J. Field Ornithol., 63(3):286–293

THE EFFECT OF BLOWFLY PARASITISM ON NESTLING EASTERN BLUEBIRD DEVELOPMENT

KARIN WITTMANN AND ROBERT C. BEASON
Biology Department
State University of New York
Geneseo, New York 14454 USA

Abstract.—Blowfly (*Protocalliphora sialia* Shannon and Dobroscky [Diptera: Calliphoridae]) parasitism of nestling Eastern Bluebirds (*Sialia sialis*) was studied in a series of 325 nest boxes located in western New York. The nests were monitored closely and nestling development recorded. The results of this study do not support the hypothesis that blowfly parasitism is detrimental to bluebird nestling development and survival. There was no difference in mass or the length of wing, tail or tarsus between parasitized and unparasitized nestlings, nor was there any difference in the age of the young when they fledged. Survival to fledging did not appear to be adversely affected by parasitism.

EFECTO DEL PARASITISMO DE *PROTOCALLIPHORA SIALIA* (DIPTERA) EN EL DESARROLLO DE PICHONES DE *SIALIA SIALIS*

Sinopsis.—Con una muestra de 325 cajas de anidamiento, se estudió el efecto del parasitismo de la mosca *Protocalliphora sialia* en el dessarrollo de pichones de *Sialia sialis* en una localidad al oeste de New York. Los resultados de este estudio no apoyan la hipótesis que el parasitismo por parte de las moscas es detrimental para el desarrollo y sobrevivencia de los pichones. No se encontró diferencia en la masa corporal, largo del ala, cola o tarso entre pichones parasitados y no-parasitados. Tampoco se encontró diferencia en la edad de los pichones al dejar el nido. La sobrevivencia, hasta alcanzar la etapa de volantones, no pareció ser afectada por el parasitismo.

One hundred and thirty-nine species of birds have been reported as natural hosts of *Protocalliphora* blowflies (Diptera: Calliphoridae) in North America (Sabrosky et al. 1989). Blowfly larvae are obligatory, blood sucking parasites of nestlings. Comparatively large and numerous, blowflies would appear to have a detrimental effect on their hosts. Although the *Protocalliphora* larvae may not ordinarily kill nestlings, under certain conditions they may weaken the nestlings so that a combination of factors results in death (Sabrosky et al. 1989).

The adult blowfly lays its eggs in the bird's nest material. The eggs hatch in 24–48 h (Sabrosky et al. 1989). The larvae feed for 10–13 d until pupation (Hall 1947) by intermittently sucking the blood of the nestlings (Mason 1944). The larvae usually spend most of their time in the nest material and are attached to the nestlings only when they are feeding, although Whitworth (1976) reported that larvae sometimes remain attached to the nestlings for much of their development. The larvae grow to a length of about 15 mm before pupation. The pupae eclose after about 12 d, and the 15-mm adults fly from the nest to continue their life cycle. The species, which morphologically resembles the common metallic blue bottlefly (*Calliphora vomitoria*), probably overwinters as adults (Sabrosky et al. 1989).

Eastern Bluebird (*Sialia sialis*) nests are composed of finely woven grasses and may contain as many as 240 blowfly larvae and pupae, with higher densities in nests with large quantities of nest material (Pinkowski 1977). Another cavity nester, the Tree Swallow (*Tachycineta bicolor*) may sometimes carry a larger parasite load (up to 430 *Protocalliphora* per nest) than the bluebird (Mason 1944). In addition to grasses, Tree Swallow nests contain feathers, which may provide better cover for the parasite.

Pinkowski (1977) reported that, although heavy infestations in bluebird nests were correlated with physiological stress, the parasite load was not the cause of the stress. Food deprivation was cited as the cause for the higher blowfly number and chick mortality in these cases. The weakened condition of the chick from malnourishment may have made it easier for the parasite to attach and feed, hence increasing parasite numbers.

The objective of our research was to determine the sublethal effects of blowfly parasitism on Eastern Bluebird growth and development. Previous work (e.g., Gold and Dahlsten 1983, Mason 1944, Pinkowski 1977, Shields and Crook 1987) dealt with nestling mortality and did not examine sublethal effects such as stunted nestling growth.

METHODS

We studied Eastern Bluebird nestling development from Apr. through Aug. 1989, in 325 nest boxes established in 1986–1988 at the Genesee Country Museum Wildlife Research Center in Mumford, New York. The nest boxes were located in fields, hedgerows, mowed lawns, old fields, along ponds and in areas with heavy pedestrian traffic.

All boxes were checked at least once a week throughout the entire nesting season. After a nest was established, it was checked more frequently with daily checks made from shortly before hatching through fledging. The hatching day was considered day 0, but no measurements were taken. Nestling health was evaluated based on: (1) tarsus length, measured from the tibiotarsal joint to the hind toe base; (2) rectrix length, measured from the center of the tail base to the tip of the longest rectrix; (3) unflattened wing chord, the distance from the bend of the wrist to the tip of the longest primary; and (4) weight, measured with a Pesola balance. The length of the tarsus, tail and wing chord were measured daily on the same arbitrarily selected nestling from each nest. Individual nestlings were identified by marking a toe with a felt tip marker until they were large enough to be banded. No measurements were made after day 14 to avoid premature fledging. These nests were still checked daily to ascertain the date of fledging and nestling mortality. To determine the effects of parasitism, the growth data for the two groups were compared using repeated measures ANOVA. This allowed us to distinguish the effects of parasitism independent of the time effects on maturation that affected all of the birds similarly.

After the young fledged, we collected each nest to determine its weight, composition and blowfly number. Differences in nest weights were assessed with Student's t-test.

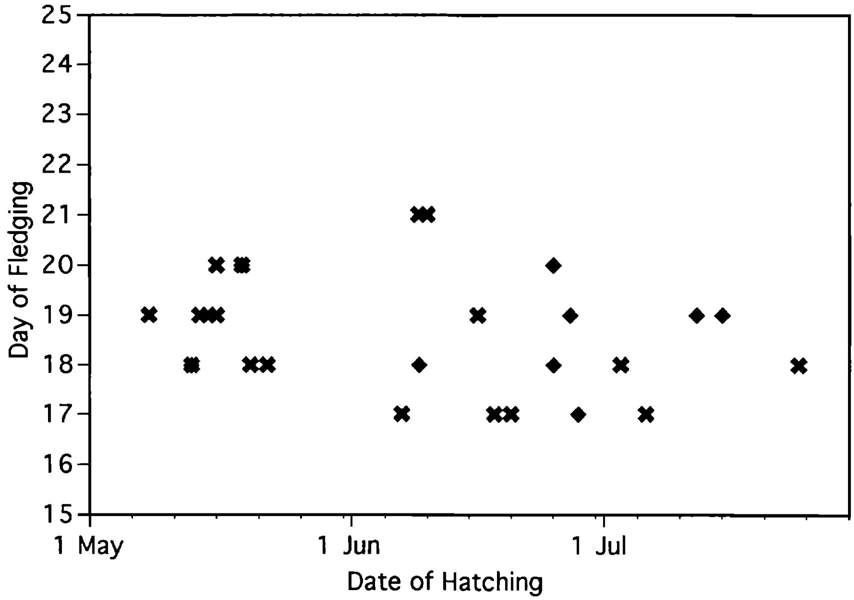


FIGURE 1. The number of days the nestlings remained in the nest compared to their hatching date. Crosses represent unparasitized nests and solid diamonds represent parasitized nests.

RESULTS

The species of blowfly parasitizing the nests was *Protocalliphora sialia* (D. Roby, pers. comm.). This species is found commonly in cavity and non-cavity nests and is one of the most common species of the genus *Protocalliphora* (Sabrosky et al. 1989).

The first bluebird eggs were laid about the same day for three consecutive years: 14 Apr. 1987, 10 Apr. 1988, and 17 Apr. 1989. In 1989, the number of days the young spent in the nest was relatively constant throughout the season, and they did not spend longer times in the nest during the cooler spring period (Fig. 1). The amount of nest material used in nest construction did not vary through the nesting season. The nests contained 20.6–78.1 g of material, with a mean of 41.0 ± 15.75 (SD) g. The average amount of nest material was significantly greater in parasitized nests, 45.85 ± 19.21 g, than in the unparasitized nests, 38.46 ± 12.86 g (t = 4.06, df = 26, $P < 0.05$). In parasitized nests, however, there was no significant relationship (r = 0.35, df = 9, $P >$ 0.05) between the amount of nest material and the number of blowfly larvae (Fig. 2). As the nesting season progressed, the number of young that fledged per nest was relatively constant, in spite of the fact that the number of blowfly larvae and pupae was greater in summer (mean = 36 ± 43 flies/nest in July) than in the spring (mean = 5 ± 12 flies/nest in May).

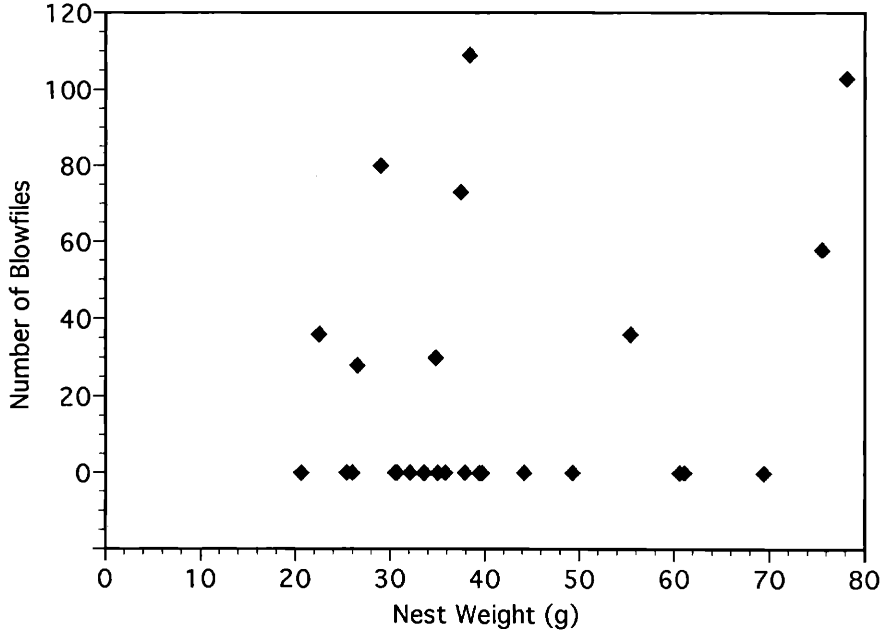
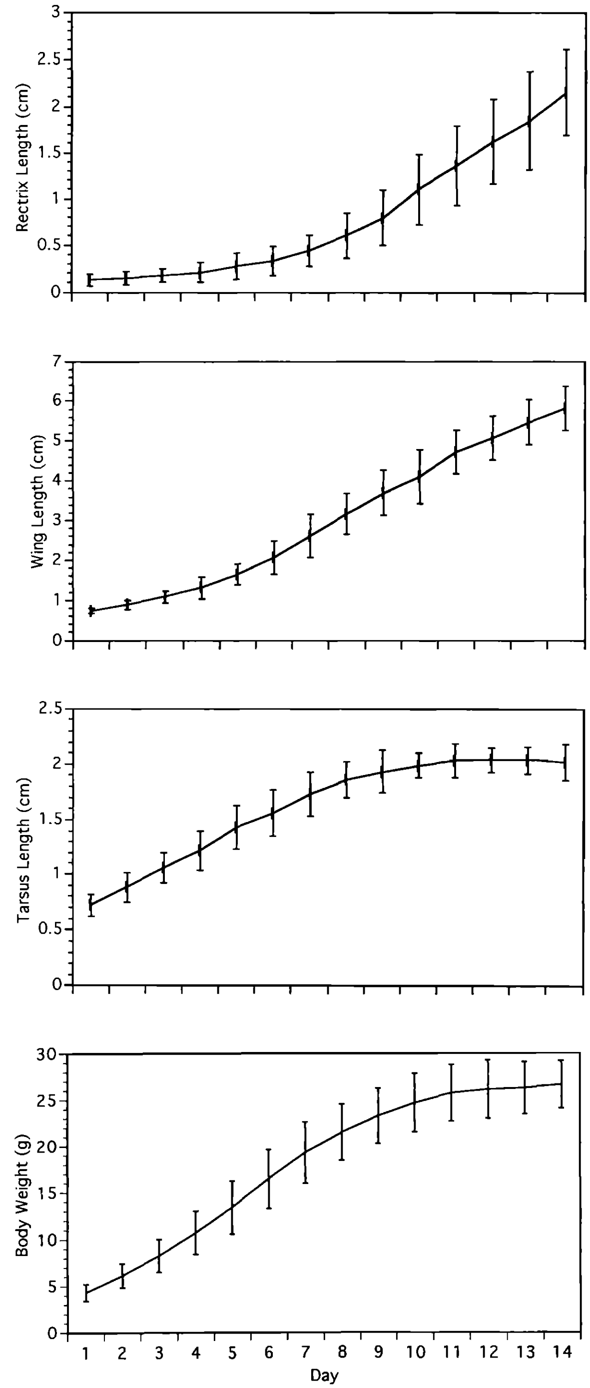


FIGURE 2. The number of blowflies per nest compared to the among of nest material ($n = 18$).

The extent of parasitism by the blowfly varied between years with significantly ($\chi^2 = 11.47$, df = 1, $P < 0.001$) more nests parasitized in 1988 (16 of 25) than in 1989 (10 of 29). Late cold weather may have limited the ability of the blowflies to reach prospective nests in 1989. The maximum number of blowfly larvae in 1989 was 109, less than the level described by Pinkowski (1975) as a heavy parasite load.

The rate of development in parasitized nestlings did not differ (repeated measures ANOVA) from their unparasitized counterparts, based on the growth of wing chord ($F = 0.451$, $P > 0.05$), rectrix length ($F = 0.538$, $P > 0.05$), tarsus length ($F = 0.853$, $P > 0.05$), or body weight ($F = 1.460$, $P > 0.05$). Consequently, the daily growth for these traits were pooled (Fig. 3). Nestling weight increased sigmoidally until day 14 (Fig. 3) when the weight began to level off at about 27.0 g, 90% of the average adult value. The tarsus grew steadily until day 10 and then plateaued at 2.20 cm. Wing and tail development were slow initially, but they grew rapidly after they started (Fig. 3).

There was no significant difference in the number of days from hatching to fledging ($t = 0.073$, df = 108, $P > 0.05$) between unparasitized and parasitized nestlings (18.6 vs. 18.7 d); with the weights of young from parasitized almost identical to young from unparasitized nests at fledging ($t = 0.033$, $n = 108$, $P > 0.05$). Nestling mortality occurred in 20% of


Rectrix Length (cm)
0
0.5
1
1.5
2
2.5
3
Wing Length (cm)
0
1
2
3
4
5
6
7
Tarsus Length (cm)
0
0.5
1
1.5
2
2.5
Body Weight (g)
0
5
10
15
20
25
30
1 2 3 4 5 6 7 8 9 10 11 12 13 14
Day

the parasitized nests and in 31.6% of the unparasitized nests. In most cases only one nestling died per nest in both parasitized and unparasitized nests.

DISCUSSION

The rates of nestling development that we found were similar to those reported by Pinkowski (1975) for Michigan bluebirds, but unlike Pinkowski, we found no difference in the rates of growth between parasitized and unparasitized nestlings. The mean number of blowflies per nest was 60.8, considerably below that reported in Michigan (91.4 blowflies per nest) by Pinkowski (1977). The higher mortality rates of unparasitized nests (31.6% vs. 20% in parasitized nests) in our study occurred early in the spring, when few nests had blowflies, and were the result of cold weather and starvation. The low blowfly population in the spring is the result of winter mortality.

Other researchers also have reported that blowflies had little effect on nestling mortality. Whitworth (1976) found that the number of young fledging for several avian species was not reduced substantially for heavily infested nestlings, but the young did experience significantly slower rates of weight gain. Gold and Dahlsten (1983), studying Mountain Chickadees (*Parus gambeli*) and Chestnut-backed Chickadees (*P. rufescens*), attributed no mortality to the blowfly even though some birds had large numbers of blowfly parasites. They did feel, however, that the stresses faced by a young, inexperienced bird right after fledging may be aggravated by the blowfly parasite.

Shields and Crook (1987), on the other hand, reported that *Protocalliphora braueri* is a major cause of nestling mortality in the Barn Swallow (*Hirundo rustica*) at Cranberry Lake, New York. The effects of this parasite may be different because it produces damage as a result of burrowing through subcutaneous tissues and is lethal if it tunnels through vital organs (Hicks 1964).

The impact of blowfly parasitism may be more severe under conditions of food stress and when the blowfly number is very great. For example, Pinkowski (1977) found mortality rates of 10% in unparasitized nests and 34% in heavily parasitized nests. The risk of mortality may be greater for nestlings that are supporting a large number of parasites and then experience a food shortage, possibly caused by the loss of a parent or extreme weather. Nestlings are often lost under conditions of food shortage regardless of the presence of blowflies, as indicated by the high mortality rates in the spring of our study when there were no parasites present.

Pinkowski (1977) also found more larvae in the summer (32.3 larvae per nestling) than in the spring (11.9 larvae per nestling). Many of our

←

FIGURE 3. Nestling development during the first 14 days after hatching. Horizontal bar = mean and vertical bar = standard deviation. (n = 110 for weight and n = 30 for the other measurements.)

early nests had no blowfly parasites. Strong winds and rain were more prevalent in spring and may have made it difficult for the adult flies to move about. Early nestlings may not have the large amounts of food available to them that were available later in the season for the same reason. Therefore, in spring there were fewer parasites and less food. There was no difference, however, in the time required for the young to develop in spring vs. summer nests, as might be expected because of the lesser amount of food available in the spring. The number of young fledged was relatively constant throughout the nesting season, indicating that if there was any impact of blowflies in the summer it must have been offset by the extra food available.

The presence of blowflies in the nest appeared to be influenced by time of year, amount of nest material and weather. The amount of material used to build the nest was relatively constant throughout the nesting season ($r^2 = 0.065$, $n = 28$, $P > 0.05$). When blowflies were present, our observations do not support the conclusion of Pinkowski (1977) that there is a direct correlation between blowfly number and the amount of nest material (Fig. 2).

Based on these results, we believe that blowfly removal techniques such as chemicals, nest replacement and painting boxes may not be warranted. Dusting the nest with 0.5–1% rotenone powder sometimes is used as protection against blowflies (Zeleny 1986). This dusting is not necessary because the blowflies are not a great burden and the chemical may be detrimental to the nestlings or to *Nasonia vitripennis* (Pteromalidae: Hymenoptera), the parasitoid wasp that reduces the number of blowflies surviving past the pupal stage. The wasp lays its eggs on the puparia and its larvae develop inside the puparia, eating the developing blowflies.

It is difficult to ascertain what causes nestling mortality when one considers all the stresses faced by nestlings. Whitworth (1976) summarized some of the many factors involved: (1) adverse weather, (2) starvation, (3) poor parental care, (4) disease, and (5) parasites. Factors other than parasitism that cause mortality may not be observable when the dead nestling is found. Weather changes, starvation, poor adult care and disease require close observation. The blowfly is a stress to the nestlings that appears to be much less severe than often perceived.

ACKNOWLEDGMENTS

This paper is from a thesis submitted to fulfill, in part, the requirements of a Master of Art's degree. We would like to thank the Genesee Country Museum and Nature Center for generously letting us study on their bluebird trail and use their equipment. Daniel D. Roby introduced us to the bluebird/blowfly/wasp interaction. R. N. Conner, P. A. Gowaty, M. P. Lombardo, and K. Yasukawa provided many helpful comments on earlier versions of the manuscript. Finally, a special thanks to the volunteers who checked the nest boxes weekly, rain or shine.

LITERATURE CITED

GOLD, C., AND D. DAHLSTEN. 1983. Effects of parasitic flies (*Protocalliphora* spp.) on nestlings of Mountain and Chestnut-backed Chickadees. Wilson Bull. 95:560–572.

HALL, D. G. 1947. The Blowflies of North America. Thomas Say Foundation, Baltimore, Maryland. 477 pp.

HICKS, E. A. 1964. On the occurrence of insects in birds' nests. Iowa State College Press, Iowa. 681 pp.

MASON, E. A. 1944. Parasitism by *Protocalliphora* and management of cavity nesting birds. J. Wildl. Manage. 8:232–247.

PINKOWSKI, B. C. 1975. Growth and development of Eastern Bluebirds. Bird-Banding 46:273–289.

———. 1977. Blowfly parasitism of Eastern Bluebirds in natural and artificial nest sites. J. Wildl. Manage. 41:272–276.

SABROSKY, C. W., G. F. BENNETT, AND T. L. WHITWORTH. 1989. Bird blowflies (*Protocalliphora*) in North America (Diptera: Calliphoridae) with notes on the Palearctic species. Smithsonian Institution Press, Washington, DC. 312 pp.

SHIELDS, W., AND J. CROOK. 1987. Barn Swallow coloniality: a net cost for group breeding in the Adirondacks? Ecology 68:1373–1386.

WHITWORTH, T. L. 1976. Host and habitat preferences, life history, pathogenicity and population regulation in species of *Protocalliphora* Hough (Diptera: Calliphoridae). Ph.D. thesis, Utah State University, Logan, Utah.

ZELENY, L. 1986. The bluebird parasitic blowfly. Sialia 8:136–138.

Received 26 Jul. 1991; accepted 1 Oct. 1991.