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Insect Emergence Variation in Northern Illinois Wetlands Used by the Yellow-headed Blackbird (*Xanthocephalus xanthocephalus*)

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ABSTRACT

In this study, we examined how insect emergence and biomass varied with nest productivity at 13 wetlands in Northern Illinois occupied by Yellow-headed Blackbirds (*Xanthocephalus xanthocephalus*), an endangered species in Illinois, during 2004 and 2005. Insects were collected every 10 days, after which abundance and dry biomass were measured. Significant differences were found for insect emergence between years, but not among wetlands. Overall lower values of insect abundance and biomass were found in 2004 compared to 2005. Year variations were the result of extreme differences in weather conditions, as 2004 was a wet year and 2005 was a dry year. These results suggest that other factors are influencing habitat selection and nest productivity of Yellow-headed Blackbird in these Northern Illinois wetlands.

Keywords: Illinois, insect emergence, Yellow-headed Blackbird, wetland

INTRODUCTION

The Yellow-headed Blackbird (*Xanthocephalus xanthocephalus*) is a neotropical migrant that breeds primarily in western North America with a few small populations scattered east of the Mississippi (Fig. 1, Ward, 2005a). In Illinois, the species is listed as endangered (Ward, 2005a). This large-bodied, polygynous blackbird typically breeds in deep water, emergent wetlands from May to mid-July (Fig. 1, Twedt and Crawford, 1995). In Northern Illinois, Yellow-headed Blackbirds utilize wetlands within a highly urbanized and rapidly developing landscape. Conservation strategies targeting wetland species have been hindered by a lack of information regarding general habitat requirements of birds in urban environments (Enstrom et al., 2000).

Recently, evidence that individuals use information gathered during late-season prospecting to select breeding sites has been reported in Yellow-headed Blackbirds (Ward, 2005b). In this case, sites with relatively high numbers of young produced per female in year$^{(x)}$ best predicted where prospecting adults settled in future years$^{(x+1)}$. Many factors may influence a bird's reproductive success, suggesting that the number of young per female produced in year$^{(x)}$ integrates many components of breeding habitat quality and make this a particularly informative habitat selection cue for birds in northern Illinois.

How food availability might be associated with Yellow-headed Blackbird nest productivity in an urban landscape is still not well understood. Spatial variation in food abundance is common within habitats (Hutto, 1993), and other work has shown that the number of Yellow-headed Blackbird young fledged at a site correlates with the amount of food there (Orians, 1980; Ward, 2004; Ward, 2005b). The Yellow-headed Blackbird feeds its young primarily odonates, but have also been known to provide trichopteran and dipteran insects (Orians, 1966). In this study we examined insect emergence and biomass in wetlands used by the Yellow-headed Blackbird in Northern Illinois during 2004 and 2005 to examine the degree that these factors were associated with Yellow-headed Blackbird nest productivity. Patterns indicating how insect emergence and biomass affect nest productivity may lead to a greater understanding of habitat selection by the Yellow-headed Blackbird in Northern Illinois and aid in conservation efforts of this species within this region.

METHODS

Study Sites

We studied insect emergence at 13 study sites occupied by Yellow-headed Blackbird in Cook, McHenry, Lake, and DuPage counties in Northern Illinois (Fig. 1) during the breeding seasons of 2004 and 2005. Study sites were selected based on previous records of Yellow-headed Blackbird use, or on the presence of suitable habitat for breeding. Sites with suitable habitat were defined as wetlands with a large area of open water and emergent vegetation capable of supporting nests, such as cattails (*Typha* spp.) and bulrush (*Scirpus* spp.) (Twedt and Crawford, 1995). Study sites were surrounded by an urbanized and rapidly developing landscape. Total precipitation during data collection varied between the two years; 2004 was a wet year (i.e., 30.96 cm. fell from May through July) with some sites flooding and 2005 was a dry year (i.e., 13.84 cm. fell from May through July) with a majority of the sites drying out by the end of the season.

Study sites were differentiated into four groups based on Yellow-headed Blackbird nest productivity in 2004 and 2005 (Table 1). Nest productivity per site, defined as the number of fledged young per nest, was estimated using the ratio of fledglings to adult females observed from mid-May to mid-July. Each site was visited at least four times between sunrise and 10:00AM to determine this ratio. Nest productivity can be determined using this approach due to the conspicuous nature of fledglings and evidence that females in this population are single-brooded (Ward pers. comm.). Because this approach is not as accurate as direct nest monitoring, these data were used to rank sites in 2004 and 2005 using a box plot distribution. Sites ranked 1 or 2 were considered to have high nest productivity and fell within the 25th percentile of the distribution, sites ranked from 3 to 5 were considered to have medium nest productivity and fell within the 50th percentile, sites from 6 to 8 had low nest productivity and fell within the 75th percentile, and sites where nesting did not occur were listed as “no nest productivity” (see site nest productivity rank [SNPR] in Table 1).

Insect Emergence

Insect emergence data were collected for each site from mid-May to mid-July. Three insect emergence traps per site were placed randomly within each wetland at the edge of the emergent vegetation. The traps floated on the water surface with an open area of 30 cm by 30 cm and a cone of mesh extending from the base to a kill jar (Ward, 2005b). Approximately every 10 days insects were collected. Insects were identified to order and Odonata were identified to family (Westfall, 1984; Daly et al., 1998). Insect abundance and dry biomass were determined for these groups (i.e. total insect, odonate, Diptera, damselfly, dragonfly, Lestidae, and Coenagrionidae).

Analysis of variance

Two-way analyses of variance (ANOVA) were used to determine if insect emergence and biomass varied with Yellow-headed Blackbird nest productivity (i.e., site nest productivity rank [SNPR], Table 1]) and year. Log transformations were used to meet ANOVAs' assumptions of normality and/or equal variance (Zar, 1999). All statistical analyses were conducted using Systat 11 (Systat Software Inc., 2004).

RESULTS AND DISCUSSION

Table 1 summarizes all the nest productivity and insect data per site for 2004 and 2005. Number of Yellow-headed Blackbird young per nest ranged from 0 to 2.3 and 1 to 2.8 in 2004 and 2005, respectively. A total of 12,814 insects was collected, with Diptera accounting for 72.5 % of all insects collected in both years. Two-way ANOVAs did not show any significant differences for insect emergence (i.e., abundance and biomass) among SNPR (all F-values < 2.733, all P-values > 0.076), but total number of insects (DF = 1, F = 9.680, P = 0.006), total number of Diptera (DF = 1, F = 10.292, P = 0.005), and Diptera dry mass (DF = 1, F = 6.096, P = 0.024) differed between years with 2004 having lower values than 2005. There were no significant differences for all other insect emergence variables between years (all F-values < 0.695, all P-values > 0.416) or interactions (all F-values < 1.086, all P-values > 0.382).

Although nest productivity and site utilization varied among wetlands examined in this study (Table 1), there was no significant difference in insect emergence and biomass among SNPR. Because insect emergence was not a good predictor of differences in nest productivity among sites, this result further indicates that while nest productivity may be important in the selection of breeding sites in Yellow-headed Blackbirds (Ward, 2005b), insect emergence does not appear to be a critical factor in that process. As mentioned previously, differences in nest productivity among sites may be due to multiple factors other than insect emergence, such as nest depredation or inclement weather (Burger, 1985).

Differences were found between years for total species richness, Diptera species richness and Diptera dry weight; values were higher in 2005 than in 2004. These differences between years can be attributed to extreme variations in overall weather conditions, as 2004 was a wet year and 2005 was a dry year. The lower levels of insect emergence we found in 2004 may be explained by emergence suppression resulting from large amounts of precipitation (MacKenzie and Kaster, 2004). These large amounts of precipitation may also have caused a greater percentage of insects to be washed off of emergence trap walls in 2004 than in 2005 (Paasivirta et al., 1988). Another possible explanation for differences in insect emergence between years can be high or low water temperatures (Batzer, 1996). However, we believe that this was not a factor in our study because mean water temperatures for the wetlands were similar in 2004 (22.02ºC) and 2005 (22.27ºC) (data analysis not shown). Lastly, Diptera was the most abundant group of insects in both years (Table 1). High abundance of Diptera in wetlands has been observed in other studies (McLaughlin and Harris, 1990; Ritcher, 2001; Stagliano et al., 1998; Whiles and Goldowitz, 2001). For example, Ritcher (2001) determined that Diptera can make up 99% of the total insect captures.

In addition to maximizing chances for securing a suitable mate, providing shelter for nesting, and protection from weather and predators, breeding habitat must also supply food for raising young (Cody, 1985). However, food availability does not appear to be the mechanism driving this process for Yellow-headed Blackbirds in Northern Illinois. Differences in food availability were not found among the wetland sites we studied in 2004 and 2005 and nestling starvation was rare (Ward, 2004). Previous studies in the same area on Yellow-headed Blackbirds and other wetland birds have found that social factors, such as the number of young produced at a site in a year, may play an important role in the habitat selection process (Ward et al., 2010a). However, most wetland bird populations in northeast Illinois are declining (Ward et al., 2010b), suggesting they may be choosing sites poorly.

It is well documented that in urban areas wetland hydrology is often highly altered and this, coupled with extreme differences in yearly precipitation, may result in situations where insect emergence is highly variable both spatially and temporally. As wetland bird populations decline it becomes imperative that we understand the factors driving insect emergence. While Yellow-headed Blackbirds do not appear to have been food limited, with such a small population in Illinois, a reduction in food availability may be the factor that ultimately extirpates the species from Illinois. More research should be conducted on the role of insect emergence in limiting or promoting wetland bird populations in urban landscapes.

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Fig. 1 The wintering and breeding range of the Yellow-headed Blackbird (*Xanthocephalus xanthocephalus*) in North America, adapted from Twedt and Crawford (1995). Inset picture shows the location of the 13 study sites within the breeding range of the Yellow-headed Blackbird in Northern Illinois (hatch area). This figure is adapted from Ward (2005a).

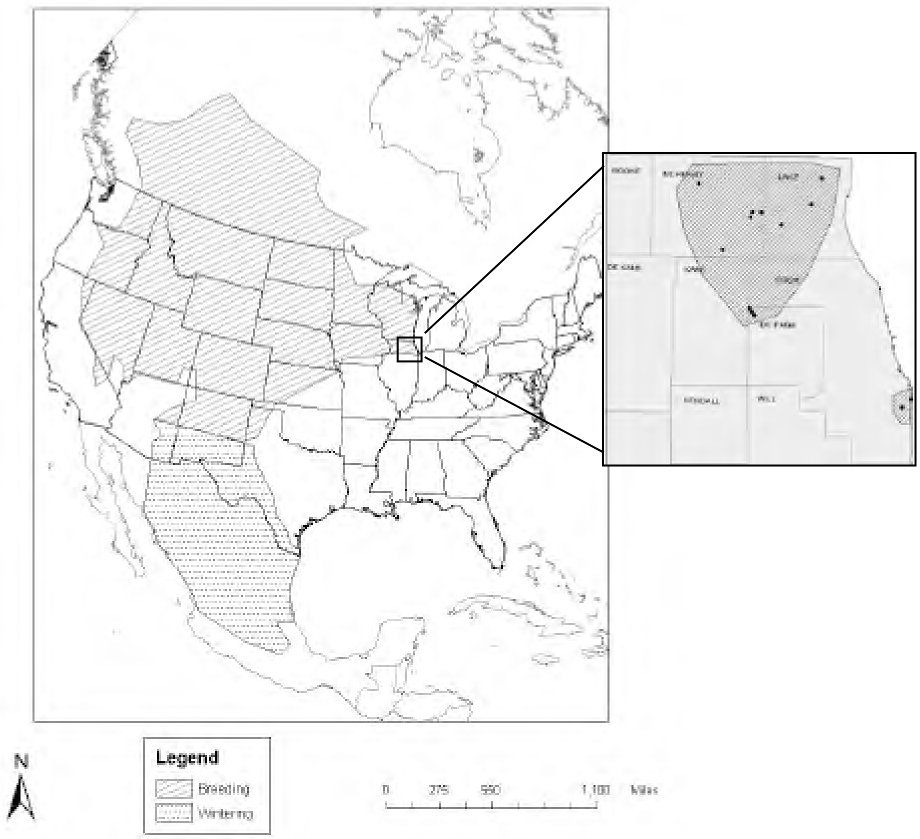

Table 1. Insect emergence data for the 13 northern Illinois wetlands in 2004 and 2005. SNPR = site nest productivity rank, NS = number of young per nest (relative yearly rank), Total = total number of insects, Odo = Odonate, Dip = Diptera, Dams = Damselflies, Drag = Dragonflies, Lest = Lestidae, Coen = Coenagrionidae, W = dry weight (g).

Site name	SNPR	NS	Total	TotalW	Odo	OdoW	Dip	DipW	Dams	DamsW	Drag	DragW	Lest	LestW	Coen	CoenW
2004																
Eggers	High	2.1 (2)	199	0.171	1	0.014	161	0.0505	1	0.014	0	0	0	0	1	0.014
Tony	High	2.3 (1)	535	2.038	60	0.779	239	0.363	55	0.294	10	0.522	1	0.004	54	0.29
Hegewisch	Medium	1.5 (5)	302	0.875	52	0.692	193	0.123	44	0.304	8	0.388	16	0.136	28	0.168
BT	Medium	2.0 (3)	95	0.125	6	0.054	84	0.054	4	0.026	2	0.028	1	0.002	3	0.024
Broberg	Medium	1.9 (4)	170	0.293	15	0.158	102	0.038	11	0.076	5	0.086	11	0.076	0	0
PWI	Low	0.8 (7)	149	0.282	9	0.085	98	0.117	9	0.112	0	0	6	0.076	3	0.036
PWII	Low	1.0 (6)	52	0.091	4	0.041	28	0.032	4	0.041	0	0	1	0.03	3	0.011
Almond	Low	0.0 (8)	336	2.46	152	2.116	129	0.184	145	1.49	7	0.626	2	0.01	143	1.48
BC	None	- (-)	90	0.26	16	0.187	36	0.026	15	0.187	0	0	0	0	15	0.187
Stickney	None	- (-)	315	0.186	9	0.056	245	0.061	9	0.042	0	0	1	0.012	8	0.03
Wadsworth	None	- (-)	802	0.853	25	0.249	692	0.525	25	0.249	0	0	4	0.034	21	0.215
Exner	None	- (-)	165	0.279	4	0.028	141	0.206	4	0.028	0	0	1	0.012	3	0.016
2005																
PWII-A	High	2.0 (2)	195	0.327	24	0.174	129	0.099	24	0.174	0	0	7	0.078	17	0.096
Tony	High	2.8 (1)	920	1.434	115	0.71	630	0.492	115	0.71	0	0	3	0.034	112	0.676
Eggers	Medium	1.8 (4)	829	1.269	52	0.89	674	0.247	35	0.242	17	0.648	10	0.104	25	0.138
PWII	Medium	1.9 (3)	692	1.335	77	0.766	512	0.455	77	0.766	0	0	35	0.496	42	0.27
BT	Medium	1.7 (5)	456	0.575	9	0.143	402	0.387	8	0.025	1	0.118	0	0	8	0.025
Hegewisch	Low	1.5 (6)	820	0.644	16	0.064	698	0.493	32	0.076	0	0	0	0	32	0.076
Broberg	Low	1.0 (7)	1564	1.115	18	0.132	1013	0.674	18	0.132	0	0	9	0.087	9	0.045
PWI	None	- (-)	141	0.157	0	0	101	0.054	0	0	0	0	0	0	0	0
BC	None	- (-)	864	1.423	176	0.84	575	0.492	176	0.84	0	0	0	0	176	0.84
Stickney	None	- (-)	113	0.291	8	0.166	80	0.028	7	0.02	0	0	1	0.008	6	0.012
Almond	None	- (-)	909	1.359	86	0.784	665	0.434	83	0.37	3	0.414	0	0	83	0.37
Wadsworth	None	- (-)	580	0.94	18	0.134	404	0.558	18	0.126	1	0.012	3	0.052	15	0.074
Exner	None	- (-)	1521	1.719	29	0.163	1258	1.419	29	0.163	0	0	0	0	29	0.163