Species-Based Variations in Hippoboscid Infestations in Midwestern Raptors

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Introduction

Flat flies (family Hippoboscidae) are obligate parasites that feed on the blood of birds and mammals.[1] The last comprehensive study of hippoboscid flies infesting Midwestern birds was undertaken in the late 1960s.[2] Recently, interest in these unusual parasites has been rekindled, as they have been implicated as potential vectors of West Nile Virus.[3] This led undergraduate student Shalini Latchman to conduct a descriptive study of hippoboscid flies at the University of Minnesota's Gabbert Raptor Center on the St. Paul campus in 2007.[4] The center sees hundreds of injured and sick birds of prey each year, and many of their patients are infested with flat flies.

In her study, Latchman observed significant variation in infestation rates among different species of raptors.[4] This species-based variation is of interest to those studying the spread of West Nile between avian hosts, as well as those involved in raptor rehabilitation and husbandry.

The goal of this study was to first confirm the observed variation, and then examine factors contributing to this phenomenon.

Predictions

Based on Latchman's study[4], we predicted that there would be significant variation in rates of infestation among species. Specifically, great horned owls, broad-winged hawks, and red-tailed hawks would show higher rates of infestation, whereas sharp-shinned hawks, American kestrels, peregrine falcons, and ospreys would show lower rates of infestation.

Furthermore, we predicted that the majority of hippoboscid flies observed would be of the species *Icosta americana*. This was again based on Latchman's observations[4], as only 3 of the 440 specimens she collected (99 %) were of other hippoboscid fly species.

Finally, we wanted to examine the reasons behind this variation. Thus, we chose to examine the size of the birds and their genetic relatedness. Size could be important because a larger bird provides flies with more places to hide. In terms of genetic relatedness, there are two orders of raptors – Falconiformes, the diurnal birds, and Strigiformes, the nocturnal birds.[5] Within these orders there are a total of seven families.[5] Birds of the same family have similar morphology and feathering, though they may vary in size. We predicted that similar rates of infestation will be observed in birds of similar sizes, and in birds of the same family group.

Methods

Flat fly specimens were collected from newly admitted patients by the Raptor Center's veterinary staff. In the course of a normal admission, flat flies were removed from patients, placed in small vials full of rubbing alcohol, labelled with patient identification number, date of collection, and number of flies that escaped capture, if any. Vials were then placed in the freezer for preservation.

We then curated all specimens, identified them to species, and then matched them to individual patients to analyze patterns of infestation among the different species of raptor patients.

Finally, we utilized the Raptor Center's patient database to match each specimen to admission records to obtain its species, age, size, and gender.

Results

Raptor Center staff saw a total of 622 patients from April through November, 2014, and 136 (21.9%) were infested by a total of 736 hippoboscid fly specimens.

Five species of flat flies were observed in the collected specimens, and the vast majority (96.9%) were *Icosta americana.* One broad-wing hawk was infested by *Ornithoctona erythrocephala*, and four Cooper's hawks were infested by *O.erythrocephala*, *O. fusciventris*, or *Ornithoica vicina*.

Nine of 24 species of raptors were infested by *I. americana* (Table 1). Great horned owls and broad-winged hawks had significantly higher rates of infestation, and American kestrels and bald eagles were found to had significantly lower rates of infestation than predicted by chance.

Table 1. Rates of *I. americana* infestation among 24 species of raptors.

Species of raptor	No. patients	No. infested	% infested	No. expected
Red-Tailed Hawk	113	27	23.9	24
Cooper's Hawk	108	19	17.6	23
Great Horned Owl	88	42*	47.7*	19
Bald Eagle	84	9*	10.7*	18
Broad-Winged Hawk	54	20*	37.0*	11
Barred Owl	34	7	20.6	7
American Kestrel	24	0*	0.0*	5
Others				
Merlin	20	0	0.0	4
Peregrine Falcon	15	0	0.0	3
Sharp-Shinned Hawk	15	5	33.3	3
Osprey	14	1	7.1	3
Northern Saw Whet Owl	10	0	0.0	2
Turkey Vulture	10	1	10.0	2
Eastern Screech Owl	6	0	0.0	1
Long-Eared Owl	4	0	0.0	1
Red-Shouldered Hawk	4	0	0.0	1
Snowy Owl	4	0	0.0	1
Rough-Legged Hawk	3	0	0.0	1
Northern Goshawk	2	0	0.0	0
Golden Eagle	1	0	0.0	0
Great Gray Owl	1	0	0.0	0
Northern Harrier Hawk	1	0	0.0	0
Prairie Falcon	1	0	0.0	0
Short-Eared Owl	1	0	0.0	0
Total	617	131	21.2	131

** Indicates significant deviation from number expected if flies were distributed at random*

Analysis of patterns among the different bird families family (Table 2) revealed that the family Falconidae had a significantly low infestation rate, whereas the family Strigidae had a significantly high infestation rate. The latter may have been due to the large number of great horned owls (88 out of 148) making up the sample.

Table 2. Rates of *I. americana* infestation, by family of raptor.

Order	Family	Total	No. infested	% infested	No. expected
Falconiformes	Falconidae	60	0*	0.0*	13
	Acciptridae	385	80	20.8	82
	Pandionidae	14	1	7.1	3
	Cathartidae	10	1	10.0	2
Strigiformes	Strigidae	148	49*	33.1*	31
Total		617	131	21.2	131

** Indicates significant deviation from number expected if flies were distributed at random*

A scatterplot of infestation rates *vs.* bird size revealed that infestation rates were independent of host size (Figure 1). In fact, many species with similar average body weights – Cooper's hawks and Broad-winged hawks, for example – had massively different infestation rates.

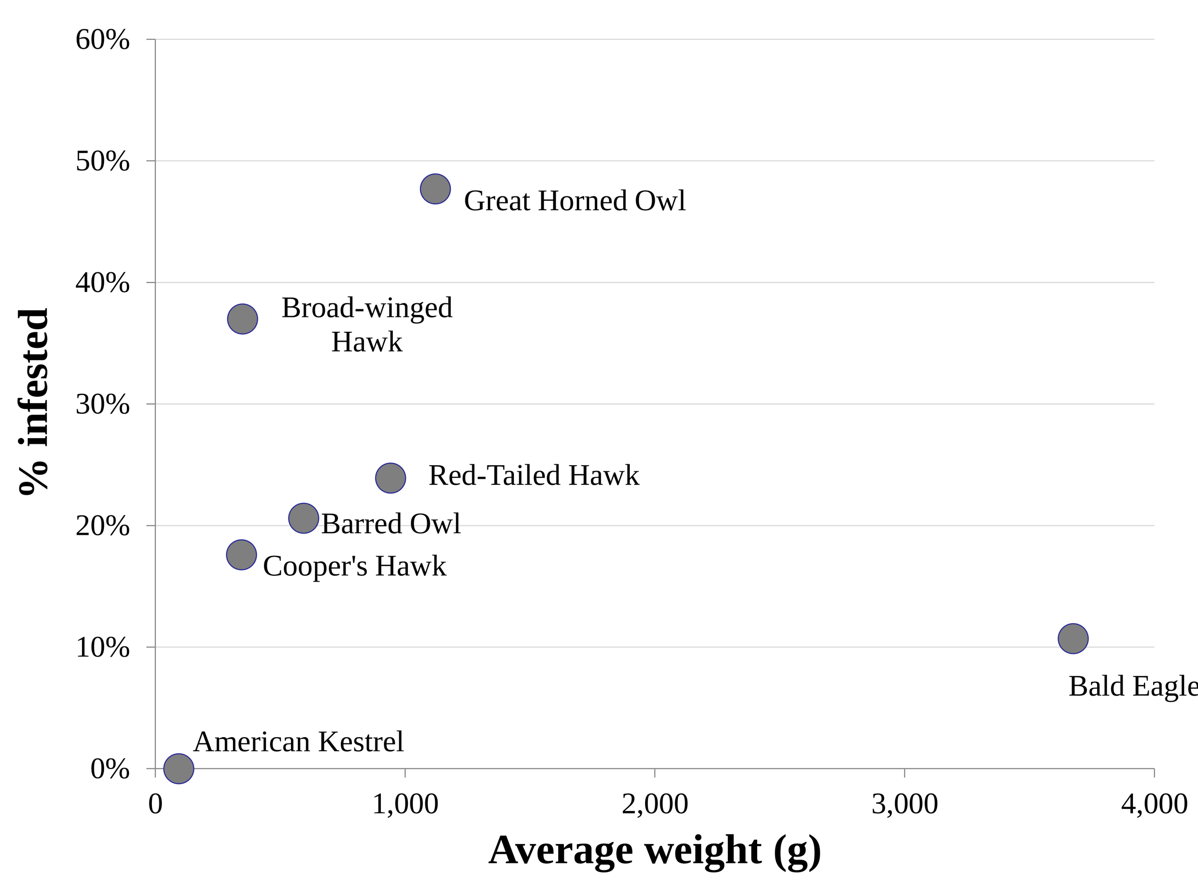

Figure 1. Average weight versus percentage infested (by species).

Conclusions

Our results are consistent with earlier findings by Latchman[4]: *Icosta americana* was the predominant hippoboscid species on Raptor Center patients, and those flies were not distributed at random among hosts. Great horned owls and broad-winged hawks had higher infestation rates than expected, and American kestrels and bald eagles had lower infestation rates.

Infestation rates were were independent of the size of the bird, as measured by average weight. In contrast, the feathering and morphology of the bird, as measured by family group, did appear to impact infestation rates. Specifically, birds of the family Falconidae had a significantly lower infestation rates than raptors in other families. Not a single Falconidae bird harbored flat flies, but Strigidae, the family to which all admitted owls belonged, had significantly higher infestation rates.

It can be concluded that morphology and feathering rather than bird size are better predictors of a raptor's susceptibility to infestation by hippoboscid flies.

References

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