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**ANIMAL SCIENCE**

# New avian hosts for *Taphropiestes plaumanni* (Coleoptera: Cavognathidae) and the record of nestlings skin lesions and body deterioration associated with parasitism

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**Abstract:** We collected data during three consecutive breeding seasons (2015-2018) to assess the effects of *Taphropiestes plaumanni* (Coleoptera: Cavognathidae) on its bird hosts in a native forest of central eastern Argentina. We monitored bird nests for *T. plaumanni* in 207 nests of Masked Gnatcatcher (*Polioptila dumicola*, Polioptilidae), 302 nests of Vermilion Flycatcher (*Pyrocephalus rubinus*, Tyrannidae), 55 nests of Blue-and-yellow Tanager (*Pipraeidea bonariensis*, Thraupidae), 99 nests of Small-billed Elaenia (*Elaenia parvirostris*, Tyrannidae), 23 nests of Yellow-browed Tyrant (*Satrapa icterophrys*, Tyrannidae), and other passerine species nesting in the same forest patches. We found 13 nests in which nestlings showed evidences of parasitism of which four species are new hosts for this parasite (Vermilion Flycatcher, Masked Gnatcatcher, Red-crested Cardinal *Paroaria coronata*, Thraupidae, and Fork-tailed Flycatcher *Tyrannus savana*). Skin lesions caused by *T. plaumanni* larvae consisted in lacerations and crusts on the belly and chest areas. In one parasitized nest of Vermilion Flycatcher and one parasitized nest of Masked Gnatcatcher we observed the death of nestlings after being parasitized. This study adds new species to the list of hosts for this parasite, reports nestling skin lesions in nests with *T. plaumanni* parasitism, and reports for the first time the death of parasitized nestlings.

**Key words:** Argentina, beetles, bird parasite, South America.

## INTRODUCTION

Among bird parasites (Loye & Carroll 1995, 1998) there is a poorly known group of beetles of the family Cavognathidae (Coleoptera: Cucujoidea) that inhabit birds' nests (Di Iorio & Turienzo 2016, Ślipiński & Tomaszewska 2010, Watt 1980). All 9 species of the family have been included in the genus *Taphropiestes* Reitter 1975, three from South America, two from Australia and four from New Zealand (Ślipiński & Tomaszewska 2010). The South American species (*T. fusca* Reitter, *T. magna* Ślipiński and Tomaszewska and *T. plaumanni* Ślipiński and Tomaszewska) are present in Argentina (Di Iorio & Turienzo 2016, Ślipiński & Tomaszewska 2010). Although little is known about the life cycle of these group of beetles, they are often regarded as bird parasites (Ślipiński & Tomaszewska 2010). Within the genus, at least *T. plaumanni* accomplishes the entirety of its life cycle inside birds' nests, with adults being found in nests throughout the year and larvae and pupae from November to April (Di Iorio & Turienzo 2016).

Although the list of avian hosts for the genus *Taphropiestes* has been increasing since the first reports (Crowson 1964, Di Iorio & Turienzo

2016, Ślipiński & Tomaszewska 2010, Watt 1980), and up to date 19 host birds have been reported for *T. plaumanni* in Argentina (Di Iorio & Turienzo 2015, 2016, Gonzalez et al. 2019, L.M. Ibañez, unpublished data, Liébana et al. 2020), evidence of direct interactions with hosts are still scarce (Di Iorio & Turienzo 2016). Previous studies reported signs of dermatitis caused by *T. plaumanni* on the nestlings of the Tufted Tit-Spinetail (*Leptasthenura platensis*), House Wren (*Troglodytes aedon*) and Common Starling (*Sturnus vulgaris*) (V.A. Cuaranta, L.M. Ibañez LM & M.E. Rebollo, unpublished data). Nonetheless, despite these reports, little is known about the parasite- host interaction, especially if they have a detrimental effect on the adult or nestling host birds (Di Iorio & Turienzo 2016, Ślipiński & Tomaszewska 2010). In this study we present novel data on the interaction between *T. plaumanni* and the bird hosts, and report for the first time detailed information on the negative effect of this parasite on birds' nestlings.

## MATERIALS AND METHODS

### Ethics statement

Research permits to conduct the study were granted by the local environmental authority (OPDS #17717, Dirección de Areas Naturales Protegidas, Buenos Aires province, Argentina).

### Study site

The study was conducted in a forest in northeastern Buenos Aires province, Argentina, locally known as 'Talares', located between Punta Indio and Verónica villages (35º 20' S, 57º 11' W). The area is composed of grasslands and semi-open forests dominated by the native trees tala (*Celtis tala*, Cannabaceae) and coronillo (*Scutia buxifolia*, Rhamnaceae) and including well represented exotic species like eucalyptus (*Eucalyptus camaldulensis*, Myrtaceae) and poplar (*Populus* spp., Salicaceae), among others (Arturi & Goya 2004). Our study site comprises 600 ha of the Wildlife Refuge 'Bahía Samborombón' (Dirección de Áreas Naturales Protegidas, Organismo Provincial para el Desarrollo Sostenible). This region has been under a continuous degradation due to the expansion of its agricultural and urban borders, and to wood and soil extraction, livestock farming and exotic trees plantations (Arturi & Goya 2004). The weather is characterized by warm, rainy summers with most precipitation occurring between October and March. The National Meteorological Service of Argentina reports an annual rainfall of 1023 mm and mean annual temperature of 16º C for the period 1981–2010.

### Data collection and analysis

During three breeding seasons (October to February of 2015-2016, 2016-2017 and 2017-2018), we systematically searched and monitored nests of Masked Gnatcatcher (*Polioptila dumicola*, Polioptilidae), Vermilion Flycatcher (*Pyrocephalus rubinus*, Tyrannidae), Blue-and-yellow Tanager (*Pipraeidea bonariensis*, Thraupidae), Small-billed Elaenia (*Elaenia parvirostris*, Tyrannidae) and Yellow-browed Tyrant (*Satrapa icterophrys*, Tyrannidae). In addition, and non-systematically, we searched and monitored nests of other passerine species that nest in the same forest patches. Nests were found by searching in potential nest sites and by observing and following territorial pairs. We visited nests daily near the hatching dates and every 2–3 days during the nestling stage. Nestlings were marked with nontoxic waterproof ink for individual identification and were carefully inspected in searching for evidence of parasitism during each visit. We monitored all nests until nestlings fledged or the nest failed. We considered a nest successful when at least one nestling left the nest and depredated if the nestlings disappeared from their nests before they were old enough to fledge and no parental activity was detected near the nest. A nest was considered parasitized by *Taphropiestes* spp. when we directly observed the larvae on the nestlings or in the nest material. In all cases, we first observed skin lesions on the nestlings and then identified the larvae associated with the nest material. We considered a decline in nestling body condition when we observed a progressive deterioration of body mass and an increased weakening (reduced movements) in subsequent nest visits. Parents regularly continued to attend the nest until the nestlings died.

### Parasite identification

Identification of the parasite at the species level was made based on the key of Ślipiński & Tomaszewska (2010) and the diagnosis from Di Iorio & Turienzo (2016), and compared with reference specimens hosted in the La Plata Museum (Museo de La Plata, Facultad de Ciencias Naturales y Museo). Collected insects used for the identification were four adults and 27 larvae found in the nests that represent only a discrete sample of the total number of parasites observed. For adult identification, we noted the characters such as the oval pits connected by an arcuate groove on the dorsal surface of the head, antenna length and antennomeres features, among others. For the larvae we observed mandibles features, antennae articulation, thoracic and abdominal tergites and urogomphi features (Di Iorio & Turienzo 2016, Ślipiński & Tomaszewska 2010). Adults and larvae were preserved in glass vials (with 96% ethanol). Entire specimens or their parts were dissected and cleared in 10% solution of KOH and submerged in glycerin for microscopic examination according to standard taxonomic techniques. All specimens studied were deposited in the La Plata Museum collection.

## RESULTS

The analysis of the parasitic insects indicated that both adult and larva specimens were *T. plaumanni*. We found and monitored 207 nests of Masked Gnatcatcher, 302 nests of Vermilion Flycatcher, 55 nests of Blue-and-yellow Tanager, 99 nests of Small-billed Elaenia, and 23 nests of Yellow-browed Tyrant. From these nests, six of Vermilion Flycatcher (2%), one of Masked Gnatcatcher (0.5%), and three of Yellow-browed Tyrant (13%) were parasitized by *T. plaumanni*. No evidence of parasitism were found for Small-billed Elaenia and Blue-and-yellow Tanager. For other species monitored we found one nest of Chalk-browed Mockingbird (*Mimus saturninus*, Mimidae), one of Red-crested Cardinal (*Paroaria coronata*) and one of Fork-tailed Flycatcher (*Tyrannus savana*) whose nestlings were parasitized by *T. plaumanni*. All parasitized nests had been built in the native tree *C. tala* with a mean nest height above ground being 3 ± 0.4 m (see Table I for more details of each nest). In all the cases we observed skin lesions on the belly and chest areas of nestlings that consisted of lacerations and crusts on the affected areas (Figure 1a, b). Both of these areas are often in direct contact with the base of the nest. *T. plaumanni* larvae always flee when we removed nestlings from nests, and would burrow into the nest material or hide in the nestlings' feathers.

In one parasitized nest of Vermilion Flycatcher and one of Masked Gnatcatcher there was a single nestling with severe skins lesions produced by *T. plaumanni* larvae, what could have been associated with the nestling death (Table I, Figure 2). The nest of Masked Gnatcatcher had one 6-day old nestling when the first signs of skin lesions appeared and a

**Table I.** **Nests parasitized by *Taphropiestes plaumanni* larvae. *VF* = Vermilion Flycatcher (*Pyrocephalus rubinus*), *MG* = Masked Gnatcatcher (*Polioptila dumicola*), *YBT* = Yellow-browed Tyrant (*Satrapa icterophrys*), *RCC* = Red-crested Cardinal (*Paroaria coronata*), *CBM* = Chalk-browed Mockingbird (*Mimus saturninus*), *FTF* = Fork-tailed Flycatcher (*Tyrannus savana*). Latency = time elapsed from hatching to skin lesions detection date (in days); # Nestlings with skin lesions / # Nestlings = number of nestlings with skin lesions / number of nestlings present in the nest.**

| Species | Skin lesions detection date | Latency | Nest height from the ground (m) | # Nestlings with skin lesions/# Nestlings | Fate |
|---|---|---|---|---|---|
| *VF* | 26.XII.2015 | 8 | 1.75 | 1/3 | Predated |
| *VF* | 09.XI.2017 | 10 | 5.25 | 1/2 | Successful |
| *VF* | 20.XI.2017 | 9 | 2.50 | 2/2 | Predated |
| *VF* | 17.XI.2017 | 7 | 3.65 | 1/2 | Successful* |
| *VF* | 23.XII.2017 | 10 | 2.15 | 2/2 | Successful |
| *VF* | 11.I.2018 | 11 | 2.80 | 2/2 | Successful |
| *MG* | 18.XI.2017 | 6 | 2.15 | 1/1 | Failed** |
| *YBT* | 04.XII.2017 | 12 | 2.10 | 1/3 | Successful |
| *YBT* | 17.XII.2017 | 11 | 6.10 | 1/3 | Predated |
| *YBT* | 28.XI.2017 | 9 | 3.50 | 1/3 | Successful |
| *RCC* | 11.XII.2015 | 8 | 1.65 | 1/2 | Successful |
| *CBM* | 22.XII.2015 | 8 | 1.70 | 1/3 | Predated |
| *FTF* | 13.I.2016 | 12 | 3.50 | 1/1 | Successful |

***Successful nest where one nestling deteriorated and died after the detection of *T. plaumanni* parasitism. **The only nestling in the nest deteriorated and died after the detection of *T. plaumanni* parasitism.**

deteriorating body condition was first noted. In the next visit (when 9-days old), the nestling was in worse conditions, had a large laceration and barely moved (Figure 1b). Finally, the next day the nestling had died and was found laying on the ground covered by ~20 larvae (Figure 1c, 2a). The nest of Vermilion Flycatcher had two 7-day old nestlings when we observed larvae on the nestlings for the first time (but no skin lesions). The next visit, when nestlings were 9-days old, the smaller nestling showed signs of skin lesions and looked weak (Figure 2b). Finally, at 12-days old the affected nestling had died (Figure 1d). The larger nestling never showed signs of skin lesions nor did it look weak (Figure 2).

## DISCUSSION

This study provides detailed data of skin lesions caused by *T. plaumanni* larvae in several avian species, adds new species to the list of hosts for this parasite, and reports for the first time the death of parasitized nestlings. At present, there is no consensus on whether the larvae does cause any type of injuries or lesions on its hosts (Di Iorio & Turienzo 2016, Ślipiński & Tomaszewska 2010). Particularly for *T. plaumanni*, some studies report that the larvae can cause dermatitis on the nestlings (Di Iorio & Turienzo 2016, L.M. Ibañez, unpublished data, Liébana et al. 2020), but others have not found any association (Turienzo & Di Iorio 2008). In this regard, Di Iorio & Turienzo (2016) recommend caution, stating that observed cases could be the results of other parasites. Although in our study we did not carry out specific histological studies to determine the cause of the nestling death (in the strict sense), the deterioration in the nestling body condition prior to its death was closely associated with the presence of


**Figure 1. Nestlings with skin lesions in nests parasitized by *Taphropiestes plaumanni* larvae. a) Fork-tailed Flycatcher (*Tyrannus savana*) nestling with crust and lacerations in the belly, where a larvae is half burrowed in the affected area (circle); b) Masked Gnatcatcher (*Polioptila dumicola*) nestling with crusts and lacerations in the belly and subcaudal areas; c) The same Masked Gnatcatcher nestling found dead on the ground covered by at least 17 larvae (circles) and with holes in its belly of the same diameter of the larvae (dashed circle); d) Vermilion Flycatcher (*Pyrocephalus rubinus*) nestling dead for at least a day with larvae still in its body (circle).**

*T. plaumanni* larvae. Moreover, we didn't find any other parasites in parasitized nests, nor signs of similar skins lesions in any of the ~400 unparasitized nests that reach the nestling stage, supporting the idea that the larvae of *T. plaumanni* should be the ones causing the skin lesions by feeding on nestling tissues (see also Figure 1a). In this sense, we believe that under certain circumstances, such as the small body size of the hosts (14 g for an adult Masked Gnatcatcher and ~13 g for an adult Vermilion Flycatcher; Alderete & Capllonch 2010, Dunning 2008) and a reduced number of siblings in the nest, *T. plaumanni* parasitism could promote nestling death.

The two nestlings that died in the nests parasitized by *T. plaumanni* were the youngest among all the parasitized nestlings (Table I). At this early stage, nestlings are more exposed to larvae parasitism due to their lack of feathers, exposed soft tissues and reduced mobility, as it has been already found for other parasites, like the dipterans *Philornis* spp. (Quiroga & Reboreda 2012, Teixeira 1999) and *Protocalliphora* spp. (Bennett & Whitworth 1991). Furthermore, in most parasitized nests (Table I), larvae seem to feed on only one of the nestlings available which can exacerbate the negative effects. The clearest example is the one described for Vermilion Flycatcher nest, in which one nestling died and the other was never affected. It could be possible that the larvae are able to follow chemical traces or mechanical cues of the wounded nestlings (Zacharuk & Shields 1991), so in this case when the first nestling gets hurt, it could be more prone to be attacked by larvae than its siblings. This parasite behavior has been further discussed for adult parasites and parasitoids (Crespo et al. 2011, Guerin et al. 2000, Loye & Carroll 1998, Tomás & Soler 2016).

Four out of the six hosts reported in this study are new for the parasite (Vermilion Flycatcher, Masked Gnatcatcher, Red-crested Cardinal, and Fork-tailed Flycatcher), two of which are the first report for the family (Polioptilidae and Thraupidae). All the parasitized species are open nesters and five of them (Masked Gnatcatcher, Vermilion Flycatcher, Fork-tailed Flycatcher, Yellow-browed Tyrant and Red-crested Cardinal) build their nests without twigs or only with small twigs (De la Peña 2013). These nests characteristics differ from those available to date, where most bird species built closed nests (i.e., Rufous Hornero *Furnarius rufus*, Lark-like Brushrunner *Coryphistera alaudina*, Brown Cacholote *Pseudoseisura lophotes*, Monk Parakeet *Myiopsitta monachus*,

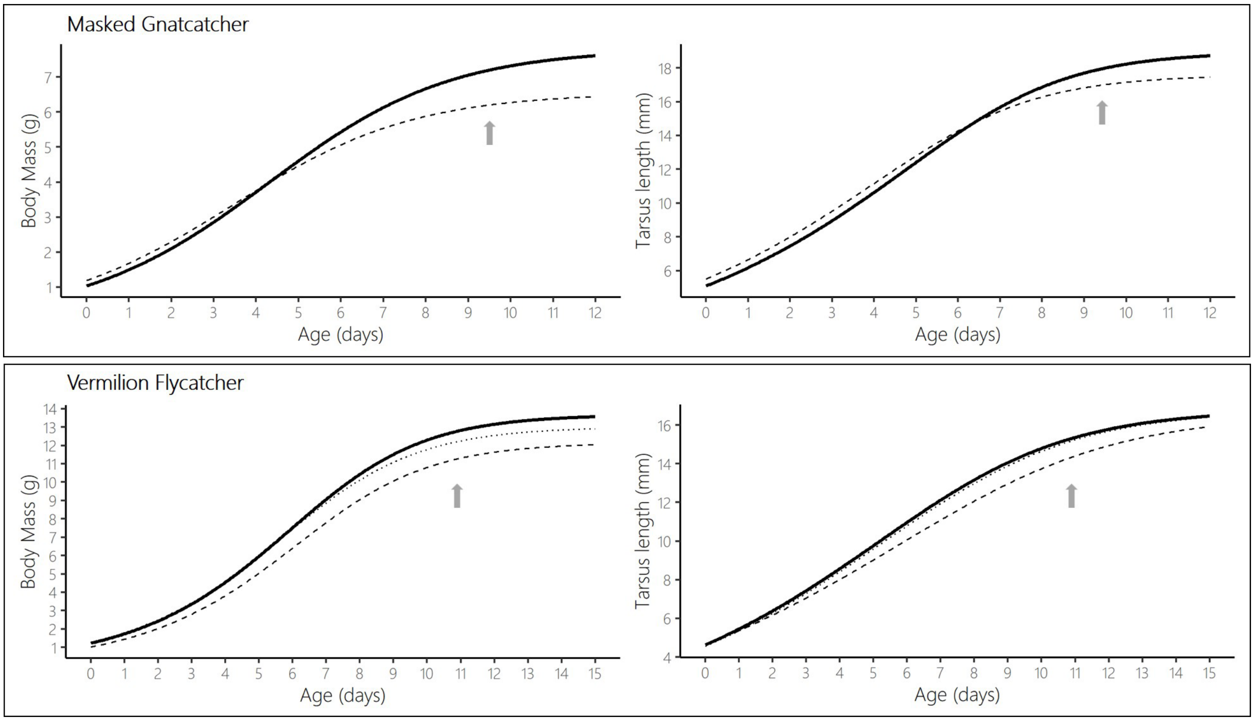


**Figure 2. Growth curves of the nestlings that died in nests parasitized by *Taphropiestes plaumanni* larvae compared with the population growth curves for Masked Gnatcatcher (*Polioptila dumicola*) and Vermilion Flycatcher (*Pyrocephalus rubinus*). Solid lines represents the study site populations growth curves and dashed lines the growth curves of parasitized nestlings. Dotted line in b represents the unparasitized sibling that fledged. Arrow indicates the estimated day the nestlings died. Individual nestlings parameters were obtained as the difference between the fixed effects and the matrix of random effects.**

Great Kiskadee *Pitangus sulphuratus*, Firewood-gatherer *Anumbius annumbi*, Chotoy Spintail *Schoeniophylax phryganophila*), reutilize closed nests or cavities (i.e., House Sparrow *Passer domesticus*, House Wren *Troglodytes aedon*, Tufted Tit-Spinetail), or used twigs considerably bigger than the majority of the species in our study (i.e., Rock Pigeon *Columba livia*, Eared Dove *Zenaida auriculata*, Chimango Caracara *Milvago chimango*) (Di Iorio & Turienzo 2016, Turienzo & Di Iorio 2008, 2010, 2011, 2014). Even though the birds may present anti-parasite behavior of nest sanitation and grooming (Bush & Clayton 2018) and the nests of the species we studied present a low volume of material, it seems that the larva is small enough to find shelter in the nest base or in the nestlings feathers, thus avoiding being detected by adults.

Given the fact that we did not inspect nest material systematically to check for larvae and adults (see Turienzo & Di Iorio 2008), and we always detected them through the evidence of skin lesions, we can state that the frequency of parasitized nests is conservative, and so the number of nests inhabited by *T. plaumanni* is probably larger. More research needs to be done in this topic, considering a systematic inspection of the nest material and, in addition, focusing on studying the life cycle of the beetle to shed more light on the interactions with the parasitized birds. Our results expand the information available on the interactions of this parasite group with its host birds and report for the first time nestlings with skin lesions in parasitized nests. Although none of the species of this study are threatened, the forests that they inhabit are under a continuous degradation and fragmentation as a consequence of multiple human activities (Arturi & Goya 2004). This evolving scenario could potentially favor not only the detrimental effects of our findings on the impact of *T. plaumanni* parasitism, but also the already known negative effects of predation (Chalfoun et al. 2002), brood parasitism (Chace et al. 2005, Domínguez et al. 2015), and ectoparasitism of botflies of the genus *Philornis* (Rabuffetti & Reboreda 2007, Segura & Reboreda 2011, Segura & Palacio 2021) in this region.

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