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Anomalous chaetotaxy in the quill mites *Torotrogla merulae* Skoracki *et al*., 2000 (Acari, Prostigmata, Syringophilidae)

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Abstract

Mites of the family Syringophilidae are small and uniformly shaped arthropods, inhabiting feather quills of many birds species. Anomalies of setae arrangement are frequently observed in this mite group. Detailed investigation of nymphs and adults *Torotrogla merulae* Skoracki *et al*., 2000, reveals the most considerable variability of chaetotaxy aspect in this family. The purpose of our examination is to document anomalies in number and configuration of setae and to hypothesize the possible factors inducing them. As an explanation, a theory based on 'fluctuating asymmetry' is proposed.

Keywords

Quill mites, ectoparasites, anomaly, chaetotaxy, inbreeding depression, fluctuating asymmetry

Introduction

Mites of the family Syringophilidae are obligatory and permanent parasites of birds. They live and reproduce in quills of the feathers. Syringophilids pierce the quill wall by styletiform chelicerae and feed on the surrounding soft tissue. There exist no detailed account of their biology, except Kethley's research on *Syringophiloidus minor* Berlese (Kethley 1971). He noticed that the sex-ratio was strongly female-biased (1 male:11 females) and that these quill mites frequently reproduced by inbreeding among siblings. We suppose that extraordinary sex ratio in this group, which does not correspond to the 'unbeatable strategy' (Hamilton 1967) has an adaptative character. It limits the number of indispersant specimens because only fertilized adult female colonizes a quill. In this paper we operate on the assumption that the remaining members of subfamily Syringophilinae have life-story similar to *S. minor* though this of course should be verified by further detailed studies. Females move into quills when the host is forming new feathers or onto nestlings prior to fledging. In most mite taxa, patterns of chaetotaxy are typically considered constant within a species or higher taxon, and therefore intraspecific variation in chaetotaxy leads to numerous problems with species identification. Unstable idiosomal and legs setation have been observed in *Bubophilus ascalaphus* Philips et Norton, 1978, in males of *Peristerophila longisoma* Casto, 1979, and data about missing the setae of legs in *Kalamotrypetes pavodaptes* Casto, 1980 (Philips and Norton 1978; Casto 1979, 1980). Instability of setae is most evident in *Torotrogla merulae* Skoracki *et al*., 2000 living in secondaries of *Turdus merula* L., 1758. Variation in number of aggenital setae in this species has been noted by Skoracki *et al*. (2000). In this paper we present the results of a thorough examination of phenotypic chaetotaxy variability in this species and discuss its probable causes.

Materials and methods

The material used in the study, quill mites of *Torotrogla merulae* Skoracki *et al*., 2000 was acquired from secondaries of *Turdus merula* L., 1758 in Kopań, Poland (Bird Ringing Camp) by Maciej Skoracki. Examination was provided during spring migration of birds (21–26 April 2000). One feather was completely removed from each bird specimen and examined under an Olympus ZSX12 compound microscope using ×7–20 magnification. When quill mites were present, the feather was dissected under the microscope and individual mites were removed. Mites destined for morphological examination were mounted on slides in Faure medium. The mite material for these studies was acquired from three infected bird specimens. Animal-care permition no. DLOPiKog. 4201/154/00.

The idiosomal setation follows Grandjean (1939) as adapted for Prostigmata by Kethley (1990). The system of nomenclature for leg chaetotaxy follows that proposed by Grandjean (1944). The application of these chaetotaxic schemes to Syringophilidae was recently provided by Bochkov

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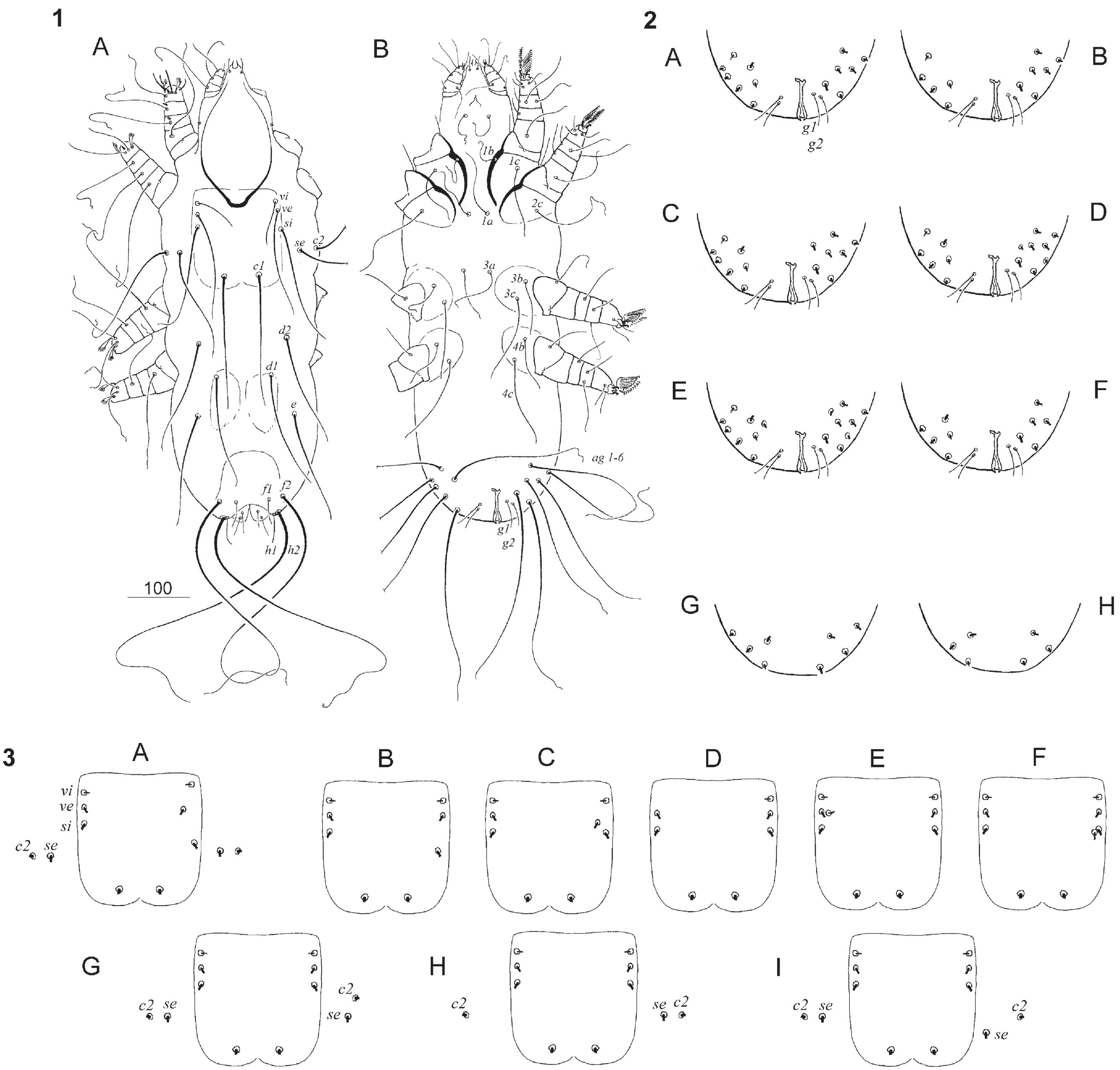
et al. (2008). Material is deposited at the Department of Animal Morphology, A. Mickiewicz University, Poznań, Poland (AMU).

Results

Tables 1–7 present the results of chaetotaxy analysis of 68 adults, 66 females and 2 males (remaining males specimens does not lend to examination), 12 protonymphs and 12 tritonymphs of *Torotrogla merulae* (Fig. 1A, B). In general, there is high variability in number and configuration of setae, both in nymphal stages and adults. The most extreme variation is in the aggenital region of adults (Table I): although the most common arrangement at 32.4% is six pairs of aggenital setae (*ag*), the majority of adults have asymmetrical numbers of setae on their left *vs* right sides (Fig. 2A-H).

We observe also variability concerning propodonotal region (Fig. 3A-I). It manifests itself as asymmetry in placement of bases of setae *ve, si, se* and *h* (in 13.2% of specimens), addition of *ve* and *si* (3%) or deletion of *vi*, *se* and *3a* (5.9%) (Table III). Among leg setae, relatively often (11.8%) setae *sc4*



Figs 1–3. *Torotrogla merulae* Skoracki *et al*., 2000. **1** – female: A – dorsal view, B – ventral view; **2** – various asymmetric arrangement of aggenital setae (*ag*) (A-F female, G-H male); **3** (A-I) – variability of arrangement of propodonotal setae in adult females

are absent (equally affecting right and left legs). Only one specimen lost *lG'*, whilst addition of seta on genu IV in 2.9% mites is registered (Table II). In tritonymphs, we also observe high asymmetry of propodonotal setae (75% of specimens; Table V), while anomalous in numbers of setae *ag* (Table IV) are only occasionally observed. Propodonotal setae pattern of 25% of protonymphs point are asymmetric (Table VII). Aggenital setae of protonymphs are stable (typical – 1 pair), only one specimen has two pairs (Table VI). Addition and deletion of setae on propodonotal region and legs of protonymphs and tritonymphs were not observed.

Table I. Number of *ag* setae in adults specimens of *Torotrogla merulae*; n = 68, F – female, M – male

Sex	*ag* right	*ag* left	No. of specimens
F	6	6	22 (32.4%)
F	7	6	12 (17.6%)
F	6	7	10 (14.7%)
F	5	6	7 (10.3%)
F	7	7	3 (4.4%)
F	5	7	2 (2.9%)
F	7	8	2 (2.9%)
F	6	8	2 (2.9%)
F	8	7	1 (1.5%)
F	8	6	1 (1.5%)
F	7	5	1 (1.5%)
F	8	8	1 (1.5%)
F	5	5	1 (1.5%)
M	4	4	1 (50%)
M	3	3	1 (50%)

Table II. Anomalous patterns of leg setae in adult specimens of *Torotrogla merulae*; n = 68, (r) – right leg, (l) – left leg

Addition	Deletion	No. of specimens
–	*sc4*(r)+(l)	8 (11.8%)
on (l)genu	–	2 (2.9%)
–	*lG"* (r)	1 (1.5%)

Table III. Propodonotal setae anomalies in adults specimens of *Torotrogla merulae*; n = 68

Addition	Deletion	Asymmetry	No. of specimens
–	–	*ve, si*	3 (4.4%)
–	–	*si*	2 (2.9%)
–	–	*se*	2 (2.9%)
–	–	*ve*	1 (1.5%)
–	–	*c2*	1 (1.5%)
–	*vi*	–	2 (2.9%)
–	*se*	–	1 (1.5%)
–	*3a*	–	1 (1.5%)
ve	–	–	1 (1.5%)
si	–	–	1 (1.5%)

Table IV. Variability in number of *ag* setae in tritonymphal stage of *Torotrogla merulae*; n = 12

ag right	*ag* left	No. of specimens
4	4	9 (75%)
4	3	1 (8.3%)
3	5	1 (8.3%)

Table V. Asymmetry in placement of setae in tritonymphal stage of *Torotrogla merulae*; n = 12

Asymmetry	No. of specimens
vi	2 (16.7%)
ve	2 (16.7%)
si	2 (16.7%)
c2	2 (16.7%)
se	1 (8.3%)

Table VI. Variability in number of aggenital setae (*ag*) in protonymphal stage of *Torotrogla merulae*; n = 12

ag right	*ag* left	No. of specimens
1	1	11 (91.7%)
2	2	1 (8.3%)

Table VII. Setae asymmetry in protonymphal stage of *Torotrogla merulae*; n =12, X – parallel displacement of *vi*, *ve* and *si*

Asymmetry	No. of specimens
X	1 (8.3%)
ve; *c2*	1 (8.3%)
c2	1 (8.3%)

Discussion

Nymphal stages as well as adults of *Torotrogla merulae* show considerable variability in chaetotaxy, manifested as different number and asymmetry of setae. Investigation of the reason behind this intraspecific variation is very difficult, because very little is known of the biology of this species. Some cases of teratology are recorded for ticks (Buczek 2004), however they concern general and local anomalies in body structure, which were caused by environmental changes (temperature and humidity) or induced by chemical factors. Habitat of quill has relatively stable thermal and humid parameters, so we exclude these factors in these suppositions. However, it can seem that variability of chaetotaxy in *Torotrogla merulae* as well as other species of quill mites, due to their incestuous reproductive strategy, might be the effect of inbreeding depression, the comparative scientific data concerning similar anomalies, contradict these presumptions and support rather the hypothesis of 'fluctuating asymmetry'. Firstly, we have at disposal the results of observations in the oribatid mite species *Heminothrus peltifer* (Koch, 1839), which reveal that many setae of lateral and ventral rows in femora and tarsi (remaining leg setae have not been studied) are affected by meristic variations (73% of setae showed asymmetrical absences) (Grandjean 1972). Secondly, leg setae examination in *Tetranychus urticae* (Koch, 1839) (Acari, Prostigmata, Tetranychidae) point numerical variations in the form of unilateral or bilateral complete absences of mechano- and/or chemo-receptors in effect of fluctuating asymmetry (Leponce *et al*. 1996). Moreover, observation on meristic variations of leg setae in an inbred laboratory strain of *Tetranychus urticae* present little variation except 10 setae, which varied in 5 to 58% of the adults studied (Wauthy *et al*. 1998). Additionally, more detailed research on *Tetranychus urticae* have demonstrated that descendants of asymmetrical progenitor do not show an increasing proportion of asymmetrical phenotype. Then lack of heritability for absences of leg setae in an inbred laboratory strain suggests that vertition could be environmental meristic variation of hair-like organs and caused by developmental accidents not corrected by homeostatic mechanisms normally disqualify nondirectional deviation from perfect bilateral symmetry (Leponce *et al*. 2001). At present, we assume that high variability of chaetotaxy in *Torotrogla merulae* may be caused by random environmental stresses, genetic problems during development or epigenetic changes and conform to the notion of 'fluctuating asymmetry'. Our explanation is a hypothesis only. It is necessary that it has been confirmed further detailed research.

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