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## Article

### Supplementary descriptions of thirteen species of soil mites (Mesostigmata: Laelapidae)

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#### ABSTRACT

This study provides additional morphological information and new illustrations for 13 species of soil mites in the family Laelapidae previously described from Iran, to supplement the original descriptions.

**KEY WORDS:** *Coleolaelaps*; *Gaeolaelaps*; *Hypoaspis*; *Laelaspis*; *Myrmozercon*; *Promacroloaelaps*.

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## INTRODUCTION

The mite family Laelapidae Berlese (Acari: Parasitiformes) is one of the most diverse families of the Order Mesostigmata, but it has not yet achieved a stable generic classification. Recent research has made significant progress in clarifying the identity of the genera that occur in soil or associated with insects (e.g. Joharchi *et al.* 2018, 2019; Babaeian *et al.* 2019). Until now about 150 species of Laelapidae from various genera have been reported from different parts of Iran (Kazemi and Rajaei 2013; Nemati *et al.* 2018). The purpose of this paper is to review the morphology of some of these species, and to add more details to their descriptions.

## MATERIALS AND METHODS

Specimens used in this survey were either borrowed from Jalal Afshar Zoological Museum, College of Agriculture, University of Tehran, Iran (JAZM) or the Acarological Collection, Department of Plant Protection, Yazd Branch, Islamic Azad University (YIAU). Photomicrographs were taken with an AxioCam 506 camera (Carl Zeiss, Germany) equipped with differential interference contrast (DIC). Figures were prepared with Adobe Photoshop CS2 software. The nomenclature used for the dorsal idiosomal chaetotaxy follows that of Lindquist and Evans (1965), the notations for leg and palp setae follow those of Evans (1963a, b), and other anatomical structures mostly follow Evans and Till (1979).

## RESULTS

### Genus *Coleolaelaps* Berlese

*Coleolaelaps* Berlese, 1914: 141. Type species *Laelaps (Iphis) agrestis* Berlese, 1887, by original

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designation.

***Coleolaelaps costai* Joharchi & Halliday, 2011 (Figs. 1–6)**

*Coleolaelaps costai* Joharchi & Halliday, 2011: 24.

*Material examined*

Holotype (ARS-20131018-5a) borrowed from Jalal Afshar Zoological Museum, Alborz, Iran.

*Notes*

Joharchi and Halliday (2011) described *Coleolaelaps costai* from specimens collected on the beetle *Polyphylla olivieri* (Castelnau) (Coleoptera: Scarabaeidae) from Iran. We have re-examined the holotype of this species (Figs. 1–6). In the original description (Joharchi and Halliday 2011, Figs. 1–9), the peritrematal shield was not illustrated, but it is present in the holotype, it is free from the dorsal shield, and tapers to a point, just anteriorly to the peritreme apex (Fig. 6). Dorsal shield without distinct reticulate ornamentation over whole surface (except for sigillae and marginal areas in both podonotal and opisthonotal regions). The illustrations provided by Joharchi and Halliday (2011) did not show all segments of the legs, so we provide them here to clarify the identity of this species. Joharchi and Halliday (2011) stated that the tibia of the palp has 12 setae, but we now correct that to 14 setae, which is typical for Laelapidae.

**Genus *Gaeolaelaps* Evans & Till, 1966**

*Hypoaspis* (*Gaeolaelaps*) Evans and Till, 1966: 159.

**Type species:** *Laelaps aculeifer* Canestrini, 1884, by original designation.

***Gaeolaelaps saboorii* Joharchi & Babaeian, 2014 (Figs. 7–11)**

*Gaeolaelaps saboorii* Joharchi & Babaeian, 2014: 90.

*Material examined*

Holotype borrowed from YIAU and one paratype (ARS-20191222-8b) borrowed from JAZM.

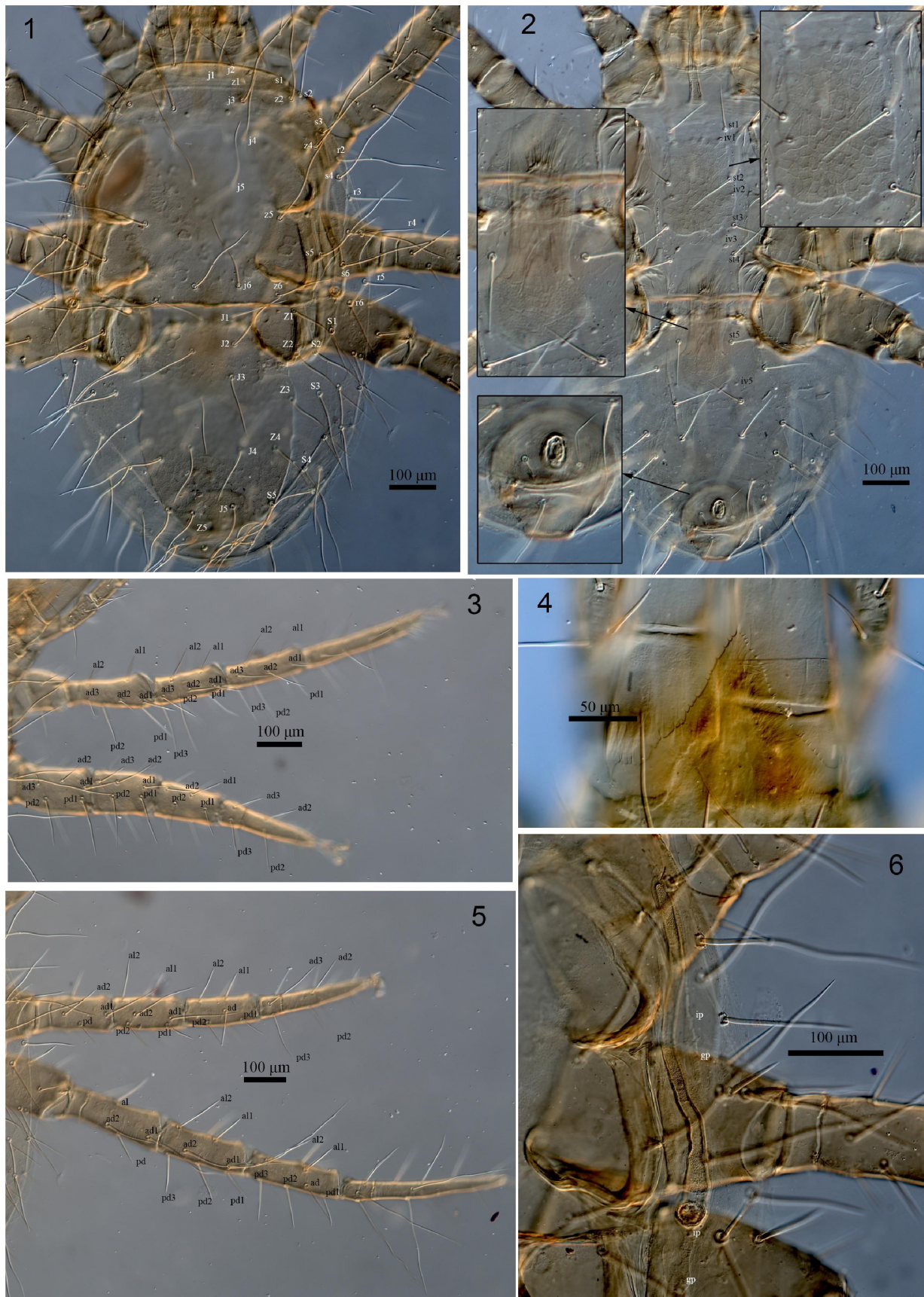
*Notes*

Joharchi and Babaeian (2014) described *Gaeolaelaps saboorii* from specimens collected on *Acinopus* sp. (Coleoptera: Carabidae) from Iran. Kazemi *et al.* (2014) excluded this species from *Gaeolaelaps* and considered it belongs to *Cosmolaelaps*, while Nemati *et al.* (2018) placed it in *Hypoaspis sensu lato*. Saeidi *et al.* (2019) returned it to *Gaeolaelaps* because it has all the diagnostic character states of *Gaeolaelaps*. We have re-examined the holotype and a paratype of this species (Figs. 7–11). Joharchi and Babaeian (2014) stated that the peritrematal shield is anteriorly free and the fixed digit of chelicera has four teeth. We now confirm that the peritrematal shield is fused to the dorsal shield apically at the level of seta *z1* (Fig. 7). The fixed digit of the chelicera has seven teeth (6 large teeth, and 1 or 2 are very small teeth, including the apical hook) (Fig. 9), not four. The dorsal aspect of legs II–IV are illustrated in Figs. 10–11. Joharchi and Babaeian (2014) stated that the tibia of the palp has 12 setae, but we now correct that to 14 setae. The holotype has been transferred from YIAU to JAZM (slide number ARS-20191222-8a) to make it more accessible.

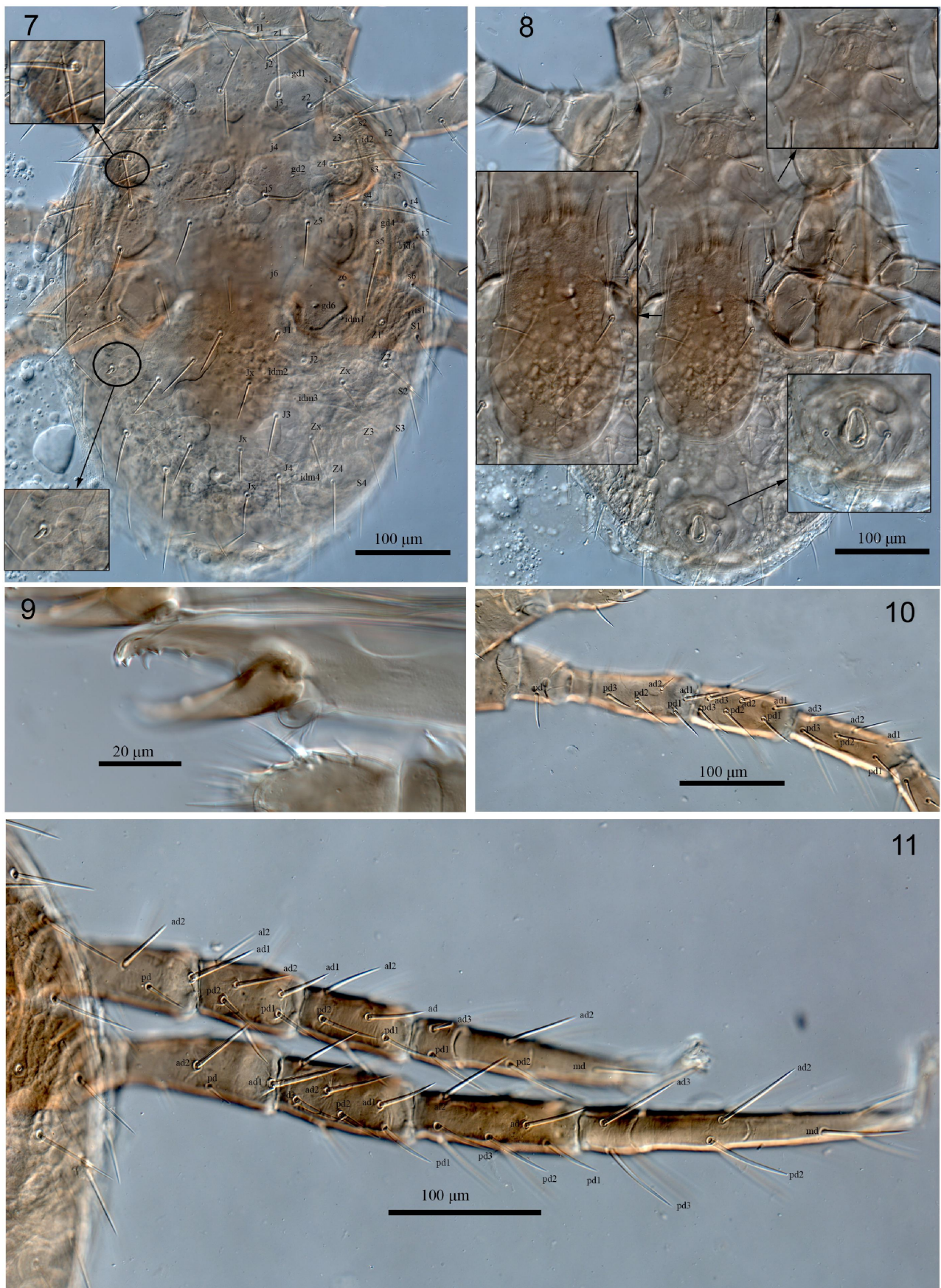
**Genus *Hypoaspis* Canestrini**

*Hypoaspis* Canestrini, 1884: 1569.

**Type species:** *Gamasus krameri* G. & R. Canestrini, 1881, designated by Berlese (1904).



**Figures 1–6.** DIC micrographs of *Coleolaelaps costai* Joharchi & Halliday, 2011 (female holotype) – 1. Dorsal idiosoma; 2. Ventral idiosoma; 3. Legs I & II in dorsal view; 4. Epistome; 5. Legs III & IV in dorsal view; 6. Peritrematal shield.



**Figures 7–11.** DIC micrographs of *Gaelaelaps saboorii* Joharchi & Babaeian, 2014 (female paratype) – 7. Dorsal idiosoma; 8. Ventral idiosoma; 9. Chelicera; 10. Leg I in dorsal view; 11. Legs III & IV in dorsal view.

***Hypoaspis alborzensis* Razavi Susan & Joharchi, 2014 (Figs. 12–15)**

*Hypoaspis alborzensis* Razavi Susan & Joharchi, in Razavi Susan *et al.*, 2014: 52.

*Material examined*

Holotype (ARS-20130311-1a) borrowed from JAZM.

*Notes*

*Hypoaspis alborzensis* Razavi Susan and Joharchi, 2014 was described from Iran, where it was found on *Oryctes* sp. (Coleoptera: Scarabaeidae). We have re-examined the holotype of this species, and now provide some additional figures to support the original description (Figs. 12–15). Note also that the palptibia has 14 setae, not 12 as setae in Razavi Susan *et al.* (2014).

***Hypoaspis elegans* Joharchi, Ostovan & Babaeian, 2014 (Figs. 16–23)**

*Hypoaspis elegans* Joharchi, Ostovan & Babaeian, 2014: 570.

*Material examined*

Holotype borrowed from YIAU and two paratypes (ARS-20191222-9b and c) borrowed from JAZM.

*Notes*

Joharchi *et al.* (2014) described *Hypoaspis elegans* from specimens collected on *Oryctes elegans* Prell. (Coleoptera: Scarabaeidae) in Iran. We now provide some additional figures to support the original description (Figs. 16–23). Joharchi *et al.* (2014) stated that the tibia of the palp has 12 setae, but we now correct that to 14 setae. The holotype has been transferred from YIAU to JAZM (slide number ARS-20191222-9a) to make it more accessible.

***Hypoaspis larvicolus* Joharchi & Halliday, 2011 (Figs. 24–29)**

*Hypoaspis larvicolus* Joharchi & Halliday, 2011: 27.

*Material examined*

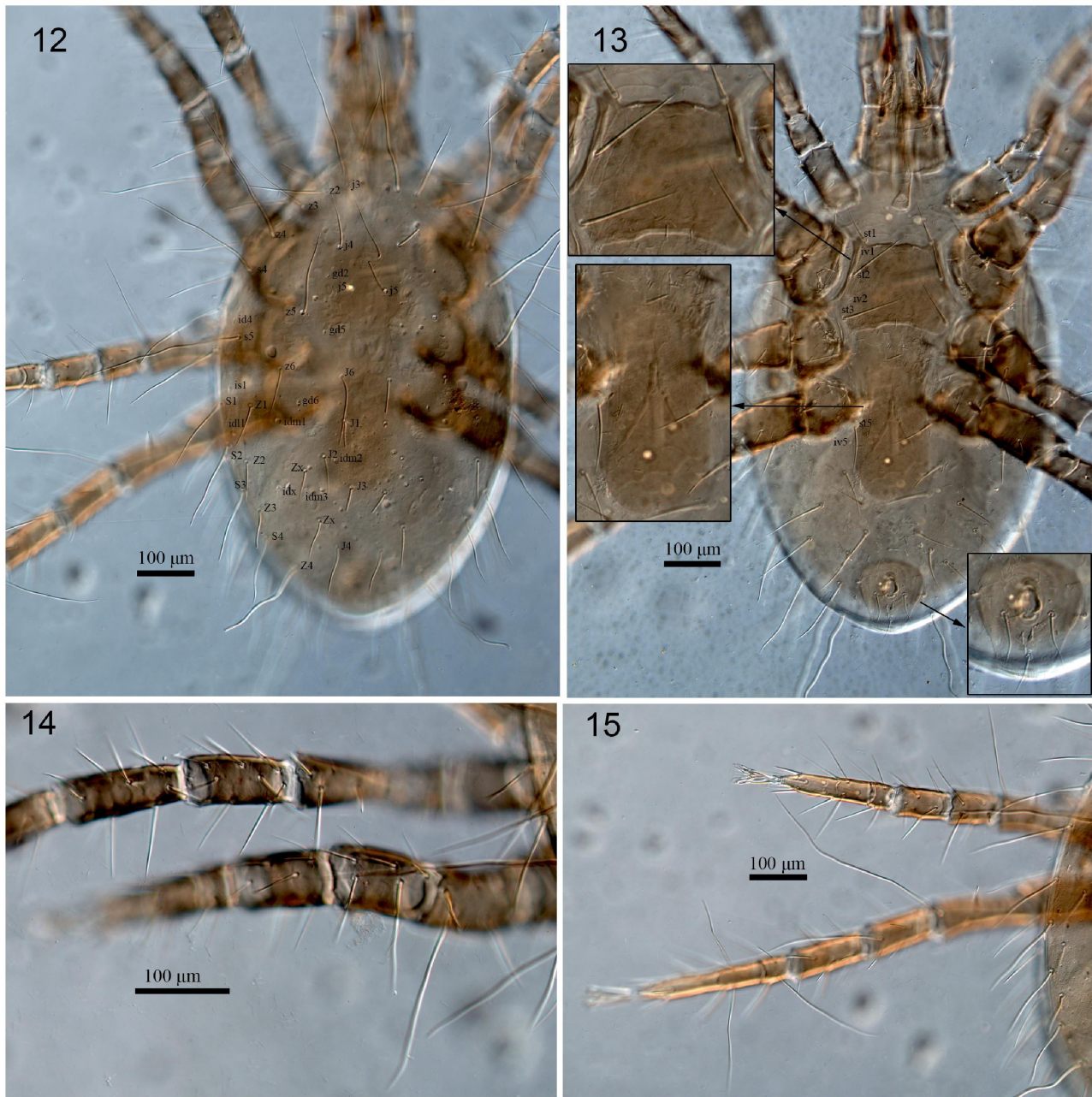
Holotype (ARS-20191222-1a) and two paratypes borrowed from YIAU.

*Notes*

Joharchi and Halliday (2011) described *Hypoaspis larvicolus* from specimens collected on the larva of *Polyphylla* sp. (Coleoptera: Scarabaeidae) in Iran. We now provide some additional illustrations to supplement the original description (Figs. 24–29). Joharchi and Halliday (2011) illustrated tibia IV with 11 setae, including *ad2*; however, among the three specimens that we re-examined (holotype and two paratypes), *ad2* was present only in the holotype, with two paratypes having therefore only 10 setae on tibia IV (Fig. 27). In addition, they stated that podonotal setae *s6* is located on the soft cuticle outside the dorsal shield, whereas it is actually inserted on the dorsal shield (Fig. 24). The illustrations provided by Joharchi and Halliday (2011) did not show all segments of legs, so we provide them here to clarify the identification of this species. Joharchi and Halliday (2011) also stated that the tibia of the palp has 12 setae, but we now correct that to 14 setae.

***Hypoaspis maryamae* Joharchi & Halliday, 2011 (Figs. 30–34)**

*Hypoaspis maryamae* Joharchi & Halliday, 2011: 31.



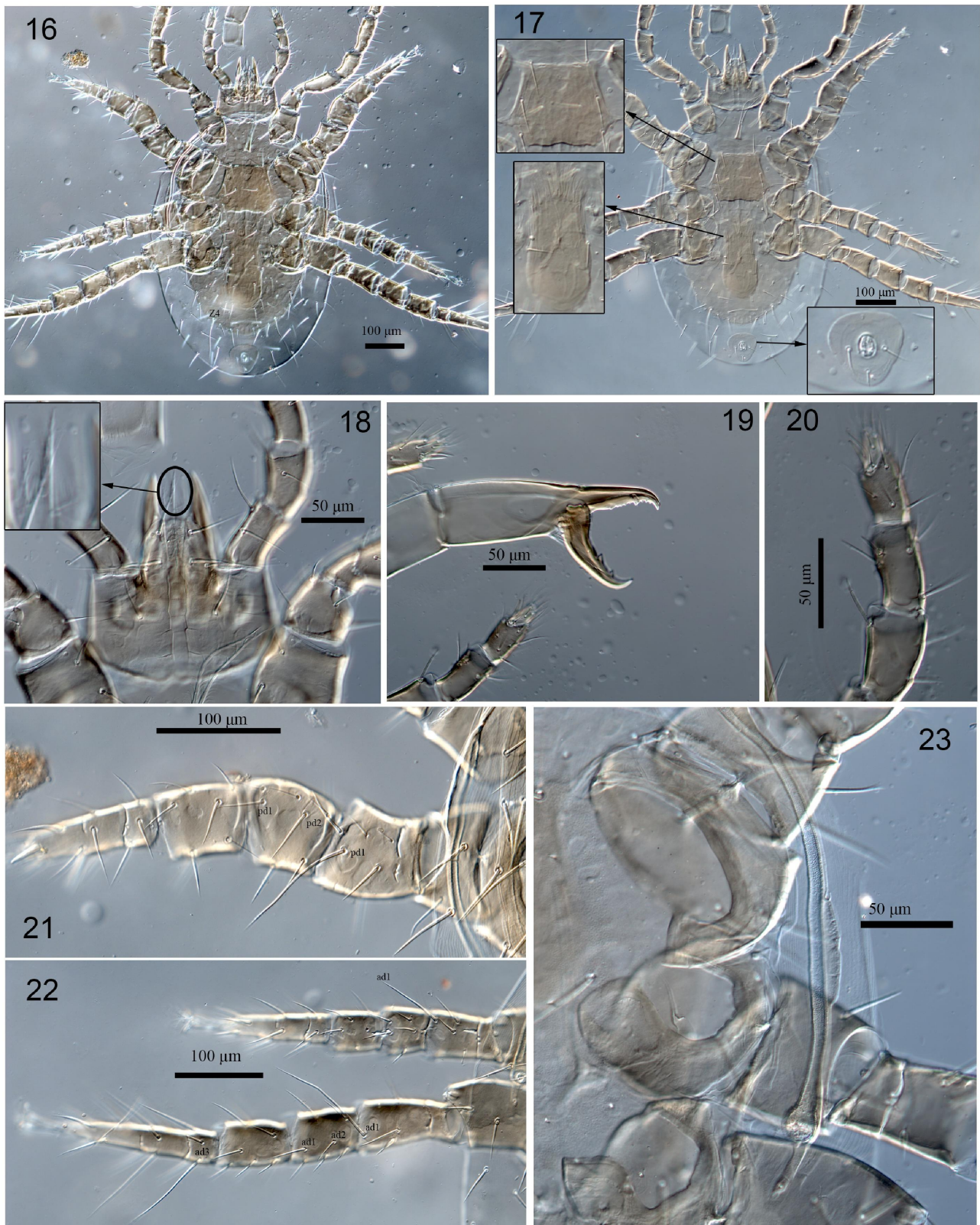
**Figures 12–15.** DIC micrographs of *Hypoaspis alborzensis* Razavi Susan & Joharchi, 2014 (female holotype) – 12. Dorsal idiosoma; 13. Ventral idiosoma; 14. Legs I & II in dorsal view; 15. Legs III & IV in dorsal view.

#### *Material examined*

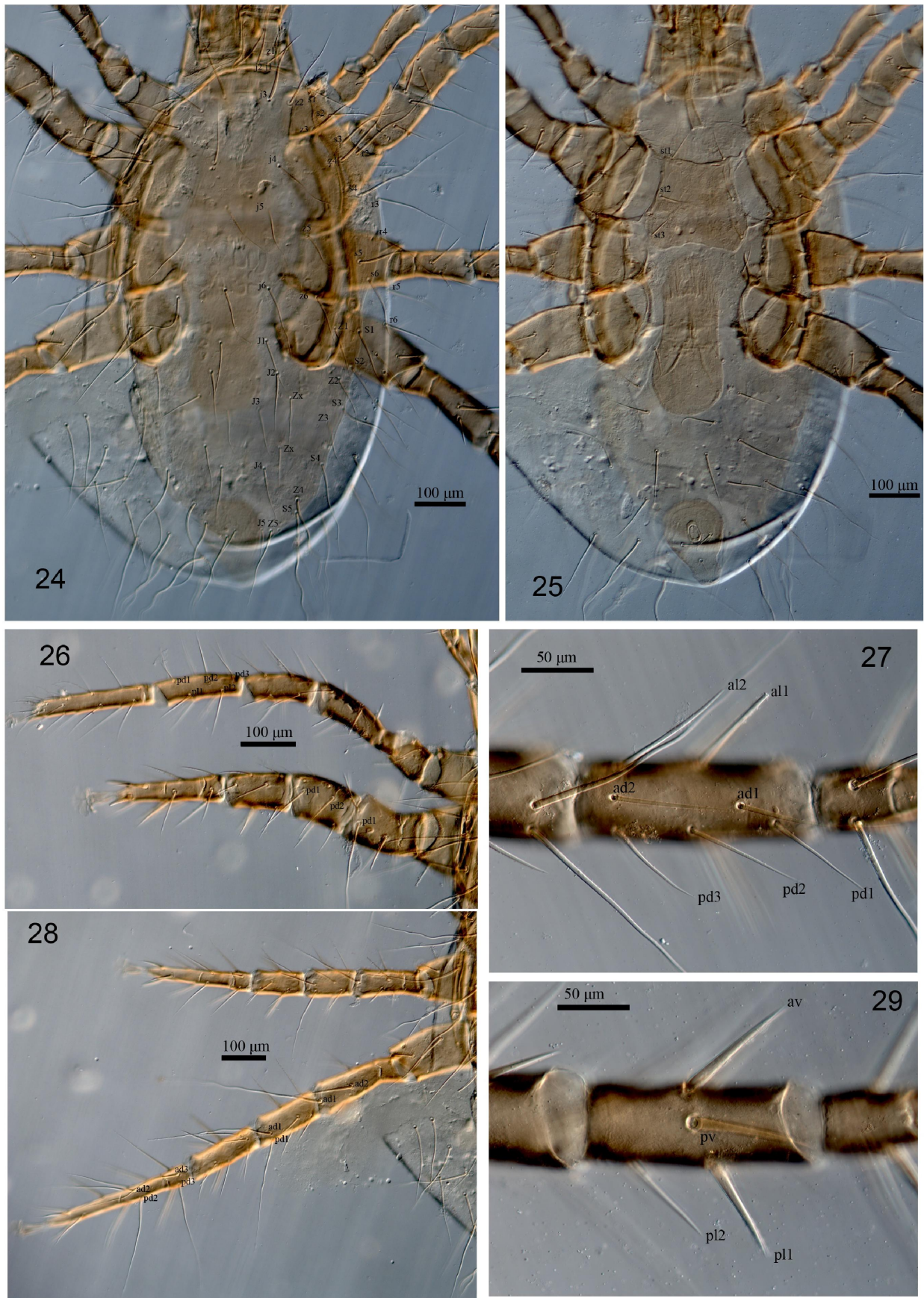
Holotype (ARS-20131020-3a) borrowed from JAZM.

#### *Notes*

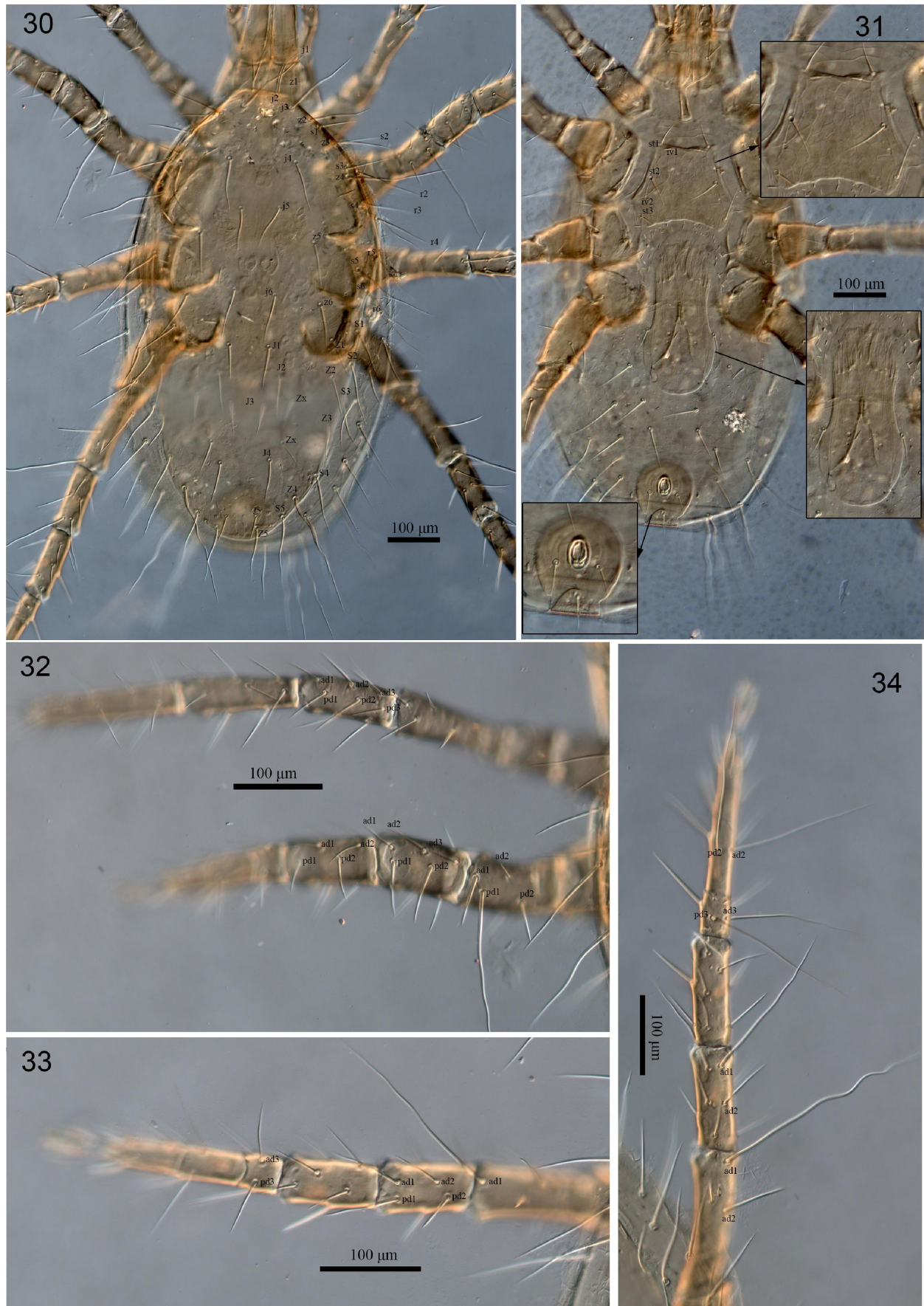
Joharchi and Halliday (2011) described *H. maryamae* from specimens collected on the adult of *Polyphylla olivieri* (Castelnau) (Coleoptera: Scarabaeidae) from Iran. We now provide some additional figures to support the original description (Figs. 30–34). Joharchi and Halliday (2011) also stated that the tibia of the palp has 12 setae, but we now correct that to 14 setae.



**Figures 16–23.** DIC micrographs of *Hypoaspis elegans* Joharchi, Ostovan & Babaeian, 2014 (female holotype) – 16. Dorsal idiosoma; 17. Ventral idiosoma; 18. Subcapitulum; 19. Chelicera; 20. Palp; 21. Leg II in dorsal view; 22. Legs III & IV in dorsal view; 23. Peritrematal shield.



**Figures 24–29.** DIC micrographs of *Hypoaspis larvicolus* Joharchi & Halliday, 2011 (female holotype) – 24. Dorsal idiosoma; 25. Ventral idiosoma; 26. Legs I & II; 27. Tibia IV in dorsal view; 28. Legs III & IV in dorsal view; 29. Tibia IV in ventral view.



**Figures 30–34.** DIC micrographs of *Hypoaspis maryamae* Joharchi & Halliday, 2011 (female holotype) – 30. Dorsal idiosoma; 31. Ventral idiosoma; 32. Legs I & II in dorsal view; 33. Leg III in dorsal view; 34. Leg IV in dorsal view.

***Hypoaspis melolonthae* Joharchi & Halliday, 2011 (Figs. 35–38)**

*Hypoaspis melolonthae* Joharchi & Halliday, 2011: 33.

*Material examined*

Holotype (ARS-20131020-4a) borrowed from JAZM.

*Notes*

Joharchi and Halliday (2011) described *H. melolonthae* from specimens collected on the adult of *Melolontha melolontha* (L.) (Coleoptera: Scarabaeidae) in Iran. We now provide some additional figures to support the original description (Figs. 35–38). Joharchi and Halliday (2011) stated that podonotal setae *r*<sub>2</sub> is absent, but it is present (Fig. 35); seta *r*<sub>3</sub>, in contrast, is indeed absent as stated in the original description. They stated that the tibia of the palp has 12 setae, but we now correct that to 14 setae.

**Genus *Laelaspis* Berlese**

*Laelaps* (*Laelaspis*) Berlese, 1903: 13.

**Type species:** *Laelaps astronomicus* Koch, 1839, by original designation.

***Laelaspis kamalii* Joharchi & Halliday, 2012 (Figs. 39–43)**

*Laelaspis kamalii* Joharchi & Halliday, in Joharchi *et al.*, 2012: 2004.

*Material examined*

Holotype (ARS-20131018-4a) borrowed from JAZM.

*Notes*

*Laelaspis kamalii* Joharchi and Halliday, 2012 was described from Iran (Joharchi *et al.* 2012), where it was found in nests of *Tapinoma* sp. (Hymenoptera: Formicidae). Joharchi *et al.* (2012) did not provide any illustrations for legs, so we now provide some additional figures to support the original description (Figs. 39–43). Joharchi *et al.* (2012) stated that the tibia of the palp has 12 setae, but we now correct that to 14 setae.

***Laelaspis pennatus* Joharchi & Halliday, 2012 (Figs. 44–49)**

*Laelaspis pennatus* Joharchi & Halliday, in Joharchi *et al.*, 2012: 2007.

*Material examined*

Holotype (ARS-20131018-5a) borrowed from JAZM.

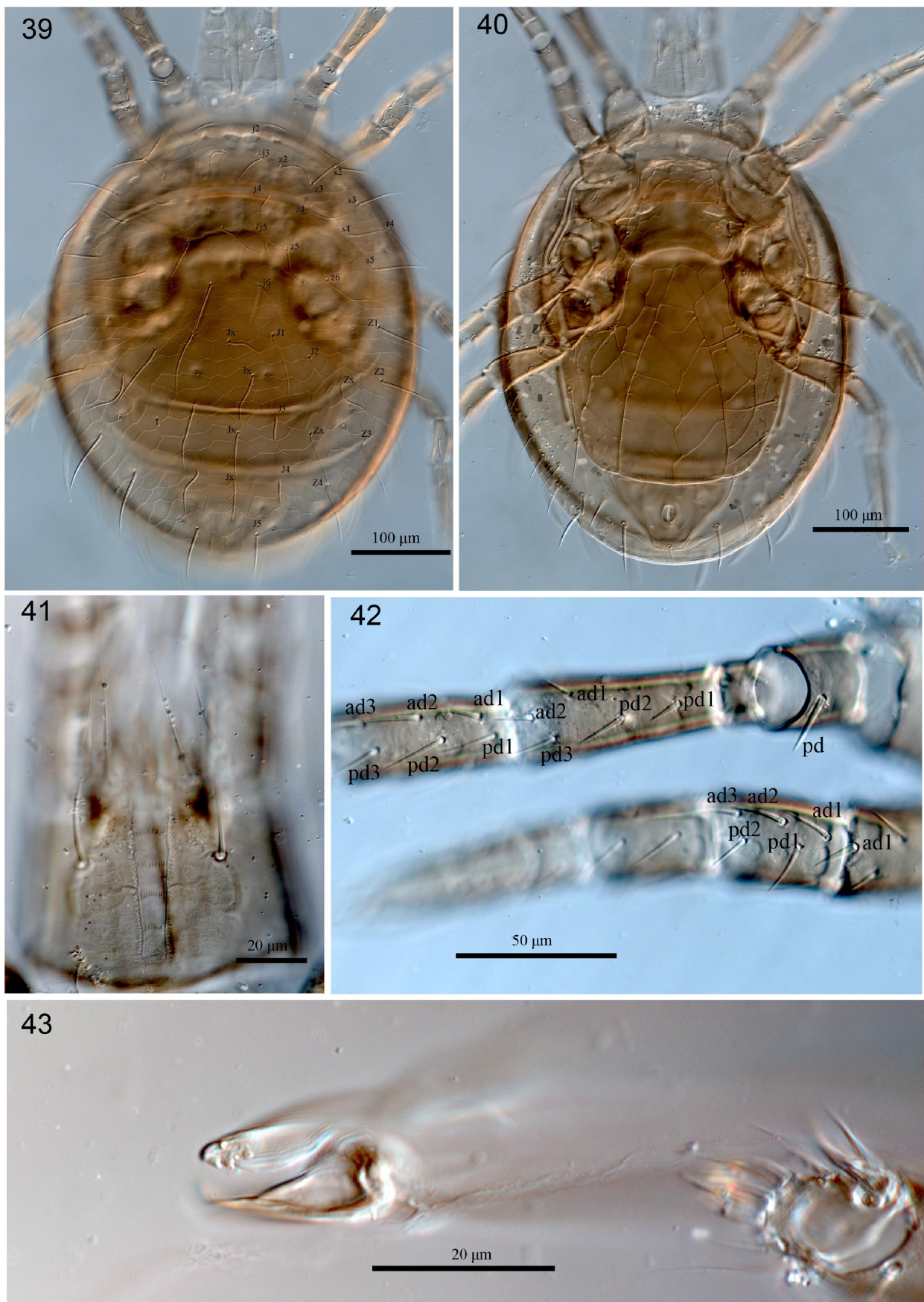
*Notes*

*Laelaspis pennatus* Joharchi and Halliday, 2012 was described from Iran (Joharchi *et al.* 2012) where it was found in nests of *Tetramorium caespitum* (L.) (Hymenoptera: Formicidae). Joharchi *et al.* (2012) did not provide any illustrations for legs, and in their illustration of the chelicera (Joharchi *et al.* 2012, Fig. 2G), the dentition is not clear. We have re-examined the holotype of this species, and herein provide additional figures to rectify this (Figs. 44–49). Joharchi *et al.* (2012) stated that the tibia of the palp has 12 setae, but we now correct that to 14 setae.

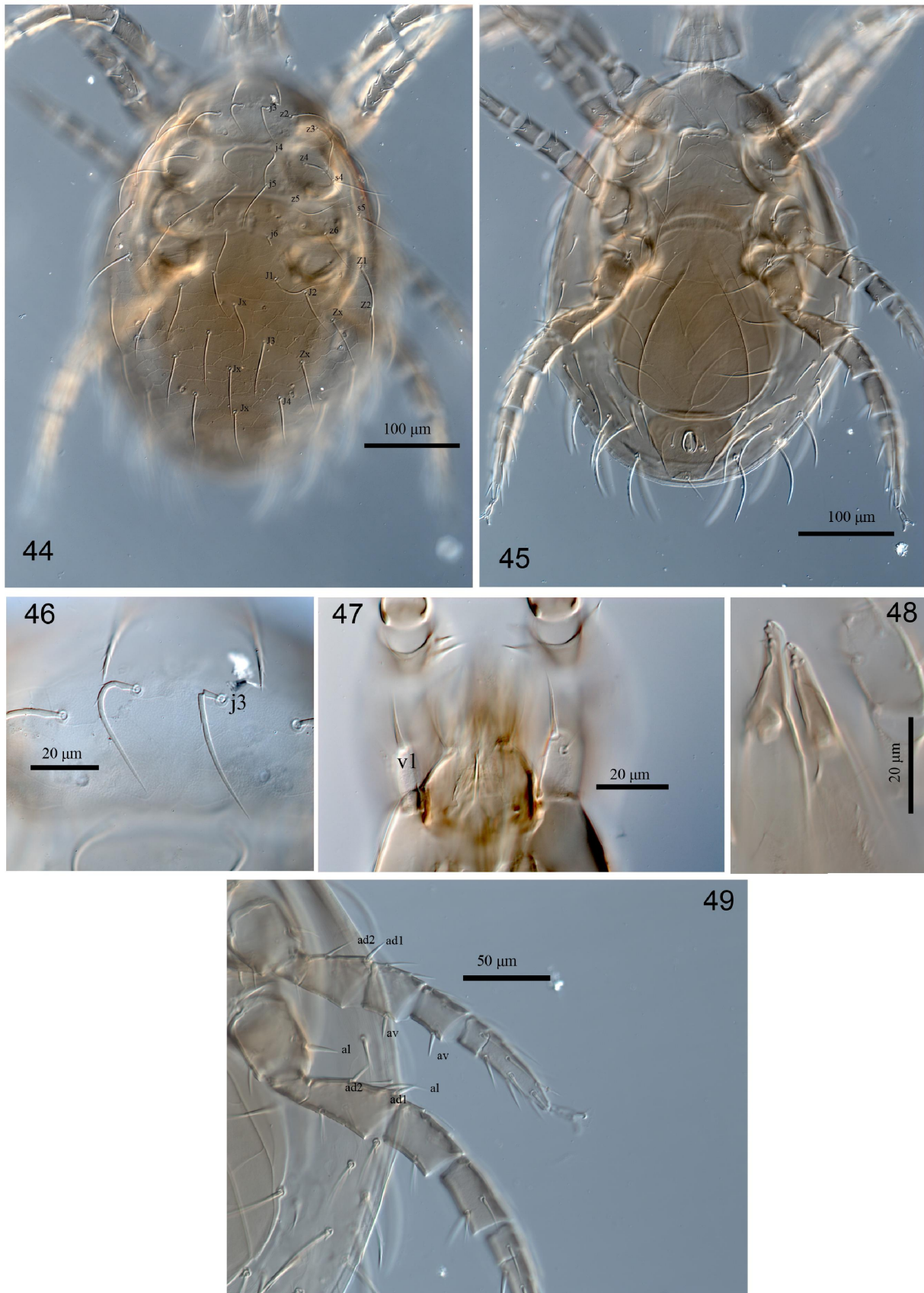
**Genus *Myrmozercon* Berlese**

*Myrmozercon* Berlese, 1902: 699.





**Figures 39–43.** DIC micrographs of *Laelaspis kamalii* Joharchi & Halliday, 2012 (female holotype) – 39. Dorsal idiosoma; 40. Ventral idiosoma; 41. Subcapitulum; 42. Legs I & II in dorsal view; 43. Chelicera.



**Figures 44–49.** DIC micrographs of *Laelaspis pennatus* Joharchi & Halliday, 2012 (female holotype) – 44. Dorsal idiosoma; 45. Ventral idiosoma; 46. Enlarged dorsal setae; 47. Subcapitulum; 48. Chelicera; 49. Legs III & IV in ventrolateral view.

**Type species:** *Myrmozercon brevipes* Berlese, 1902, by monotypy.

***Myrmozercon brachytrichos* Joharchi *et al.*, 2017 (Figs. 50–51)**

*Myrmozercon brachytrichos* Joharchi, Arjomandi & Trach, 2017: 726.

*Material examined*

Holotype borrowed from YIAU.

*Notes*

We now supplement the original description with photomicrographs of the dorsal shield (Fig. 50) and ventral idiosoma (Fig. 51). Joharchi *et al.* (2017) stated that the tibia of the palp has 11 setae. The palp tibia and tarsus in this species are fused, and the combined tibia/tarsus has 23–24 setae. The holotype has been transferred from YIAU to JAZM (slide number ARS-20191222-15a) to make it more accessible.

***Myrmozercon hunteri* Joharchi *et al.*, 2015 (Figs. 52–53)**

*Myrmozercon hunteri* Joharchi, Babaeian & Seeman, 2015: 550.

*Material examined*

Holotype (ARS-20191222-12a) borrowed from JAZM.

*Notes*

We now supplement the description of this species by adding photomicrographs of the dorsal shield (Fig. 52) and ventral idiosoma (Fig. 53).

***Myrmozercon karajensis* Joharchi *et al.*, 2011 (Figs. 54–62)**

*Myrmozercon karajensis* Joharchi, Halliday, Saboori & Kamali, 2011: 29.

*Material examined*

Holotype (ARS-20191222-2a) borrowed from JAZM.

*Notes*

Joharchi *et al.* (2011) described *M. karajensis* from nest of *Camponotus* sp. (Hymenoptera: Formicidae) in Iran. We have re-examined the holotype of this species, and now provide some additional illustrations to support the original description (Figs. 54–62). The original description of this species shows two pairs of setae in the soft skin posterior to the dorsal shield, *J5* and *Z5* (Joharchi *et al.* 2011, Fig. 19). The posterior margin of the shield is irregular and poorly defined in places, so the exact placement of these setae is difficult to determine. The holotype appears to have four pairs of setae in the soft skin posterior to the shield (Fig. 57). They also stated that the tibia of the palp has 12 setae. The palp tibia and tarsus in this species are fused, and the combined tibia/tarsus has 23–24 setae.

**Genus *Promacrolaelaps* Costa**

*Promacrolaelaps* Costa, 1971: 94.

**Type species:** *Promacrolaelaps hunteri* Costa, 1971, by monotypy.

***Promacrolaelaps propomacrus* Joharchi *et al.*, 2013 (Figs. 63–67)**

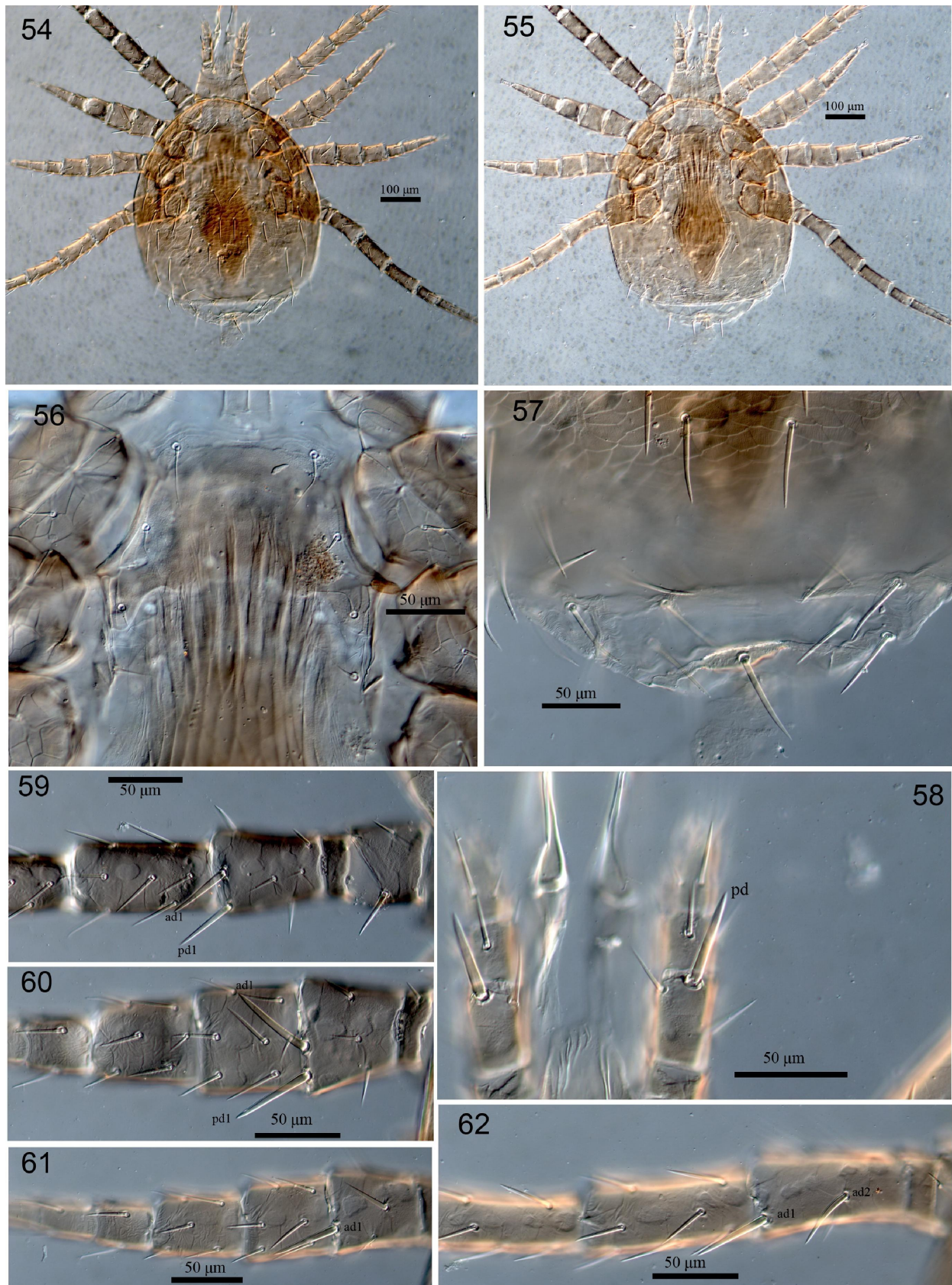
*Promacrolaelaps propomacrus* Joharchi, Halliday & Beyzavi, 2013: 380.

*Material examined*

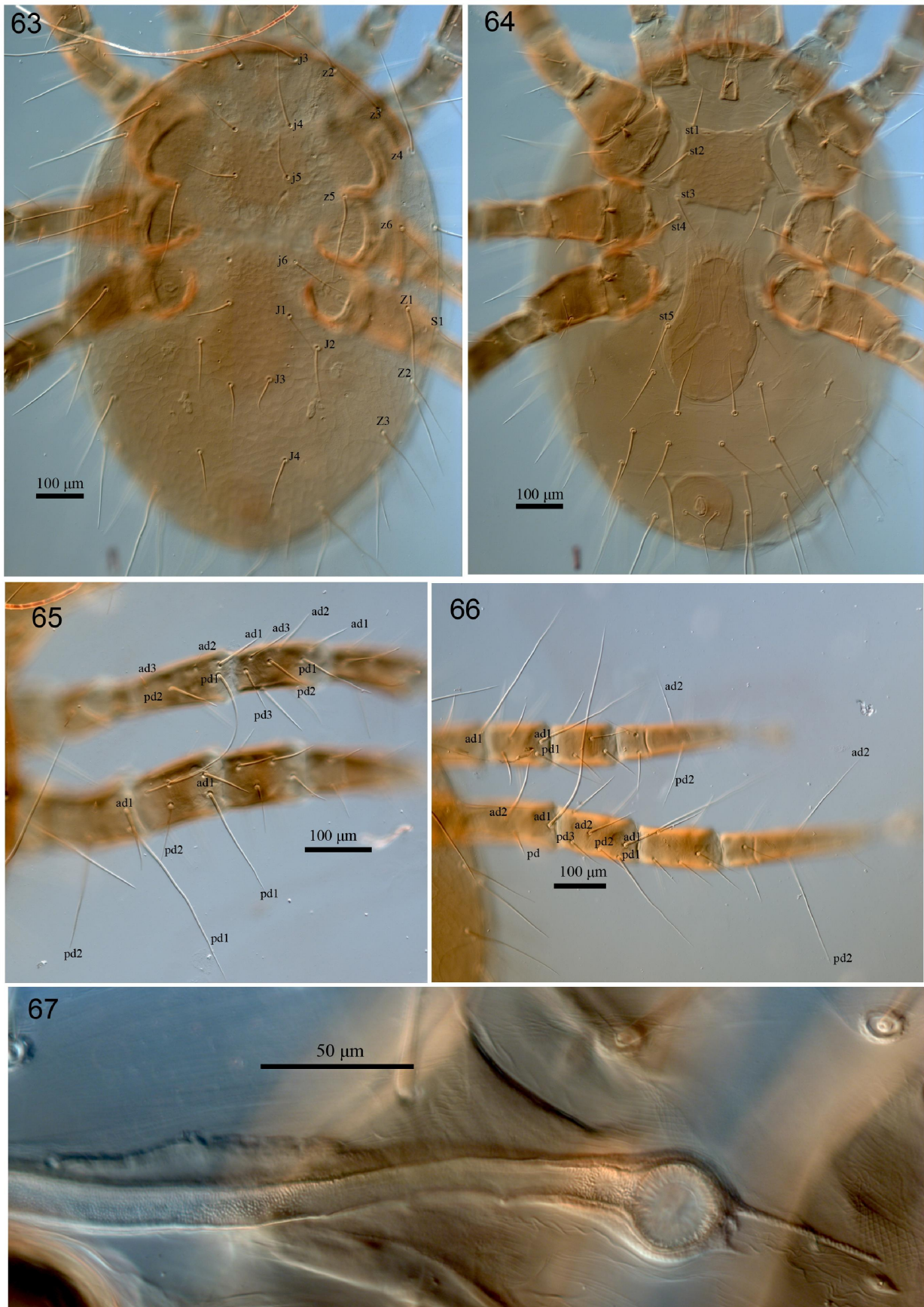
Holotype borrowed from YIAU and three paratypes (ARS-20191222-4b, c and d) borrowed from JAZM.



**Figures 50–53.** DIC micrographs of *Myrmozercon brachytrichos* Joharchi, Arjomandi & Trach, 2017 (female holotype) – 50. Dorsal idiosoma; 51. Ventral idiosoma; *Myrmozercon hunteri* Joharchi, Babaeian & Seeman, 2015 (female holotype) – 52. Dorsal idiosoma; 53. Ventral idiosoma.



**Figures 54–62.** DIC micrographs of *Myrmozercon karajensis* Joharchi, Halliday, Saboori & Kamali, 2011 (female holotype) – 54. Dorsal idiosoma; 55. Ventral idiosoma; 56. Sternal shield; 57. Posterior of dorsal shield and postanal seta; 58. Palp in dorsal view, showing spinelike *pd* of palpfemur; 59. Leg I (trochanter-genu) in dorsal view; 60. Leg II (femur-tibia) in dorsal view; 61. Leg III (femur-tibia) in dorsal view; 62. Leg IV (femur-tibia) in dorsal-lateral view.



**Figures 63–67.** DIC micrographs of *Promacrolaelaps propomacrus* Joharchi, Halliday & Beyzavi, 2013 (female holotype) – 63. Dorsal idiosoma; 64. Ventral idiosoma; 65. Legs II & III in dorsal view; 66. Legs III & IV in dorsal view; 67. Posterior portion of peritrematal shield, with very narrow posterior projection.

## Notes

*Promacrolaelaps propomacrus* was described from Iran (Joharchi *et al.* 2013) where it was found on the adult of *Propomacrus bimucronatus* (Pallas) (Coleoptera: Scarabaeidae). Nemati *et al.* (2018) placed this specie in *Hypoaspis*. Joharchi *et al.* (2019) returned it to *Promacrolaelaps* and fully compared this genus with other morphologically similar hypoaspidine genera associated with scarab beetles. We now supplement the original description with photomicrographs of the dorsal shield (Fig. 63), ventral idiosoma (Fig. 64), legs (Figs. 65–66) and peritreme (Fig. 67). Joharchi *et al.* (2013) stated that the tibia of the palp has 12 setae, but we now correct that to 14 setae. The holotype has been transferred from YIAU to JAZM (slide number ARS-20191222-4a) to make it more accessible.

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## توصیفات تکمیلی برای سیزده گونه کنه خاکزی (Mesostigmata: Laelapidae)

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### چکیده

این مطالعه اطلاعات ریخت‌شناسی اضافی و تصاویر جدیدی را برای ۱۳ گونه کنه خاکزی از خانواده Laelapidae پیش‌تر توصیف شده از ایران، برای تکمیل توصیف‌های اصلی فراهم می‌کند.

واژگان کلیدی: *Promacrolaelaps* ؛ *Myrmozercon* ؛ *Laelaspis* ؛ *Hypoaspis* ؛ *Gaeolaelaps* ؛ *Coleolaelaps*.

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