

PREDATION OF BIRDS AT FEEDERS IN WINTER

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Abstract.—A continentwide survey of homes with bird feeders produced 567 reports documenting 1138 incidents of predation. Of the 25 species of predators recorded, three (Sharp-shinned Hawk, *Accipiter striatus*; domestic cat; Cooper's Hawk, *A. cooperii*) were responsible for 80% of the incidents in which the predator was known. Ten of the 62 species of prey identified accounted for 92% of all victims. The birds most vulnerable to predation were those that commonly occur at feeders throughout the continent (i.e., the most widespread species), but additionally, flocking species were more vulnerable to avian predators than more solitary ones. Prey size was correlated to size of avian predators, but cats concentrated on small birds. Hawks were attracted to feeders with particularly high levels of bird activity, but cats were not. The bird-feeding environment does not appear to expose birds to a higher risk of predation than is encountered in the absence of feeders.

DEPREDACIÓN DE AVES EN COMEDEROS DURANTE EL INVIERNO

Síopsis.—Se hizo una encuesta, a nivel continental, en residencias en donde se les provee de comederos a aves, que produjo 567 informes en los cuales se documentan 1138 incidentes de depredación. De las 25 especies de depredadores informados tres de éstos, a saber *Accipiter striatus*, *A. cooperii* y el gato doméstico, fueron responsables del 80% de los incidentes en donde el depredador fue identificado. Diez de las 62 especies que sirvieron como presas, formaron el 92% de todas las víctimas. Las aves más vulnerables a la depredación fueron aquellas que más comúnmente utilizan comederos artificiales a nivel continental (ej. las especies más ampliamente distribuidas). No obstante las aves que se alimentan en grupos resultaron más vulnerables que las que lo hacen de forma solitaria. El tamaño de la presa se correlacionó al tamaño del depredador, aunque los gatos concentraron sus esfuerzos en aves pequeñas. Los halcones fueron atraídos a comederos, con altos niveles de actividad aviar, mientras que ocurrió lo opuesto con los gatos. Los ambientes en donde hay comederos artificiales no parecen exponer a las aves a un riesgo mayor de depredación, que en lugares en donde éstos no se encuentran.

The backyard bird feeder is often a scene of predation, and feeder owners sometimes worry that they are drawing birds away from a safer natural environment to one where dense bird concentrations and relatively open habitat may increase the risk of predation.

A survey of mortality at feeders, conducted during the winter of 1989–1990, sheds light on the links between predation and bird feeding, as well as providing information on predators' choice of prey species. Data were provided by participants in Project FeederWatch, a continentwide survey of winter birds at feeders.

METHODS

Participants in Project FeederWatch were provided with special forms on which they could record any bird or mammal deaths occurring in their

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FIGURE 1. Project FeederWatch Regions mentioned in text.

yards. For predation deaths, information was requested on species of predator and of prey taken, date and time of the incident, and behavior of predator or prey.

FeederWatch participants also watched their feeders for 1 or 2 d during each of 10 2-wk periods from 11 Nov. 1989 through 6 Apr. 1990 ("count periods"; see Dunn 1992 for details). For each bird species observed at their feeders, FeederWatchers recorded the peak number of individuals seen during each count period. Numbers of birds, and information on the characteristics of the bird-feeding site (e.g., habitat, number of feeders, type of food offered) were recorded on computer-readable forms.

For analysis purposes, the continent was divided into eight Regions (Fig. 1). FeederWatch participants were distributed throughout the populated regions of the continent, but the majority (70%) were in the Northeast. For each species, the "mean number per feeder" (annual average peak number of individuals per feeder site) was calculated as a geometric mean to normalize distributions skewed by a few feeders with exceptional activity. Continental means are average values from smaller units (usually states).

Sample sizes vary throughout the paper because cases were excluded that lacked information relevant to a given analysis.

Bird identification skills of FeederWatch participants as a group are very good (judging from results of our species-editing procedures), and we consider our results for the frequently observed predator and prey species to be highly reliable.

RESULTS

Of the 5500 Project FeederWatch participants who submitted observations for the winter of 1989–1990, 567 (10%) also reported incidents of predation. At sites that reported predation, there was an average of 2.0 predation deaths per site during the 4-mo period December through March. At homes reporting mortality from any cause, there was an average of 1.0 predation death per site.

Most participants (67%) reported a single predation event, and 94% of cases involved four or fewer incidents during the winter. The remaining 6% of participants accounted for 29% of all predation events, with an average of just over 10 incidents each.

Sharp-shinned Hawk (*Accipiter striatus*) was the top-ranked predator, responsible for 35% of all predation deaths in which the predator was identified. The domestic cat ranked second, causing 29%. Cooper's Hawk (*A. cooperii*) and Sharp-shinned Hawk together were implicated in 51% of cases, including those in which the observer could not distinguish between the two species. The three next-most frequent predators (Red-tailed Hawk, *Buteo jamaicensis*; American Kestrel, *Falco sparverius*; and Merlin, *F. columbarius*) were implicated in only 12% of cases. Altogether, these six most-common predators accounted for 90% of all predation deaths in which the predator was identified.

The remaining 10% of kills were made by 19 other predators, each of which was implicated in less than 2% of all incidents: four hawks (Northern Harrier, *Circus cyaneus*; Northern Goshawk, *Accipiter gentilis*; Red-shouldered Hawk, *Buteo lineatus*; Broad-winged Hawk, *B. platypterus*), two owls (Great Horned Owl, *Bubo virginianus*; Northern Pygmy Owl, *Glaucidium gnoma*); Northern Shrike (*Lanius excubitor*); six other birds (Greater Roadrunner, *Geococcyx californianus*; Scrub Jay, *Aphelocoma coerulescens*; Black-billed Magpie, *Pica pica*; American Crow, *Corvus brachyrhynchos*; European Starling, *Sturnus vulgaris*; Common Grackle, *Quiscalus quiscula*); four mammals (dog, *Canis familiaris*—mainly one individual that ate House Sparrows; fox, *Vulpes* sp.; woodrat, *Neotoma* sp.; shorttail weasel, *Mustela erminea*), and two snakes (rattlesnake, *Crotalus* sp.; and probable garter snake, *Thamnophis* sp.).

Sites with reports of cat predation suffered a winter average of 2.3 birds killed, whereas those reporting hawk predation averaged 1.9 birds killed. The difference was not significant. (Mann-Whitney *U*-test, $n = 125, 392$; $P = 0.776$). Few sites (3.8%) reported predation both by cats and hawks.

Neither cat nor raptor predation was reported from all FeederWatch Regions in the same proportion as the number of participants living there

(cats: $\chi^2 = 62.9$, $n = 306$, $P < 0.001$; hawks: $\chi^2 = 28.5$, $n = 619$, $P < 0.001$).

Incidents of cat predation were distributed evenly over the four winter months December through March ($\chi^2 = 4.2$, $n = 129$, $P = 0.243$). Deaths caused by Cooper's and Sharp-shinned Hawks peaked early in the winter, however, with 40% of cases in December, 19% in January, 26% in February and 15% in March ($\chi^2 = 42.5$, $n = 286$, $P < 0.001$).

Predator attacks were spaced equally among three 3-h time blocks from 0800 to 1700 hours (hawks: $\chi^2 = 5.3$, $n = 209$, $P = 0.071$; cats: $\chi^2 = 4.9$, $n = 37$, $P = 0.085$). Sharp-shinned and Cooper's Hawk activity (combined) tended to peak in the middle time block, mainly due to a noticeable rise in incidents between 1200 and 1300 hours. Cat predation dropped by half in the latest time block, but sample sizes were too small to demonstrate significance.

Ten species of prey accounted for 92% of all victims (Table 1). An additional 52 prey species were identified, including four mammals, but none constituted as much as 2% of all prey items. Every one of the prey species has been recorded taking food from feeders at least occasionally by Project FeederWatch. Most (85%) visited at least 15% of the feeders within a FeederWatch Region during the winter of 1989–1990.

Prey choice of the five most common avian predators depended partly on size (Fig. 2). Predator weight (average of male and female mass; Dunning 1984) was positively correlated with mean weight of identified prey ($r = 0.983$, $n = 5$, $P < 0.01$). Cats, although heavy themselves, concentrated on lighter prey.

Another factor in prey choice was species distribution and abundance at feeders. Among regular feeder visitors (those recorded at 15% or more of feeders across the continent), the number of each species killed (including zeros) was directly related to how widespread that species was (in terms of percentage of feeders visited: $r = 0.72$; $n = 28$; $P < 0.001$).

In addition, the species commonly taken by avian predators (Table 1) had higher peak counts (i.e., greater tendency to flock) than less commonly taken species counted by FeederWatchers (5.4 vs. 2.8 birds per peak count, $n = 22$ species, t -test, $P < 0.031$). This was not true for cats. Peak counts of each species and the percent of feeders they visited were not correlated with each other ($r = 0.33$; $n = 28$; $P < 0.331$).

The sum of the annual average peak counts for the ten most common prey species was higher at sites that reported hawk predation than at sites that did not report any predation (59.7 vs. 38.7, $n = 178$, 3722; t -test $P < 0.001$). There was no such difference between sites with and without cat predation (43.6 vs. 38.8, $n = 53$, 3720; t -test $P < 0.183$). (Sample sizes do not total 5500 because many participants had incomplete records for the winter).

Sites that reported deaths by avian predators were more likely than those without avian predators to have these characteristics: deciduous woodlots within 0.8 km of the feeding station (42% of homes with deaths vs. 32% of other homes), a large feeding area (75% vs. 65%), many

TABLE 1. Main predators and their favored prey in yards with bird feeders, in the winter of 1989-1990¹.

Prey species	Percent of all identified prey taken by each predator (total <i>n</i> of cases in parentheses):						
	All predators combined ² (976)	Sharp-shinned Hawk <i>Accipiter striatus</i> (299)	Domestic cats <i>Felis catus</i> (224)	Cooper's Hawk <i>Accipiter cooperii</i> (107)	American Kestrel <i>Falco sparverius</i> (42)	Merlin <i>Falco columbarius</i> (38)	Red-tailed Hawk <i>Buteo jamaicensis</i> (24)
Mourning Dove	17	13	6	36	10	—	48
<i>Zenaidura macroura</i>							
Dark-eyed Junco	15	18	21	12	7	11	—
<i>Junco hyemalis</i>							
Blue Jay	14	5	—	—	—	—	—
<i>Cyanocitta cristata</i>							
House Sparrow	12	18	5	8	19	26	—
<i>Passer domesticus</i>							
European Starling	8	10	—	11	10	5	8
<i>Sturnus vulgaris</i>							
Pine Siskin	8	10	15	—	—	5	—
<i>Carduelis spinus</i>							
House Finch	7	6	10	—	7	24	—
<i>Carpodacus mexicanus</i>							
American Goldfinch	5	—	7	—	26	18	—
<i>Carduelis tristis</i>							
Northern Cardinal	4	—	6	—	—	—	—
<i>Cardinalis carolinensis</i>							
Rock Dove	2	—	—	—	—	—	36
<i>Columba livia</i>							
All others (<i>n</i> of species)	8 (52)	17 (21)	30 (26)	33 (18)	19 (8)	11 (4)	8 (2)

¹ Prey listed by species are those constituting 5% of more of identified prey for any of the six predators listed here.² Includes all cases in which prey was identified, even if predator unknown.

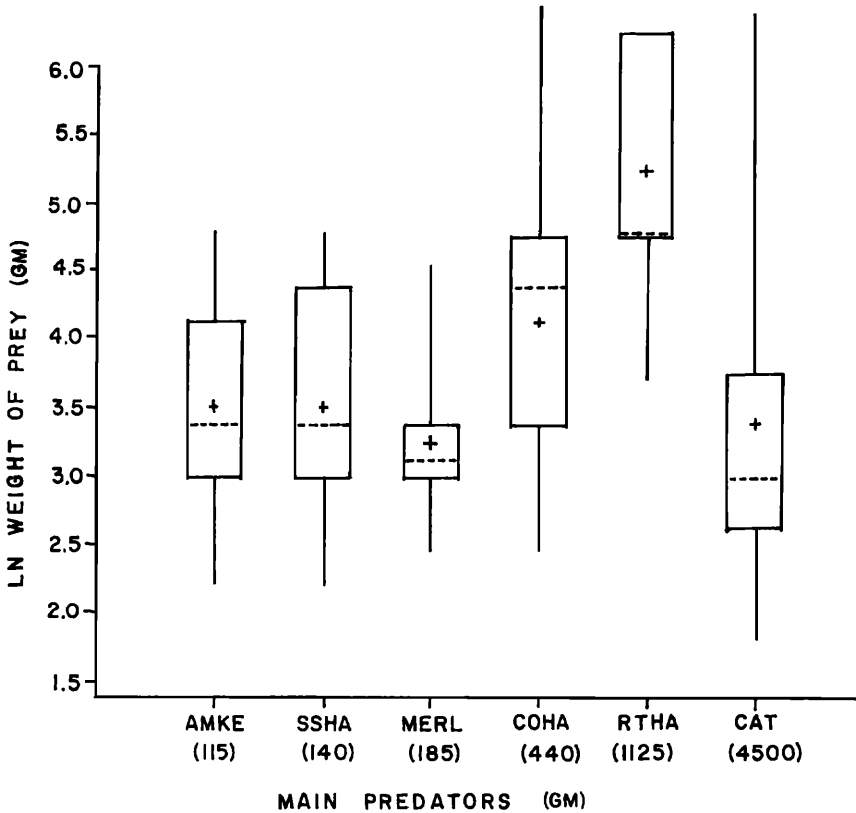


FIGURE 2. Box plots of weight of prey taken at feeders (weights from Dunning 1984). Symbols: + = mean, horizontal line = median, wide bar includes 75% of observations, and vertical line shows entire range. Codes for predators: AMKE = American Kestrel, SSHA = Sharp-shinned Hawk, MERL = Merlin, COHA = Cooper's Hawk, RHTA = Red-tailed Hawk.

plantings in the yard (86% vs. 81%), year-round feeding (68% vs. 58%), more than six feeders (76% vs. 54%), and more than five types of food (categorizing water, sugar water, suet and each seed type as a separate food; 68% vs. 56%; χ^2 tests; $n = 345, 4863$; all P 's < 0.05).

Sites reporting cat predation were more likely than sites without cat predation to offer food on the ground (47% of homes with deaths vs. 37% of other homes) and to have less-specialized bird feeding practices. For example, they were less likely to serve niger, suet or peanuts, and more likely to offer suet/seed mixes. They were also, not surprisingly, more prone to having frequent visits by cats (91% vs. 66%), and perhaps as a consequence, were less likely to have squirrels at their feeders (62% vs. 73%).

DISCUSSION

Avian predators were attracted to feeders with high levels of activity. Hawks took individuals more frequently than expected from flocking species that also feed readily on the ground, behavioral traits that perhaps make prey especially conspicuous from the air. Sites that reported avian predators had more of these flocking species at their feeders than did other sites, probably as a result of habitat characteristics that enhance feeder visitation (i.e., year-round, more-specialized and larger feeding programs, and well-treed habitat in the vicinity).

By contrast, cat predation was not associated with any habitat characteristics that would particularly enhance bird activity. Sites with predation caused by cats had relatively unspecialized feeding programs, few plantings nearby, and more ground feeding when compared to sites without cat predation. Unlike hawks, cats were not more active at sites where the common prey species were most numerous. As territorial predators, the cats appear to concentrate on whatever is locally available, whereas the avian predators move to the most active sites.

Raptor predation was reported more often than expected in the Southwest and West Coast Regions, where Sharp-shinned and Cooper's Hawks are especially common in winter (Root 1988). Predation rates were lower in the Northeast than expected on the basis of numbers of project participants there. Overall there was a decline in hawk predation after December, and this probably reflects completion of migration away from the feeder-rich north. Cat predation was also high in the Southwest, perhaps due to mild weather allowing cats more time outdoors in winter.

We found a mid-day peak in accipiter attacks, but this may have been an artifact. Many feeder owners watch their yards more closely over the lunch hour. Other studies suggest that, at least on migration, Sharp-shins hunt mainly in early and late hours of the day (Palmer 1988).

The average number of predation deaths per site (from sites where participants reported witnessing any type of mortality) was 1.0 birds per winter. This figure is obviously very imprecise. If the several thousand active FeederWatch participants who failed to report any deaths actually did not see any predation, the true rate of predation at feeders is much lower than 1.0 bird per site per winter. On the other hand, the chances of a feeder owner missing a predation event are quite high. Attacks are brief and rarely cause noise that would attract house occupants. Cat predation is often detected only if the cat presents prey to its owners. Moreover, some people who witnessed predation may not have submitted mortality reports. We have no basis for judging the relative importance of these biases. It is clear, however, that homes without any bird feeders at all will suffer a far lower rate of predation than reported here.

Nonetheless, we doubt that bird feeding causes higher predation mortality than would be found in more natural settings. Only 2% of sites reporting avian predation recorded more than 10 deaths (maximum from one site was 37), whereas 67% reported only one death. A Cooper's Hawk,

however, probably needs to eat at least 120 small birds over the course of a winter (1–3 prey items per day in the size range of birds taken at feeders; Palmer 1988). Although some feeders are certainly a regular source of food for resident hawks, most are evidently raided only in passing.

Avian predation can sometimes have a significant impact on small bird populations. One study estimated that 10% of finches passing through a migratory stopover site were killed by predators in autumn (Lindstrom 1989), and up to 30% of juvenile tits (*Parus* spp.) were killed in the nesting season by Sparrowhawks (*Accipiter nisus*; Perrins and Birkhead 1980). Our figures suggest that avian predation at feeders during the winter has a lower impact. The average FeederWatch count for the 10 most preyed-upon species combined was 59.7 birds for sites with avian predators, and the average loss to those predators was 1.9 birds. Even if our predation rate of 1.0 bird per winter is a severe underestimate, avian predators must be killing the majority of their prey elsewhere.

As hawks must kill to survive, bird mortality from raptor attacks should not increase overall because bird feeding is becoming more common, unless easy access to food on migration or in winter causes raptor populations to increase. Evidence from the Breeding Bird Survey, however, shows that neither Sharp-shinned nor Cooper's Hawk populations have changed significantly during the period 1966–1989 (S. Droege, pers. comm.).

Cat predation can also have a significant effect on bird populations, and the toll appears to be highest in residential areas (Churcher and Lawton 1987, Coman and Brunner 1972, Hubbs 1951, McMurray and Sperry 1941). Cats take whatever prey is most available, and the lawns and lack of understory in suburbia have low small mammal populations and relatively vulnerable birds. Churcher and Lawton (1987) estimated that a significant proportion of annual mortality in House Sparrows (*Passer domesticus*) in an English village was caused by well-cared-for house cats. There was no overall decline in the local House Sparrow population over the 1-yr period of the study, however. The highest proportion of birds in the diet occurred in mid-winter, when the total number of prey caught was at a minimum. Another peak of bird prey came in May and June, when fledglings were available (Churcher and Lawton 1987; see also Hubbs 1951).

Individual cats in Churcher and Lawton's (1987) study varied widely in their hunting propensities, and kill rates declined as cats aged (Churcher and Lawton 1987). Our study, too, showed that a relatively small proportion of house cats caused frequent deaths at feeders (only 4% made more than 10 kills per winter).

Cats with strong hunting propensities may kill just as many birds in the absence of feeders as when they are present. It is very probable, however, that bird feeding tempts other cats to mount attacks, too. The impact of this "extra" mortality on bird populations is difficult to assess. Certainly the prey species most frequently involved are common and widespread. Studies in rural areas indicate that birds are taken much less

frequently by cats (Coman and Brunner 1972, Hubbs 1951, McMurray and Sperry 1941). Predation rates from predominantly suburban sites (this study, Churcher and Lawton 1987), should not be extrapolated to all environments.

Some evidence suggests that feeders may actually provide relatively safe havens from predation. There are more individual birds on hand to be alert and sound alarms (Popp 1988, Siegfried and Underhill 1975, Waite 1987). Moreover, food supplements may reduce foraging time and, concurrently, the periods of maximum exposure to predators (Jansson et al. 1981).

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