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Character-state evaluation when discriminating Thysanoptera taxa (Insecta)

KAMBIZ MINAEI[1] & LAURENCE MOUND[2]
[1] *Department of Plant Protection, College of Agriculture, Shiraz University, Shiraz, Iran.*
kminaei@shirazu.ac.ir; https://orcid.org/0000-0002-0168-178X
[2] *CSIRO Australian National Insect Collection, Canberra, ACT, Australia.*
laurence.mound@csiro.au; https://orcid.org/0000-0002-6019-4762

Abstract

Problems are discussed in evaluating character state variation in the insect order Thysanoptera, particularly in the family Phlaeothripidae, illustrated by two such problems in the genus *Haplothrips* Amyot & Serville. The synonymy of *Jironiella* Retana-Salazar & Soto-Rodriguez with *Haplothrips* is reconfirmed, and *Haplothrips aliakbarii* Mirab-balou & Miri is recognised as a new synonym of *H. globiceps* Bagnall.

Key words: *Haplothrips*, interpretation, character state reversal, new synonym

Introduction

Taxonomy is commonly regarded as being essentially descriptive, involving the differences that can be observed between individuals. Darwin (1877: 178) observed that "in determining whether two or more allied forms ought to be ranked as species … naturalists are practically guided by … the amount of difference between them". However, he went on to discuss at length the problems of evaluating the significance of such observed differences, emphasising that all such differences must be assessed within the context of the biology of the organism involved, and the variation to be found in related organisms. Despite such guiding principles, taxonomists often forget that each of their hypotheses that constitutes a new genus or a new species (Gaston & Mound 1993) requires testing and evaluation within the context of what is known about related taxa. As a result, many common species of Thysanoptera that vary in colour and size depending on their living conditions, such as *Thrips tabaci*, have been described under many different names that are now considered synonyms. In many genera of Phlaeothripidae species exhibit sexual and alary dimorphisms, as well as body size-related polyphenic variation involving allometry. Large and small individuals of such species have often been interpreted as representing different species or even different genera (Mound 2005), with many names now considered synonyms in genera such as *Idolothrips*, *Elaphrothrips* and *Kladothrips* (Mound & Hastenpflüg-Vesmanis 2021). The objective here is to consider problems involved in the evaluation of observed structural differences, using two examples from the genus *Haplothrips*, one from Costa Rica and the other from Iran.

Methods and materials

A paratype female of *Haplothrips saidi* was studied in Canberra on loan from the Natural History Museum, London. The holotype and one male paratype of *H. aliakbarii* were studied through the courtesy of Majid Mirab-balou. Both a Leica DM2500 microscope and an Olympus BX51 microscope were used for morphological examination. Photomicrographs were made using the latter microscope with DP27 digital camera and cellSens software.

Section I. Interpretation of missing character states

An interesting problem in character state evaluation arises when a structure that is typically present in the members

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of a genus is absent in one or more of the included species. For example, most species in the Thripidae genera *Dichromothrips* and *Pseudanaphothrips* have two pairs of prominent posteroangular setae on the pronotum, but one or more species in both of these genera have only one pair or even no long setae (Mound 1976; Minaei 2012; Mound & Tree 2020). Similarly, different species of the genus *Thrips* have either eight or seven antennal segments (Palmer 1992), and a similar reduction from the plesiotypic antennal condition of eight segments to the 7-segmented (or even 6-segmented) condition occurs widely among other Thripidae genera (Zhang *et al*. 2019). Even among the Aeolothripidae, all of which share the ancestral condition of 9-segmented antennae, the occasional specimen of *Aeolothrips* is aberrant in having only eight segments, and one species of this genus has been found in Iran that has only 7 antennal segments (rarely 5 or 6) (Minaei & Mound 2019).

Character state reversals such as these have often been interpreted as apomorphies, such that an unusual species is given separate taxonomic status on the basis of the absence of a single character state. But identical "loss apomorphies" such as this can result through different genetic pathways, as is clear from the reduction in antennal segment number among widely separated genera of Thripidae (Zhang *et al*. 2019). The words "lost" and "absent" that are used for such a situation might more appropriately be expressed as "not visible". One example of such a "lost" structure has been described by Bhatti (1999) concerning the tentorial bridge within the thysanopteran head. This structure is well developed in species of Aeolothripidae and Melanthripidae, and its absence in species of Thripidae is considered to be a derived condition (Mound *et al*. 1980). However, Bhatti discovered and illustrated a very slender, but non-functional, tentorial bridge in adults of *Thrips tabaci*. The apparent absence of a structure, like any other character-state difference, needs to be evaluated in relation to the structure of closely related taxa. The following example has been a matter of dispute concerning the phylogenetic significance of the absence of a particular character state.

Haplothrips Amyot & Serville

Haplothrips Amyot & Serville, 1843: 640. Type species *Phloeothrips albipennis* Burmeister [=*Thrips aculeatus* Fabricius], by monotypy.

Jironiella Retana-Salazar & Soto-Rodriguez, 2007: 632. Type species *Jironiella saidi* Retana-Salazar & Soto-Rodriguez, by monotypy. **Syn.n.**

The genus *Jironiella* was erected for a single species collected from Cyperaceae in Costa Rica, and was distinguished from *Haplothrips* on the grounds that the maxillary bridge between the maxillary stylets in the head is "absent". Goldarazena *et al*. (2008) disputed this statement, claiming that fragments of the maxillary bridge could be seen in a paratype of *saidi*, and they regarded *Jironiella* as a synonym of *Haplothrips*. Unfortunately, these authors also erroneously synonymized *saidi* with *Haplothrips graminis* Hood, a common species on grasses in Central America. In contrast, Bhatti *et al*. (2020) rejected the generic synonymy and re-validated the genus *Jironiella*, as discussed below. We have now re-examined the *saidi* paratype and confirm that the maxillary bridge is "not visible", and that *saidi* is a valid species distinguishable from *graminis*.

In rejecting the synonymy of *Jironiella* with *Haplothrips* Bhatti *et al*. (2020) provided no other discriminating character state to distinguish these genera apart from the lack of a maxillary bridge. No comment was made on the phylogenetic relationship between them, despite the many shared character states and the fact that many *Haplothrips* species also live on Poaceae and Cyperaceae. Although the paper by Bhatti *et al*. (2020) was published in an Indian journal, no mention was made of a genus from India, *Aphlothrips* Tyagi & Kumar (2006), that was also described for a single species taken from grass. That genus was also distinguished from *Haplothrips* only by the absence of a maxillary bridge. Thus, even if the "absence" of a maxillary bridge is considered phylogenetically significant, the genus *Jironiella* might need to be considered a synonym of *Aphlothrips*. Given that the species involved share most of their character states with the species of *Haplothrips*, there are two ways of interpreting this situation: either these two species from disparate parts of the world represent an ancient lineage in which the maxillary bridge that is typical of Haplothripini had not yet evolved, or the absence of the maxillary bridge in the two species is a reversal – that is, a "loss apomorphy". There being no evidence to support the first possibility, the second is here considered to be the most sensible as it is in accordance with the well-established philosophical principle of parsimony known as Occam's Razor.

Curiously, Bhatti *et al*. (2020) stated in the "ABSTRACT" to their paper "*Jironiella* is related to *Bamboosiella*" another genus associated with Poaceae. But the authors give no information in support of this statement in the main text of the paper. They ignored that the species of *Bamboosiella* lack prosternal basantral sclerites, the antennae have two sense cones on the third segment and three on the fourth, and the maxillary stylets are scarcely retracted into the head capsule anterior to the post-occipital ridge. Currently, because of these character states, the genus *Bamboosiella* is not considered to be a member of the tribe Haplothripini (Okajima 2006; Mound & Minaei 2007). We therefore conclude that the apparent absence of a maxillary bridge in the Costa Rican species *Haplothrips saidi* is yet another “loss apomorphy”, a reversal that has arisen more than once among *Haplothrips* species, and is thus of limited significance in indicating systematic relationships within this species-rich genus.

Section II. Intraspecific character state variation

The number of specimens studied, that is the sample size, is important in making decisions in taxonomy. A sample of 20 adults from a single flower may represent the offspring of a single female, and is thus not as representative of the potential variation within a species as 20 adults taken from several flowers or at different sites. Despite this many thrips species have been described from samples that subsequent investigation has shown to be statistically inadequate. This has resulted in many species-level synonymies within genera such as *Haplothrips* with, for example, eight and six synonyms listed respectively under the common European species *aculeatus* and *setiger*. Here we consider the effect of small sample size on the recognition of a species of *Haplothrips* from the eastern Mediterranean region.

Haplothrips globiceps (Bagnall)

Hapliothrips globiceps Bagnall, 1934: 496.
Haplothrips inoptatus Priesner, 1954.
Haplothrips aliakbarii Mirab-balou & Miri, 2018: 608. **Syn. n.**

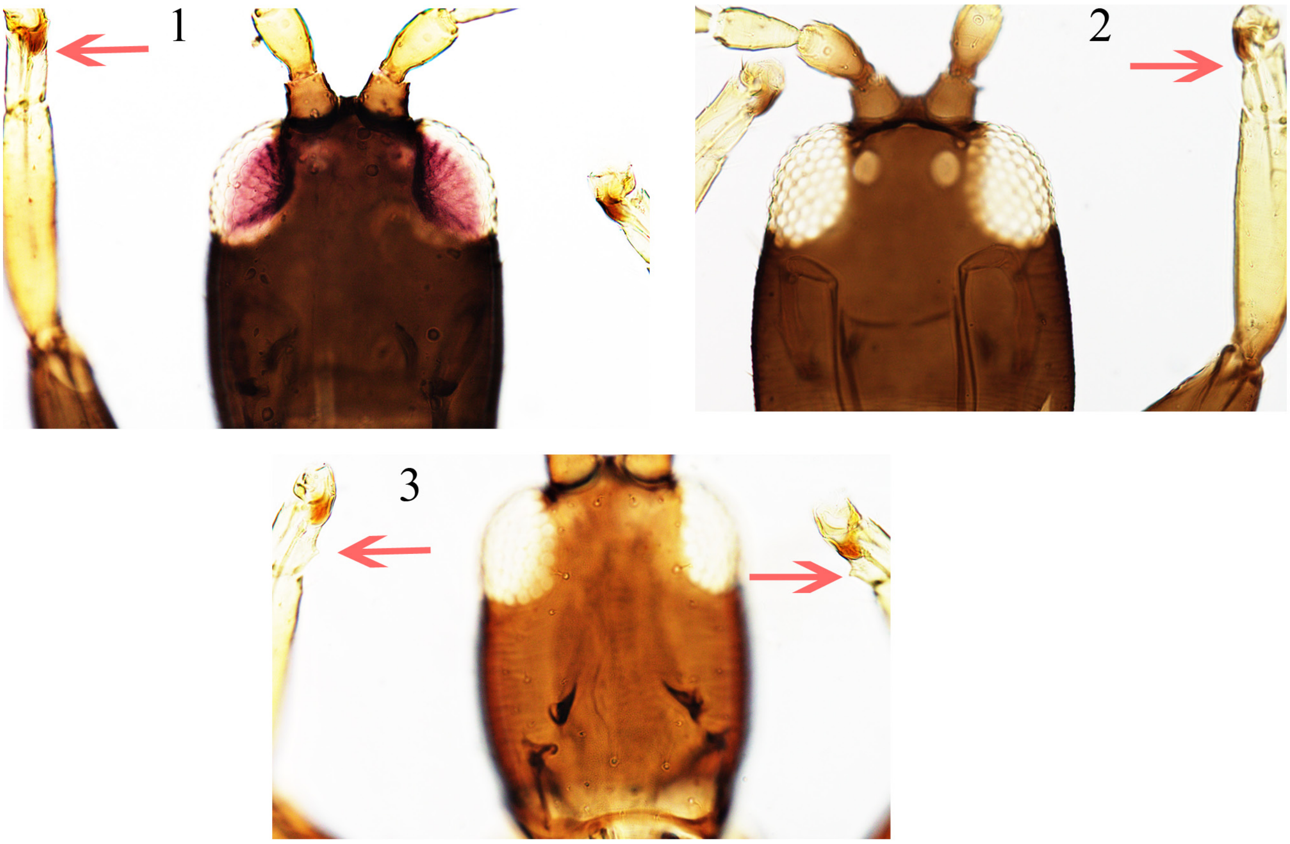
The recently described *Haplothrips aliakbarii* was stated by the authors to be “most similar” to *H. aculeatus* (Fabricius), but with the further comment “In addition, the new species looks like *H. andresi* and *H. subtilissimus*”. However, following the description of the new species the authors presented a well-organised key to the species of *Haplothrips* from Iran. In this key the new species tracks cleanly to couplet 22 that is shared only with *H. globiceps* (Bagnall). In this couplet, *aliakbarii* is distinguished from *globiceps* by the two character states: the male has “no fore tarsal tooth” whereas *globiceps* has a “very small tooth”, and the major body setae are “shaded” in contrast to “dark brown” in *globiceps*. Unfortunately, no indication is given of how many specimens of *globiceps* were studied to support these statements, in particular, how many males. The description of *aliakbarii* was based on 14 females but only a single male. In contrast, Minaei & Mound (2008), having studied 14 males of *globiceps* from various sites, state that these males “rarely have a minute fore tarsal tooth” (Figs 1–3).

The holotype female and the single paratype male of *aliakbarii* have been re-examined. We confirm that the male lacks a fore tarsal tooth, as do several males of *globiceps* that we have studied and list below. Moreover, despite the original description quoted above, there appears to be no significant difference in the colour of the major setae of the holotype or paratype from various non-type specimens of *globiceps*. We therefore conclude that the species *aliakbarii* is a **new synonym** of the eastern Mediterranean species *globiceps*, a thrips that is recorded from foliage in Turkey and Iran and is considered to be predatory on other small arthropods (Minaei & Mound 2008).

Haplothrips globiceps was described from Turkey (Bagnall 1934) and later reported from Iran (see Minaei & Mound 2008), but the species is not reported from any other country, and all of the slides of this species in the museums in Frankfurt and London are from Turkey. The number of plants from which this species has been collected in Iran is much greater than indicated in the revision of Haplothripini from Iran (Minaei & Mound 2008), as indicated by the following list.

Specimens studied (other than those mentioned in Minaei & Mound, 2008) (all collected on leaves): IRAN, **Fars province**, Noorabad Mamasani, 2 females from *Ficus carica*, 31.iii.2008, (KM 32); Kazerun, 3 females, 1 male from *Quercus* sp., 17.vi.2008, (KM 146); Sepidan, 4 females, 1 male from *Juglans regia*, 29.viii.2011, (KM 524); Sepidan, 2 females, 2 males from *Prunus* sp., 31.v.2012, (KM 831); Shiraz, 2 females, 2 males from *Ulmus* sp., 13.vii.2012, (KM 872); Sepidan, 1 female from *Tamarix* sp., 19.vii.2012, (KM 880); Shiraz, 1 female from

Ficus carica, 5.ix.2012, (KM 892); same place, 1 female from *Ficus carica* (leaves), 25.iv.2014, (KM 1168); Mahrloo, 3 females, 2 males from *Amygdalus scoparia*, 2.iv.2018, (KM 1779). **Isfahan province**, Isfahan, 3 females from *Prunus* sp., 29.iii.2012, (FH 75); same place, 4 females from *Prunus cerasus*, 8.iv.2012, (FH 93); same place, 3 females, 2 males from *Rumex* sp., 1.vii.2012, (FH 149). **Kohgiluyeh and Boyer-Ahmad province**, Keryak, 2 females, 1 male from *Platanus orientalis*, 23.viii.2017, (KM 1699).



FIGURES 1–3. Fore tarsal tooth in male of *Haplothrips globiceps*, (1) paratype of *aliakbarii*, without tooth; (2) a male from *Prunus* sp., without tooth; (3) a male from *Vitis vinifera*, with small tooth. PLEASE USE AN ARROW TO SHOW IT TO READERS

Discussion

Taxonomy is essentially comparative, not simply descriptive. Among thrips, the deployed character states range widely from colour, number of antennal segments, number and lengths of setae, host plant associations, and even the CO1 gene. Each of these may remain valid for any particular taxon, but each may fail when dealing with larger samples and other taxa. The processes involved in taxon discrimination are iterative, with support for the chosen discriminants often modified with increasing diversity of available data. Most importantly, the selected discriminants need to be correlated with independent parameters, such as host plant and distributions, and considered within the phylogenetic relationships of the taxon involved. As a result, given the complexities of the evolutionary processes, no single discriminant can be appropriate across all members of a group.

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