Journal of Avian Biology

JAV-02424
Williams, H. M. and DeLeon, R. L. 2020. Using artificial intelligence classification of videos to examine the environmental, evolutionary and physiological constraints on provisioning behavior. – J. Avian Biol. 2020: e02424

Supplementary material

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Supplementary Material Appendix 1

i) Estimating Daily Blowfly Volumes

We harnessed information on the life cycle of blowfly and our nest collection abundance counts (3 collections per nest for parasite reduction treatment nests and 1 collection for each control nest) to estimate a daily nest blowfly volume. Adult blowfly females enter nests and oviposit, typically within a few days of bird eggs hatching (Sabrosky et al. 1989). Development of the eggs and larva is temperature dependent (Dawson et al. 2005), but is typically 2 days for egg hatch, 11 days at the larval stage and 12 days at the pupal stage, where only the larval stage is blood feeding (Gold and Dahlsten 1983, Bennett and Whitworth 1991). Although larval growth curves are not well documented in *Protocalliphora*, they are available for members of another genus in the family (*Calliphora spp*.), in which larval mass typically peaks after two thirds of the developmental duration and then declines at a similar rate (Donovan et al. 2006). We used the 90th percentile of our distribution of blowfly larval volumes (235 mm^3) to represent the peak mean larval volume and assumed, following the *Calliphora spp*. model (Donovan et al. 2006), that this was achieved at day 9. We assumed linear growth from day 1-9 of the larval stage and the same rate of linear decline in day 10-11.

In control nests (only collected after birds have fledged), we sometimes collected pupae (where the blowfly is still in the pupal stage) and sometimes collected pupal cases (from which the new adult blowfly had already emerged), but never a mixture of both and never larvae. Under the assumption of a single oviposition event (which is supported by larval sizes generally being similar at individual nest collections in parasite reduction nests and the absence of mixed collections of pupae and pupal cases in control nests) and the assumption that blowfly eggs were never laid prior to purple martin egg hatching (as the adults are thought to use olfactory detection of nestlings as an oviposition cue (Sabrosky et al. 1989)) we used knowledge of the blowfly lifecycle to constrain the possible days that larvae could have been blood feeding. For example, when we collected empty pupal cases from a nest collected after birds fledged at 28 days, we reasoned that the larval stage (11-day duration) must have occurred between day 5 and 16 at the latest (to allow for adult emergence prior to the nest collection) or day 2 to 13 at the earliest (to allow for development of eggs and adults with an oviposition date equal to the martin hatch date). Similarly, when we collected occupied pupae from a nest collected after birds fledged at 28 days, we reasoned the larval stage must have occurred between day 16 and 27 at the latest (to allow for development from larvae to pupa before day 28) or day 6 to 17 at the earliest (any earlier and the adults should have already emerged).

For each control nest, we calculated the most likely volume of blowfly larva per day, based on the abundance of pupae/pupal cases, the constrained probabilities of the timing of the larval stage and the modeled growth rate of the larvae. As the possible larval period was spread over a range of days, we summed the potential daily larval volumes for each possible larval age and divided by the number of potential larval ages. This resulted in a single probabilistic estimate of larval volume for each day of nestling development.

In experimental nests, we exclusively collected blowfly in the larval stage. We measured length and width; estimated the volume of these larvae, and used our modeled larval growth rate to determine for how many days the larva had been in the blood-feeding phase by matching the observed volumes to the closest modeled daily volume. We then estimated daily blowfly larval volume for each day from collection back to the estimated egg hatch day. We assumed that all blowfly larvae were removed from nests during nest changes, but allowed for the possibility that eggs were missed during collections.

ii) Estimating Daily Mite and Flea Volumes

Both fleas and mites complete their entire lifecycles from egg, to egg laying adult within the nest environment. We expect overlapping generations and exponential growth of the population (at least over the limited time span considered here) (Maurer and Baumgartner 1992, Tripet and Richner 1999). Thus, given an assumed population size of zero at the beginning of nestling development ($t = 0$), the natural log of population size at time, t, is equal to the product of the rate of increase, r, and nestling age (Maurer and Baumgartner 1992, Tripet and Richner 1999). Daily flea and mite loads for each nest were thus calculated by presuming exponential decay from the population size at the time nests were collected (3 collections for parasite reduction treatments, and a single collection for control nests) back to zero at either the time of the previous nest collection or nestling hatch day. Volumes were then obtained by multiplying these daily abundances by the volume estimates for each species.

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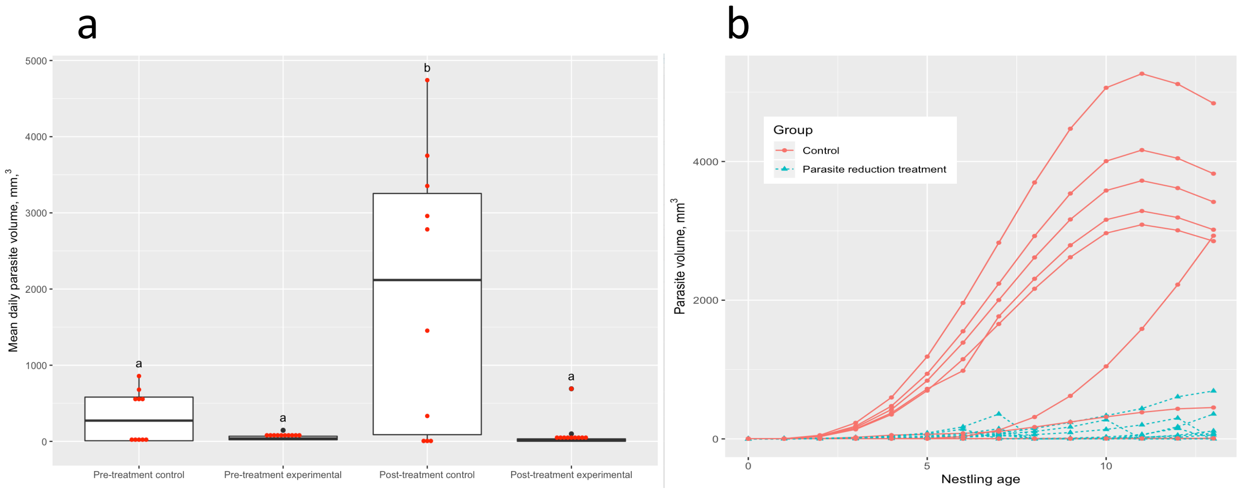

Figure A1 – A) Box and whisker plot showing mean daily parasite volume per nest in each of the experimental conditions. Red points show actual data. Groups with statistically different parasite volumes are shown with different letters (a and b) above bars. Parasite load is significantly higher in the post-treatment control group than in any other group. B) Plot showing growth in parasite load over the first half of nestling development. Each line shows a single nest.

Table A1 - AIC model selection data for variable selection for the main random forest model; the alternate random forest model (which includes the combined effect of all three nest ectoparasites as a predictor); and the main general linear mixed model (GLMM). The most parsimonious (Δ AIC=0) models are shown in bold for each dependent variable. The top 10 model are shown for the GLMM and variance explained refers to the conditional R^2 value.

Variables included	**k**	**Variance explained**	**Δ AICc**
Main Model			
Nestling age, brood size, temperature, rainfall, wind speed, blowfly volume, time of day, adult female age, adult male age, nest ID, hatch date	11	0.43	289.3016137
Nestling age, brood size, temperature, rainfall, wind speed, blowfly volume, time of day, adult female age, nest ID, hatch date	10	0.43	243.2635882
Nestling age, brood size, temperature, rainfall, wind speed, blowfly volume, time of day, nest ID, hatch date	9	0.43	178.7636351
Nestling age, brood size, temperature, wind speed, blowfly volume, time of day, nest ID, hatch date	8	0.43	186.5475643
Nestling age, brood size, temperature, wind speed, time of day, nest ID, hatch date	7	0.43	153.0705202
Nestling age, temperature, wind speed, time of day, nest ID, hatch date	6	0.43	49.09343597

Nestling age, temperature, time of day, nest ID, hatch date	5	0.42	157.659562
Nestling age, temperature, time of day, nest ID	4	0.42	68.8286494
Nestling age, temperature, nest ID	3	0.39	741.4857277
Nestling age, temperature	2	0.29	2267.982566
Nestling age	1	0.18	3535.19645
Nestling age, temperature, wind speed, time of day, nest ID, hatch date, blowfly volume	7	0.42	96.11101231
Nestling age, temperature, wind speed, time of day, nest ID, blowfly volume	**6**	**0.42**	**0**
Nestling age, temperature, time of day, nest ID, blowfly volume	5	0.41	101.1983445
Nestling age, temperature, time of day, nest ID, blowfly volume, rainfall	6	0.43	94.60119932
Alternate model			
Nestling age, brood size, temperature, rainfall, wind speed, parasite volume, time of day, adult female age, adult male age, nest ID, hatch date	11	0.43	247.3838697
Nestling age, brood size, temperature, rainfall, wind speed, parasite volume, time of day, adult female age, nest ID, hatch date	10	0.42	218.6777649

Nestling age, brood size, temperature, rainfall, wind speed, parasite volume, time of day, nest ID, hatch date	9	0.43	163.529885
Nestling age, brood size, temperature, wind speed, parasite volume, time of day, nest ID, hatch date	8	0.42	164.6427215
Nestling age, temperature, wind speed, parasite volume, time of day, nest ID, hatch date	7	0.42	71.36061632
Nestling age, temperature, wind speed, time of day, nest ID, hatch date	6	0.42	52.27151782
Nestling age, temperature, time of day, nest ID, hatch date	5	0.42	160.8376439
Nestling age, temperature, time of day, nest ID	4	0.42	72.00673125
Nestling age, temperature, nest ID	3	0.39	2269.160648
Nestling age, temperature	2	0.29	3536.374532
Nestling age, temperature, wind speed, time of day, nest ID, hatch date, parasite volume	7	0.43	95.46559651
Nestling age, temperature, wind speed, time of day, nest ID, parasite volume	**6**	**0.42**	**0**
Nestling age, temperature, time of day, nest ID, parasite volume	5	0.43	102.3764263
Nestling age, temperature, time of day, nest ID, blowfly volume, rainfall	6	0.43	95.77928117
GLMM			

Figure A3 – Plots showing the predicted relationships between provisioning rate and the predictor variables supported by AICc model selection in the GLMM model.