A new genus and species of Laelapidae (Acari: Mesostigmata) from Iran

SHAHROOZ KAZEMI1 & FRÉDÉRIC BEAULIEU2

1Department of Biodiversity, Institute of Science and High Technology and Environmental Sciences, Graduate University of Advanced Technology, Kerman, Iran. E-mails: shahroozkazemi@yahoo.com, sh.kazemi@kgut.ac.ir
2Canadian National Collection of Insects, Arachnids and Nematodes, Agriculture and Agri-Food Canada, 960 Carling Avenue, Ottawa, ON K1A 0C6, Canada. E-mail: frederic.beaulieu@agr.gc.ca

Abstract

A new monotypic mite genus of the family Laelapidae, Persicolaelaps gen. nov., is described to accommodate a new species, P. hallidayi sp. nov., on the basis of adult female specimens collected from decaying wood, soil and litter in northern Iran, Golestan and Mazandaran provinces, respectively. The new genus can be distinguished from other members of the family by a combination of morphological attributes, some of which are unique or rarely observed in laelapids, such as (1) a series of small subrectangular sclerites flanking dorsally coxae I and gnathosomal base and adjoining podal plates anterolaterally, which are extending from and fused with sternal shield between coxae I and II; (2) an epigynal shield, so broad as to reach or even overlap acetabula III–IV, posteriorly axe-shaped; (3) metasternal setae absent; (4) a typical anal shield, though capturing pair of opisthogastric setae JV3; (5) gnathotectum triangular and acuminate; (6) the presence of six setae on trochanter IV; (7) genu IV with two ventral setae (occasional in Laelapidae); (8) internal malae with a series of thick, elongate filaments.

Key words: Parasitiformes, Dermanyssoidea

Introduction

The family Laelapidae as currently defined (e.g. Lindquist et al., 2009, generally in agreement with Casanueva, 1993), is remarkably disparate morphologically and ecologically, including predators, vertebrate parasites, nest dwellers, and associates of arthropods with poorly-known feeding habits (Evans, 1955; Evans & Till, 1965; Domrow, 1988). Knowledge of the laelapid fauna of Iran remains limited, although it has undergone a rapid growth recently, with several species of free-living or arthropod-associated laelapids newly described or reported from the country lately (e.g. Joharchi & Halliday, 2011; Moraza & Kazemi, 2012; Kazemi, 2013, 2015; Kazemi & Rajaei, 2013; Joharchi & Babaeian, 2014; Kazemi et al., 2014, 2016; Nemati & Gwiazdowicz, 2016). One of us (SK) discovered a new mite from decaying wood, in Golestan Province of Iran. We herein describe the mite species, and erect a new genus to accommodate it, which possesses some distinctive features.

The new genus can be readily classified as Laelapidae, based on at least one attribute putatively unique to the family: opisthonotal (1) setae px2–3 (Zx2–3 of other authors; note that other forms of neotrichy may also occur in the opisthonotal areas in other families); as well as on a series of homoplastic or plesiomorphic attributes, individually possessed (but never in full combination) by various taxa in other families of the infraorder Gamasina: (2) median, unpaired setae Jx (frequently present in Laelapidae, but also in other families, e.g. Spadiseius, Melicharidae, Lindquist & Moraza, 2008; some Antennoseius spp., Ascididae, Kazemi & Moraza, 2013; some Gamasiphis, Womersley, 1956); (3) a holodorsal shield, essentially holotrichous, including (4) setae Z5 inserted posterior to J5; (5) a single epignyal shield, rounded posteriorly, well-separated from (6) an inversely subtriangular anal shield; (7) a well-developed leg chaetome (normal for Laelapidae, Evans & Till, 1965, with two exceptions, see genus diagnosis, features 6–7), including femur I with 13 setae, including four ventrals, tibia and genu I each with 13 setae (2 3/2 3/1 2), tibia III with eight setae (2 1/1 2/1 1), and tibia IV with 10 setae (2 1/1, 3/1 2); (8) female movable cheliceral digit bidentate; (9) sternal shield with three pairs of setae and two pairs of poroids; (10)
peritrematal shield free posteriorly; (11) palp tarsal claw two-tined; (12) deutosternal groove relatively narrow, with six rows of denticles; (13) gnathotectum with anterior margin denticulate and with a simple, single moderate prominence; (14) arthrodial envelope of movable cheliceral digit a simple fimbriae. These features of the new genus are also characteristic of most genera typically included in the subfamily Hypoaspidae (Karg 1965; Krantz 1978; Casanueva 1993, including parts of ‘Melittiphidinae’ defined therein), as well as a setiform, simple pilus dentilis, without or with minimal hypertrichy of the idiosoma, and coxal and idiosomal setae not modified into spines like many Laelapinae and related groups of facultative or obligate haematophagous laelapids (Tipton, 1960; Evans & Till, 1966; Radovksy & Gettinger, 1999).

Material and methods

Mites were collected in northern Iran, Golestan and Mazandaran provinces, from (1) the humus-like layer developed in the surface of a rotting stump, and from (2) a sample of soil and litter. Mites were extracted from the material using Berlese-Tullgren funnels. Specimens were then cleared in Nesbitt’s fluid and slide-mounted on microscope slides in Hoyer’s medium before examination.

Morphological observations, measurements and illustrations were made using compound microscopes equipped with differential interference contrast and phase contrast optical systems, and a drawing tube. Measurements were made in micrometres. The length and width of the dorsal shield were respectively taken from the anterior to posterior shield margins along the midline and from the lateral margins at the broadest point, between setae s6 and S1. The sternal shield length was measured from the anterior to posterior margins along the midline, and its width from the lateral margins at the level of setae s2. The epigynal shield length was taken from the anterior margin of the hyaline extension to the posterior margin along the midline, and shield widths taken both at the level of st5 and at the broadest point. The anal shield length was measured along the midline from the anterior to posterior margins, including the cribrum, and the width at the broadest point. The length of legs were taken from the base of the coxa to the apex of the tarsus, excluding the ambulacrum (stalk, claws and pulvillus). The length of the second cheliceral segment was measured from its base to the apex of the fixed digit, and its width at the broadest point. The fixed cheliceral digit was measured from the dorsal poroid to the apex, and the movable digit from its base to apex.

The notation for idiosomal setae follows that of Lindquist & Evans (1965) adapted by Evans & Till (1965, 1966) and Lindquist (1994); notation for leg and palp setae follows that of Evans (1963a, 1963b), and that for idiosomal pore-like structures as gland pores and poroids (proprioceptors or stress receptors, often called ‘lyriffissures’, perhaps most appropriately when lyre-shaped or slit-like) (Athias-Henriot, 1969, 1971) follows mostly that of Athias-Henriot (1971, 1975) adapted by Kazemi et al. (2014).

Taxonomy

Persicolaelaps new genus
(Figs 1–21)

Type species: Persicolaelaps hallidayi sp. nov., by monotypy.

Diagnosis (adult female). The genus can be readily distinguished from other laelapids by the following characters, unique or rarely observed in the family: (1) an epigynal shield widened and expanded anteriorly, overlapping much of posterior half of sternal shield, axe-shaped posteriorly; well removed from anal shield, bearing st5. Anteroventral region of idiosoma well sclerotised, showing (2) fusion of sternal shield with endopodal and exopodal plates between acetabula I and II, and (3) a strip of small subrectangular sclerites extending from anterior extension of exopodals and flanking dorsally coxae I and gnathosomal base. (4) An anal shield normally shaped (inversely subtriangular), capturing one pair of ventral setae (JV3). (5) Metasternal setae st4 absent. Legs with (6) trochanter IV bearing six (1 1/1 1/2 0) setae, including pd, and (7) genu IV bearing 10 setae (2 2/1 3/1 1), including pv (this seta is present in a few other laelapid genera); leg setation otherwise normal for Laelapidae (sensu Evans 1963b). (8) Gnathotectum triangular, acuminate, finely denticulate laterally. (9) Internal malae composed of several
thick, tentacle-like projections. The genus is further defined by this combination of characters variously shared with other Laelapidae: dorsal shield covering all dorsal idiosoma, oval, somewhat dome-like, bearing 39 pairs of setae, including \( px2-3 \), and a few unpaired setae \( Jx \); dorsal setae short, mostly smooth and slender; \( r6 \) and \( R \) series absent; shield with 23 pairs of pore-like structures, including seven pairs of gland pores (\( gd1-2, gd4-6, gd8-9 \)). A pair of well-sclerotised pretarsal plates. Sternal shield well sclerotised, wider than long. Peritremes long, narrow. Deutosternal groove moderately narrow, with six rows of denticles, each with 2–6 denticles. Chelicera moderately stout, chelate-dentate; pilus dentilis short and setiform. Palp tarsal claw two-tined.

**Description.** Dorsal idiosoma (Fig. 1). Dorsal shield covering all dorsal idiosoma, oval-shaped, dome-like, slightly extending to venter laterally, bearing 39 pairs of short, slender setae (Fig. 2); setae \( Jx \) may be present; \( r6 \) and \( R \) series absent. Dorsal shield with a complement of 23 pairs of pore-like structures, including seven pairs of gland pores (\( gd1-2, gd4-6, gd8-9 \)) and 16 pairs of poroids.

**Ventral idiosoma** (Fig. 5). Trichosternum with a pair of free pilose laciniae and columnar base. A pair of well-developed sclerotised pretarsal plates. Sternal shield wider than long (Figs 5, 17), well sclerotised, fused to endopodal elements between coxae I–II into arms that join exopodal strips; a series of small sclerites extending from anterior extension of podal elements and dorsally flanking gnathosomal base and coxae I (Fig. 5). Metasternal setae \( st4 \) absent; \( iv3 \) on soft cuticle. Epigynal shield (Fig. 20) expansive, broadened posteriorly, angled posterolaterally behind coxae IV, rounded postero-medially, well separated from anal shield, lineate-reticulate, with a wide \( \Lambda \)-shape lineation, bearing pair of epigynal setae (\( st5 \)). Anal shield inversely subtriangular (Fig. 19), capturing one pair of ventral setae (\( JV3 \)). Peritrematal shield well developed, widely fused anteriorly to dorsal shield, free posteriorly, bearing five discernible pairs of pore-like structures, including two gland pores and three poroids. Endopodal plateset between coxae III–IV well developed, free from sternal shield, although may overlap it. Opisthogastric region not hypertrichous.

**Gnathosoma** (Figs 3–4, 6–7, 21). Gnathotectum a subtriangular, acuminate projection, denticulate laterally (Figs 3, 21). Corniculi horn-like; internal malae longer than corniculi, composed of a pair of fringed median projections, and lateral tentacle-like projections; hypostomal and capitular setae smooth; deutosternal groove with six rows of denticles, and a smooth ridge anteriorly (Fig. 4). Chelicera moderately stout, chelate-dentate, with relative thick, setiform dorsal seta, fixed digit with few small teeth, pilus dentilis short and setiform. Palp tarsal claw two-tined.

**Legs** (Figs 8–16, 18). Legs moderately long, leg I approximately as long as idiosoma, leg IV longer than idiosoma; all legs with well-developed paired subequal claws and rounded pulvilli borne on ambulacral stalk. Setation of legs I-II-III-IV: coxae 2, 2, 2, 1; trochanters 6, 5, 5, 6, trochanter IV with a \( pd \) seta (1 1/1 1/2 0) (Fig. 18); femora 13 (2 3/1 2/3 2), 11 (2 3/1 2/2 1), 6 (1 2/1 1/0 1), 6 (1 2/1 1/0 1); genua 13 (2 3/2 3/1 2), 11 (2 3/1 2/1 2), 9 (2 2/1 2/1 1), 10 (2 2/1 2/1 1) (Fig. 20); tibiae 13 (2 3/2 3/1 2), 10 (2 2/1 2/1 2), 8 (2 1/1 2/1 1), 10 (2 1/1 3/1 2); tarsi II-IV 18 (3 3/2 3/2 + mv, md). Many setae on tarsi II–IV slightly thickened or spine-like, especially ventral setae, dorsal and ventral setae of femur I, and ventral setae of genua and tibiae (Figs 12–15).

**Remarks.** In addition to the attributes mentioned in the introduction, the well-developed internal malae of *Persicolaelaps* are indicative of Laelapidae in general, and their thick, elongate filaments show a resemblance (or possible relation) to some laelapids species such as *Cosmolaelaps cuneifer* (Michael) (Evans & Till, 1966), *Cosmolaelaps vacua* species group (Michael), *Laelaspis* spp., *Pneumolaelaps* spp. (FB & SK pers. obs.), *Androlaelaps walkerae* Till, 1963, *Gaeloaelaps saboort* Joharchi & Babaeian, 2014 and ‘*Hypoaspis*’ *cavitatis* Karg, 1982, (which, at least superficially, resemble some *Laelaspisella* species). The internal malae of *Mesolaelaps accessoria* Tenorio & Radovsky, 1974 also have thick projections, but they appear shorter and originate from the lateral margin of the main, median processes. Some *Laelaspisella* and the apparently related *Pogonolaelaps* species have elongate fringed internal malae, but composed of hair-like and thinner filaments, based on illustrations and personal examination of some species (Marais & Loots, 1969; Nemati & Gowiazdowicz, 2016; SK pers. obs.).

*Persicolaelaps* actually shares most of the character states of the putative early-derivative lineage of dermanyssoids, best exemplified by some members of *Gaeloaelaps* or the ‘*Hypoaspis* complex’ (Laelapidae), from which other groups of facultative and obligate haematophagous groups of laelapids and other dermanyssoids theoretically evolved (Evans & Till, 1966; Radovsky, 1969, 1994). These basal laelapids are part of the subfamily Hypoaspini, which includes a large portion of the free-living (putatively predatory) laelapids and many insect
symbionts. Like many hypoaspidines, Persicolaelaps also has a strong leg chaetome, with many setae thickened or spine-like. Persicolaelaps can suitably be placed in this subfamily, until laelapid classification improves to better reflect phylogenetic relationships. The departure of Persicolaelaps from the basic laelapid or dermanyssoid type (see Evans & Till, 1966: 111) corresponds to the main diagnostic features of the genus (features #1–9 listed in genus diagnosis), as well as the addition of dorsal unpaired setae \( J \), the loss of setae \( r6 \), \( R \) and \( UR \), and a dorsal shield that covers the idiosoma entirely. However, each of these features also occur in at least a few other members of laelapids, with the exception of the anal shield bearing setae \( JV3 \), which may well be unique in Laelapidae, and trochanter IV with six setae, which appears as a unique attribute within Mesostigmata (Evans, 1963a, 1972). The fragmented band of sclerites extending anteriorly from fused endo-exo-sternal elements is also exceptional, and may be rare in Mesostigmata. Note that other laelapids, e.g. fragmented band of sclerites extending anteriorly from fused endo-exo-sternal elements is also exceptional, and may be rare in Mesostigmata (Evans, 1963a, 1972). The tint), rounded dorsal shield (more elongate in some

Pogonolaelaps relationship, or alternatively, morphological convergence, or even plesiomorphies. In particular, species of

Reticulolaelaps share with Persicolaelaps a strongly developed, well-sclerotised (thick, as indicated by the brownish tint), rounded dorsal shield (more elongate in some Oloelaeelaps, Jordaan & Loots, 1987, SK pers. obs.), bearing attenuate (slender) dorsal setae; an epigynal shield broadly expanded anteriorly; a pair of sclerotised preterrestrial platelets; endopodals, exopodals and sternal shield more or less coalesced anteriorly; well-developed endopodals mesad coxae III–IV; relatively broad peritrematal shield; parapodal plate thicker than usual; a gnathotectum somewhat triangular (less acuminate in Oloelaeelaps), finely denticulate (more sparingly in Oloelaeelaps); and a deutosternal groove with few denticles per row (Evans & Till, 1966; Jordaan & Loots, 1987; FB & SK, pers. obs. on Oloelaeelaps spp. from North America, Iran and Australia). Furthermore, at least some Oloelaeelaps have a band of sclerotised cuticle extending anteriorly from the podal plates between coxae I and II, and flanking coxae I laterally (Jordaan & Loots, 1987; we have seen such a cuticular band, although weakly sclerotised, in some specimens of at least two species examined by us, FB & SK). It is possible that this band extends and dorsally surrounds the gnathosomal base (but observation is difficult in this dark, crowded region), just as the series of (more conspicuous) sclerites do in Persicolaelaps. Oloelaeelaps is otherwise readily distinguished from Persicolaelaps by its epigynal shield hyperdeveloped posteriorly and fused to the anal shield, the presence of setae \( st4 \) in adult female, more slender leg setae, as well as by not having several other features characterising Persicolaelaps (#2, 4, 6, 7, 9 in genus diagnosis above).

Although also exhibiting many differences from Persicolaelaps, species of Oloopticus, Laelaspisella, Pogonolaelaps and Reticulolaelaps share with it a salient attribute: the absence of metasternal setae (Marais & Loots, 1969; Karg, 2003; Nemati et al., 2013; Nemati & Gwiazdowicz, 2016; Joharchi et al., 2016). Except for Oloopticus, which has a well-developed sternal shield (and apparently bearing deep pits at the region usually occupied by \( st4 \)), the absence of \( st4 \) in these genera and Persicolaelaps may be a result of a marked anterior expansion of the epigynal shield, leaving too little space, and little functional role (being so close to another pair of setae, \( st3 \)) for them to develop. An intermediate stage may be exhibited by Oloelaeelaps, for which seta \( st4 \) is inserted in the postero lateral margins of an otherwise normal sternal shield, near setae \( st3 \). Setae \( st4 \) are also lost in some species of the insect-associated laelapid genera Myrmozercon, Urozercor and Dinogamasus (Lundqvist, 1998; Klimov & O'Connor, 2004; Ghafariyan et al., 2013). The sternal shield is also broader than long in Oloelaeelaps, Laelaspisella and Pogonolaelaps, and concave posteriorly (also in Reticulolaelaps), seemingly also to accommodate the anterior expansion of the epigynal shield, a correlation seen in some members of many other genera of laelapids or relatives, especially associated with insects (e.g. Pneumolaelaps, Holostaspis, Laelaspis, Bisternalis, insect-associated Gaecolaelaps, Gymnolaelaps myrmophila (Michael), Melittiphisoides, Melittophis alvearius (Berlese); Evans & Till, 1966; Baker et al., 1983; Delfinado-Baker et al., 1984; Kazemi et al., 2014) or vertebrates (Androleelaps, Haemogamasus; Till, 1963) and more strikingly in dermanyssids, macronyssids and hirstionyssids (Evans & Till, 1966; Domrow, 1988), for which this may represent an adaptation for an increased capacity for engorgement in blood by having the opisthogastric region mostly covered by soft cuticle (Radovsky, 1969).
Laelaspisella, Pogonolaelaps and Reticulolaelaps share an additional feature with Persicolaelaps: the presence of two ventral setae on genu IV. This character also occurs in several disparate laelapid genera (e.g. Pneumolaelaps, Melitiphis, and some Laelaps and Myrmozercon species, Shaw & Seeman, 2009), as well as several genera of macronyssids (Evans & Till, 1965), and a few species of ‗Hypoaspis‘ s. lat. that are difficult to classify (e.g. H. giffoni Evans & Till, H. lubrica Voigts & Oudemans, H. atomarius Berlese; Evans & Till, 1966; van Aswegen & Loots, 1970). This indicates the plasticity in the development of seta pv of genu IV. Indeed, genu IV bears a pv seta in members of various other gamasine families, while being absent in many others (Evans, 1963a).

Etymology. The generic name Persicolaelaps refers to the ancient name of Iran, Persia, the country of origin of the genus (feminine).

**Persicolaelaps hallidayi** new species
(Figs 1–21)

Diagnosis. In addition to attributes given in the genus diagnosis, the new species can be further distinguished from other Mesostigmata, including other laelapids: dorsal shield oval, extending slightly onto ventrolateral aspect of idiosoma; anteriorly smooth, finely reticulate in posterior half (posterad J2 and s6), bearing 2–3 unpaired setae Jx between level of J2 and J4; setae j1, z1 situated more or less ventrally, dorsal setae much shorter than distance to following setal base, mostly smooth and slender, except setae J4–5, Z5, S5 slightly thicker, sparsely barbed, and j1 stout, blunt apically. Sternal shield strongly concave posteriorly, bearing long setae; reticulate, except smooth posterior area covered by expansive epigynal shield, reaching almost half-way of sternal shield medially, and anterolaterally setae st3 and edges of acetabula III; epigynal shield 1.2 x as long as wide, reticulate, with lineae almost reaching anterior shield margin; with variably-shaped cells, well separated from anal shield, with setae JV2 in-between. Anal shield with two small projections anteriorly; shield slightly wider than long. Setae JV3 longer than circumanal setae, post-anal seta slightly longer than para-anals. Peritremes anteriorly reaching level of coxae I. Soft opisthogastric cuticle with eight pairs of setae, JV1–2 longest. Metapodal plates divided, primary metapodals narrow, elongate. Internal malae with pair of median projections, flanked by 3–4 pairs of longer, tentacle-like projections. Deutosternal groove narrowing posteriorly. Leg setae moderately long, with many setae thickened or spine-like.

Female (n=3). (Figs 1–21). Dorsal idiosoma (Fig. 1). Dorsal shield length 847–922, width 615–672, broadest at level of setae s6–S1, extending slightly onto ventrolateral aspect of idiosoma, with j1, z1 and occasionally some marginal (r2–5) and lateral (s6, S1–3) setae inserted more or less ventrally; shield smooth anteriorly, with fine reticulate ornamentation posterad level of setae J2 medially and level of s6 laterally; 39 pairs of setae, 2–3 unpaired setae Jx, all setae relatively short, slender, mostly 26–38 long, j1 slightly thicker than other setae, apically blunt, 27–29 long, z1 shortest (21–23); J4, J5, Z5, S5 sparsely barbed. Adenotaxy and poroidotaxy as in genus description.

Ventral idiosoma (Figs 5–6, 17, 19–20). Tritosternal base 38–41 long, 25–27 wide proximally and 13–15 apically, with two entirely free, pilose laciniae (96–108). A pair of relatively large (71–73 x 15–17) and well-sclerotised pretelal platelets flanking tritosternum base. Sternal shield length 98–106, width 156–164 (ratio of length/width ≈ 0.65), anterior margin irregularly straight, posterior margin strongly concave, shield mostly reticulate, smooth posteriorly where epigynal shield overlaps, including a pair of putative gland openings gv1; sternal setae smooth and long, st1 82–86, st2 88–93, st3 94–98 long, poroids iv1–2 slit-like, iv1 aligned transversally, iv2 oblique (Figs 5, 17). Poroids iv3 ovoid, on soft cuticle, adjacent to endopodals between coxae III–IV. Endopodal element between coxae I–II fused to sternal shield, bearing gland pore gv1, and fused anteriorly to exopodal strip that flanks coxae I–IV; endopodal platelets between coxae III–IV well-developed, slightly overlapping posterolateral corners of sternal shield; parapodal element behind coxae IV relatively thick (Figs 5, 17). Epigynal shield expansive, length 304–319, width at level of st5 207–216, at broadest point behind coxae IV 252–263 (ratio of length/width at broadest point ≈ 1.2), anterior hyaline margin of shield reaching beyond level of iv2 anteriorly and beyond st3 laterally, posterior margin rounded medially, angled posterolaterally; shield well removed from anal shield, lineate-reticulate, with variously shaped cells, Λ-shaped linea enclosing nine variously-shaped cells (sometimes irregularly arranged in rows of two, Fig. 20); setae st5 (69–73) inserted on shield at mid-
level of coxae IV (Fig. 5). Anal shield inversely subtriangular, length 112–120, width 122–128, anterior margin almost straight with two small projections medially, reticulate; setae on shield smooth, ventral setae JV3 (40–44) longer than circumanal setae, para-anal setae (34–36) inserted at posterior level of anal opening, slightly shorter than post-anal seta (25–28); cribrum well-developed, extending anterolaterally to level of post-anal seta; anal opening located midway of shield length; pair of gland pores g1 on lateral shield margins at level near that of anterior margin of anus (Figs 5, 19). Peritrematal shields well-developed, broadly fused anteriorly to dorsal shield at level of coxae I, bearing three pairs of poroids and two pairs of gland pores; poststigmatic region extending to posterior level of coxae IV. Peritremes long (171–175) and narrow (6 wide), extending to level of anterior margin of coxae I. Soft opisthogastric integument with two pairs of small paragenital platelets between ZV1 and JV1; pair of primary, outer metapodals long and narrow (61–75 x 8–9), secondary, inner metapodals small (20–22 x 7–8); eight pairs of smooth opisthogastric setae JV1 (55–59), JV2 (51–52), JV4–5 (25–29), ZV1 (41–43), ZV2 (44–46), ZV3 (30–31), ZV4 (26–26); seven pairs of poroids, including paragenital poroids iv5 (Fig. 5). Spermathecal apparatus not seen.


*Gnathosoma* (Figs 3–4, 6–7, 21). Gnathotectum with broad triangular projection, with smooth median spike and minute denticles laterally (7–9 denticles on each side), lineate posteriorly (Figs 3, 21). Corniculi horn-like, relatively short (56–57); salivary stylets apically blunt. Internal malae longer than corniculi, comprising a pair of pilose median projections, and 3–4 lateral, longer, tentacle-like, smooth projections; labrum acuminate, considerably longer than internal malae, fringed; hypostomal and capitular setae smooth, $h_3$ (75–78) > $pc$ (61–63) > $h_l$ (53–55) > $h_2$ (43–46); deutosternal groove with six rows of 2–6 denticles each, and a smooth anterior ridge, narrowing posteriorly, anteriormost row slightly convex (Fig. 4). Basal cheliceral segment 75–76 long, second
segment 237–247 long, 50–52 wide; fixed digit 57–58 long, with 4–6 small teeth, including a subapical, small offset tooth; movable digit 65–67 long, bidentate; dorsal cheliceral seta stout, relatively long (15–16), setiform; pilus dentilis apically curved (Fig. 6). Palpgenu setae al1 and al2 and palpfemur al slightly thickened and spatulate apically; palpfemur pd1 and pd2 thickened; palp tarsal claw with two tines (Fig. 7).

Legs (Figs 8–16, 18). Leg chaetotaxy as in genus description, including two ventral setae on genu IV (Fig. 18), and six setae, including a small pd1, on trochanter IV (Figs 15, 18). All legs with ambulacrum (ambulacral stalk, pretarsus and claws), that of leg I (40–43) shorter than those of legs II (53–55), III (57–61) and IV (62–65) (Figs 13–16). Lengths of legs I: 727–744, II 611–625, III 587–601, IV 837–852. Lengths of femora I 178–179, II 123–129, III 124–129, IV 173–185; genua I 107–113, II 94–97, III 73–81, IV 115–118; tibiae I 119–123, II 88–94, III 79–81, IV 118–120; tarsi I 194–200, II 168–170, III 179–185, IV 253–262. Setae simple, smooth, moderately long, except some shortened and many thickened setae: trochanter I with al, av and pl short and fine, ad spur-like, pv2 elongate; trochanter III–IV with ad thickened or spur-like; trochanter IV with pd short and fine. Femur I with al2, av pl short and fine, all other setae except pl2 thickened, ad3 short; femur II with al1–2 and ad2–3 short, ad1, av, pd1–2, pv1–2 slightly thickened; femur III with al, ad1–2 thickened, av elongate, pd and pl short; femur IV with al, av, pd slightly thickened, ad1–2 thickened, pl short and fine. Genu I with av2 and pv slightly thickened; genu II with al2, ad2–3, av, pv thickened; genu III with av and pv spine-like, pd2 and pl slightly thickened; genu IV with al1–2, pd2–3 thickened, av and pv spine-like. Tibia I with av2 and pv thickened, pv longest; tibia II with ventral setae thickened; tibia III with al2–3, pl thickened, av, pv spine-like; tibia IV with al1–2, pd2 slightly thickened, pl1–2, av, pv thickened. Tarsi II–IV with nearly all setae thickened or spine-like, especially al1, pl1, and ventral setae of tarsus II; tarsus IV with longest setae, although not whip-like; ad1, pd1 as fine apical processes.

Material examined. Holotype: female, from rotten wood, northern Iran, Golestan Province, Qarn-Abad Forest, (36°47' N; 54° 03' E), 522 m above sea level, 2 June 2012, coll. A. Katuli, deposited in Acarological Collection, Institute of Science and High Technology and Environmental Sciences, Graduate University of Advanced Technology, Kerman, Iran (ACISTE). Paratypes: one female with same collection data, deposited in ACISTE; two females collected in soil and litter, northern Iran, Mazandaran Province, Noor City (36° 34' N; 52° 03' E), -22 m above sea level, summer 2013, coll. unknown, deposited in ACISTE.

Etymology. The species is named in honour of Bruce Halliday, for his valuable work on Acari, especially Mesostigmata.

Discussion

Some morphological features of Persicolaelaps hallidayi suggests a predatory lifestyle rather than a parasitic one, at least not obligatorily so, since well-developed chelate-dentate chelicerae also occur in facultative haematophagous laelapids (e.g. Laelapinae: Laelaps spp.) or relatives (e.g. Haemogamasus spp.), some of which are morphologically similar to hypoaspidines, such as Androlaelaps (Laelapinae) (Evans, 1955; Radovsky, 1969). Other features suggestive of a free-living lifestyle other than strong chelicerae include normally developed deutosternum and corniculi, as well as well-armoured, essentially holotrichous idiosoma, and long legs with spine-like setae. Strong idiosoma and legs are probably adaptations for defense or escape against predators—therefore may be indicative of an environment thriving with natural enemies, such as litter or decaying wood. Note, however, that feeding habits of most laelapids remain speculative, and even groups such as Hypoaspis (s. str.), associated with scarab beetles have unresolved feeding habits (Joharchi & Halliday, 2011).

The many thick, elongate thread-like projections of the internal malae of P. hallidayi have unknown significance, but seem to occur in laelapids that are associated with ants or bees (some Cosmolaelaps, Laelaspis, and Pneumolaelaps spp.; see Remarks above). It has been suggested that internal malae (and corniculi) are for preventing debris adhering to the chelicerae from entering the internal spaces between the gnathotectum and hypostome (Evans & Till, 1979).

A gnathotectum with denticulate margins, such as that of P. hallidayi, is typical of free-living laelapids, although its well-defined triangular shape is unusual. For instance, some Laelaspis, Laelaspisella and Pogonolaelaps species have (sub)triangular gnathotecta, but have a smooth margin or only a few denticles (Marais & Loots, 1969; Kazemi, 2015; Nemati & Gwiazdowicz, 2016). Species of Hypoaspis s. str. and Coleolaelaps have a denticulate, subtriangular gnathotectum, although it is more rounded apically, somewhat tongue-shaped (Costa &
NEW GENUS OF LAELAPIDAE

Based on where it was found (in part), in decaying wood, it is possible that the new mite lives in association with some wood-dwelling arthropods. Furthermore, the additional soil-litter sample in which it was found contained a number of ants. Many hypoaspidines are associated with scarab and passalid beetles (e.g. Costa, 1971; Hyatt, 1964), cockroaches (e.g. Faraji & Halliday, 2009), and particularly bees (Eickwort, 1994) and ants (e.g. Evans & Till, 1966; Kazemi, 2015), insect groups that all comprise wood-nesting species.

Persicolaelaps hallidayi is a well-sclerotised animal, leaving approximately one third of the ventral surface with soft cuticle, posteriorly. The mite is particularly well protected anteriorly, with rather broad peritrematal sclerites in the literature on Mesostigmata, but we suspect that it occurs in other well-sclerotised laelapids or straddling the base of the gnathosoma and forecoxae. We have not come across any mention of such series of characters reminiscent of some Mesostigmata. A wider epigynal shield, occupying nearly half of the idiosomal width at level of coxae III–IV, was illustrated for Synasponyssus wenzeli Radovksy & Furman, 1969, a macronyssid that gives birth to protonyms. Other Mesostigmata have an epigynal shield about as broad as that of Persicolaelaps in the anterior portion between coxae III or beyond (e.g. some and Pseudolaelaps, Nematariidae; Lindquist & Moraza, 2010). Such a relative width of epigynal shield is close to the maximal observed in Mesostigmata. A wider epigynal shield, occupying nearly half of the idiosomal width at level of acetabulum III and IV at their level, and anteriorly wider than a third of the width of the idiosoma at that level (of setae st3), might be an adaptation for the laying of large eggs (although compare the supersized eggs of Opilioseiulus (Blattissicidae) relative to its modest epigynal shield; Lindquist & Moraza, 2010). This overall high level of idiosomal sclerotisation of P. hallidayi is still surpassed by some hypoaspidines (e.g. Ololoelaps, Oloopticus), haemogamasine (Eulaelaps), and clearly by many parasitids, macrochelids, pachylaelapids, and some of the fully armoured ologamasids, uropodoids and trigynaspids (e.g. Evans & Till, 1979). The dome-like dorsal shield also provides protection against predators (or hosts if it was phoretic), as a more convex surface is more difficult to seize or penetrate than a flatter surface. Such a well-armored, dorsally convex idiosoma may compensate for the reduction in size of the dorsal setae, a combination of characters reminiscent of some Oloelaps, as well as some ologamasids (e.g. Gamasiphis spp., Lee, 1970). The (anteriorly) broad epigynal shield, wider than twice the width of acetabulum III and IV at their level, and anteriorly and posteriorly wider than a third of the width of the idiosoma that at level of st3, might be an adaptation for the laying of large eggs (although compare the supersized eggs of Opilioseiulus (Blattissicidae) relative to its modest epigynal shield; Lindquist & Moraza, 2010).

Female laelapids show a remarkable range of epigynal shields in terms of size and shape. The somewhat axe-shaped shield of P. hallidayi is distinctive, but it can be compared to that of other laelapids such as Hypoaspis passali Hyatt, 1964, Laelosphoides odorvayae Eickwort, 1966, Euandrolaelaps sardous (Berlese), and C. cuneifer (Evans & Till, 1966), which also have strong inflexion in the margin posterior to level of setae st5, although not as developed as in this shape that of P. hallidayi. Females of leptolaelapids such as Hunteracarus and Leptolaelaps also have a large axe-shaped epigynal shield (Costa, 1975; Evans, 1957), as well as certain Proctolaelaps (Melnicharidae; Lindquist & Evans, 1965).

The presence of six setae on the trochanter of leg IV, including a small seta in posterodorsal position, appears as a unique or rare apomorphy within Mesostigmata (e.g. Evans, 1963, 1972). Although this added pd seta is as weak or weaker than the smallest setae of the legs (pl of coxa I and femur IV), it was seen in both trochanters IV of all females of P. hallidayi studied. This may make this apomorphy less significant than if it was, say, a stout spine. Six setae have been mentioned for the trochanter IV of a diplogniid, Weiseronyssus persicus Kazemi et al. (Trigynaspida, Kazemi et al., 2008); however, this is erroneous and the trochanters formula of the species is actually 6-5-5-5 (not 5-5-5-6 as originally published; Kazemi, pers. obs.). Given its rarity, at least in Gamasina, we hypothesize that this seta was added late in the development, probably at the deutonymphal stage.
Persicolaelaps hallidayi, like members of other genera that have two ventral setae on genu IV and lack metasternal seta st4 (e.g. Laelaspisella, Pogonolaelaps, Reticulolaelaps), may not be identified readily as a Laelapidae when using current identification keys to families of Mesostigmata (e.g. Lindquist et al., 2009). These relatively uncommon character states have to be considered when studying character couplet 39(b) and 43(b) of the key in Lindquist et al. (2009) (also 44b, where two ventrals on genu IV is mentioned as a possible exception). The absence of st4 also makes couplet choice 45b problematic, but that seta might always be present in Rhodacaroidea. In addition, at couplet 52, it must be considered that the subapical spur-like setae (al1, pl1) of tarsus II of *P. hallidayi* and of many other hypoaspidines (e.g. Gaeolaelaps aculeifer) are not as developed as the ‘distal spurs’ (usually al1, pl1) of many pachylaelapids. The atypical epigynal shield of *P. hallidayi*, with its inflexion posterolaterally, may cause further hesitation in couplet 54. Finally, although a ventrianal shield may be defined as an anal shield expanded sufficiently to include one or more pairs of setae in addition to the three circumanal setae, *Persicolaelaps hallidayi* should be considered to have an anal shield, despite bearing JV3 setae, so that it does not conflict with couplet choice 60b. Finding the male (and the immature stages), may also facilitate its identification and of many other hypoaspidines.

Acknowledgments

We thank Evert Lindquist and an anonymous reviewer for their constructive comments on an earlier version of the manuscript. We also thank A. Katuli, A. Nemati and E. Arjomandi for their kind help to provide the specimens examined in this paper.

References


http://dx.doi.org/10.1111/j.1096-3642.1957.tb01552.x


http://dx.doi.org/10.1080/01647950903059445


http://dx.doi.org/10.3897/zookeys.272.4404


http://dx.doi.org/10.1051/acarologia/20142119


http://dx.doi.org/10.3897/zookeys.549.6939


http://dx.doi.org/10.11646/zootaxa.4044.3.5


http://dx.doi.org/10.11646/zootaxa.3861.6.1


http://dx.doi.org/10.3897/zookeys.549.7435


NEW GENUS OF LAELAPIDAE

Zootaxa 4200 (4) © 2016 Magnolia Press · 499


