323.1
Upper Peoria Lake	-27.5	2	7.6	98.4	1.7	107.6
Wightman Lake	-15.1	3	21.7	6.8	2.4	30.9
Woodford/Marshall Co. SFWA	-33.8	7	128.3	2.6	10.6	141.5
Worley Lake	1.9	6	61.3	1.0	543.0	605.3
Illinois/Mississippi River Confluence	**-25.8**	**43**	**35.4**	**2.1**	**235.1**	**272.6**
Mississippi River SFWA-Fowler Lake	-30.7	6	58.4	0.9	151.5	210.7
Mississippi River SFWA-Fuller Lake	-29.6	11	41.4	0.5	335.9	377.8
Mississippi River SFWA-Godar Unit	-20.3	3	16.6	0.2	176.6	193.5
Swan Lake NWR	-22.6	23	25.2	6.6	276.5	308.3
Mississippi River Pool 19	**-4.3**	**69**	**25.2**	**2.1**	**36.5**	**63.5**
Dam at Hamilton, IL	22.7	1	18.6	1.5	13.5	33.6
Reed's Landing at Nauvoo, IL	-18.3	16	23.1	2.9	16.4	41.8
Sheridan to Larry Creeks	-17.2	41	33.8	1.8	79.4	115.1
Illinois/Central Mississippi River Valley Total	**-12.5**	**313**	**54.4**	**7.6**	**166.6**	**228.5**

Table 19. Sampling locations of lesser scaup (*Aythya affinis*) during springs 2014–2015 along with an index of foraging habitat quality (daily lipid dynamics; DLD), number of samples collected, and densities of seeds and tubers (seeds), invertebrates, and combined (Overall) that are typically consumed by diving ducks.

Location	DLD	n	Benthos	Nekton	Seeds	Overall
Central Illinois River	**-8.2**	**173**	**112.4**	**16.3**	**204.9**	**331.1**
Anderson Lake SFWA	-27.7	4	32.3	5.1	425.5	462.9
Babb's Slough	-2.2	7	103.7	3.5	7.4	114.7
Bath Lake	-11.3	9	255.3	0.7	412.7	668.8
Big Lake	1.3	7	219.8	7.9	82.7	310.4
Billsbach	-27.2	1	129.6	99.4	2.3	231.3
Chain Lake	17.7	20	3.3	1.0	2.3	231.3
Chautauqua NWR	-16.0	27	65.3	7.0	14.4	26.2
Clear Lake	-23.4	2	9.5	2.4	102.3	106.6
Emiquon NWR-Wilder Unit	8.6	2	3.7	4.2	2.4	30.9
Emiquon Preserve	-15.9	29	69.0	33.3	109.0	181.3
Lower Peoria Lake	-9.4	9	211.5	0.0	811.7	850.1
Meredosia Lake	-10.0	4	54.1	2.3	0.0	27.8
Merwin Preserve	3.2	1	9.9	0.2	22.6	79.0
Moscow Bay	23.9	3	761.9	1.8	449.9	460.0
Otter Lake/Cuba Island	-8.4	2	103.2	0.2	143.5	907.2
Quiver Creek	6.2	8	75.0	25.9	721.7	825.1
Hennepin and Hopper Lakes	-7.2	16	33.9	38.0	195.8	296.1
Upper Peoria Lake	-27.5	2	7.6	98.4	183.3	284.2
Wightman Lake	-15.1	3	21.7	6.8	1.7	107.6
Woodford/Marshall Co. SFWA	-33.8	7	128.3	2.6	601.6	609.5
Worley Lake	1.9	6	61.3	1.0	10.6	141.5
Illinois/Mississippi River Confluence	**-26.2**	**41**	**35.9**	**1.8**	**242.0**	**279.7**
Mississippi River SFWA-Fowler Lake	-30.7	6	58.4	0.9	151.5	210.7
Mississippi River SFWA-Fuller Lake	-29.6	11	41.4	0.5	335.9	377.8
Mississippi River SFWA-Godar Unit	-20.3	3	16.6	0.2	176.6	193.5
Swan Lake NWR	-24.1	21	27.4	5.5	304.0	336.9
Mississippi River Pool 19	**-19.9**	**41**	**26.1**	**2.0**	**43.2**	**71.1**
Reed's Landing at Nauvoo, IL	-20.0	11	22.6	2.9	18.2	43.3
Sheridan to Larry Creeks	-19.8	19	29.7	1.1	68.1	98.9
Illinois/Central Mississippi River Valley Total	**-18.1**	**255**	**58.1**	**6.7**	**163.4**	**227.3**

Table 20. Sampling locations of canvasbacks (*Aythya valisineria*) during springs 2014–2015 along with an index of foraging habitat quality (daily lipid dynamics; DLD), number of samples collected, and densities of seeds and tubers (seeds), invertebrates, and combined (Overall) that are typically consumed by diving ducks.

Location	DLD	n	Benthos	Nekton	Seeds	Overall
Central Illinois River	**6.5**	**26**	**146.2**	**17.6**	**270.8**	**434.6**
Anderson Lake SFWA-Carlson Unit	26.6	1	3.9	2.9	659.1	665.9
Bath Lake	-18.4	1	7.0	1.1	223.7	231.8
Chain Lake	-39.5	3	54.8	0.1	4.1	58.9
Chautauqua NWR	-0.4	3	878.9	6.1	66.8	951.9
Emiquon NWR-Wilder Unit	97.5	1	24.4	3.0	710.5	737.9
Emiquon Preserve	17.6	6	46.8	19.5	371.1	437.5
Lower Peoria Lake	-8.7	2	44.4	0.9	29.6	74.9
Moscow Bay	7.7	2	19.9	109.3	343.8	473.0
Quiver Creek	-32.2	6	344.5	0.2	131.2	475.9
Hennepin and Hopper Lakes	14.2	1	37.0	33.1	167.9	238.0
Illinois/Mississippi River Confluence	**-7.0**	**2**	**2.7**	**17.9**	**1.1**	**21.8**
Swan Lake NWR	-7.0	2	2.7	17.9	1.1	21.8
Mississippi River Pool 19	**-2.3**	**28**	**36.3**	**1.3**	**34.3**	**71.8**
Dam at Hamilton, IL	22.7	1	18.6	1.5	13.5	33.6
Reed's Landing at Nauvoo, IL	-14.6	5	48.7	1.0	6.1	55.4
Sheridan to Larry Creeks	-15.0	22	33.0	2.4	73.3	108.7
Illinois/Central Mississippi River Valley Total	**-1.0**	**56**	**61.7**	**12.3**	**102.0**	**176.0**

Table 21. Lesser scaup (LESC; *Aythya affinis*) and canvasbacks (CANV; *A. valisineria*) captured and banded at Emiquon Preserve and Chautauqua National Wildlife Refuge (NWR) in the Illinois River valley during spring 2012–2015 with mean apparent stopover duration (days).

Species	Year	Sex	*n*	Location	Dates	Recaptures	
						n	Days
LESC	2012	Male	823	Emiquon Preserve	2–8 Mar	---	---
		Female	174	Emiquon Preserve	2–8 Mar	---	---
		Total	**997**				
	2013	Male	368	Emiquon Preserve	9–14 Mar	---	---
		Female	31	Emiquon Preserve	9–14 Mar	---	---
		Male	578	Chautauqua NWR	12–14 Mar	---	---
		Female	52	Chautauqua NWR	12–14 Mar	---	---
		Total	**1,029**				
	2014	Male	1670	Emiquon Preserve	13 Mar–14 Apr	178	6.3
		Female	264	Emiquon Preserve	13 Mar–14 Apr	30	4.6
		Male	440	Chautauqua NWR	24 Mar–14 Apr	196	8.4
		Female	114	Chautauqua NWR	24 Mar–14 Apr	59	7.1
		Total	**2,488**			**463**	**7.1**
	2015	Male	1,607	Emiquon Preserve	10–29 Mar	967	9.3
		Female	210	Emiquon Preserve	10–29 Mar	143	9.7
		Male	1,062	Chautauqua NWR	21–29 Mar	741	10.8
		Female	142	Chautauqua NWR	21–29 Mar	65	9.0
		Total	**3,021**			**1,917**	**9.8**
CANV	2012	Male	4	Emiquon Preserve	2–6 Mar	---	---
		Female	4	Emiquon Preserve	2–6 Mar	---	---
		Total	**8**				
	2013	Male	7	Emiquon Preserve	9–12 Mar	---	---
		Female	5	Emiquon Preserve	9–12 Mar	---	---
		Total	**12**				
	2014	Male	3	Emiquon Preserve	13–14 Mar	1	---
		Total	**3**				
	2015	Male	9	Emiquon Preserve	10 Mar–11 Apr	1	---
		Female	2	Emiquon Preserve	10 Mar–11 Apr		
		Male	5	Chautauqua NWR	21–26 Mar	1	---
		Female	5	Chautauqua NWR	21–26 Mar	1	---
		Total	**21**			**2**	

Figure 7. Transects and strata used along Pool 19 of the Mississippi River during aerial surveys of diving ducks in March and April 2013 (left) and 2014–2015 (right).

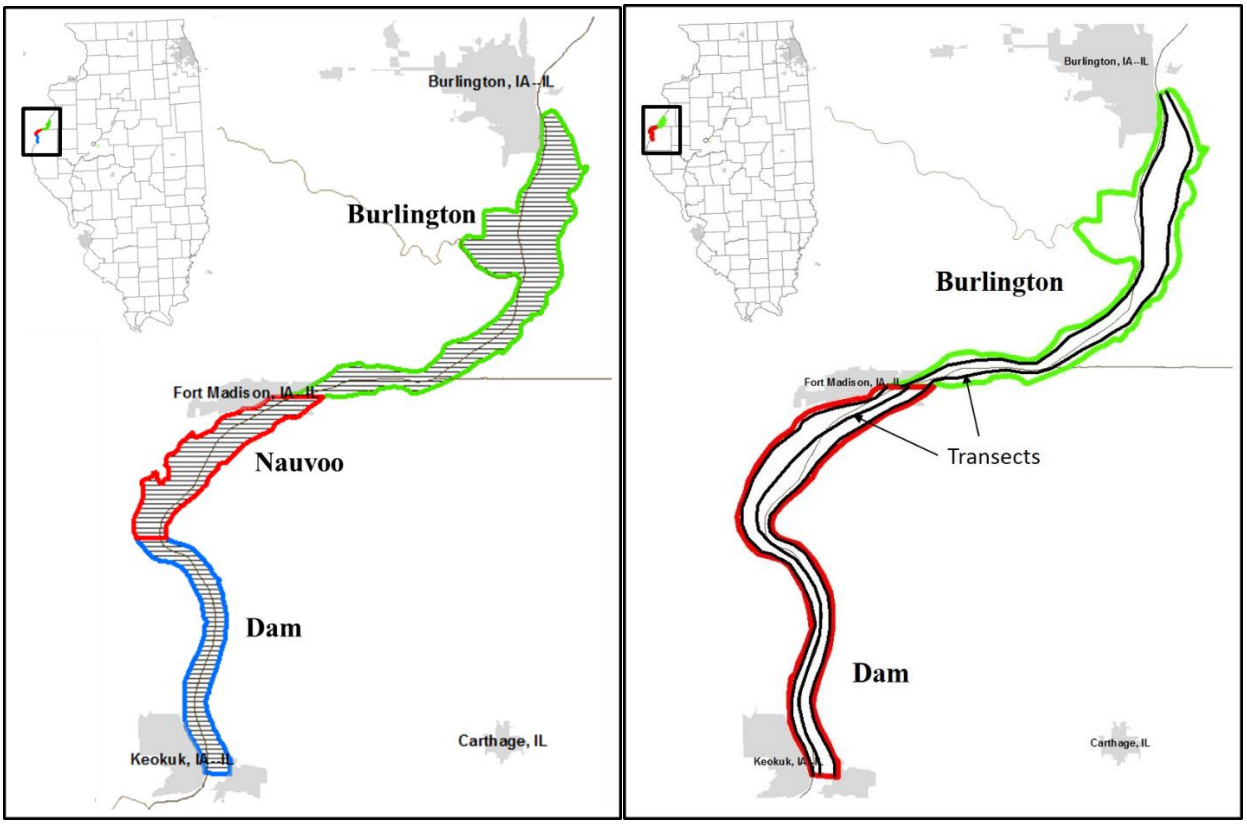


Figure 8. Transects (n = 5) surveyed along La Grange Pool of the Illinois River during aerial transect surveys of waterbirds in March and April 2015.

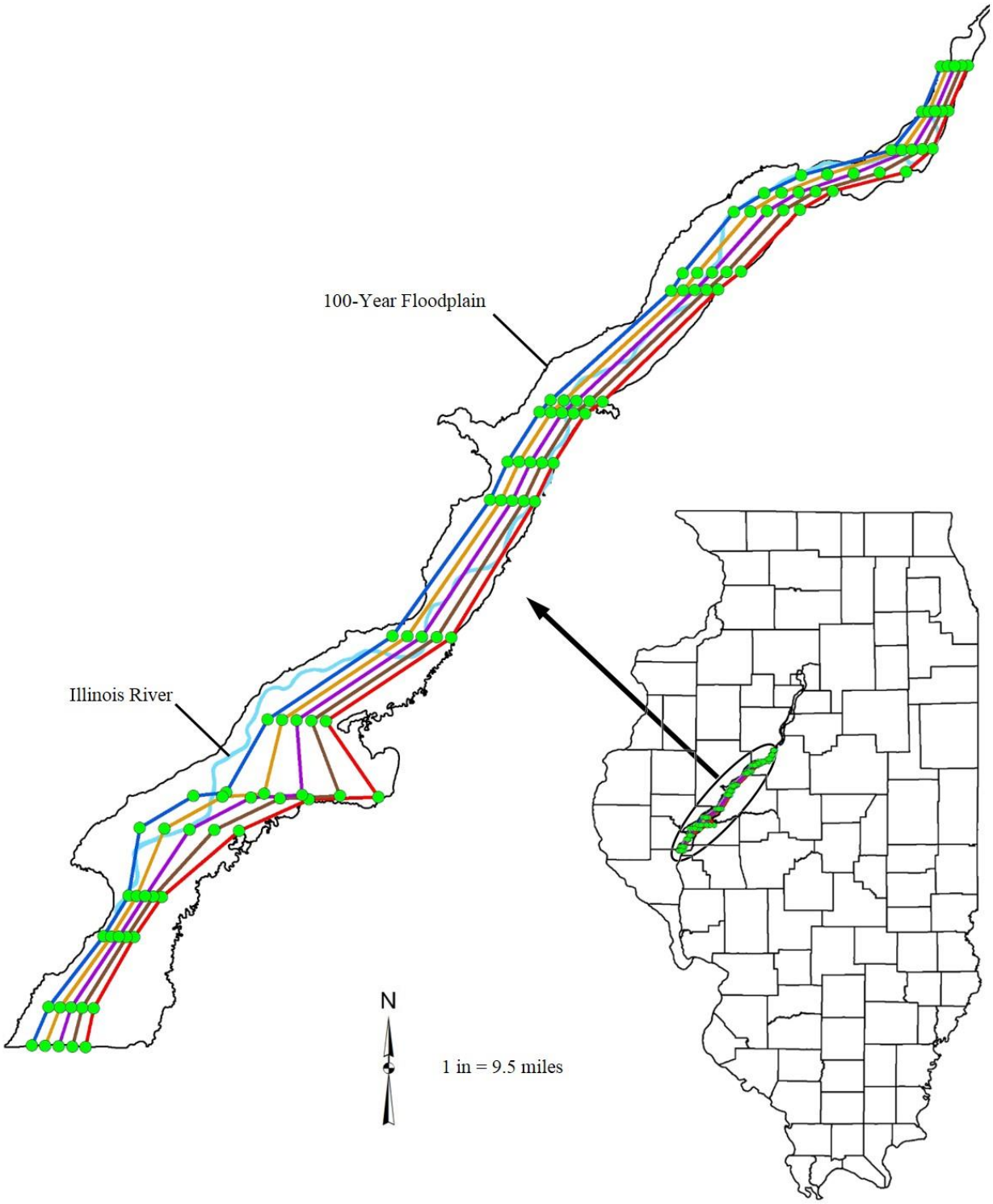


Figure 9. Average total food biomass from core and sweep samples combined (± SE) collected at behavioral scan sites for lesser scaup (*Aythya affinis*) and canvasbacks (*A. valisineria*) in the Illinois and Mississippi river valleys during 2012–2015.

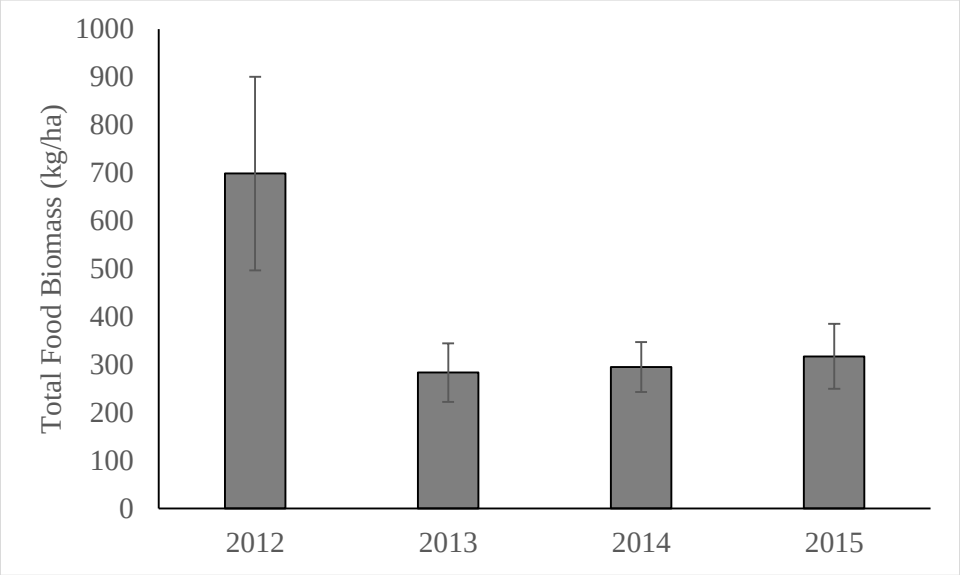


Figure 10. Average proportion of individuals engaged in foraging (± SE) during behavioral scans of lesser scaup (*Aythya affinis*) and canvasbacks (*A. valisineria*) in the Illinois and Mississippi river valleys during 2012–2015.

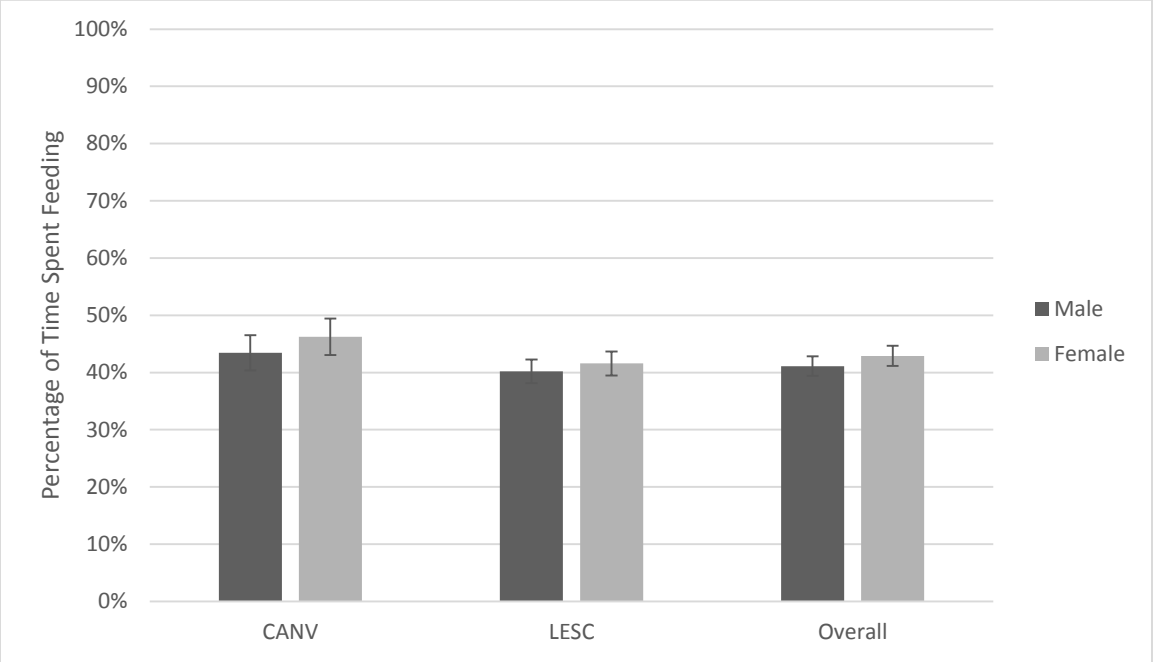


Figure 11. Proportion of time spent feeding by lesser scaup (*Aythya affinis*) and canvasbacks (*A. valisineria*) compared to total food biomass in the Illinois and Mississippi river valleys during 2012–2015.

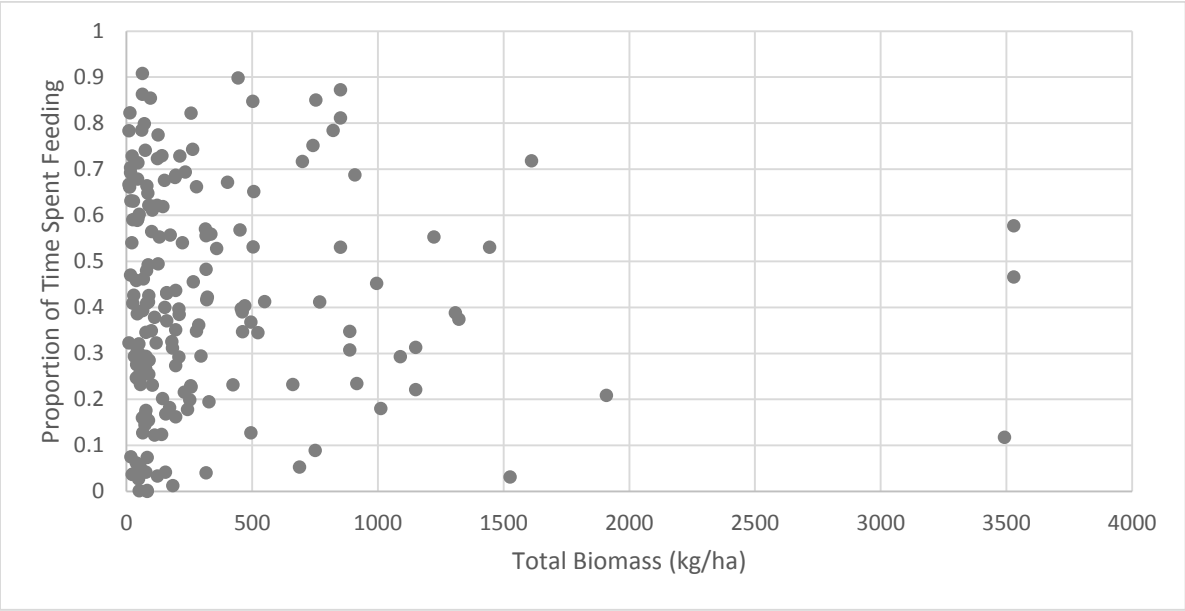


Figure 12. Proportion of time spent feeding by lesser scaup (*Aythya affinis*) and canvasbacks (*A. valisineria*) compared to benthic invertebrate biomass in the Illinois and Mississippi river valleys during 2012–2015.

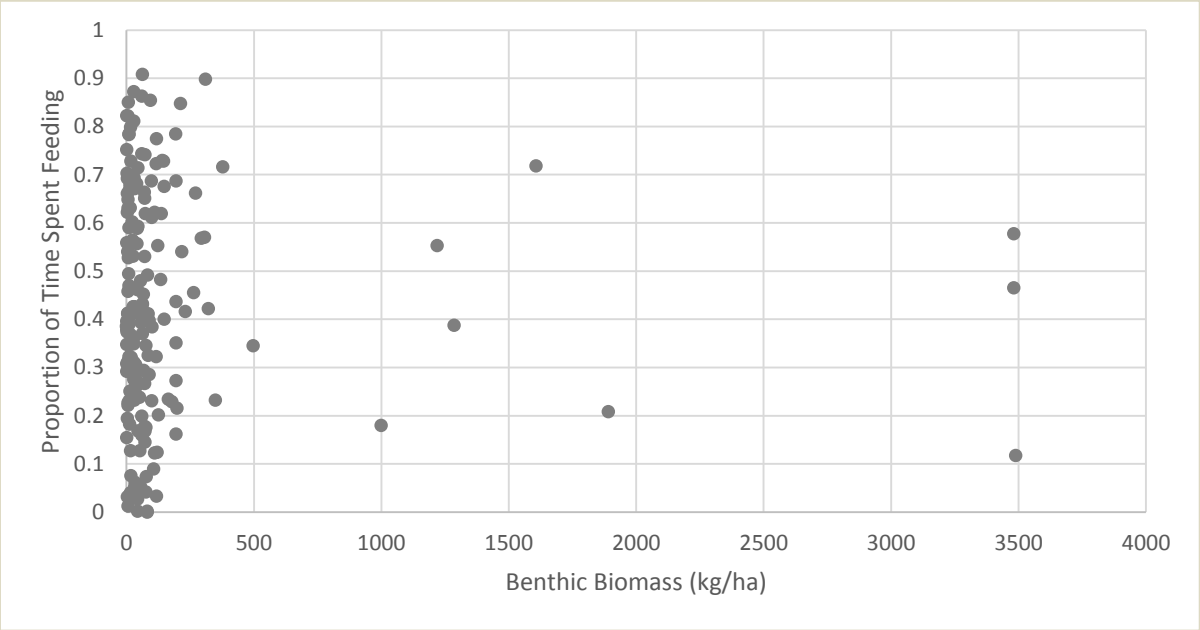


Figure 13. Proportion of time spent feeding by lesser scaup (*Aythya affinis*) and canvasbacks (*A. valisineria*) compared to seed and tuber biomass in the Illinois and Mississippi river valleys during 2012–2015.

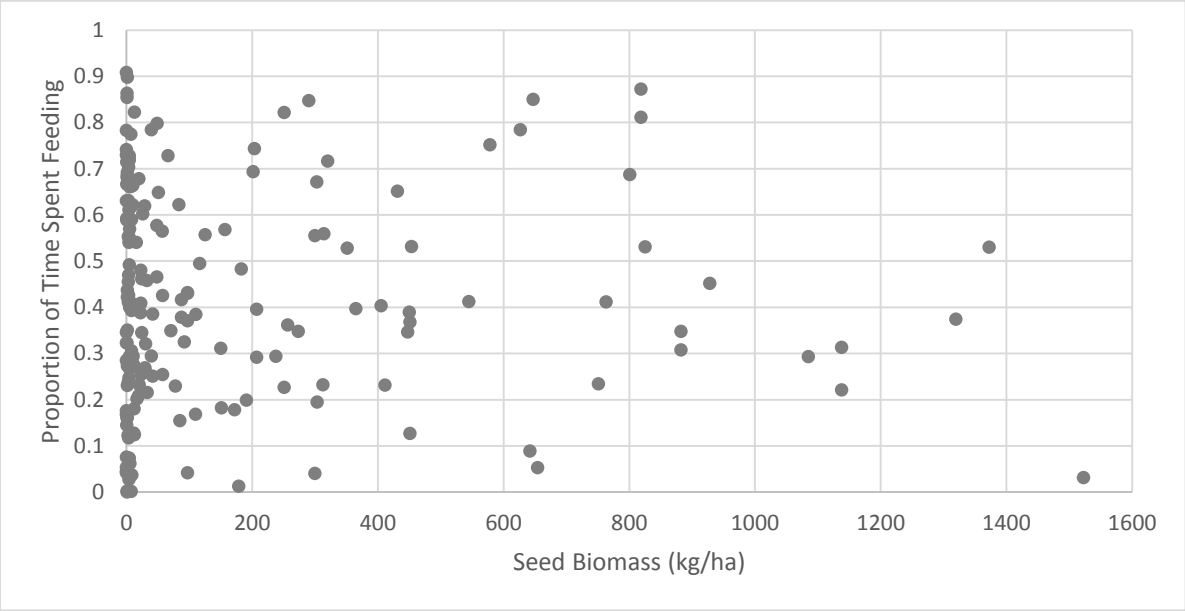


Figure 14. Proportion of time spent feeding by lesser scaup (*Aythya affinis*) and canvasbacks (*A. valisineria*) compared to nektonic invertebrate biomass in the Illinois and Mississippi river valleys during 2012–2015.

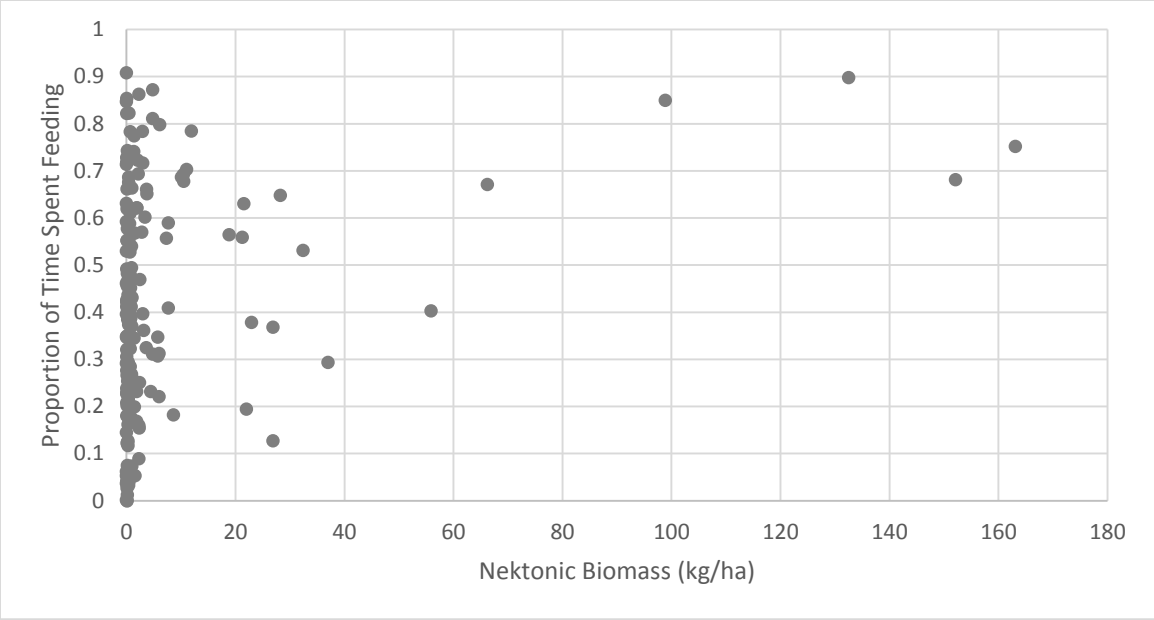
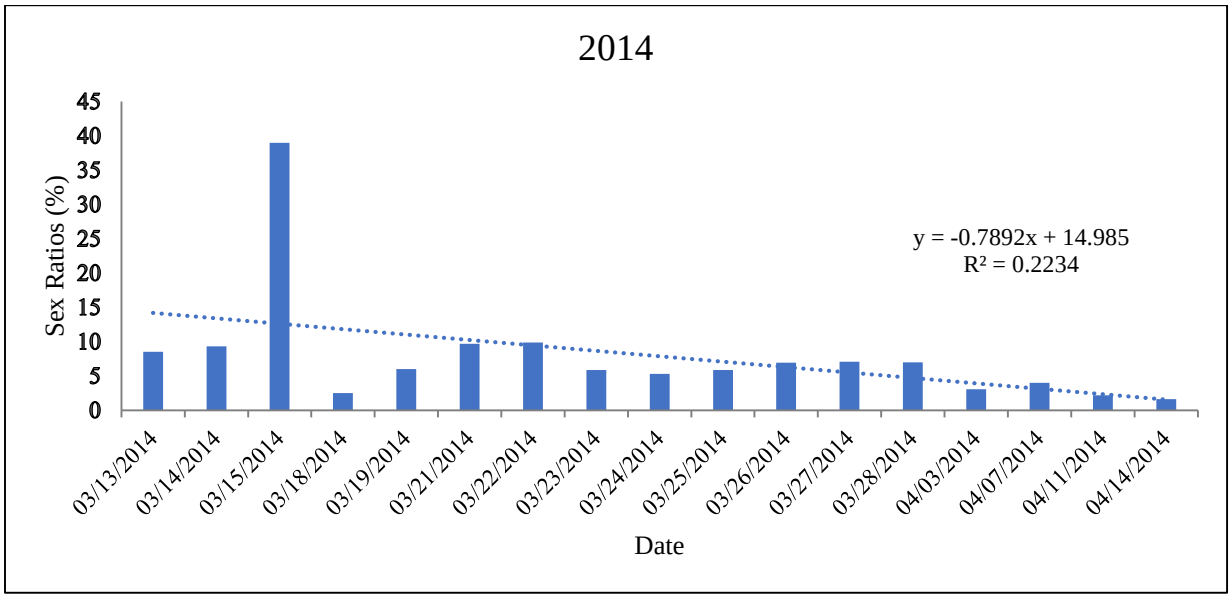


Figure 15. Trends in sex ratios (male:female) of lesser scaup (*Aythya affinis*) captured and banded in the Illinois River valley during springs 2014–2015.



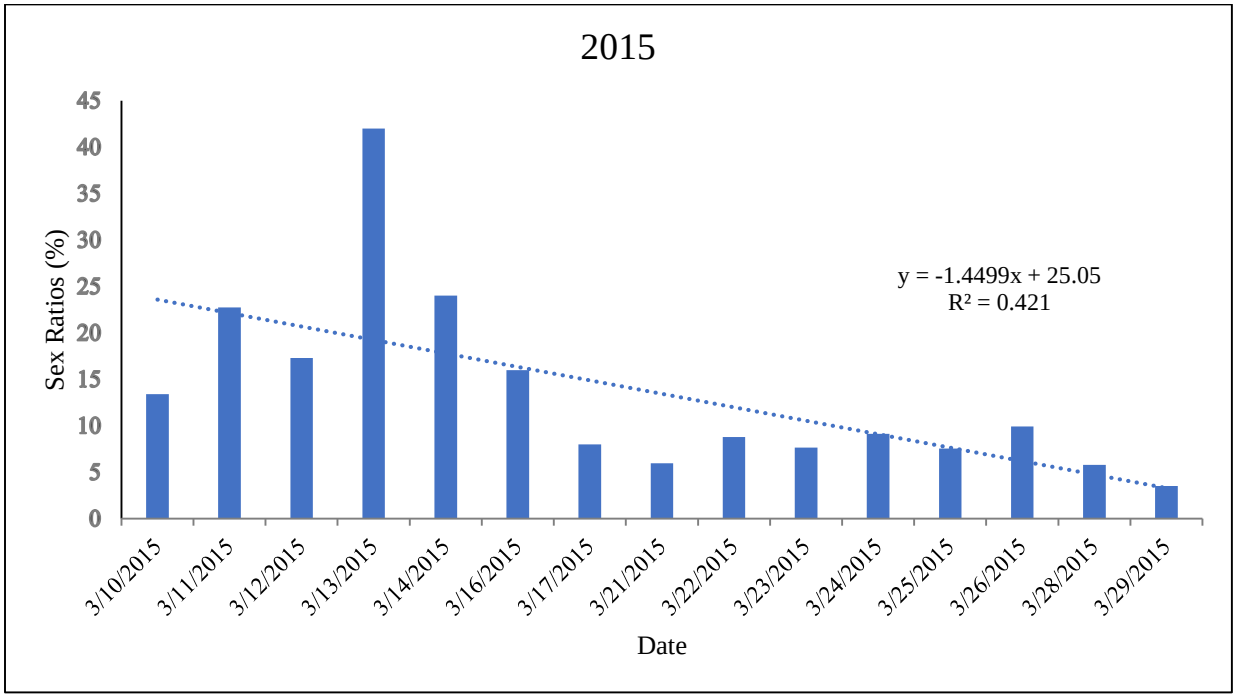
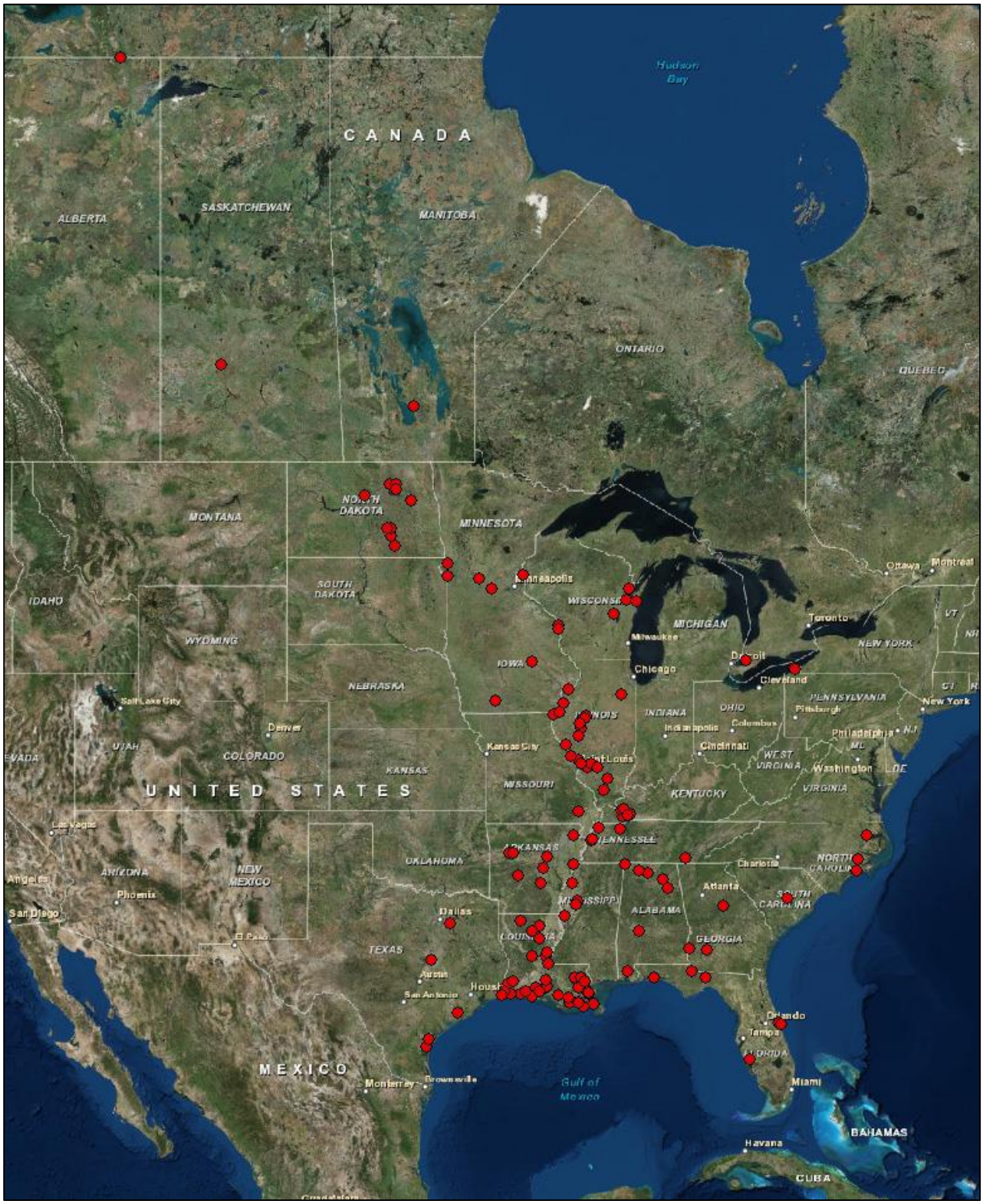


Figure 16. Distribution of leg-band recoveries of lesser scaup (*Aythya affinis*) banded along the Illinois River at Chautauqua National Wildlife Refuge and the Emiquon Preserve near Havana, IL during spring 2012–2015.



JOB 120: EVALUATION OF AN AERIAL QUADRAT WATERFOWL SURVEY ALONG THE ILLINOIS RIVER

Objectives: 1) Evaluate feasibility and cost of an aerial quadrat waterfowl survey along the Illinois River compared to traditional aerial inventories (Job 118).

2) Estimate bias in traditional aerial waterfowl inventories.

3) Determine sample size necessary to yield target level of precision (<20%) and factors affecting precision.

Introduction

Aerial counts of waterfowl have been conducted along the Illinois River of Illinois since 1948. Methodologies have remained the same since initiation of the survey, making the survey a reliable index of waterfowl abundances over time (Havera 1999). A myriad of stakeholders use aerial survey data of waterfowl for recreation, research, conservation planning, and administrative purposes (see Study 118). However, there is increasing need to estimate actual population size by using a randomized survey design and incorporating methods which allow determination of detection probability (Pearse et al. 2008*a*,*b*). In fact, conservation planners seek population estimates of waterfowl in order to prioritize wetland habitat conservation and management activities across the state and the region (Soulliere et al. 2007, Schultheis and Eichholz 2013).

An evaluation of long-term aerial surveys conducted by the INHS and IDNR are needed to determine bias in relation to actual population sizes. Two projects have recently been completed to evaluate aerial survey designs for rivers with an associated floodplain. Hennig et al. (2013) used a quadrat survey design consisting of 2.6 km2 (1-mi^2) sections (i.e., sample units) to enumerate waterfowl along the Wabash River in southeastern Illinois and recommended this approach for riverine areas. Shirkey (2012) recommended transect surveys with distance methods for estimating population sizes of diving ducks, but Hagy et al. (2013) used transect surveys perpendicular to the river course on Pool 19 of the Mississippi River and concluded that distance methods produced highly variable and unrealistic population sizes. Unlike transect surveys, quadrat surveys allow observers to use natural reference points on the landscape (e.g., mile sections) and are logistically compatible with currently available low-winged aircraft. Moreover, transect surveys in river systems require frequent turns and may be less economical and taxing on personnel than a quadrat design.

Given consistent methodology for more than 60 years and uniqueness of the long-term data set (see Study 118), a concurrent evaluation of a new survey design with existing traditional aerial inventory methods is needed. Evaluating and refining a new survey design concurrent with an existing inventory design will allow comparisons between counts and estimates. Understanding this relationship will provide a linkage between estimates produced by new aerial surveys and counts produced using traditional methods.

Methods

Abundance

We delineated our study area from Hennepin to Meredosia, IL, using the 100-year floodplain of the Illinois River as determined by the Illinois State Water Survey. Using ArcMap 10.2, we generated a grid of 1-mi^2 quadrats (n = 432) and layered the boundary shapefile on a second shapefile outlining the typical concentration areas of waterbirds within core survey locations inventoried under Job 118. We excluded Upper Peoria Lake, Goose Lake (Fulton County), and Spunky Bottoms from core areas because of their lack of ducks during waterfowl hunting season. During early flights, we determined that we could survey approximately 60 quadrats per day within our study area. From the population of "core" quadrats which were within the 100-year floodplain and overlapped an area where waterfowl concentrations during fall were typically high (n = 73; *c.f.* high density stratum from Pearse et al. [2008*a*]), we randomly selected at least one quadrat overlapping each traditional aerial survey location each week until 25 were selected. Larger sites which typically hosted large concentrations of waterfowl, such as Chautauqua National Wildlife Refuge and Emiquon Preserve, had more than one "core" quadrat each week. Additionally, we randomly selected 25 quadrats that did not overlap core locations but were within the 100-year floodplain of the Illinois River (n = 359; low density stratum). Following waterfowl enumeration and identification within each of the 50 quadrats, we re-surveyed 10 randomly selected quadrats from within the core stratum to determine if time-of day influenced counts. We used ArcMap spatial analyst to generate kernel density estimates of total duck abundance that illustrate the spatial distribution of waterfowl in the IRV.

We flew aerial quadrat surveys from a single-engine, fixed-wing aircraft flying approximately 241 kph (150 mph) and 91 m (300 ft) above ground level. We flew quadrat surveys the day following traditional waterfowl aerial inventories (Study 118) unless prevented by weather, but for comparison both inventory and quadrat surveys were always flown within the same week. A pilot plus two observers flew a diagonal from the NE to SW corner and around

the outside of each 1-mi^2 quadrat. The front seat observer estimated waterbird abundances by species while the rear seat observer recorded habitat information from within the 1-m^2 quadrat (e.g., inundated, woody vegetation, open water, herbaceous vegetation, ice coverage).

We compared abundance estimates between the traditional survey methods (Study 118) and the aerial quadrat design. Quadrat observations that included fewer than 50 individuals were excluded from analyses due to their disproportionate impact on the final results. Differences between aerial survey methods were calculated using the equation:

$$\% \, Difference = \frac{I - G}{I} * 100$$

where I = the estimate from the aerial inventory and G = the estimate from the aerial quadrat survey. Results are presented in relation to the traditional aerial inventory. Counts from locations where individuals did not occur in both survey types were excluded. Means and standard errors were calculated by species and location.

Additionally, we attempted to determine waterbird abundance estimates during aerial quadrat surveys from photographs collected from a camera mounted to the fuselage of the aircraft. While flying the diagonal of each quadrat, the rear seat observer operated the photographic equipment. Once activated at the edge of the quadrat, the camera was programed to take a photo every 0.81 seconds totaling 42 photos across the diagonal leg of the quadrat. Photos were taken at a rate that each photo lined up to the edge of the next photo, creating a sequence that covered the entire diagonal of the quadrat. With the plane flying at an elevation of ~91 m (300 ft), we estimated the area of each photo was 0.28 ha. If this method produces reasonable abundance estimates, it can be used to determine detection probability in the future.

We successfully collected photos on 6 surveys during fall 2014 on a total of 236 quadrats. Due to the impracticalities of maintaining a constant speed, elevation, and heading while flying the quadrat, not every photo was analyzed. The first and last five photos taken per quadrat were not photo-interpreted to eliminate photos occurring outside the quadrat. Additionally, we determined duck abundance in every other photo to eliminate the possibility of double counting birds in overlapping photos. Therefore, 16 pictures were photo-interpreted per quadrat. We enumerated waterbird abundance in each photo using the count tool in Adobe Photoshop. All birds were identified to species if possible. Birds that could not be identified to species were identified to the lowest possible taxonomic group (e.g., dabbler, diver, duck, goose, swan). We averaged number of individual waterbirds per photo for each major taxonomic grouping (e.g., waterfowl, ducks, geese, swans, American Coot) within each quadrat. We multiplied the average

number of individuals per photo for each major taxonomic group by 941.2 (259 ha/0.28 ha) to calculate the number of birds per quadrat. We then calculated percent error by comparing waterbird numbers detected via photos to aerial estimates for each quadrat. Percent errors were averaged to determine a mean percent error for each taxonomic group.

We used double observer methods to determine detection probability during traditional aerial inventories and quadrat surveys (Bart and Earnst 2002). Immediately before an aerial survey, a ground observer enumerated all waterbirds within a discrete area by species from an elevated location where visibility was unobstructed by vegetation or infrastructure. Due to the large size of the quadrats (1 mi^2) and inability of ground observers to view entire quadrats, most ground survey locations were comparably small (<25 ha) and well defined areas that could be counted effectively. When possible, we used natural landmarks as boundaries (e.g., shorelines, levees, vegetation) to define a survey location. When natural landmarks were not present, we used buoys (e.g., brightly painted duck decoys) to define plot boundaries. Before surveys, we provided both aerial and ground observers a map of the survey location. When possible, discrete ground locations were nested within quadrats or traditional census locations. We used optics (e.g., spotting scope, binoculars) to tally all waterbirds present in the survey location. All individuals were identified to species or smallest possible taxonomic group (e.g., dabbling duck, diving duck, goose, grebe, gull).

Disturbance

While conducting ground surveys, we documented disturbance to waterbirds presumably attributable to the aerial survey. Ground observers counted and recorded the number of each species within each count area that 1) exhibited a noticeable response to the airplane (e.g., flew but settled back in the survey area, dove under water, ran across the water but remained in the survey area) and 2) abandoned the plot completely and did not immediately return during or immediately following aerial surveys. We also estimated the distance abandoning birds traveled when they abandoned the survey area. We determined disturbance rates for all waterfowl species and American coot.

Results

Detection Probability

We compared aerial estimates to ground counts to calculate a detection rate (Table 22). The aerial observer had an average detection rate of 100.1% (SE = 22%) for all waterfowl resulting in a correction factor of 0.999 (essentially 1.0). On average, ducks were overestimated by 15% (average detection rate = 115.1%, SE = 18%) resulting in a correction factor of 0.87

Dabbling ducks were overestimated by 15% (average detection rate = 115.2%, SE = 22%,) with a correction actor of 0.87, diving ducks were underestimated by 4% (average detection rate = 95.6%, SE = 37%,) with a correction factor of 1.05, and mergansers were underestimated by 49% (average detection rate = 50.7%, SE = 25%,) with a correction factor of 1.97. On average, geese were underestimated by 7% (average detection rate = 93.0%, SE = 15%) and had a correction factor of 1.08. Swans were underestimated by 25% (average detection rate = 75.0%, SE = 25%) with a correction factor of 1.3. American coot were overestimated by 18% (average detection rate = 117.9%, SE = 43%) with a correction factor of 0.85.

Our data show that photo-estimated numbers for all waterfowl were greater than that of aerial estimates with an average percent error of 99.9% (SE = 45). Ducks had an average percent error of 93.1% (SE = 46%), geese had an average percent error of 255.2% (SE = 82%), and swans had an average percent error of 600.7% (SE = 119%). Our photo interpreted estimates of American coot abundance were lower than that of aerial estimates with and average percent error of -83.2% (SE = 6%).

Disturbance

We determined that on average 13.1% (SE = 4%) of waterfowl were disturbed by aerial surveys and 5.6% (SE = 3%) of waterfowl abandoned the survey site completely. For ducks, we estimated 7.5% (SE = 3%) were disturbed (dabbling ducks = 9.7% [SE = 4%], diving ducks = 3.7% [SE = 2%], mergansers = 4.5% [SE = 3%]) and 2.7% (SE = 2%) abandoned the survey site (dabbling ducks = 1.2% [SE = 1%], diving ducks = 2.8% [SE = 8%], mergansers = 4.5% [SE = 3%]). For geese, on average 11.1% (SE = 5%) were disturbed and 4.8% (SE = 4%) abandoned the survey site. American coot and swans were not disturbed by aerial surveys (Table 23).

We identified differences in disturbance rates of quadrat surveys and traditional inventory-style surveys. Each had similar disturbance rates for all waterfowl species combined; quadrat surveys had a disturbance rate of 13.1% (SE = 4%) and an abandonment rate of 5.2% (SE = 3%) while traditional area surveys had a disturbance rate of 13.2% (SE = 7%) and an abandonment rate of 6.1% (SE = 6%) for total ducks. However, other than swans and American coot that were not influenced by surveys, we identified that ducks had greater disturbance rates during quadrat surveys (disturbance rate = 15.6% [SE = 5%], abandoning rate = 5.4% [SE = 3%]) than during traditional area surveys (disturbance rate = 0.1% [SE = 0%], abandoning rate = 0% [SE = 0%]). In contrast, geese were more disturbed during the traditional area surveys (disturbance rate = 18.8% [SE = 10%], abandoning rate = 8.7% [SE = 8%]) than during the quadrat surveys (disturbance rate = 1.5% [SE = 1%], abandoning rate = 0.0% [SE = 0%]).

Abundance at Traditional Survey Sites

We identified highly variable error rates in site-based estimates from quadrat surveys. Errors ranged from -2,376.4% (Senachwine) to 63.7% (Jack Lake) for total waterbirds (Table 24). Senachwine consistently had more between-survey error than other sites, with the second-most extreme value coming from Big Prairie (-427.5%) for total waterbirds. Senachwine also had the most negative survey error for mallards (*Anas platyrhynchos*; -4,813.5%), while Grass Lake displayed the most positive error (98.3%). The location exhibiting the least amount of between-survey error was Goose Lake – Putnam County, which had a difference of -1.1% for total ducks and 0.4% for total waterbirds. Between-survey error was positive at 38% of the locations, indicating aerial inventory estimates were frequently lower than quadrat survey estimates.

Overall Abundance

When we combined all locations in the IRV, error between the two survey types ranged from -498.6% for ruddy ducks to 92.4% for lesser scaup (Table 25). We found error values for highlighted species/guilds were positive 25% of the time, indicating the aerial inventory often yielded lower estimates than the quadrat survey for these species/guilds. We noted mallards yielded a difference of -120.2% between survey methods, while total ducks and total waterbirds had survey errors of -94.9% and -91.2%, respectively. Species/guilds with the smallest amount of between-survey error were American coots (-11.2%) and swans (11.3%). We found surveys were more parsimonious during early time periods, with total ducks and waterbirds displaying errors of -8.6% and 5.6%, respectively. However, between-survey error increased during later time periods for both ducks (-152.5%) and total waterbirds (-155.8%).

We generated three "thunderstorm" distribution maps generated from kernel density estimates of quadrat surveys defining different time periods during fall 2014. We selected the October 21st survey to detail the duck distribution in the IRV during early fall migration (Fig. 17). We used the November 7th survey to represent duck distribution at the peak of fall migration (Fig. 18). Finally we used the December 18th flight to document the distribution of ducks during freeze-up and late season (Fig. 19). As expected, duck distributions were confined to a few ice-free areas during the late season when mallards were highly concentrated (Fig. 19).

Discussion

Generally, abundance estimates from quadrat surveys overlapping a traditional inventory site had high and variable error compared to inventories. Quadrat surveys were designed to produce an unbiased abundance estimate of population size for the entire study area (i.e., La

Grange and Peoria Pools) and use of quadrats overlapping traditional survey sites to generate site-specific abundance estimates was unreliable. Since waterbirds do not distribute randomly across sites, error rates can be high and extremely variable among surveys.

Senachwine had the most between-survey error of any site within the study, resulting from the large extrapolated quadrat survey estimates relative to inventory estimates. Aerial inventory estimates were often lower than quadrat-based surveys, which was likely due to the nonrandom placement of birds in wetlands. When extrapolating quadrat survey estimates to an entire wetland site, the assumption was made that birds were evenly distributed across the site. However, this was not the case, since many waterbirds, especially gregarious waterfowl, were congregated in areas with increased resources or areas isolated from hunting pressure. As a result, the quadrat survey overestimated the number of birds in these scenarios. However, due to the random placement of quadrats, this survey would underestimate waterbird numbers when ducks were concentrated outside of the quadrat locations within core areas. This phenomenon was caused by the nonrandom placement of waterfowl due to behavior and resource selection or by birds being concentrated due to ice cover. This was further supported by the fact that surveys from early time periods exhibited less between-survey error than surveys from later time periods, when ice was more common. Waterbirds, especially waterfowl, were unevenly distributed across wetlands, so using a random quadrat method may have been an ineffective way to generate site-specific abundance estimates in the IRV.

At the resolution of the study area for which the quadrat study was designed, abundance estimates from quadrat surveys were generally greater than traditional inventory counts. The direction and magnitude of the difference was intuitive as ducks may use areas outside of traditional inventory locations. Species more likely to be counted in areas outside of traditional inventory locations (e.g., field feeding mallards) had greater error whereas species less likely to use areas outside of traditional locations (e.g., American coot) had less error or counts were even conservative (quadrat survey underestimated abundances). In future segments, we may allocate additional sampling units to traditional sites (high-density stratum) to decrease variances.

Table 22. Average detection rates of waterbirds during aerial quadrat surveys during fall 2014 along the Illinois River floodplain.

Species/Guild	% Detected	Correction Factor
Waterfowl	100.1%	1.00
Ducks	115.1%	0.87
Dabblers	115.2%	0.87
Divers	95.6%	1.05
Mergansers	50.7%	1.97
Geese	93.0%	1.08
Swans	75.0%	1.33
American Coot	117.9%	0.85

Table 23. Percentage of waterbird guilds exhibiting a response to or abandoning quadrats and selected survey areas during aerial surveys along the Illinois River in autumn 2014.

Species/Guild	% Disturbed			% Abandoned		
	Overall	Quadrat	Area	Overall	Quadrat	Area
Waterfowl	13.1%	13.1%	13.2%	5.6%	5.2%	6.1%
Ducks	7.5%	15.6%	0.1%	2.7%	5.4%	0.0%
Dabblers	9.7%	19.2%	0.1%	1.2%	2.3%	0.0%
Divers	3.7%	7.0%	0.0%	2.8%	5.0%	0.0%
Mergansers	4.5%	11.2%	0.0%	4.5%	11.2%	0.0%
Geese	11.1%	1.5%	18.8%	4.8%	0.0%	8.7%
Swans	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
American coot	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%

Table 24. Error rates between aerial inventory and extrapolated aerial quadrat survey estimates across all survey periods at select sites within the Illinois River valley, with associated standard errors. Differences represented in relation to the aerial inventory (e.g. aerial inventory estimate is x% greater or less than the quadrat survey estimate). DABB = Dabbling Ducks, DUCKS = Total Ducks, WTRB = Total Waterbirds. * = Data unavailable.

Location	MALL		DABB		DUCKS		WTRB	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Banner Marsh	-188.8%	108.0%	-204.1%	120.1%	-202.1%	119.4%	-283.8%	152.5%
Big Lake	-68.3%	100.1%	-67.4%	101.0%	-18.1%	58.5%	2.9%	60.2%
Big Prairie	-471.1%	137.3%	-404.1%	159.0%	-405.1%	158.6%	-427.5%	163.6%
Clear Lake	-465.6%	177.9%	-77.3%	76.1%	-224.5%	176.8%	-97.1%	87.5%
CNWR North	33.0%	56.0%	67.2%	30.1%	67.2%	30.1%	50.0%	47.0%
CNWR South	-31.0%	47.3%	-15.8%	37.9%	-15.9%	37.8%	4.7%	31.2%
Crane Lake	-427.7%	351.1%	-189.1%	215.5%	-191.7%	106.8%	-234.8%	120.4%
Cuba Island	-16.7%	37.4%	9.7%	25.8%	8.0%	20.9%	20.4%	18.6%
Douglas Lake	-55.3%	58.1%	-3.7%	23.0%	-9.0%	18.5%	-16.7%	16.7%
Duck Creek	-142.6%	183.1%	-103.8%	157.2%	-87.9%	141.2%	-31.2%	87.8%
Emiquon Preserve	-269.0%	141.8%	-208.6%	108.4%	-21.0%	21.5%	-104.9%	60.0%
Goose Lake - Putnam	-23.1%	66.3%	-2.2%	69.7%	-1.1%	70.1%	0.4%	70.2%
Goose Lake - Woodford	-523.3%	400.3%	-163.2%	62.9%	-165.7%	63.4%	-150.6%	54.6%
Grass Lake	98.3%	*	-122.4%	220.7%	-49.1%	147.0%	60.4%	22.3%
Hennepin & Hopper	-150.1%	147.8%	-120.9%	138.1%	-76.1%	92.7%	-10.3%	27.3%
Hitchcock Slough	*	*	24.0%	*	24.0%	*	52.0%	28.0%
Jack Lake	33.7%	*	79.8%	18.4%	60.7%	12.6%	63.7%	12.5%
Meredosia Lake	-30.9%	111.0%	2.8%	70.3%	-265.6%	334.7%	-267.6%	334.4%
Rice Lake	-487.2%	107.0%	-449.3%	86.9%	-227.3%	144.9%	-170.3%	112.3%
Senachwine	-4813.5%	3589.3%	-4887.0%	3645.1%	-3089.7%	1991.3%	-2376.4%	1694.0%
Stewart	*	*	*	*	-20.1%	62.2%	-17.4%	62.0%
Total	**-503.0%**	**245.1%**	**-378.7%**	**209.3%**	**-219.7%**	**100.0%**	**-201.2%**	**87.8%**

Table 25. Error between aerial inventory and extrapolated aerial quadrat survey estimates across all survey periods and locations within the Illinois River valley for select waterbird species/guilds, with associated standard errors, and sample sizes. Differences represented in relation to the aerial inventory (e.g. aerial inventory estimate is x% greater or less than the quadrat survey estimate). "Early" data included the first 4 survey periods, "late" data were survey periods 5-10, and "overall" includes all survey periods. SWAN = Total Swans, DABB = Total Dabbling Ducks, DUCKS = Total Ducks, MERG = Total Mergansers, WTRB = Total Waterbirds. * = Data unavailable.

Species/Guild	Early			Late			Overall		
	Mean	SE	N	Mean	SE	N	Mean	SE	N
MALL	-52.4%	23.1%	4	-165.3%	101.4%	6	-120.2%	61.9%	10
ABDU	-16.1%	67.3%	4	-381.2%	213.8%	5	-219.0%	132.6%	9
NOPI	8.1%	19.1%	4	-1061.4%	*	1	-205.8%	214.4%	5
AGWT	45.6%	32.3%	4	*	*	0	45.6%	32.3%	4
GADW	-44.1%	82.5%	4	-197.1%	108.1%	5	-129.1%	71.4%	9
LESC	98.3%	0.8%	2	80.5%	*	1	92.4%	5.9%	3
RNDU	-78.2%	53.4%	4	-88.7%	105.6%	3	-82.7%	49.1%	7
CANV	-157.5%	167.6%	4	14.3%	*	1	-123.1%	134.3%	5
RUDU	-143.0%	73.6%	4	-972.8%	979.9%	3	-498.6%	408.4%	7
CAGO	-31.8%	27.1%	4	-87.1%	25.5%	6	-65.0%	19.9%	10
SWAN	-38.3%	19.4%	2	27.9%	17.9%	6	11.3%	17.4%	8
AMCO	35.5%	15.4%	4	-73.4%	73.4%	3	-11.2%	36.3%	7
DABB	-1.7%	24.3%	4	-161.9%	99.0%	6	-97.8%	63.5%	10
DIVE	-105.4%	80.9%	4	0.7%	59.6%	6	-41.8%	48.6%	10
MERG	41.4%	*	1	-30.4%	44.9%	6	-20.1%	39.3%	7
DUCKS	-8.6%	25.6%	4	-152.5%	95.6%	6	-94.9%	60.7%	10
WTRB	5.6%	18.9%	4	-155.8%	91.5%	6	-91.2%	59.5%	10

Figure 17. Distribution of ducks estimated from an aerial quadrat survey of the Illinois River valley from Hennepin to Meredosia, IL on October 21, 2014.

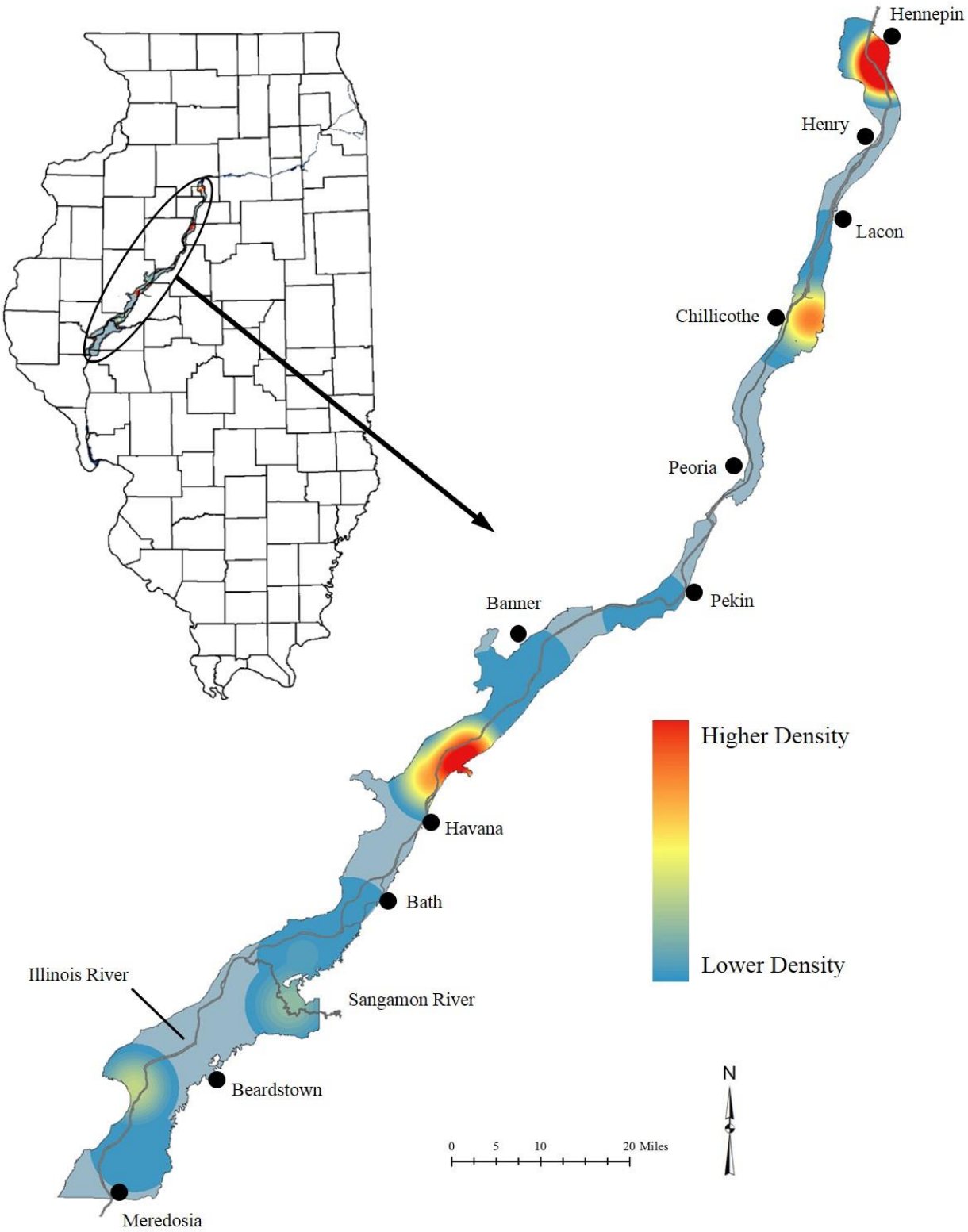


Figure 18. Distribution of ducks estimated from an aerial quadrat survey of the Illinois River valley from Hennepin to Meredosia, IL on November 7, 2014.

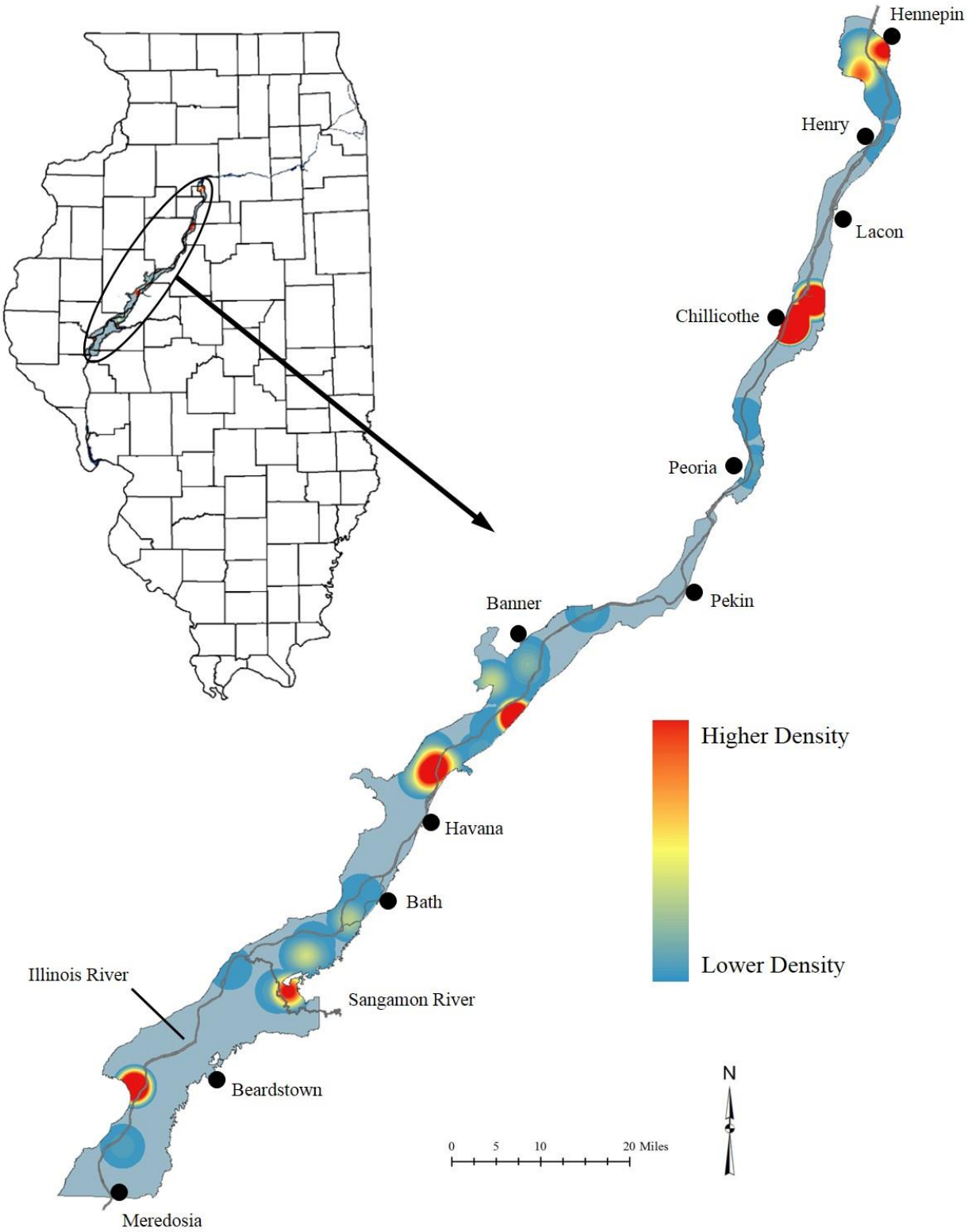
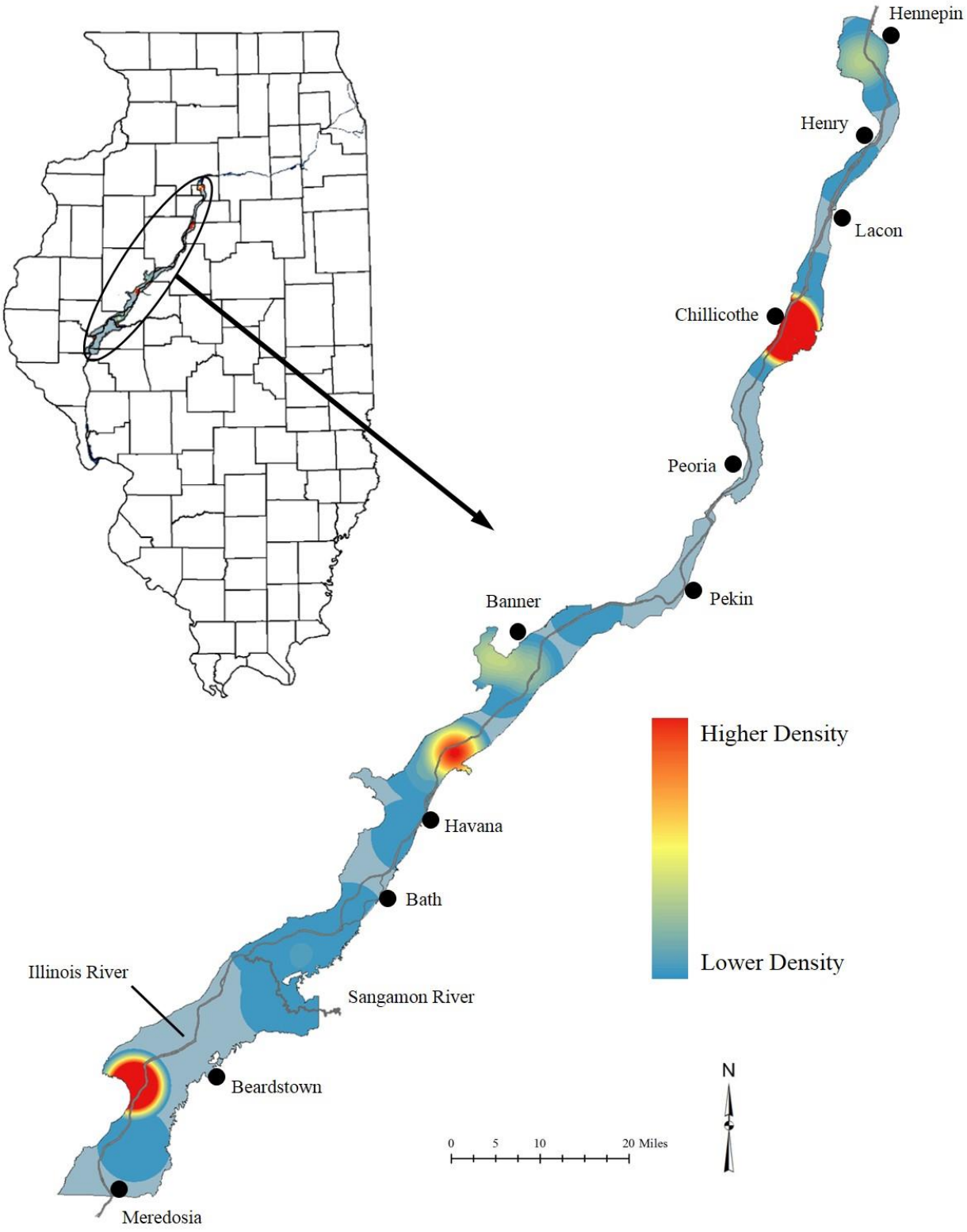


Figure 19. Distribution of ducks estimated from an aerial quadrat survey of the Illinois River valley from Hennepin to Meredosia, IL on December 18, 2014.



JOB 121: BREEDING BIRD USE OF WETLANDS MANAGED FOR WATERFOWL IN ILLINOIS

Objectives:

1) Estimate general use, including density, diversity, and richness of breeding birds using managed moist-soil vegetation in dewatered, seasonal wetlands in Illinois.

2) Estimate nest density and success of breeding birds using managed moist-soil vegetation in dewatered, seasonal wetlands in Illinois.

3) Identify factors influencing nest success of breeding birds using managed moist-soil vegetation in dewatered, seasonal wetlands in Illinois.

Introduction

Grassland, shrubland, and other guilds of breeding birds have declined precipitously in Illinois and across North America due to habitat alteration and loss. Many breeding birds traditionally used fallow fields, weedy and shrubby fencerows, and grasslands for reproduction, but those habitats have been eliminated in much of Illinois over the last century (Warner 1994, Potter et al. 2007). Limited evidence from other regions suggests that seasonal wetlands (e.g., moist-soil wetlands) may provide habitat for breeding birds when they are dewatered (Fleming 2010, Benson et al. 2011). Similarly, Robinson et al. (2007) noted that low, wet areas containing some shrubs surrounded by grasslands and herbaceous vegetation contained large abundances of species of management concern for Illinois. Moreover, grasses and annual broadleaf plants managed for waterfowl may provide structure and food for grassland breeding birds during summer. Despite this anecdotal evidence, few studies have examined use of dewatered, seasonal wetlands by breeding birds.

The Illinois Department of Natural Resources (IDNR) manages at least 35 sites that include moist-soil wetlands (e.g., Anderson Lake State Fish and Wildlife Area), and numerous other areas which may provide moist-soil habitat under passive management or during drought years (e.g., Big Lake [Brown County]; Stafford et al. 2011). These areas may provide critical habitat for breeding birds that utilize herbaceous habitats, including grassland breeding species of concern (e.g., dickcissel [*Spiza americana*], bobolink [*Dolichonyx oryzivorus*], grasshopper sparrow [*Ammodramus savannarum*], and henslow's sparrow [*Ammodramus henslowii*]). Quantifying the benefits of moist-soil vegetation managed for waterfowl to other wildlife would help guide development of IDNR land management strategies and the Illinois Wetlands

Campaign guiding documents. In fact, the Illinois Comprehensive Wildlife Conservation Plan and Strategy (hereafter, Strategy) specifically identifies increasing moist-soil management strategies on public lands as primary action of the Wetlands Campaign.

A key assumption of conservation planning is that some non-wetland bird habitat and population objectives can be accomplished by fulfilling waterfowl habitat objectives (e.g., shorebirds [Upper Mississippi Valley / Great Lakes Shorebird Conservation Plan; de Szalay et al. 2000, Potter et al. 2007] and waterbirds [Illinois Wetlands Campaign; Schultheis and Eichholz 2013]). However, few researchers have examined the relationship between wetlands managed for waterfowl and the provision of habitat for other migratory birds, especially in the breeding season. The Wetlands Campaign of the Strategy identifies the "contribution of moist-soil management to wildlife objectives" as an important information gap which requires additional research. Wetland management techniques used by IDNR to meet objectives of the Wetlands Campaign include active and passive moist-soil management and planting of supplemental food plots (e.g., corn [*Zea mays*], Japanese millet [*Echinochloa frumentacea*]). Benefits of moist-soil management and supplemental planting are well documented (Pankau 2008, Fleming 2010), but research describing bird use and reproduction in managed areas or comparing benefits among management regimes is warranted. Accordingly, we evaluated such use by breeding birds and reproduction in moist-soil wetlands and associated grasslands in the Illinois River valley (IRV).

Methods

Study Area and Duration

We surveyed sites contained within or near the 100-year floodplain of the Illinois River on land managed by private landowners, the IDNR, Ducks Unlimited, and the U.S. Fish and Wildlife Service. Data were collected during June–September 2014 and May–October 2015 on dewatered sites ranging as far north as Chillicothe, IL to as far south as Astoria, IL. Survey sites ranged in area from 2 ha to 170 ha with an average of 41 ha, exceeding the minimum area requirement for many nesting grassland birds (Herkert 1994). Record flooding occurred in both years of research and resulted in an irregular survey pattern in some areas, particularly in 2015 after the Illinois River reached its second highest peak in recorded history.

Point Counts

We conducted point counts for grassland bird species at random locations within each site. Point counts were conducted at 2–10 randomly generated locations within each site in 2014. Sites were generally smaller in 2015, and only 3 points were surveyed within each site.

Points were at least 100 m away from any other surrounding habitat (e.g., forests), and at least 250 m away from one another to preclude double-counting. Points were surveyed between 30 minutes before sunrise to approximately 3 hours after sunrise, but were not surveyed in instances of dense fog, moderate to heavy precipitation, or winds exceeding 28 kilometers per hour (Gutzwiller 1991). We conducted counts for 10 minutes, recording bird species, sex (if known), distance from observer (within 100 m), number of individuals, and time of detection. Additional measures recorded were the time of detection, sex and age if possible, distance from the observer, and number of individuals. Post-survey, we recorded a standardized description of the vegetation within a 100-m radius, information regarding the identity and timing of the survey, and standardized measures of weather conditions and ambient noise (Gutzwiller 1991, Alldredge et al. 2007).

Vegetation

Following each point count, we measured vegetation structure and composition within 3 random 2-m^2 plots near each point count location. Random plots were placed at the end of three random azimuths at random distances between 0 and 25 m using the point count location as a radial anchor. At each plot, we visually estimated plant cover (woody, forb, grass, or sedge), highest and lowest plant height, and percent cover and depth of litter. Additionally, we collected a waterfowl foraging score (Naylor et al. 2005) was collected for each vegetation plot during the last survey of the season.

Nest Searches

We conducted nest searches at each point count location following the completion of all point counts. Observers systematically searched an 800 m^2 area to the east of the point (Fig. 20). When a nest was found, the nest location, date, species (if possible), adult presence, nest contents, stage of development of eggs/nestlings, nest bowl vegetation, vegetation height, water depth, and a full vegetation analysis within a 2-m radius of the nest were recorded. We estimated embryo development using a field candler made of foam pipe insulation, and revisited nests at 3 to 4-day intervals until nestlings fledged or fate could be determined (Johnson and Temple 1990, Lokemoen and Koford 1996). To augment nest density calculations, we searched between points count locations every survey period. Nests discovered incidentally outside of the search areas were used in the calculation of nest success instead of nest density, but were otherwise treated in the same manner as nests found during searches. We used behavioral cues (e.g., displaying male birds, near agitated adults, and near birds holding food or nest material) to

supplement nest discovery within sites (Vickery et al. 1992, Davis and Sealy 2000, Kosciuch et al. 2006). Supplemental nests were included in nest survival calculations; however, because those searches were not spatially replicated, detection probabilities were not known, and a known sized area wasn't searched, we did not include these nests in nest density estimates.

Transect Surveys

At the initiation of re-flooding of study sites after the breeding season ended, we conducted walking transect surveys in three sites to monitor migrating species. Transect lines remained spatially consistent among surveys, and were surveyed three times during mid-September–October 2015. Transect lines were ≥100 m away from surrounding habitat, and ≥150 m from adjacent transect lines. Total distance traveled per survey depended on the size of the site, and varied between 0.5 km and 1.5 km. To avoid duplicate observations, we did not survey distance between transects. Surveys began approximately one hour after sunrise for adequate lighting, and concluded before dusk. Observers traveled the transect line at a slow, steady pace and recorded all birds seen or heard to an unlimited distance. We recorded the point of each bird's first observed location, its distance perpendicular to the transect line, water depth, and percent vegetation cover at each survey location. We conducted subsequent surveys for each site at varying parts of the day for a more complete picture of the bird activity in that area.

Marsh Bird Detection

We conducted fall marsh bird playback surveys in the same three sites as transect surveys. We initiated playbacks 30 minutes before until three hours after sunrise on three occasions per survey site. We followed guidelines set forth by the Standardized North American Marsh Bird Monitoring Protocol (Conway 2011) and included in callbacks the black rail (*Laterallus jamaicensis*), least bittern (*Ixobrychus exilis*), yellow rail (*Coturnicops noveboracensis*), sora (*Porzana carolina),* Virginia rail (*Rallus limicola*), king rail (*Rallus elegans*), American bittern (*Botaurus lentiginosus*), common gallinule (*Gallinula galeata*), American coot (*Fulica americana*), and pied-billed grebe (*Podilymbus podiceps*).

Results and Discussion

In 2015, which spanned from May to October, we made several changes to methodology such as additional vegetation measures, more thorough nest searching and monitoring procedures, adding fall migration surveys including transects and marsh bird surveys, and expanding study sites to include a mix of moist-soil and grassland (control sites).

Record flooding of the Illinois River in 2015 resulted in sustained inundation (>2 m of water) in normally-dry sites, and many sites were therefore not surveyed throughout the entire season. In 2015, ten sites were successfully surveyed three times. Of those sites, five were considered grasslands (control) and five were moist-soil wetlands. Seven additional moist-soil sites were surveyed early in the season before extreme flooding rendered them inaccessible for the remainder of the breeding season.

In 2014, we surveyed a total of ten sites three times for a total area of 559.6 hectares (ha). During 2014 surveys, we recorded a total of 2,498 birds within the 100-m radius of point counts. In 2015, we surveyed 17 sites at least once for a total of 597.5 ha. Surveys in 2015 covered 188.4 ha, and we recorded 1,005 birds within 100 m of point counts. Combining both years, we surveyed approximately 1,157 ha and recorded 3,503 individuals.

Tree swallows (TRSW), red-winged blackbirds (RWBL), and dickcissels (DICK) were the most common species of birds observed, composing approximately 66.5% of all observations between the 2014 and 2015 field seasons. We observed a total of 78 species within the 100-m radius of survey points during 2014–2015. Birds observed outside of the 100-m radius were not used in quantitative analyses. We observed several endangered and threatened birds during surveys, including the common gallinule (*Gallinula galaeta*) and Forster's tern (*Sterna forsteri*). Additional species within this category that were observed within study sites but outside of survey parameters were the northern harrier (*Circus cyaneus*) and peregrine falcon (*Falco peregrinus)*. Species of lesser but still noted conservation concern observed during surveys included the bell's vireo (*Vireo bellii*), bobolink (*Dolichonyx oryzivorous*), dickcissel (*Spiza americana*), grasshopper sparrow (*Ammodramus savannarum*), pied-billed grebe (*Podilymbus podiceps*), prothonotary warbler (*Protonotaria citrea*), red-headed woodpecker (*Melanerpes erythrocephalus*), sedge wren (*Cistothorus platensis*), and willow flycatcher (*Empidonax traillii*).

We estimated avian densities using program Distance 6.2 across data pooled from 2014 and 2015 (Fig. 21). Avian density in moist-soil wetlands (n = 237) and grasslands (n = 43) was 11.2 birds/ha (SE = 0.9) and 12.9 birds/ha (SE = 1.4), respectively, suggesting a slightly higher avian density in grasslands. Similarly, the average number of birds we observed 5.5 and 7.7 birds/point in grassland and moist-soil wetlands, respectively, followed the same trend. Densities decreased over the course of the breeding season, beginning at 13.9 birds/ha in period 1, to 9.6 birds/ha in period 2, and then 9.6 birds/ha in period 3. This difference was most apparent in the more mildly-flooded summer of 2014, with densities progressing from 15.3 birds/ha in period 1,

8.8 birds/ha in period 2, and 7.5 birds/ha in period 3. Survey periods were more irregular in 2015 due to abnormally high flood levels, causing long interruptions or suspension of survey effort in certain areas. These inconsistencies may have impacted density estimates by period. That being said, calculated density estimates in 2015 were 10.5 birds/ha for period 1, 9.6 birds/ha for 2, and 10.6 birds/ha for 3.

During 2014, we observed 17 nests, three of which (17.6%) successfully hatched chicks and one (5.9%) failed. Nest failure was likely caused by a flooding event. The remaining nests (13 nests, 76.3% of total) were either empty for each visit, or of an undetermined fate due to insufficient evidence for success or failure. During 201,5 we observed 26 nests, four of which (15%) successfully fledged chicks, 16 (62%) failed, and six (23%) were empty for each visit. Extreme flooding in 2015 caused failure of many nests early in the season, either due to the heavy rainfall or being completely submerged by water. Failure due to flooding likely skewed the success to failure ratio. We estimated daily nest survival (0.888) using the Mayfield method.

In 2015, eighteen of the total nests (69% of total) were found in grasslands, and 8 (31%) were found in moist-soil wetlands. Each habitat produced 2 successful nests, but moist-soil wetlands had 11 failures while grasslands had only 5. At least two of the nest failures in the moist-soil areas were caused by flooding. Nest success rates were 11.1% and 25% in moist-soil wetlands and grasslands, respectively. Failure rates were 61.1% and 62.5%. The remaining nests were empty for each visit.

Grasslands tended to have a greater diversity of birds nesting in them than moist-soil wetlands (Fig. 3). In grasslands, five species were confirmed nesting including the red-winged blackbird, grasshopper sparrow, brown thrasher (a species of concern in Illinois, *Toxostoma rufum*), indigo bunting (*Passerina cyanea*), and dickcissel. In moist-soil wetlands, all nests except for one were red-winged blackbirds, the exception being a grasshopper sparrow. Interestingly, grasshopper sparrows are described as an obligate grassland species. Similarly, in 2014, a successful dickcissel nest was observed in a moist-soil wetland.

Future Plans

This year, M.S. student Kristen Walter has presented her research at the 75th Midwest Fish and Wildlife Conference in Indianapolis, IN and The Illinois Chapter of The Wildlife Society meeting in Champaign, IL. Kristen has completed necessary and elective coursework at the University of Illinois to fulfill academic requirements and to learn skills relevant to her research, and completed her second field season. In the next year, Kristen will finish data

analysis using programs such as statistical software SAS, in which she will use a Mayfield logistic regression model to measure the relationship between nest presence/absence and success to vegetation composition. Additionally, she plans to use program MARK to generate nest survival estimates. Using each species Partners in Flight conservation score for the appropriate region of the country, she will generate avian richness scores to reflect the conservation status of each species.

Table 26. Species and number of birds observed within a 100-m radius of point count locations in moist-soil wetlands in the Illinois River valley during summer 2014–2015.

2014		2015		Combined	
Species Code	No. Birds	Species Code	No. Birds	Species Code	No. Birds
Tree swallow	1029	Red-winged blackbird	274	Tree swallow	1194
Red-winged blackbird	578	Tree swallow	165	Red-winged blackbird	852
Dickcissel	166	Dickcissel	97	Dickcissel	263
American white pelican	135	Indigo bunting	57	American white pelican	135
Indigo bunting	73	Common yellowthroat	49	Indigo bunting	130
American robin	64	American goldfinch	35	Common yellowthroat	97
Common yellowthroat	48	Cliff swallow	33	American robin	73
Killdeer	39	Barn swallow	27	Barn swallow	62
Barn swallow	35	Field sparrow	25	Cliff swallow	59
Lesser yellowlegs	32	Song sparrow	23	Song sparrow	54
Song sparrow	31	Bobolink	14	Killdeer	52
Cliff swallow	26	House wren	14	Field sparrow	38
Chimney swift	21	Killdeer	13	American goldfinch	35
Gray catbird	17	Chimney swift	12	Chimney swift	33
Unknown swallow	16	Sedge wren	12	Lesser yellowlegs	32
Eastern meadowlark	15	Northern cardinal	11	Gray catbird	27
Mourning dove	14	Gray catbird	10	Unknown swallow	23
Field sparrow	13	American robin	9	Eastern meadowlark	19
Cedar waxwing	12	Bell's vireo	8	House wren	19
Red-headed woodpecker	8	Mallard	8	Sedge wren	19
Ruby-throated hummingbird	8	Red-headed woodpecker	8	Mourning dove	17
Grasshopper sparrow	7	Unknown sparrow	8	Cedar waxwing	16
Sedge wren	7	Northern bobwhite	7	Red-headed woodpecker	16
Bell's vireo	6	Unknown swallow	7	Bobolink	15
Unknown sparrow	6	Willow flycatcher	7	Northern cardinal	15
Warbling vireo	6	Eastern towhee	5	Bell's vireo	14
House wren	5	Brown cowbird	4	Unknown sparrow	14
Chipping sparrow	4	Caspian tern	4	Mallard	10
Common grackle	4	Cedar waxwing	4	Great-crested flycatcher	9
Eastern kingbird	4	Eastern kingbird	4	Ruby-throated hummingbird	9
Eastern wood pewee	4	Eastern meadowlark	4	Grasshopper sparrow	9
European starling	4	Baltimore oriole	3	Eastern kingbird	8
Great egret	4	Green heron	3	Northern bobwhite	8
Northern cardinal	4	Mourning dove	3	Warbling vireo	8
Short-billed dowitcher	4	Chipping sparrow	2	Willow flycatcher	8
Black-capped chickadee	3	Common grackle	2	Chipping sparrow	6
Great blue heron	3	Great blue heron	2	Common grackle	6
Green heron	3	Great-crested flycatcher	2	Eastern towhee	6
Northern flicker	3	Grasshopper sparrow	2	Green heron	6
Bald eagle	2	Unknown gull	2	Brown cowbird	5

Brown thrasher	2
Downy woodpecker	2
Great-crested flycatcher	2
Unknown gull	2
Mallard	2
Prothonotary warbler	2
Scarlet tanager	2
Sora	2
Unknown warbler	2
White-breasted nuthatch	2
Belted kingfisher	1
Bobolink	1
Brown cowbird	1
Eastern towhee	1
Hairy woodpecker	1
House finch	1
Least flycatcher	1
Northern bobwhite	1
Spotted sandpiper	1
Unknown flycatcher	1
Unknown shorebird	1
Unknown woodpecker	1
Willow flycatcher	1
Winter wren	1
Yellow-rumped warbler	1
Total	2498

Horned lark	2
Northern flicker	2
Ring-necked pheasant	2
Warbling vireo	2
American kestrel	1
Black-capped chickadee	1
Belted kingfisher	1
Blue-gray gnatcatcher	1
Common gallinule	1
Downy woodpecker	1
European starling	1
Great egret	1
Hairy woodpecker	1
Northern mockingbird	1
Rose-breasted grosbeak	1
Ruby-throated hummingbird	1
Sora	1
Tree sparrow	1
White-breasted nuthatch	1
Wood duck	1
Yellow-billed cuckoo	1
Yellow warbler	1
Total	1005

European starling	5
Great blue heron	5
Great egret	5
Northern flicker	5
Black-capped chickadee	4
Caspian tern	4
Eastern wood pewee	4
Unknown gull	4
Short-billed dowitcher	4
Baltimore oriole	3
Downy woodpecker	3
Sora	3
White-breasted nuthatch	3
Bald eagle	2
Belted kingfisher	2
Brown thrasher	2
Hairy woodpecker	2
Horned lark	2
Prothonotary warbler	2
Ring-necked pheasant	2
Scarlet tanager	2
Unknown warbler	2
American kestrel	1
Blue-gray gnatcatcher	1
Common gallinule	1
House finch	1
Least flycatcher	1
Northern mockingbird	1
Rose-breasted grosbeak	1
Spotted sandpiper	1
Tree sparrow	1
Unknown flycatcher	1
Unknown shorebird	1
Unknown woodpecker	1
Winter wren	1
Wood duck	1
Yellow-billed cuckoo	1
Yellow-rumped warbler	1
Yellow warbler	1
Total	3503

Figure 20. Spatially constant nest search pattern for obtaining nest density. The star represents the starting point of the search, which is also a point count location. The observer travels a total of 400 m during a single nest search, checking one meter on each side of the path. This provided an 800-m^2 search area for each survey.

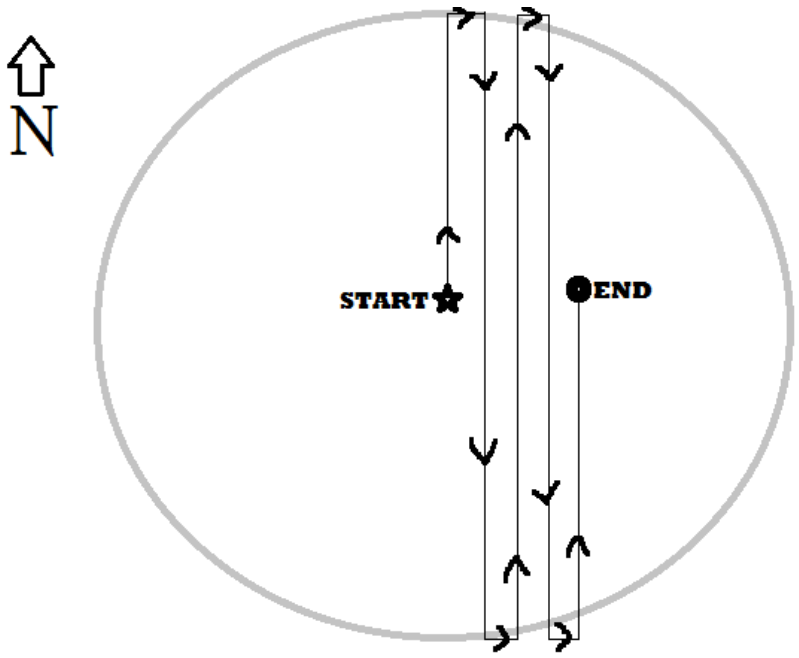


Figure 21. Detection probability curve for avian point count data in 2014 (blue) and the chosen model in Density 6.2 (red, a uniform simple polynomial).

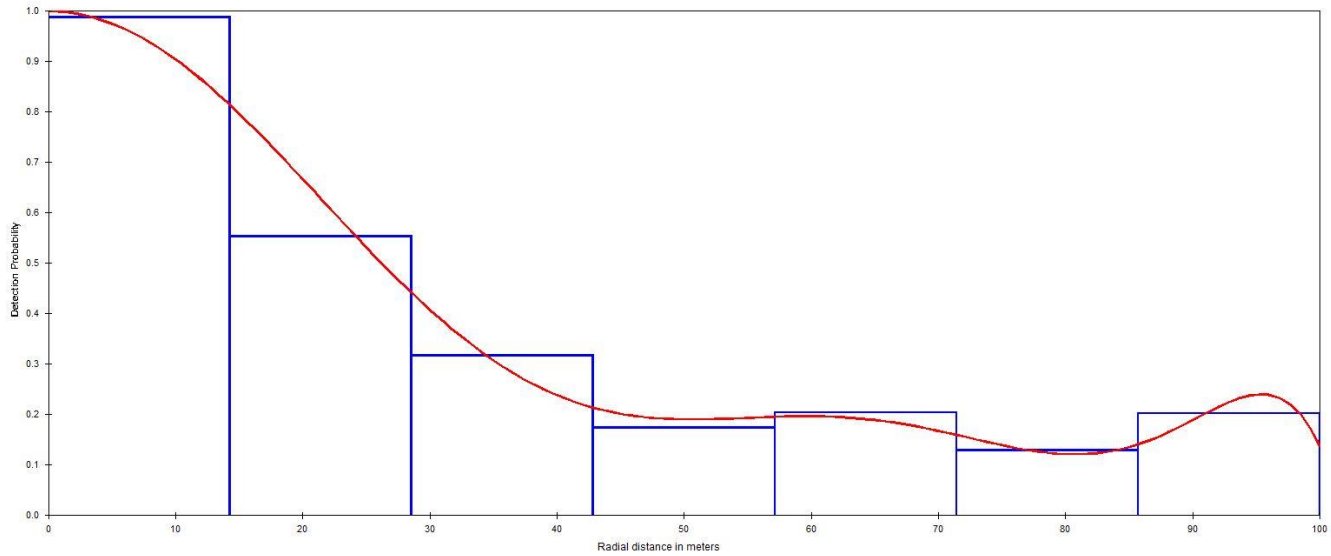
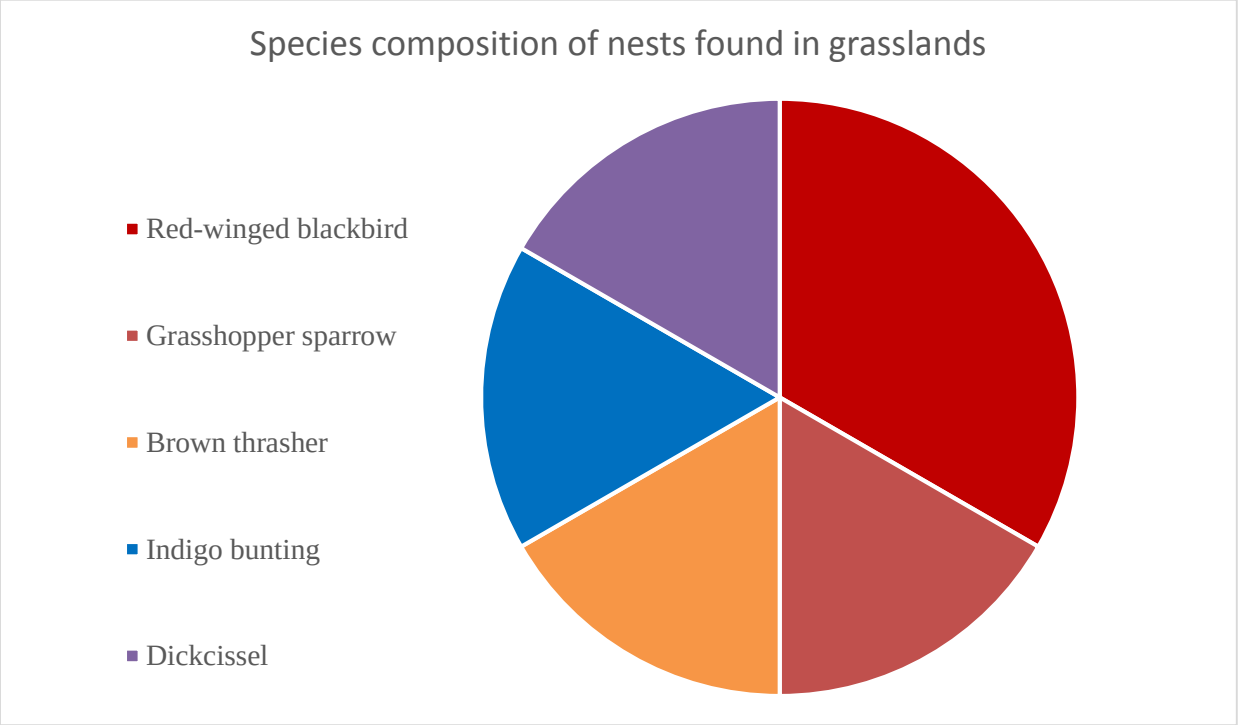
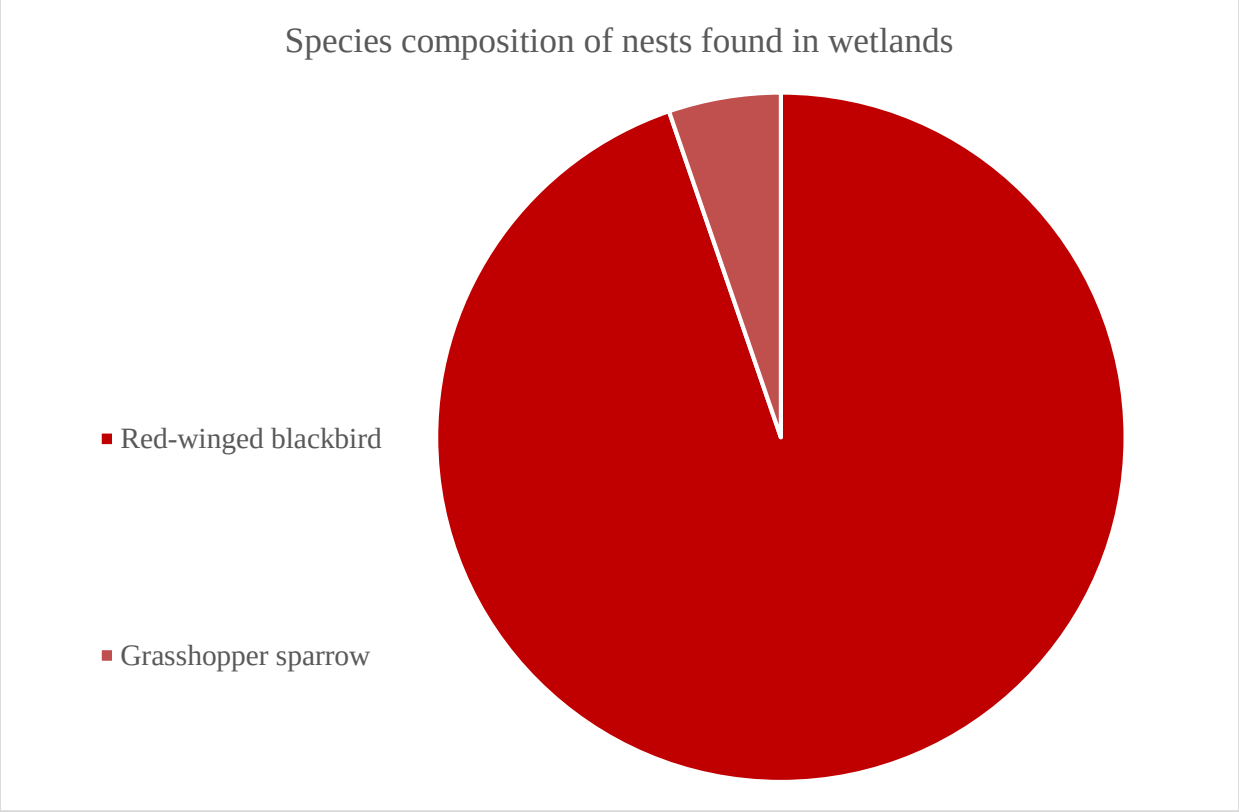


Figure 22. Species composition of nests found in grasslands and wetlands in summer 2015 in the Illinois River valley.





JOB 122: REPRODUCTIVE SUCCESS AND SURVIVAL OF THE EASTERN POPULATION OF SANDHILL CRANES

Objectives:

1) Investigate reproductive success of Sandhill Cranes at different population densities and in different landscapes of the eastern population's (EP) range.

2) Evaluate age-specific survival, status-dependent survival (i.e. breeding vs. non-breeding), and survivorship to breeding-age of EP sandhill cranes.

3) Generate models of EP growth and abundance under different management and land use scenarios.

Introduction

The Eastern Population (EP) of Greater Sandhill Cranes (*Grus canadensis tabida*) has demonstrated an impressive recovery since the population's historic low in the 1930s (e.g. ~25 breeding pairs documented in Wisconsin; Henika 1936, Meine and Archibald 1996). At present, the EP numbers more than 70,000 birds (Kruse and Dubovsky 2015) and interest in harvest for recreation and to mitigate crop depredation has come to the forefront of discussions on the population's management. The Management Plan for the Eastern Population of Sandhill Cranes (2010) has proposed a harvest-management strategy based on fall surveys to monitor the population and maintain running three-year average indices above 30,000 cranes (Ad Hoc Eastern Population Sandhill Crane Committee 2010). While precedents set by the harvest of the Mid-Continent Population (MCP) and Rocky Mountain Population (RMP) of Sandhill Cranes support this approach, the landscape within the EP's range is far more varied than the landscapes in the MCP and RMP ranges and continues to be rapidly urbanized (Fig. 1, Appendix 3). If cranes are able to thrive in these urbanizing landscapes it is likely that the EP will continue to increase, perhaps mirroring the population trajectory of the Giant Canada Goose throughout the Midwest in the last 33 years (17.5% per year; Sauer et al. 2011). However, there remain several knowledge gaps in the demographics of the EP including landscape-dependent reproductive success and juvenile and adult survival (e.g. two studies published on reproductive success in or near urban environments; Dwyer and Tanner 1992, Toland 1999). Evaluating these vital rates in different landscapes of the EP's range and at different population densities is essential to refining models of population growth and abundance under different land-use and management scenarios (e.g. urban sprawl and EP harvest).

Methods

In order to investigate the reproductive success of sandhill cranes, we estimated the survival of nests and fledglings in northeastern Illinois and southeast and south-central Wisconsin. Nests were located via aerial surveys and monitored until the eggs hatched. Young were radio-tagged and subsequently monitored to determine the fate of these individuals. We radio-tagged both juveniles and adults and monitored them during the breeding season every 2–3 days using vehicle-mounted radio receivers. After the breeding season, automated telemetry receiving units (a.k.a. automated receiving units or "ARUs"; JDJC Corporation) positioned in the EP migration route at Chain O'Lakes State Park in Illinois and at a primary migratory stopover site at Jasper-Pulaski State Fish and Wildlife Area in Indiana (JP) were used to record the movements of radio-marked juvenile and adult cranes. ARUs increase the probability of detecting marked birds during migration by increasing search time which can inadvertently increase precision of survival analyses through increased detections. Moreover, these units are expected to provide insight into potential status-dependent (e.g. breeding vs. non-breeding) migratory timing and behavior as well as generating data on birds from geographically distinct regions of the EP breeding range. Data were used to construct known fate models in Program MARK (v.7.0) to estimate nest productivity and fledging success. In addition, simple multi-state models were also constructed in Program MARK (v.7.0) to evaluate age- and status-dependent survival.

Results

Reproductive Success

Nineteen percent of 240 nests throughout central Wisconsin and southeastern Wisconsin/northeastern Illinois study regions were successful in fledging at least one bird (mean brood size at fledging was 1.2). Individual survivorship from hatching to fledging was 27% (n = 482 young from 341 broods). Top-ranked models revealed study region – a proxy for crane population density – explained the preponderance of variation observed in reproductive success. Specifically, nests in the core breeding region of central Wisconsin were 10% more likely to fledge young than those at the peripheries of the breeding range in southeastern Wisconsin/northeastern Illinois. Contrasting survivorship of individuals from hatching to fledging in central Wisconsin (45%) and southeastern Wisconsin/northeastern Illinois (22%) was even more evident. Only a single model testing landscape-dependence in reproductive success was well supported. This model was the highest ranked fledging success model and revealed a

positive correlation between fledging success and the percentage of urban development within 1,500 m of nests. Alternatively, the top-ranked model of nest productivity highlighted the strength with which intra-brood fates were intertwined. Specifically, the mortality of one colt in a brood of two precipitated a 46% reduction in survivorship to fledging for the remaining individual in the brood. Additive models including study region and year were the second best supported models for both nest productivity and fledging success, indicating substantial annual and geographic variation in reproductive success.

Survival

One hundred and twenty-eight hatch-year birds and 66 adults were equipped VHF transmitters attached to leg bands to facilitate the acquisition of data on post-fledging vital rates. These transmitters broadly and prematurely failed and principal sources of data on post-fledging vital rates were consequently lost. Fortunately, the sum of available data on all banded birds (n = 265) was sufficient to evaluate age- and status-dependent survival. Juvenile survival (i.e. survivorship post-fledging to 1 year old adult) was 65% (n = 170). Annual survival of adult birds was 94% (n = 124) and was not well correlated with breeding status or study region. The results of Objectives 1 and 2 together revealed survivorship from egg to three (earliest breeding age), four (average breeding age), and five years of age of 9%, 8.5% and 8%, respectively. Additional data (e.g., 2015 resightings and third-party reports) continue to be incorporated to help compensate for transmitter failure and improve the estimates reported here. These data will be applied to models of population growth used by agencies for harvest management (Appendix 3).

Discussion

The Eastern Population (EP) of Greater Sandhill Cranes has recovered from a historic low of approximately 25 breeding pairs in the 1930s to over 70,000 individuals today (Henika 1936, Meine and Archibald 1996, Kruse and Dubovsky 2015). While the EP has increased dramatically, the data generated from this study are necessary to help shape future management decisions to provide a sustainable population of sandhill cranes, while allowing potential harvest opportunities for hunters. Adult survival for birds in this study averaged 94%, which is consistent with a 95% adult survival rate observed for birds in the Rocky Mountain Population (RMP; Subcommittee on Rocky Mountain Greater Sandhill Cranes 2007). Annual recruitment of juveniles to adults in the RMP averaged 8% during 1972–1992, and Mid-Continent Population (MCP) recruitment averaged 11% during 1987-1992. Our data show a 9% recruitment rate of

juveniles to the breeding population (3 years of age), indicating a higher annual recruitment than other populations (RMP and MCP) of greater sandhill cranes.

While sandhill cranes in the Rocky Mountain Population (RMP) have been documented abandoning nests or territories in response to human disturbance, EP individuals showed a positive relationship between fledgling success and urbanization (Drewien 1973, Walkinshaw 1973, Boise 1976). As the percentage of urban development within 1,500 m of sandhill crane nests increased, fledging success also increased. While this contradicts data from the RMP, it appears individuals in the EP are adapting to successfully nest in close proximity to people. Though the mechanism for this is unclear, urbanization may be creating small refuges that minimize nest and juvenile depredation. It is possible that this relationship between urbanization and fledging success may continue to increase to a point, at which urbanization may come at the cost of reduced availability of nesting habitat. At this point, the breeding range of EP individuals may need to expand if the population continues to increase.

While the data do not represent the entire Eastern Population of greater sandhill cranes, survival and recruitment values meet or exceed those from other populations of cranes (RMP and MCP), which currently offer ample opportunities for management through harvest. Data from the overall EP are necessary to successfully manage this particular population, and these data will be used to generate population models to estimate the future trajectory of EP sandhill crane numbers, inform management decisions, and regulate a sustainable harvest of sandhill cranes (Appendix 3).

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Disclaimer

Any opinions, findings, conclusions, or recommendations expressed in this report are those of the authors and do not necessarily reflect the views of TNC, USFWS, Illinois DNR, Wisconsin DNR, Iowa DNR, or other organizations that supported this research.

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Appendix 1. 2014 Fall Waterfowl Inventories of the Upper and Lower Divisions of the Illinois and Central Mississippi Rivers by Date and Location

ILLINOIS NATURAL HISTORY SURVEY WATERFOWL AERIAL INVENTORY DATA

UPPER ILLINOIS RIVER VALLEY Date: 09/03/2014 Observer: Aaron Yetter

LOCATION	%WET	MALL	ABDU	NOPI	BWTE	AGWT	AMWI	GADW	NSHO	LESC	RNDU	CANV	REDH	RUDU	COGO	BUFF	COME	HOME	TOTAL DUCKS	CAGO	GWFG	LSGO	WHPE	AMCO
Hennepin/Hopper	100	60	0	10	60	0	0	0	70	0	0	0	0	0	0	0	0	0	200	5	0	0	70	50
Goose Lake	60	260	0	250	1,550	50	0	0	320	0	0	0	0	0	0	0	0	0	2,430	20	0	0	150	0
Senachwine Lake	90	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,800	0
Hitchcock Slough	100	0	0	0	0	0	0	0	50	0	0	0	0	0	0	0	0	0	50	0	0	0	0	0
Douglas Lake	40	50	0	1,000	300	100	0	0	400	0	0	0	0	0	0	0	0	0	1,850	50	0	0	50	0
Goose Lake	95	0	0	100	0	0	0	0	50	0	0	0	0	0	0	0	0	0	150	0	0	0	200	0
Upper Peoria	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL UPPER		370	0	1,360	1,910	150	0	0	890	0	0	0	0	0	0	0	0	0	4,680	75	0	0	2,270	50
LOWER ILLINOIS RIVER VALLEY																								
Goose Lake	90	10	0	0	500	50	0	0	30	0	0	0	0	0	0	0	0	0	590	25	0	0	1,900	0
Rice Lake	90	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	300	0
Big Lake	90	0	0	0	100	0	0	0	0	0	0	0	0	0	0	0	0	0	100	320	0	0	1,800	0
Banner Marsh	80	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	0	0	15	0
Duck Creek	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Clear Lake	80	10	0	0	150	0	0	0	0	0	0	0	0	0	0	0	0	0	160	5	0	0	0	0
Chautauqua	50	300	0	3,625	8,680	2,340	0	0	3,055	0	0	0	0	0	0	0	0	0	18,000	660	0	0	410	0
Emiquon/Spoon Btm	60	220	0	595	5,950	1,190	0	0	595	0	0	0	0	0	0	0	0	0	8,550	100	0	0	380	20
Grass Lake	75	35	0	150	220	50	0	0	70	0	0	0	0	0	0	0	0	0	525	10	0	0	30	0
Jack Lake	90	10	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	20	10	0	0	0	0
Stewart Lake	95	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	30	0
Crane Lake	60	0	0	0	150	0	0	0	0	0	0	0	0	0	0	0	0	0	150	0	0	0	355	0
Cuba Island	40	10	0	10	50	10	0	0	10	0	0	0	0	0	0	0	0	0	90	400	0	0	20	0
Big Lake	50	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0	1,900	0
Spunky Bottoms	25	0	0	0	30	0	0	0	0	0	0	0	0	0	0	0	0	0	30	50	0	0	175	0
Meredosia Lake	70	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	50	0
TOTAL LOWER		610	0	4,380	15,840	3,640	0	0	3,760	0	0	0	0	0	0	0	0	0	28,230	1,595	0	0	7,365	20
TOTAL ILLINOIS		980	0	5,740	17,750	3,790	0	0	4,650	0	0	0	0	0	0	0	0	0	32,910	1,670	0	0	9,635	70
10-Year Average 2004-2013		2,409	0	1,327	16,641	5,334	0	6	1,474	0	0	0	0	0	0	0	0	0	27,191	732	0	0	10,056	654

ILLINOIS NATURAL HISTORY SURVEY WATERFOWL AERIAL INVENTORY DATA

UPPER MISSISSIPPI RIVER VALLEY Date: 09/03/2014 Observer: Aaron Yetter

LOCATION	%WET	MALL	ABDU	NOPI	BWTE	AGWT	AMWI	GADW	NSHO	LESC	RNDU	CANV	REDH	RUDU	COGO	BUFF	COME	HOME	TOTAL DUCKS	CAGO	GWFG	LSGO	WHPE	AMCO
Keokuk-Nauvoo	100	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0	20	0
Arthur Refuge	100	10	0	0	70	0	0	0	20	0	0	0	0	0	0	0	0	0	100	90	0	0	65	0
Nauvoo-Ft. Madison	95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	70	0	0	105	0
Ft. Madison-Dallas	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	50	0	0	10	0
Henderson Creek	75	10	0	150	490	0	0	0	125	0	0	0	0	0	0	0	0	0	775	160	0	0	225	0
Keithsburg Refuge	80	0	0	10	10	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0	0	0	0
Louisa Refuge	60	10	0	0	250	50	0	0	0	0	0	0	0	0	0	0	0	0	310	40	0	0	4,450	0
TOTAL UPPER		40	0	160	820	50	0	0	145	0	0	0	0	0	0	0	0	0	1,215	410	0	0	4,875	0
LOWER MISSISSIPPI RIVER VALLEY																								
Swan Lake	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3,530	0
Gilbert Lake	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0	0
Long Lake	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dardenne Club	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cuivre Club	50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Batchtown Refuge	90	0	0	0	50	0	0	0	0	0	0	0	0	0	0	0	0	0	50	0	0	0	0	0
Cannon Refuge	5	0	0	0	150	20	0	0	10	0	0	0	0	0	0	0	0	0	180	0	0	0	0	0
Towhead Lake	50	0	0	0	20	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0	0	0	0
Delair Refuge	75	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0
Shanks Refuge	5	0	0	100	200	0	0	0	0	0	0	0	0	0	0	0	0	0	300	25	0	0	0	0
Meyer-Keokuk	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	125	0	0	75	0
TOTAL LOWER		5	0	100	420	20	0	0	10	0	0	0	0	0	0	0	0	0	555	160	0	0	3,605	0
TOTAL MISSISSIPPI		45	0	260	1,240	70	0	0	155	0	0	0	0	0	0	0	0	0	1,770	570	0	0	8,480	0
10-Year Average 2004-2013		516	0	87	4,545	858	0	0	103	0	0	0	0	0	0	0	0	0	6,109	628	0	0	2,772	11

ILLINOIS NATURAL HISTORY SURVEY WATERFOWL AERIAL INVENTORY DATA

UPPER ILLINOIS RIVER VALLEY Date: 09/11/2014 Observer: Aaron Yetter

LOCATION	%WET	MALL	ABDU	NOPI	BWTE	AGWT	AMWI	GADW	NSHO	LESC	RNDU	CANV	REDH	RUDU	COGO	BUFF	COME	HOME	TOTAL DUCKS	CAGO	GWFG	LSGO	WHPE	AMCO
Hennepin/Hopper	100	50	0	200	410	220	0	5	300	0	0	0	0	0	0	0	0	0	1,185	45	0	0	25	300
Goose Lake	90	30	0	35	1,000	2,000	0	0	150	0	0	0	0	0	0	0	0	0	3,215	170	0	0	630	0
Senachwine Lake	90	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0	0	250	0
Hitchcock Slough	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0
Douglas Lake	70	100	0	1,100	800	2,000	0	0	400	0	0	0	0	0	0	0	0	0	4,400	75	0	0	0	0
Goose Lake	100	10	0	0	20	0	0	0	0	0	0	0	0	0	0	0	0	0	30	5	0	0	400	0
Upper Peoria	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	70	0
TOTAL UPPER		210	0	1,335	2,230	4,220	0	5	850	0	0	0	0	0	0	0	0	0	8,850	305	0	0	1,395	300

LOWER ILLINOIS RIVER VALLEY

Goose Lake	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30	0
Rice Lake	95	0	0	0	20	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0	0	105	0
Big Lake	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	180	0
Banner Marsh	90	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	55	0	0	0	0
Duck Creek	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Clear Lake	95	0	0	0	15	0	0	0	0	0	0	0	0	0	0	0	0	0	15	20	0	0	1,120	0
Chautauqua	80	20	0	2,100	7,700	3,600	0	0	2,020	0	0	0	0	0	0	0	0	0	15,440	20	0	0	1,205	0
Emiquon/Spoon Btm	90	60	0	310	4,330	3,730	0	0	1,110	0	0	0	0	0	0	0	0	0	9,540	25	0	0	730	1,120
Grass Lake	90	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	20	0	0	1,200	0
Jack Lake	100	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	300	0
Stewart Lake	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	180	0
Crane Lake	90	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	330	0
Cuba Island	80	30	0	10	15	0	0	0	100	0	0	0	0	0	0	0	0	0	155	55	0	0	30	0
Big Lake	70	10	0	5	400	50	0	0	20	0	0	0	0	0	0	0	0	0	485	0	0	0	1,500	0
Spunky Bottoms	90	0	0	0	20	0	0	0	0	0	0	0	0	0	0	0	0	0	20	130	0	0	800	0
Meredosia Lake	90	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	10	25	0	0	985	0
TOTAL LOWER		140	0	2,425	12,510	7,380	0	0	3,250	0	0	0	0	0	0	0	0	0	25,705	350	0	0	8,695	1,120
TOTAL ILLINOIS		350	0	3,760	14,740	11,600	0	5	4,100	0	0	0	0	0	0	0	0	0	34,555	655	0	0	10,090	1,420
10-Year Average 2004-2013		3,944	0	2,499	17,055	8,271	36	516	1,893	0	0	0	0	0	0	0	0	0	34,215	903	0	0	12,806	2,799

ILLINOIS NATURAL HISTORY SURVEY WATERFOWL AERIAL INVENTORY DATA

UPPER MISSISSIPPI RIVER VALLEY Date: 09/11/2014 Observer: Aaron Yetter

LOCATION	%WET	MALL	ABDU	NOPI	BWTE	AGWT	AMWI	GADW	NSHO	LESC	RNDU	CANV	REDH	RUDU	COGO	BUFF	COME	HOME	TOTAL DUCKS	CAGO	GWFG	LSGO	WHPE	AMCO
Keokuk-Nauvoo	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	65	0
Arthur Refuge	100	0	0	0	5	0	0	0	5	0	0	0	0	0	0	0	0	0	10	0	0	0	200	0
Nauvoo-Ft. Madison	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	740	0
Ft. Madison-Dallas	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	400	0
Henderson Creek	90	105	0	100	350	50	0	0	200	0	0	0	0	0	0	0	0	0	805	50	0	0	1,005	0
Keithsburg Refuge	100	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0	450	0
Louisa Refuge	75	10	0	25	200	250	0	0	75	0	0	0	0	0	0	0	0	0	560	85	0	0	360	0
TOTAL UPPER		125	0	125	555	300	0	0	280	0	0	0	0	0	0	0	0	0	1,385	135	0	0	3,220	0

LOWER MISSISSIPPI RIVER VALLEY

Swan Lake	95	10	0	0	200	200	0	0	50	0	0	0	0	0	0	0	0	0	460	10	0	0	535	0
Gilbert Lake	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0
Long Lake	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dardenne Club	70	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cuivre Club	80	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0
Batchtown Refuge	90	0	0	0	25	0	0	0	0	0	0	0	0	0	0	0	0	0	25	0	0	0	0	0
Cannon Refuge	40	10	0	50	200	300	0	0	100	0	0	0	0	0	0	0	0	0	660	70	0	0	0	0
Towhead Lake	60	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0
Delair Refuge	70	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Shanks Refuge	20	0	0	50	40	0	0	0	50	0	0	0	0	0	0	0	0	0	140	0	0	0	0	0
Meyer-Keokuk	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	10	0
TOTAL LOWER		35	0	100	465	500	0	0	200	0	0	0	0	0	0	0	0	0	1,300	90	0	0	545	0
TOTAL MISSISSIPPI		160	0	225	1,020	800	0	0	480	0	0	0	0	0	0	0	0	0	2,685	225	0	0	3,765	0
10-Year Average 2004-2013		910	0	457	4,272	2,216	36	44	349	0	0	0	0	0	0	0	0	0	8,285	930	0	0	3,541	73

ILLINOIS NATURAL HISTORY SURVEY WATERFOWL AERIAL INVENTORY DATA

UPPER ILLINOIS RIVER VALLEY Date: 09/16/2014 Observer: Aaron Yetter

LOCATION	%WET	MALL	ABDU	NOPI	BWTE	AGWT	AMWI	GADW	NSHO	LESC	RNDU	CANV	REDH	RUDU	COGO	BUFF	COME	HOME	TOTAL DUCKS	CAGO	GWFG	LSGO	WHPE	AMCO
Hennepin/Hopper	100	40	0	100	600	600	0	0	550	0	0	0	0	0	0	0	0	0	1,890	105	0	0	155	2,400
Goose Lake	90	15	0	1,000	100	800	0	0	200	0	0	0	0	0	0	0	0	0	2,115	230	0	0	1,000	0
Senachwine Lake	95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	205	0
Hitchcock Slough	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Douglas Lake	80	0	0	1,760	550	3,140	0	0	510	0	0	0	0	0	0	0	0	0	5,960	0	0	0	90	50
Goose Lake	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Upper Peoria	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	0
TOTAL UPPER		55	0	2,860	1,250	4,540	0	0	1,260	0	0	0	0	0	0	0	0	0	9,965	335	0	0	1,465	2,450
LOWER ILLINOIS RIVER VALLEY																								
Goose Lake	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,200	0
Rice Lake	95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	45	0
Big Lake	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	130	0
Banner Marsh	90	0	0	0	10	0	0	0	5	0	0	0	0	0	0	0	0	0	15	55	0	0	35	0
Duck Creek	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0
Clear Lake	100	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	10	15	0	0	155	0
Chautauqua	80	100	0	3,885	1,590	13,245	0	0	2,080	0	0	0	0	0	0	0	0	0	20,900	210	0	0	225	10
Emiquon/Spoon Btm	90	125	0	600	3,800	1,600	0	0	705	0	0	0	0	0	0	0	0	0	6,830	55	0	0	235	3,800
Grass Lake	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0	0
Jack Lake	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	115	0	0	0	0
Stewart Lake	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crane Lake	90	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	0
Cuba Island	90	0	0	0	0	100	0	0	0	0	0	0	0	0	0	0	0	0	100	450	0	0	0	0
Big Lake	80	105	0	100	0	300	0	0	0	0	0	0	0	0	0	0	0	0	505	260	0	0	0	0
Spunky Bottoms	100	0	0	0	0	20	0	0	0	0	0	0	0	0	0	0	0	0	20	10	0	0	0	0
Meredosia Lake	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0
TOTAL LOWER		330	0	4,585	5,400	15,265	0	0	2,800	0	0	0	0	0	0	0	0	0	28,380	1,190	0	0	2,065	3,810
TOTAL ILLINOIS		385	0	7,445	6,650	19,805	0	0	4,060	0	0	0	0	0	0	0	0	0	38,345	1,525	0	0	3,530	6,260
10-Year Average 2004-2013		4,226	0	4,725	11,841	9,485	153	798	2,234	0	0	0	0	0	0	0	0	0	33,462	1,000	0	0	7,928	5,972

ILLINOIS NATURAL HISTORY SURVEY WATERFOWL AERIAL INVENTORY DATA

UPPER MISSISSIPPI RIVER VALLEY Date: 09/16/2014 Observer: Aaron Yetter

LOCATION	%WET	MALL	ABDU	NOPI	BWTE	AGWT	AMWI	GADW	NSHO	LESC	RNDU	CANV	REDH	RUDU	COGO	BUFF	COME	HOME	TOTAL DUCKS	CAGO	GWFG	LSGO	WHPE	AMCO
Keokuk-Nauvoo	100	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	55	0	0	40	0
Arthur Refuge	100	5	0	0	0	20	0	0	0	0	0	0	0	0	0	0	0	0	25	125	0	0	300	10
Nauvoo-Ft. Madison	100	0	0	0	50	0	0	0	100	0	0	0	0	0	0	0	0	0	150	10	0	0	740	0
Ft. Madison-Dallas	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	400	0
Henderson Creek	90	30	0	200	200	100	0	0	110	0	0	0	0	0	0	0	0	0	640	0	0	0	1,160	0
Keithsburg Refuge	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	240	0
Louisa Refuge	70	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	100	0	0	20	0
TOTAL UPPER		45	0	210	250	120	0	0	210	0	0	0	0	0	0	0	0	0	835	290	0	0	2,900	10
LOWER MISSISSIPPI RIVER VALLEY																								
Swan Lake	100	0	0	100	20	200	0	0	30	0	0	0	0	0	0	0	0	0	350	125	0	0	1,155	0
Gilbert Lake	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Long Lake	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0
Dardenne Club	70	0	0	0	0	0	0	0	30	0	0	0	0	0	0	0	0	0	30	10	0	0	0	0
Cuivre Club	80	0	0	0	50	50	0	0	15	0	0	0	0	0	0	0	0	0	115	0	0	0	0	0
Batchtown Refuge	90	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cannon Refuge	30	45	0	50	0	10	0	0	20	0	0	0	0	0	0	0	0	0	125	10	0	0	2,650	0
Towhead Lake	50	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0
Delair Refuge	70	0	0	0	0	100	0	0	0	0	0	0	0	0	0	0	0	0	100	20	0	0	0	0
Shanks Refuge	20	10	0	20	120	0	0	0	30	0	0	0	0	0	0	0	0	0	180	35	0	0	75	0
Meyer-Keokuk	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	160	0	0	10	0
TOTAL LOWER		55	0	170	200	360	0	0	125	0	0	0	0	0	0	0	0	0	910	360	0	0	3,900	0
TOTAL MISSISSIPPI		100	0	380	450	480	0	0	335	0	0	0	0	0	0	0	0	0	1,745	650	0	0	6,800	10
10-Year Average 2004-2013		594	0	828	2,789	2,668	70	30	409	0	0	0	0	0	0	0	0	0	7,388	988	0	0	2,375	653

ILLINOIS NATURAL HISTORY SURVEY WATERFOWL AERIAL INVENTORY DATA

UPPER ILLINOIS RIVER VALLEY Date: 09/23/2014 Observer: Aaron Yetter

LOCATION	%WET	MALL	ABDU	NOPI	BWTE	AGWT	AMWI	GADW	NSHO	LESC	RNDU	CANV	REDH	RUDU	COGO	BUFF	COME	HOME	TOTAL DUCKS	CAGO	GWFG	LSGO	WHPE	AMCO
Hennepin/Hopper	100	0	0	1,300	100	400	0	0	1,000	0	0	0	0	0	0	0	0	0	2,800	400	0	0	135	19,500
Goose Lake	90	100	0	1,100	0	700	0	0	700	0	0	0	0	0	0	0	0	0	2,600	400	0	0	400	0
Senachwine Lake	90	0	0	150	0	100	0	0	0	0	0	0	0	0	0	0	0	0	250	0	0	0	55	0
Hitchcock Slough	90	25	0	500	0	1,000	0	0	100	0	0	0	0	0	0	0	0	0	1,625	0	0	0	100	0
Douglas Lake	70	0	0	1,525	150	1,200	0	0	30	0	0	0	0	0	0	0	0	0	2,905	0	0	0	0	0
Goose Lake	95	0	0	1,100	0	20	0	0	0	0	0	0	0	0	0	0	0	0	1,120	0	0	0	350	0
Upper Peoria	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL UPPER		125	0	5,675	250	3,420	0	0	1,830	0	0	0	0	0	0	0	0	0	11,300	800	0	0	1,040	19,500

LOWER ILLINOIS RIVER VALLEY

Goose Lake	100	0	0	50	20	20	0	0	0	0	0	0	0	0	0	0	0	0	90	0	0	0	30	0
Rice Lake	95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	0	0	110	0
Big Lake	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	70	0
Banner Marsh	90	0	0	0	30	0	0	0	0	0	0	0	0	0	0	0	0	0	30	160	0	0	100	0
Duck Creek	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	30	0
Clear Lake	100	50	0	300	200	200	0	0	100	0	0	0	0	0	0	0	0	0	850	150	0	0	30	0
Chautauqua	80	580	0	8,780	1,780	17,430	0	0	3,090	0	0	0	0	0	0	0	0	0	31,660	170	0	0	200	100
Emiquon/Spoon Btm	90	135	0	380	2,340	1,370	50	50	1,170	0	0	0	0	0	0	0	0	0	5,495	15	0	0	280	21,500
Grass Lake	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0
Jack Lake	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stewart Lake	100	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	5	5	0	0	175	0
Crane Lake	90	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0
Cuba Island	90	50	0	3,100	500	500	0	0	50	0	0	0	0	0	0	0	0	0	4,200	705	0	0	0	0
Big Lake	50	10	0	1,000	0	50	0	0	0	0	0	0	0	0	0	0	0	0	1,060	25	0	0	100	0
Spunky Bottoms	90	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	10	55	0	0	5	0
Meredosia Lake	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	85	0
TOTAL LOWER		825	0	13,610	4,870	19,575	50	50	4,420	0	0	0	0	0	0	0	0	0	43,400	1,315	0	0	1,215	21,600
TOTAL ILLINOIS		950	0	19,285	5,120	22,995	50	50	6,250	0	0	0	0	0	0	0	0	0	54,700	2,115	0	0	2,255	41,100
10-Year Average 2004-2013		6,799	0	14,395	14,520	19,525	189	449	7,411	0	0	0	0	0	0	0	0	0	63,288	1,279	0	0	8,934	20,899

ILLINOIS NATURAL HISTORY SURVEY WATERFOWL AERIAL INVENTORY DATA

UPPER MISSISSIPPI RIVER VALLEY Date: 09/23/2014 Observer: Aaron Yetter

LOCATION	%WET	MALL	ABDU	NOPI	BWTE	AGWT	AMWI	GADW	NSHO	LESC	RNDU	CANV	REDH	RUDU	COGO	BUFF	COME	HOME	TOTAL DUCKS	CAGO	GWFG	LSGO	WHPE	AMCO
Keokuk-Nauvoo	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	45	0
Arthur Refuge	90	25	0	50	0	100	0	0	0	0	0	0	0	0	0	0	0	0	175	450	0	0	130	50
Nauvoo-Ft. Madison	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	110	0
Ft. Madison-Dallas	100	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	5	20	0	0	65	0
Henderson Creek	80	10	0	750	515	1,000	0	0	135	0	0	0	0	0	0	0	0	0	2,410	45	0	0	340	2,500
Keithsburg Refuge	90	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	0	0	0	0
Louisa Refuge	60	0	0	30	0	150	0	0	0	0	0	0	0	0	0	0	0	0	180	135	0	0	0	0
TOTAL UPPER		35	0	830	515	1,255	0	0	135	0	0	0	0	0	0	0	0	0	2,770	675	0	0	690	2,550

LOWER MISSISSIPPI RIVER VALLEY

Swan Lake	100	25	0	250	300	50	0	0	0	0	0	0	0	0	0	0	0	0	625	200	0	0	865	0
Gilbert Lake	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Long Lake	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	350	0
Dardenne Club	60	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cuivre Club	60	0	0	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30	5	0	0	0	0
Batchtown Refuge	80	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	300	0
Cannon Refuge	10	20	0	0	0	15	0	0	0	0	0	0	0	0	0	0	0	0	35	0	0	0	0	0
Towhead Lake	50	0	0	0	0	20	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0	0	0	100
Delair Refuge	70	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0	0
Shanks Refuge	10	5	0	50	200	150	0	0	0	0	0	0	0	0	0	0	0	0	405	0	0	0	0	0
Meyer-Keokuk	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	45	0	0	60	0
TOTAL LOWER		50	0	330	500	235	0	0	0	0	0	0	0	0	0	0	0	0	1,115	265	0	0	1,575	100
TOTAL MISSISSIPPI		85	0	1,160	1,015	1,490	0	0	135	0	0	0	0	0	0	0	0	0	3,885	940	0	0	2,265	2,650
10-Year Average 2004-2013		1,574	0	3,251	1,799	3,827	84	508	581	0	0	0	0	0	0	0	0	0	11,624	1,707	0	1	2,072	1,082

ILLINOIS NATURAL HISTORY SURVEY WATERFOWL AERIAL INVENTORY DATA

UPPER ILLINOIS RIVER VALLEY Date: 10/16/2014 Observer: Aaron Yetter

LOCATION	%WET	MALL	ABDU	NOPI	BWTE	AGWT	AMWI	GADW	NSHO	LESC	RNDU	CANV	REDH	RUDU	COGO	BUFF	COME	HOME	TOTAL DUCKS	CAGO	GWFG	LSGO	WHPE	AMCO
Hennepin/Hopper	100	820	0	2,050	0	2,050	2,050	1,230	4,100	0	820	150	0	150	0	0	0	0	13,420	950	0	0	405	27,880
Goose Lake	100	5	0	4,000	0	3,000	0	300	0	0	100	0	0	0	0	0	0	0	7,405	425	0	0	400	300
Senachwine Lake	100	605	0	300	0	0	0	0	0	0	0	0	0	0	0	0	0	0	905	0	0	0	65	0
Hitchcock Slough	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Douglas Lake	100	100	0	9,100	0	2,200	0	0	100	0	0	0	0	0	0	0	0	0	11,500	150	0	0	0	700
Goose Lake	100	7,500	10	0	0	500	0	0	0	0	0	0	0	0	0	0	0	0	8,010	0	0	0	250	0
Upper Peoria	100	600	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0	0	610	0	0	0	5	0
TOTAL UPPER		9,630	10	15,450	0	7,750	2,050	1,530	4,200	0	920	150	0	160	0	0	0	0	41,850	1,525	0	0	1,125	28,880
LOWER ILLINOIS RIVER VALLEY																								
Goose Lake	90	25	5	0	0	20	0	0	0	0	0	0	0	20	0	0	0	0	70	0	0	0	0	50
Rice Lake	95	130	0	250	0	0	0	0	0	0	0	0	0	0	0	0	0	0	380	15	0	0	0	0
Big Lake	90	0	0	0	0	100	0	0	0	0	0	0	0	60	0	0	0	0	160	95	0	0	10	0
Banner Marsh	95	30	0	400	0	0	0	30	0	0	100	0	0	0	0	0	0	0	560	75	0	0	25	30
Duck Creek	100	0	0	0	0	0	0	200	0	0	0	0	0	0	0	0	0	0	200	20	0	0	20	0
Clear Lake	100	10	0	0	0	10	0	0	0	0	0	0	0	250	0	0	0	0	270	10	0	0	130	0
Chautauqua	70	800	0	3,470	0	25,140	500	1,185	2,105	0	0	0	0	50	0	0	0	0	33,250	385	0	0	0	14,975
Emiquon/Spoon Btm	90	300	0	5,635	0	3,140	4,260	7,100	2,890	0	1,420	0	0	500	0	0	0	0	25,245	40	0	0	130	119,290
Grass Lake	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Jack Lake	100	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0	0	0	20	0	0	0	0	200
Stewart Lake	100	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0	0	10	5	0	0	0	0
Crane Lake	100	0	0	0	0	0	0	100	0	0	0	0	0	100	0	0	0	0	200	5	0	0	0	0
Cuba Island	100	150	0	3,800	5	3,250	50	300	20	0	0	0	0	0	0	0	0	0	7,575	15	0	0	0	50
Big Lake	40	60	0	200	0	1,800	0	100	25	0	0	0	0	0	0	0	0	0	2,185	0	0	0	20	0
Spunky Bottoms	90	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	205
Meredosia Lake	80	5	0	305	0	0	0	0	0	0	0	0	0	300	0	0	0	0	610	10	0	0	30	0
TOTAL LOWER		1,510	5	14,060	5	33,460	4,810	9,015	5,040	0	1,520	0	0	1,310	0	0	0	0	70,735	675	0	0	380	134,800
TOTAL ILLINOIS		11,140	15	29,510	5	41,210	6,860	10,545	9,240	0	2,440	150	0	1,470	0	0	0	0	112,585	2,200	0	0	1,505	163,680
10-Year Average 2004-2013		23,405	172	22,947	2,183	25,256	3,537	10,879	9,632	3	974	17	13	2,787	0	0	0	0	101,804	2,140	21	0	3,288	67,118

ILLINOIS NATURAL HISTORY SURVEY WATERFOWL AERIAL INVENTORY DATA

UPPER MISSISSIPPI RIVER VALLEY Date: 10/16/2014 Observer: Aaron Yetter

LOCATION	%WET	MALL	ABDU	NOPI	BWTE	AGWT	AMWI	GADW	NSHO	LESC	RNDU	CANV	REDH	RUDU	COGO	BUFF	COME	HOME	TOTAL DUCKS	CAGO	GWFG	LSGO	WHPE	AMCO
Keokuk-Nauvoo	100	0	0	0	0	0	0	0	0	0	0	0	0	1,310	0	0	0	0	1,310	0	0	0	50	3,500
Arthur Refuge	90	10	0	100	0	200	25	0	0	0	0	0	0	0	0	0	0	0	335	415	0	0	55	105
Nauvoo-Ft. Madison	100	10	0	0	50	250	0	0	15	0	0	0	0	0	0	0	0	0	325	25	0	0	55	730
Ft. Madison-Dallas	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	250	0	0	140	0
Henderson Creek	100	120	0	1,500	0	500	0	200	250	0	100	0	0	100	0	0	0	0	2,770	1,020	5	0	370	600
Keithsburg Refuge	100	60	0	50	0	50	0	0	105	0	0	0	0	0	0	0	0	0	265	525	0	0	40	1,500
Louisa Refuge	80	0	0	500	0	50	0	5	0	0	0	0	0	0	0	0	0	0	555	490	0	0	50	200
TOTAL UPPER		200	0	2,150	50	1,050	25	205	370	0	100	0	0	1,410	0	0	0	0	5,560	2,725	5	0	760	6,635
LOWER MISSISSIPPI RIVER VALLEY																								
Swan Lake	100	15	0	0	0	0	0	10	0	0	100	0	0	40	0	0	0	0	165	85	0	0	115	100
Gilbert Lake	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	35	0	0	0	0
Long Lake	100	10	0	5	0	0	0	5	0	0	0	0	0	0	0	0	0	0	20	0	0	0	0	0
Dardenne Club	50	100	0	1,500	0	100	0	0	30	0	0	0	0	0	0	0	0	0	1,730	0	0	0	0	0
Cuivre Club	100	25	0	250	0	50	0	0	0	0	0	0	0	0	0	0	0	0	325	25	0	0	0	250
Batchtown Refuge	100	50	0	20	0	100	0	0	0	0	0	0	0	0	0	0	0	0	170	225	0	0	0	0
Cannon Refuge	30	500	0	8,000	0	6,000	0	0	10	0	0	0	0	0	0	0	0	0	14,510	70	0	0	0	450
Towhead Lake	90	150	0	1,900	0	2,850	0	0	100	0	0	0	0	0	0	0	0	0	5,000	150	0	0	0	200
Delair Refuge	90	25	0	200	0	1,200	50	100	25	0	0	0	0	0	0	0	0	0	1,600	350	0	0	0	0
Shanks Refuge	50	35	0	700	0	900	0	20	0	0	0	0	0	0	0	0	0	0	1,655	0	0	0	0	40
Meyer-Keokuk	100	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	20	0	0	120	0
TOTAL LOWER		930	0	12,575	0	11,200	50	135	165	0	100	0	0	40	0	0	0	0	25,195	960	0	0	235	1,040
TOTAL MISSISSIPPI		1,130	0	14,725	50	12,250	75	340	535	0	200	0	0	1,450	0	0	0	0	30,755	3,685	5	0	995	7,675
10-Year Average 2004-2013		12,095	3	18,811	522	16,137	1,663	6,249	2,972	0	1,854	1	0	1,736	0	0	0	0	62,042	2,527	74	0	1,809	16,578

ILLINOIS NATURAL HISTORY SURVEY WATERFOWL AERIAL INVENTORY DATA

UPPER ILLINOIS RIVER VALLEY Date: 10/20/2014 Observer: Aaron Yetter

LOCATION	%WET	MALL	ABDU	NOPI	BWTE	AGWT	AMWI	GADW	NSHO	LESC	RNDU	CANV	REDH	RUDU	COGO	BUFF	COME	HOME	TOTAL DUCKS	CAGO	GWFG	LSGO	WHPE	AMCO
Hennepin/Hopper	100	1,225	0	1,225	0	1,225	1,020	2,040	1,225	25	410	205	20	0	0	0	0	0	8,620	0	0	0	135	32,230
Goose Lake	100	600	0	7,000	0	6,000	0	0	0	0	0	0	0	100	0	0	0	0	13,700	1,350	0	0	150	400
Senachwine Lake	100	1,780	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,780	0	0	0	50	0
Hitchcock Slough	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Douglas Lake	100	300	50	6,100	100	2,500	300	100	1,500	0	500	50	0	100	0	0	0	0	11,600	0	0	0	0	1,600
Goose Lake	100	2,500	5	50	0	0	0	0	0	0	0	0	0	200	0	0	0	0	2,755	0	0	0	0	0
Upper Peoria	100	500	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0	0	510	0	0	0	0	25
TOTAL UPPER		6,905	55	14,375	100	9,725	1,320	2,140	2,725	25	910	255	20	410	0	0	0	0	38,965	1,350	0	0	335	34,255
LOWER ILLINOIS RIVER VALLEY																								
Goose Lake	100	5	0	0	0	0	0	0	0	0	0	0	0	40	0	0	0	0	45	0	0	0	0	0
Rice Lake	90	325	0	0	0	0	0	0	50	0	0	0	0	0	0	0	0	0	375	0	0	0	0	0
Big Lake	100	0	0	0	0	250	0	0	0	0	0	0	0	70	0	0	0	0	320	25	0	0	45	150
Banner Marsh	100	30	0	0	0	200	0	0	20	0	0	0	0	0	0	0	0	0	250	85	0	0	0	0
Duck Creek	100	0	0	0	0	0	0	55	0	0	0	0	0	0	0	0	0	0	55	130	0	0	0	10
Clear Lake	100	80	0	25	0	0	0	35	20	0	0	0	0	400	0	0	0	0	560	30	0	0	65	55
Chautauqua	70	5,100	15	9,910	30	14,990	850	3,395	5,375	0	0	0	0	0	0	0	0	0	39,665	445	0	0	270	13,000
Emiquon/Spoon Btm	90	3,605	0	13,440	0	5,680	1,075	5,380	5,380	0	1,075	0	0	300	0	0	0	0	35,935	315	0	0	80	75,320
Grass Lake	100	15	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	35	0	0	0	5	10
Jack Lake	100	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	10
Stewart Lake	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crane Lake	100	55	0	0	0	0	160	160	75	0	0	0	0	0	0	0	0	0	450	180	0	0	0	0
Cuba Island	100	300	0	3,000	0	3,500	0	0	400	0	300	0	0	50	0	0	0	0	7,550	485	0	0	0	500
Big Lake	40	500	0	3,200	0	6,000	100	100	310	0	0	0	0	100	0	0	0	0	10,310	5	0	0	300	10
Spunky Bottoms	70	10	0	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30	25	0	0	0	175
Meredosia Lake	90	10	0	100	0	0	25	25	0	0	0	0	0	350	0	0	0	0	510	20	0	0	5	30
TOTAL LOWER		10,040	20	29,695	30	30,620	2,210	9,150	11,630	0	1,375	0	0	1,310	0	0	0	15	96,095	1,745	0	0	770	89,270
TOTAL ILLINOIS		16,945	75	44,070	130	40,345	3,530	11,290	14,355	25	2,285	255	20	1,720	0	0	0	15	135,060	3,095	0	0	1,105	123,525
10-Year Average 2004-2013		49,454	604	34,404	1,576	29,759	5,364	20,679	13,344	263	1,979	54	50	4,220	0	0	0	7	161,757	2,463	17	22	1,681	76,784

ILLINOIS NATURAL HISTORY SURVEY WATERFOWL AERIAL INVENTORY DATA

UPPER MISSISSIPPI RIVER VALLEY Date: 10/20/2014 Observer: Aaron Yetter

LOCATION	%WET	MALL	ABDU	NOPI	BWTE	AGWT	AMWI	GADW	NSHO	LESC	RNDU	CANV	REDH	RUDU	COGO	BUFF	COME	HOME	TOTAL DUCKS	CAGO	GWFG	LSGO	WHPE	AMCO
Keokuk-Nauvoo	100	0	0	0	0	0	0	0	0	0	25	0	0	1,210	0	0	0	0	1,235	10	0	0	5	4,405
Arthur Refuge	90	0	0	0	5	45	5	0	5	0	0	0	0	0	0	0	0	0	60	640	0	0	40	0
Nauvoo-Ft. Madison	100	0	0	10	0	50	0	0	0	0	0	0	0	0	0	0	0	0	60	0	0	0	110	2,550
Ft. Madison-Dallas	100	105	0	0	0	0	0	0	20	0	0	0	0	0	0	0	0	0	125	50	0	0	35	0
Henderson Creek	90	600	0	200	0	360	0	0	75	0	0	0	0	0	0	0	0	0	1,235	165	0	0	520	1,125
Keithsburg Refuge	100	280	0	0	0	0	50	0	10	0	0	0	0	0	0	0	0	0	340	725	0	0	0	100
Louisa Refuge	80	50	0	700	0	50	0	0	10	0	0	0	0	0	0	0	0	0	810	780	0	0	330	700
TOTAL UPPER		1,035	0	910	5	505	55	0	120	0	25	0	0	1,210	0	0	0	0	3,865	2,370	0	0	1,040	8,880
LOWER MISSISSIPPI RIVER VALLEY																								
Swan Lake	95	110	0	15	0	300	0	110	50	0	65	0	0	150	0	0	0	0	800	230	0	0	10	200
Gilbert Lake	100	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0
Long Lake	100	0	0	135	0	0	0	20	0	0	50	0	0	0	0	0	0	0	205	0	0	0	10	0
Dardenne Club	70	900	0	9,100	0	200	0	0	0	0	0	0	0	0	0	0	0	0	10,200	0	0	0	0	0
Cuivre Club	90	10	0	710	0	300	0	5	10	0	0	0	0	0	0	0	0	0	1,035	0	0	0	0	0
Batchtown Refuge	90	155	0	0	0	500	0	0	0	0	0	0	0	0	0	0	0	0	655	400	0	0	0	0
Cannon Refuge	30	1,050	0	13,200	0	12,000	0	50	250	0	100	0	0	0	0	0	0	0	26,650	0	0	0	0	400
Towhead Lake	80	100	0	100	0	400	0	0	100	0	100	0	0	0	0	0	0	0	800	0	0	0	0	200
Delair Refuge	90	150	0	100	0	1,000	50	0	200	0	0	0	0	0	0	0	0	0	1,500	170	0	0	0	0
Shanks Refuge	50	150	0	225	0	400	0	0	100	0	0	0	0	0	0	0	0	0	875	0	0	0	0	5
Meyer-Keokuk	100	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30	10	0	0	140	0
TOTAL LOWER		2,665	0	23,585	0	15,100	50	185	710	0	315	0	0	150	0	0	0	0	42,760	810	0	0	160	805
TOTAL MISSISSIPPI		3,700	0	24,495	5	15,605	105	185	830	0	340	0	0	1,360	0	0	0	0	46,625	3,180	0	0	1,200	9,685
10-Year Average 2004-2013		28,544	14	26,808	399	18,665	2,298	13,121	2,223	550	3,118	150	19	3,669	0	6	0	1	99,584	2,692	88	4	1,160	20,601

ILLINOIS NATURAL HISTORY SURVEY WATERFOWL AERIAL INVENTORY DATA

UPPER ILLINOIS RIVER VALLEY Date: 10/29/2014 Observer: Aaron Yetter

LOCATION	%WET	MALL	ABDU	NOPI	BWTE	AGWT	AMWI	GADW	NSHO	LESC	RNDU	CANV	REDH	RUDU	COGO	BUFF	COME	HOME	TOTAL DUCKS	CAGO	GWFG	LSGO	WHPE	AMCO
Hennepin/Hopper	100	1,090	0	1,635	0	1,090	1,090	5,450	1,635	0	2,725	545	0	1,635	0	0	0	0	16,895	1,090	0	0	100	37,605
Goose Lake	80	5,300	100	0	0	11,700	0	100	1,000	0	0	0	0	0	0	0	0	0	18,200	0	0	0	0	1,100
Senachwine Lake	100	730	20	150	0	0	0	0	0	5	0	0	0	5	0	0	0	0	910	0	0	0	0	500
Hitchcock Slough	100	0	0	0	0	2,800	0	0	0	0	0	0	0	0	0	0	0	0	2,800	0	0	0	0	0
Douglas Lake	100	1,800	0	1,200	0	3,700	120	3,600	600	0	1,200	0	0	0	0	0	0	0	12,220	0	0	0	0	3,000
Goose Lake	100	11,000	100	2,000	0	2,000	0	200	500	0	0	0	0	7,000	0	0	0	0	22,800	0	0	0	0	2,000
Upper Peoria	100	3,050	0	110	0	0	0	0	0	10	0	0	0	500	0	0	0	0	3,670	0	0	0	0	500
TOTAL UPPER		22,970	220	5,095	0	21,290	1,210	9,350	3,735	15	3,925	545	0	9,140	0	0	0	0	77,495	1,090	0	0	100	44,705

LOWER ILLINOIS RIVER VALLEY

Goose Lake	100	10	0	0	0	30	0	0	0	0	0	0	0	0	0	0	0	0	40	0	0	0	5	200
Rice Lake	100	710	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	710	0	0	0	0	0
Big Lake	100	0	0	0	0	0	0	10	0	0	0	0	0	200	0	0	0	0	210	0	0	0	0	2,900
Banner Marsh	100	315	0	100	0	0	0	180	0	0	0	0	0	10	0	0	0	0	605	300	0	0	0	310
Duck Creek	100	1,010	0	0	0	0	0	2,850	0	0	0	0	0	25	0	0	0	0	3,885	130	0	0	0	10
Clear Lake	100	200	0	0	0	2,000	0	200	100	0	0	0	0	1,000	0	0	0	0	3,500	100	0	0	0	3,000
Chautauqua	60	8,415	0	6,565	370	34,370	0	3,700	3,880	0	0	0	0	0	0	0	0	0	57,300	830	0	0	0	8,200
Emiquon/Spoon Btm	80	2,880	15	5,680	0	6,005	1,710	4,375	4,275	855	2,665	0	0	2,565	0	0	0	0	31,025	60	0	0	115	60,705
Grass Lake	100	20	0	0	0	30	0	0	0	0	0	0	0	0	0	0	0	0	50	0	0	0	0	200
Jack Lake	100	320	0	100	0	100	300	2,000	200	0	0	0	0	500	0	0	0	0	3,520	0	0	0	0	5,605
Stewart Lake	100	0	0	0	0	0	0	0	0	0	0	0	0	110	0	0	0	0	110	0	0	0	0	250
Crane Lake	100	10	0	25	0	0	0	505	0	0	200	0	0	0	0	0	0	0	740	0	0	0	0	2,800
Cuba Island	100	2,300	0	7,000	0	1,200	300	3,900	300	0	1,000	0	0	0	0	0	0	0	16,000	450	0	0	0	700
Big Lake	40	200	10	1,100	0	10,000	0	500	500	0	0	0	0	0	0	0	0	0	12,310	0	0	0	150	4,000
Spunky Bottoms	70	100	0	100	0	800	0	500	100	0	0	0	0	0	0	0	0	0	1,600	15	0	0	15	700
Meredosia Lake	70	100	0	50	0	550	5	410	0	0	0	0	0	100	0	0	0	0	1,215	0	0	0	10	7,650
TOTAL LOWER		16,590	25	20,720	370	55,085	2,315	19,130	9,355	855	3,865	0	0	4,510	0	0	0	0	132,820	1,885	0	0	295	97,230
TOTAL ILLINOIS		39,560	245	25,815	370	76,375	3,525	28,480	13,090	870	7,790	545	0	13,650	0	0	0	0	210,315	2,975	0	0	395	141,935
10-Year Average 2004-2013		89,226	931	43,458	420	35,388	4,986	35,176	9,481	580	7,113	841	144	9,790	0	10	0	2	237,543	3,240	73	121	1,360	79,466

ILLINOIS NATURAL HISTORY SURVEY WATERFOWL AERIAL INVENTORY DATA

UPPER MISSISSIPPI RIVER VALLEY Date: 10/29/2014 Observer: Aaron Yetter

LOCATION	%WET	MALL	ABDU	NOPI	BWTE	AGWT	AMWI	GADW	NSHO	LESC	RNDU	CANV	REDH	RUDU	COGO	BUFF	COME	HOME	TOTAL DUCKS	CAGO	GWFG	LSGO	WHPE	AMCO
Keokuk-Nauvoo	100	0	0	0	0	0	0	0	50	0	1,000	0	0	6,000	0	0	0	0	7,050	0	0	0	0	14,600
Arthur Refuge	90	200	0	150	0	410	0	0	0	0	0	0	0	0	0	0	0	0	760	620	0	0	0	1,150
Nauvoo-Ft. Madison	100	0	0	0	0	40	0	10	25	5	0	5	0	0	0	0	0	0	85	0	0	0	10	14,600
Ft. Madison-Dallas	100	0	0	0	0	50	0	0	10	0	0	0	0	10	0	0	0	0	70	10	0	0	0	50
Henderson Creek	90	130	0	0	0	40	0	235	0	0	150	0	0	0	0	0	0	0	555	5	0	0	5	5,620
Keithsburg Refuge	100	560	0	0	0	80	0	810	50	0	0	0	0	0	0	0	0	0	1,500	600	0	0	5	100
Louisa Refuge	80	380	0	200	0	10	20	50	20	0	0	0	0	0	0	0	0	0	680	405	0	0	50	800
TOTAL UPPER		1,270	0	350	0	630	20	1,105	155	5	1,150	5	0	6,010	0	0	0	0	10,700	1,640	0	0	70	36,920
LOWER MISSISSIPPI RIVER VALLEY																								
Swan Lake	100	7,320	0	500	0	5,210	0	11,100	110	50	10,000	0	0	0	0	0	0	0	34,290	135	5	0	190	11,300
Gilbert Lake	100	60	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	60	200	0	0	0	0
Long Lake	100	300	0	0	0	300	0	1,000	0	0	0	0	0	0	0	0	0	0	1,600	0	0	0	0	0
Dardenne Club	90	4,100	0	19,200	0	2,500	0	2,000	0	0	0	0	0	0	0	0	0	0	27,800	0	0	0	0	400
Cuivre Club	100	200	0	500	0	700	0	100	50	0	0	0	0	0	0	0	0	0	1,550	0	0	0	0	500
Batchtown Refuge	80	700	0	100	0	9,000	0	0	0	0	0	0	0	0	0	0	0	0	9,800	730	0	0	0	0
Cannon Refuge	40	5,400	0	18,000	0	7,200	200	3,600	1,800	0	0	0	0	0	0	0	0	0	36,200	0	0	0	0	0
Towhead Lake	80	0	0	0	0	0	0	0	0	0	250	0	0	0	0	0	0	0	250	0	0	0	0	4,100
Delair Refuge	100	600	0	500	0	4,000	0	1,000	300	0	0	0	0	0	0	0	0	0	6,400	500	0	0	0	0
Shanks Refuge	50	390	0	50	0	1,650	0	50	100	0	0	0	0	0	0	0	0	0	2,240	10	0	0	0	200
Meyer-Keokuk	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	40	0	0	95	20
TOTAL LOWER		19,070	0	38,850	0	30,560	200	18,850	2,360	50	10,250	0	0	0	0	0	0	0	120,190	1,615	5	0	285	16,520
TOTAL MISSISSIPPI		20,340	0	39,200	0	31,190	220	19,955	2,515	55	11,400	5	0	6,010	0	0	0	0	130,890	3,255	5	0	355	53,440
10-Year Average 2004-2013		47,279	44	30,667	3	23,161	1,809	18,903	2,129	6,334	8,659	3,455	36	6,782	19	120	0	0	149,396	3,752	87	476	1,226	25,592

ILLINOIS NATURAL HISTORY SURVEY WATERFOWL AERIAL INVENTORY DATA

UPPER ILLINOIS RIVER VALLEY Date: 11/05/2014 Observer: Aaron Yetter

LOCATION	%WET	MALL	ABDU	NOPI	BWTE	AGWT	AMWI	GADW	NSHO	LESC	RNDU	CANV	REDH	RUDU	COGO	BUFF	COME	HOME	TOTAL DUCKS	CAGO	GWFG	LSGO	WHPE	AMCO
Hennepin/Hopper	100	9,480	0	3,950	0	7,900	1,000	15,800	7,900	3,000	7,900	2,370	200	3,950	0	0	0	0	63,450	1,910	0	0	235	23,700
Goose Lake	90	13,250	250	0	0	1,500	0	1,600	710	100	5,000	0	0	0	0	0	0	0	22,410	10	0	0	0	6,300
Senachwine Lake	100	7,200	220	0	0	3,500	0	0	200	200	1,000	0	0	2,700	0	0	0	0	15,020	0	0	0	0	2,600
Hitchcock Slough	90	100	0	0	0	3,100	0	0	100	0	0	0	0	0	0	0	0	0	3,300	0	0	0	0	0
Douglas Lake	100	8,400	25	12,440	0	3,110	930	4,665	1,555	400	4,000	0	0	0	0	0	0	0	35,525	0	0	0	0	600
Goose Lake	100	29,700	500	8,250	0	2,000	0	2,750	1,000	4,125	4,125	0	0	5,500	0	0	0	0	57,950	0	0	0	20	7,000
Upper Peoria	100	6,500	50	0	0	0	0	0	0	8,700	1,000	0	0	3,500	0	0	0	10	19,760	0	0	0	30	3,300
TOTAL UPPER		74,630	1,045	24,640	0	21,110	1,930	24,815	11,465	16,525	23,025	2,370	200	15,650	0	0	0	10	217,415	1,920	0	0	285	43,500
LOWER ILLINOIS RIVER VALLEY																								
Goose Lake	100	0	0	0	0	0	0	300	0	0	0	0	0	3,500	0	0	0	0	3,800	0	0	0	0	2,310
Rice Lake	90	1,800	0	100	0	0	0	0	0	0	0	0	0	1,310	0	0	0	0	3,210	0	0	0	0	1,000
Big Lake	100	850	0	250	0	0	0	3,700	0	2,100	0	0	0	8,000	0	0	0	0	14,900	0	0	0	0	7,900
Banner Marsh	100	1,350	0	150	0	0	0	1,970	200	0	0	0	0	100	0	0	0	0	3,770	175	0	0	0	900
Duck Creek	100	4,210	0	0	0	0	0	7,110	0	0	0	0	0	0	0	0	0	0	11,320	120	0	0	0	100
Clear Lake	100	1,300	25	300	0	4,000	0	2,200	400	1,500	300	50	0	4,000	0	0	0	0	14,075	150	0	0	0	2,000
Chautauqua	70	9,130	0	9,300	0	31,200	1,170	8,850	6,900	0	0	0	0	2,380	0	0	0	0	68,930	470	0	0	0	6,770
Emiquon/Spoon Btm	90	13,040	0	6,400	0	6,640	2,555	19,170	12,780	12,780	7,135	3,835	640	12,790	0	0	0	0	97,765	0	0	0	60	33,920
Grass Lake	100	1,100	0	0	0	0	0	2,000	0	200	1,500	0	0	400	0	0	0	0	5,200	0	0	0	0	3,650
Jack Lake	100	5,700	0	1,140	0	1,000	470	17,000	1,900	3,800	1,900	100	190	3,800	0	0	0	0	37,000	0	0	0	0	1,000
Stewart Lake	100	30	0	0	0	0	0	100	100	500	200	0	0	3,400	0	0	0	0	4,330	0	0	0	50	3,200
Crane Lake	100	300	0	420	0	25	525	8,750	260	1,750	1,750	0	0	4,200	0	0	0	0	17,980	50	0	0	10	1,000
Cuba Island	100	2,075	0	7,625	0	6,375	430	3,225	645	0	4,000	0	0	0	0	0	0	0	24,375	210	0	0	0	3,725
Big Lake	40	6,500	0	5,000	0	5,000	200	7,000	1,000	0	0	0	0	0	0	0	0	0	24,700	5	0	0	10	400
Spunky Bottoms	20	80	0	0	0	200	0	0	0	0	0	0	0	0	0	0	0	0	280	5	0	0	0	0
Meredosia Lake	70	1,310	0	60	0	130	0	1,300	250	9,000	1,000	200	0	500	0	0	0	0	13,750	0	0	0	20	2,010
TOTAL LOWER		48,775	25	30,745	0	54,570	5,350	82,675	24,435	31,630	17,785	4,185	830	44,380	0	0	0	0	345,385	1,185	0	0	150	69,885
TOTAL ILLINOIS		123,405	1,070	55,385	0	75,680	7,280	107,490	35,900	48,155	40,810	6,555	1,030	60,030	0	0	0	10	562,800	3,105	0	0	435	113,385
10-Year Average 2004-2013		129,164	1,178	34,716	0	43,694	4,952	41,194	10,530	1,081	20,208	1,686	61	8,356	7	113	0	42	296,984	4,794	239	161	456	42,989

ILLINOIS NATURAL HISTORY SURVEY WATERFOWL AERIAL INVENTORY DATA

UPPER MISSISSIPPI RIVER VALLEY Date: 11/05/2014 Observer: Aaron Yetter

LOCATION	%WET	MALL	ABDU	NOPI	BWTE	AGWT	AMWI	GADW	NSHO	LESC	RNDU	CANV	REDH	RUDU	COGO	BUFF	COME	HOME	TOTAL DUCKS	CAGO	GWFG	LSGO	WHPE	AMCO
Keokuk-Nauvoo	100	0	0	0	0	0	0	0	0	15,600	5,500	100	0	7,400	0	250	0	0	28,850	0	0	0	0	8,200
Arthur Refuge	90	400	0	600	0	1,400	0	50	0	0	0	0	0	0	0	0	0	0	2,450	550	0	0	0	420
Nauvoo-Ft. Madison	100	10	0	0	0	100	0	105	5	600	0	10	60	100	0	0	0	0	990	0	0	0	35	9,000
Ft. Madison-Dallas	100	0	0	0	0	0	0	400	0	50	0	10	0	0	0	0	0	0	460	200	0	0	0	2,150
Henderson Creek	90	3,525	0	500	0	5,000	0	3,030	30	30,000	10,000	2,000	0	5,000	0	0	0	0	59,085	10	0	0	0	6,300
Keithsburg Refuge	100	350	0	100	0	10	0	3,550	0	0	300	110	0	100	0	0	0	0	4,520	450	0	0	10	500
Louisa Refuge	80	2,200	50	3,300	0	4,500	0	1,700	100	0	1,800	0	0	150	0	0	0	0	13,800	1,110	0	0	0	2,600
TOTAL UPPER		6,485	50	4,500	0	11,010	0	8,835	135	46,250	17,600	2,230	60	12,750	0	250	0	0	110,155	2,320	0	0	45	29,170

LOWER MISSISSIPPI RIVER VALLEY

Swan Lake	100	12,820	0	12,600	0	12,600	2,520	27,720	6,300	25,200	15,700	2,520	1,260	3,780	0	0	0	0	123,020	235	300	200	510	6,300
Gilbert Lake	100	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	270	25	0	0	0
Long Lake	100	2,000	0	5,500	0	2,000	250	7,000	500	0	0	0	0	0	0	0	0	0	17,250	0	0	0	0	0
Dardenne Club	100	7,000	0	25,000	0	2,000	0	2,000	700	0	0	0	0	0	0	0	0	0	36,700	0	0	0	0	400
Cuivre Club	100	3,000	0	1,000	0	3,200	0	700	250	0	0	0	0	0	0	0	0	0	8,150	0	0	0	0	300
Batchtown Refuge	100	1,300	0	500	0	2,000	0	1,000	400	200	1,500	0	0	0	0	0	0	0	6,900	360	0	0	0	100
Cannon Refuge	60	11,250	0	32,250	0	18,850	1,500	7,500	3,950	0	0	0	0	0	0	0	0	0	75,300	50	0	0	0	100
Towhead Lake	60	700	0	300	0	200	0	1,550	0	0	400	25	0	0	0	0	0	0	3,175	0	0	0	0	300
Delair Refuge	90	1,800	0	500	0	1,000	0	1,000	200	0	0	0	0	0	0	0	0	0	4,500	450	50	0	0	0
Shanks Refuge	50	1,200	0	1,050	0	2,100	0	1,400	100	0	200	0	10	100	0	0	0	0	6,160	50	0	0	0	380
Meyer-Keokuk	100	50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	50	80	0	0	25	50
TOTAL LOWER		41,125	0	78,700	0	43,950	4,270	49,870	12,400	25,400	17,800	2,545	1,270	3,880	0	0	0	0	281,210	1,495	375	200	535	7,930
TOTAL MISSISSIPPI		47,610	50	83,200	0	54,960	4,270	58,705	12,535	71,650	35,400	4,775	1,330	16,630	0	250	0	0	391,365	3,815	375	200	580	37,100
10-Year Average 2004-2013		67,454	54	35,408	0	21,323	2,435	22,413	3,098	12,532	14,642	8,120	0	6,104	83	438	0	0	194,103	3,931	48	1,204	608	20,430

ILLINOIS NATURAL HISTORY SURVEY WATERFOWL AERIAL INVENTORY DATA

UPPER ILLINOIS RIVER VALLEY Date: 11/12/2014 Observer: Aaron Yetter

LOCATION	%WET	%ICE	MALL	ABDU	NOPI	BWTE	AGWT	AMWI	GADW	NSHO	LESC	RNDU	CANV	REDH	RUDU	COGO	BUFF	COME	HOME	TOTAL DUCKS	CAGO	GWFG	LSGO	WHPE	AMCO
Hennepin/Hopper	100	10	5,510	0	100	0	0	950	2,000	2,950	950	2,000	200	50	950	0	0	0	0	15,660	800	0	0	100	3,800
Goose Lake	100	10	6,100	50	300	0	5,200	0	200	1,200	0	550	0	0	200	0	0	0	0	13,800	0	0	0	0	150
Senachwine Lake	100	10	4,200	0	0	0	400	0	0	600	400	600	100	0	10	0	200	0	0	6,510	200	0	0	0	0
Hitchcock Slough	100	30	0	0	0	0	1,000	0	0	0	0	0	0	0	0	0	0	0	0	1,000	0	0	0	0	0
Douglas Lake	100	0	12,100	300	5,000	0	0	0	1,000	1,050	0	5,000	100	0	0	0	0	0	0	24,550	10	0	0	0	1,000
Goose Lake	100	20	2,100	0	7,000	0	3,000	0	0	0	0	0	0	0	0	0	0	0	0	12,100	0	0	0	0	2,000
Upper Peoria	100	0	15,015	350	0	0	200	0	0	0	2,700	0	0	0	400	0	0	0	30	18,695	200	0	0	0	200
TOTAL UPPER			45,025	700	12,400	0	9,800	950	3,200	5,800	4,050	8,150	400	50	1,560	0	200	0	30	92,315	1,210	0	0	100	7,150
LOWER ILLINOIS RIVER VALLEY																									
Goose Lake	100	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0
Rice Lake	100	0	4,500	20	300	0	0	0	100	0	0	0	0	0	0	0	0	0	35	4,955	0	0	0	0	0
Big Lake	100	0	5,400	0	0	0	0	0	500	0	55	300	0	10	0	0	10	0	0	6,275	0	0	0	0	700
Banner Marsh	100	0	4,310	50	200	0	0	0	2,200	0	0	0	0	0	5	0	0	0	0	6,765	85	0	0	0	850
Duck Creek	100	0	18,830	200	0	0	0	5	5,050	0	0	0	0	0	0	0	0	0	0	24,085	180	0	0	0	150
Clear Lake	100	10	4,000	20	0	0	14,500	0	500	2,000	50	1,000	0	0	1,000	0	200	0	0	23,270	100	0	0	0	1,600
Chautauqua	80	50	3,300	0	4,000	0	16,300	0	1,500	1,000	0	0	0	0	0	0	0	0	0	26,100	410	0	0	0	100
Emiquon/Spoon Btm	90	10	2,930	0	50	0	200	50	3,850	400	2,100	0	770	0	1,500	0	600	0	160	12,610	15	0	0	30	5,400
Grass Lake	100	0	6,800	0	0	0	0	0	500	0	0	0	0	0	0	0	50	0	0	7,350	0	0	0	0	300
Jack Lake	100	0	6,010	10	0	0	0	0	1,000	0	0	3,000	0	0	700	0	0	0	0	10,720	0	0	0	0	1,000
Stewart Lake	100	10	230	0	0	0	0	0	0	0	50	100	0	0	500	0	0	0	10	890	0	0	0	0	0
Crane Lake	100	0	3,400	0	0	0	0	0	1,000	300	50	1,500	200	0	0	0	100	0	0	6,550	0	0	0	0	1,500
Cuba Island	100	0	7,700	0	3,100	0	400	200	3,000	1,000	0	4,000	0	0	0	0	0	0	0	19,400	250	20	0	0	3,600
Big Lake	40	30	700	10	300	0	7,000	0	200	700	0	0	0	0	0	0	0	0	0	8,910	0	0	0	0	0
Spunky Bottoms	20	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Meredosia Lake	70	10	5,210	0	0	0	420	0	200	300	100	0	300	0	300	0	200	0	10	7,040	0	0	0	100	1,000
TOTAL LOWER			73,325	310	7,950	0	38,820	255	19,600	5,700	2,405	9,900	1,270	10	4,005	0	1,160	0	215	164,925	1,040	20	0	130	16,200
TOTAL ILLINOIS			118,350	1,010	20,350	0	48,620	1,205	22,800	11,500	6,455	18,050	1,670	60	5,565	0	1,360	0	245	257,240	2,250	20	0	230	23,350
10-Year Average 2004-2013			148,225	1,604	23,690	0	35,688	3,153	40,624	7,207	1,909	15,628	1,223	44	8,641	28	149	0	107	287,917	3,361	254	56	511	37,982

ILLINOIS NATURAL HISTORY SURVEY WATERFOWL AERIAL INVENTORY DATA

UPPER MISSISSIPPI RIVER VALLEY Date: 11/12/2014 Observer: Aaron Yetter

LOCATION	%WET	%ICE	MALL	ABDU	NOPI	BWTE	AGWT	AMWI	GADW	NSHO	LESC	RNDU	CANV	REDH	RUDU	COGO	BUFF	COME	HOME	TOTAL DUCKS	CAGO	GWFG	LSGO	WHPE	AMCO
Keokuk-Nauvoo	100	0	0	0	0	0	0	0	0	0	14,500	3,000	10,500	100	4,350	0	1,705	0	0	34,155	0	0	0	0	4,600
Arthur Refuge	90	75	3,000	0	500	0	500	0	0	100	0	0	0	0	0	0	0	0	0	4,100	0	0	0	5	0
Nauvoo-Ft. Madison	100	10	110	0	0	0	70	0	0	30	0	0	100	0	50	0	0	0	0	360	0	0	0	0	12,300
Ft. Madison-Dallas	100	10	0	0	0	0	0	0	0	0	0	0	0	0	50	0	30	0	0	80	150	0	0	0	100
Henderson Creek	100	10	14,050	50	0	0	100	0	1,100	400	2,000	400	0	50	0	0	200	0	0	18,350	0	0	0	0	3,000
Keithsburg Refuge	100	10	9,400	0	0	0	100	0	2,850	250	0	0	0	0	0	0	0	0	10	12,610	525	0	0	0	0
Louisa Refuge	100	20	3,600	0	310	0	2,800	100	650	350	0	1,200	0	0	0	0	0	0	0	9,010	270	0	0	0	100
TOTAL UPPER			30,160	50	810	0	3,570	100	4,600	1,130	16,500	4,600	10,600	150	4,450	0	1,935	0	10	78,665	945	0	0	5	20,100
LOWER MISSISSIPPI RIVER VALLEY																									
Swan Lake	100	0	56,900	0	2,500	0	10,200	0	7,000	2,200	400	18,700	350	0	200	0	1,500	0	10	99,960	155	0	0	150	2,000
Gilbert Lake	100	0	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	110	100	0	0	0	0
Long Lake	100	0	13,000	0	2,000	0	5,000	0	1,000	1,000	0	0	0	0	0	0	0	0	0	22,000	0	0	0	0	0
Dardenne Club	100	0	48,000	0	12,000	0	1,000	0	2,100	0	0	0	0	0	0	0	0	0	0	63,100	0	0	0	0	1,000
Cuivre Club	100	0	8,000	0	500	0	0	0	1,100	0	0	300	0	0	0	0	0	0	0	9,900	0	0	0	0	600
Batchtown Refuge	100	0	6,000	0	500	0	5,600	0	500	200	0	500	0	0	0	0	0	0	0	13,300	300	0	0	0	0
Cannon Refuge	70	0	109,810	0	13,900	0	2,780	1,390	6,950	4,170	0	0	0	0	0	0	0	0	0	139,000	50	0	0	0	0
Towhead Lake	100	0	4,000	0	0	0	0	0	300	100	0	800	0	0	0	0	0	0	0	5,200	0	0	0	0	0
Delair Refuge	100	0	17,000	0	2,500	0	3,000	200	2,200	1,500	0	0	0	0	0	0	0	0	0	26,400	1,400	0	0	0	0
Shanks Refuge	70	0	41,600	0	2,100	0	2,000	0	1,500	300	0	200	0	0	0	0	0	0	0	47,700	0	0	0	0	1,500
Meyer-Keokuk	100	0	50	0	0	0	0	0	0	0	0	0	0	0	0	0	30	0	0	80	0	0	0	75	0
TOTAL LOWER			304,460	0	36,000	0	29,580	1,590	22,650	9,470	400	20,500	350	0	200	0	1,530	0	20	426,750	2,005	0	0	225	5,100
TOTAL MISSISSIPPI			334,620	50	36,810	0	33,150	1,690	27,250	10,600	16,900	25,100	10,950	150	4,650	0	3,465	0	30	505,415	2,950	0	0	230	25,200
10-Year Average 2004-2013			116,681	411	35,228	0	27,573	3,426	34,257	4,923	18,074	24,888	10,748	214	13,338	126	914	3	58	290,864	4,258	184	1,201	319	14,392

ILLINOIS NATURAL HISTORY SURVEY WATERFOWL AERIAL INVENTORY DATA

UPPER ILLINOIS RIVER VALLEY Date: 11/20/2014 Observer: Aaron Yetter

LOCATION	%WET	%ICE	MALL	ABDU	NOPI	BWTE	AGWT	AMWI	GADW	NSHO	LESC	RNDU	CANV	REDH	RUDU	COGO	BUFF	COME	HOME	TOTAL DUCKS	CAGO	GWFG	LSGO	WHPE	AMCO
Hennepin/Hopper	100	99	10	0	0	0	0	0	100	10	0	0	0	0	125	10	0	0	0	255	355	0	0	0	0
Goose Lake	100	99	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Senachwine Lake	100	99	20,500	20	0	0	0	0	0	0	0	0	0	0	0	100	0	100	0	20,720	0	0	0	0	0
Hitchcock Slough	100	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Douglas Lake	100	99	13,100	0	300	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13,400	0	0	0	0	0
Goose Lake	100	99	11,000	50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11,050	0	0	0	0	0
Upper Peoria	100	99	10,450	0	0	0	0	0	0	0	300	0	100	0	700	1,750	0	10	0	13,310	0	0	0	0	0
TOTAL UPPER			55,060	70	300	0	0	0	100	10	300	0	100	0	825	1,860	0	110	0	58,735	355	0	0	0	0
LOWER ILLINOIS RIVER VALLEY																									
Goose Lake	100	99	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rice Lake	100	99	25	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	30	0	0	0	0	0
Big Lake	100	99	0	0	0	0	0	0	10	0	0	0	0	0	0	10	0	0	0	20	0	0	0	0	0
Banner Marsh	100	99	4,055	0	0	0	0	0	5	0	15	0	0	0	0	0	0	0	0	4,075	465	0	0	0	150
Duck Creek	100	10	34,600	0	0	0	0	0	350	0	0	0	50	0	0	0	0	0	0	35,000	1,550	0	5	0	0
Clear Lake	100	99	0	0	0	0	0	0	0	0	0	0	10	0	150	30	0	0	0	190	0	0	0	0	0
Chautauqua	80	99	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0
Emiquon/Spoon Btm	90	95	12,315	10	0	0	0	0	15	0	0	0	50	10	330	500	0	0	10	13,240	0	0	0	0	15
Grass Lake	100	95	4,500	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4,520	0	0	0	0	0
Jack Lake	100	80	1,100	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,110	0	0	0	0	0
Stewart Lake	100	95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crane Lake	100	90	10	0	0	0	0	0	10	0	30	0	0	0	20	20	0	0	10	100	0	0	0	0	0
Cuba Island	100	95	5,500	25	0	0	0	0	0	0	50	10	0	0	0	10	0	0	0	5,595	275	0	0	0	0
Big Lake	40	90	7,500	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7,500	0	0	0	0	0
Spunky Bottoms	20	99	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Meredosia Lake	70	99	0	0	0	0	0	0	0	0	10	0	0	0	105	30	0	0	5	150	0	0	0	0	0
TOTAL LOWER			69,605	65	0	0	0	0	390	0	105	10	110	10	605	600	5	0	25	71,530	2,295	0	5	0	165
TOTAL ILLINOIS			124,665	135	300	0	0	0	490	10	405	10	210	10	1,430	2,460	5	110	25	130,265	2,650	0	5	0	165
10-Year Average 2004-2013			178,060	1,322	18,831	0	27,901	1,831	31,147	6,932	1,581	16,429	1,181	36	6,656	265	832	2	117	293,121	6,499	283	506	282	25,984

ILLINOIS NATURAL HISTORY SURVEY WATERFOWL AERIAL INVENTORY DATA

UPPER MISSISSIPPI RIVER VALLEY Date: 11/20/2014 Observer: Aaron Yetter

LOCATION	%WET	%ICE	MALL	ABDU	NOPI	BWTE	AGWT	AMWI	GADW	NSHO	LESC	RNDU	CANV	REDH	RUDU	COGO	BUFF	COME	HOME	TOTAL DUCKS	CAGO	GWFG	LSGO	WHPE	AMCO
Keokuk-Nauvoo	100	10	0	0	0	0	0	0	0	0	13,000	1,000	106,350	1,100	6,700	6,000	550	0	0	134,700	0	0	0	0	0
Arthur Refuge	100	80	500	0	0	0	0	0	0	0	0	0	3,000	0	0	0	0	0	0	3,500	0	0	0	0	0
Nauvoo-Ft. Madison	100	10	1,000	0	0	0	0	0	0	0	2,000	0	13,000	0	1,000	14,300	0	0	0	31,300	0	0	0	0	0
Ft. Madison-Dallas	100	10	2,550	0	0	0	0	0	0	0	0	0	1,150	0	0	200	0	0	0	3,900	1,010	0	0	0	0
Henderson Creek	100	80	23,005	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	23,005	0	0	0	0	0
Keithsburg Refuge	100	99	6,000	25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6,025	600	0	0	0	0
Louisa Refuge	100	99	12,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12,000	1,000	0	0	0	0
TOTAL UPPER			45,055	25	0	0	0	0	0	0	15,000	1,000	123,500	1,100	7,700	20,500	550	0	0	214,430	2,610	0	0	0	0
LOWER MISSISSIPPI RIVER VALLEY																									
Swan Lake	100	99	48,000	0	2,000	0	0	0	0	0	0	0	0	0	0	50	0	0	0	50,050	0	200	0	0	0
Gilbert Lake	100	99	50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	50	250	20	0	0	0
Long Lake	100	99	31,200	0	3,500	0	0	0	0	0	0	0	0	0	0	0	0	0	0	34,700	0	0	0	0	0
Dardenne Club	100	99	47,000	0	1,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	48,000	0	0	0	0	0
Cuivre Club	100	99	38,500	0	3,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	41,500	0	0	0	0	0
Batchtown Refuge	100	99	32,000	0	0	0	0	0	0	0	0	1,000	0	0	0	0	0	0	0	33,000	0	0	0	0	0
Cannon Refuge	70	99	44,000	0	500	0	0	0	10	0	0	0	0	0	0	0	0	0	0	44,510	0	0	0	0	0
Towhead Lake	100	95	15,300	50	0	0	1,000	0	0	0	0	0	0	0	0	0	0	0	0	16,350	0	10	0	0	0
Delair Refuge	100	99	10,500	0	0	0	0	0	0	30	0	0	0	0	0	0	0	0	0	10,530	85	0	0	0	0
Shanks Refuge	70	99	4,400	0	0	0	0	0	0	30	0	0	0	0	0	0	0	0	0	4,430	10	0	0	0	0
Meyer-Keokuk	100	10	110	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	110	135	0	0	5	0
TOTAL LOWER			271,060	50	10,000	0	1,000	0	10	60	0	1,000	0	0	0	50	0	0	0	283,230	480	230	0	5	0
TOTAL MISSISSIPPI			316,115	75	10,000	0	1,000	0	10	60	15,000	2,000	123,500	1,100	7,700	20,550	550	0	0	497,660	3,090	230	0	5	0
10-Year Average 2004-2013			165,551	534	35,367	0	27,866	1,552	24,563	4,294	17,362	25,649	33,503	233	8,109	577	3,010	122	109	348,404	5,728	468	4,644	225	14,107

ILLINOIS NATURAL HISTORY SURVEY WATERFOWL AERIAL INVENTORY DATA

UPPER ILLINOIS RIVER VALLEY Date: 11/25/2014 Observer: Aaron Yetter

LOCATION	%WET	%ICE	MALL	ABDU	NOPI	BWTE	AGWT	AMWI	GADW	NSHO	LESC	RNDU	CANV	REDH	RUDU	COGO	BUFF	COME	HOME	TOTAL DUCKS	CAGO	GWFG	LSGO	WHPE	AMCO
Hennepin/Hopper	100	50	100	0	0	0	0	0	0	0	0	0	10	0	5	0	0	0	0	115	35	0	0	0	0
Goose Lake	100	50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0
Senachwine Lake	100	60	20,000	100	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	20,105	0	0	0	0	0
Hitchcock Slough	100	90	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Douglas Lake	100	90	21,400	50	500	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21,950	0	0	0	0	0
Goose Lake	100	40	22,000	100	500	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22,600	0	0	0	0	0
Upper Peoria	100	10	16,000	0	0	0	0	0	0	0	1,500	0	2,500	0	700	2,300	0	100	0	23,100	30	0	0	0	0
TOTAL UPPER			79,500	250	1,000	0	0	0	0	0	1,500	0	2,510	0	710	2,300	0	100	0	87,870	70	0	0	0	0
LOWER ILLINOIS RIVER VALLEY																									
Goose Lake	100	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rice Lake	100	10	350	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	350	0	0	0	0	0
Big Lake	100	10	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30	0	0	0	0	0
Banner Marsh	100	10	4,050	0	0	0	0	0	20	0	0	0	0	0	0	0	0	0	0	4,070	625	0	0	0	0
Duck Creek	100	0	17,250	0	0	0	0	0	3,250	0	0	0	10	0	0	100	0	20	0	20,630	520	0	0	0	0
Clear Lake	100	40	10	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0	20	40	0	0	0	0	0
Chautauqua	80	70	6,600	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6,630	125	0	0	0	0
Emiquon/Spoon Btm	90	10	15,405	5	30	0	0	0	100	0	0	10	5	0	105	430	0	175	170	16,435	0	0	0	0	10
Grass Lake	100	10	3,000	0	0	0	0	0	0	0	0	0	0	0	5	0	0	5	0	3,010	0	0	0	0	0
Jack Lake	100	10	0	0	0	0	0	0	0	0	0	0	0	0	100	0	0	0	50	150	0	0	0	0	0
Stewart Lake	100	20	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	10	0	0	0	0	0
Crane Lake	100	10	310	0	0	0	100	0	50	0	0	25	50	0	100	200	0	0	0	835	125	0	0	0	0
Cuba Island	100	10	15,230	0	0	0	2,000	0	100	0	0	100	0	0	20	0	0	0	0	17,450	300	0	0	0	0
Big Lake	40	30	16,100	200	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16,300	0	0	0	0	0
Spunky Bottoms	20	50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Meredosia Lake	70	10	10	0	0	0	0	0	0	0	0	0	0	0	5	40	0	0	0	55	0	0	0	0	0
TOTAL LOWER			78,350	235	30	0	2,100	0	3,520	0	0	135	65	0	345	770	0	200	245	85,995	1,695	0	0	0	10
TOTAL ILLINOIS			157,850	485	1,030	0	2,100	0	3,520	0	1,500	135	2,575	0	1,055	3,070	0	300	245	173,865	1,765	0	0	0	10
10-Year Average 2004-2013			194,479	1,119	10,744	0	11,979	631	13,404	4,366	387	11,991	976	0	3,479	94	311	3	123	254,085	3,455	1,099	65	101	7,507

ILLINOIS NATURAL HISTORY SURVEY WATERFOWL AERIAL INVENTORY DATA

UPPER MISSISSIPPI RIVER VALLEY Date: 11/25/2014 Observer: Aaron Yetter

LOCATION	%WET	%ICE	MALL	ABDU	NOPI	BWTE	AGWT	AMWI	GADW	NSHO	LESC	RNDU	CANV	REDH	RUDU	COGO	BUFF	COME	HOME	TOTAL DUCKS	CAGO	GWFG	LSGO	WHPE	AMCO
Keokuk-Nauvoo	100	10	0	0	0	0	0	0	0	0	5,100	3,400	144,500	3,400	5,600	10,100	0	100	0	172,200	0	0	0	0	0
Arthur Refuge	100	90	2,100	0	50	0	0	0	0	0	0	0	75	0	0	300	0	0	0	2,525	360	0	0	0	0
Nauvoo-Ft. Madison	100	10	0	0	0	0	0	0	0	0	700	0	9,200	0	200	6,400	0	200	0	16,700	0	0	0	0	10
Ft. Madison-Dallas	100	10	160	0	0	0	0	0	0	0	80	0	0	0	0	520	0	0	0	760	350	0	0	0	0
Henderson Creek	100	50	7,505	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	7,510	0	0	0	0	0
Keithsburg Refuge	100	80	600	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	600	970	0	0	0	0
Louisa Refuge	100	70	15,100	0	0	0	0	0	0	0	0	0	0	0	0	50	0	0	0	15,150	1,460	0	0	0	0
TOTAL UPPER			25,465	0	50	0	0	0	0	0	5,880	3,400	153,775	3,400	5,800	17,375	0	300	0	215,445	3,140	0	0	0	10
LOWER MISSISSIPPI RIVER VALLEY																									
Swan Lake	100	10	22,000	100	0	0	1,200	0	0	0	0	7,000	0	0	10	200	0	5	0	30,515	640	25	0	25	0
Gilbert Lake	100	10	200	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	200	200	0	0	0	0
Long Lake	100	0	45,000	0	1,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	46,000	0	0	0	0	0
Dardenne Club	100	10	77,000	0	2,000	0	0	200	2,000	0	0	0	0	0	0	0	0	0	0	81,200	0	0	0	0	25
Cuivre Club	100	0	18,000	0	4,000	0	0	0	1,000	0	0	0	0	0	0	0	0	0	0	23,000	0	0	0	0	0
Batchtown Refuge	100	0	4,110	0	300	0	0	0	0	0	0	0	0	0	1,500	0	0	0	0	5,910	125	0	0	0	0
Cannon Refuge	80	10	65,000	0	1,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	66,000	200	0	0	0	0
Towhead Lake	10	10	17,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17,000	0	0	0	0	0
Delair Refuge	10	10	10,000	0	200	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10,200	1,200	200	0	0	0
Shanks Refuge	70	10	24,300	0	2,000	0	0	0	100	0	0	200	0	0	0	0	0	0	0	26,600	25	0	0	0	0
Meyer-Keokuk	100	0	50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	60	10	0	0	0	15
TOTAL LOWER			282,660	100	10,500	0	1,200	200	3,100	0	0	7,200	0	0	1,510	200	0	15	0	306,685	2,400	225	0	25	40
TOTAL MISSISSIPPI			308,125	100	10,550	0	1,200	200	3,100	0	5,880	10,600	153,775	3,400	7,310	17,575	0	315	0	522,130	5,540	225	0	25	50
10-Year Average 2004-2013			206,694	163	24,980	0	19,519	549	19,391	2,463	14,167	14,249	86,316	344	5,182	4,551	2,574	311	41	401,685	4,199	621	2,866	134	7,058

ILLINOIS NATURAL HISTORY SURVEY WATERFOWL AERIAL INVENTORY DATA

UPPER ILLINOIS RIVER VALLEY Date: 12/03/2014 Observer: Aaron Yetter

LOCATION	%WET	%ICE	MALL	ABDU	NOPI	BWTE	AGWT	AMWI	GADW	NSHO	LESC	RNDU	CANV	REDH	RUDU	COGO	BUFF	COME	HOME	TOTAL DUCKS	CAGO	GWFG	LSGO	WHPE	AMCO
Hennepin/Hopper	100	90	1,900	0	0	0	0	0	0	0	0	0	0	0	0	0	0	50	0	1,950	1,200	0	0	0	0
Goose Lake	100	40	17,900	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18,000	0	0	0	0	0
Senachwine Lake	100	60	500	0	0	0	0	0	0	0	0	0	0	0	0	400	0	50	0	950	0	0	0	0	0
Hitchcock Slough	100	80	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	400	0	0	0	0
Douglas Lake	100	90	200	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	200	50	0	0	0	200
Goose Lake	100	80	70,700	300	3,000	0	0	0	0	0	0	2,000	0	0	0	0	0	0	0	76,000	0	0	0	0	0
Upper Peoria	100	30	800	0	0	0	0	0	0	0	50	0	0	0	0	1,800	0	0	0	2,650	0	0	0	5	0
TOTAL UPPER			92,000	400	3,000	0	0	0	0	0	50	2,000	0	0	0	2,200	0	100	0	99,750	1,650	0	0	5	200
LOWER ILLINOIS RIVER VALLEY																									
Goose Lake	100	99	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30	0	30	0	0	0	0	0
Rice Lake	100	99	0	0	0	0	0	0	0	0	0	0	0	0	0	60	0	5	0	65	200	0	0	0	0
Big Lake	100	99	5	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	10	0	70	0	0	0
Banner Marsh	100	99	8,000	0	0	0	0	0	30	0	0	0	0	0	0	0	0	0	0	8,030	570	5	0	0	0
Duck Creek	100	10	25,500	0	0	0	0	0	50	0	0	0	20	0	0	200	0	410	5	26,185	920	320	0	0	30
Clear Lake	100	99	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	175	100	0	0	0
Chautauqua	80	99	25	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	10	40	530	10	5	0	0
Emiquon/Spoon Btm	90	99	210	0	0	0	0	0	0	0	0	10	0	0	0	560	25	550	0	1,355	0	0	0	0	0
Grass Lake	100	99	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100	0	0	0	0	0
Jack Lake	100	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stewart Lake	100	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crane Lake	100	99	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0
Cuba Island	100	95	8,100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8,100	410	0	0	0	0
Big Lake	40	99	10,000	50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10,050	0	0	0	0	0
Spunky Bottoms	20	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Meredosia Lake	70	20	105	0	0	0	10	0	20	0	0	0	200	0	10	0	0	280	10	635	5	0	0	0	0
TOTAL LOWER			52,050	50	0	0	10	0	100	0	0	10	220	0	10	830	25	1,275	25	54,605	2,810	505	5	0	30
TOTAL ILLINOIS			144,050	450	3,000	0	10	0	100	0	50	2,010	220	0	10	3,030	25	1,375	25	154,355	4,460	505	5	5	230
10-Year Average 2004-2013			175,769	1,335	6,651	0	14,169	70	13,811	4,976	1,886	11,325	1,323	28	7,859	546	697	260	391	241,096	8,728	1,161	1,416	64	9,832

ILLINOIS NATURAL HISTORY SURVEY WATERFOWL AERIAL INVENTORY DATA

UPPER MISSISSIPPI RIVER VALLEY Date: 12/03/2014 Observer: Aaron Yetter

LOCATION	%WET	%ICE	MALL	ABDU	NOPI	BWTE	AGWT	AMWI	GADW	NSHO	LESC	RNDU	CANV	REDH	RUDU	COGO	BUFF	COME	HOME	TOTAL DUCKS	CAGO	GWFG	LSGO	WHPE	AMCO
Keokuk-Nauvoo	100	80	0	0	0	0	0	0	0	0	1,000	0	50,150	0	500	4,000	0	2,100	0	57,750	225	0	0	0	0
Arthur Refuge	100	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nauvoo-Ft. Madison	100	70	100	0	0	0	0	0	0	0	2,000	0	20,000	0	0	6,000	0	6,000	0	34,100	200	0	0	0	0
Ft. Madison-Dallas	100	80	0	0	0	0	0	0	0	0	0	0	4,000	0	0	600	0	4,500	0	9,100	0	0	0	0	0
Henderson Creek	100	99	8,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8,000	0	0	0	0	0
Keithsburg Refuge	100	99	1,500	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,500	2,000	0	0	0	0
Louisa Refuge	100	99	300	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	300	450	0	0	0	0
TOTAL UPPER			9,900	0	0	0	0	0	0	0	3,000	0	74,150	0	500	10,600	0	12,600	0	110,750	2,875	0	0	0	0

LOWER MISSISSIPPI RIVER VALLEY

Swan Lake	100	30	19,000	0	20	0	0	0	10	0	0	6,000	300	0	500	200	0	50	0	26,080	875	0	0	10	0
Gilbert Lake	100	30	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	110	400	200	0	0	0
Long Lake	100	10	64,000	0	1,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	65,000	0	0	0	0	0
Dardenne Club	100	70	45,000	0	5,000	0	3,000	0	0	0	0	0	0	0	0	0	0	0	0	53,000	0	0	0	0	0
Cuivre Club	100	50	10,000	0	3,000	0	1,000	0	0	0	0	0	0	0	0	0	0	0	0	14,000	0	0	0	0	0
Batchtown Refuge	100	20	20,100	0	0	0	0	0	0	0	0	4,000	0	0	0	0	0	0	0	24,100	600	0	0	0	0
Cannon Refuge	80	90	80,300	0	5,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	85,300	200	0	0	0	0
Towhead Lake	100	70	30,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30,000	0	0	0	0	0
Delair Refuge	100	90	46,000	0	1,000	0	1,000	0	0	0	0	0	0	0	0	0	0	0	0	48,000	450	350	10	0	0
Shanks Refuge	70	90	35,200	0	1,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	36,200	25	0	0	0	0
Meyer-Keokuk	100	20	110	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	115	65	0	0	0	130
TOTAL LOWER			349,810	0	16,020	0	5,000	0	10	0	0	10,000	300	0	500	200	0	55	10	381,905	2,615	550	10	10	130
TOTAL MISSISSIPPI			359,710	0	16,020	0	5,000	0	10	0	3,000	10,000	74,450	0	1,000	10,800	0	12,655	10	492,655	5,490	550	10	10	130
10-Year Average 2004-2013			242,386	909	29,951	0	13,046	1,464	15,849	3,029	15,171	22,775	45,859	463	4,463	6,066	3,604	2,311	67	407,414	7,904	1,165	5,334	139	5,856

ILLINOIS NATURAL HISTORY SURVEY WATERFOWL AERIAL INVENTORY DATA

UPPER ILLINOIS RIVER VALLEY Date: 12/09/2014 Observer: Aaron Yetter

LOCATION	%WET	%ICE	MALL	ABDU	NOPI	BWTE	AGWT	AMWI	GADW	NSHO	LESC	RNDU	CANV	REDH	RUDU	COGO	BUFF	COME	HOME	TOTAL DUCKS	CAGO	GWFG	LSGO	WHPE	AMCO
Hennepin/Hopper	100	80	150	0	0	0	0	0	0	0	0	400	10	0	0	50	0	400	0	1,010	1,520	0	0	0	0
Goose Lake	100	40	3,610	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3,610	0	0	0	0	0
Senachwine Lake	100	50	2,000	0	0	0	0	0	0	0	0	0	0	0	0	120	0	0	0	2,120	10	0	0	0	0
Hitchcock Slough	100	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	590	0	0	0	0
Douglas Lake	100	70	1,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,000	0	0	0	0	0
Goose Lake	100	10	56,000	250	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	56,250	0	0	0	0	0
Upper Peoria	100	0	3,000	0	0	0	0	0	0	0	300	0	1,500	0	100	3,300	0	200	0	8,400	450	0	0	0	0
TOTAL UPPER			65,760	250	0	0	0	0	0	0	300	400	1,510	0	100	3,470	0	600	0	72,390	2,570	0	0	0	0
LOWER ILLINOIS RIVER VALLEY																									
Goose Lake	100	50	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	305	0	0	0	0
Rice Lake	100	50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	80	0	80	20	0	0	0	0
Big Lake	100	50	12,000	50	0	0	0	0	0	0	0	0	0	0	0	0	0	1,000	0	13,050	185	300	0	0	0
Banner Marsh	100	60	550	0	0	0	0	0	20	0	0	0	0	0	0	0	0	0	10	580	980	0	0	0	0
Duck Creek	100	0	1,010	0	0	0	0	0	100	0	0	0	0	0	10	0	0	30	15	1,165	260	0	0	0	205
Clear Lake	100	40	110	0	0	0	0	0	10	0	0	0	0	0	0	5	0	80	0	205	0	0	0	0	0
Chautauqua	80	50	20,500	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	20,605	1,010	700	0	0	0
Emiquon/Spoon Btm	90	70	50	0	0	0	0	0	0	0	0	0	0	0	0	150	0	580	25	805	10	0	0	0	0
Grass Lake	100	90	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Jack Lake	100	80	40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	45	0	0	0	0	0
Stewart Lake	100	70	0	0	0	0	0	0	0	0	0	0	0	0	0	40	0	40	0	80	0	0	0	0	0
Crane Lake	100	60	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	900	0	0	0	0
Cuba Island	100	10	1,800	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,800	810	600	10	0	0
Big Lake	40	60	21,200	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21,210	0	730	0	0	0
Spunky Bottoms	20	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Meredosia Lake	70	10	160	0	0	0	0	0	0	0	0	0	0	0	0	0	0	145	30	335	110	0	0	0	0
TOTAL LOWER			57,430	160	0	0	0	0	130	0	0	0	0	0	10	195	0	1,955	90	59,970	4,590	2,330	10	0	205
TOTAL ILLINOIS			123,190	410	0	0	0	0	130	0	300	400	1,510	0	110	3,665	0	2,555	90	132,360	7,160	2,330	10	0	205
10-Year Average 2004-2013			142,205	956	8,409	0	2,810	0	3,603	491	206	2,998	137	0	2,224	574	216	476	249	165,552	12,194	475	1,288	9	1,986

ILLINOIS NATURAL HISTORY SURVEY WATERFOWL AERIAL INVENTORY DATA

UPPER MISSISSIPPI RIVER VALLEY Date: 12/09/2014 Observer: Aaron Yetter

LOCATION	%WET	%ICE	MALL	ABDU	NOPI	BWTE	AGWT	AMWI	GADW	NSHO	LESC	RNDU	CANV	REDH	RUDU	COGO	BUFF	COME	HOME	TOTAL DUCKS	CAGO	GWFG	LSGO	WHPE	AMCO
Keokuk-Nauvoo	100	10	3,110	0	0	0	0	0	0	0	0	0	5,020	200	0	3,100	0	710	0	12,140	80	0	0	5	0
Arthur Refuge	100	90	2,100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2,100	605	0	0	0	0
Nauvoo-Ft. Madison	100	10	1,500	0	0	0	0	0	0	0	3,000	0	65,300	0	0	15,000	0	3,020	0	87,820	50	0	0	0	0
Ft. Madison-Dallas	100	10	0	0	0	0	0	0	0	0	0	0	100	0	0	2,600	0	600	0	3,300	100	0	0	0	0
Henderson Creek	100	80	5,500	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5,510	200	0	0	0	0
Keithsburg Refuge	100	90	300	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	300	1,970	0	0	0	0
Louisa Refuge	100	90	600	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	600	825	0	0	0	0
TOTAL UPPER			13,110	10	0	0	0	0	0	0	3,000	0	70,420	200	0	20,700	0	4,330	0	111,770	3,830	0	0	5	0
LOWER MISSISSIPPI RIVER VALLEY																									
Swan Lake	100	0	20,600	25	200	0	3,000	0	0	0	10	7,500	0	0	0	0	20	100	5	31,460	220	100	9,000	0	0
Gilbert Lake	100	0	50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	50	650	300	0	0	0
Long Lake	100	0	21,700	0	0	0	0	0	0	0	0	3,000	0	0	0	0	0	0	0	24,700	0	0	0	0	0
Dardenne Club	100	0	70,000	0	3,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	73,000	0	0	0	0	0
Cuivre Club	100	0	15,000	0	1,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16,000	0	0	0	0	0
Batchtown Refuge	100	0	15,000	0	0	0	0	0	0	0	0	2,500	0	0	0	0	0	0	0	17,500	200	0	0	0	0
Cannon Refuge	80	0	38,500	0	500	0	0	0	600	0	0	0	0	0	0	0	0	0	0	39,600	550	400	0	0	0
Towhead Lake	100	0	10,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10,000	20	150	5	0	0
Delair Refuge	100	0	34,000	0	500	0	3,500	0	1,200	0	0	0	0	0	0	0	0	0	0	39,200	410	1,500	10	0	0
Shanks Refuge	90	10	29,820	0	1,000	0	500	0	0	0	0	0	0	0	0	0	0	0	0	31,320	50	150	0	0	0
Meyer-Keokuk	100	10	150	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	150	120	0	0	20	0
TOTAL LOWER			254,820	25	6,200	0	7,000	0	1,800	0	10	13,000	0	0	0	0	20	100	5	282,980	2,220	2,600	9,015	20	0
TOTAL MISSISSIPPI			267,930	35	6,200	0	7,000	0	1,800	0	3,010	13,000	70,420	200	0	20,700	20	4,430	5	394,750	6,050	2,600	9,015	25	0
10-Year Average 2004-2013			137,656	74	10,838	0	7,180	0	5,189	751	7,403	6,414	28,558	406	2,920	5,180	3,279	2,641	18	218,956	6,119	334	814	13	2,046

ILLINOIS NATURAL HISTORY SURVEY WATERFOWL AERIAL INVENTORY DATA

UPPER ILLINOIS RIVER VALLEY Date: 12/17/2014 Observer: Aaron Yetter

LOCATION	%WET	%ICE	MALL	ABDU	NOPI	BWTE	AGWT	AMWI	GADW	NSHO	LESC	RNDU	CANV	REDH	RUDU	COGO	BUFF	COME	HOME	TOTAL DUCKS	CAGO	GWFG	LSGO	WHPE	AMCO
Hennepin/Hopper	100	10	0	0	0	0	0	0	0	0	0	300	10	0	0	150	0	400	0	860	590	100	5	0	0
Goose Lake	100	10	5,900	45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5,945	0	0	0	0	0
Senachwine Lake	100	10	3,200	0	0	0	0	0	0	0	200	0	0	0	0	10	0	0	0	3,410	200	0	0	0	0
Hitchcock Slough	100	90	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	100	0	0	0	0
Douglas Lake	100	10	9,500	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9,500	0	0	0	0	0
Goose Lake	100	20	43,700	300	0	0	0	0	0	0	0	1,100	10	0	0	0	0	0	0	45,110	0	0	0	0	0
Upper Peoria	100	0	9,050	50	0	0	0	0	0	0	410	0	275	0	100	4,310	0	150	0	14,345	50	0	0	0	0
TOTAL UPPER			71,360	395	0	0	0	0	0	0	610	1,400	295	0	100	4,470	0	550	0	79,180	940	100	5	0	0
LOWER ILLINOIS RIVER VALLEY																									
Goose Lake	100	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rice Lake	100	10	1,205	5	0	0	0	0	0	0	0	0	0	0	0	0	0	15	5	1,230	180	0	0	0	0
Big Lake	100	10	4,400	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4,410	0	0	0	0	0
Banner Marsh	100	10	640	0	0	0	0	0	115	0	0	0	0	0	0	10	0	10	0	775	240	0	0	0	0
Duck Creek	100	0	4,510	0	0	0	0	0	100	0	0	0	0	0	0	0	0	0	10	4,620	165	355	0	0	200
Clear Lake	100	20	150	10	0	0	0	0	0	0	0	0	0	0	0	0	0	20	5	185	125	0	0	0	0
Chautauqua	90	60	19,300	150	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19,460	760	1,700	3,500	0	0
Emiquon/Spoon Btm	90	10	510	15	0	0	0	0	70	0	15	0	10	0	20	500	0	1,550	240	2,930	15	0	0	0	5
Grass Lake	100	10	200	0	0	0	0	0	0	0	0	0	0	0	10	10	0	0	0	220	0	0	0	0	0
Jack Lake	100	10	0	0	0	0	0	0	0	0	0	0	0	0	0	30	0	10	0	40	0	0	0	0	0
Stewart Lake	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	50	5	55	0	0	0	0	5
Crane Lake	100	0	100	0	0	0	0	0	0	0	0	0	0	0	100	0	0	0	5	205	500	100	0	0	0
Cuba Island	100	0	4,700	0	0	0	0	0	200	0	0	0	0	0	0	0	0	0	0	4,900	900	200	0	0	0
Big Lake	30	30	13,000	50	100	0	0	0	0	0	0	5	0	0	0	0	0	0	5	13,160	0	400	0	0	0
Spunky Bottoms	20	50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Meredosia Lake	70	10	1,000	0	0	0	0	0	0	0	115	0	30	0	100	25	0	20	0	1,290	10	0	0	0	0
TOTAL LOWER			49,715	240	110	0	0	0	485	0	130	5	40	0	230	575	0	1,675	275	53,480	2,895	2,755	3,500	0	210
TOTAL ILLINOIS			121,075	635	110	0	0	0	485	0	740	1,405	335	0	330	5,045	0	2,225	275	132,660	3,835	2,855	3,505	0	210
10-Year Average 2004-2013			118,762	1,073	2,943	0	5,421	7	2,928	1,951	160	4,091	96	0	533	1,040	147	1,030	247	140,431	14,359	3,080	2,664	3	1,939

ILLINOIS NATURAL HISTORY SURVEY WATERFOWL AERIAL INVENTORY DATA

UPPER MISSISSIPPI RIVER VALLEY Date: 12/17/2014 Observer: Aaron Yetter

LOCATION	%WET	%ICE	MALL	ABDU	NOPI	BWTE	AGWT	AMWI	GADW	NSHO	LESC	RNDU	CANV	REDH	RUDU	COGO	BUFF	COME	HOME	TOTAL DUCKS	CAGO	GWFG	LSGO	WHPE	AMCO
Keokuk-Nauvoo	100	10	35	0	0	0	0	0	0	0	425	0	1,310	0	0	2,250	0	300	5	4,325	300	0	0	0	0
Arthur Refuge	100	90	5,100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5,100	650	200	0	0	0
Nauvoo-Ft. Madison	100	10	400	0	0	0	0	0	0	0	2,000	0	75,000	0	0	17,520	0	3,900	0	98,820	405	0	0	0	0
Ft. Madison-Dallas	100	10	0	0	0	0	0	0	0	0	0	0	150	0	0	1,000	0	1,100	0	2,250	160	0	0	0	0
Henderson Creek	100	10	4,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4,000	200	400	0	0	0
Keithsburg Refuge	100	20	55	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	55	2,015	0	0	0	0
Louisa Refuge	100	30	330	0	0	0	0	0	0	0	0	0	0	0	0	0	0	360	0	690	1,095	150	0	0	0
TOTAL UPPER			9,920	0	0	0	0	0	0	0	2,425	0	76,460	0	0	20,770	0	5,660	5	115,240	4,825	750	0	0	0

LOWER MISSISSIPPI RIVER VALLEY

Swan Lake	100	0	5,300	0	0	0	0	0	0	0	0	5,500	30	0	800	200	0	300	50	12,180	470	315	10	5	0
Gilbert Lake	100	0	400	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	400	500	300	0	0	0
Long Lake	100	0	6,000	0	0	0	0	0	0	0	0	4,000	0	0	0	0	0	0	0	10,000	0	0	0	0	0
Dardenne Club	100	0	24,000	0	5,000	0	0	0	1,000	0	0	0	0	0	0	0	0	0	0	30,000	0	0	0	0	0
Cuivre Club	100	0	8,000	0	1,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9,000	0	0	0	0	0
Batchtown Refuge	100	0	7,000	0	0	0	0	0	0	0	0	2,500	0	0	50	0	5	0	0	9,555	1,000	0	0	0	0
Cannon Refuge	80	10	34,400	0	0	0	0	0	25	0	0	0	0	0	0	0	0	0	0	34,425	400	3,000	350	0	0
Towhead Lake	100	0	15,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15,000	100	2,500	200	0	10
Delair Refuge	100	0	18,500	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18,500	1,000	1,200	0	0	0
Shanks Refuge	90	0	35,100	0	0	0	0	0	100	0	0	0	0	0	0	0	0	0	0	35,200	40	550	10	0	0
Meyer-Keokuk	100	0	150	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	155	0	0	0	20	0
TOTAL LOWER			153,850	0	6,000	0	0	0	1,125	0	0	12,000	30	0	850	200	5	305	50	174,415	3,510	7,865	570	25	10
TOTAL MISSISSIPPI			163,770	0	6,000	0	0	0	1,125	0	2,425	12,000	76,490	0	850	20,970	5	5,965	55	289,655	8,335	8,615	570	25	10
10-Year Average 2004-2013			162,606	488	3,092	0	5,175	17	2,760	855	8,101	6,649	25,723	227	2,150	14,118	4,738	6,488	0	243,186	9,863	450	1,835	24	1,416

ILLINOIS NATURAL HISTORY SURVEY WATERFOWL AERIAL INVENTORY DATA

UPPER ILLINOIS RIVER VALLEY Date: 12/29/2014 Observer: Aaron Yetter

LOCATION	%WET	%ICE	MALL	ABDU	NOPI	BWTE	AGWT	AMWI	GADW	NSHO	LESC	RNDU	CANV	REDH	RUDU	COGO	BUFF	COME	HOME	TOTAL DUCKS	CAGO	GWFG	LSGO	WHPE	AMCO
Hennepin/Hopper	100	40	0	0	0	0	0	0	0	0	0	100	0	0	0	200	0	300	0	600	3,300	0	0	0	0
Goose Lake	100	50	10,100	60	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10,160	515	400	0	0	0
Senachwine Lake	100	30	1,810	10	0	0	0	0	0	0	0	0	0	0	0	100	0	0	0	1,920	10	0	0	0	0
Hitchcock Slough	100	40	150	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	150	150	0	0	0	0
Douglas Lake	100	50	19,800	200	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20,000	0	0	0	0	100
Goose Lake	100	10	28,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	28,000	600	100	0	0	0
Upper Peoria	100	10	900	0	0	0	0	0	0	0	300	0	0	0	0	800	0	50	0	2,050	350	0	0	0	0
TOTAL UPPER			60,760	270	0	0	0	0	0	0	300	100	0	0	0	1,100	0	350	0	62,880	4,925	500	0	0	100

LOWER ILLINOIS RIVER VALLEY

Goose Lake	100	40	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30	235	0	0	0	0
Rice Lake	100	70	6,450	0	0	0	0	0	0	0	0	0	0	0	0	0	0	55	0	6,505	250	3,500	0	0	0
Big Lake	100	50	2,600	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2,600	0	0	0	0	0
Banner Marsh	100	40	760	0	0	0	0	0	60	0	0	0	0	0	0	0	0	0	0	820	1,810	0	0	0	0
Duck Creek	100	10	5,810	0	0	0	0	0	100	0	0	200	0	0	0	10	0	450	25	6,595	15	2,505	0	0	150
Clear Lake	100	90	200	0	0	0	0	0	0	0	0	0	0	0	0	50	0	100	0	350	0	0	0	0	0
Chautauqua	90	90	25,500	50	0	0	2,000	0	0	0	0	0	0	0	0	200	0	0	0	27,750	1,140	7,250	15,000	0	0
Emiquon/Spoon Btm	90	50	600	0	0	0	0	0	0	0	0	0	20	0	0	2,010	0	1,250	40	3,920	80	1,000	0	0	20
Grass Lake	100	20	4,000	0	0	0	0	0	0	0	0	0	0	0	0	50	0	210	0	4,260	50	2,200	7,000	0	0
Jack Lake	100	20	0	0	0	0	0	0	0	0	0	0	0	0	0	50	0	200	0	250	0	0	0	0	0
Stewart Lake	100	70	0	0	0	0	0	0	0	0	0	0	0	0	0	300	0	0	0	300	0	10	0	0	0
Crane Lake	100	30	1,250	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,250	600	1,600	0	0	0
Cuba Island	100	70	13,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100	0	13,100	2,300	5,100	0	0	0
Big Lake	30	80	10,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10,000	0	1,200	10,000	0	0
Spunky Bottoms	20	90	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Meredosia Lake	70	30	705	0	0	0	0	0	0	0	0	0	0	0	0	0	0	105	10	820	70	0	0	0	0
TOTAL LOWER			70,905	50	0	0	2,000	0	160	0	0	200	20	0	0	2,670	0	2,470	75	78,550	6,550	24,365	32,000	0	170
TOTAL ILLINOIS			131,665	320	0	0	2,000	0	160	0	300	300	20	0	0	3,770	0	2,820	75	141,430	11,475	24,865	32,000	0	270
10-Year Average 2004-2013			78,149	655	70	0	700	0	1,594	102	312	973	125	0	1,195	1,436	113	2,205	78	87,922	26,864	2,896	717	1	522

Observer Note: There were a lot of snow geese in the Havana area; however, most of them were field feeding when the survey was conducted at Chautauqua Lake and Emiquon on December 29th. There were maybe 100,000 or more in the area. We just missed them on the survey.

ILLINOIS NATURAL HISTORY SURVEY WATERFOWL AERIAL INVENTORY DATA

UPPER MISSISSIPPI RIVER VALLEY Date: 12/29/2014 Observer: Aaron Yetter

LOCATION	%WET	%ICE	MALL	ABDU	NOPI	BWTE	AGWT	AMWI	GADW	NSHO	LESC	RNDU	CANV	REDH	RUDU	COGO	BUFF	COME	HOME	TOTAL DUCKS	CAGO	GWFG	LSGO	WHPE	AMCO
Keokuk-Nauvoo	100	10	10	0	0	0	0	0	0	0	0	100	110	0	0	2,600	0	600	0	3,420	300	0	0	0	0
Arthur Refuge	100	50	4,250	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4,250	700	450	0	0	0
Nauvoo-Ft. Madison	100	10	350	0	0	0	0	0	0	0	5,000	0	61,100	0	0	15,200	0	4,300	0	85,950	0	0	0	0	0
Ft. Madison-Dallas	100	10	10	0	0	0	0	0	0	0	50	0	0	0	0	1,300	0	250	0	1,610	410	0	0	0	0
Henderson Creek	100	40	11,000	0	0	0	0	0	100	0	0	0	200	0	0	0	0	0	0	11,300	630	1,800	0	0	0
Keithsburg Refuge	100	90	600	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	600	1,150	75	0	0	0
Louisa Refuge	100	90	7,900	0	0	0	0	0	0	0	0	0	0	0	0	100	0	600	0	8,600	1,300	5,100	0	0	0
TOTAL UPPER			24,120	0	0	0	0	0	100	0	5,050	100	61,410	0	0	19,200	0	5,750	0	115,730	4,490	7,425	0	0	0
LOWER MISSISSIPPI RIVER VALLEY																									
Swan Lake	100	20	19,700	0	200	0	0	0	0	0	0	6,000	30	0	400	100	0	100	0	26,530	1,270	710	8,000	5	0
Gilbert Lake	100	50	105	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	105	550	0	0	0	0
Long Lake	100	0	30,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30,000	0	0	0	0	0
Dardenne Club	100	40	65,000	0	5,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	70,000	0	0	0	0	0
Cuivre Club	100	10	15,000	0	1,500	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16,500	0	0	0	0	0
Batchtown Refuge	100	20	20,000	0	0	0	0	0	0	0	0	500	0	0	0	0	0	0	0	20,500	500	0	0	0	0
Cannon Refuge	80	70	57,700	0	3,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	60,700	100	2,500	0	0	0
Towhead Lake	50	60	9,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9,000	0	550	0	0	0
Delair Refuge	100	90	10,300	0	1,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11,300	350	8,000	10	0	0
Shanks Refuge	90	90	26,600	0	1,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	27,600	200	2,130	0	0	0
Meyer-Keokuk	100	0	150	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	150	250	0	0	15	0
TOTAL LOWER			253,555	0	11,700	0	0	0	0	0	0	6,500	30	0	400	100	0	100	0	272,385	3,220	13,890	8,010	20	0
TOTAL MISSISSIPPI			277,675	0	11,700	0	0	0	100	0	5,050	6,600	61,440	0	400	19,300	0	5,850	0	388,115	7,710	21,315	8,010	20	0
10-Year Average 2004-2013			135,684	404	2,844	0	1,880	2	1,702	140	4,617	5,963	34,779	56	801	6,072	1,668	9,374	0	207,945	13,504	1,306	3,008	40	365

ILLINOIS NATURAL HISTORY SURVEY WATERFOWL AERIAL INVENTORY DATA

UPPER ILLINOIS RIVER VALLEY Date: 01/05/2015 Observer: Aaron Yetter

LOCATION	%WET	%ICE	MALL	ABDU	NOPI	BWTE	AGWT	AMWI	GADW	NSHO	LESC	RNDU	CANV	REDH	RUDU	COGO	BUFF	COME	HOME	TOTAL DUCKS	CAGO	GWFG	LSGO	WHPE	AMCO
Hennepin/Hopper	100	99	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	10	50	0	0	0	0
Goose Lake	100	99	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	550	0	0	0	0
Senachwine Lake	100	99	1,000	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,020	200	0	0	0	0
Hitchcock Slough	100	99	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0	0	0	0
Douglas Lake	100	99	0	0	0	0	0	0	0	0	0	0	0	0	0	50	0	0	0	50	0	0	0	0	0
Goose Lake	100	99	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Upper Peoria	100	99	41,790	210	0	0	0	0	0	0	0	0	0	0	0	7,900	0	0	0	49,900	0	0	0	0	0
TOTAL UPPER			42,810	230	0	0	0	0	0	0	0	0	0	0	0	7,950	0	10	0	51,000	800	0	0	0	0

LOWER ILLINOIS RIVER VALLEY

Goose Lake	100	99	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rice Lake	100	99	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Big Lake	100	99	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0	0	20	0	0	0	0	0
Banner Marsh	100	90	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,510	0	0	0	0
Duck Creek	100	10	19,700	0	0	0	0	0	100	0	0	0	0	0	0	160	0	410	0	20,370	13,500	15,400	0	0	10
Clear Lake	100	99	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chautauqua	90	99	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,000	1,000	500	0	0
Emiquon/Spoon Btm	90	99	0	0	0	0	0	0	0	0	10	0	0	0	0	0	0	60	0	70	15	20	0	0	0
Grass Lake	100	99	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0	10	100	1,600	0	0	0
Jack Lake	100	99	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stewart Lake	100	99	0	0	0	0	0	0	0	0	0	0	0	0	0	30	0	100	0	130	0	0	0	0	0
Crane Lake	100	99	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	10	0	15	30	30	10	0	0
Cuba Island	100	99	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100	0	100	1,305	6,500	1,000	0	0
Big Lake	30	99	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Spunky Bottoms	20	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Meredosia Lake	70	99	50	0	0	0	0	0	0	0	10	0	5	0	0	50	0	40	0	155	370	0	0	0	0
TOTAL LOWER			19,750	0	0	0	0	0	100	0	20	0	5	0	0	275	0	720	0	20,870	17,830	24,550	1,510	0	10
TOTAL ILLINOIS			62,560	230	0	0	0	0	100	0	20	0	5	0	0	8,225	0	730	0	71,870	18,630	24,550	1,510	0	10
10-Year Average 2004-2013			40,781	452	25	0	0	0	576	33	45	314	518	0	164	1,016	1	3,272	3	47,199	17,194	4,032	3,781	13	203

ILLINOIS NATURAL HISTORY SURVEY WATERFOWL AERIAL INVENTORY DATA

UPPER MISSISSIPPI RIVER VALLEY Date: 01/05/2015 Observer: Aaron Yetter

LOCATION	%WET	%ICE	MALL	ABDU	NOPI	BWTE	AGWT	AMWI	GADW	NSHO	LESC	RNDU	CANV	REDH	RUDU	COGO	BUFF	COME	HOME	TOTAL DUCKS	CAGO	GWFG	LSGO	WHPE	AMCO
Keokuk-Nauvoo	100	99	0	0	0	0	0	0	0	0	0	0	5,000	0	0	0	0	30	0	5,030	200	0	0	0	0
Arthur Refuge	100	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nauvoo-Ft. Madison	100	99	0	0	0	0	0	0	0	0	0	0	34,000	0	0	40	0	100	0	34,140	0	0	0	0	0
Ft. Madison-Dallas	100	99	0	0	0	0	0	0	0	0	0	0	800	0	0	100	0	190	0	1,090	50	0	20	0	0
Henderson Creek	100	99	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30	50	0	0	0	0
Keithsburg Refuge	100	99	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30	0	0	0	0
Louisa Refuge	100	99	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	5	0	0	0	0
TOTAL UPPER			35	0	0	0	0	0	0	0	0	0	39,800	0	0	140	0	320	0	40,295	335	0	20	0	0

LOWER MISSISSIPPI RIVER VALLEY

Swan Lake	100	99	6,000	0	0	0	0	0	0	0	0	300	50	0	0	80	0	0	0	6,430	750	700	0	5	0
Gilbert Lake	100	99	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	500	0	0	0
Long Lake	100	99	6,500	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6,500	0	0	0	0	0
Dardenne Club	100	99	98,000	0	2,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100,000	0	0	0	0	0
Cuivre Club	100	99	60,000	0	5,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	65,000	0	0	0	0	0
Batchtown Refuge	100	99	3,000	0	0	0	0	0	0	0	0	300	0	0	0	0	0	0	0	3,300	50	0	0	0	0
Cannon Refuge	80	99	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3,000	1,000	0	0
Towhead Lake	50	99	150	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	150	500	1,250	0	0	0
Delair Refuge	100	99	20,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20,000	450	7,600	0	0	0
Shanks Refuge	90	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Meyer-Keokuk	100	90	20	0	0	0	0	0	0	0	0	0	0	0	0	100	0	270	0	390	90	0	0	0	0
TOTAL LOWER			193,670	0	7,000	0	0	0	0	0	0	600	50	0	0	180	0	270	0	201,770	1,850	13,050	1,000	5	0
TOTAL MISSISSIPPI			193,705	0	7,000	0	0	0	0	0	0	600	39,850	0	0	320	0	590	0	242,065	2,185	13,050	1,020	5	0
10-Year Average 2004-2013			104,987	142	713	0	375	0	754	0	3,701	1,478	31,986	6	66	5,125	1,280	7,155	0	157,768	10,047	1,853	2,139	5	104

Appendix 2. 2012–2015 Spring-Migration Diving Duck Inventories of the Illinois River Valley and Pool 19 of the Mississippi River by Date and Location

ILLINOIS NATURAL HISTORY SURVEY WATERFOWL AERIAL INVENTORY DATA

UPPER ILLINOIS RIVER VALLEY Date: March 1, 2012 Observer: Aaron Yetter

LOCATION	LESC	RNDU	CANV	REDH	RUDU	COGO	BUFF	COME	HOME	TOTAL DUCKS
Turner Lake	0	0	0	0	0	0	0	100	0	100
Depue, Spring	0	7,000	3,000	0	0	0	0	180	0	10,180
Coleman Lake	0	0	0	0	0	0	0	220	0	220
Bureau Ponds	0	250	0	0	0	0	0	50	0	300
Goose Lake	0	0	50	0	0	0	0	150	0	200
Senachwine Lake	500	0	700	0	0	25	0	50	0	1,275
Hennepin/Hopper	0	0	0	0	0	0	0	250	10	260
Swan Lake	0	0	0	0	0	0	0	0	0	0
Sawmill Lake	0	10	0	0	0	0	0	0	0	10
Billsbach Lake	200	0	100	0	0	0	0	20	0	320
Weis Lake	200	0	0	0	0	100	0	100	0	400
Sparland	0	0	0	0	0	0	0	55	0	55
Wightman Lake	10	300	0	0	0	0	0	10	0	320
Sawyer Slough	0	0	0	0	0	0	0	0	0	0
Hitchcock Slough	0	0	0	0	0	0	0	0	0	0
Babbs Slough	200	0	0	0	0	0	0	30	0	230
Meadow Lake	0	0	0	0	0	0	0	0	0	0
Douglas Lake	200	100	300	0	10	0	0	0	0	610
Goose Lake	370	0	100	0	700	10	0	200	0	1,380
Upper Peoria	475	0	150	0	300	15	0	55	0	995
Lower Peoria	60	0	100	0	350	0	0	0	0	510
TOTAL UPPER	2,215	7,660	4,500	0	1,360	150	0	1,470	10	17,365
TOTAL LOWER	8,275	35,250	10,235	340	7,710	430	580	1,245	235	64,300
TOTAL	10,490	42,910	14,735	340	9,070	580	580	2,715	245	81,665

ILLINOIS NATURAL HISTORY SURVEY WATERFOWL AERIAL INVENTORY DATA

LOWER ILLINOIS RIVER VALLEY Date: March 1, 2012 Observer: Aaron Yetter

LOCATION	LESC	RNDU	CANV	REDH	RUDU	COGO	BUFF	COME	HOME	TOTAL DUCKS
Pekin Lake	0	0	0	0	0	0	0	0	0	0
Powerton Lake	0	0	0	0	0	0	0	0	0	0
Spring Lake	0	0	0	0	0	0	0	0	0	0
Spring Lake Bottoms	0	500	0	0	0	0	0	0	0	500
Goose Lake	270	0	0	0	0	0	0	0	0	270
Rice Lake	150	3,000	0	0	300	0	0	30	0	3,480
Big Lake	0	200	0	0	0	0	0	0	0	200
Banner Marsh	0	0	0	0	0	0	0	0	0	0
Duck Creek	0	0	0	0	0	0	0	10	0	10
Clear Lake	550	0	1,000	0	100	0	0	30	0	1,680
North Pool	300	0	200	10	2,500	0	100	0	0	3,110
South Pool	0	2,200	0	0	0	0	10	0	0	2,210
Quiver Creek	0	0	0	0	0	0	0	0	0	0
Quiver Lake	0	0	0	0	0	0	0	0	0	0
Thompson/Flag Lake	3,465	460	3,465	230	2,310	230	460	1,155	230	12,005
North Globe	0	0	0	0	0	0	0	0	0	0
Dickson Mounds	0	0	0	0	0	0	0	0	5	5
South Globe	0	0	0	0	0	200	0	0	0	200
Wilder/Bellrose	0	0	0	0	0	0	0	0	0	0
Spoon River Btms	0	0	0	0	0	0	0	0	0	0
Matanza Lake	0	0	0	0	0	0	0	0	0	0
Bath Lake	0	0	0	0	0	0	0	0	0	0
Moscow Lake	1,000	10,000	2,000	0	0	0	0	0	0	13,000
Jack Lake	100	1,020	50	0	1,700	0	0	0	0	2,870
Grass Lake	350	1,700	750	0	500	0	0	0	0	3,300
Anderson Lake	0	0	100	0	0	0	0	10	0	110
Snicarte Slough	0	0	0	0	0	0	0	0	0	0
Ingram Lake	100	200	410	0	100	0	0	10	0	820
Chain Lake	0	0	0	0	0	0	0	0	0	0
Stewart Lake	1,400	0	600	0	100	0	0	0	0	2,100
Crane Lake	0	150	50	0	0	0	0	0	0	200
Cuba Island	440	9,460	660	0	0	0	0	0	0	10,560
Sanganois	0	4,200	0	100	0	0	0	0	0	4,300
Treadway Lake	0	0	0	0	0	0	0	0	0	0
Muscooten Bay	0	0	100	0	0	0	0	0	0	100
Big Lake	50	2,000	700	0	0	0	0	0	0	2,750
Meredosia Lake	100	110	150	0	100	0	10	0	0	470
Smith Lake	0	0	0	0	0	0	0	0	0	0
Spunky Bottoms	0	50	0	0	0	0	0	0	0	50
TOTAL LOWER	8,275	35,250	10,235	340	7,710	430	580	1,245	235	64,300

ILLINOIS NATURAL HISTORY SURVEY WATERFOWL AERIAL INVENTORY DATA

UPPER ILLINOIS RIVER VALLEY Date: March 13, 2012 Observer: Aaron Yetter

LOCATION	LESC	RNDU	CANV	REDH	RUDU	COGO	BUFF	COME	HOME	TOTAL DUCKS
Turner Lake	100	0	0	0	0	0	0	100	0	200
Depue, Spring	600	1,400	810	0	0	0	0	0	0	2,810
Coleman Lake	275	0	200	0	0	0	0	0	0	475
Bureau Ponds	0	0	0	0	0	0	0	0	0	0
Goose Lake	210	110	200	0	900	0	40	10	0	1,470
Senachwine Lake	500	0	2,000	0	730	0	0	0	0	3,230
Hennepin/Hopper	50	75	0	0	0	0	0	0	0	125
Swan Lake	350	200	150	0	0	0	0	0	0	700
Sawmill Lake	150	50	0	0	0	0	0	0	0	200
Billsbach Lake	225	500	200	0	700	0	30	0	0	1,655
Weis Lake	700	200	100	0	2,100	0	0	0	0	3,100
Sparland	2,400	0	300	0	220	0	0	0	0	2,920
Wightman Lake	0	0	0	0	0	0	0	0	0	0
Sawyer Slough	30	0	0	0	0	0	0	0	0	30
Hitchcock Slough	0	0	0	0	0	0	0	0	0	0
Babbs Slough	250	0	50	0	0	0	0	0	0	300
Meadow Lake	665	0	10	0	0	0	0	0	0	675
Douglas Lake	600	500	350	0	0	0	100	0	0	1,550
Goose Lake	2,600	0	450	0	3,200	0	0	0	0	6,250
Upper Peoria	2,440	0	910	0	910	0	0	0	0	4,260
Lower Peoria	100	0	0	0	1,300	0	0	0	0	1,400
TOTAL UPPER	12,245	3,035	5,730	0	10,060	0	170	110	0	31,350
TOTAL LOWER	21,285	6,370	9,235	340	32,235	1,060	1,510	1,350	50	73,435
TOTAL	33,530	9,405	14,965	340	42,295	1,060	1,680	1,460	50	104,785

ILLINOIS NATURAL HISTORY SURVEY WATERFOWL AERIAL INVENTORY DATA

LOWER ILLINOIS RIVER VALLEY Date: March 13, 2012 Observer: Aaron Yetter

LOCATION	LESC	RNDU	CANV	REDH	RUDU	COGO	BUFF	COME	HOME	TOTAL DUCKS
Pekin Lake	0	0	0	0	0	0	0	0	0	0
Powerton Lake	100	200	0	0	100	0	0	0	0	400
Spring Lake	10	0	0	0	0	0	0	0	0	10
Spring Lake Bottoms	10	0	0	0	0	0	0	0	0	10
Goose Lake	700	0	0	0	0	0	0	0	0	700
Rice Lake	4,235	300	1,200	0	2,300	0	0	0	0	8,035
Big Lake	0	0	0	0	0	0	0	0	0	0
Banner Marsh	10	0	0	0	0	10	0	0	0	20
Duck Creek	0	0	50	0	0	110	10	0	0	170
Clear Lake	300	0	50	0	0	0	0	0	0	350
North Pool	820	50	500	0	5,800	150	0	0	0	7,320
South Pool	500	0	0	0	0	0	0	0	0	500
Quiver Creek	0	200	0	0	0	0	0	0	0	200
Quiver Lake	0	0	0	0	0	0	0	0	0	0
Thompson/Flag Lake	6,740	340	675	340	3,370	675	1,350	1,350	50	14,890
North Globe	0	0	0	0	0	0	0	0	0	0
Dickson Mounds	0	0	0	0	0	0	0	0	0	0
South Globe	0	0	0	0	0	0	0	0	0	0
Wilder/Bellrose	0	0	0	0	0	0	0	0	0	0
Spoon River Btms	0	0	0	0	0	0	0	0	0	0
Matanza Lake	0	0	0	0	0	0	0	0	0	0
Bath Lake	50	0	30	0	0	0	0	0	0	80
Moscow Lake	2,000	0	100	0	0	0	100	0	0	2,200
Jack Lake	3,150	630	630	0	6,865	65	0	0	0	11,340
Grass Lake	1,500	300	1,500	0	5,100	50	0	0	0	8,450
Anderson Lake	200	0	350	0	0	0	0	0	0	550
Snicarte Slough	0	0	0	0	0	0	0	0	0	0
Ingram Lake	500	0	200	0	2,200	0	0	0	0	2,900
Chain Lake	0	0	0	0	500	0	0	0	0	500
Stewart Lake	100	0	1,800	0	4,600	0	0	0	0	6,500
Crane Lake	50	0	200	0	0	0	0	0	0	250
Cuba Island	300	3,000	500	0	100	0	0	0	0	3,900
Sanganois	10	600	0	0	0	0	0	0	0	610
Treadway Lake	0	0	1,000	0	400	0	0	0	0	1,400
Muscooten Bay	0	0	0	0	0	0	0	0	0	0
Big Lake	0	250	300	0	300	0	0	0	0	850
Meredosia Lake	0	0	150	0	100	0	50	0	0	300
Smith Lake	0	0	0	0	500	0	0	0	0	500
Spunky Bottoms	0	500	0	0	0	0	0	0	0	500
TOTAL LOWER	21,285	6,370	9,235	340	32,235	1,060	1,510	1,350	50	73,435

ILLINOIS NATURAL HISTORY SURVEY WATERFOWL AERIAL INVENTORY DATA

UPPER ILLINOIS RIVER VALLEY Date: March 30, 2012 Observer: Aaron Yetter

LOCATION	LESC	RNDU	CANV	REDH	RUDU	COGO	BUFF	COME	HOME	TOTAL DUCKS
Turner Lake	0	0	0	0	0	0	0	0	0	0
Depue, Spring	0	0	0	0	0	0	0	0	0	0
Coleman Lake	0	0	0	0	0	0	0	0	0	0
Bureau Ponds	0	0	0	0	0	0	0	0	0	0
Goose Lake	0	0	0	0	210	0	0	0	0	210
Senachwine Lake	0	0	0	0	0	0	0	0	0	0
Hennepin/Hopper	10	0	0	0	50	0	0	0	0	60
Swan Lake	0	0	0	0	0	0	0	0	0	0
Sawmill Lake	0	0	0	0	0	0	0	0	0	0
Billsbach Lake	20	0	30	0	300	0	0	0	0	350
Weis Lake	0	0	0	0	0	0	0	0	0	0
Sparland	50	0	0	0	100	0	0	0	0	150
Wightman Lake	0	0	0	0	0	0	0	0	0	0
Sawyer Slough	0	0	0	0	0	0	0	0	0	0
Hitchcock Slough	0	0	0	0	0	0	0	0	0	0
Babbs Slough	15	0	0	0	0	0	0	0	0	15
Meadow Lake	30	0	0	0	0	0	0	0	0	30
Douglas Lake	0	0	0	0	0	0	0	0	0	0
Goose Lake	10	0	0	0	250	0	0	0	0	260
Upper Peoria	15	0	0	0	300	0	0	0	0	315
Lower Peoria	0	0	0	0	0	0	0	0	0	0
TOTAL UPPER	150	0	30	0	1,210	0	0	0	0	1,390
TOTAL LOWER	545	0	15	0	4,495	125	255	0	0	5,435
TOTAL	695	0	45	0	5,705	125	255	0	0	6,825

ILLINOIS NATURAL HISTORY SURVEY WATERFOWL AERIAL INVENTORY DATA

LOWER ILLINOIS RIVER VALLEY Date: March 30, 2012 Observer: Aaron Yetter

LOCATION	LESC	RNDU	CANV	REDH	RUDU	COGO	BUFF	COME	HOME	TOTAL DUCKS
Pekin Lake	15	0	0	0	0	0	0	0	0	15
Powerton Lake	5	0	0	0	50	0	0	0	0	55
Spring Lake	0	0	0	0	0	0	0	0	0	0
Spring Lake Bottoms	0	0	0	0	0	0	0	0	0	0
Goose Lake	0	0	0	0	0	0	0	0	0	0
Rice Lake	20	0	5	0	400	0	0	0	0	425
Big Lake	0	0	0	0	0	0	0	0	0	0
Banner Marsh	0	0	0	0	0	0	0	0	0	0
Duck Creek	0	0	0	0	0	0	0	0	0	0
Clear Lake	40	0	0	0	0	0	0	0	0	40
North Pool	40	0	0	0	100	0	0	0	0	140
South Pool	0	0	0	0	0	0	0	0	0	0
Quiver Creek	0	0	0	0	0	0	0	0	0	0
Quiver Lake	0	0	0	0	0	0	0	0	0	0
Thompson/Flag Lake	255	0	0	0	2,550	125	255	0	0	3,185
North Globe	0	0	0	0	0	0	0	0	0	0
Dickson Mounds	0	0	0	0	0	0	0	0	0	0
South Globe	0	0	0	0	0	0	0	0	0	0
Wilder/Bellrose	0	0	0	0	0	0	0	0	0	0
Spoon River Btms	0	0	0	0	0	0	0	0	0	0
Matanza Lake	0	0	0	0	0	0	0	0	0	0
Bath Lake	0	0	0	0	0	0	0	0	0	0
Moscow Lake	0	0	0	0	0	0	0	0	0	0
Jack Lake	0	0	0	0	500	0	0	0	0	500
Grass Lake	0	0	5	0	220	0	0	0	0	225
Anderson Lake	0	0	0	0	0	0	0	0	0	0
Snicarte Slough	0	0	0	0	0	0	0	0	0	0
Ingram Lake	0	0	0	0	0	0	0	0	0	0
Chain Lake	0	0	0	0	0	0	0	0	0	0
Stewart Lake	0	0	0	0	300	0	0	0	0	300
Crane Lake	50	0	0	0	0	0	0	0	0	50
Cuba Island	30	0	0	0	50	0	0	0	0	80
Sanganois	0	0	0	0	0	0	0	0	0	0
Treadway Lake	0	0	0	0	0	0	0	0	0	0
Muscooten Bay	0	0	0	0	0	0	0	0	0	0
Big Lake	30	0	0	0	0	0	0	0	0	30
Meredosia Lake	60	0	5	0	300	0	0	0	0	365
Smith Lake	0	0	0	0	25	0	0	0	0	25
Spunky Bottoms	0	0	0	0	0	0	0	0	0	0
TOTAL LOWER	545	0	15	0	4,495	125	255	0	0	5,435

ILLINOIS NATURAL HISTORY SURVEY WATERFOWL AERIAL INVENTORY DATA

Pool 19 Mississippi River Date: March 1, 2012 Observer: Aaron Yetter

LOCATION	LESC	RNDU	CANV	REDH	RUDU	COGO	BUFF	COME	HOME	TOTAL DUCKS
Keokuk-Nauvoo	5,770	200	46,400	100	50	100	250	250	0	53,120
Arthur Refuge	0	0	10	0	0	0	0	10	0	20
Nauvoo-Ft. Mad.	7,600	500	31,100	0	400	1,100	450	4,350	0	45,500
Ft.Madison-Dallas	50	0	650	0	10	0	50	750	0	1,510
Dallas-Burlington	0	0	200	0	0	100	0	850	0	1,150
Turkey Slough	0	0	150	0	0	0	0	0	0	150
Burling. - 18 Dam	0	0	0	0	0	0	0	0	0	0
Crystal Lake	10	0	0	0	0	0	0	0	0	10
TOTAL	13,430	700	78,510	100	460	1,300	750	6,210	0	130,260

ILLINOIS NATURAL HISTORY SURVEY WATERFOWL AERIAL INVENTORY DATA

Pool 19 Mississippi River Date: March 13, 2012 Observer: Aaron Yetter

LOCATION	LESC	RNDU	CANV	REDH	RUDU	COGO	BUFF	COME	HOME	TOTAL DUCKS
Keokuk-Nauvoo	5,200	0	10,770	0	100	100	110	0	0	16,280
Arthur Refuge	0	0	0	0	0	0	0	0	0	0
Nauvoo-Ft. Mad.	70,500	200	8,100	0	2,435	2,500	1,200	1,200	0	86,135
Ft.Madison-Dallas	4,300	0	2,300	0	0	260	0	200	0	7,060
Dallas-Burlington	7,200	0	100	0	100	0	0	0	0	7,400
Turkey Slough	600	0	100	0	10	0	0	0	0	710
Burling. - 18 Dam	0	0	0	0	0	0	0	0	0	0
Crystal Lake	0	100	0	0	0	0	0	0	0	100
Total	87,800	300	21,370	0	2,645	2,860	1,310	1,400	0	117,685

ILLINOIS NATURAL HISTORY SURVEY WATERFOWL AERIAL INVENTORY DATA

Pool 19 Mississippi River Date: March 30, 2012 Observer: Aaron Yetter

LOCATION	LESC	RNDU	CANV	REDH	RUDU	COGO	BUFF	COME	HOME	TOTAL DUCKS
Keokuk-Nauvoo	735	0	0	0	400	0	0	0	0	1,135
Arthur Refuge	0	0	0	0	0	0	0	0	0	0
Nauvoo-Ft. Mad.	5,005	0	0	0	1,400	0	0	0	0	6,405
Ft.Madison-Dallas	0	0	0	0	0	0	0	0	0	0
Dallas-Burlington	0	0	0	0	0	0	0	0	0	0
Turkey Slough	0	0	0	0	5	0	0	0	0	5
Burling. - 18 Dam	100	0	0	0	0	0	0	0	0	100
Crystal Lake	0	0	0	0	0	0	0	0	0	0
Total	5,840	0	0	0	1,805	0	0	0	0	7,645

ILLINOIS NATURAL HISTORY SURVEY WATERFOWL AERIAL INVENTORY DATA

UPPER ILLINOIS RIVER VALLEY Date: March 8, 2013 Observer: Aaron Yetter

LOCATION	LESC	RNDU	CANV	REDH	RUDU	COGO	BUFF	COME	HOME	TOTAL DUCKS
Turner Lake	0	0	0	0	0	0	0	60	0	60
Depue, Spring	0	0	0	0	0	0	0	0	0	0
Coleman Lake	0	0	0	0	0	0	0	5	0	5
Bureau Ponds	1,000	0	200	100	0	0	0	30	0	1,330
Goose Lake	0	0	0	0	0	0	0	200	0	200
Senachwine Lake	1,200	0	800	50	0	60	10	210	0	2,330
Hennepin/Hopper	0	0	0	0	0	0	0	0	0	0
Swan Lake	100	0	25	0	0	10	0	10	0	145
Sawmill Lake	50	0	10	0	0	50	0	0	0	110
Billsbach Lake	150	0	25	0	0	25	0	105	0	305
Weis Lake	0	10	0	0	0	0	0	30	0	40
Sparland	1,200	0	100	0	0	60	0	50	0	1,410
Wightman Lake	0	0	0	0	0	0	0	0	0	0
Sawyer Slough	0	0	0	0	0	0	0	0	0	0
Hitchcock Slough	0	0	0	0	0	0	0	0	0	0
Babbs Slough	100	10	0	0	0	25	0	20	0	155
Meadow Lake	0	0	0	0	0	0	0	0	0	0
Douglas Lake	400	0	100	0	0	50	0	15	0	565
Goose Lake	1,000	0	200	0	0	370	0	175	0	1,745
Upper Peoria	1,000	0	495	0	25	1,135	0	300	0	2,955
Lower Peoria	725	0	25	10	20	50	0	80	0	910
TOTAL UPPER	6,925	20	1,980	160	45	1,835	10	1,290	0	12,265
TOTAL LOWER	30,190	6,015	13,840	560	1,925	1,205	210	6,225	295	60,465
TOTAL	37,115	6,035	15,820	720	1,970	3,040	220	7,515	295	72,730

LOWER ILLINOIS RIVER VALLEY Date: March 8, 2013 Observer: Aaron Yetter

LOCATION	LESC	RNDU	CANV	REDH	RUDU	COGO	BUFF	COME	HOME	TOTAL DUCKS
Pekin Lake	25	0	0	0	0	0	0	10	0	35
Powerton Lake	0	0	0	0	0	0	0	0	0	0
Spring Lake	0	0	0	0	0	0	0	310	0	310
Spring Lake Bottoms	0	0	0	0	0	0	0	20	0	20
Goose Lake	2,300	0	700	0	0	0	0	0	0	3,000
Rice Lake	1,400	0	100	0	10	60	0	240	0	1,810
Big Lake	0	0	0	0	0	0	0	100	0	100
Banner Marsh	10	0	0	0	0	50	0	895	25	980
Duck Creek	0	0	0	0	0	0	0	170	0	170
Clear Lake	350	50	300	0	0	0	0	30	0	730
North Pool	105	0	200	0	0	0	0	120	0	425
South Pool	7,000	200	2,000	0	0	700	0	850	0	10,750
Quiver Creek	0	0	0	0	0	0	0	0	0	0
Quiver Lake	0	0	0	0	0	0	0	0	0	0
Thompson/Flag Lake	2,075	415	415	210	830	210	210	2,075	210	6,650
North Globe	0	0	0	0	0	0	0	0	0	0
Dickson Mounds	0	0	0	0	0	10	0	10	10	30
South Globe	0	0	0	0	0	0	0	0	0	0
Wilder/Bellrose	0	0	0	0	0	0	0	0	0	0
Spoon River Btms	0	0	0	0	0	0	0	0	0	0
Matanza Lake	0	0	25	0	0	25	0	0	0	50
Bath Lake	75	0	100	0	0	0	0	0	0	175
Moscow Lake	3,500	1,500	6,000	200	300	0	0	200	0	11,700
Jack Lake	500	1,000	200	0	200	0	0	200	0	2,100
Grass Lake	900	1,350	2,100	0	0	100	0	200	0	4,650
Anderson Lake	100	0	300	0	0	0	0	0	0	400
Snicarte Slough	0	0	0	0	0	0	0	100	0	100
Ingram Lake	500	0	0	0	0	0	0	100	0	600
Chain Lake	200	0	50	0	150	0	0	0	0	400
Stewart Lake	0	0	0	0	0	0	0	10	0	10
Crane Lake	150	0	400	0	10	0	0	110	0	670
Cuba Island	200	0	100	0	0	0	0	100	0	400
Sanganois	800	500	0	0	0	0	0	300	0	1,600
Treadway Lake	100	0	500	0	200	0	0	50	50	900
Muscooten Bay	4,000	0	0	0	0	0	0	0	0	4,000
Big Lake	150	0	150	0	0	0	0	0	0	300
Meredosia Lake	5,550	1,000	200	150	225	50	0	25	0	7,200
Smith Lake	100	0	0	0	0	0	0	0	0	100
Spunky Bottoms	100	0	0	0	0	0	0	0	0	100
TOTAL LOWER	30,190	6,015	13,840	560	1,925	1,205	210	6,225	295	60,465

ILLINOIS NATURAL HISTORY SURVEY WATERFOWL AERIAL INVENTORY DATA

UPPER ILLINOIS RIVER VALLEY Date: March 14, 2013 Observer: Aaron Yetter

LOCATION	LESC	RNDU	CANV	REDH	RUDU	COGO	BUFF	COME	HOME	TOTAL DUCKS
Turner Lake	0	0	0	0	0	0	0	45	0	45
Lake Depue	0	0	0	0	0	0	0	10	0	10
Coleman Lake	300	0	0	0	0	0	210	0	0	510
Bureau Ponds	0	0	0	0	0	0	0	0	0	0
Goose Lake	2,500	1,500	600	0	0	0	0	10	0	4,610
Senachwine Lake	100	0	30	0	0	0	0	15	0	145
Hennepin/Hopper	250	0	35	0	0	0	50	30	0	365
Swan Lake	150	600	100	0	0	50	0	120	0	1,020
Sawmill Lake	0	0	0	0	10	0	0	0	0	10
Billsbach Lake	0	0	0	0	0	0	0	0	0	0
Weis Lake	235	1,000	50	0	0	0	0	0	0	1,285
Sparland	0	0	100	0	0	0	0	0	0	100
Wightman Lake	0	0	0	0	0	0	0	0	0	0
Sawyer Slough	400	0	0	0	0	0	0	0	0	400
Hitchcock Slough	50	0	0	0	0	0	0	0	0	50
Babbs Slough	25	0	500	0	0	0	0	0	0	525
Meadow Lake	0	0	0	0	0	0	0	0	0	0
Douglas Lake	325	1,450	160	0	0	0	0	100	0	2,035
Goose Lake	50	200	50	0	0	0	0	0	0	300
Upper Peoria	1,295	135	110	0	2,700	20	0	20	0	4,280
Lower Peoria	100	0	10	0	170	0	0	0	0	280
TOTAL UPPER	5,780	4,885	1,745	0	2,880	70	260	350	0	15,970
TOTAL LOWER	17,500	48,705	6,735	305	7,745	820	385	1,445	270	83,910
TOTAL	23,280	53,590	8,480	305	10,625	890	645	1,795	270	99,880

LOWER ILLINOIS RIVER VALLEY Date: March 14, 2013 Observer: Aaron Yetter

LOCATION	LESC	RNDU	CANV	REDH	RUDU	COGO	BUFF	COME	HOME	TOTAL DUCKS
Pekin Lake	0	0	0	0	0	0	0	0	0	0
Powerton Lake	0	0	0	0	0	0	0	0	0	0
Spring Lake	0	0	0	0	0	25	0	100	0	125
Spring Lake Bottoms	100	3,100	0	0	0	0	0	0	0	3,200
Goose Lake	50	50	200	0	0	0	0	0	0	300
Rice Lake	260	50	10	0	550	0	0	20	0	890
Big Lake	70	3,500	100	0	50	0	0	0	0	3,720
Banner Marsh	30	10	0	0	0	60	30	455	5	590
Duck Creek	0	0	0	0	0	0	0	20	0	20
Clear Lake	125	215	10	0	800	0	0	0	0	1,150
North Pool	5	0	300	0	975	0	0	5	0	1,285
South Pool	6,700	23,700	1,810	0	0	100	100	200	0	32,610
Quiver Creek	0	0	0	0	0	0	0	0	0	0
Quiver Lake	1,000	200	300	0	0	0	0	0	0	1,500
Thompson/Flag Lake	760	760	510	255	1,270	510	255	510	255	5,085
North Globe	0	0	0	0	0	0	0	0	0	0
Dickson Mounds	0	0	0	0	300	0	0	25	0	325
South Globe	0	0	0	0	0	0	0	0	0	0
Wilder/Bellrose	0	0	0	0	0	0	0	0	0	0
Spoon River Btms	0	0	0	0	0	0	0	0	0	0
Matanza Lake	20	0	0	0	0	0	0	0	0	20
Bath Lake	20	0	0	0	0	0	0	0	0	20
Moscow Lake	100	2,500	100	0	100	10	0	0	0	2,810
Jack Lake	100	1,110	135	50	820	0	0	100	0	2,315
Grass Lake	450	4,350	300	0	1,310	0	0	0	0	6,410
Anderson Lake	2,000	500	1,060	0	400	0	0	0	10	3,970
Snicarte Slough	0	0	0	0	0	0	0	0	0	0
Ingram Lake	60	0	0	0	0	10	0	0	0	70
Chain Lake	0	0	0	0	10	0	0	0	0	10
Stewart Lake	310	50	0	0	0	0	0	0	0	360
Crane Lake	40	10	400	0	200	5	0	0	0	655
Cuba Island	1,100	4,200	600	0	0	0	0	0	0	5,900
Sanganois	2,750	3,400	600	0	0	100	0	10	0	6,860
Treadway Lake	0	0	0	0	0	0	0	0	0	0
Muscooten Bay	300	500	300	0	0	0	0	0	0	1,100
Big Lake	0	500	0	0	0	0	0	0	0	500
Meredosia Lake	1,000	0	0	0	660	0	0	0	0	1,660
Smith Lake	150	0	0	0	300	0	0	0	0	450
Spunky Bottoms	0	0	0	0	0	0	0	0	0	0
TOTAL LOWER	17,500	48,705	6,735	305	7,745	820	385	1,445	270	83,910

ILLINOIS NATURAL HISTORY SURVEY WATERFOWL AERIAL INVENTORY DATA

UPPER ILLINOIS RIVER VALLEY Date: March 22, 2013 Observer: Aaron Yetter

LOCATION	LESC	RNDU	CANV	REDH	RUDU	COGO	BUFF	COME	HOME	TOTAL DUCKS
Turner Lake	0	0	0	0	0	0	0	100	0	100
Lake Depue	4,000	0	500	0	200	500	0	700	0	5,900
Coleman Lake	3,000	0	0	0	0	0	0	0	0	3,000
Bureau Ponds	500	5,000	200	0	0	0	0	0	0	5,700
Goose Lake	7,500	5,000	900	0	0	0	0	900	0	14,300
Senachwine Lake	4,900	2,100	1,200	0	0	1,050	0	800	0	10,050
Hennepin/Hopper	0	0	0	0	0	0	0	0	0	0
Swan Lake	2,000	1,000	200	0	0	0	0	0	0	3,200
Sawmill Lake	125	100	0	0	0	0	0	50	0	275
Billsbach Lake	2,200	2,000	700	0	0	0	0	200	0	5,100
Weis Lake	1,500	2,000	100	0	0	200	0	0	0	3,800
Sparland	800	0	100	0	200	0	50	100	0	1,250
Wightman Lake	0	0	0	0	0	0	0	0	0	0
Sawyer Slough	450	0	0	0	0	0	0	0	0	450
Hitchcock Slough	700	1,000	0	0	0	0	0	0	0	1,700
Babbs Slough	4,200	500	200	0	0	0	0	0	0	4,900
Meadow Lake	10	0	300	0	0	0	0	0	0	310
Douglas Lake	1,600	2,300	400	0	0	0	0	100	0	4,400
Goose Lake	4,200	1,500	1,000	0	1,700	100	10	110	0	8,620
Upper Peoria	18,300	1,200	2,510	100	9,000	50	0	0	0	31,160
Lower Peoria	3,900	200	250	10	3,200	0	0	30	0	7,590
TOTAL UPPER	59,885	23,900	8,560	110	14,300	1,900	60	3,090	0	111,805
TOTAL LOWER	37,760	128,315	9,750	495	44,255	2,490	2,195	3,455	365	229,080
TOTAL	97,645	152,215	18,310	605	58,555	4,390	2,255	6,545	365	340,885

LOWER ILLINOIS RIVER VALLEY Date: March 22, 2013 Observer: Aaron Yetter

LOCATION	LESC	RNDU	CANV	REDH	RUDU	COGO	BUFF	COME	HOME	TOTAL DUCKS
Pekin Lake	1,100	1,500	200	0	0	0	0	0	0	2,800
Powerton Lake	0	0	0	0	0	10	0	20	0	30
Spring Lake	100	50	0	0	0	230	0	330	0	710
Spring Lake Bottoms	50	50	0	0	0	0	0	0	0	100
Goose Lake	300	9,000	0	0		0	0	0	0	9,300
Rice Lake	180	0	25	0	5,100	100	0	10	0	5,415
Big Lake	400	11,000	50	0	1,100	0	0	0	0	12,550
Banner Marsh	350	0	50	0	400	300	85	420	0	1,605
Duck Creek	0	0	0	0	0	0	0	45	0	45
Clear Lake	100	30	10	0	1,700	0	10	0	0	1,850
North Pool	110	0	1,500	0	4,200	0	20	10	0	5,840
South Pool	6,950	52,125	3,475	100	3,475	1,160	1,160	1,160	0	69,605
Quiver Creek	0	0	0	0	0	0	0	0	0	0
Quiver Lake	500	1,000	0	0	0	0	0	0	0	1,500
Thompson/Flag Lake	2,070	3,450	1,380	345	17,150	690	690	1,380	345	27,500
North Globe	0	0	0	0	0	0	0	0	0	0
Dickson Mounds	0	0	0	0	100	0	0	50	20	170
South Globe	0	0	0	0	0	0	0	0	0	0
Wilder/Bellrose	0	0	0	0	0	0	0	0	0	0
Spoon River Btms	100	1,000	50	0	0	0	0	0	0	1,150
Matanza Lake	1,000	4,000	50	0	0	0	0	0	0	5,050
Bath Lake	0	600	0	0	0	0	30	0	0	630
Moscow Lake	450	1,000	100	0	300	0	100	0	0	1,950
Jack Lake	200	1,000	0	0	800	0	0	10	0	2,010
Grass Lake	1,900	2,300	250	0	3,300	0	0	0	0	7,750
Anderson Lake	2,200	5,800	1,250	0	5,500	0	0	0	0	14,750
Snicarte Slough	0	1,000	0	0	0	0	0	0	0	1,000
Ingram Lake	100	1,000	0	0	0	0	0	0	0	1,100
Chain Lake	0	0	10	0	20	0	0	10	0	40
Stewart Lake	3,200	100	50	0	110	0	0	0	0	3,460
Crane Lake	700	12,100	500	50	900	0	0	10	0	14,260
Cuba Island	3,500	6,000	300	0	0	0	100	0	0	9,900
Sanganois	350	2,000	0	0	0	0	0	0	0	2,350
Treadway Lake	5,000	1,000	100	0	0	0	0	0	0	6,100
Muscooten Bay	1,000	0	0	0	0	0	0	0	0	1,000
Big Lake	2,200	8,100	200	0	0	0	0	0	0	10,500
Meredosia Lake	3,550	2,610	200	0	0	0	0	0	0	6,360
Smith Lake	100	500	0	0	100	0	0	0	0	700
Spunky Bottoms	0	0	0	0	0	0	0	0	0	0
TOTAL LOWER	37,760	128,315	9,750	495	44,255	2,490	2,195	3,455	365	229,080

ILLINOIS NATURAL HISTORY SURVEY WATERFOWL AERIAL INVENTORY DATA

UPPER ILLINOIS RIVER VALLEY Date: March 27, 2013 Observer: Aaron Yetter

LOCATION	LESC	RNDU	CANV	REDH	RUDU	COGO	BUFF	COME	HOME	TOTAL DUCKS
Turner Lake	130	0	300	0	0	0	0	75	0	505
Lake Depue	120	500	150	0	0	0	0	150	0	920
Coleman Lake	400	500	600	0	0	0	50	100	0	1,650
Bureau Ponds	50	0	50	0	0	0	0	0	0	100
Goose Lake	4,300	2,900	1,510	200	0	150	50	610	0	9,720
Senachwine Lake	465	520	600	0	485	0	5	95	0	2,170
Hennepin/Hopper	20	0	5	0	0	0	20	10	0	55
Swan Lake	900	1,400	150	0	0	0	0	100	0	2,550
Sawmill Lake	2,000	1,000	200	0	0	0	0	5	0	3,205
Billsbach Lake	1,200	700	50	0	0	0	10	100	0	2,060
Weis Lake	500	900	700	0	0	0	0	0	0	2,100
Sparland	200	700	300	0	0	0	0	10	0	1,210
Wightman Lake	310	100	50	0	0	0	0	20	0	480
Sawyer Slough	350	0	0	0	0	0	0	0	0	350
Hitchcock Slough	1,200	100	0	0	0	0	0	10	0	1,310
Babbs Slough	660	100	450	0	0	0	0	50	0	1,260
Meadow Lake	100	100	100	0	0	0	0	0	0	300
Douglas Lake	700	350	275	50	0	0	0	0	0	1,375
Goose Lake	800	750	200	0	2,200	10	0	35	0	3,995
Upper Peoria	6,510	1,900	350	0	1,500	0	0	170	0	10,430
Lower Peoria	660	0	0	0	1,500	0	0	10	0	2,170
TOTAL UPPER	21,575	12,520	6,040	250	5,685	160	135	1,550	0	47,915
TOTAL LOWER	33,800	60,710	10,660	1,835	19,220	1,580	1,065	1,640	320	130,830
TOTAL	55,375	73,230	16,700	2,085	24,905	1,740	1,200	3,190	320	178,745

LOWER ILLINOIS RIVER VALLEY Date: March 27, 2013 Observer: Aaron Yetter

LOCATION	LESC	RNDU	CANV	REDH	RUDU	COGO	BUFF	COME	HOME	TOTAL DUCKS
Pekin Lake	1,000	1,500	100	0	0	0	0	0	0	2,600
Powerton Lake	10	0	0	0	0	0	0	0	0	10
Spring Lake	50	0	0	0	10	165	25	135	0	385
Spring Lake Bottoms	10	60	10	0	0	0	10	0	0	90
Goose Lake	200	3,100	0	100	0	0	0	0	0	3,400
Rice Lake	120	150	0	0	1,700	10	0	15	0	1,995
Big Lake	750	900	100	50	800	0	0	10	0	2,610
Banner Marsh	220	100	0	0	0	0	60	310	0	690
Duck Creek	0	0	0	0	0	0	0	15	0	15
Clear Lake	90	0	0	0	600	0	0	5	0	695
North Pool	100	0	335	0	1,250	0	0	0	0	1,685
South Pool	15,335	28,400	8,520	1,135	1,135	1,135	570	570	0	56,800
Quiver Creek	0	0	0	0	0	0	0	0	0	0
Quiver Lake	400	0	300	0	0	0	0	0	0	700
Thompson/Flag Lake	540	1,085	135	135	1,355	270	270	270	270	4,330
North Globe	0	0	0	0	0	0	0	0	0	0
Dickson Mounds	0	0	0	0	0	0	0	50	50	100
South Globe	50	0	50	0	0	0	0	0	0	100
Wilder/Bellrose	500	1,800	0	0	0	0	0	0	0	2,300
Spoon River Btms	0	0	0	0	0	0	0	0	0	0
Matanza Lake	10	100	20	0	0	0	5	0	0	135
Bath Lake	15	200	0	0	0	0	5	0	0	220
Moscow Lake	150	705	0	0	100	0	60	100	0	1,115
Jack Lake	0	1,010	0	0	100	0	0	0	0	1,110
Grass Lake	350	1,900	10	5	1,370	0	0	0	0	3,635
Anderson Lake	500	1,500	500	300	1,900	0	0	0	0	4,700
Snicarte Slough	0	0	0	0	0	0	0	0	0	0
Ingram Lake	500	1,500	0	0	3,200	0	0	0	0	5,200
Chain Lake	50	0	0	0	100	0	0	0	0	150
Stewart Lake	950	1,300	0	0	0	0	0	0	0	2,250
Crane Lake	1,200	2,000	100	10	2,400	0	0	0	0	5,710
Cuba Island	1,900	2,500	100	0	0	0	50	50	0	4,600
Sanganois	600	1,100	100	0	0	0	0	100	0	1,900
Treadway Lake	0	0	0	0	0	0	0	0	0	0
Muscooten Bay	5,000	0	0	0	100	0	0	0	0	5,100
Big Lake	400	8,100	100	100	0	0	0	0	0	8,700
Meredosia Lake	2,400	1,000	180	0	3,100	0	0	10	0	6,690
Smith Lake	400	700	0	0	0	0	0	0	0	1,100
Spunky Bottoms	0	0	0	0	0	0	10	0	0	10
TOTAL LOWER	33,800	60,710	10,660	1,835	19,220	1,580	1,065	1,640	320	130,830

ILLINOIS NATURAL HISTORY SURVEY WATERFOWL AERIAL INVENTORY DATA

UPPER ILLINOIS RIVER VALLEY Date: April 2, 2013 Observer: Aaron Yetter

LOCATION	LESC	RNDU	CANV	REDH	RUDU	COGO	BUFF	COME	HOME	TOTAL DUCKS
Turner Lake	0	0	0	0	0	0	0	0	0	0
Lake Depue	75	175	0	0	0	0	0	0	0	250
Coleman Lake	800	400	0	0	0	0	0	0	0	1,200
Bureau Ponds	400	400	0	0	0	0	0	0	0	800
Goose Lake	710	1,850	160	0	0	0	0	0	0	2,720
Senachwine Lake	575	0	70	0	225	0	0	0	25	895
Hennepin/Hopper	70	0	0	0	30	100	95	5	10	310
Swan Lake	800	1,000	100	0	0	0	0	0	0	1,900
Sawmill Lake	900	1,000	50	0	0	0	110	0	0	2,060
Billsbach Lake	1,100	50	0	0	0	0	10	0	0	1,160
Weis Lake	1,000	2,000	50	0	0	0	0	0	0	3,050
Sparland	300	1,910	50	0	0	0	0	0	0	2,260
Wightman Lake	300	10	0	0	50	0	20	0	0	380
Sawyer Slough	0	50	0	0	0	0	35	0	0	85
Hitchcock Slough	2,100	0	0	0	200	0	0	0	0	2,300
Babbs Slough	1,500	0	0	0	200	0	0	0	0	1,700
Meadow Lake	10	500	0	0	0	0	0	0	0	510
Douglas Lake	810	2,600	25	0	0	50	50	0	0	3,535
Goose Lake	325	100	100	0	3,000	0	10	0	0	3,535
Upper Peoria	3,450	100	115	0	8,600	0	50	0	0	12,315
Lower Peoria	870	0	0	0	100	0	0	0	0	970
TOTAL UPPER	16,095	12,145	720	0	12,405	150	380	5	35	41,935
TOTAL LOWER	12,780	36,970	1,375	1,520	15,005	300	2,185	535	250	70,920
TOTAL	28,875	49,115	2,095	1,520	27,410	450	2,565	540	285	112,855

LOWER ILLINOIS RIVER VALLEY Date: April 2, 2013 Observer: Aaron Yetter

LOCATION	LESC	RNDU	CANV	REDH	RUDU	COGO	BUFF	COME	HOME	TOTAL DUCKS
Pekin Lake	270	0	0	0	50	0	0	0	0	320
Powerton Lake	0	0	0	0	0	0	0	0	0	0
Spring Lake	20	10	0	0	100	25	70	35	0	260
Spring Lake Bottoms	20	0	0	0	0	0	0	0	0	20
Goose Lake	15	75	0	25	650	0	0	0	0	765
Rice Lake	25	200	0	0	1,305	10	0	0	0	1,540
Big Lake	0	110	0	0	100	0	100	10	0	320
Banner Marsh	25	0	0	0	25	0	25	5	0	80
Duck Creek	0	0	0	0	0	0	0	0	0	0
Clear Lake	115	0	0	0	300	0	0	0	0	415
North Pool	200	0	100	0	1,700	0	10	0	0	2,010
South Pool	4,200	13,900	650	400	500	25	400	120	0	20,195
Quiver Creek	0	0	0	0	0	0	0	0	0	0
Quiver Lake	50	0	0	0	0	0	0	0	0	50
Thompson/Flag Lake	1,190	240	240	120	3,925	240	1,190	240	240	7,625
North Globe	0	0	0	0	0	0	0	0	0	0
Dickson Mounds	0	0	0	0	0	0	0	0	10	10
South Globe	0	0	0	0	0	0	0	0	0	0
Wilder/Bellrose	200	820	0	0	0	0	0	0	0	1,020
Spoon River Btms	0	0	0	0	0	0	0	0	0	0
Matanza Lake	100	10	0	0	50	0	0	0	0	160
Bath Lake	10	0	0	0	0	0	0	0	0	10
Moscow Lake	500	3,000	75	0	100	0	0	0	0	3,675
Jack Lake	0	100	0	0	1,200	0	60	0	0	1,360
Grass Lake	250	850	0	0	1,350	0	25	0	0	2,475
Anderson Lake	150	800	0	150	700	0	45	0	0	1,845
Snicarte Slough	0	35	0	0	0	0	0	0	0	35
Ingram Lake	150	100	0	0	0	0	10	0	0	260
Chain Lake	250	100	25	0	150	0	0	0	0	525
Stewart Lake	250	2,600	10	0	0	0	0	0	0	2,860
Crane Lake	50	400	0	0	700	0	0	0	0	1,150
Cuba Island	1,280	7,000	125	200	0	0	50	0	0	8,655
Sanganois	1,500	1,800	50	0	500	0	110	125	0	4,085
Treadway Lake	0	0	0	0	100	0	0	0	0	100
Muscooten Bay	400	0	0	0	100	0	10	0	0	510
Big Lake	400	3,700	0	300	0	0	50	0	0	4,450
Meredosia Lake	1,050	1,010	100	300	1,350	0	0	0	0	3,810
Smith Lake	110	110	0	25	50	0	30	0	0	325
Spunky Bottoms	0	0	0	0	0	0	0	0	0	0
TOTAL LOWER	12,780	36,970	1,375	1,520	15,005	300	2,185	535	250	70,920

ILLINOIS NATURAL HISTORY SURVEY WATERFOWL AERIAL INVENTORY DATA

Pool 19 Mississippi River Date: March 8, 2013 Observer: Aaron Yetter

LOCATION	LESC	RNDU	CANV	REDH	RUDU	COGO	BUFF	COME	HOME	TOTAL DUCKS
Keokuk-Nauvoo	56,475	1,500	47,700	750	1,500	300	100	630	0	108,955
Arthur Refuge	0	0	0	0	0	10	0	0	0	10
Nauvoo-Ft. Mad.	70,940	4,600	98,320	970	920	6,500	100	14,900	0	197,250
Ft.Madison-Dallas	10,000	25	16,000	0	0	700	0	1,510	0	28,235
Dallas-Burlington	2,500	0	3,000	0	0	1,000	0	1,150	0	7,650
Turkey Slough	0	0	100	0	0	500	0	1,585	0	2,185
Burling. - 18 Dam	0	0	0	0	0	0	0	0	0	0
Crystal Lake	0	0	0	0	0	0	0	0	0	0
Total	139,915	6,125	165,120	1,720	2,420	9,010	200	19,775	0	344,285

ILLINOIS NATURAL HISTORY SURVEY WATERFOWL AERIAL INVENTORY DATA

Pool 19 Mississippi River Date: March 14, 2013 Observer: Aaron Yetter

LOCATION	LESC	RNDU	CANV	REDH	RUDU	COGO	BUFF	COME	HOME	TOTAL DUCKS
Keokuk-Nauvoo	89,410	1,505	108,160	100	500	605	500	400	0	201,180
Arthur Refuge	1,100	0	1,000	0	0	0	300	210	0	2,610
Nauvoo-Ft. Mad.	44,850	2,685	36,410	450	895	5,450	1,245	3,710	0	95,695
Ft.Madison-Dallas	8,895	0	200	0	0	970	0	635	0	10,700
Dallas-Burlington	4,000	0	2,000	0	0	200	10	500	0	6,710
Turkey Slough	100	0	250	0	0	0	0	200	0	550
Burling. - 18 Dam	0	0	0	0	0	0	0	0	0	0
Crystal Lake	0	100	0	0	0	0	0	0	0	100
Total	148,355	4,290	148,020	550	1,395	7,225	2,055	5,655	0	317,545

ILLINOIS NATURAL HISTORY SURVEY WATERFOWL AERIAL INVENTORY DATA

Pool 19 Mississippi River Date: March 22, 2013 Observer: Aaron Yetter

LOCATION	LESC	RNDU	CANV	REDH	RUDU	COGO	BUFF	COME	HOME	TOTAL DUCKS
Keokuk-Nauvoo	69,000	1,000	40,250	1,000	1,000	1,000	1,000	1,000	0	115,250
Arthur Refuge	2,500	100	300	0	50	200	0	110	0	3,260
Nauvoo-Ft. Mad.	113,280	0	44,250	1,770	8,850	2,170	2,270	4,540	0	177,130
Ft.Madison-Dallas	13,700	200	7,600	0	100	350	500	500	0	22,950
Dallas-Burlington	5,325	600	2,900	0	50	200	0	430	0	9,505
Turkey Slough	500	0	3,000	0	0	0	0	200	0	3,700
Burling. - 18 Dam	0	0	0	0	0	0	0	0	0	0
Crystal Lake	0	0	0	0	0	0	0	0	0	0
Total	204,305	1,900	98,300	2,770	10,050	3,920	3,770	6,780	0	331,795

ILLINOIS NATURAL HISTORY SURVEY WATERFOWL AERIAL INVENTORY DATA

Pool 19 Mississippi River Date: March 27, 2013 Observer: Aaron Yetter

LOCATION	LESC	RNDU	CANV	REDH	RUDU	COGO	BUFF	COME	HOME	TOTAL DUCKS
Keokuk-Nauvoo	99,425	1,000	26,780	1,000	1,000	1,000	2,680	1,000	0	133,885
Arthur Refuge	50	0	0	0	0	100	0	400	0	550
Nauvoo-Ft. Mad.	86,790	500	17,475	580	5,495	2,630	2,630	3,895	0	119,995
Ft.Madison-Dallas	19,600	50	4,510	0	0	400	100	1,110	0	25,770
Dallas-Burlington	2,230	0	1,100	0	0	200	260	535	0	4,325
Turkey Slough	2,800	0	600	0	0	200	300	500	0	4,400
Burling. - 18 Dam	400	0	0	0	0	0	0	0	0	400
Crystal Lake	0	0	0	0	0	0	0	0	0	0
Total	211,295	1,550	50,465	1,580	6,495	4,530	5,970	7,440	0	289,325

ILLINOIS NATURAL HISTORY SURVEY WATERFOWL AERIAL INVENTORY DATA

Pool 19 Mississippi River Date: April 2, 2013 Observer: Aaron Yetter

LOCATION	LESC	RNDU	CANV	REDH	RUDU	COGO	BUFF	COME	HOME	TOTAL DUCKS
Keokuk-Nauvoo	43,700	500	1,000	0	500	0	500	500	0	46,700
Arthur Refuge	200	0	0	0	0	0	50	50	0	300
Nauvoo-Ft. Mad.	40,300	0	500	0	0	500	1,000	500	0	42,800
Ft.Madison-Dallas	4,600	0	50	0	200	100	200	200	0	5,350
Dallas-Burlington	350	0	0	0	0	0	0	45	0	395
Turkey Slough	350	0	0	0	0	5	5	125	0	485
Burling. - 18 Dam	1,000	0	0	0	0	0	0	0	0	1,000
Crystal Lake	0	0	0	0	0	0	0	0	0	0
Total	90,500	500	1,550	0	700	605	1,755	1,420	0	97,030

ILLINOIS NATURAL HISTORY SURVEY WATERFOWL AERIAL INVENTORY DATA

ILLINOIS RIVER VALLEY Date: March 17, 2014 Observer: Aaron Yetter

LOCATION	LESC	RNDU	CANV	REDH	RUDU	COGO	BUFF	COME	HOME	TOTAL DUCKS
Turner Lake	375	0	35	0	0	0	10	0	0	420
Depue, Spring	300	0	300	0	0	30	50	320	0	1,000
Coleman Lake	100	150	0	0	0	0	0	0	0	250
Bureau Ponds	0	0	0	0	0	0	0	10	0	10
Goose Lake	610	50	125	0	100	0	10	10	0	905
Senachwine Lake	6,750	200	1,160	30	0	0	25	30	0	8,195
Hennepin/Hopper	0	0	0	0	0	0	0	0	0	0
Swan Lake	100	200	300	0	0	0	0	30	0	630
Sawmill Lake	0	0	300	0	0	0	0	0	0	300
Billsbach Lake	900	200	1,000	0	0	0	0	0	0	2,100
Weis Lake	100	0	300	0	0	0	50	0	0	450
Sparland	2,500	300	520	200	20	0	110	0	0	3,650
Wightman Lake	10	0	0	0	0	0	10	0	0	20
Sawyer Slough	300	0	300	0	0	0	0	0	0	600
Hitchcock Slough	100	100	100	20	0	0	0	0	0	320
Babbs Slough	4,100	0	100	0	0	50	0	0	0	4,250
Meadow Lake	50	100	100	0	0	0	50	0	0	300
Douglas Lake	4,200	0	1,000	0	0	0	0	0	0	5,200
Goose Lake	14,200	0	1,500	0	200	200	200	50	0	16,350
Upper Peoria	6,100	100	1,200	0	100	350	100	230	0	8,180
Lower Peoria	2,600	0	0	0	200	0	0	10	0	2,810
Pekin Lake	800	0	100	0	0	0	0	0	0	900
Powerton Lake	0	0	0	0	0	0	0	0	0	0
Spring Lake	0	0	50	0	0	0	0	80	20	150
Spring Lake Bottoms	0	100	0	0	0	0	60	10	0	170
Goose Lake	7,500	12,000	6,500	200	0	100	0	500	0	26,800
Rice Lake	300	0	400	0	0	0	0	50	0	750
Big Lake	12,000	4,000	2,000	300	1,000	0	500	0	0	19,800
Banner Marsh	0	0	0	0	0	20	10	60	0	90
Duck Creek	100	0	0	0	0	0	0	230	0	330
Clear Lake	10,675	500	610	0	75	0	0	20	0	11,880
North Pool	100	0	10	0	0	10	70	20	0	210
South Pool	1,000	500	5,000	0	0	20	20	10	0	6,550
Quiver Creek	200	5,000	500	0	0	0	0	0	0	5,700
Quiver Lake	1,500	1,050	400	0	0	20	0	0	0	2,970
Thompson/Flag Lake	8,190	2,100	3,150	210	5,250	630	420	1,050	0	21,000
North Globe	0	0	0	0	0	0	0	0	0	0
Dickson Mounds	0	0	0	0	0	0	0	10	0	10
South Globe	1,000	0	100	0	400	0	100	0	0	1,600
Wilder/Bellrose	4,200	5,600	11,200	0	280	840	280	560	0	22,960
Spoon River Btms	100	0	0	0	0	0	0	0	0	100
Matanza Lake	100	0	200	0	100	0	0	0	0	400
Bath Lake	5,000	5,000	10,300	0	0	0	0	0	0	20,300
Moscow Lake	600	2,500	1,000	0	0	0	0	0	0	4,100
Jack Lake	2,200	0	100	0	0	50	100	150	0	2,600
Grass Lake	1,950	3,200	610	0	0	0	0	0	0	5,760
Anderson Lake	200	100	600	0	400	60	0	200	0	1,560
Snicarte Slough	2,000	8,000	3,200	0	0	0	0	0	0	13,200
Ingram Lake	1,100	1,000	600	0	0	0	0	0	0	2,700
Chain Lake	0	0	0	0	600	0	0	0	0	600
Stewart Lake	5,000	1,000	200	0	0	0	0	0	0	6,200
Crane Lake	4,100	4,000	910	0	150	0	0	10	0	9,170
Cuba Island	3,000	1,000	300	0	0	0	0	0	0	4,300
Sanganois	0	2,000	0	0	0	0	0	100	0	2,100
Treadway Lake	1,600	200	1,700	0	200	0	0	0	0	3,700
Muscooten Bay	0	0	0	0	0	0	0	0	0	0
Big Lake	1,500	12,000	900	0	0	0	0	0	0	14,400
Meredosia Lake	1,800	5,000	4,100	0	0	0	0	0	0	10,900
Smith Lake	0	0	100	0	0	0	0	0	0	100
Spunky Bottoms	3,500	16,500	10,500	840	560	0	100	100	0	32,100
TOTAL	124,710	93,750	73,680	1,800	9,635	2,380	2,275	3,850	20	312,100

ILLINOIS NATURAL HISTORY SURVEY WATERFOWL AERIAL INVENTORY DATA

ILLINOIS RIVER VALLEY Date: April 8-9, 2014* Observer: Aaron Yetter

LOCATION	LESC	RNDU	CANV	REDH	RUDU	COGO	BUFF	COME	HOME	TOTAL DUCKS
Turner Lake	125	0	0	0	0	0	5	0	10	140
Depue, Spring	490	0	5	0	0	0	0	0	0	495
Coleman Lake	4,000	1,500	100	300	0	0	0	0	0	5,900
Bureau Ponds	875	0	0	0	0	0	5	0	0	880
Goose Lake	2,600	2,050	200	0	150	0	0	0	0	5,000
Senachwine Lake	500	0	0	0	100	0	0	0	0	600
Hennepin/Hopper	12,375	1,375	825	550	825	0	0	0	0	15,950
Swan Lake	3,500	200	0	500	100	0	0	0	0	4,300
Sawmill Lake	500	0	0	0	0	0	0	0	0	500
Billsbach Lake	250	700	0	0	100	0	0	0	0	1,050
Weis Lake	4,000	1,000	0	0	100	0	0	0	0	5,100
Sparland	0	0	0	25	100	0	0	0	0	125
Wightman Lake	300	100	0	0	0	0	0	0	0	400
Sawyer Slough	300	50	0	0	0	0	0	0	0	350
Hitchcock Slough	300	1,500	0	0	50	0	0	0	0	1,850
Babbs Slough	1,100	0	0	0	150	0	0	0	0	1,250
Meadow Lake	1,500	200	50	0	0	0	0	0	20	1,770
Douglas Lake	150	900	25	0	0	0	50	0	0	1,125
Goose Lake	560	210	0	0	300	0	0	0	0	1,070
Upper Peoria	110	0	0	0	1,000	0	0	0	0	1,110
Lower Peoria	100	0	0	0	0	0	10	0	0	110
Pekin Lake	12,000	1,000	500	0	0	0	0	0	0	13,500
Powerton Lake	0	0	0	0	0	0	0	0	0	0
Spring Lake	10	0	0	0	0	0	10	0	0	20
Spring Lake Bottoms	505	0	0	100	0	0	0	0	0	605
Goose Lake	0	100	0	0	0	0	0	0	0	100
Rice Lake	570	0	5	0	200	0	15	0	0	790
Big Lake	15	530	5	0	15	0	0	0	0	565
Banner Marsh	0	0	0	0	0	0	10	0	0	10
Duck Creek	0	0	0	0	0	0	0	0	0	0
Clear Lake	755	200	0	0	30	0	0	0	0	985
North Pool	170	2,200	0	10	1,350	0	0	0	0	3,730
South Pool	1,800	1,600	50	250	50	0	20	0	0	3,770
Quiver Creek	0	0	0	0	0	0	0	0	0	0
Quiver Lake	400	100	0	0	0	0	0	0	0	500
Thompson/Flag Lake	1,115	670	225	225	2,230	0	225	110	0	4,800
North Globe	50	0	0	0	0	0	0	0	0	50
Dickson Mounds	0	0	0	0	0	0	0	0	0	0
South Globe	0	0	0	0	60	0	0	0	0	60
Wilder/Bellrose	0	10	0	0	0	0	0	0	0	10
Spoon River Btms	10	25	0	0	0	0	0	0	0	35
Matanza Lake	0	0	0	0	0	0	0	0	0	0
Bath Lake	100	400	0	0	0	0	0	0	0	500
Moscow Lake	65	150	0	0	30	0	0	0	0	245
Jack Lake	355	440	90	60	50	0	0	0	0	995
Grass Lake	410	300	0	0	310	0	0	0	0	1,020
Anderson Lake	450	0	200	0	4,100	0	0	0	0	4,750
Snicarte Slough	150	400	0	0	0	0	0	0	0	550
Ingram Lake	10	300	0	0	0	0	0	0	0	310
Chain Lake	560	400	0	0	400	0	0	0	0	1,360
Stewart Lake	225	0	0	0	205	0	0	0	0	430
Crane Lake	120	0	0	0	0	0	0	0	0	120
Cuba Island	420	7,500	0	100	0	0	0	0	0	8,020
Sanganois	635	820	20	0	0	0	10	0	0	1,485
Treadway Lake	800	1,300	0	200	100	0	0	0	0	2,400
Muscooten Bay	0	300	0	0	0	0	0	0	0	300
Big Lake	30	100	0	0	225	0	0	0	0	355
Meredosia Lake	90	1,100	0	200	60	0	0	0	0	1,450
Smith Lake	10	0	0	35	10	0	0	0	0	55
Spunky Bottoms	0	200	0	0	0	0	0	0	0	200
TOTAL	55,465	29,930	2,300	2,555	12,400	0	360	110	30	103,150

*Upper Illinois River above Pekin was flown April 8th and Lower Illinois River below Pekin was flown April 9th.

ILLINOIS NATURAL HISTORY SURVEY WATERFOWL AERIAL INVENTORY DATA

ILLINOIS RIVER VALLEY Date: April 15, 2014 Observer: Aaron Yetter

LOCATION	LESC	RNDU	CANV	REDH	RUDU	COGO	BUFF	COME	HOME	TOTAL DUCKS
Turner Lake	0	0	5	0	0	0	0	0	0	5
Depue, Spring	30	0	0	0	25	0	0	0	0	55
Coleman Lake	1,000	2,000	100	0	10	0	0	0	0	3,110
Bureau Ponds	2,100	0	0	0	300	0	100	0	0	2,500
Goose Lake	50	0	0	0	235	0	50	0	0	335
Senachwine Lake	50	0	0	100	175	0	0	0	0	325
Hennepin/Hopper	2,000	0	650	50	0	0	170	0	0	2,870
Swan Lake	400	0	0	0	0	0	0	0	0	400
Sawmill Lake	200	0	0	0	0	0	0	0	0	200
Billsbach Lake	500	1,000	0	100	0	0	0	0	0	1,600
Weis Lake	100	10	0	0	0	0	0	0	0	110
Sparland	0	0	0	0	200	0	0	0	0	200
Wightman Lake	320	0	0	0	0	0	0	0	0	320
Sawyer Slough	50	0	0	0	0	0	0	0	0	50
Hitchcock Slough	0	0	0	0	250	0	0	0	0	250
Babbs Slough	0	0	0	0	200	0	0	0	0	200
Meadow Lake	405	0	0	0	50	0	0	0	0	455
Douglas Lake	155	0	0	0	110	0	10	0	0	275
Goose Lake	5	0	0	0	10	0	0	0	0	15
Upper Peoria	0	0	0	0	0	0	0	0	0	0
Lower Peoria	0	0	0	0	0	0	0	0	0	0
Pekin Lake	2,000	0	0	0	0	0	0	0	0	2,000
Powerton Lake	0	0	0	0	0	0	0	0	0	0
Spring Lake	0	0	0	0	0	0	0	0	0	0
Spring Lake Bottoms	50	0	0	100	0	0	0	0	0	150
Goose Lake	0	0	0	0	0	0	0	0	0	0
Rice Lake	150	0	0	0	1,600	0	0	0	0	1,750
Big Lake	0	0	0	0	100	0	0	0	0	100
Banner Marsh	0	0	0	0	0	0	0	0	0	0
Duck Creek	0	0	0	0	0	0	0	0	0	0
Clear Lake	10	0	0	0	200	0	0	0	0	210
North Pool	700	200	0	0	660	0	0	0	0	1,560
South Pool	310	0	0	0	150	0	10	0	0	470
Quiver Creek	100	0	0	0	0	0	0	0	0	100
Quiver Lake	10	0	0	0	0	0	0	0	0	10
Thompson/Flag Lake	1,025	410	410	205	2,050	0	205	0	0	4,305
North Globe	0	0	0	0	0	0	0	0	0	0
Dickson Mounds	0	0	0	0	0	0	0	0	0	0
South Globe	0	0	0	0	0	0	0	40	0	40
Wilder/Bellrose	0	0	0	0	0	0	0	0	0	0
Spoon River Btms	0	0	0	0	0	0	0	0	0	0
Matanza Lake	0	0	0	0	0	0	0	0	0	0
Bath Lake	10	0	0	0	0	0	0	0	0	10
Moscow Lake	0	0	0	0	0	0	0	0	0	0
Jack Lake	0	0	0	0	300	0	0	0	0	300
Grass Lake	0	0	0	0	1,900	0	0	0	0	1,900
Anderson Lake	0	0	0	0	1,230	0	0	0	0	1,230
Snicarte Slough	0	0	0	0	0	0	0	0	0	0
Ingram Lake	0	0	0	0	0	0	0	0	0	0
Chain Lake	0	0	0	0	200	0	0	0	0	200
Stewart Lake	0	0	0	0	200	0	0	0	0	200
Crane Lake	50	0	0	0	300	0	0	0	0	350
Cuba Island	0	0	0	0	0	0	0	0	0	0
Sanganois	0	0	0	0	0	0	0	0	0	0
Treadway Lake	10	0	0	0	0	0	0	0	0	10
Muscooten Bay	0	0	0	0	0	0	0	0	0	0
Big Lake	20	150	0	0	100	0	0	0	0	270
Meredosia Lake	0	0	0	0	0	0	0	0	0	0
Smith Lake	0	0	0	0	50	0	0	0	0	50
Spunky Bottoms	20	0	0	0	500	0	0	0	0	520
TOTAL	11,830	3,770	1,165	555	11,105	0	545	40	0	29,010

ILLINOIS NATURAL HISTORY SURVEY WATERFOWL AERIAL INVENTORY DATA

ILLINOIS RIVER VALLEY Date: April 23, 2014 Observer: Aaron Yetter

LOCATION	LESC	RNDU	CANV	REDH	RUDU	COGO	BUFF	COME	HOME	TOTAL DUCKS
Turner Lake	0	0	0	0	0	0	0	0	0	0
Depue, Spring	0	0	0	0	0	0	0	0	0	0
Coleman Lake	0	0	0	0	0	0	0	0	0	0
Bureau Ponds	10	0	0	0	0	0	0	0	0	10
Goose Lake	0	0	0	0	0	0	0	0	0	0
Senachwine Lake	0	0	0	0	20	0	0	0	0	20
Hennepin/Hopper	95	130	0	0	270	0	20	0	0	515
Swan Lake	0	0	0	0	0	0	0	0	0	0
Sawmill Lake	0	0	0	0	0	0	0	0	0	0
Billsbach Lake	5	0	0	0	0	0	0	0	0	5
Weis Lake	0	0	0	0	0	0	0	0	0	0
Sparland	0	0	0	0	0	0	0	0	0	0
Wightman Lake	0	0	0	0	25	0	0	0	0	25
Sawyer Slough	0	0	0	0	0	0	0	0	0	0
Hitchcock Slough	0	0	0	0	0	0	0	0	0	0
Babbs Slough	0	0	0	0	10	0	0	0	0	10
Meadow Lake	0	0	0	0	0	0	0	0	0	0
Douglas Lake	0	0	0	0	0	0	0	0	0	0
Goose Lake	0	0	0	0	0	0	0	0	0	0
Upper Peoria	0	0	0	0	0	0	0	0	0	0
Lower Peoria	0	0	0	0	0	0	0	0	0	0
Pekin Lake	150	10	0	0	0	0	0	0	0	160
Powerton Lake	0	0	0	0	0	0	0	0	0	0
Spring Lake	0	0	0	0	0	0	0	0	0	0
Spring Lake Bottoms	0	0	0	0	0	0	0	0	0	0
Goose Lake	0	0	0	0	0	0	0	0	0	0
Rice Lake	0	0	0	0	0	0	0	0	0	0
Big Lake	0	0	0	0	0	0	0	0	0	0
Banner Marsh	5	0	0	0	0	0	0	0	0	5
Duck Creek	0	0	0	0	0	0	0	0	0	0
Clear Lake	0	0	0	0	0	0	0	0	0	0
North Pool	100	0	0	0	610	0	0	0	0	710
South Pool	20	0	0	0	0	0	10	0	0	30
Quiver Creek	0	0	0	0	0	0	0	0	0	0
Quiver Lake	0	0	0	0	0	0	0	0	0	0
Thompson/Flag Lake	300	50	5	0	500	0	50	0	0	905
North Globe	0	0	0	0	0	0	0	0	0	0
Dickson Mounds	0	0	0	0	0	0	0	0	0	0
South Globe	0	0	0	0	0	0	0	0	0	0
Wilder/Bellrose	0	0	0	0	0	0	0	0	0	0
Spoon River Btms	0	0	0	0	0	0	0	0	0	0
Matanza Lake	10	0	0	0	0	0	0	0	0	10
Bath Lake	0	0	0	0	0	0	0	0	0	0
Moscow Lake	0	0	0	0	0	0	0	0	0	0
Jack Lake	0	0	0	0	0	0	0	0	0	0
Grass Lake	0	0	0	0	0	0	0	0	0	0
Anderson Lake	0	0	0	0	5	0	0	0	0	5
Snicarte Slough	0	0	0	0	0	0	0	0	0	0
Ingram Lake	0	0	0	0	0	0	0	0	0	0
Chain Lake	0	0	0	0	0	0	0	0	0	0
Stewart Lake	0	0	0	0	0	0	0	0	0	0
Crane Lake	0	0	0	0	0	0	0	0	0	0
Cuba Island	5	0	0	0	0	0	0	0	0	5
Sanganois	5	0	0	0	0	0	0	0	0	5
Treadway Lake	0	0	0	0	0	0	0	0	0	0
Muscooten Bay	0	0	5	0	0	0	0	0	0	5
Big Lake	0	0	0	0	0	0	0	0	0	0
Meredosia Lake	0	0	0	0	0	0	0	0	0	0
Smith Lake	0	0	0	0	0	0	0	0	0	0
Spunky Bottoms	0	0	0	0	0	0	0	0	0	0
TOTAL	705	190	10	0	1,440	0	80	0	0	2,425

ILLINOIS NATURAL HISTORY SURVEY WATERFOWL AERIAL INVENTORY DATA

Pool 19 Mississippi River Date: March 17, 2014 Observer: Aaron Yetter

LOCATION	LESC	RNDU	CANV	REDH	RUDU	COGO	BUFF	COME	HOME	TOTAL DUCKS
Keokuk-Nauvoo	41,410	1,700	38,350	450	160	60	60	610	10	82,810
Arthur Refuge	9,300	0	200	0	0	0	0	0	0	9,500
Nauvoo-Ft. Mad.	51,500	0	16,065	0	100	3,510	10	850	0	72,035
Ft.Madison-Dallas	1,700	500	4,800	0	0	55	20	800	0	7,875
Dallas-Burlington	20,100	5,000	24,055	0	0	50	0	0	0	49,205
Turkey Slough	2,500	0	11,200	0	0	0	0	100	0	13,800
Burling. - 18 Dam	0	0	0	0	0	0	0	0	0	0
Total	126,510	7,200	94,670	450	260	3,675	90	2,360	10	235,225

ILLINOIS NATURAL HISTORY SURVEY WATERFOWL AERIAL INVENTORY DATA

Pool 19 Mississippi River Date: April 7, 2014 Observer: Aaron Yetter

LOCATION	LESC	RNDU	CANV	REDH	RUDU	COGO	BUFF	COME	HOME	TOTAL DUCKS
Keokuk-Nauvoo	43,745	1,055	2,635	0	2,635	265	1,055	265	0	51,655
Arthur Refuge	1,000	0	0	0	0	0	0	10	0	1,010
Nauvoo-Ft. Mad.	45,650	550	2,750	0	4,400	275	550	275	0	54,450
Ft.Madison-Dallas	27,330	0	500	0	605	50	160	20	0	28,665
Dallas-Burlington	7,500	0	0	0	200	0	0	0	0	7,700
Turkey Slough	1,810	0	0	0	220	0	0	0	0	2,030
Burling. - 18 Dam	1,510	0	0	0	0	0	0	0	0	1,510
Total	128,545	1,605	5,885	0	8,060	590	1,765	570	0	147,020

ILLINOIS NATURAL HISTORY SURVEY WATERFOWL AERIAL INVENTORY DATA

Pool 19 Mississippi River Date: April 9, 2014 Observer: Aaron Yetter

LOCATION	LESC	RNDU	CANV	REDH	RUDU	COGO	BUFF	COME	HOME	TOTAL DUCKS
Keokuk-Nauvoo	37,215	205	410	0	2,045	0	820	205	0	40,900
Arthur Refuge	215	0	0	0	50	0	0	0	0	265
Nauvoo-Ft. Mad.	25,560	355	355	0	1,520	0	420	455	0	28,665
Ft.Madison-Dallas	19,800	275	275	0	1,400	0	325	275	0	22,350
Dallas-Burlington	2,630	0	0	0	10	0	0	0	0	2,640
Turkey Slough	200	0	0	0	0	0	10	0	0	210
Burling. - 18 Dam	3,500	0	0	0	0	0	0	0	0	3,500
Total	89,120	835	1,040	0	5,025	0	1,575	935	0	98,530

ILLINOIS NATURAL HISTORY SURVEY WATERFOWL AERIAL INVENTORY DATA

Pool 19 Mississippi River Date: April 15, 2014 Observer: Aaron Yetter

LOCATION	LESC	RNDU	CANV	REDH	RUDU	COGO	BUFF	COME	HOME	TOTAL DUCKS
Keokuk-Nauvoo	1,705	0	0	0	135	0	30	0	0	1,870
Arthur Refuge	0	0	0	0	0	0	0	0	0	0
Nauvoo-Ft. Mad.	1,935	0	10	0	430	0	90	0	0	2,465
Ft.Madison-Dallas	620	0	0	0	60	0	0	0	0	680
Dallas-Burlington	1,360	0	0	0	0	0	10	0	0	1,370
Turkey Slough	400	0	0	0	0	0	0	0	0	400
Burling. - 18 Dam	210	0	0	0	0	0	0	0	0	210
Total	6,230	0	10	0	625	0	130	0	0	6,995

ILLINOIS NATURAL HISTORY SURVEY WATERFOWL AERIAL INVENTORY DATA

Pool 19 Mississippi River Date: April 21, 2014 Observer: Aaron Yetter

LOCATION	LESC	RNDU	CANV	REDH	RUDU	COGO	BUFF	COME	HOME	TOTAL DUCKS
Keokuk-Nauvoo	135	0	5	0	560	0	20	0	0	720
Arthur Refuge	0	0	0	0	0	0	0	0	0	0
Nauvoo-Ft. Mad.	165	10	0	0	260	0	0	0	0	435
Ft.Madison-Dallas	120	0	0	0	40	0	0	0	0	160
Dallas-Burlington	5	0	0	0	0	0	0	0	0	5
Turkey Slough	0	0	0	0	0	0	0	0	0	0
Burling. - 18 Dam	5	0	0	0	0	0	0	0	0	5
Total	430	10	5	0	860	0	20	0	0	1,325

ILLINOIS NATURAL HISTORY SURVEY WATERFOWL AERIAL INVENTORY DATA

ILLINOIS RIVER VALLEY Date: March 12, 2015 Observer: Aaron Yetter

LOCATION	LESC	RNDU	CANV	REDH	RUDU	COGO	BUFF	COME	HOME	TOTAL DUCKS
Turner Lake	0	0	0	0	0	0	0	0	0	0
Depue, Spring	230	0	300	0	0	100	0	530	0	1,160
Coleman Lake	0	0	0	0	0	0	0	0	0	0
Bureau Ponds	0	0	0	0	0	0	0	0	0	0
Goose Lake	600	0	100	0	0	500	0	230	0	1,430
Senachwine Lake	200	0	10	0	0	0	0	0	0	210
Hennepin/Hopper	0	0	0	0	0	10	0	0	0	10
Swan Lake	500	50	100	0	0	50	0	25	0	725
Sawmill Lake	200	0	10	0	0	0	0	0	0	210
Billsbach Lake	1,200	100	200	50	0	50	0	100	0	1,700
Weis Lake	0	0	0	0	0	0	0	0	0	0
Sparland	600	0	100	0	250	100	0	50	0	1,100
Wightman Lake	100	0	0	0	0	0	0	0	0	100
Sawyer Slough	0	0	0	0	0	0	0	5	0	5
Hitchcock Slough	160	0	0	0	0	0	0	5	0	165
Babbs Slough	0	0	0	0	0	0	0	0	0	0
Meadow Lake	100	0	0	0	0	0	0	0	0	100
Douglas Lake	300	300	1,100	50	0	100	0	200	0	2,050
Goose Lake	2,300	0	150	100	0	300	0	1,060	0	3,910
Upper Peoria	2,850	0	250	0	330	1,200	0	205	0	4,835
Lower Peoria	1,500	0	450	0	0	250	0	0	0	2,200
Pekin Lake	5	0	10	0	0	0	0	0	0	15
Powerton Lake	200	50	300	100	0	0	0	0	0	650
Spring Lake	0	100	100	10	0	150	0	300	0	660
Spring Lake Bottoms	100	0	50	0	0	25	0	0	0	175
Goose Lake	0	300	0	0	0	100	0	20	0	420
Rice Lake	50	500	0	0	0	0	0	585	0	1,135
Big Lake	100	0	100	50	5	100	0	0	0	355
Banner Marsh	0	0	0	0	0	0	0	10	10	20
Duck Creek	0	0	0	0	0	0	0	860	0	860
Clear Lake	100	200	0	0	0	0	0	250	10	560
North Pool	50	50	0	0	0	0	0	10	0	110
South Pool	400	10	10	0	0	50	0	210	0	680
Quiver Creek	100	200	0	0	0	0	0	0	0	300
Quiver Lake	50	0	0	5	0	0	0	0	0	55
Thompson/Flag Lake	3,700	250	610	0	100	150	0	300	0	5,110
North Globe	0	0	0	0	0	0	0	0	0	0
Dickson Mounds	0	0	0	0	0	0	0	0	0	0
South Globe	100	200	0	0	0	0	0	0	0	300
Wilder/Bellrose	0	0	0	0	0	0	0	0	0	0
Spoon River Btms	0	0	0	0	0	0	0	0	0	0
Matanza Lake	0	0	0	0	0	0	0	0	0	0
Bath Lake	100	0	10	0	0	0	0	10	0	120
Moscow Lake	20	500	0	0	0	0	0	10	0	530
Jack Lake	0	0	0	0	0	0	0	130	0	130
Grass Lake	1,100	510	0	0	0	0	0	200	0	1,810
Anderson Lake	300	200	200	100	0	0	0	50	0	850
Snicarte Slough	0	0	200	0	20	0	0	0	0	220
Ingram Lake	300	0	0	0	200	0	0	0	0	500
Chain Lake	1,000	0	1,000	0	0	0	0	10	0	2,010
Stewart Lake	2,250	200	210	0	110	200	10	260	50	3,290
Crane Lake	0	0	10	0	0	0	0	470	0	480
Cuba Island	200	100	0	0	0	0	0	0	0	300
Sanganois	50	0	10	0	0	10	0	200	0	270
Treadway Lake	700	150	350	0	0	0	0	0	0	1,200
Muscooten Bay	0	0	0	0	0	0	0	0	0	0
Big Lake	100	0	0	0	0	0	0	0	0	100
Meredosia Lake	100	300	100	0	0	0	0	310	0	810
Smith Lake	0	200	0	0	250	0	0	100	0	550
Spunky Bottoms	0	0	400	0	0	0	10	0	0	410
TOTAL	22,015	4,470	6,440	465	1,265	3,445	20	6,705	70	44,895

ILLINOIS NATURAL HISTORY SURVEY WATERFOWL AERIAL INVENTORY DATA

ILLINOIS RIVER VALLEY Date: March 18, 2015 Observer: Aaron Yetter

LOCATION	LESC	RNDU	CANV	REDH	RUDU	COGO	BUFF	COME	HOME	TOTAL DUCKS
Turner Lake	620	510	0	10	5	0	0	0	0	1,145
Depue, Spring	660	50	0	0	0	10	0	190	0	910
Coleman Lake	10	200	0	0	0	50	0	150	0	410
Bureau Ponds	200	5,000	50	200	0	0	0	0	0	5,450
Goose Lake	1,600	600	4,000	0	0	100	0	60	0	6,360
Senachwine Lake	1,900	300	100	100	700	50	0	0	0	3,150
Hennepin/Hopper	4,500	1,500	2,000	0	0	0	0	155	0	8,155
Swan Lake	1,100	2,000	100	100	0	100	0	150	0	3,550
Sawmill Lake	500	0	0	0	100	50	0	0	0	650
Billsbach Lake	2,250	2,000	150	0	100	50	0	0	0	4,550
Weis Lake	410	0	0	0	0	0	0	5	0	415
Sparland	500	0	0	0	50	0	0	0	0	550
Wightman Lake	0	200	0	0	0	0	0	5	0	205
Sawyer Slough	300	0	0	0	0	5	0	5	0	310
Hitchcock Slough	500	500	0	0	0	0	0	0	0	1,000
Babbs Slough	2,600	0	0	0	0	0	0	0	0	2,600
Meadow Lake	200	0	0	0	0	0	5	0	0	205
Douglas Lake	2,300	11,700	200	0	100	0	0	100	0	14,400
Goose Lake	6,000	1,000	200	0	100	0	100	0	0	7,400
Upper Peoria	7,305	0	0	0	200	0	0	0	0	7,505
Lower Peoria	1,570	0	0	0	560	0	0	0	0	2,130
Pekin Lake	0	0	0	0	0	0	0	0	0	0
Powerton Lake	0	0	0	0	0	5	0	0	0	5
Spring Lake	0	0	0	0	0	0	0	5	0	5
Spring Lake Bottoms	50	2,000	0	0	0	0	0	0	0	2,050
Goose Lake	0	500	0	0	0	5	0	10	0	515
Rice Lake	30	500	0	40	25	0	0	0	0	595
Big Lake	410	100	0	50	205	0	0	0	0	765
Banner Marsh	205	0	0	0	15	5	0	5	5	235
Duck Creek	0	5	0	0	0	0	0	410	0	415
Clear Lake	6,910	0	410	0	450	0	5	10	0	7,785
North Pool	5,000	5	400	0	3,500	0	100	0	0	9,005
South Pool	9,500	3,400	300	0	0	50	50	0	0	13,300
Quiver Creek	0	0	0	0	0	0	0	0	0	0
Quiver Lake	105	0	0	0	0	0	0	0	0	105
Thompson/Flag Lake	5,800	3,000	1,300	310	2,700	200	1,800	305	0	15,415
North Globe	0	0	0	0	0	0	0	0	0	0
Dickson Mounds	0	100	0	0	0	0	0	0	0	100
South Globe	0	0	0	0	0	0	0	0	0	0
Wilder/Bellrose	0	0	0	0	0	0	0	0	0	0
Spoon River Btms	0	0	0	0	0	0	0	0	0	0
Matanza Lake	0	0	0	0	0	0	0	0	0	0
Bath Lake	0	500	50	0	10	0	0	5	0	565
Moscow Lake	50	200	200	0	300	0	50	0	0	800
Jack Lake	1,100	100	0	0	300	0	0	0	0	1,500
Grass Lake	2,200	100	0	0	400	0	10	0	0	2,710
Anderson Lake	2,000	700	300	0	25	0	0	0	0	3,025
Snicarte Slough	10	0	0	0	0	0	0	0	0	10
Ingram Lake	1,050	0	0	10	250	0	0	0	0	1,310
Chain Lake	3,800	0	100	0	200	0	100	0	0	4,200
Stewart Lake	2,200	0	100	0	600	0	0	0	0	2,900
Crane Lake	200	0	0	0	200	0	0	5	0	405
Cuba Island	300	2,000	200	0	0	0	0	0	0	2,500
Sanganois	500	100	50	25	0	5	0	10	0	690
Treadway Lake	700	0	0	0	0	0	50	0	0	750
Muscooten Bay	0	0	0	0	0	0	0	0	0	0
Big Lake	1,250	0	10	0	100	0	0	0	0	1,360
Meredosia Lake	4,800	500	200	0	250	0	0	30	0	5,780
Smith Lake	100	0	0	0	300	0	0	0	0	400
Spunky Bottoms	0	1,100	0	0	100	0	0	0	0	1,200
TOTAL	83,295	40,470	10,420	845	11,845	685	2,270	1,615	5	151,450

ILLINOIS NATURAL HISTORY SURVEY WATERFOWL AERIAL INVENTORY DATA

ILLINOIS RIVER VALLEY Date: March 26, 2015 Observer: Aaron Yetter

LOCATION	LESC	RNDU	CANV	REDH	RUDU	COGO	BUFF	COME	HOME	TOTAL DUCKS
Turner Lake	610	0	10	0	0	0	0	20	0	640
Depue, Spring	5	0	0	0	0	0	0	55	0	60
Coleman Lake	350	400	0	0	0	0	0	10	0	760
Bureau Ponds	0	0	0	0	0	0	0	300	0	300
Goose Lake	520	2,500	200	0	0	0	15	95	5	3,335
Senachwine Lake	0	0	0	0	0	0	0	10	0	10
Hennepin/Hopper	6,000	2,900	4,200	0	800	0	0	30	0	13,930
Swan Lake	1,100	2,700	100	0	0	0	0	0	0	3,900
Sawmill Lake	20	500	0	0	50	0	0	10	0	580
Billsbach Lake	400	10	10	0	50	0	0	0	0	470
Weis Lake	310	100	35	0	0	0	10	10	0	465
Sparland	10	0	0	0	10	0	0	0	0	20
Wightman Lake	150	510	0	0	0	0	0	0	0	660
Sawyer Slough	0	0	0	0	30	0	0	0	0	30
Hitchcock Slough	200	0	0	0	0	0	10	10	0	220
Babbs Slough	500	0	10	0	0	0	0	0	0	510
Meadow Lake	20	0	0	0	10	0	100	20	0	150
Douglas Lake	3,100	14,500	800	0	0	0	100	0	0	18,500
Goose Lake	200	0	0	0	0	0	0	10	0	210
Upper Peoria	1,050	0	20	0	300	0	10	10	0	1,390
Lower Peoria	510	0	0	0	60	0	5	0	0	575
Pekin Lake	40	0	0	0	5	0	5	10	0	60
Powerton Lake	100	0	0	0	10	0	25	20	0	155
Spring Lake	0	0	0	10	250	0	25	10	0	295
Spring Lake Bottoms	0	700	0	50	0	0	0	0	0	750
Goose Lake	0	0	0	0	50	0	0	0	0	50
Rice Lake	2,000	0	205	10	230	0	200	140	0	2,785
Big Lake	300	0	0	0	0	0	0	0	10	310
Banner Marsh	405	0	0	0	5	0	0	35	10	455
Duck Creek	0	0	0	0	0	0	0	0	0	0
Clear Lake	2,010	0	100	0	330	0	0	0	15	2,455
North Pool	4,700	0	200	0	200	0	0	0	0	5,100
South Pool	3,700	50	250	200	700	0	210	100	0	5,210
Quiver Creek	0	0	0	0	0	0	0	0	0	0
Quiver Lake	0	0	0	0	0	0	0	5	0	5
Thompson/Flag Lake	7,750	900	700	25	350	0	860	255	10	10,850
North Globe	0	0	0	0	0	0	0	0	0	0
Dickson Mounds	50	0	0	0	0	0	0	0	0	50
South Globe	0	0	0	0	0	0	0	0	0	0
Wilder/Bellrose	0	0	0	0	0	0	0	0	0	0
Spoon River Btms	0	0	0	0	0	0	0	0	0	0
Matanza Lake	1,000	0	0	10	0	0	10	5	0	1,025
Bath Lake	300	0	0	0	200	0	0	0	0	500
Moscow Lake	710	0	0	0	50	0	300	100	0	1,160
Jack Lake	650	0	0	0	500	0	15	0	0	1,165
Grass Lake	4,100	10	0	0	100	0	0	0	0	4,210
Anderson Lake	3,000	0	100	0	100	25	100	100	0	3,425
Snicarte Slough	10	0	0	0	0	0	0	0	0	10
Ingram Lake	100	0	0	0	0	0	60	0	0	160
Chain Lake	700	500	0	0	100	0	0	0	0	1,300
Stewart Lake	4,350	0	300	0	400	0	0	0	0	5,050
Crane Lake	500	0	100	0	450	0	10	10	0	1,070
Cuba Island	3,500	2,250	100	0	100	0	100	10	0	6,060
Sanganois	800	100	10	0	0	0	0	0	0	910
Treadway Lake	700	0	100	0	0	0	0	0	0	800
Muscooten Bay	0	0	0	0	0	0	0	0	0	0
Big Lake	100	1,200	0	0	200	0	0	0	0	1,500
Meredosia Lake	2,000	100	50	0	0	0	100	0	0	2,250
Smith Lake	700	0	0	0	10	0	10	0	0	720
Spunky Bottoms	100	100	0	0	0	0	0	0	0	200
TOTAL	59,430	30,030	7,600	305	5,650	25	2,280	1,390	50	106,760

ILLINOIS NATURAL HISTORY SURVEY WATERFOWL AERIAL INVENTORY DATA

ILLINOIS RIVER VALLEY Date: March 31, 2015 Observer: Aaron Yetter

LOCATION	LESC	RNDU	CANV	REDH	RUDU	COGO	BUFF	COME	HOME	TOTAL DUCKS
Turner Lake	260	0	5	0	50	0	0	30	0	345
Depue, Spring	100	0	0	0	0	0	0	230	0	330
Coleman Lake	100	1,300	0	0	0	0	0	0	0	1,400
Bureau Ponds	100	0	0	0	0	0	0	0	0	100
Goose Lake	500	3,500	100	0	0	0	0	0	0	4,100
Senachwine Lake	100	0	0	0	20	5	0	0	0	125
Hennepin/Hopper	4,900	300	950	0	500	0	215	5	0	6,870
Swan Lake	100	500	0	0	0	0	0	0	0	600
Sawmill Lake	0	0	0	0	0	0	0	0	0	0
Billsbach Lake	400	0	0	0	0	0	0	0	0	400
Weis Lake	0	0	0	0	100	0	0	0	0	100
Sparland	25	0	0	0	60	0	0	0	0	85
Wightman Lake	900	100	0	0	0	0	0	0	0	1,000
Sawyer Slough	0	0	0	0	0	0	0	0	0	0
Hitchcock Slough	0	100	0	0	0	0	0	0	0	100
Babbs Slough	200	0	10	0	0	0	0	0	0	210
Meadow Lake	0	0	0	0	0	0	0	0	0	0
Douglas Lake	200	600	50	0	200	0	0	0	0	1,050
Goose Lake	1,050	0	0	0	350	0	0	0	0	1,400
Upper Peoria	830	0	0	0	900	0	0	0	0	1,730
Lower Peoria	450	0	0	0	350	0	10	0	0	810
Pekin Lake	100	0	0	0	5	0	0	0	0	105
Powerton Lake	1,500	0	50	0	0	0	0	0	0	1,550
Spring Lake	10	0	0	0	0	0	0	0	0	10
Spring Lake Bottoms	0	500	0	0	0	0	0	0	0	500
Goose Lake	50	0	0	0	0	0	0	0	0	50
Rice Lake	250	0	0	0	100	0	0	0	0	350
Big Lake	900	0	0	0	200	0	0	0	0	1,100
Banner Marsh	200	0	0	0	0	0	0	0	0	200
Duck Creek	0	0	0	0	0	0	0	10	0	10
Clear Lake	2,010	5	0	0	1,200	0	5	0	0	3,220
North Pool	3,300	0	200	0	0	0	0	0	0	3,500
South Pool	2,300	200	50	50	1,400	0	1,200	0	0	5,200
Quiver Creek	0	100	0	10	10	0	0	0	0	120
Quiver Lake	10	0	0	0	400	0	0	0	0	410
Thompson/Flag Lake	7,200	700	350	50	1,300	0	500	0	0	10,100
North Globe	0	0	0	0	0	0	0	0	0	0
Dickson Mounds	0	0	0	0	0	0	0	0	0	0
South Globe	0	0	0	0	0	0	0	0	0	0
Wilder/Bellrose	0	0	0	0	0	0	0	0	0	0
Spoon River Btms	0	0	0	0	0	0	0	0	0	0
Matanza Lake	1,150	0	0	0	200	0	0	0	0	1,350
Bath Lake	10	0	0	0	0	0	0	0	0	10
Moscow Lake	300	0	50	0	150	0	0	0	0	500
Jack Lake	850	0	0	0	100	0	100	0	0	1,050
Grass Lake	3,000	500	0	0	700	0	0	0	0	4,200
Anderson Lake	250	0	0	0	250	0	205	0	0	705
Snicarte Slough	0	0	0	0	0	0	0	0	0	0
Ingram Lake	1,600	0	0	0	50	0	125	0	0	1,775
Chain Lake	800	100	0	0	2,000	0	0	0	0	2,900
Stewart Lake	1,200	0	0	0	1,500	0	0	0	0	2,700
Crane Lake	0	200	0	0	0	0	0	0	0	200
Cuba Island	500	2,000	0	0	0	0	0	0	0	2,500
Sanganois	600	200	0	0	100	0	0	0	0	900
Treadway Lake	150	0	0	0	300	0	5	0	0	455
Muscooten Bay	0	0	0	0	0	0	0	0	0	0
Big Lake	500	0	0	0	400	0	0	0	0	900
Meredosia Lake	2,300	500	0	0	100	0	0	0	0	2,900
Smith Lake	310	0	0	0	5	0	10	0	0	325
Spunky Bottoms	0	0	0	0	0	0	10	0	0	10
TOTAL	41,565	11,405	1,815	110	13,000	5	2,385	275	0	70,560

ILLINOIS NATURAL HISTORY SURVEY WATERFOWL AERIAL INVENTORY DATA

ILLINOIS RIVER VALLEY Date: April 14, 2015 Observer: Aaron Yetter

LOCATION	LESC	RNDU	CANV	REDH	RUDU	COGO	BUFF	COME	HOME	TOTAL DUCKS
Turner Lake	50	0	0	0	0	0	0	0	0	50
Depue, Spring	0	0	0	0	25	0	0	0	0	25
Coleman Lake	100	50	0	0	0	0	0	0	0	150
Bureau Ponds	0	0	0	0	0	0	0	0	0	0
Goose Lake	0	0	0	0	0	0	0	0	0	0
Senachwine Lake	0	0	0	0	20	0	0	0	0	20
Hennepin/Hopper	1,200	250	250	0	2,400	0	250	0	0	4,350
Swan Lake	0	0	0	0	0	0	0	0	0	0
Sawmill Lake	0	0	0	0	5	0	0	0	0	5
Billsbach Lake	10	0	0	0	0	0	0	0	0	10
Weis Lake	0	0	0	0	0	0	0	0	0	0
Sparland	200	0	0	0	1,500	0	0	0	0	1,700
Wightman Lake	300	0	0	0	0	0	0	0	0	300
Sawyer Slough	0	0	0	0	0	0	0	0	0	0
Hitchcock Slough	200	0	0	0	0	0	0	0	0	200
Babbs Slough	100	0	0	0	2,500	0	0	0	0	2,600
Meadow Lake	100	0	10	0	200	0	0	0	0	310
Douglas Lake	0	0	0	0	0	0	0	0	0	0
Goose Lake	425	0	0	0	1,000	0	0	0	0	1,425
Upper Peoria	150	0	0	0	1,400	0	0	0	0	1,550
Lower Peoria	0	0	0	0	0	0	0	0	0	0
Pekin Lake	0	0	0	0	0	0	0	0	0	0
Powerton Lake	5	0	0	0	100	0	0	0	0	105
Spring Lake	55	0	0	0	0	0	0	0	0	55
Spring Lake Bottoms	0	0	0	0	0	0	10	0	0	10
Goose Lake	0	0	0	0	0	0	0	0	0	0
Rice Lake	0	0	0	0	0	0	0	0	0	0
Big Lake	0	0	0	0	0	0	0	0	0	0
Banner Marsh	0	0	0	0	0	0	0	0	0	0
Duck Creek	0	0	0	0	0	0	0	0	0	0
Clear Lake	0	0	0	0	5,500	0	0	0	0	5,500
North Pool	500	0	0	0	3,500	0	0	0	0	4,000
South Pool	500	50	0	0	900	0	100	0	0	1,550
Quiver Creek	0	0	0	0	0	0	0	0	0	0
Quiver Lake	0	0	0	0	0	0	0	0	0	0
Thompson/Flag Lake	1,460	0	100	200	6,400	0	630	0	0	8,790
North Globe	0	0	0	0	0	0	0	0	0	0
Dickson Mounds	0	0	0	0	0	0	0	0	0	0
South Globe	0	0	0	0	0	0	0	0	0	0
Wilder/Bellrose	0	0	0	0	0	0	0	0	0	0
Spoon River Btms	0	0	0	0	0	0	0	0	0	0
Matanza Lake	0	0	0	0	0	0	0	0	0	0
Bath Lake	0	0	0	0	0	0	0	0	0	0
Moscow Lake	15	0	0	0	0	0	0	0	0	15
Jack Lake	0	0	0	0	0	0	0	0	0	0
Grass Lake	5	0	0	0	400	0	0	0	0	405
Anderson Lake	0	0	0	0	0	0	0	0	0	0
Snicarte Slough	0	0	0	0	0	0	0	0	0	0
Ingram Lake	0	0	0	0	0	0	0	0	0	0
Chain Lake	10	0	0	0	1,230	0	0	0	0	1,240
Stewart Lake	0	0	0	0	100	0	0	0	0	100
Crane Lake	0	0	0	0	0	0	0	0	0	0
Cuba Island	650	100	0	0	0	0	0	0	0	750
Sanganois	0	0	0	0	0	0	0	0	0	0
Treadway Lake	0	0	0	0	0	0	0	0	0	0
Muscooten Bay	0	0	0	0	0	0	0	0	0	0
Big Lake	0	0	0	0	0	0	10	0	0	10
Meredosia Lake	100	0	0	0	900	0	0	0	0	1,000
Smith Lake	0	0	0	0	0	0	0	0	0	0
Spunky Bottoms	0	0	0	0	0	0	0	0	0	0
TOTAL	6,135	450	360	200	28,080	0	1,000	0	0	36,225

ILLINOIS NATURAL HISTORY SURVEY WATERFOWL AERIAL INVENTORY DATA

Pool 19 Mississippi River Date: March 12, 2015 Observer: Aaron Yetter

LOCATION	LESC	RNDU	CANV	REDH	RUDU	COGO	BUFF	COME	HOME	TOTAL DUCKS
Keokuk - Nauvoo	14,700	700	37,010	500	0	1,200	0	900	0	55,010
Arthur Refuge	0	0	0	0	0	0	0	0	0	0
Nauvoo - Ft. Mad.	13,100	100	36,500	100	0	6,800	0	1,470	0	58,070
Ft.Mad. - Dallas	2,920	0	1,310	0	100	760	0	1,150	0	6,240
Dallas - Burlington	4,000	0	4,000	0	0	10	0	350	0	8,360
Turkey Slough	600	0	600	0	0	300	30	300	0	1,830
Burling. - 18 Dam	0	0	0	0	0	0	0	0	0	0
Total	35,320	800	79,420	600	100	9,070	30	4,170	0	129,510

ILLINOIS NATURAL HISTORY SURVEY WATERFOWL AERIAL INVENTORY DATA

Pool 19 Mississippi River Date: March 20, 2015 Observer: Aaron Yetter

LOCATION	LESC	RNDU	CANV	REDH	RUDU	COGO	BUFF	COME	HOME	TOTAL DUCKS
Keokuk - Nauvoo	53,570	3,000	22,030	200	900	400	400	110	0	80,610
Arthur Refuge	0	0	0	0	0	0	0	0	0	0
Nauvoo - Ft. Mad.	42,500	500	9,000	0	100	1,000	100	365	0	53,565
Ft.Mad. - Dallas	6,500	0	1,210	0	200	150	0	20	0	8,080
Dallas - Burling.	4,800	0	100	0	0	100	0	20	0	5,020
Turkey Slough	1,000	0	100	0	0	0	0	100	0	1,200
Burling. - 18 Dam	0	0	0	0	0	0	0	0	0	0
Total	108,370	3,500	32,440	200	1,200	1,650	500	615	0	148,475

ILLINOIS NATURAL HISTORY SURVEY WATERFOWL AERIAL INVENTORY DATA

Pool 19 Mississippi River Date: March 27, 2015 Observer: Aaron Yetter

LOCATION	LESC	RNDU	CANV	REDH	RUDU	COGO	BUFF	COME	HOME	TOTAL DUCKS
Keokuk - Nauvoo	165,850	1,000	60,925	1,350	6,800	1,350	3,800	200	0	241,275
Arthur Refuge	0	0	0	0	0	0	0	0	0	0
Nauvoo - Ft. Mad.	49,100	1,000	11,300	0	3,410	5,210	1,250	1,500	0	72,770
Ft.Mad. - Dallas	25,450	0	1,100	0	0	0	115	50	0	26,715
Dallas - Burling.	10,020	0	1,010	0	0	50	200	50	0	11,330
Turkey Slough	100	0	100	0	0	50	200	150	0	600
Burling. - 18 Dam	0	0	0	0	0	0	0	0	0	0
Total	250,520	2,000	74,435	1,350	10,210	6,660	5,565	1,950	0	352,690

ILLINOIS NATURAL HISTORY SURVEY WATERFOWL AERIAL INVENTORY DATA

Pool 19 Mississippi River Date: April 1, 2015 Observer: Aaron Yetter

LOCATION	LESC	RNDU	CANV	REDH	RUDU	COGO	BUFF	COME	HOME	TOTAL DUCKS
Keokuk - Nauvoo	167,150	0	7,650	0	15,100	0	900	0	0	190,800
Arthur Refuge	100	0	0	0	0	0	100	0	0	200
Nauvoo - Ft. Mad.	24,500	0	1,000	0	500	300	5,400	1,100	0	32,800
Ft.Mad. - Dallas	19,000	0	100	0	50	0	410	100	0	19,660
Dallas - Burling.	12,680	0	0	0	0	0	100	0	0	12,780
Turkey Slough	1,000	0	0	0	0	0	0	0	0	1,000
Burling. - 18 Dam	0	0	0	0	0	0	0	0	0	0
Total	224,430	0	8,750	0	15,650	300	6,910	1,200	0	257,240

ILLINOIS NATURAL HISTORY SURVEY WATERFOWL AERIAL INVENTORY DATA

Pool 19 Mississippi River Date: April 15, 2015 Observer: Aaron Yetter

LOCATION	LESC	RNDU	CANV	REDH	RUDU	COGO	BUFF	COME	HOME	TOTAL DUCKS
Keokuk - Nauvoo	9,750	0	10	0	810	0	100	0	0	10,670
Arthur Refuge	0	0	0	0	0	0	0	0	0	0
Nauvoo - Ft. Mad.	2,910	0	0	0	120	0	0	0	0	3,030
Ft.Mad. - Dallas	1,300	0	0	0	50	0	50	0	0	1,400
Dallas - Burling.	2,300	0	0	0	0	0	0	0	0	2,300
Turkey Slough	700	0	0	0	0	0	0	0	0	700
Burling. - 18 Dam	0	0	0	0	0	0	0	0	0	0
Total	16,960	0	10	0	980	0	150	0	0	18,100

Appendix 3. Final Report on Reproductive Success and Survival of Eastern Population of Sandhill Cranes

Reproductive Success and Survival in the Eastern Population of Sandhill Cranes

Jeffrey Fox

Summary Background

The Eastern Population (EP) of Greater Sandhill Cranes (*Grus canadensis tabida*) has demonstrated an impressive recovery since the population's historic low circa the 1930s (e.g. ≈25 breeding pairs documented in Wisconsin; Henika 1936, Meine and Archibald 1996). At present, the EP perhaps numbers more than 70,000 birds (Kruse and Dubovsky 2015) and interest in harvest for recreation and to mitigate crop depredation has come to the forefront of discussions on the population's management. The Management Plan for the Eastern Population of Sandhill Cranes (2010) has proposed a harvest-management strategy based on fall surveys to monitor the population and maintain running three-year average indices above 30,000 cranes (Ad Hoc Eastern Population Sandhill Crane Committee 2010). While precedents set by the harvest of the Mid-Continent Population (MCP) and Rocky Mountain Population (RMP) of Sandhill Cranes support this approach, the landscape within the EP's range is far more varied than the landscapes in the MCP and RMP ranges and continues to be rapidly urbanized (Fig. 1). If cranes are able to thrive in these urbanizing landscapes it is likely that the EP will continue to increase, perhaps mirroring the population trajectory of the Giant Canada Goose throughout the Midwest in the last 33 years (17.5% per year; Sauer et al. 2011). However, there remain several knowledge gaps in the demographics of the EP including landscape-dependent reproductive success and juvenile and adult survival (e.g. two studies published on reproductive success in or near urban environments; Dwyer and Tanner 1992, Toland 1999). Evaluating these vital rates in different landscapes of the EP's range and at different population densities is essential to refining models of population growth and abundance under different land-use and management scenarios (e.g. urban sprawl and EP harvest).

Project Objectives

The primary objectives of this study are to (1) investigate reproductive success of Sandhill Cranes at different population densities and in different landscapes of the EP's range and (2) evaluate age-specific survival, status-dependent survival (i.e. breeding vs. non-breeding), and survivorship to breeding-age. Conducting this work through consecutive years will help to distinguish the relative role(s) of annual stochasticity from potential density-, landscape-, and state-dependent effects. These data will then be applied to (3) generate models of EP growth and abundance under different management and land use scenarios.

1) Evaluate Density- and Landscape-Dependent Reproductive Success

-Defined Parameters of Reproductive Success

-Nest Productivity – The probability of a nest producing at least one fledged young.

-Fledging Success – The probability of young surviving from hatching until capable of flight (≈10 weeks old; Drewien 1973 *in* Gerber et al. 2014).

a. Density-Dependent Reproduction

i. Assess reproductive success in the densely populated core of the EP's range in central Wisconsin and at the population's peripheries in southeastern Wisconsin and northeastern Illinois (Fig. 2).

b. Landscape-Dependent Reproduction

i. Assess reproductive success in the rural-agricultural region of central Wisconsin and the rural-agricultural-urban matrix of southeastern Wisconsin and northeastern Illinois (Fig. 2).

2) Evaluate Age-Specific and Status-Dependent Survival and Survivorship to Breeding Age

    a. Age-Specific Survival – Survival of known-age birds (i.e. marked during hatch year) during their juvenile stage (i.e. post-fledging to independence at approximately 9 to 10 months of age; Gerber et al. 2014), subsequent annual adult survival, and the probability of transitioning from one age-class to the next.

    b. Status-Dependent Survival – Annual survival of breeding and non-breeding adult birds and the probability of transitioning from a non-breeding to a breeding state or a breeding to a non-breeding state.

    c. Survivorship to Breeding Age – Survivorship of known-age individuals to first confirmed successful reproduction and survivorship to previously reported earliest and average ages of first successful reproduction (3 and 4.3 years of age, respectively; Nesbitt 1992).

3) Population Growth

    a. Population Projection Modeling

        i. Density- and Landscape-Dependent Vital Rates

            1. Reproduction – Objectives 1a-b

            2. Survival – Objectives 2a-c

Additionally, automated telemetry receiving units (a.k.a. automated receiving units or "ARUs"; JDJC corp) positioned in the EP flyway and at a primary migratory stopover site at Jasper-Pulaski State Fish and Wildlife Area in Indiana (JP) are being used to record the movements of radio-marked juvenile and adult cranes. This method increases the probability of detecting marked birds during migration and thus the precision of survival analyses. Moreover, these units are expected to provide insight into potential status-dependent (e.g. breeding vs. non-breeding) migratory timing and behavior as well as generating data on birds from geographically distinct regions of the EP breeding range.

Summary of Preliminary Analyses

Objective 1: Evaluate Density- and Landscape-Dependent Reproductive Success

Known fate models were constructed in program MARK (v.7.0) to estimate nest productivity and fledging success (Tables 1 and 2). Nineteen percent of 240 nests throughout central Wisconsin and southeastern Wisconsin/northeastern Illinois study regions were successful in fledging at least one bird (mean brood size at fledging was 1.2; Fig. 3). Individual survivorship from hatching to fledging was 27% (n=482 young from 341 broods). Top-ranked models revealed study region – a proxy for crane population density – explained the preponderance of variation observed in reproductive success (Tables 1 and 2). Specifically, nests in the core region of the EP in central Wisconsin were 10% more likely to fledge young than those at the peripheries of the EP in southeastern Wisconsin/northeastern Illinois (Fig. 4). Contrasting survivorship of individuals from hatching to fledging in central Wisconsin (45%) and southeastern Wisconsin/northeastern Illinois (22%) was even more evident (Fig. 4). Only a single model testing landscape-dependence in reproductive success was well supported. This model was the highest ranked fledging success model and revealed a positive correlation between fledging success and the percentage of urban development within 1500m of nests (Table 2; Fig. 5). Alternatively, the top-ranked model of nest productivity highlighted the strength with which intra-brood fates were intertwined (Table 1). Specifically, the mortality of one colt in a brood of two precipitated a 46% reduction in survivorship to fledging for the remaining individual in the brood. Additive models including study region and year were the second best supported models for both nest productivity and fledging success, supporting a prominent role for annual variation in reproductive success (Tables 1 and 2; Fig. 6).

Objective 2: Evaluate Age-Specific and Status-Dependent Survival and Survivorship to Breeding Age

One hundred and twenty-eight hatch-year birds and 66 adults were equipped with leg-band VHF transmitters to facilitate the acquisition of data on post-fledging vital rates. These transmitters broadly and prematurely failed and principal sources of data on post-fledging vital rates were consequently lost (see **Project Notes**). Fortunately, the sum of available data on all banded birds (n=265) was sufficient to construct simple multi-state models in program MARK

(v.7.0) evaluating age- and status-dependent survival (Table 3). Juvenile survival (i.e. survivorship post-fledging to 1 year old adult) was 65% (n=170; Fig. 7). Annual survival of adult birds was 94% (n=124; Fig. 7) and was not well correlated with breeding status or study region (Table 3). The results of Objectives 1 and 2 together revealed survivorship from egg to three (earliest breeding age), four (average breeding age), and five years of age of 9%, 8.5% and 8%, respectively (Fig. 7). Additional data (e.g. 2015 resightings and third-party reports) continue to be incorporated to help compensate for transmitter failure and improve the preliminary estimates reported here. These data will be applied to models of population growth (**Objective 3**) and presented in the final report.

Project Notes

A primary focus of this research was to establish longitudinal data via equipping 120 birds with leg-band VHF transmitters (Advanced Telemetry Systems Model #A3590, >1400 day battery life). These transmitters exhibited multiple modes of premature failure: Detachment from leg-bands, antenna degradation, and antenna detachment. Recovery of transmitters that had detached from leg-bands within the first year of deployment revealed that the materials with which each transmitter had been painted and clear-coated had rapidly degraded with exposure and begun to peel and crack. Photographs of recovered units were provided to the manufacturer (Fig. 8). The manufacturer confirmed that this was the cause of transmitter detachment and that none of the units should have been assembled and shipped in this condition. Concurrently, the antennas on transmitters began to degrade, exposing frayed stainless steel cable (Fig. 9). This posed clear potential to diminish birds' quality of life. These issues were resolved at our expense and efforts were reoriented to recapture and re-equip previously marked birds with the modified transmitters. Transmitters were subsequently and increasingly noted without antennas within the second year post-deployment (Fig. 10). Despite mutual agreement that none of the units had been manufactured to specification and almost unilaterally began to fail within the warranty period (708 days) it was only after protracted deliberation that the manufacturer agreed to provide a limited number of replacements (85). Surprisingly, these replacements were not constructed according to mutually agreed upon –

and manufacturer recommended – specifications. These replacement units were unable to be modified and, per the manufacturer's original claims, were therefore more apt to have antennas detach. These obstacles largely confounded our efforts to reliably track birds beyond their established territories and during migration via the ARUs (e.g. inconsistent probabilities of detection of radio-marked individuals). More importantly, these experiences have highlighted a much broader issue. Comprehensive reviews of specific transmitter manufacturers and models are broadly unavailable. Researchers are thus overly dependent on anecdotal reports and manufacturers' claims regarding the performance of their own products. Faulty designs are therefore likely to plague one research project after another because manufacturers are presented with little incentive to resolve issues brought to their attention. A centralized database where researchers can submit and access performance reviews of wildlife transmitters and associated equipment is sorely needed to incentivize product improvement.

Also of note is the inclusion of additional measurements of young with known hatch dates collected each year. These data will continue to increase the precision of age estimates for young with unknown hatch dates. Previous age-estimates may therefore differ by as much as one week.

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Table 1: Known-fate models constructed in Program Mark (v.7.0) evaluating the probability of Sandhill Crane nests producing at least one fledged young ("nest productivity) relative to study region and land cover within 1500m of nests (urban, urban open space, agriculture, grassland/savanna, wooded, wetland, and open water). Models are ranked by Akaike's Information Criterion (AICc; Delta AICc 2nd column). Note study region is a proxy for population density – "region" models distinguish nests in areas with high crane population densities in central Wisconsin from nests in areas with low crane population densities in southeastern Wisconsin/northeastern Illinois (Fig. 2). "Nest date" models distinguish nests initiated during peak nesting in April from those initiated later. "Renest" models distinguish confirmed renests from initial nesting attempts. "Year" models distinguish nests according to year. "Brood size" models distinguish broods of 1 from broods of two. Note that the top ranked models reveal a strong correlation between the mortality of one individual in a brood and subsequent mortality of the second and that variations in productivity were most apparent between study regions and years.

PRODUCTIVITY MODELS	Δ AICc	AICc Weights	Model Likelihood	Evidence Ratios	# Par.	Deviance
AGE + BROOD SIZE + SIB FATE	0.00	0.50	1.00	1.00	14	1414.88
AGE + REGION + YEAR	1.91	0.19	0.38	2.60	19	1406.62
AGE + REGION + AGRICULTURE	4.73	0.05	0.09	10.66	14	1419.61
AGE + REGION + URBAN	4.80	0.05	0.09	11.00	14	1419.67
AGE + REGION	5.23	0.04	0.07	13.65	13	1422.13
AGE + REGION + OPEN WATER	5.93	0.03	0.05	19.35	14	1420.80
AGE + WETLAND	6.08	0.02	0.05	20.91	13	1422.98
AGE + REGION + WETLAND	6.75	0.02	0.03	29.22	14	1421.62
AGE + REGION + GRASSLAND/SAVNANNA	7.10	0.01	0.03	34.72	14	1421.97
AGE + REGION + URBAN OPEN SPACE	7.20	0.01	0.03	36.56	14	1422.07
AGE + REGION + WOODED	7.25	0.01	0.03	37.50	14	1422.12
AGE + AGRICULTURE	7.41	0.01	0.02	40.57	13	1424.31
AGE	7.52	0.01	0.02	42.89	12	1426.45
AGE + YEAR	7.73	0.01	0.02	47.77	18	1414.47
AGE + NEST DATE	8.55	0.01	0.01	71.86	13	1425.45
AGE + BROOD SIZE	8.67	0.01	0.01	76.40	13	1425.58
AGE + GRASSLAND/SAVANNA	8.80	0.01	0.01	81.28	13	1425.70
AGE + URBAN OPEN SPACE	8.88	0.01	0.01	84.90	13	1425.79
AGE + WOODED	9.03	0.01	0.01	91.48	13	1425.93
AGE + URBAN	9.30	0.00	0.01	104.60	13	1426.20
AGE + OPEN WATER	9.38	0.00	0.01	108.97	13	1426.29
AGE + NEST DATE + RENEST	9.91	0.00	0.01	142.07	14	1424.79
AGE + ALL LAND COVER	13.56	0.00	0.00	885.38	19	1418.26

Table 2: Known-fate models constructed in Program Mark (v.7.0) evaluating the probability of individual Sandhill Crane chicks fledging relative to study region and land cover within 1500m of nests (urban, urban open space, agriculture, grassland/savanna, wooded, wetland, and open water). Models are ranked by Akaike's Information Criterion (AICc; Delta AICc 2nd column). Note study region is a proxy for population density – "region" models distinguish birds in areas with high crane population densities in central Wisconsin from birds in areas with low crane population densities in southeastern Wisconsin/northeastern Illinois (Fig. 2). "Nest date" models distinguish young hatched from nests initiated during peak nesting in April from those that hatched later. "Renest" models distinguish birds hatched from confirmed renests from those hatched from initial nesting attempts. "Year" models distinguish birds based on year. "Brood size" models distinguish broods of 1 from broods of two. Note that the top ranked models reveal a strong correlation between individual fledging success and study region, urban development, and year of the study.

INDIVIDUAL FLEDGING SUCCESS MODELS	Δ AICc	AICc Weights	Model Likelihood	Evidence Ratios	# Par.	Deviance
AGE + REGION + URBAN	0.00	0.66	1.00	1.00	13	1628.38
AGE + REGION + YEAR	2.70	0.17	0.26	3.86	18	1620.94
AGE + REGION + AGRICULTURE	4.68	0.06	0.10	10.36	13	1633.05
AGE + REGION + GRASSLAND/SAVNANNA	5.96	0.03	0.05	19.67	13	1634.33
AGE + REGION	6.53	0.03	0.04	26.24	12	1636.93
AGE + REGION + OPEN WATER	7.05	0.02	0.03	33.89	13	1635.42
AGE + REGION + WETLAND	8.35	0.01	0.02	64.90	13	1636.72
AGE + REGION + URBAN OPEN SPACE	8.49	0.01	0.01	69.79	13	1636.87
AGE + REGION + WOODED	8.51	0.01	0.01	70.47	13	1636.89
AGE + ALL LAND COVER	13.43	0.00	0.00	821.83	20	1627.60
AGE + WETLAND	14.64	0.00	0.00	1494.23	12	1645.03
AGE + BROOD SIZE + SIB FATE	14.99	0.00	0.00	1776.92	13	1643.37
AGE + GRASSLAND/SAVANNA	17.43	0.00	0.00	5976.91	12	1647.83
AGE + NEST DATE	17.57	0.00	0.00	6574.60	12	1647.97
AGE + YEAR	18.20	0.00	0.00	9392.29	17	1638.47
AGE + NEST DATE + RENEST	19.47	0.00	0.00	16436.50	13	1647.84
AGE + AGRICULTURE	20.37	0.00	0.00	32873.00	12	1650.76
AGE + WOODED	21.08	0.00	0.00	32873.00	12	1651.48
AGE + URBAN OPEN SPACE	21.22	0.00	0.00	32873.00	12	1651.62
AGE	21.25	0.00	0.00	32873.00	11	1653.67
AGE + URBAN	22.74	0.00	0.00	65746.00	12	1653.13
AGE + BROOD SIZE	23.08	0.00	0.00	65746.00	12	1653.48
AGE + OPEN WATER	23.15	0.00	0.00	65746.00	12	1653.55

Table 3: Multi-state models with live-resight and dead recoveries constructed in Program Mark (v.7.0) evaluating survivorship from fledging to one year of age (approximating juvenile survival to independence) and adult survival (breeding, non-breeding, and combined breeding and non-breeding). "Study region" distinguished birds from central Wisconsin from those in southeastern Wisconsin/northeastern Illinois. Note that there was relatively little support for state-dependent survival in adults (i.e. breeding vs. non-breeding) or variation between study regions.

SURVIVAL MODELS	Δ AICc	AICc Weights	Model Likelihood	Evidence Ratios	# Par.	Deviance
{JUVENILE vs ADULT}	0.00	0.54	1.00	1.00	8	276.87
{JUVENILE vs NONBREEDING ADULT vs BREEDING ADULT}	1.46	0.26	0.48	2.08	9	276.22
{JUVENILE vs ADULT} + STUDY REGION	1.96	0.20	0.37	2.67	9	276.72

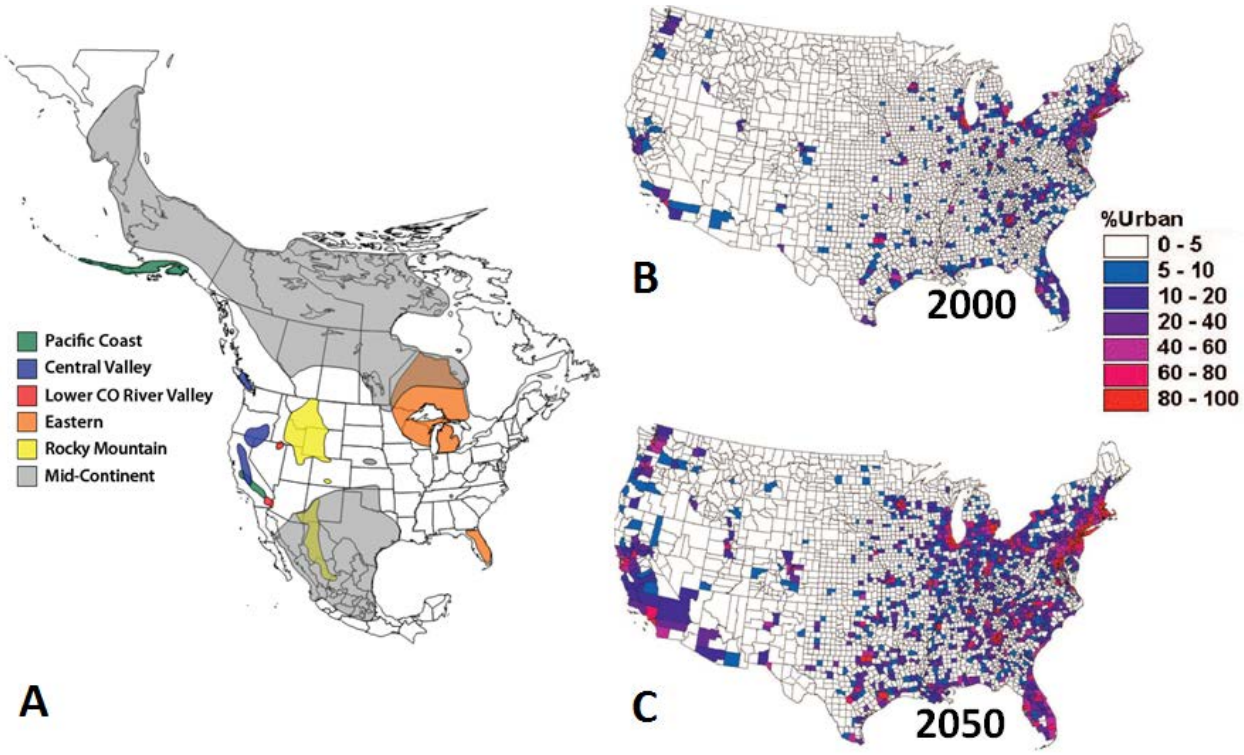

Figure 1: The distribution of migratory Sandhill Crane populations in North America (Case and Sanders 2009) and projected trends in urbanization, by county, from 2000 to 2050 (B and C respectively; Nowak and Walton 2005). Harvests of the Rocky Mountain Population (RMP; panel A, yellow) and Mid-Continent Population (MCP; panel A, grey) are established and monitored via annual population indices at migratory staging and stopover sites. A similarly managed harvest of the Eastern Population (EP; panel A, orange) has been proposed (Ad Hoc Eastern Population Sandhill Crane Committee 2010). Note the rapid urbanization projected for EP range relative to the RMP and MCP ranges.

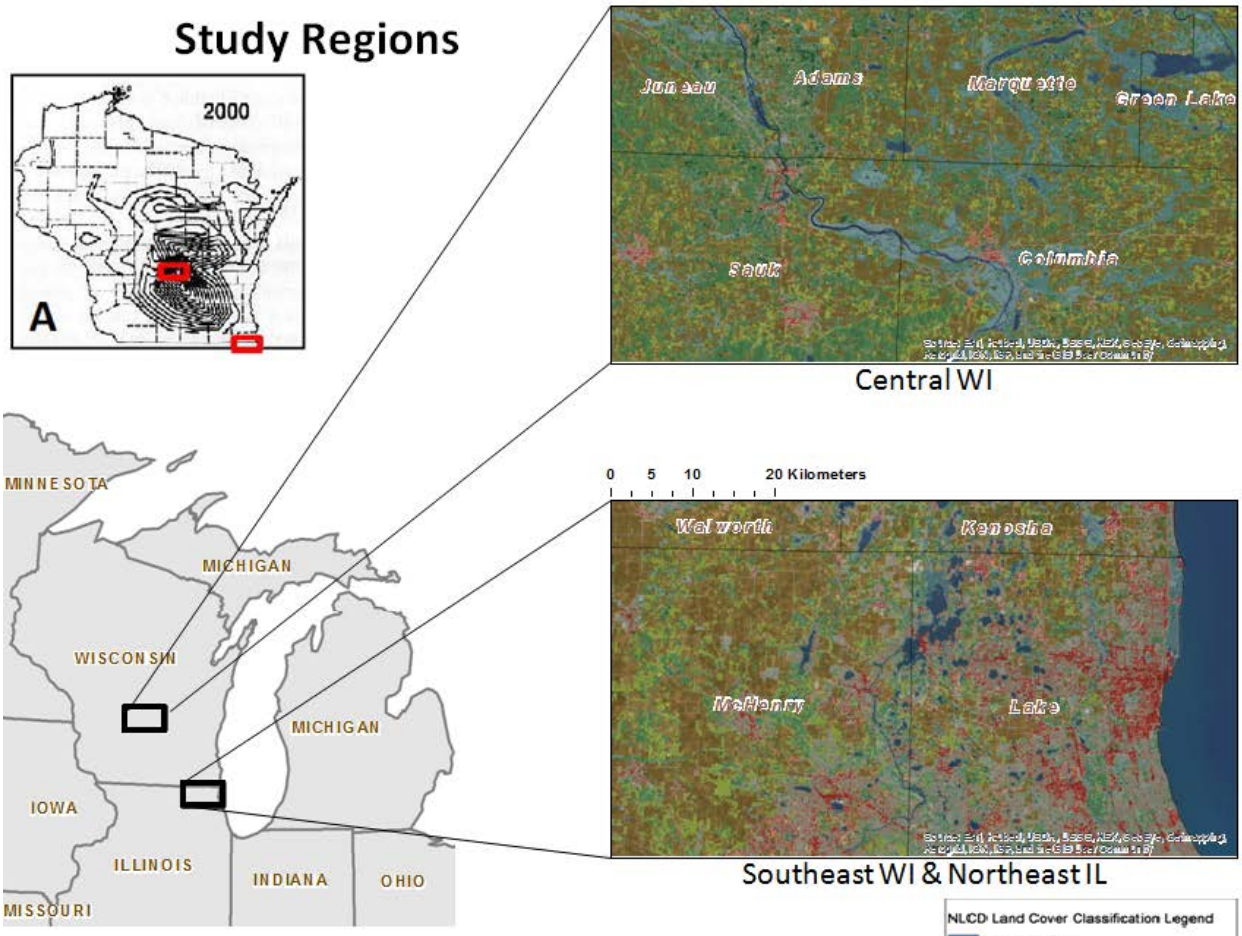

Figure 2: Location of primary study regions (red boxes, panel A) relative to Sandhill Crane densities (each line represents 100 bird intervals beginning from the outside; Su et al. 2004). Also, note the rural-agricultural (B) and rural-agricultural-urban matrix (C) of these study regions (land cover data from the National Land Cover Database 2006; Fry et al. 2011). Together these study regions allow reproductive success and survival to be evaluated relative to crane population densities and across a diversity of landscapes, including the urban habitats predicted to increase throughout the population's range (Fig. 1).

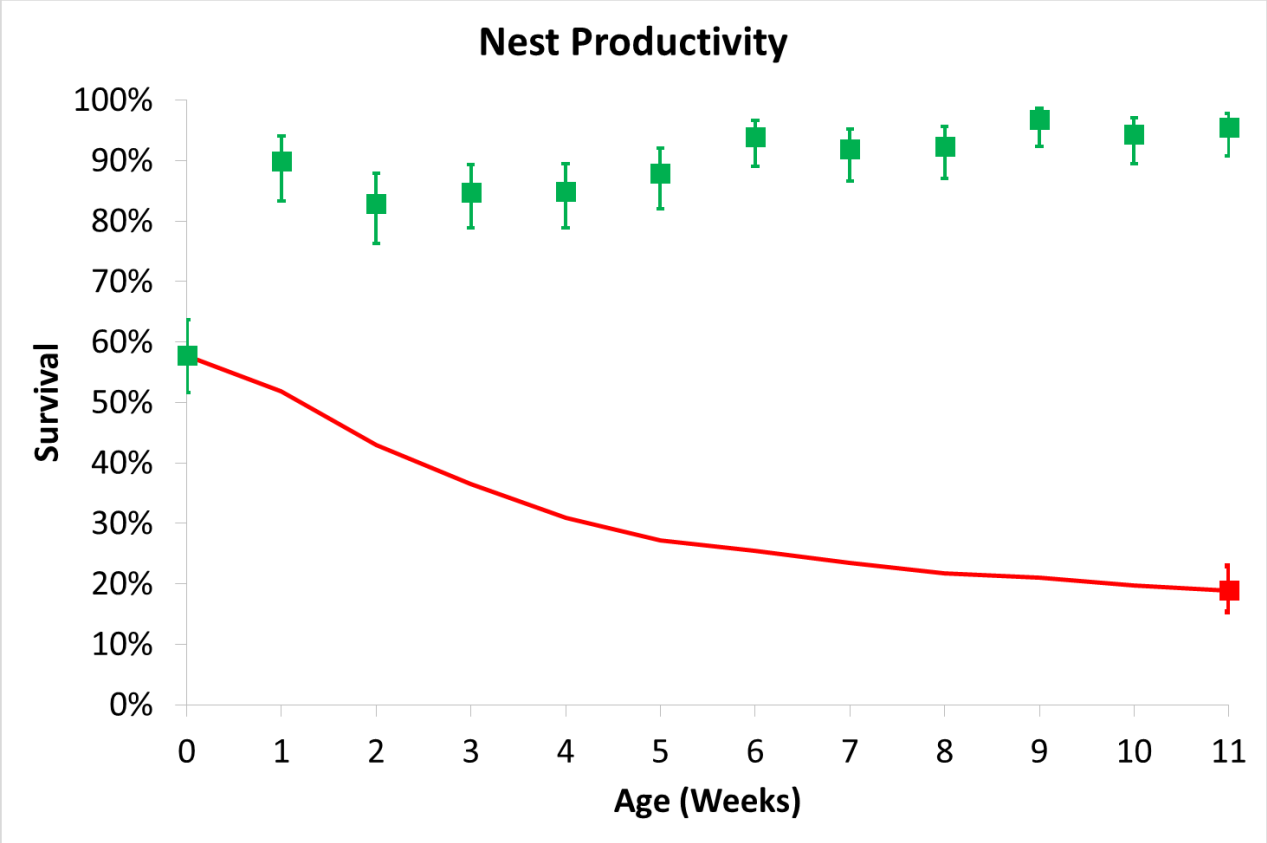

Figure 3: Survival probabilities (y-axis) of nests (i.e. hatching ≥ 1 egg; green square and 95%CI at age 0; x-axis) and subsequent weekly brood survival to fledging (green squares and 95%CIs, x-axis). Brood survivorship probabilities (y-axis) from nest to the x-axis stated age (red line) reveal 19% of all nests in central Wisconsin and southeastern Wisconsin/northeastern Illinois produced at least one fledged bird (red box with 95%CI; n=240). Note mean brood size at fledging was 1.2.

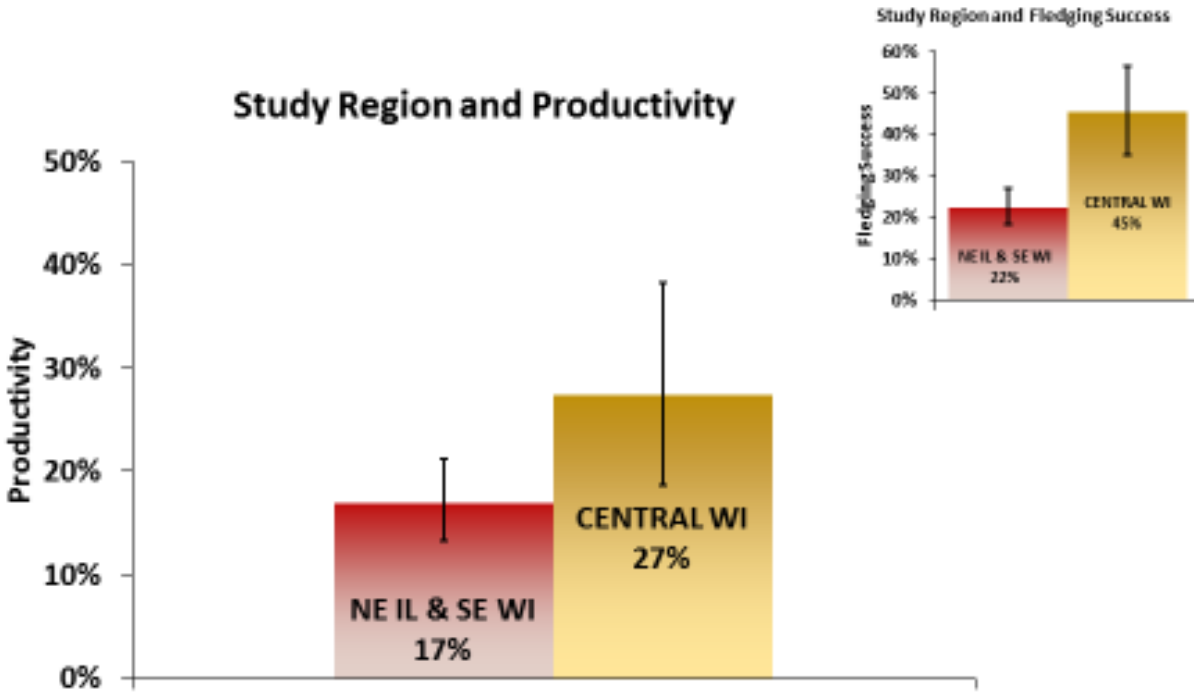

Figure 4: The probability of a nest producing at least one fledged young (y-axis) in central Wisconsin (orange bar with 95%CI, n=31) or in southeastern Wisconsin/northeastern Illinois (red bar with 95%CI, n=209). Note that the probabilities of individual fledging success in these study regions were 45% (n=106) and 22% (n=376), respectively (top right).

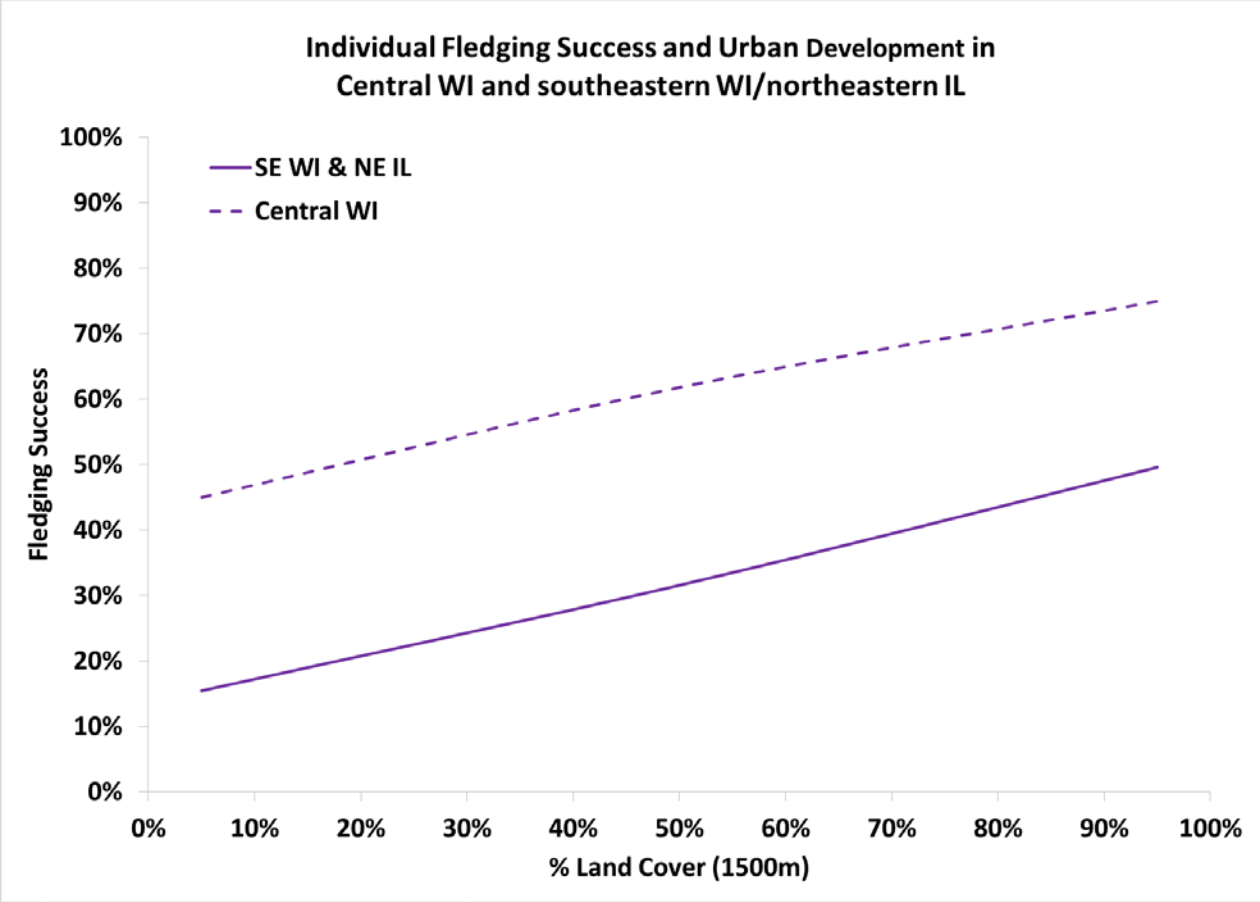

Figure 5: Survivorship from hatching to fledging (y-axis) relative to the percentage of urban development within 1500m of nests (x-axis) in central Wisconsin (hatched purple line) and in southeastern Wisconsin/northeastern Illinois (solid purple line). Note that urban development within 1500m of nests ranged from 2% to 32% in central Wisconsin (mean = 6%) and 3% to 77% in southeastern Wisconsin/northeastern Illinois (mean = 25%). Also note that urban development alone explained little of the variation in fledging success but together with study region represented the best supported model of individual fledging success (Table 2).

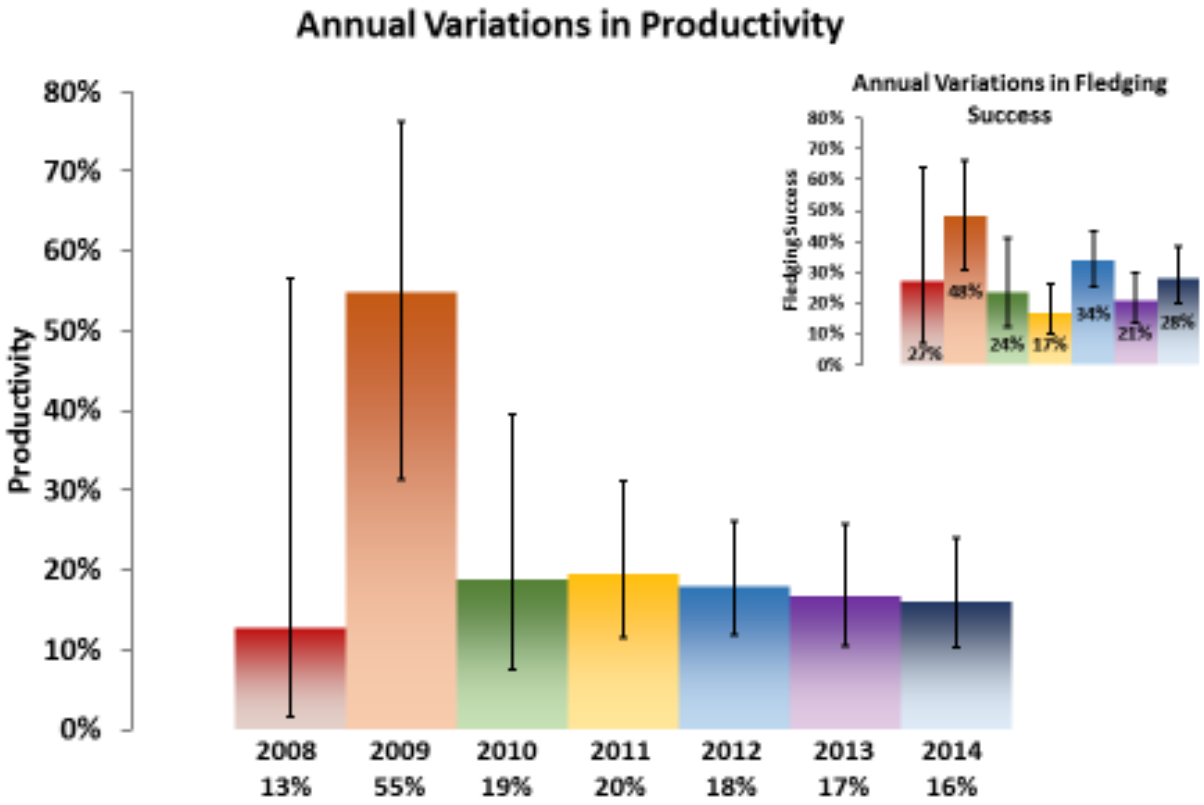

Figure 6: The probability of a nest producing at least one fledged young (y-axis) by year (vertical bars with 95%Cis). Note the greater annual variation in individual fledging success (top right) relative to overall productivity, suggesting that fledging success is more variable than nest success between years.

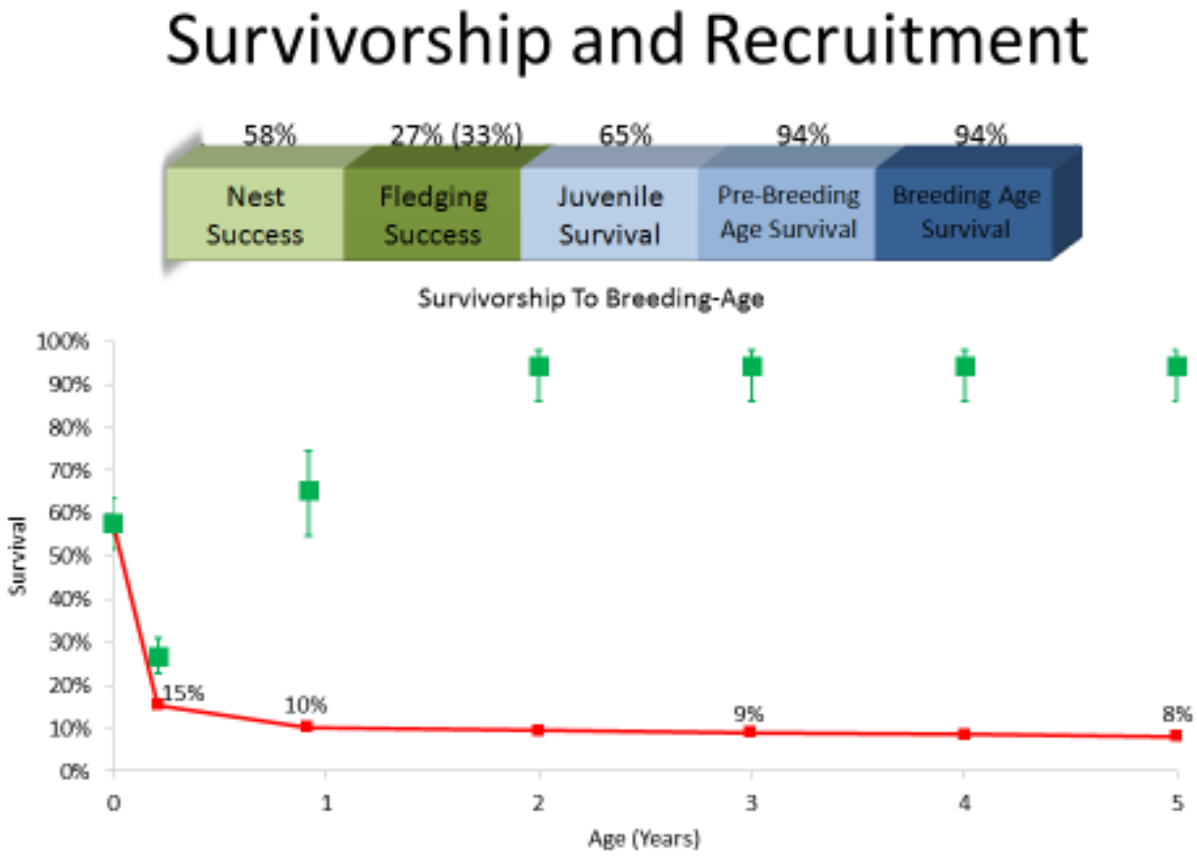

Figure 7: Survivorship (y-axis) to the x-axis specified age (red line) based on age-specific vital rate estimates (specified at top and green boxes with 95%CIs). Note that the estimates for fledging success represent post-hatching to fledging survivorship of individuals (27%) and broods (33%). For example, survivorship from egg to age of recruitment into the breeding population (i.e. 3-5 years old) was 8-9% (i.e. product of nest success, individual fledging success, juvenile survival, and two to four years of adult survival), whereas annual nesting productivity per breeding pair was 19% (i.e. product of nest success and brood survivorship to fledging; average size of fledged broods = 1.2).

Figure 8: Two examples of transmitter failure via detachment from leg-bands. The transmitter on the left was deployed on 6/21/2012 and was recovered on 5/13/2013. Note the pealing of the outer coating of the transmitter, remnants of which visibly remained on the bird's leg band. The transmitter on the right was deployed for a comparable length of time but was recovered prior to detachment (note the remnants of the old bands that remained attached to the epoxy). This example demonstrates how the colored coating underlying the clear coating cracked, which often resulted in separation from the epoxy used to attach transmitters to bands (i.e. epoxy was frequently observed on birds' leg bands post transmitter detachment, similar to the fragment on the right). The manufacturer refused to allow us to speak with their engineers to resolve these problems but confirmed that none of the units should have been assembled with these two outer coatings.

Figure 9: An assortment of transmitters exhibiting antenna degradation and frayed stainless steel cable. All were recovered within less than two years post-deployment. This problem was noted for 100% of the transmitters purchased. Because we had resolved the issue of detachment prior to observing this mode of transmitter failure these units raised serious concerns about potential long-term interference with nest incubation and quality of life. Significant effort was devoted to recapturing and removing these units from birds instead of increasing sample size and progressing with the funded research.

Figure 10: This transmitter was deployed on 7/27/2012 and removed from the bird during a recapture on 7/3/2014. Note that the antenna had completely fallen off and only the spring remained, resulting in a non-functional transmitter. This mode of failure was noted to begin occurring within less than two years post-deployment and appeared to be systemic. The manufacturer claimed that the antenna was not an integral component of a functional transmitter.