

EFFECTS OF HUMAN ACTIVITY ON BIRD DISTRIBUTION IN AN ILLINOIS NATURE PRESERVE

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STUDY OBJECTIVE AND LOCATION

Our objective in this project was to estimate human activity and its impact on the avian community (including site-specific species diversity, abundance, and distribution) at Carpenter Park Nature Preserve north of Springfield, Illinois.

RATIONALE

Carpenter Park Nature Preserve is a 342 acre old-growth forest bordering the Sangamon River. It is part of the 707 acre Carpenter-Gurgens Park complex belonging to and managed by the City of Springfield, Illinois. The preserve contains fragments of high quality wet-mesic floodplain forest as well as mature dry-mesic upland forest (Lerczak 2000).

Carpenter Park is contained within the city limits of Springfield; thus, human development shares many boundaries with the park. The Rail Golf Course, which hosts an LPGA world-class tournament each year, borders the north side of the park along with a residential neighborhood. The proposed development of a strip mall on the east side of the park and a resort in conjunction with the golf course, may pose threats to the park.

The Carpenter-Gurgens park complex sees varying amounts of human activity during a typical year, and a growing number of studies indicate that human recreational activity in natural areas impacts wildlife negatively (Knight and Gutzwiller, eds. 1995). Bird species in particular may show increases in heart rate, oxygen consumption, and other stress-related parameters (Gabrielson and Smith 1995), as well as more obvious disturbances such as flushing and retreating from an approaching human.

Human intrusion, defined by Gutzwiller et al. (1998), is "a pervasive and chronic disturbance that occurs even in protected habitats," that has been shown to alter composition of the avian community (Riffel et al. 1996; Blakesly et al. 1988; Camp and Knight 1998). Birds may nest higher in trees (Dhindsa et al. 1988), or alter their foraging locales (Kaiser et al. 1984) as a result of human disturbance. Pets accompanying owners may cause birds to flush (Miller et al. 2001) and can pose an additional threat by inadvertently trampling or predateding nests of ground-nesting species. Several researchers have also noted that declines of migratory forest-dwelling passerines are greater in smaller or relatively narrow forest fragments, where human intrusions and activities are more likely to occupy a greater fraction of forest area (Wilcove 1985; Robinson et al. 1995).

While a number of birding enthusiasts visit Carpenter Park regularly, studies investigating microhabitat use by bird species and correlations with patterns and type of human activity are lacking. Data from this research will provide assessment of human activity and its possible effect on the avian community in Carpenter Park.

RELATED LITERATURE

Before investigating the direct effects of human activities on birds, one must look at effects caused by humans in terms of fragmentation of forested landscapes. Forest fragmentation is defined as the "disruption in the continuity of forest habitat" (Robinson et al. 1995).

The existence of trails through forested areas, one source of forest fragmentation, has been demonstrated to alter species composition and increase nest predation. In a study of breeding birds, data indicated that both avian species composition and bird abundance were altered adjacent to trails in forested as well as grassland ecosystems (Miller et al. 1998). In addition, fewer birds nested nearer to trails and predation was more common nearer to trails (Miller et al. 1998). Blue jays, American robins and cowbirds were also more abundant on trailed sites than on untrailed sites. Jays, robins and cowbirds are commonly considered to be "edge" species (i.e., birds that conduct all or most daily activities in proximity to an edge

[Yahner 1988]), and fragmentation increases the amount of edge relative to interior forested space (Keyser et al. 1998).

Robinson et al (1995) demonstrated that both nest predation and parasitism by brown-headed cowbirds increased with an increase in forest fragmentation. Wilcove (1985) found predation rates to be lower in the larger of his study sites (his sites ranged in size from 3.8 ha to 209,000 ha). In particular, Wilcove (1985) found predation rates to be very high (approaching 50% of nests) in relatively narrow forest sites. He concluded that relatively narrow sites (a configuration similar to that seen at Carpenter Park) allow avian predators such as blue jays and American crows easy access to interior nests.

Forest fragmentation has also been shown to alter the composition of the avian community. Indeed, populations of neotropical migratory bird species have shown the greatest declines. Numbers of neotropical migrants declined in both isolated and connected boreal forests while numbers of habitat generalists did not (Schmegelow, et al 1997).

Increasing outdoor recreation by humans has caused forests to become more fragmented. Habitat alterations to accommodate human needs include clearing of vegetation for trails, camping sites, and picnic facilities (Anderson 1995). Vegetation removal and trampling alters availability of nesting, roosting, and food procurement sites for birds.

Outdoor recreation has also led to an increase in contact between humans and wildlife (both deliberate and accidental). In a literature review of various recreational activities and human encounters with wildlife (including birds), Boyle and Samson (1985) reported few positive and many negative encounters with wildlife. Activities of hikers, wildlife observers, and nature photographers may be potentially more disturbing to wildlife due to the greater frequency of encounters and longer duration of the activity (Boyle and Samson 1985).

Contact with humans alters avian behavior causing birds to flush and expend unnecessary energy or to leave a nest unattended and subject to predation or parasitism (Anderson 1995). Human presence has been shown to increase nesting and roosting heights of birds (Dhindsa et al. 1989; Gutzwiller et al. 1998), and the presence

of humans has also been shown to alter the timing and singing consistency of male song, potentially negatively affecting reproductive success and survivorship (Gutzwiller et al. 1994; Gutzwiller et al. 1997). Male song primarily occurs during the breeding season and is necessary for establishing territory, identifying the territory holder, attracting a mate by the male and mate selection by the female, identifying birds of the same species, and teaching young the species' songs (Ehrlich et al. 1988).

Gutzwiller and Marcum (1993, 1994) showed that birds can also react to color of clothing worn by human intruders. Their conclusions were cautionary in that color of clothing worn may decrease the detectability of some bird species leading to biased estimates of avian community composition. Repeated human intrusion, like forest fragmentation, can alter the composition of the avian community.

METHODS

Sixteen circular survey plots (50m diameter) were identified by flagging and located in the park so as to account for variation in habitat type (i.e., floodplain to upland forest) and human use (Fig. 1). The only parking area for Carpenter Park is located at the east end of the park; this was expected to create a gradient of human use being heaviest at the east end and declining to the west. Survey plot centers were located based on representation of habitat type, likelihood of observing human activity through the plot, and proximity to other survey plots; plot centers were located using GPS. Edges of each plot were then indicated using flagging tape to allow for ready identification as to whether particular birds or humans were inside or outside of plots.

Each site was visited for 20 minutes during 26 sampling periods. Observations recorded include identity and number of individuals of each avian species present, and type and frequency of human activity including numbers of individuals in a group and whether accompanied by pets. Immediate response of birds to the transitory presence of humans within the site was also noted. Additional bird species occurrences and habitat use and human habitat use data were gathered opportunistically as well. In addition, 39 10-minute point species counts at 9 of the sites were conducted beginning in September 2001 by Kevin Veara.

For analyses, number of species and number of individual birds occurring in survey plots were correlated with intensity of human use, distance of a plot from an edge of the forest preserve, and longitudinal (east-west) location of plots relative to the parking lot in the park using non-parametric rank correlation analyses (Sokal and Rohlf 1995). Non-parametric analyses are likely more appropriate than parametric correlations or regressions simply because we do not have confidence in the nature of the underlying distribution of our variables. Observations of species of conservation concern during this study were also examined in light of historical records.

RESULTS

Table 1 graphically presents ecological information regarding selected bird species. Birds included in this table are those considered for the purposes of this study to be abundant (here defined as being observed at 7 of 16 plots), previously confirmed to have bred in Carpenter Park (as reported in a species list prepared by David Bohlen of the Illinois State Museum and included with the management plan for Carpenter Park), and for which sensitivity to habitat fragmentation is known (Herkert, et al. 1993). Of the 12 "abundant" species observed at seven or more plots in this study, 9 of these species are known to exhibit low sensitivity to fragmentation (Herkert, et al. 1993), and several of these species are known to be tolerant of human-altered habitats.

In examining effects of human activity on species distribution, we found no significant correlation between average number of humans to pass through a survey plot and either the average number of avian species observed during a sampling period (Spearman's $r = 0.005$, $P > 0.9$) or the average number of individual birds observed during a sampling period ($r = 0.342$, $P > 0.9$). There was also no significant correlation between level of human activity and the total number of avian species observed at a site during the whole study ($r = 0.612$, $P < 0.23$). These patterns were the same whether we analyzed ranked data or raw data.

In looking at distribution of species within Carpenter Park, we did observe marginally significant negative correlations between distance of a site from a human-modified edge of the forest preserve (not including the Sangamon River) and (a) average number of species observed at a survey plot ($r = -0.572$, $P < 0.062$) and (b)

average number of individuals observed ($r = -0.555$, $P < 0.077$) (Fig. 2). There were no significant correlations between these response variables and the distance of a site from any edge (where "distance from any edge" included the Sangamon River edge to the south). Distance from the east perimeter of the park (location of park entrance and parking lot) was negatively correlated with average number of avian species and number of individual birds observed at sampling plots ($r = -0.316$ and $r = -0.523$, respectively), although these relationships were not statistically significant (Fig. 3).

Contrary to expectation, level of human activity was not significantly related to longitudinal (east-west) site location ($r = -0.272$, $P < 0.9$). Human activity during sampling periods was too infrequent to allow quantifying correlations between species number, bird abundance, and particular human activities (e.g., bicycle riding versus horseback riding, hiking, running, birdwatching, etc.). There were also too few observations of human intrusion into a survey site to make definite conclusions regarding the immediate response of birds in Carpenter Park to human presence.

DISCUSSION

Human activity in Carpenter Park appears to be seasonal, not as intense as expected, and concentrated in and near the parking lot. Human trail use consists primarily of walking and jogging. On only two occasions was evidence of horseback riding apparent on any trail. Due to the presence of an occasional bicycle observed in the parking lot, it is suspected that bike riding may occur in the park but bicycling was not observed during this study. Allowing wind-downed timber and deadfall to remain across trails as well as allowing herbaceous plants to encroach upon the trails (especially during summer) may contribute to the rare occurrence of these two activities. On the other hand, mushroom picking in off-trail sites was observed routinely during mushroom season.

Although number of vehicles and quantity of humans in the parking/picnic area have been noted, these figures have not been used in our analysis of human use (i.e., the parking area was not utilized as a survey site). Contrary to our expectations, our observations suggested that there is relatively little variation in human activity along a longitudinal gradient from the parking area. This may explain why we could detect no

significant effect of human activity on either bird species abundance or on bird distribution within Carpenter Park. It must also be noted that heavy spring rains reduced the number of planned surveys, and that flooding of floodplain sites in during spring 2002 barred observations in that habitat type; further surveys in the floodplain sites during 2002 and early in 2003 will give us more confidence in our description of human impacts on Carpenter Park.

Many bird species observed during this study are considered to be edge species (i.e., birds that conduct all or most daily activities at or within close proximity to edges at least seasonally; Yahner, 1988). Several species of interest, whose numbers appear to be declining in much of their ranges and that have been previously recorded in Carpenter Park have either gone undetected (e.g., cerulean warbler) during the duration of this study or are present in few numbers and at few sites (e.g., wood thrush and Kentucky warbler). There has been a period of several years during which wood thrush were not detected during the breeding season at Carpenter Park (Vern Kleen, personal correspondence). However, a wood thrush was observed on Riverside trail in June and July of 2002. During one of our visits, an adult wood thrush was seen carrying food, but we could not confirm any nesting behavior. While evaluation of nesting success was beyond the scope of this project, it is an important indicator of the potential effect of human activity on bird communities, and future studies are needed to address this component.

Pets accompanying their owners were observed both at study plots as well as opportunistically; however, observations of pets were too rare to allow any quantitative evaluation of their effect on bird distribution. On several occasions, unleashed pets (primarily dogs) were observed roaming off-trail away from their owners. Pets were observed chasing small mammals and flushing birds which may compound any effects of avian and mammalian predators and avian parasitism on local songbird species.

The attached General Species List, a compilation of total bird species detected both on and off survey plots by Vicki Hedrick and Kevin Veara, highlights Carpenter Park's importance as a stop-over for migrating forest species. Of the 28 warblers observed, 23 visit the park to rest and refuel before proceeding northward. In addition, Swainson's, veery, and hermit thrushes, both ruby-crowned and golden-crowned

kinglets, and yellow-bellied sapsuckers utilize Carpenter Park to some degree. Flooded lowlands provide nesting opportunity for wood ducks and mallards.

Our data suggest that Carpenter Park is configured in such a way that it is not viewed as interior forest by interior-nesting species. With a view to attracting and providing a safer nesting environment for forest interior birds, maintenance along several trails could cease. Most of the human activity in the park is centered between the parking lot and the river banks to the south. Thus, allowing Redbud, Blackberry and the west-most loop of Twisted Tree trails to revegetate, or converting these loop trails to dead-end trails with observation areas at their ends, would increase the amount of unbroken forest, reducing fragmentation and providing less-disturbed areas for species sensitive to fragmentation (Miller et al, 1998) without decreasing human enjoyment of the park. Increased monitoring for violations of preserve regulations may reduce the number of unleashed pets allowed to enter forested areas and would help to insure more protection for wildlife.

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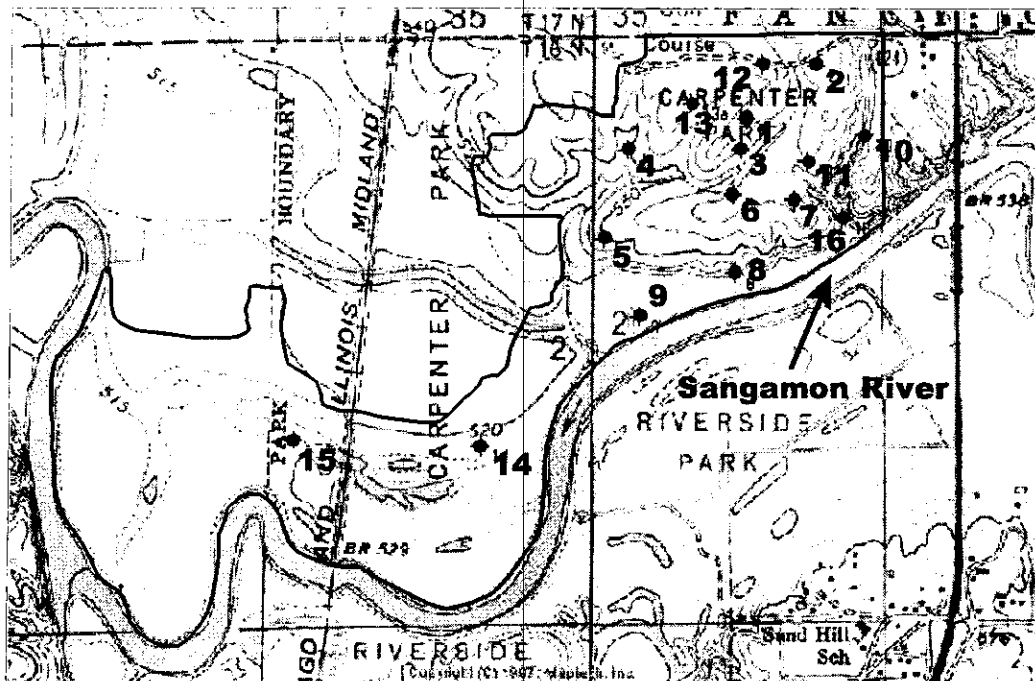


Figure 1. Topographic map showing location of Carpenter Park north of Springfield, Illinois and north of the Sangamons River. Each of the 16 study plots visited in this study are indicated by dark circles and numbered; the Carpenter/Gurgens Park complex is outlined with a black line.

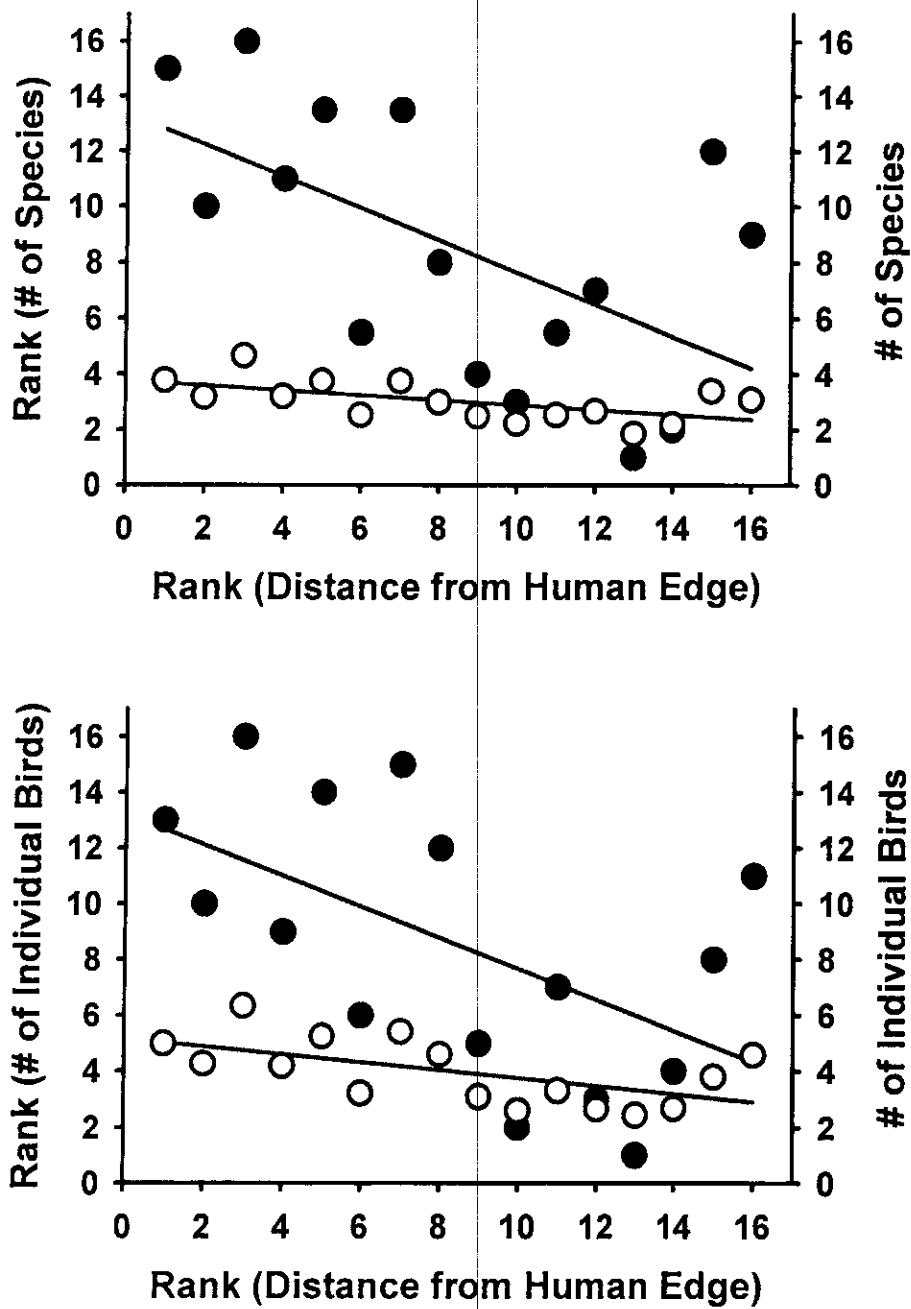


Figure 2. Correlation between distance of a survey plot from a human-modified edge and (top) number of bird species observed and (bottom) average number of individual birds observed; open circles represent raw data, closed circles represent ranked data.

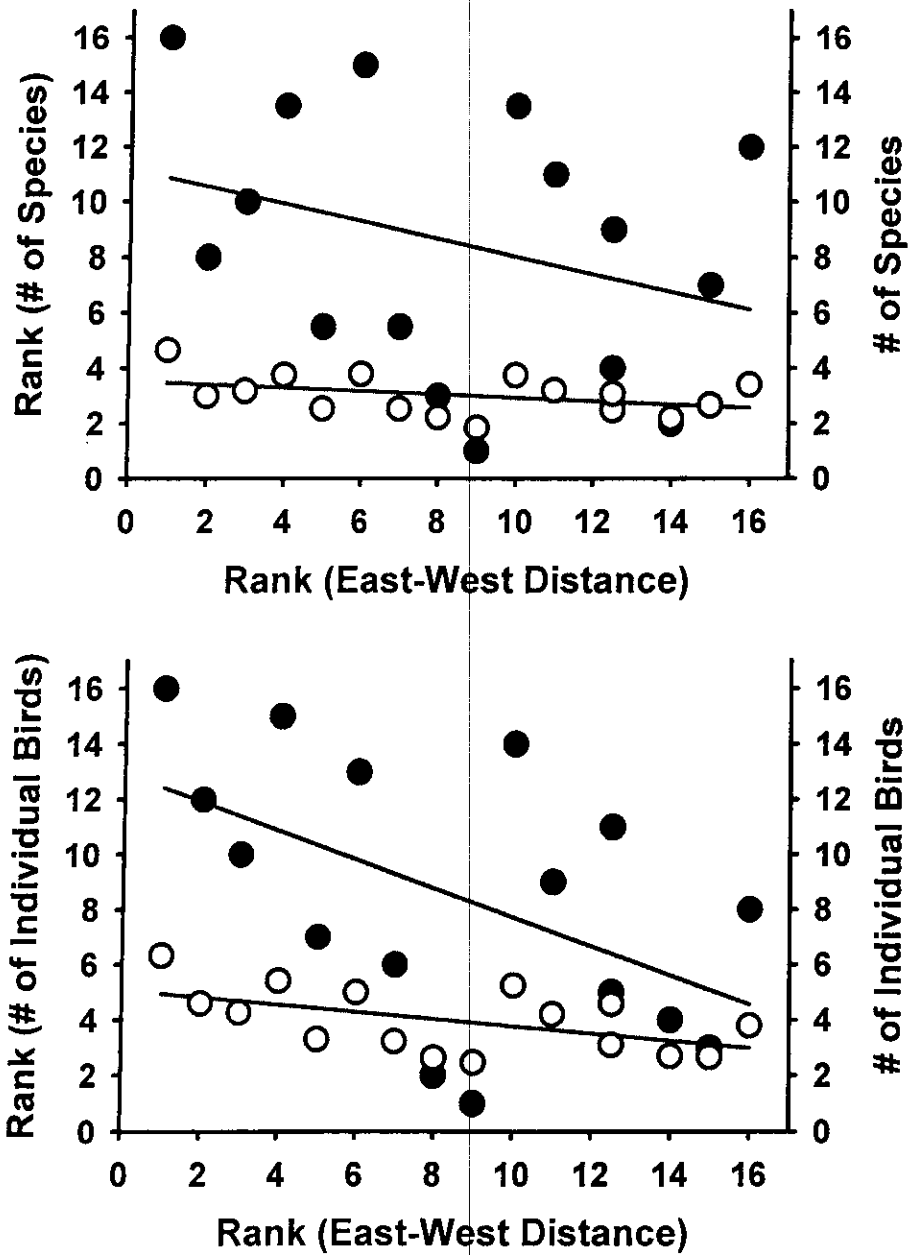


Figure 3. Correlation between east-west (longitudinal) distance of a survey plot from the parking lot and (top) number of bird species observed and (bottom) average number of individual birds observed; open circles represent raw data, closed circles represent ranked data.

CARPENTER PARK - GENERAL SPECIES LIST: 2001-2002

	JUNE		JULY		AUG		2001 SEPT		OCT		NOV		DEC		JAN		FEB		MAR		2002 APR		MAY		JUNE		JULY				
	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B			
	GREAT BLUE HERON																						X	X							
GREEN HERON																							X	X							
WOOD DUCK																							X	X							
MALLARD																							X	X							
COOPERS HAWK		X		X																			X	X							
SHARP SHINNED HAWK																							X	X							
RED SHOULDERED HAWK																								X	X						
BROADWINGED HAWK																								X	X						
RED-TAILED HAWK												X	X			X	X		X	X	X	X	X	X	X						
AMERICAN KESTREL												X	X			X	X		X	X	X	X	X	X	X					X	
WILD TURKEY													X										X	X							
NORTHERN BOBWHITE																							X	X							
ROCK DOVE																							X	X							
MOURNING DOVE																X	X	X	X	X	X	X	X	X	X						
YELLOW-BILLED CUCKOO		X		X		X		X															X	X				X	X	X	
BARRED OWL												X											X	X							
GREAT HORNED OWL													X											X	X						
CHIMNEY SWIFTS																								X	X						
RUBYTHROAT HUMMINGBIRD		X		X		X																	X	X			X	X	X	X	
BELTED KINGFISHER												X			X							X	X								
YELLOW SHAFED FLICKER		X		X		X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X							
RED BELLIED WOODPECKER		X		X		X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	
DOWNY WOODPECKER		X		X		X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	
RED HEADED WOODPECKER		X		X		X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	
PILEATED WOODPECKER								X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	
HAIRY WOODPECKER		X		X		X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	
YELLOW BELLIED SAPSUCKER								X															X	X				X	X	X	
GREAT CRESTED FLYCATCHER		X		X		X																	X	X			X	X	X	X	
EASTERN KINGBIRD																							X	X							
EASTERN PHOEBE										X													X	X							
EASTERN WOOD PEEWEE		X		X		X		X	X	X												X	X			X	X	X	X	X	
LEAST FLYCATCHER																							X	X							
ACADIAN FLYCATCHER		X		X		X																	X	X							
WARBLING VIREO																							X	X							
RED EYED VIREO		X		X		X		X	X	X													X	X			X	X	X	X	
YELLOW THROATED VIREO				X																			X	X			X	X	X	X	
WHITE-EYED VIREO																							X	X			X	X	X	X	
AMERICAN CROW		X		X		X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	
BLUE JAY		X		X		X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	
BARN SWALLOW																							X	X			X	X	X	X	
EASTERN TUFTED TITMOUSE		X		X		X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	
BLACK-CAPPED CHICKADEE		X		X		X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	
BROWN CREEPER																							X	X							
WHITE BREASTED NUTHATCH		X		X		X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	
CAROLINA WREN				X		X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	
HOUSE WREN																							X	X			X	X	X	X	
WINTER WREN																							X	X			X	X	X	X	
GOLDEN CROWNED KINGLET																							X	X							
RUBY-CROWNED KINGLET																							X	X							
BLUE GRAY GNATCATCHER		X		X		X																	X	X			X	X	X	X	
VEERY																								X							
SWAINSON'S THRUSH												X											X	X							
WOOD THRUSH																							X	X							
HERMIT THRUSH																							X	X					X	X	
AMERICAN ROBIN		X		X		X		X	X	X	X	X											X	X			X	X	X	X	
EASTERN BLUEBIRD																							X	X			X	X	X	X	

CARPENTER PARK - GENERAL SPECIES LIST 2001-2002 (CONT'D)

	JUNE		JULY		AUG		2001 SEPT		OCT		NOV		DEC		2002 JAN		FEB		MAR		APR		MAY		JUNE		JULY			
	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B		
GRAY CATBIRD																														
BROWN THRASHER																														
EUROPEAN STARLING																														
GEORGEAN STARLING																														
OWENBIRD																														
ORANGE-CROWNED WARBLER																														
PROTHONOTARY WARBLER																														
HOODED WARBLER																														
NORTHERN PARULA																														
CANADA WARBLER																														
BAY-BREASTED WARBLER																														
AMERICAN REDSTART																														
CHESTNUT SIDED WARBLER																														
CAPE MAY WARBLER																														
TENNESSEE WARBLER																														
NASHVILLE WARBLER																														
MYRTLE WARBLER (YELLOW RUMP)																														
BLACKBURNIAN WARBLER																														
BLACK-THROATED GREEN WARBLER																														
INDIANA WARBLER																														
HOARING WARBLER																														
KEVICK WARBLER																														
BLACK AND WHITE WARBLER																														
BLACK-POLE WARBLER																														
BLUE-WINGED WARBLER																														
GOLDEN WINGED WARBLER																														
LOUISIANA WATER THRUSH																														
NORTHERN WATER THRUSH																														
PINE WARBLER																														
YELLOW THROATED WARBLER																														
PALM WARBLER																														
COMMON YELLOWTHROAT																														
ROSE-BREASTED GROSBECK																														
NORTHERN CARDINAL																														
INDIGO BUNTING																														
SCARLET TANAGER																														
SLAMMER TANAGER																														
DARK EYED JUNCO																														
SONG SPARROW																														
CHIPPING SPARROW																														
WHITE THROATED SPARROW																														
WHITE CROWNED SPARROW																														
FIELD SPARROW																														
RUFOUS-SIDED TOWHEE																														
COMMON GRACKLE																														
PALMATED ORIOLE																														
RED WINGED BLACKBIRD																														
BROWN HEADED COWBIRD																														
EASTERN MEADOWLARK																														
HOUSE FINCH																														
AMERICAN GOLDFINCH																														

GENERAL SPECIES INDEX. BIRDS OBSERVED IN CARPENTER PARK NATURE PRESERVE BETWEEN JUNE 2001 AND JULY 2002. A. DAYS 1 THROUGH 15; B. DAYS 16 THROUGH MONTH'S END. PREPARED BY VICHI HEDRICK AND KENN VEARA