PROTOCALLIPHORA AVIUM (DIPTERA) MYIASIS IN GREAT HORNED OWLS, RED-TAILED HAWKS, AND SWAINSON'S HAWKS IN NORTH DAKOTA

by
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Abstract

In Grand Forks County, North Dakota, in 1970–1971, I found the following numbers of nestlings parasitized by *Protocalliphora avium* (Diptera): Great Horned Owl, 1; Red-tailed Hawk, 34; and Swainson's Hawk, 2. I found cutaneous myiasis in the auditory meatus, nape and neck, axillary area, anal area, and a retrix follicle. Aggregations of eggs in the axillary areas and uniformly-sized larvae in the aural cavities of Red-tailed Hawks suggest that eggs of *P. avium* were deposited directly upon the host. Larvae remained in the ears of a captive Red-tailed Hawk until they were mature. Nestlings with several sites of infestation were visibly weaker, smaller, and more poorly developed than other nestlings. Sibling attacks on nestling Red-tailed Hawks with heavy infestations of *P. avium* may result in death.

Introduction

North American raptors are well-known hosts for Bird Nest Screw Worm Flies, *Protocalliphora* sp. (syn. *Apaulina* Hall; Diptera). Protocalliphorids have been found in the nares, ear canals, axillae, feather sheaths, ventral surfaces or nests of 11 species of hawks and owls (Shannon and Dobrosky 1924, Sargent 1938, Hill and Work 1947, Hamerstrom and Hamerstrom 1954, Meng 1954, Lee and Ryckman 1954, Hickey 1969, Seidensticker and Reynolds 1971, Swartz pers. comm. 1976). Sargent (1938) suggested that the infestation of the Red-tailed (*Buteo jamaicensis*) and Red-shouldered (*B. linneatus*) Hawk nests is nearly 100 percent. According to Sabrosky (pers. comm. 1971), all hawks and owls should be good hosts.

The pathology of these infestations has not been well established. Sargent (1938) and Hamerstrom and Hamerstrom (1954) did not observe a loss of auditory acuity with infestations of the aural canal in Red-tailed, Red-shouldered or Cooper's (*Accipiter cooperii*) Hawks. Sargent also reported that normal feathers developed on a Red-tailed Hawk nestling with myiasis of the nape and crown. Cooper's Hawks with aural infestations did not appear to be appreciably weakened (Meng 1954). Seidensticker and Reynolds (1971) did not attribute any mortality to *Protocalliphora* sp., although nearly all Red-tailed Hawk nestlings observed were infested. However, Hill and Work (1947) suspected that these larvae were responsible for the death of a young American Kestrel (*Falco sparverius*). Young of the Marsh Hawk (*Circus cyaneaus*) died when larvae (unidentified, probably protocalliphorids) penetrated the brain by way of the nares (Hamerstrom and Hamerstrom 1954).

In 1970–1971, I investigated the significance of *Protocalliphora* sp. myiasis in the nesting biology of the Red-tailed Hawk and the Great Horned Owl (*Bubo virginianus*) in Grand Forks County, North Dakota. Additional observations were made on

nestlings of the Swainson's Hawk (*B. swainsoni*) in 1971.

Methods

Nestling raptors were examined to estimate the number of Protocalliphora larvae and eggs, to observe the sites and period of infestation, and to determine any injurious aspects of myiasis. Nests were examined for eggs, larvae, and pupae. There were 9 Great-horned Owl nests, 1 Swainson's Hawk nest, and 19 Red-tailed Hawk nests under observation. In these nests, young of Great Horned Owls and of Swainson's Hawks were examined at ages 2–3 and 5–6 weeks; young of Red-tailed Hawks were examined each week from age 1 week to age 6 weeks. Periodic attempts were made to observe egg-laying by *Protocalliphora* sp. from a blind at a Red-tailed Hawk nest in 1970 and 1971.

Larvae periodically collected in the field from nestlings and nest substrates were preserved in 70 percent ethyl alcohol. In 1970, I collected mature larvae as they dropped from a Red-tailed Hawk nestling confined in a cage with a bare floor. These larvae were placed in a container on a sterile substrate of equal parts sand, loam, and vermiculite. The container was placed in a fine mesh cage and the substrate kept moist at room temperature. In 1971 mature larvae were collected from the three species of raptor nestlings and nest material and placed in small jars with perforated tops containing shredded laboratory paper toweling. The toweling was kept moist and maintained at ambient room temperature. As adult flies emerged, they were killed and preserved in 70 percent ethyl alcohol. Both methods utilized to rear adults from larvae appeared to be equally successful.

In the field, larvae were removed from the ears of two nestling Red-tailed Hawks on two different occasions. These nestlings were subsequently examined for signs of reinfestation.

Results and Discussion

One of 14 Great Horned Owl nestlings examined in 1971 was parasitized with *Protocalliphora*. This myiasis was also present in 34 of 36 Red-tailed Hawks in 1970 and 1971, and in the 2 Swainson's Hawk nestlings examined in 1971 (table 1). I observed the earliest infestation on 20 May 1971, in the Great Horned Owl nestling. The latest infestation was on 11 August 1971, in a Swainson's Hawk nestling. Thus, adult *Protocalliphora* sp. were active for at least 83 days in 1971, and I was able to observe and collect several generations. Adult flies were hatched from mature larvae taken from the ears of a captive Red-tailed Hawk nestling in 1970, and from the ears and bodies of 13 Red-tailed Hawk nestlings and 1 Great Horned Owl nestling in 1971. Adults were also hatched from mature larvae taken from the substrate of the Swainson's Hawk nest in 1971. All adult protocalliphorids raised from mature larvae were identified as *P. avium*, and the other larvae collected or observed were apparently of the same species (Sabrosky pers. comm. 1971).

The numbers of larvae present on infested nestlings varied. Red-tailed Hawk nestlings with only aural myiasis usually had a few large, or many small larvae, numbering 5–40. Larvae between 5.0 mm and 7.5 mm were observed in all lesions. Few immature larvae were found in the interior of the nests although often large numbers of mature larvae and pupae were present. I estimated that there were 300–400 *P. avium* larvae and pupae in one Red-tailed Hawk nest. In this nest both nestlings were heavily parasitized at most foci of infestation.

Table 1. Loci of infestation in nestling Great Horned Owls, Red-Tailed Hawks and Swainson's Hawks parasitized by *Protocalliphora avium*, 1971, Grand Forks County, North Dakota

Loci of Infestation	14 Great Horned Owls[a]	36 Red-tailed Hawks[b]	2 Swainson's Hawks[c]
None	13	2	0
Auditory Meatus	1	34	2
Axilla	0	15	2
Nape and Neck	0	7	2
Anal Area	0	4	2
Retrix Follicle	0	1	0

[a]9 nests
[b]19 nests; includes 7 nestlings observed in 1970, 5 of which were infested in the auditory meatus
[c]1 nest

In 1970, *P. avium* myiasis occurred only as an infestation of the aural cavity. Infestations in Red-tailed Hawks began at approximately one week of age. Eventually larvae plugged and stretched the auditory meatus. The ear opening and surface of the ear canal were covered with a red-brown exudate, and the area surrounding the ear was inflamed and swollen. It appeared that this condition irritated the nestlings, which were frequently observed shaking and scratching their heads. Infestations of the aural cavity occurred until nestlings were 4–5 weeks old.

In 1971, in addition to aural myiasis, 15 Red-tailed and 2 Swainson's Hawks were observed with myiasis in the axillary areas (fig. 1), nape and neck, and in the anal area. Cutaneous myiasis appeared as scabby, denuded areas with larvae enclosed in small dermal pockets of down and dried exudate. An unusual condition was seen in a Red-tailed Hawk nestling (fig. 2). Several larvae had invaded a retrix follicle and destroyed the developing feather. The opening to this cavity was sealed with exudate. Nestlings were first parasitized in the auditory meatus, with subsequent infestations in the axilla, nape and neck, anal area, and retrix follicle. This sequence, however, was not always complete. Infestations occurred in Red-tailed Hawks and Swainson's Hawks at age 3–4 weeks, with recovery at age 4–5 weeks as the mobility of the nestlings increased. However, some sites were denuded or feathers developed poorly. Of the five sites of parasitization, the presence of protocalliphorid larvae in feather follicles is reported here for the first time.

Hamerstrom and Hamerstrom (1954) suggest that hot, wet weather may enhance *Protocalliphora* sp. myiasis. The additional sites of *P. avium* myiasis which occurred in 1971 may be explained by the mean daily humidity of 77 percent as compared to 70 percent as a 10-year mean for June. Also, frequent precipitation which occurred in early June 1971 may have forced Red-tailed Hawks to brood newly hatched young for lengthy periods. Assuming that *P. avium* eggs or larvae were present on the nestlings, their survival may have been aided by the increased warmth and stationary aspect of their host.

Data from this study indicate that parasitization by *P. avium* may be an infrequent event in Great Horned Owls. On the other hand, the incidence of myiasis in Red-tailed Hawks and Swainson's Hawks approaches 100 percent as suggested by Sargent (1938). The average hatching date of Red-tailed Hawks was 4 June, 2 months later

than the hatching date of most Great Horned Owlets. At this time, adult *P. avium* had already emerged and been active for several weeks. Therefore, the occurrence of a parasitized Great Horned Owlet in this study may be explained by its late hatching date of 22 April.

P. avium females apparently laid eggs directly on nestling Red-tailed Hawks. Flies were observed entering the ears of two nestlings from which larvae had been removed. Subsequently, each ear cavity was infested within one day by approximately 40 uniformly sized larvae, each 2.5 mm in length. In addition, small clumps of eggs were observed several times near the axillary areas of nestlings.

Meng (1954) reported that *Protocalliphora* sp. eggs are deposited along the edge of the nests, and that larvae subsequently find their way into the ear openings. However, Rausch (1972) observed an aggregation of larvae in a single locus on the head and speculated that *P. hirudo* eggs might be deposited directly on a host. Females of *P. avium* may prefer the ear canal to other areas of the raptor body or nest for deposition of eggs because the ear canal provides warmth, moisture, protection, and a readily available food supply for their larvae. The enlarged ear openings covered with exudate resulting from initial infestations may attract other *P. avium* females and thus enhance continuous reinfestation, as in this study.

Although Sargent (1938), Boyd (1951) and Meng (1954) reported that the larvae feed intermittently and do not remain in the ear, only mature larvae dropped from the ears of my captive Red-tailed Hawk. The Hamerstroms (1954) similarly gathered mature larvae as they dropped from the ears of two Cooper's Hawk eyasses in a screened cage, and further concluded that maggots spend the entire time from hatching until pupation within the hawk's ear. Sabrosky (pers. comm. 1976) suggested that larvae safely situated in a body cavity or sheltered niche might remain in situ, though probably disengaging their mouth parts.

In 1970 when myiasis was limited to the ears, it did not visibly retard the development or impair the hearing of 2 captive Red-tailed Hawk nestlings. Similar to observations made by Hamerstrom and Hamerstrom (1954), the nestling Red-tailed Hawks were able to respond to a feeding whistle. When maggots dropped from the ears, or were removed by hand, no inflammation or secondary infection of the auditory meatus was evident. Larvae of *P. avium* may produce bacteriostatic secretion similar to that of *Cuterebra* sp., *Cephenemyia* sp., *Oestrus* sp., and *Gasterophilus* sp. (Landi 1960).

In 1971, when additional sites of myiasis occurred, the development and survival of raptor nestlings seemed to be adversely affected. Of 15 Red-tailed Hawk nestlings with several sites of myiasis, only 5 survived to fledge. All of these nestlings were visibly weaker, smaller, and less well developed than nestmates which had only aural infestations. On 3 occasions, I observed Red-tailed Hawk nestlings pecking and biting the heads of more heavily parasitized siblings. After one attack, I removed the victim for more detailed observation: the scalp was split and bleeding and the nape denuded; and I counted 213 *P. avium* larvae in the ears, axillae and flank, retrix follicle, and nape and neck. This nestling died approximately one hour after its removal from the nest. Five other Red-tailed Hawk nestlings had similar wounds and wounds at other sites at which larvae of *P. avium* were present. The health and condition of these nestlings deteriorated until they died, approximately one week after receiving the wounds. Similarly, the weaker and more heavily parasitized Swainson's Hawk nestling disappeared at age 4–5 weeks. Nestlings that were weakened by additional infestations were probably less able to compete for food and to protect themselves

from their siblings. Thus, in this study it appears that 6 of 36 Red-tailed Hawk nestlings died from infestations of *P. avium* and sibling attacks.

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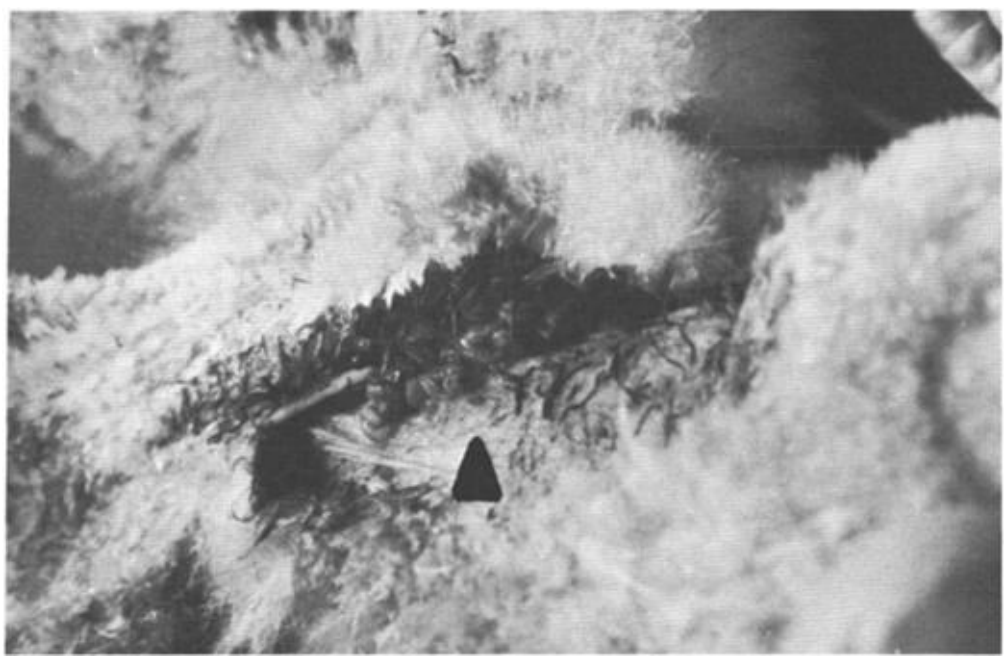

Figure 1. Larvae of *P. avium* in right axilla of nestling Red-tailed Hawk (see arrow); leg of nestling is at right; nape at upper left.

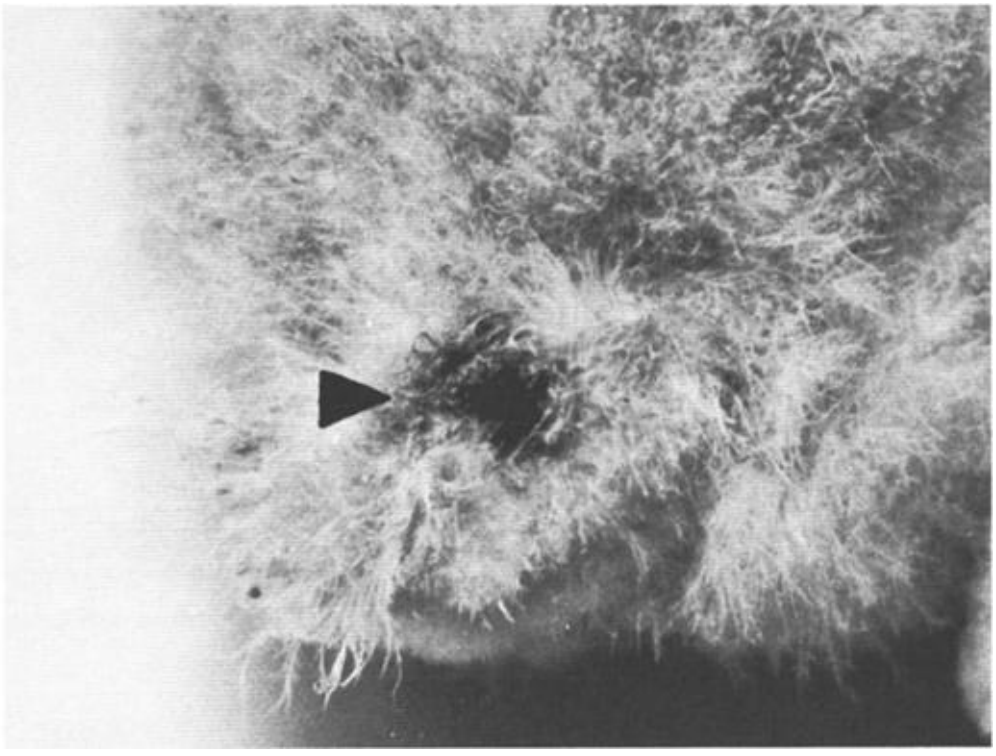

Figure 2. Cavity in tail of nestling Red-tailed Hawk caused by entrance of *P. avium* larvae with subsequent destruction of retrix follicle (see arrow).