Notes

Bird Blow Flies, *Protocalliphora* (Diptera: Calliphoridae), in Cavity Nests of Birds in the Boreal Forest of Saskatchewan

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The frequency of infestation by larval bird blow flies, *Protocalliphora*, an obligate blood-sucking parasite of nestling birds, in the nests of American Kestrels (*Falco sparverius*) was documented in north-central Saskatchewan. We found no evidence of feeding *Protocalliphora* in 76 intensively monitored nests. Nesting material from 92 nests was searched for puparia after chicks had fledged, and only a single *P. avium* puparium was recovered. We suggest that *Protocalliphora* are not important parasites for nestling kestrels in the boreal forest. Although *Protocalliphora* were also absent in four Boreal Owl (*Aegolius funereus*) nests, we did recover *P. shannoni* from Tree Swallow (*Tachycineta bicolor*) and House Wren (*Troglodytes aedon*) nests. These latter results suggest the absence of *Protocalliphora* in kestrel nests is probably due to species that normally infest kestrels not occurring on our study area, as opposed to the genus as a whole being absent. This study is the first to document *P. avium* in American Kestrel nests, and expands the known range of *P. shannoni*.

Key Words: Bird Blow Flies, *Protocalliphora*, haematophagous parasites, American Kestrel, *Falco sparverius*, Boreal Owl, *Aegolius funereus*, House Wren, *Troglodytes aedon*, Tree Swallow, *Tachycineta bicolor*, Saskatchewan.

The genus *Protocalliphora* (Diptera: Calliphoridae) is a Holarctic group whose larvae are obligate haematophagous parasites of nestlings birds (Sabrosky et al. 1989). Larvae of most species are intermittent feeders, living among nest material between blood meals, or occasionally remaining on nestlings (Sabrosky et al. 1989; Bennett and Whitworth 1991). Further information on the life history of *Protocalliphora* can be found elsewhere (Sabrosky et al. 1989; Bennett and Whitworth 1991, 1992; Whitworth and Bennett 1992).

Although most studies have been unable to implicate *Protocalliphora* in the deaths of nestlings (Whitworth 1976; Sabrosky et al. 1989; Rogers et al. 1991; Roby et al. 1992; Wittman and Beason 1992; Miller and Fair 1997; but see Pinkowski 1977; Merino and Potti 1995), Whitworth (1976) speculated that *Protocalliphora* may expedite nestling mortality during periods of food shortage or inclement weather (see also Howe 1992). Furthermore, Roby et al. (1992) found subtle differences in nestling mass of Eastern Bluebirds (*Sialia sialis*) and Tree Swallows (*Tachycineta bicolor*) infested with *Protocalliphora* larvae. Reduced fledging mass in passerines has been associated with lower post-fledging survival (Tinbergen and Boerlijst 1990; Magrath 1991), suggesting the possibility that even small effects of *Protocalliphora* parasitism can have fitness consequences for birds. Moreover, it has been suggested that parent birds may increase their rates of energy expenditure when feeding offspring in infested nests (Johnson and Albrecht 1993).

Avian ecologists have become increasingly aware of the deleterious effects of ectoparasites (see references in Christe et al. 1996), so we sought to examine whether *Protocalliphora* might play a role in the reproductive success of American Kestrels (*Falco sparverius*), a small falcon. As a starting point for our investigation, we documented the degree of *Protocalliphora* parasitism in nests of kestrels in the boreal forest of north-central Saskatchewan. Our initial results prompted us to also investigate, on a limited scale, the degree of *Protocalliphora* infestations in several other species of cavity nesting birds on our study area.

Methods

We studied American Kestrels breeding in nest boxes during 1995 in the boreal forest near Besnard Lake, Saskatchewan (55°N, 106°W). Nest boxes contained a few centimeters of wood shavings, and old nesting material was removed from our nest boxes prior to the breeding season, which may have reduced the prevalence and intensity of some ectoparasite infestations (Møller 1989). Further details of our general methods can be found elsewhere (Bortolotti 1994; Dawson and Bortolotti 1997a).

During the course of routine field work, we visited kestrel nests and inspected each nestling for the presence of actively feeding *Protocalliphora* larvae, or other evidence that chicks were being fed upon by *Protocalliphora*, such as scabs or larval faeces from larvae occupying aural or nasal cavities (see Bortolotti 1985). At this time, we also documented the degree of parasitism by *Carnus hemapterus* (Diptera: Carnidae) (Dawson and Bortolotti 1997b).

We collected nesting material from 90 kestrel nests approximately eight days (range 1 to 21 days) after nestlings fledged. Also, material was collected from two additional kestrel nests when chicks were 11 and 20 days old. All material from nest boxes was carefully placed in paper bags, sealed, and stored in an outdoor shelter. Nesting material was subsequently examined by T. L. W. for the presence of *Protocalliphora* puparia as well as for adult flies that may have emerged after nesting material was collected. In addition, we also examined material from two Boreal Owl (*Aegolius funereus*) nests collected in 1993, and two Boreal Owl, two Tree Swallow, and two House Wren (*Troglodytes aedon*) nests collected in 1996 from nest boxes on our study area.

Results

In total, we inspected 306 individual kestrel chicks from 76 nests a total of 1303 times. Ages at inspection ranged from the day of hatching to 25 days (approximate minimum fledging age; personal observation). We observed dipteran larvae on nestlings at only one nest during the course of the study. During a visit to this nest on 24 June 1995, the smallest nestling, which was less than 24-hours old, had a cavity 6 mm in diameter in its abdominal area where the umbilicus had been attached. Inside this cavity, which appeared to penetrate into the coelom, were at least 7 larvae. The chick was noticeably weak and pale. None of the other four chicks showed evidence of feeding during this visit. The next day, the previously infested chick was gone from the nest, and we assumed it had died and been removed or cannibalized by its parents (see Bortolotti et al. 1991). One other chick in this nest had a 2 mm diameter cavity in its left wing axillae that penetrated into muscle tissue, and another nestling had a similar-sized cavity in its left wing axillae that contained a single larva. This larva was collected and preserved in 70% alcohol. The larva was a second instar, and although even generic identification at this stage of the life cycle is difficult, it did not resemble *P. braueri*, the only *Protocalliphora* known to cause subcutaneous myiasis (Sabrosky et al. 1989). We suspect that the observed larvae in this nest were myiasis-producing scavenger species such as *Phormia regina*. We visited this nest seven additional times during the course of the next 24 days. Larvae were not observed again, and all four remaining nestlings fledged successfully from the nest.

Only a single *Protocalliphora* puparium was found in 92 kestrel nests collected in 1995, and it was identified as *P. avium*. No evidence of *Protocalliphora* infestations were detected in the Boreal Owl nests; however, 60 *P. shannoni* puparia and several emerged adults were found in one Tree Swallow nest, and one House Wren nest had 15 *P. shannoni* puparia. We lack information on whether the uninfested wren and swallow nests successful fledged young or whether they failed early in the nestling period. The condition of the nesting material suggested they did not fledge young. It is generally necessary for nestlings to survive at least 7 to 10 days to allow sufficient time for *Protocalliphora* larvae to reach the third instar stage and pupate, and thus be detectable when nesting material is searched (Bennett and Whitworth 1991).

Discussion

We found little evidence that *Protocalliphora* larvae are common parasites of American Kestrel nestlings in the boreal forest of Saskatchewan. The single puparium encountered in kestrel nests is, to our knowledge, the first report of *P. avium* from American Kestrels. Bortolotti (1985) found all nestling Bald Eagles (*Haliaeetus leucocephalus*) on our study area harbored *P. avium* at some point during their development. *P. avium* is a common species, but is generally found in large open nests in the forest canopy (Sabrosky et al. 1989; Bennett and Whitworth 1992). The presence of *P. avium* in kestrel nests is therefore atypical.

Møller (1989) suggested that removal of old nesting material from nest boxes might reduce levels of some avian ectoparasites. We do not believe this can account for the lack of *Protocalliphora* in our kestrel nests. Previous studies have suggested that parasitism by *Protocalliphora* is not associated with either the presence or absence of old nesting material (Johnson 1996; Rendell and Verbeek 1996) because *Protocalliphora* overwinter as adults, as pupae cannot survive through the winter (Bennett and Whitworth 1991). Adult *Protocalliphora* would certainly have dispersed from the host nest after emergence (Rendell and Verbeek 1996). Moreover, removal of old nesting material may reduce levels of the wasp *Nasonia vitripennis* (Hymenoptera: Pteromalidae), and other pteromalids that attack *Protocalliphora* pupae (Sabrosky et al. 1989).

Although it is tempting to speculate that kestrels are not suitable hosts for *Protocalliphora*, Bennett and Whitworth (1992) reported 33% of kestrel nests in Utah contained *Protocalliphora*, and Balgooyen (1976) suggested up to 25% of nests in the Sierra

Nevada of California can be infested. Biotic or abiotic attributes of our study area also cannot explain the paucity of *Protocalliphora* in kestrel nests. Bortolotti's (1985) previous work, as well as the detection of *P. shannoni* in Tree Swallow and House Wren nests in this study, confirm that *Protocalliphora* exist on our study area. Instead, we suggest that our study area has relatively few *Protocalliphora* species that commonly infest kestrels. Species that are more typically found in kestrel nests, such as *P. sialia* and, to a lesser extent *P. lata* (Bennett and Whitworth 1992), have not been documented in the vicinity of our study area (see Sabrosky et al. 1989), and may therefore not occur on our study area. As the distribution of *Protocalliphora* is very poorly known (Sabrosky et al. 1989), further study is necessary to confirm this.

We conclude that given the low frequency of infestations, *Protocalliphora* are not considered to be a significant factor in the reproductive success of American Kestrels in the boreal forest of Saskatchewan. When subcutaneous myiasis by *Phormia regina* (or *Protocalliphora braueri*) occurs, it is possible that mortality can occur, as we observed for one nestling; however, because of the rarity of this event, we also do not believe that *Phormia* are important parasites for kestrels in the boreal forest. The presence of *P. shannoni* in House Wren and Tree Swallow nests in north-central Saskatchewan expands the known range of this species. Most previous records of *P. shannoni* have come from southeastern Canada and the northeastern United States, plus scattered records from British Columbia, the Yukon, Montana, and Utah (Sabrosky et al. 1989).

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Additional Notes on Vegetation of Dry Openings Along the Trent River, Ontario

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Additions and corrections are provided for two tables which accompanied a recently published description and analysis of dry, open, natural habitats along the Trent River in the eastern portion of southern Ontario. The vascular floras of two additional dry open areas near Crowe Bridge and Campbellford are recorded. The former site is on shallow soil over limestone and includes some of the few examples of alvar plant communities that remain undisturbed and relatively rich in native species along the Trent River system. The latter site is an important addition to the relict limestone savannas that provide an indication of the natural vegetation that once characterized much of the Trent River system. It is also of phytogeographic interest and includes a rich native flora and rare species.

Key Words: alvar, savanna, rare species, vegetation, Trent River, eastern Ontario.

Native vegetation of dry openings has been reduced to a small percentage of its original extent in southern Ontario (Catling and Brownell 1995, in press; Catling and Catling 1993; Catling et al. 1992). The remaining habitats are therefore important for consideration for protection and as an indication of the composition of declining natural vegetation in the southern part of the province. The vascular flora

TABLE 1. Corrections and additions to Appendix Table 1 *in* Catling and Catling 1993, which provided a list of vascular plants of dry, natural openings along the Trent River in eastern Ontario.

Species	Notes
Bouteloua curtipendula (Michx.) Torr., Side Oats Grama	delete 1, add 13
Bromus pubescens Willd., Hairy Brome	delete 6, add 1
Cyperus lupulinus (Sprengel) Marcks, Slender Cyperus	add 6 and 7
Linum sulcatum Riddell, Grooved Yellow Flax	delete 11, add 6
Panicum (*Dichanthelium*) *columbianum* Scribner, Panic Grass	add 3
Panicum (*Dichanthelium*) *depauperatum* Muhl., Panic Grass	delete 2, add 8
Panicum (*Dichanthelium*) *perlongum* Nash, Panic Grass	add 12
Potentilla recta L., Rough-fruited Cinquefoil	delete from table since not native
Salix humilis Marshall, Prairie Willow	add 7
Saxifraga virginiensis Michx., Early Saxifrage	delete 11, add 6
Thuja occidentalis L., Eastern White Cedar	delete 3, add 13
Vaccinium angustifolium Aiton, Low Sweet Blueberry	delete 11, add 6
Viola affinis Le Conte, Le Conte's Violet	add 3
Viola fimbriatula Smith, Arrow-leaved Violet	add 12
Vitis riparia Michx., Riverbank Grape	add 14
Zanthoxylum americanum Miller, Prickly-ash	add 2