FEATHER MITES (ACARINA, XOLALGIDAE) IN THE UROPYGIAL GLAND TUFT OF ARATINGA HOLOCHLORA (SCLATER) (AVES, PSITTACIDAE)


The microhabitats for all stages of a new species of feather mite near Fainalges longissimus Mejía-González and Pérez, 1988 (Acari, Analgoidea, Xoligidae) on Aratinga holochlora (Sclater, 1859) (Aves, Psittacidae) are reported. Eggs are laid on the barbs of the eight modified down feathers of the uropygial gland tuft, moulting takes place within the quills of these feathers, and active instars inhabit the downy barbs of the tail coverts. The uropygial gland tuft for the host bird is briefly described.

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Key words. – Feather mite, Xoligidae, parrot, Psittacidae, uropygial gland tuft.

Ontogenetic studies of astigmatic mitid mites are limited. To add to the meager information on this subject, I am associating all instars of seven species of the feather mite genus Fainalges Gaud & Berla, 1964 (Xoligidae) from field collected specimens of the green conure, Aratinga holochlora (Sclater), taken in Tamaulipas, Mexico.

The most demanding part of this and similar ontogenetic studies is to unequivocally associate feather mite larvae with their eggs. To do this, it is necessary to dissect fully developed larvae from their eggs for microscopic examination. In the Fainalges investigation, the larvae of six species had been identified and associated with their eggs, but the egg of a seventh larva, a new species near Fainalges longissimus Mejía-González & Pérez (1988) remained undetected until a small group of specialized feathers were examined, namely, the uropygial gland tuft. Herein, this specialized microhabitat and their acarine occupants will be described.

MATERIALS AND METHODS

Uropygial gland papillae were taken from two frozen, field collected Aratinga holochlora. The tuft feathers were excised, the quills split lengthwise and the quill contents either mounted on SEM stubs or microslides. To obtain mature larvae for identification, eggs were taken from the barbs and opened, either on an SEM stub or in a small drop of Hoyers mounting medium. Thus, correlation of eggs and larvae were established. Additional specimens for ontogenetic studies were obtained from samples taken from approximately 30 museum study skins.

Dissections and measurements of the feathers were done with a dissecting microscope equipped with an ocular micrometer. Identification of the mite life stages was with a Wild-Heerbrugg M-20 phase contrast microscope and specimens for electron scanning microscopy were gold-coated and examined with an Amray 1000 SEM.

Uropygial gland papilla and associated feathers

The uropygial gland (oil gland, preen gland, rump gland) is positioned dorsomedially in the tail region of a bird. When present and functional, the bilobed gland is usually indicated by an elevation of the skin, the uropygial eminence, from which a terminal papilla arises; the papilla usually contains two ducts opening to the exterior at its tip. The papilla is variously shaped and may have a cluster of modified down or modified semiplumes, termed the uropygial gland tuft or circulus uropygialis, surrounding the openings of the uropygial gland ducts; the tuft feathers are in different numbers and arrangements according to group (Lucas & Stettenheim 1972, Jacob & Ziswiler 1982: table 1, Johnston 1988). Tuft feathers have unusually large quills and relatively short barbs when compared to typical down feathers.

In Aratinga holochlora the papilla is cylindrical (3.6
mm in length, 2.2 mm in diameter, N=1) and the uropygial gland tuft (barbs only, 7.9-9.4 mm, N=2) is arranged as a single oval of eight modified down feathers around the duct orifices. The tuft is saturated with uropygial gland secretions, but when degreased it resembles an airgun dart as all diverging barbs end at the same level (Type I of Johnston 1988). Each uropygial gland feather lacks a rachis and hyporachis (aftershaft), and the barbs arise directly from the upper rim of the calamus at the skin level (figs. 1, 2). The calamus (approximately 3.0 mm, N=12), completely embedded in the skin, is a tubular structure (fig. 1) filled with pulp caps. The eight quills form a rosette around the apex of the papilla. The distal end of the quill may represent the superior umbilicus, and as mites can enter, the umbilicus must be open. By being open, each quill probably contains uropygial gland secretions (sebum) and can provide a refuge for organisms unaffected by these secretions.

**Fainalges and the uropygial gland tuft**

When studying the biology of the seventh *Fainalges* species mentioned above, all active instars were observed on the down barbs of the tail coverts, but neither eggs nor exuviae were noted. In previous studies of the feather mites of parrots, it had been determined that for some mite species, different instars occur in different microhabitats (e.g. Pérez & Atreo 1984, Atreo & Pérez 1988). Therefore, the feathers above and below the tail coverts were examined, but again, neither eggs nor exuviae were discovered. The only feathers never examined were those of the uropygial gland tuft, a microhabitat that was never considered a viable candidate for mite habitation as it has been thought that the uropygial gland secretions inhibit parasites (e.g. Jacob & Ziswiler 1982). So, a tuft was excised and examined under a dissecting microscope. At the bases of the barbs and surrounding papillary skin, detritus could be seen, but under higher magnification, the 'detritus' consisted of masses of eggs, egg shells and exuviae. Eggs (fig. 2) and immatures were observed on the barbs. Furthermore, the eight quills of the tuft, examined through the translucent papillary skin, appeared dark brown, a color condition of quills containing feather mites.

Individual feathers and surrounding papillary tissue were removed and quills split longitudinally (fig. 1). Within each quill there was a compact plug of material which, when removed, revealed densely packed and haphazardly arranged exuviae, pharates and active stages for all immature instars partially covered with uropygial gland secretions (fig. 3).

The density of mites within a quill varied. When few mites were observed, limited numbers occupied the more distal interspaces between the pulp caps, up to 4/5 of the distal quill. Some quills were so packed with mite material that the pulp caps were no longer evident. These compact masses (plugs) always overflowed the quill interior, to form a mound of 'detritus' external to the quill proper. The lengths of the plugs varied from quill to quill in the same bird.

From 30 museum study skins and eight field collected *Aratinga holochlora*, the active stages of this new species have been known for four to five years, but neither oviposition nor moulting sites had not been described until now. On a related host species, the orange-fronted conure, *A. canicularis* (Linnaeus, 1758), the active instars of *Fainalges longissimus* were described from a single microhabitat, the downy barbs of the tail coverts (Mejía-González & Pérez 1988), but oviposition sites were not studied.

From the information obtained from mites of *Aratinga holochlora*, it was hypothesized that the uropygial gland tuft is the oviposition and ecdisial site for *Fainalges longissimus* and related species on other parrot taxa. For a preliminary test of the hypothesis, a tuft was removed from one specimen each of *Aratinga canicularis* and a related taxon, the Carolina parakeet, *Conuropsis carolinensis* (Linnaeus, 1758), which has been extinct since the 1920s.

**Results**

Each quill of the uropygial gland tufts examined from *Aratinga holochlora*, *A. canicularis* and *Conuropsis carolinensis* had at least small populations of *Fainalges* species in all tuft feather quills and many barbules had *Fainalges* eggs cemented to them. Each host species supported a different species of the *Fainalges longissimus* morphotype. This morphotype, as characterized by Mejía-González & Pérez (1988), has all instars with leaflike ventral setae on tarsi I and II (fig. 6), and in immatures and females, tarsi III and IV have many spinelike setae, minute ambulacral discs, and ambulacral stalks longer than the corresponding tibiae (fig. 4). *Fainalges longissimus* is associated with *Aratinga canicularis*, whereas *A. holochlora* and *Conuropsis carolinensis* each support a new species of the *F. longissimus* species complex.

**Discussion**

The probable scenario for these species of *Fainalges* is: females oviposit on bases of the barbs, the barbules of the tuft feathers (Fig. 2) and on the papillary skin; the emerging larvae move to the downy barbs of the tail coverts for feeding; and eventually go to a uropygial gland quill for moulting. Each successive instar has the same activity, that is, emerging from the quill, feeding, and then returning to the quill for ecdisis. Because of the out-of-quill sites for the active instars, it is assumed that the uropygial gland secretions with-
Figs. 1-6. Scanning electron micrographs. – 1. One uropygial gland feather embedded in papillary tissue cut along longitudinal axis (approximately 1/3 of quill cut off) to show interior of most of the calamus: two left arrows = area of quill from which plug (fig. 3) was removed (constriction of quill is artifact due to pressure while cutting), right arrow = Fainalages egg; 2, detail of uropygial gland feather with truncated barbs; arrow = Fainalages egg; 3, 'plug' of mites and exuviae removed from quill of fig. 1: arrows = legs III and IV of nymph; 4, enlargement of fig. 3: arrows = same legs in fig. 3; 5, exuviae emphasizing protosomata; 6, enlargement of exuvial leg I of fig. 5 showing tarsal structures needed for morphotype identification. Scale bars: figs. 1, 2: 1000 μm; fig. 3: 200 μm; figs. 4, 5: 50 μm; fig. 6: 10 μm.
in the quill provide little or no nourishment, and also that the secretions have no deleterious effect(s) on the mites or their eggs.

Three questions need to be addressed: Is there a relationship between the moult of the uropygial gland tuft feathers and populations of feather mites? Does preening reduce the mite populations of these mites? Do undiscovered species of the Fainalges longissimus morphotype have the same modus operandi vis-a-vis oviposition and moulting sites?

The literature does not specifically answer the question of whether or not the old gland feathers moult. Even so, it is assumed that these feathers do moult as populations of mites within the quills vary, which also suggests that these feathers moult at different times.

The previously reported microhabitats of feather mites on the external feather surfaces relate to the channels created by adjacent barbs, usually on the ventral feather surfaces (e.g., Dubinin 1951, Atyeo & Pérez 1988). Thus, these mites live in a three-dimen-
sional space bounded by ramal walls laterally and bar-
bules dorsally or ventrally; this space affords protec-
tion from the bills of preening birds.

Depending on the type of uropygial papilla, sebun for preening is obtained by various methods, 'either directly from the drops passing out of the [gland] orifices or by drawing away the fluid from the tuft circlet feathers' (Jacob & Ziswiler 1982: 252). As regards the uropygial gland tuft in Aratinga species, these parrots probably '...take the sebum by brushing its beak along the tuft whenever it needs it' (Jacob & Ziswiler 1982: 252). With this suggested type of preening, it is doubtful that many mite eggs or active instars would be dislodged or destroyed.

Do species related to Fainalges longissimus oviposit and ecdyse in the uropygial gland feather quills? The genus Fainalges has never been revised, however, distinct morphotypes are known (Mejía-González & Pérez 1988). The F. longissimus type, restricted to New World parrots, was characterized as having all instars with leaflike ventral setae of tarsi I and II (fig. 6), and in immatures and females, pretarsi III and IV (fig. 4) with many spinelike setae, minute ambulacrals discs, and ambulacra longer than the corresponding tarsi (Mejía-González & Pérez 1988). The F. longissi-

mus morphotype is now known from three species of the Aratinginac (sensu Wolters 1975), therefore, it is probable that this morphotype will be found on oth-
er New World Aratinginac, and possibly on other parrots with tufted uropygial gland feathers.

**Acknowledgements**

The research, supported in part by the National Science Foundation (BSR 89-08301), was conducted in the Department of Invertebrates, Museum of Comparative Zoology, Harvard University. I am in-
debted to Warren T. Atyeo, University of Georgia, for reviewing this manuscript, and Mrs. Robin Pinto, SEM Laboratory, Museum of Comparative Zoology, for her assistance in taking the micrographs for this publication.

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ally published September, 1975, included the Psittacidae).

Received: 12 July 1991

Accepted: 1 October 1991