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Effects of *Protocalliphora braueri* (Diptera: Calliphoridae) Parasitism and Inclement Weather on Nestling Sage Thrashers

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ABSTRACT: Infection with blow fly larvae (*Protocalliphora braueri*) had no effect on sage thrasher (*Oreoscoptes montanus*) nestling weight or size at fledging nor on mean fledging age. However, the combination of cold, wet weather and parasite infection did significantly reduce nestling survival and the percent young fledged.

Key words: Blow fly larvae, *Protocalliphora braueri*, sage thrasher, *Oreoscoptes montanus*, nestling survival, nestling size, ectoparasites of birds.

Larvae of the bird blow fly (*Protocalliphora braueri*) have been reported to parasitize nestlings of many North American birds (Garrison et al., 1986; Halstead, 1988; Eastman et al., 1989; Gold and Dahlsten, 1989; Sabrosky et al., 1989). Howe (1991) found *P. braueri* larvae infecting 38% (n = 40) of the sage thrasher (*Oreoscoptes montanus*) nests on a site in southern Blaine County, Idaho (USA, 43°14′N, 114°16′W). The purpose of this paper is to address what effects, if any, parasitism by *P. braueri* had on these nestling sage thrashers.

Sage thrashers nested from late April through July. Nestlings were altricial but grew rapidly and fledged 10.3 ± 0.14 (SE) days post hatch (n = 84, range = 8 to 13) at an average weight of 34.4 ± 0.50 g (n = 83). Adults produced a mean of 3.5 ± 0.27 young/successful nest (i.e., nest from which at least one young was fledged).

Most bird blow flies live in nest material and feed intermittently on host blood; however, *P. braueri* burrow into the subcutaneous tissue of their hosts. Despite this myiasis producing habit *P. braueri* larvae are obligate hematophores which require 1 to 3 blood meals to mature (Sabrosky et al., 1989). Larvae were visible for 4 to 5 days on nestling sage thrashers and frequently matured by the time the nestlings fledged.

Sage thrasher nests were monitored every other day from discovery until nestling age reached 8 days. Each day after 8 days until fledging, young were weighed to the nearest 0.5 g, and standard length measurements were taken to the nearest 0.01 mm of the number nine primary feather, wing, tarsus, and foot. Fledging measurements were defined as the last weights and lengths taken before nestlings fledged. In successful nests, mean fledging age and percent young surviving from hatch to fledging were calculated.

For each of the fledging measurements, I tested the null hypothesis that nonparasitized nestlings were the same size as parasitized nestlings. Because I predicted that parasitized nestlings would be smaller than non-parasitized nestlings, one-tailed tests of significance were performed for all fledging measurements using SAS GLM ANOVA (SAS Institute, Inc., 1988). Differences in mean fledgling age (two-tailed test) and arcsine transformations of percent young fledged (one-tailed test) were also tested with ANOVA. Differences in individual nestling survival as a function of parasitism were tested with the χ^2 statistic (SAS Institute, Inc., 1988). Power (1-*beta*) was calculated *a posteriori* for all non-significant test results using an *alpha* level of 0.05 for two-tailed tests and 0.10 for one-tailed tests.

Blow fly larvae were collected from nestlings in three nests. Larvae were collected in a manner which would not bias the results, i.e., nestling age was at least 10 days and larvae were visibly present for at least 4 days. To facilitate identification, larvae were reared to adults in screen-covered glass containers filled with sawdust.

Protocalliphora braueri parasitism had no significant effect on any of the fledging measurements of nestling sage thrashers in either year ($P > 0.05$). Because of a small sample size in 1989 ($n = 22$) and large natural variance in some measurements during both years, power to detect a 5% difference was poor for primary feather lengths (0.16 to 0.35), poor to moderate for wing length and weight (0.27 to 0.60), but good for tarsus and foot lengths (0.75 to 1.00). Power to detect a 10% difference was good (>0.75) for all 1990 measurements and all except primary feather (0.32) and wing (0.65) measurements in 1989.

Parasitism did have a marked influence on mortality of nestlings in 1990. Nine of 34 parasitized nestlings perished while only one of 27 uninfected nestlings died ($\chi^2 = 5.95$, 1 df, $P = 0.02$). This effect was not seen in 1989 when all nestlings, regardless of parasitism, survived. The percent of nestlings fledged/successful nest ($n = 14$) also was significantly less for parasitized nests in 1990 ($P = 0.01$). The test to determine differences in percent fledged was not performed for 1989 data because of the low sample of nests ($n = 7$) in that year. The average fledging age was not affected by blow fly parasitism in 1989 ($n = 22$, $P = 0.09$) or 1990 ($n = 51$, $P = 0.62$); power to detect a 1-day difference in mean fledging age was good both years (0.75 and 0.84, respectively).

The effects of *P. braueri* parasitism on sage thrasher nestling survival in 1990 were confounded by the effects of cold, wet weather during the observation period; all mortality occurred during a period of inclement weather from 24 May to 2 June. Nestlings were not exposed to any such period of inclement weather in 1989. It appeared that the combination of parasitism and poor weather in 1990 caused the observed decreases in nestling survival and percent young fledged.

Sabrosky et al. (1989) reviewed whether *Protocalliphora* spp., and *P. braueri* in particular, have caused direct mortality of nestlings. They concluded that the larvae do not usually directly kill their hosts, but "may so weaken the young that other factors will be lethal or will combine . . . to cause death." Eastman et al. (1989) found that *P. braueri* larvae did not appear to affect the survival of house wren (*Troglodytes aedon*) nestlings in Wyoming. However, Shields and Crook (1987) found that *P. hirundo* (a synonym of *P. braueri*) appeared to be a major source of barn swallow (*Hirundo rustica*) nestling mortality in the Adirondacks; they also found significant decreases in the percent nest success in parasitized nests.

Eastman et al. (1989) also found that parasitism did not affect the size of nestlings at fledging (nestling day 12) as measured by tarsus length. Arendt (1985) and Shields and Crook (1987) point out that while weights of parasitized and non-parasitized nestlings may not be different at fledging, the parasitism may alter nestling growth patterns earlier in the nestling period.

In order to reduce nest disturbance during the early nestling stage, I did not measure growth of sage thrasher nestlings throughout the nestling period, and thus could not determine effects of parasitism on growth patterns. However, I did use several measurements of nestling size after 8 days, and found no significant differences in nestling sage thrasher size or weight attributable to *P. braueri* parasitism. Nest disturbance during the late nestling stage probably caused some premature fledging of young; however, this would not have biased results of the study since both parasitized and non-parasitized birds were treated similarly.

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