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Food Habits of Raptors Using Airports in North-Central Kentucky

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Abstract: As domestic air travel and wildlife populations have increased in recent years, wildlife-aircraft collisions (wildlife strikes) have increased, prompting concerns for human safety and the economic impacts of wildlife strikes. Most of these wildlife strikes occur in the immediate vicinity of airports. Therefore, removal of wildlife attractants from the airfields themselves is an important component of effective wildlife strike hazard management programs. In response to a such a wildlife strike problem, the U.S. Department of Agriculture's Wildlife Services program initiated a wildlife hazard mitigation program at airports in north-central Kentucky which included direct control of raptors. To identify the food-based attractants that may be attracting raptors to these facilities, we salvaged digestive tracts from carcasses of raptors removed from these airports and identified food items contained within. These data will be used to focus prey-base management activities and help reduce the attractiveness of airfield habitats to foraging raptors in an effort to reduce wildlife strikes and the need for direct control of these birds.

Key Words: great horned owl, *Bubo virginianus*, airport, wildlife strike, bird strike, red-tailed hawk, *Buteo jamaicensis*

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INTRODUCTION

As air travel has increased over the past 20 years, greater attention has been directed to aviation safety and the economic importance of the aviation industry (Dolbeer 2000). Collisions between wildlife and aircraft (wildlife strikes) have recently been regarded as a serious threat to aviation safety (Cleary et al. 2000, Dolbeer et al. 2000). Many local populations of various bird species have either increased substantially or remained constant throughout the midwestern United States (Sauer et al. 2001) while air traffic and wildlife strikes have also increased (Dolbeer 2000).

From 1990 to 1999 over \$9 million dollars in damage to civil aircraft operating within the U.S. was attributed to collisions with raptors (Cleary et al. 2000). This damage suggests the need for an increased awareness of management practices resulting in fewer raptor strikes with aircraft. Raptors require open grassland areas for capturing various prey species. The vast expanses offered by many airfields, usually consisting of short vegetation (<6") and surrounded by a predominantly urban environment, offer fragments of excellent raptor habitat. The hunting behavior, attraction to airports, and the individual large body size (>1 kg) of many raptors (Dunning 1993) combine to present a hazard to compromise human safety and increase the risk of significant damage to property.

Populations of some raptors in Kentucky, specifically red-tailed hawks (*Buteo jamaicensis*), have increased since 1966 (Sauer et al. 2001). This growth and the physical expansion of airports serving northern Kentucky have resulted in an increasing threat from collisions with raptors to operating aircraft. We salvaged digestive tracts from raptors removed from airports in

north-central Kentucky to determine which prey items were used by raptors on airfields. We used these data to develop hypotheses on how prey abundance and availability may be managed to reduce gatherings of various species of raptors on airports in Kentucky.

STUDY AREAS AND METHODS

We examined the stomach and esophageal contents of 63 raptors consisting of 1 American kestrel (*Falco sparverius*), 3 broad-winged hawks (*Buteo platypterus*), 8 great horned owls (*Bubo virginianus*) and 51 red-tailed hawks from February 1997 until January 2002. One hundred twenty-two individual prey items were recovered from the 63 study animals. The digestive tracts were salvaged from carcasses of birds taken during routine wildlife hazard patrols on airfields in north-central Kentucky.

Our methods of collection included the use of Swedish goshawk traps, bow traps, shooting, and pole traps. All methods other than pole trapping used lure animals or previously salvaged parts of such animals. All lures were placed in an area of the trap device that was inaccessible to captured raptors. Pole trapping consisted of a Victor No. 1 coil spring soft-catch leghold trap placed atop a perch designed specifically for raptors. Most (99%) of the perches were artificial and temporary in nature, solely used for this effort, the remainder of perches were of a more permanent nature which historically had proven to be desired raptor loafing areas.

Upon collection, stomach and esophageal contents were extracted from each individual. After extraction, contents were separated into taxonomic categories and identified to species, if possible. Mammalian remains were identified through conventional forensic techniques

based on skeletal and hair remains. Skulls and other whole skeletal structures were catalogued according to a dichotomous key prepared by Sealander and Heidt (1990). Hair was distinguished to a genus level using methods described by Moore et al. (1974) and Adjordan and Kolensky (1969). Due to various stages of digestion, specific numbers of individuals were recorded only if distinguishable. Comparisons were made to a reference collection of small mammal skulls and study skins for further identification. Avian remains were identified using similar gross morphological identifications where possible. More detailed identifications based on feather structure were conducted by the Smithsonian Institution in Washington, D.C. Invertebrate remains were identified to family or order using dissecting microscopes, field guides, and dichotomous keys (Borror and White 1970).

Table 1. Total number of prey items recovered from digestive tracts of raptors at airports in north-central Kentucky, 1997-2002.

Diet Item	Number of individual items recovered from all raptors (%)	Number of investigated digestive tracts with indicated item N=63 (%)
Small Mammals		
<i>Microtus</i> spp.	48 (39.3)	28 (44.4)
<i>Peromyscus</i> spp.	27 (22.1)	16 (25.3)
<i>Sylvilagus floridanus</i>	6 (4.9)	6 (9.5)
<i>Blarina brevicauda</i>	6 (4.9)	4 (6.3)
<i>Scalopus aquaticus</i>	1 (>1)	1 (1.5)
Unknown small mammals	6 (4.9)	5 (7.9)
Total	94 (77.0)	
Other Mammals		
<i>Didelphis virginiana</i>	1 (<1)	1 (1.5)
Birds		
<i>Zenaida macroura</i>	3 (2.4)	2 (3.1)
<i>Sturnella magna</i>	3 (2.4)	2 (3.1)
<i>Turdus migratorius</i>	2 (2.4)	2 (3.1)
Unknown birds	1 (<1)	1 (1.5)
Total	9 (7.2)	
Insects and Reptiles		
Orthoptera	6 (4.9)	1 (1.5)
Lepidoptera	6 (4.9)	2 (3.1)
Hymenoptera	1 (<1)	1 (1.5)
Lucanidae	1 (<1)	1 (1.5)
Coccinellidae	1 (<1)	1 (1.5)
<i>Coluber constrictor</i>	1 (<1)	1 (1.5)
Unknown snake	2 (1.6)	2 (3.1)
Total	18 (11.4)	
Total items recovered	122	

RESULTS

Raptors in this study primarily consumed various species of small mammals (*Peromyscus* spp., *Microtus* spp., *Blarina brevicauda*, *Scalopus aquaticus*, and *Sylvilagus floridanus*) which consisted of 77% (Table 1) of the total items examined. *Microtus* spp. and *Peromyscus* spp. were not only the most commonly discovered small mammal prey items (Table 1), but also made up 61.4% of all discovered prey individuals and were present in 44 (69.8%) of all investigated digestive tracts (Table 1). Avian species (Eastern meadowlarks *Sturnella magna*, American robins *Turdus migratorius*, mourning doves *Zenaida macroura*, and unknown birds) were found in 7 (11.1%) of all examined digestive tracts (Table 1). Insects, from Orders Orthoptera and Lepidoptera, were discovered to be the only prey item in 3 (4.7%) raptors (Table 1). Snakes were determined to be the only prey item in 3 (4.1%) of the studied individuals (Table 1). Eight (12.6%) raptor specimens were found to be void of any prey items and were catalogued as "empty."

Table 2. Total number of prey items recovered from digestive tracts of red-tailed hawks at airports in north-central Kentucky, 1997-2002.

Diet Item	Number of individual items recovered (%)	Number of investigated digestive tracts with indicated item N=51 (%)
Small Mammals		
<i>Microtus</i> spp.	46 (40.3)	26 (50.9)
<i>Peromyscus</i> spp.	27 (23.6)	16 (31.3)
<i>Sylvilagus floridanus</i>	4 (3.5)	4 (7.8)
<i>Blarina brevicauda</i>	6 (5.2)	4 (7.8)
<i>Scalopus aquaticus</i>	1 (>1)	1 (1.9)
Unknown small mammals	6 (5.2)	5 (9.8)
Total	90 (78.9)	
Birds		
<i>Zenaida macroura</i>	3 (2.6)	2 (3.9)
<i>Sturnella magna</i>	3 (2.6)	2 (3.9)
<i>Turdus migratorius</i>	1 (<1)	1 (1.9)
Unknown birds	1 (<1)	1 (1.9)
Total	8 (7.0)	
Insects and Reptiles		
Orthoptera	6 (5.2)	1 (1.9)
Lepidoptera	5 (4.3)	1 (1.9)
Hymenoptera	1 (<1)	1 (1.9)
Coccinellidae	1 (<1)	1 (1.9)
<i>Coluber constrictor</i>	1 (<1)	1 (1.9)
Unknown snake	2 (1.7)	2 (3.9)
Total	16 (14.0)	
Total items recovered	114	

The majority of red-tailed hawk prey items consisted of various small mammal species (78.9%, Table 2). Of the 51 red-tailed hawk digestive tracts analyzed, *Microtus* spp. and *Peromyscus* spp. were the preferred prey items, comprising 64% of the total items recovered and present in 26 and 16 of the investigated red-tailed hawks, respectively. Birds were found to be the primary prey item of 6 (11.7%) red-tailed hawks. Two (3.9%) individual hawk stomachs contained multiple avian prey items. Eastern meadowlarks and mourning doves were the most common food item in 4 (7.8%) individuals. Various insects were recovered from 7 (13.7%) hawks, composed primarily from the Orders Orthoptera and Lepidoptera. Reptiles, 1 *Coluber constrictor* and 2 unknown species of snakes, were found in 3 (4.7%) red-tailed hawk stomachs. 4 (7.8%) of the examined red-tailed hawk stomachs were found to be void of any food items and were classified as “empty.”

We also discovered red-tailed hawks to be the raptor most likely to consume multiple food items, as 24 (47%) of the studied specimens contained multiple prey. One hawk in this study contained 6 *Peromyscus* spp. individuals. We also found red-tailed hawks more likely to prey on *Peromyscus* spp. during December through May, with little or no predation variation throughout the

year regarding *Microtus* spp. and *Sylvilagus floridanus* (Table 3). Preference for avian prey also showed no substantial variation from December through August. However, as noted in Table 3, no birds were consumed by red-tailed hawks during the fall months (September through November).

We found that 3 mammal species (*Microtus* spp., *Sylvilagus floridanus*, and *Didelphis virginiana*) made up 66% of the recovered food items from great horned owls. *Sylvilagus floridanus* was the preferred prey in 2 (33%) great horned owls. The American robin, the only avian species recovered from 1 great horned owl, composed 16% of the total owl prey items selected. Insects representing Family Lucanidae were present in 1 (16%) owl. We found great horned owls to be very opportunistic feeders, selecting a variety of prey. Two owl digestive tracts were found to be void of any prey items.

As previously mentioned, we included 3 broad-winged hawks and 1 American kestrel in this study (Table 4). *Microtus* spp. and insects representing Order Lepidoptera were discovered in examined digestive tracts from the 4 study specimens of these 2 raptor species. However, 2 (50%) of the aforementioned specimens contained no stomach contents.

Table 3. Seasonal* trends in food habits among red-tailed hawks at airports in north-central Kentucky, 1997-2002.

Diet item	Number of total recovered prey items (%)				
	Fall	Winter	Spring	Summer	Total
<i>Microtus</i> spp.	13 (11)	11 (10)	10 (9)	12 (11)	46 (40)
<i>Peromyscus</i> spp.	6 (5)	10 (9)	10 (9)	1 (<1)	27 (24)
<i>Sylvilagus floridanus</i>	1 (<1)	1 (<1)	1 (<1)	1 (<1)	4 (4)
<i>Scalopus aquaticus</i>	1 (<1)				1 (<1)
<i>Blarina brevicauda</i>				6 (5)	6 (5)
Unknown small mammals	1 (<1)	3 (3)		2 (2)	6 (5)
<i>Sturnella magna</i>			2 (2)	1 (<1)	3 (3)
<i>Zenaidura macroura</i>		2 (2)		1 (<1)	3 (3)
<i>Turdus migratorius</i>		1 (1)			1 (<1)
Unknown bird			1 (<1)		1 (<1)
<i>Coluber constrictor</i>			1 (<1)		1 (<1)
Unknown snake				2 (2)	2 (2)
Orthoptera	6 (5)				6 (5)
Lepidoptera	5 (4)				5 (4)
Hymenoptera	1 (<1)				1 (<1)
Coccinellidae				1 (<1)	1 (<1)

* Fall = September through November

Winter = December through February

Spring = March through May

Summer = June through August

Table 4. Seasonal* collection data for all examined raptors collected from airports in north-central Kentucky, 1997-2002.

Diet item	Number of total recovered prey items (%)				
	Fall	Winter	Spring	Summer	Total
Red-tailed hawk (<i>Buteo jamaicensis</i>)	14 (27.4)	16 (31.3)	10 (19.6)	11 (21.5)	51 (100)
Great horned owl (<i>Bubo virginianus</i>)	2 (25)	2 (25)	1(12.5)	3 (37.5)	8 (100)
Broad-winged hawk (<i>Buteo platypterus</i>)	2 (66.6)	1 (33.3)	0	0	3 (100)
American kestrel (<i>Falco sparverius</i>)	0	0	1 (100)	0	1 (100)

* Fall = September through November
 Winter = December through February
 Spring = March through May
 Summer = June through August

DISCUSSION AND MANAGEMENT IMPLICATIONS

Diet patterns among red-tailed hawks were similar to those cited by Bent (1961), especially the predominance of small mammal remains (77% of total prey recovered versus 73-82% cited in Bent 1961). Bent (1961) noted that in two studies, 18% of red-tailed hawk diets were avian species. We found that only 7% of total prey of red-tailed hawks was comprised of birds (Table 1), less than half the occurrence cited by Bent (1961). Klippel and Parmalee (1982) found that 1 long-eared owl (*Asio otus*) derived 7% of its diet from avian species. In our study, birds made up 16% of the diet of great horned owls, whereas mammals constituted 66% of the discovered remains. As in our study, Bent (1961) reported instances of multiple prey individuals of the same species being contained in red-tailed hawk stomachs. Bent (1961) also noted, in the two described studies, 8% and 2% of the diet of red-tailed hawks was derived from various insect species. We found insects were approximately 7.5% of raptor diets.

Small mammals were the most frequently selected prey items of raptors in this effort, though birds and insects together constituted nearly a third of their diets on these airports in Kentucky. Because of the hazards associated with wildlife strikes (Cleary et al. 2000), our findings should be applied in future Integrated Wildlife Hazard Management Plans to reduce the presence of resident or migrant raptors on airports. Airport managers and wildlife biologists charged with reducing wildlife threats to aircraft should consider the effects of prey population management, as discussed by Allen (1998) and Baker and Brooks (1981), on their airports as one method of reducing raptor strikes. Various factors affecting prey abundance may include grass height (Barras et al. 2000), toxic baiting applications targeting resident small mammals (e.g., zinc phosphide baiting), and selected insecticides designed to reduce targeted species of insects. Our results demonstrate that small

birds that may not appear to pose bird strike hazards themselves may serve as prey for hazardous raptors. Furthermore, insects may attract numerous small bird species, which are hunted by foraging raptors. Therefore, prey population management may prove to be an effective indirect method of reducing the attractiveness of airfields to birds of prey and subsequently reduce the presence of raptors on specific locations.

Future research projects should evaluate the effects of local, site-specific management of prey abundance on raptor abundance. Also, temporal feeding trends of raptors may be further examined in relation to prey abundance, weather conditions, observed localized raptor population fluctuations, and changes in aircraft-raptor collisions.

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