


# Mesostigmatid mites (Acari: Mesostigmata) associated with wild mushrooms in Northern Iran

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## Abstract

A faunistic study of mites (Acari) associated with wild mushrooms in Guilan province, northern Iran was carried out during 2022. Totally, 21 species belonging to 17 different genera and 12 families were collected and identified. The 17 species including of *Cosmolaelaps lutegiensis*, *Dendrolaelaps saprophilus*, *Gamasiphis lanceolatus*, *Gaeolaelaps kargi*, *Laelaspis persicus*, *Macrocheles perglaber*, *Neoseiulus barkeri*, *Olopachys caucasicus*, *Onchodellus alpinus*, *Oplitis paradoxa*, *Pachylaelaps grandis*, *Podocinum pacificum*, *Polyaspis patavinus*, *Uroobovella flagelliger*, *Uroobovella varians*, *Uropoda orbicularis* and *Uropoda (Trachycilliba) splendida* are reported for the first time from Iran in association with mushrooms. Collection information of identified species is provided.

**Key words:** Arthropoda, Acari, Fauna, Guilan, Wild fungi

## 1. Introduction

The northern provinces of Iran have diverse vegetation including grasslands, fields, gardens and forests. Guilan province has very variable climatic condition. This remarkable situation has prevailed the province with a variety of fauna and flora (Islah Arabani, 2001). Different types of wild mushrooms which grow on the ground, rocks, fallen trees, or on the body parts of live plants, are found in this area. Wild mushrooms are attacked by a large number of mites especially mesostigmatid and prostigmatid mites. Some of these mites associated with mushrooms are fungivorous but some are predators and the rest have uncertain association. So far, few attempts have been made to study the mite's species, associated with mushrooms in Iran. The new species *Hoploseius bispinosetus* Faraji *et al.*, 2006, was described and illustrated based on specimens collected from wood fungi and decomposing wood in north of Iran (Faraji *et al.*, 2006).

The mites fauna associated with button mushrooms [*Agaricus bisporus* (Lange)] in the Karaj region was studied. In this study seventeen mycophagous, predaceous and saprophagous mite species belonging to 3 orders and 9 families were found (Kheradmand *et al.*, 2007). Acari fauna related with button mushrooms (*A. bisporus*) in the Shiraz region was studied. In this study 10 mite species were collected and identified (Keshtmand *et al.*, 2011). A study was conducted to study on the fauna of some mesostigmatid mites associated with

*Fomes* sp. and *Agricales* sp. in different regions of Chaharmahal va Bakhtiari Province. In this study 12 species of mesostigmatid mites were collected and identified (Khalili-Moghadam and Nemati, 2014). Blattisociid mite species *Lasioseius frankbakkeri* Faraji *et al.*, 2006 was recorded from mushrooms grown in soil in Rasht city, Guilan province (Javadpour *et al.*, 2018). The arthropods existing in mushroom cultivation systems were collected in Zarandieh county, Marakazi province. In this study 3 mite species *Tyrophagus putrescentiae* (Schränk, 1781), *Pediculaster* sp. and *Macrocheles glaber* Müller, 1860 were collected and identified (Tanha and Kheradpir, 2022). The new genus *Bulbolaelaps* and the new species *Bulbolaelaps bossei* Faraji *et al.*, 2021 from family Digamasellidae were described based on adult females and males that collected from the fruiting bodies of gilled fungi on a tree trunk in Zanjan province, Iran (Faraji *et al.*, 2021). Heterostigmatic mites (Acari: Prostigmata) associated with mushroom-forming fungi were studied in forestry areas of Gorgan, northern Iran. In this study five species including four new records and one new species of Heterostigmatic mites were collected and identified (Majidi *et al.*, 2024). More studies are needed to find out that various mites associated with edible and wild mushrooms in Iran.

## 2. Materials and methods

During 2022, various areas of Guilan province were surveyed and wild mushrooms were collected and brought to the laboratory in polythene bags. Each sample contained about 2 kg of wild mushrooms and a bit of their surrounding soil. Mites were extracted from the samples using Berlese funnels. Specimens were sorted and preserved in 70% ethanol, cleared in Nesbitt's fluid and mounted on microscope slides using Hoyer's medium. The mites were identified by the relevant taxonomic keys and papers (Ghilyarov & Bregetova, 1977; Karg, 1993; Mašan, 2001, 2003; Faraji *et al.*, 2006, 2008; Hajizadeh and Faraji, 2016; Mojahed *et al.*, 2017; Hajizadeh and Joharchi, 2018; Hajizadeh *et al.*, 2023; Mohammadi and Hajizadeh, 2023). We also made a search of the literature on the mites associated with mushrooms of Iran published to date, using electronic and printed data sources. For precise inspection of morphological characters of prepared specimens, a compound Olympus microscope (Olympus Optical Co., Ltd, Tokyo, Japan) equipped with differential interference contrast and phase contrast optical system, Canon camera (EOS Kiss X5; Japan) was used. The voucher specimens of each species were preserved as slide-mounted specimens in the Acarology Laboratory, Department of Plant Protection, Faculty of Agricultural Sciences, University of Guilan, Rasht, Iran. All specimens were collected by Jalil Hajizadeh.

## 3. Results and Discussion

During the current faunistic study of mesostigmatid mites associated with wild mushrooms (Figure 1) in Guilan province, northern Iran, 21 species belonging to 17 genera and 12 families were collected and identified. An alphabetical list and detailed collection information of each identified species of mesostigmatid mites associated with wild mushrooms in Guilan province, northern Iran, is provided. The 17 species including of *Cosmolaelaps lutegiensis*, *Dendrolaelaps saphophilus*, *Gamasiphis lanceolatus*, *Gaeolaelaps kargi*, *Laelaspis persicus*, *Macrocheles pergaber*, *Neoseiulus barkeri*, *Olopachys caucasicus*, *Onchodellus alpinus*, *Oplitis paradoxa*, *Pachylaelaps grandis*, *Podocinum pacificum*, *Polyaspis patavinus*, *Uroobovella flagelliger*, *Uroobovella varians*, *Uropoda orbicularis* and *Uropoda (Trachycilliba) splendida* are reported for the first time from Iran in association with mushrooms in Iran.

### Order Mesostigmata

#### Family Blattisociidae

*Hoploseius bispinosetus* Faraji *et al.*, 2006 (Figure 2)

Material examined: Fifty females and 40 males, during November to December 2022, mushrooms on rotten tree trunks, Rasht County, campus of University of Guilan, (37°11'44.5"N 49°38'30.7"E, 28m); one female and 1 male, December 1, 2022, mushrooms on forest floor, Rezvanshahr City (37°32'53"N 49°08'08"E, 15m).



**Figure 1.** Schematic figure of different types of mushrooms examined for associated mites.

*Lasioseius sugawarai* Ehara, 1964 (Figure 3)

Material examined: Two females, November 1, 2022, mushrooms on tree trunks, 3 females, December 1, 2022, mushrooms on forest floor, 2 females and 1 male, November 19, 2022, mushrooms on grass floor, 4 females, November 21, 2022, mushrooms on apple tree trunk, Rezvanshahr City (37°32'53"N 49°08'08"E, 15m).

**Remark:** The family Blattisociidae generally comprises predators and fungivorous mites that are sometimes phoretic on insects. Some species of the genus *Lasioseius* have been reported feeding on phytophagous mites, small insects, springtails and nematodes while some others have also been observed to feed on fungi. Mites of genus *Hoploseius* have been described and are found mainly in association with fungi, some species are also phoretic on insects associated with this habitat (Faraji *et al.*, 2006; Christian and Karg 2006; Lindquist *et al.*, 2009, Moraes *et al.*, 2016).

**Family Digamasellidae**

*Dendrolaelaps saprophilus* Huhua, 1982 (Figure 4)

Material examined: One female, November 1, 2022, mushrooms on tree trunks, Rezvanshahr (37°32'53"N 49°08'08"E, 15m).

**Remark:** Mites of the family Digamasellidae are widespread in soil and decaying organic material, they feed on collembolans, nematodes, arthropod eggs and possibly fungi (Lindquist *et al.*, 2009; Walter and Proctor, 2013).

**Family Laelapidae**

*Cosmolaelaps lutegiensis* (Shcherbak, 1971) (Figure 5)

Material examined: One female, November 15, 2022, mushrooms on the floor of pine trees, Rasht County, campus of University of Guilan, (37°11'44.5"N 49°38'30.7"E, 28m).

*Euandrolaelaps karawaiewi* (Berlese, 1903) (Figure 6)

Material examined: One female, November 1, 2022, mushrooms on rotten tree trunks, Rasht County, campus of University of Guilan, (37°11'44.5"N 49°38'30.7"E, 28m); One female, November 19, 2022, mushrooms on grass floor, Rezvanshahr (37°32'53"N 49°08'08"E, 15m).

*Gaeolaelaps kargi* (Costa, 1968) (Figure 7)

Material examined: One female, November 11, 2022, mushrooms on the grass floor, Rasht County, Keshavarz park, (37°16'40.5"N 49°36'23.4"E, 1m).

*Gaeolaelaps aculeifer* (Canestrini, 1884) (Figure 8)

Material examined: One female, November 19, 2022, mushrooms on grass floor, Rezvanshahr (37°32'53"N 49°08'08"E, 15m).

*Laelaspis persicus* Joharchi & Halliday, 2012 (Figure 9)

Material examined: One female, December 13, 2022, mushrooms on grass floor, Rasht County, campus of University of Guilan, (37°11'44.5"N 49°38'30.7"E, 28m).

**Remark:** Mites of the family Laelapidae are free-living predators that inhabit soil and litters (Lindquist *et al.*, 2009).

**Family Macrochelidae**

*Macrocheles perglaber* Filipponi & Pegazzano, 1962 (Figure 10)

Material examined: One female, November 15, 2022, mushrooms on plant remains, Rasht County, electricity Factory Road (37°11'44.5"N 49°38'30.7"E, 30m).

**Remark:** Mites of the family Macrochelidae live in a wide range of terrestrial and aboveground substrates, including compost, manure, leaf litter, decaying wood, and stored foods. They include predators, fungivorous and pollen-feeding species (Halliday, 1997; Lindquist et al., 2009).

### Family Ologamasidae

*Gamasiphis lanceolatus* Karg, 1987 (Figure 11)

Material examined: One Female, November 1, 2022, mushrooms on rotten tree trunks, Rasht County, campus of University of Guilan, (37°11'44.5"N 49°38'30.7"E, 28m); one female, November 1, 2022, mushrooms on tree trunks, one female and 1 male, December 1, 2022, mushrooms on forest floor, one female, November 11, 2022, mushrooms on apple trunk, Rezvanshahr City (37°32'53"N 49°08'08"E, 15m); one female, November 15, 2022, mushrooms on plant remains, Rasht county, electricity Factory Road (37°11'44.5"N 49°38'30.7"E, 30m); one female, November 15, 2022, mushrooms on the floor of pine trees, Rasht county, campus of University of Guilan, (37°11'44.5"N 49°38'30.7"E, 28m); one female, November 19, 2022, mushrooms on grass floor, Rezvanshahr City (37°32'53"N 49°08'08"E, 15m); one female, November 20, 2022, mushrooms on citrus trunk, Roudsar County (37° 8' 0" N, 50° 17' 0" E, 10m); one female, November 21, 2022, mushrooms on grass floor, Rezvanshahr City (37°32'53"N 49°08'08"E, 15m); one female, December 13, 2022, mushrooms on grass floor, Rasht county, campus of University of Guilan, (37°11'44.5"N 49°38'30.7"E, 28m).

**Remark:** The family Ologamasidae is a large group of predatory mites encountered in soil, humus and compost (Lindquist *et al.*, 2009).

### Family Pachylaelapidae

*Olopachys caucasicus* Koroleva, 1976 (Figure 12)

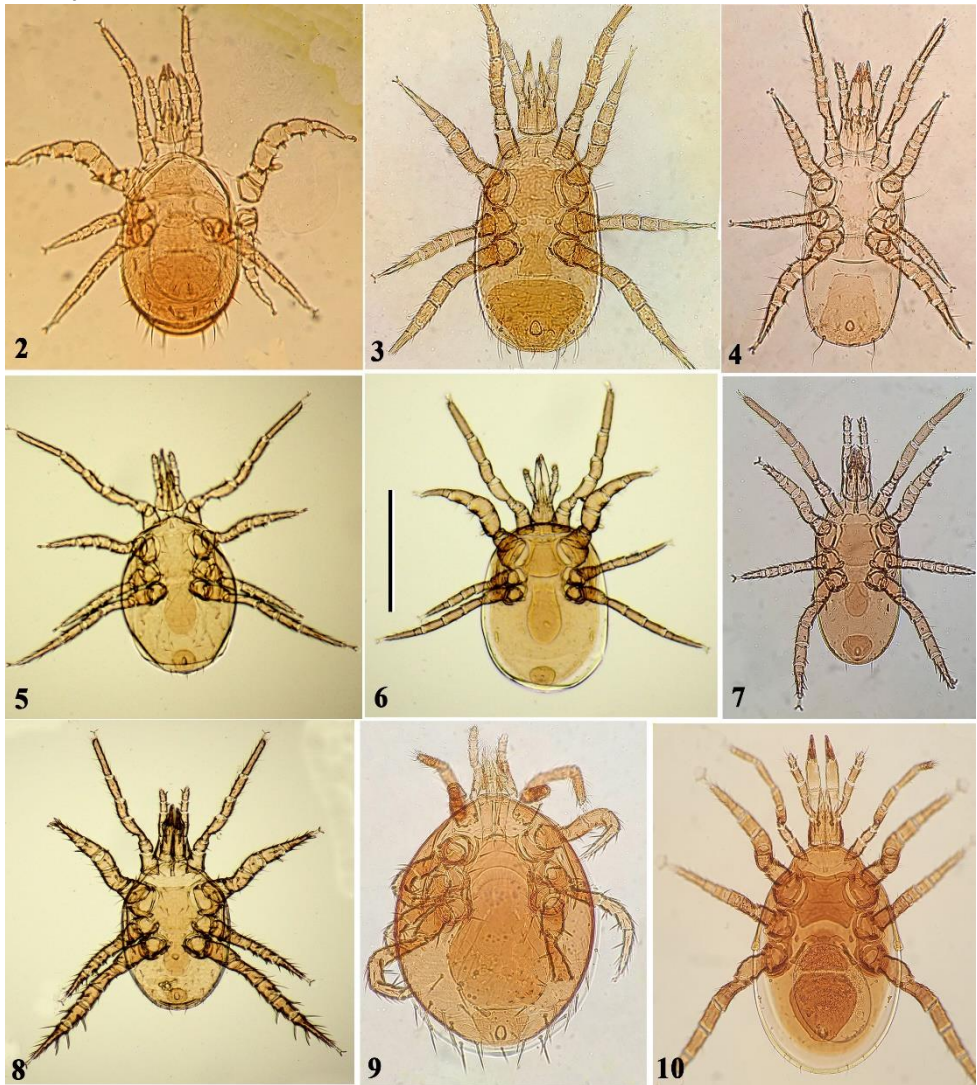
Material examined: One female, December 1, 2022, mushrooms on forest floor, 1 female, November 19, 2022, mushrooms on grass floor, Rezvanshahr City (37°32'53"N 49°08'08"E, 15m).

*Onchodellus alpinus* (Willmann, 1953) (Figure 13)

Material examined: One female, December 1, 2022, mushrooms on forest floor, Rezvanshahr (37°32'53"N 49°08'08"E, 15m).

*Pachylaelaps grandis* Koroleva, 1977 (Figure 14)

Material examined: Two females, November 15, 2022 and November 21, 2022, mushrooms on plant remains, Rasht county, electricity Factory Road (37°11'44.5"N 49°38'30.7"E, 30m); 2 females, November 19, 2022, mushrooms on grass floor, Rezvanshahr City (37°32'53"N 49°08'08"E, 15m); One female, December 13, 2022, mushrooms on grass floor, Rasht county, campus of University of Guilan, (37°11'44.5"N 49°38'30.7"E, 28m).



**Figures 2-10:** Adult females, 2. *Hoploseius bispinosetus*, 3. *Lasioseius sugawarai*, 4. *Dendrolaelaps saprophilus*, 5. *Cosmolaelaps lutegiensis*, 6. *Euandrolaelaps karawaiewi*, 7. *Gaeolaelaps kargi*, 8. *Gaeolaelaps aculeifer*, 9. *Laelaspis persicus*, 10. *Macrocheles perglaber*. Scale bar 360  $\mu\text{m}$  for 2, 240  $\mu\text{m}$  for 3, 280  $\mu\text{m}$  for 4, 460  $\mu\text{m}$  for 5, 350  $\mu\text{m}$  for 6, 330  $\mu\text{m}$  for 7, 540  $\mu\text{m}$  for 8, 245  $\mu\text{m}$  for 9, 440  $\mu\text{m}$  for 10.

**Remark:** Members of the family Pachylaelapidae are found in all kinds of decomposing organic matter, especially soil, humus, leaf-litter, moss, dead-wood and plant debris, as well as the nests of mammals, birds and social insects (Maśán 2007). They are predators and feed on a range of micro-invertebrates (Lindquist *et al.*, 2009).

#### **Family Phytoseiidae**

*Neoseiulus barkeri* Hughes, 1948 (Figure 15)

Material examined: Five females, November 1, 2022, mushrooms on rotten tree trunks, Rasht County, campus of University of Guilan, (37°11'44.5"N 49°38'30.7"E, 28m).



**Remark:** Phytoseiid mites are natural enemies of phytophagous mites and other small insect pests. They feed on small arthropods, pollen, honeydew, plant exudates and fungi (Lindquist *et al.*, 2009).

#### **Family Podocinidae**

*Podocinum pacificum* (Berlese, 1895) (Figure 16)

Material examined: One female, December 13, 2022, mushrooms on grass floor, Rasht County, campus of University of Guilan, (37°11'44.5"N 49°38'30.7"E, 28m).

**Remark:** The mites of family Podocinidae inhabit humus and litter habitats, they feed on Collembola and soil mites (Lindquist *et al.*, 2009; Castilho *et al.*, 2015).

#### **Cohort Uropodina**

##### **Family Urodinychidae**

*Uroobovella flagelliger* (Berlese, 1910) (Figures 17-19)

Material examined: Fifty Females, 40 males and 50 deutonymphs, during November to December 2022, mushrooms on rotten tree trunks, Rasht County, campus of University of Guilan, (37°11'44.5"N 49°38'30.7"E, 28m).

*Uroobovella varians* Hirschmann & Zimngiebl-Nicol, 1962 (Figure 20)

Material examined: One female and 1 deutonymph November 21, 2022, mushrooms on grass floor, Rezvanshahr (37°32'53"N 49°08'08"E, 15m).

##### **Family Uropodidae**

*Uropoda (Trachycylliba) splendida* Kramer, 1882 (Figure 21)

Material examined: One female, December 1, 2022, mushrooms on forest floor, Rezvanshahr (37°32'53"N 49°08'08"E, 15m); 1 female, December 13, 2022, mushrooms on grass floor, Rasht county, campus of University of Guilan, (37°11'44.5"N 49°38'30.7"E, 28m).

*Uropoda orbicularis* (Müller, 1776) (Figure 22)

Material examined: One female, November 1, 2022, mushrooms on tree trunks, Rezvanshahr (37°32'53"N 49°08'08"E, 15m); One deutonymph, November 11, 2022, mushrooms on apple trunk, Rezvanshahr (37°32'53"N 49°08'08"E, 15m); One deutonymph, November 20, 2022, mushrooms on citrus trunk, Roudsar County (37°8'0"N 50°17'0"E, 10m).

##### **Family Oplitidae**

*Oplitis paradoxa* (Canestrini & Berlese, 1884) (Figure 23)

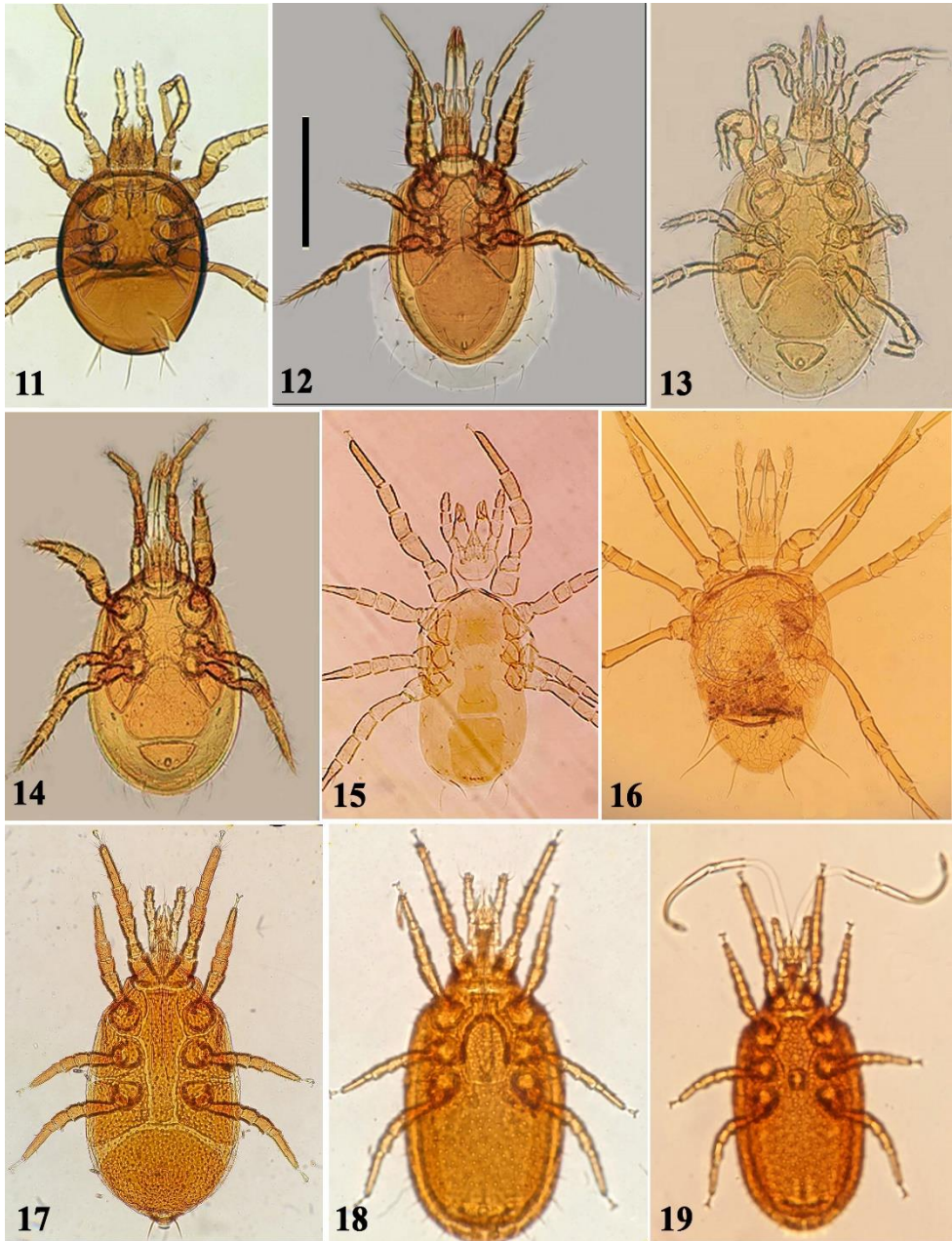
Material examined: One female, November 20, 2022, mushrooms on citrus trunk, Roudsar County (37°8'0"N 50°17'0"E, 10m).

##### **Family Polyaspinidae** Berlese, 1917

*Polyaspis patavinus* Berlese, 1881 (Figure 24)

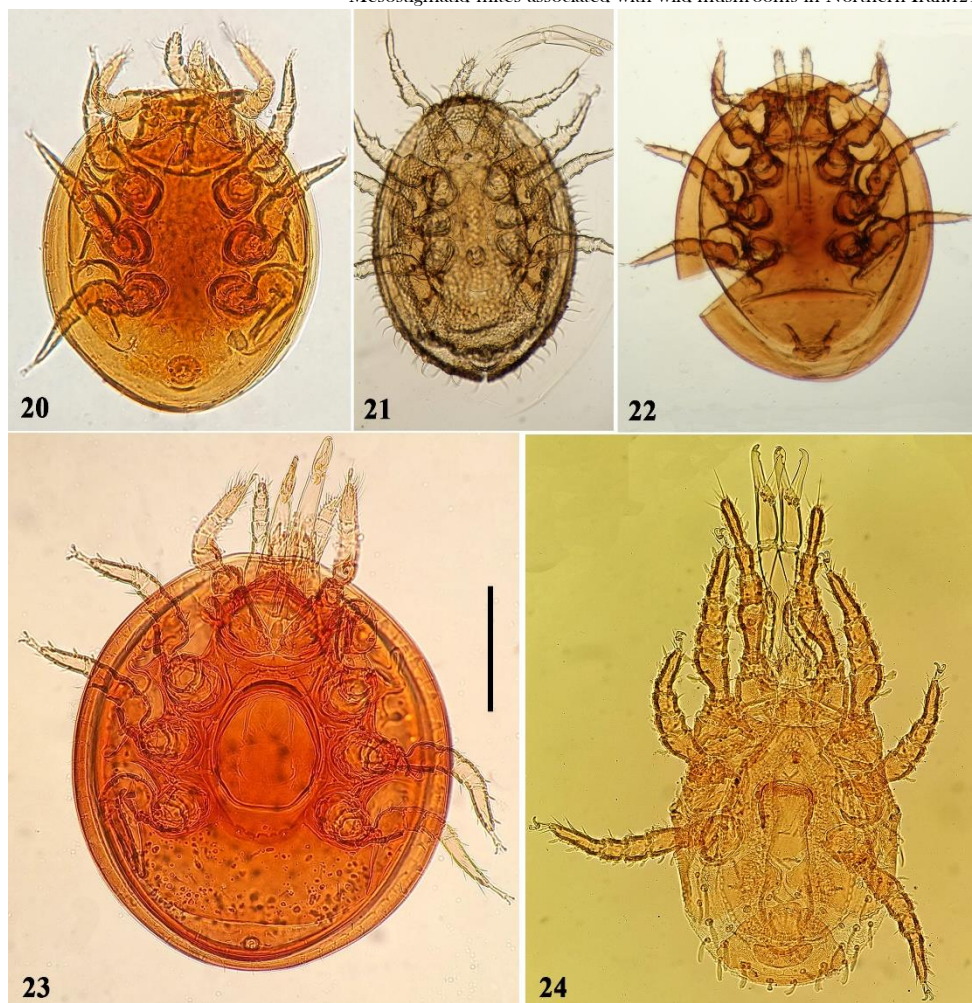
Material examined: One female, December 13, 2022, mushrooms on grass floor, Rasht County, campus of University of Guilan, (37°11'44.5"N 49°38'30.7"E, 28m).

**Remark:** Mites in the Cohort Uropodina are very abundant in forest litter, they can also be found in moss, under stones, in ant nests, in the nests and burrows made by vertebrates, and in dung and carrion. Most appear to be predators that feed on nematodes or other small invertebrates, but others may feed on living and dead fungi and plant tissue (Lindquist *et al.*, 2009; Halliday, 2015).



**Figures 11-19.** 11. *Gamasiphis lanceolatus* female, 12. *Olopachys caucasicus* female, 13. *Onchodellus alpinus* female, 14. *Pachylaelaps grandis* female, 15. *Neoseiulus barkeri* female, 16. *Podocinum pacificum* female, 17- *Uroobovella flagelliger* deutonymph, 18. *Uroobovella flagelliger* female, 19. *Uroobovella flagelliger* male. Scale bar 340  $\mu$ m for 11, 420  $\mu$ m for 12, 310  $\mu$ m for 13, 375  $\mu$ m for 14, 270  $\mu$ m for 15, 312  $\mu$ m for 16, 290  $\mu$ m for 17, 295  $\mu$ m for 18, 370  $\mu$ m for 19.





**Figures 20-24.** 20. *Uroobovella varians* deutonymph, 21. *Uropoda (Trachycylliba) splendida* female, 22. *Uropoda orbicularis* deutonymph, 23. *Oplitis paradoxa* female, 24. *Polyaspis patavinus* female. Scale bar 120  $\mu\text{m}$  for 20, 320  $\mu\text{m}$  for 21, 310  $\mu\text{m}$  for 22, 140  $\mu\text{m}$  for 23, 225  $\mu\text{m}$  for 24

#### 4. Conclusions

The main pests of mushrooms are insects, mites and nematodes. Mushrooms are attacked by a large number of mites and insects; some are damage causing, some are predators and the rest are of uncertain association (Pakira and Gupta, 2022). Some mite species have adapted to the fruiting bodies of bracket fungi (Basidiomycota, Polyporales). For example, members of several mesostigmatid genera like *Hoploseius*, *Mycolaelaps*, *Fungiseius* and *Discoseius* (Ascidae/Blattisociidae) are found exclusively on or in the fungi (Saloña-Bordas *et al.*, 2022). The beneficial predatory mites that associated with mushrooms feed on damage causing insects and mites and thus help us suppress their population (Dutta, *et al.*, 2022). Faunal information on beneficial mites associated with wild and cultural mushrooms helps us in the integrated management of arthropod pests associated with cultural mushrooms. This study is a contribution to the mesostigmatid mites fauna associated with wild mushrooms in

Guilan province, northern Iran. The results of this study can be useful in using these predatory mites to control arthropod pests of cultivated mushrooms in Iran in the future.

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## Conflict of interests

The authors declare that they have no competing interests.

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