

New Zerconid Mites (Acari: Mesostigmata: Zerconidae) from Taiwan

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Zsolt Ujvári (2011) New zerconid mites (Acari: Mesostigmata: Zerconidae) from Taiwan. *Zoological Studies* 50(1): 87-102. A new monotypic genus, *Rotundozercon* Ujvári, gen. nov., 1 new subgenus, *Parazercon* (*Formosella*) Ujvári, subgen. nov., and 3 new species, *Rotundozercon shuriken* Ujvári, sp. nov., *Parazercon* (*Formosella*) *mirabilis* Ujvári, sp. nov., and *Zercon tsoi* Ujvári, sp. nov. of the family Zerconidae are described from mountainous regions of central and eastern Taiwan. *Mesozercon plumatus* (Aoki, 1966) is recorded in the country for the 1st time. <http://zoolstud.sinica.edu.tw/Journals/50.1/87.pdf>

Key words: Zerconidae, New genus, New species, Taiwan.

The family Zerconidae, currently represented by over 350 species of 35 genera, is widely distributed in the Holarctic region, particularly inhabiting boreal and temperate climate zones. Zerconid mites are usually found among moss, leaf litter, organic detritus, and soil on the floor of different forests.

Our knowledge of the Zerconidae fauna of East and Southeast Asia is poor; however, some regions are relatively well investigated. The 1st studies of East Asia were carried out by Aoki (1964 1966), who described several new species from Japanese islands. Observation of the Japanese Mesostigmata fauna continued later, with new Zerconidae occurrences as well (Ishikawa 1969 1972). In the 1970s, Błaszak made important contributions to the Asian zerconid mite fauna. A great number of new species were discovered after investigations of soil samples collected on the Korean Peninsula (Błaszak 1976a b c), Japanese islands (Błaszak 1977), Hentii and Khangai Mts., Mongolia (Błaszak 1978a), and the Himalayas (Błaszak 1978b). In 1979, the same author published the 1st summary of the Asian Zerconidae

(Błaszak 1979), mentioning 59 species from the continent. Following Błaszak, investigations of the fauna of the Korean Peninsula continued (Halašková 1979, Lim and Lee 2001, Lee and Lim 2004), currently 23 species are known from the region, and therefore it can be considered relatively well known compared to other Asian regions. To the present, many other studies were carried out from single localities of East and Southeast Asia, such as the Himalayas, Nepal (Athias-Henriot 1976), and Yulunshan Mts (Yunnan), Changbai Mts. and Xiao Hinggan Ling Mts., China (Petrova and Taskaeva 1968, Ma and Yin 1999, Ma 2002 2003a b, Bei et al. 2002); however, the largest part of the continent is still unstudied.

The Zerconidae fauna of Taiwan has not been studied so far. The island is situated on the Tropic of Cancer, separated from the Asian mainland by the Taiwan Strait, and has a subtropical monsoon and oceanic climate. Currently no zerconid mites are known from such a humid and warm climate zone, hence the new records presented below constitute an interesting contribution to the present knowledge on the distribution of this family.

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MATERIALS AND METHODS

Soil samples were taken from the forest floor of several different forest types in central and eastern Taiwan. Mites were extracted from the samples using Berlese-funnels. Specimens were separated under a stereomicroscope, cleared in lactic acid, and mounted in glycerin. Preparations were examined using light microscopy, and drawings were made with the aid of a drawing tube. Scanning micrographs were taken in the Hungarian Natural History Museum, Budapest with a Hitachi S-2600N scanning electron microscope; specimens investigated were sputter-coated with gold-palladium. Mites were stored in 70% alcohol. The terminology of setae follows Lindquist and Evans (1965), with modifications for the caudal region as given by Lindquist and Moraza (1998). The system of notation for dermal glands and lyrifissures is based on Johnston and Moraza (1991). Measurements are given in micrometers (μm) and are presented as the mean. Abbreviations used include NMNS, National Museum of Natural Sciences, Taichung, Taiwan; HNHM, Collections of Soil Zoology of the Hungarian Natural History Museum, Budapest, Hungary; DN, deutonymph; and PN, protonymph.

TAXONOMY

Genus *Rotundozercon* Ujvári, gen. nov. (monotypic)

Etymology: The name of the new genus is composed of the Latin epithet, *rotundus*, for the rotund shape of the type species and the name, Zercon.

Gender: Male.

Type species: *Rotundozercon shuriken* Ujvári, sp. nov.

Diagnosis: Peritrematal shield truncate, reaching level of R1-2, separated from podonotal shield by a broad, weakly sclerotized slit. Podonotum with 22 pairs of setae, setae r1 and r3 situated on peritrematal shields, each short, smooth, and needle-like. Peritremes bent, hook-shaped, expanding to anterior region of coxae III. Glands *gv2* present, with 2 openings, surrounded by conspicuous adgenital platelets. A pair of narrow postgenital sclerites present. Ventrianal shield expanded anterolaterally, with a concave anterior margin. Dorsal shields expanded to ventral side of idiosoma, forming

ventrolateral shields which are fused to ventrianal shield. Anterior margin of ventrianal shield with 2 pairs of setae (setae ZV1 present). Ventrianal pores *gv3* situated anterolaterally to insertions of adanal setae. Margins of opisthonotum with extraordinarily deep serration, 7 pairs of R-setae present. Dorsal cavities clearly conspicuous, well-sclerotized. Idiosoma rotund, wider than long. Epistome with 3 elongate medial processes (Fig. 10).

Differential diagnosis: The new genus belongs to the group of genera having 2 short, smooth peritrematal setae and a freely ending, posteriorly truncate peritrematal shield. The presence of ventrolateral shields, the strikingly concave shape of the ventrianal shield, and the extraordinarily deep serrations of the opisthonotum seem to be apomorphic characters. On the basis of the ventrolateral shields, the genus is most closely related to the Nearctic genera *Macrozercon* Błaszak, 1975 and *Krantzas* Błaszak, 1981; distinguishing characters of the 3 genera are presented in table 1.

Rotundozercon shuriken Ujvári, sp. nov. (Figs. 1-10)

Material examined: Holotype: ♀: AS-873, Taiwan, Hualien County (Co.), Taroko National Park (NP), Hohuan Mt., Siafoukung, ESRI High Elevation Station, pine forest, dry-rotted tree, 24°09.704'N, 121°17.230'E, 3008 m elev., 22 May 2008, leg. L. Dányi, Z. Korsós, E. Lazányi (deposited in HNHM).

Paratypes: Locality and date same as for holotype (1 ♀, deposited in NMNS); AS-916, Taiwan, Hualien Co., Xiulin Township, Taroko NP, Hohuan Mt., ESRI High Elevation Station, pine forest, leaf litter, 24°09.702'N, 121°17.216'E, 2998 m elev., 12 Oct. 2009, leg. L. Dányi, E. Lazányi (5 ♀♀, 3 ♂♂, deposited in HNHM); AS-929, Taiwan, Hualien Co., Xiulin Township, Taroko NP, Hohuan Mt., ESRI High Elevation Station, pine forest, moss from trunks, 24°09.702'N, 121°17.216'E, 2998 m elev., 12 Oct. 2009, leg. L. Dányi, E. Lazányi (2 ♀♀, deposited in HNHM); Taiwan, Yushan, 2400 m elev., soil, 13 Feb. 2004, leg. K.-W. Huang (1 ♀, deposited in HNHM).

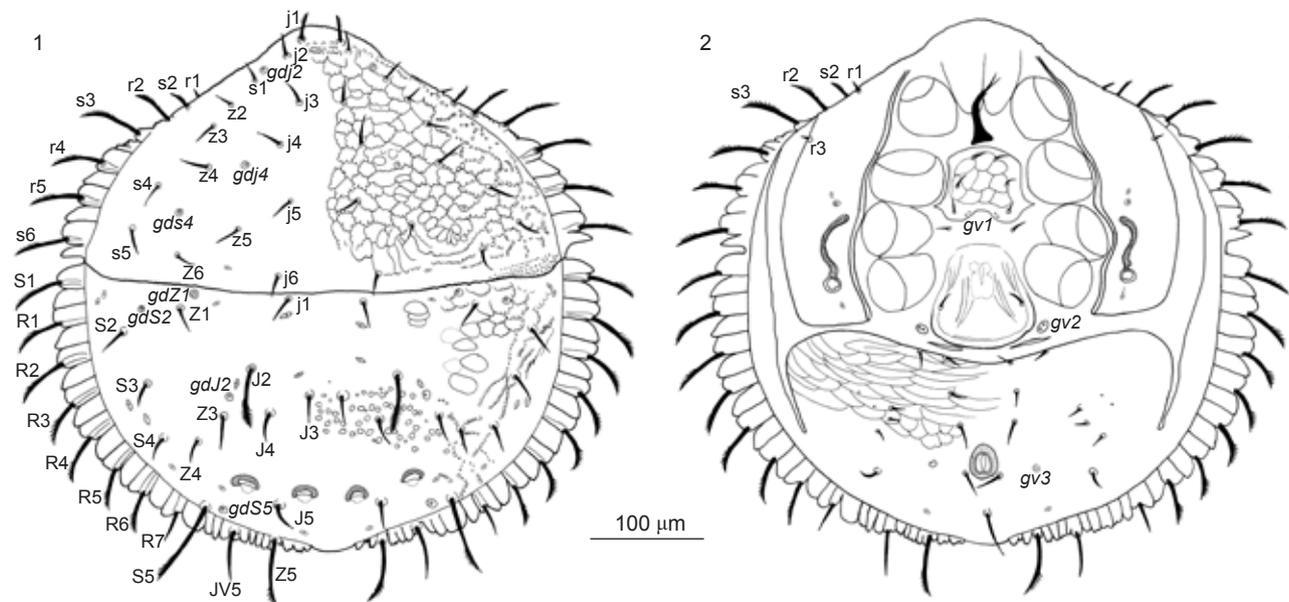
Etymology: The species is named after a throwing weapon called the 'shuriken' due its round shape and the blade-like marginal setae.

Diagnosis: Central and submarginal setae

of podonotum smooth (except j1), marginal setae blade-like, distally serrate. Setae J2, Z5, and S5 elongate, thickened, feathered, other central and submarginal opisthotal setae smooth. Setae Z2 absent. Setae J2-4 positioned near each other in center of opisthontum; J2 and J4 situated laterally; J3 in medial position. J5 located behind line of dorsal cavities. Podonotum covered by a serrulate, tile-like pattern; central area of opisthontum ornamented with large spots. Dorsal cavities saddle-like, with smooth anterior margin.

Description: Female. Length of idiosoma 460-468 μm , width 472-478 μm ($n = 2$).

Dorsum: (Fig. 1) Podonotum with 22 pairs of setae (j1-6, z2-6, s1-6, r1-5). Setae j1 thickened, apically barbed; central and submarginal setae short, smooth, needle-like. Marginal setae increasing in length posteriorly, thickened, blade-like, distally serrate. Glands *gdj2* (po1) situated on line connecting insertions of j2 and s1; *gdj4* (po2) positioned below line connecting j4 and z4; *gds4* (po3) on line connecting z5 and s4. Podonotum covered by small, serrulate tiles (Fig. 5), posterior and lateral parts with reticulate pattern composed of small drops. Opisthontum with 22 pairs of setae (J1-5, Z1-5, S1-5, R1-7).



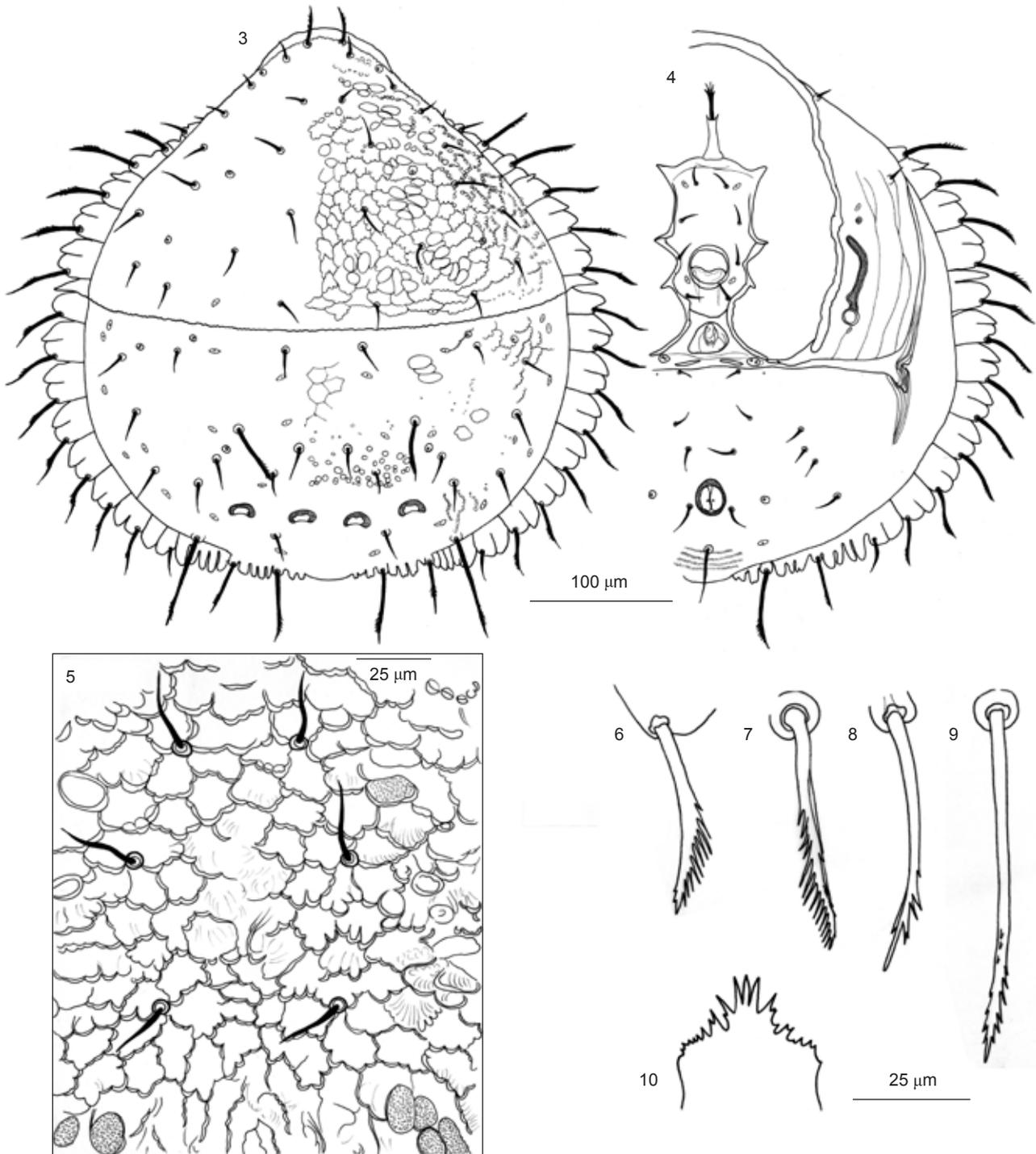
Figs. 1-2. *Rotundozercon shuriken* Ujvári, sp. nov., female. 1. Dorsal view; 2. ventral view.

Table 1. Distinguishing characters of *Rotundozercon* Ujvári, gen. nov., *Macrozercon* Błaszak 1975, and *Krantzas* Błaszak 1981

	<i>Rotundozercon</i>	<i>Macrozercon</i>	<i>Krantzas</i>
Situation of peritrematal shield	separated from dorsal shields by a wide slit behind setae r2	separated from dorsal shields by a narrow slit behind setae r2	separated from dorsal shields by a wide slit behind setae r5
Situation of ventrolateral shield	fused to ventrianal shield, anteriorly expanding to level of r4	fused to ventrianal shield, anteriorly expanded to level of S1	ends freely, anteriorly expanding to level of s6-S1
Setae ZV1	present	unknown	absent
Shape of peritremes	hook-shaped	bifurcate, bent	bifurcate, bent
Adgenital region	gv2 absent, with 2 openings, surrounded by adgenital platelets	unknown	gv2 absent
Marginal serration	extraordinarily deep	shallow	moderately deep
Number of R-setae	7	7	8

Setae J1 short, simple, not reaching bases of J2. Setae J2 (Fig. 7) thickened, elongate, feathered, situated anterolaterally to setae J3, lying far from each other, distance between their bases 130 μm . Setae J3 short, simple, positioned near

each other in center of opisthonorium, distance between their bases 28 μm . Setae J4 similar in shape and length to J3, positioned posterolaterally to them. Setae J2-4 not reaching bases of next setae in series; however, J2 reaching beyond



Figs. 3-10. *Rotundozercon shuriken* Ujvári, sp. nov. 3. Dorsal view of male; 4. ventral view of male. 5-10: Female; 5. Podonotal ornamentation; 6. seta R2; 7. seta J2; 8. seta Z5; 9. seta S5; 10. epistome.

bases of J4 as a result of their extraordinary situation. Setae J5 short, simple, located behind line of dorsal cavities, not reaching posterior margin of idiosoma. Setae Z5 (Fig. 8) and S5 (Fig. 9), similar to marginal setae, thickened, blade-like, apically serrate. Setae Z1 and Z3-4 similar in shape and length to short J-setae. Setae Z2 absent. Setae Z3 positioned anteromedially to Z4, located on line connecting insertions of J2 and Z4. Setae S2-4 similar in shape and length, short and simple. Setae S1 and marginal R-setae (Fig. 6) similar to podonotal marginal setae, long, blade-like, apically serrate; R7 shorter, smooth. Glands *gdZ1* (Po1) located anteromedially to insertions of setae Z1; *gdS2* (Po2) situated above line connecting insertions of Z1 and S2; *gdJ2* (Po3) positioned on line connecting J2 and Z3; *gdS5* (Po4) placed medially to insertion of S5. Body-margin fairly wide, with deep incisions, marginal serration obtuse. Central area of opisthonotum covered by large, distinct, irregular or triangular protuberances; anterolateral surface covered by small, serrulate tiles; lateral parts with reticulate pattern composed of small, pearl-like drops and spines. Dorsal cavities uniform, well-sclerotized, saddle-like, relatively small, with smooth anterior margin. Medial pair of dorsal cavities with axes parallel to that of body, lateral pair with axes slightly converging anteriorly. Size of setae and distances between their insertions given in table 2.

Venter: (Fig. 2) All ventral setae smooth. Peritrematal shield truncate between level of R1 and R2, separated by a wide slit from dorsal shields behind setae r2. Peritremes bent, hook-shaped. Sternal shield 65 μm long, 65 μm wide at level of setae st2; its posterior margin firmly concave. Glands *gv2* present, with 2 openings, surrounded by conspicuous adgenital platelets.

A pair of narrow postgenital sclerites present. Ventrolateral shields fused to ventrianal shield at level of setae R4-5, anteriorly expanded to setae r4. Anterior margin of ventrianal shield with 2 pairs of setae (setae ZV1 present), strikingly concave, anterolateral corners expanded anteriorly. Ventrianal pores *gv3* situated anterolaterally to adanal setae. Setae JV5 significantly longer than preanal setae, smooth. Sternal shield with reticulate ornamentation; ventrianal shield covered by tile-like pattern.

Male: Length of idiosoma 380-392 μm , width 395-403 μm ($n = 3$).

Chaetotaxy, poroidotaxy, and sculpture pattern of dorsal (Fig. 3) and ventral shields (Fig. 4) similar to those of female. Sternigenital shield divided; anterior part bearing genital operculum and 4 pairs of short setae, posterior part with no setae. Ventrolateral shields fused to ventrianal shield at level of setae R2. Membranous cuticle between ventrolateral shields and peritrematal shields very narrow; these shields may be fused anteriorly to different degrees. Size of setae and distances between their insertions given in table 2.

Immature stages: Unknown.

Genus *Parazercon* Trägårdh, 1931
Subgenus *Formosella* Ujvári, subgen. nov.

Etymology: The name of the new subgenus refers to the old name of its original location, Formosa (Taiwan was called 'Formosa' by Portuguese sailors in the 17th century).

Gender: Female.

Type species: *Parazercon (Formosella) mirabilis* Ujvári, sp. nov.

Diagnosis: Peritrematal shield separated from podonotal shield by a narrow, weakly sclerotized

Table 2. Lengths of opisthonotal setae and distances between setal bases within longitudinal rows in *Rotundozercon shuriken* Ujvári, sp. nov. (units: μm)

Setae	Female	Male	Setae	Female	Male	Setae	Female	Male
J1	24	20	Z1	23	15	S1	46	40
J1-J2	70	64	Z1-Z3	103	81	S1-S2	68	56
J2	53	43	Z3	28	21	S2	27	21
J2-J3	54	48	Z3-Z4	27	20	S2-S3	47	39
J3	25	22	Z4	23	21	S3	24	23
J3-J4	38	25	Z4-Z5	116	81	S3-S4	49	43
J4	25	16	Z5	58	51	S4	24	24
J4-J5	77	43				S4-5	72	56
J5	25	20				S5	75	71

slit. Posterolateral tips of peritrematal shield posteriorly expanded, not connected to ventrianal shield. Three pairs of peritrematal setae short, smooth, r1 situated at level of z3; r2 and r3 at level of s3. Peritremes straight. Glands *gv2* present, with 2 openings, surrounded by conspicuous adgnital platelets. A pair of narrow postgenital sclerites present. Anterior margin of ventrianal shield with 1 pair of setae. Ventrianal pores situated laterally to insertions of adanal setae. Anterior margin of podonotum strikingly deflexed, insertions of setae j1 situated on ventral side. Setae z1 present. Margin of opisthonotum with 7 pairs of setae. Dorsal cavities clearly conspicuous, well-sclerotized. Epistome with numerous points and 3 elongate medial processes (Fig. 13).

Remarks on the subgenus: The new species *Parazercon (Formosella) mirabilis* Ujvári, sp. nov. is closely related to *Parazercon* species on the basis of the shape and situation of the ventral shields, the appearance of the adgenital region, the general chaetotaxy, and poroidotaxy (3 pairs of peritrematal setae, the presence of setae z1, and the absence of Po2); however, it does not correspond to the latter genus in the shape of the peritrematal setae. Setae r3 are elongate and plumose in *Parazercon* species, while they are short and smooth in *Parazercon (Formosella) mirabilis* Ujvári, sp. nov. The autopomorphic character state of setae r3 and the conspicuousness of the dorsal cavities supports the Taiwanese species representing a unique evolutionary lineage. On the basis of similarities; however, I suggest placing the new species into the genus *Parazercon*, as a separate subgenus, *Parazercon (Formosella)*.

In addition, some systematic work mentions the posterolateral fusion of the peritrematal shield and ventrianal shield as a generic character (Halašková 1977), in other diagnoses and figures, a free-ending peritrematal shield can be found (Błaszak 1975). On the basis of known *Parazercon* species, it can be announced that the posterolateral tips of the peritrematal shield are always expanded posteriorly, in some cases connected to ventrianal shield and in other cases not connected to the latter. The relation of the peritrematal and ventrianal shields does not seem to be a reliable character for generic distinction and should be avoided in generic diagnosis of the genus *Parazercon*.

***Parazercon (Formosella) mirabilis* Ujvári, sp. nov.**

(Figs. 11-21)

Material examined: Holotype: ♀: AS-847, Taiwan, Taitung Co., Southern Cross I. Highway, Wulu, secondary mixed forest, from canopy, 23°08.496'N, 121°02.669'E, 1631 m elev., 28 May 2008, leg. L. Dányi, Z. Korsós, E. Lazányi (deposited in HHNM).

Paratypes: Locality and date same as for holotype (2 ♀♀, deposited in NMNS); AS-864, Taiwan, Taitung Co., Southern Cross I. Highway, Wulu, secondary mixed forest, 23°08.496'N, 121°02.669'E, 1631 m elev., 28 May 2008, leg. L. Dányi, Z. Korsós, E. Lazányi (22 ♀♀, 9 ♂♂, 13 deutonymphs, 1 protonymph, deposited in HHNM); AS-873, Taiwan, Hualien Co., Taroko NP, Hohuan Mt., Siafoukung ESRI High Elevation Station, pine forest, dry-rotted tree, 24°09.704'N, 121°17.230'E, 3008 m elev., 22 May 2008, leg. L. Dányi, Z. Korsós, E. Lazányi (13 ♀♀, 1 ♂, 1 deutonymph, deposited in NMNS); AS-876, Taiwan, Nantou Co., Kunyang, logging road, primary broadleaf forest, from leaf-litter, 24°06.705'N, 121°11.977'E, 2200 m elev., 22 May 2008, leg. L. Dányi, Z. Korsós, E. Lazányi, (1 ♀, deposited in HHNM).

Etymology: The name of the new species refers to its extraordinary and ornate sculpturing pattern.

Diagnosis: All dorsal setae plumose. Setae S2 situated anterolaterally to Z1; setae S2, Z2, S3, S4, and Z4 forming a row on lateral side of opisthonotum. Glands *gdJ4* (Po3) positioned on line connecting insertions of J4 and Z3. Podonotum with reticulate ornamentation composed of small, pearl-like drops, around J-series large, distinct pits visible. Dorsal cavities 1/2-moon shaped, well-sclerotized, medial ones situated very close to each other.

Description: ♀. Length of idiosoma 335-363 μm, width 261-273 μm (*n* = 39).

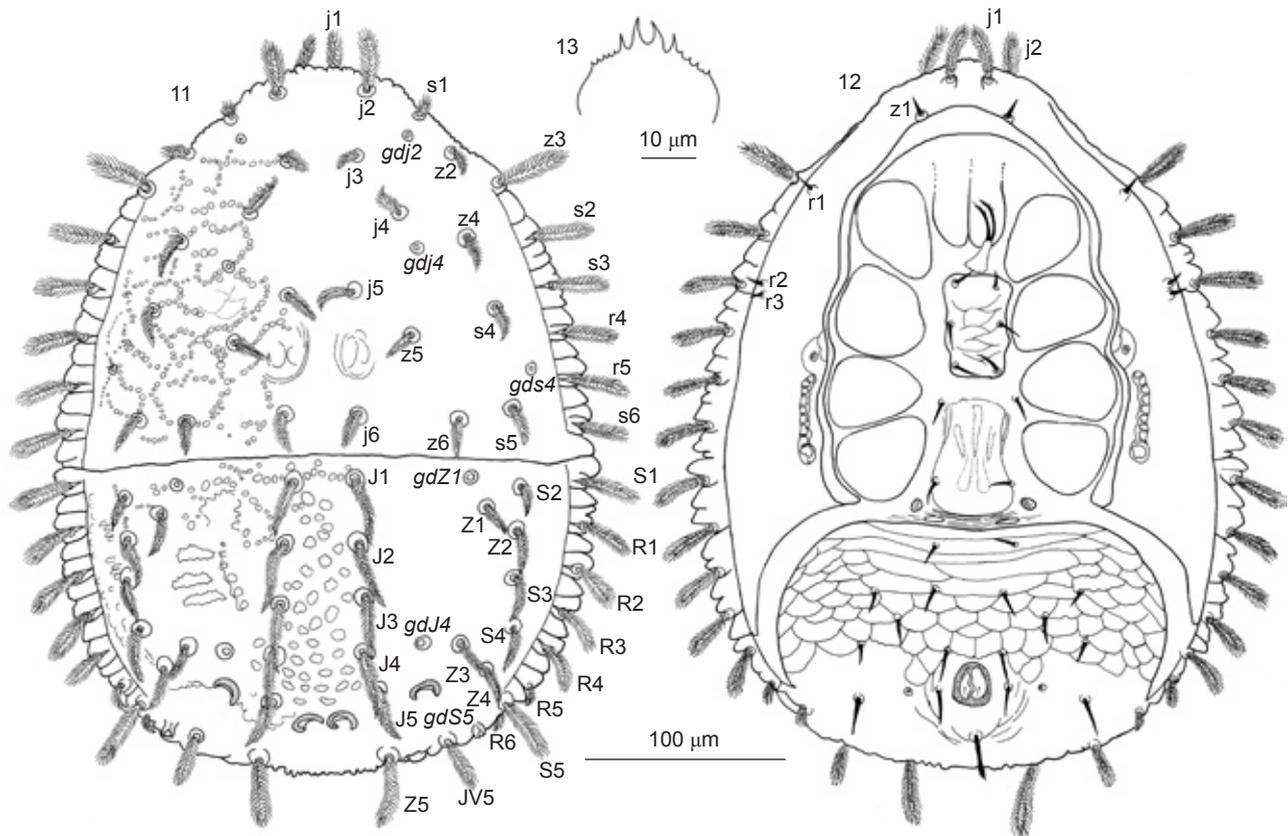
Dorsum: (Figs. 11, 18) Podonotum with 23 pairs of setae (j1-6, z1-6, s1-6, r1-5). Setae j1-2 and podonotal marginal setae brush-like, plumose; central and submarginal podonotal setae feathered, densely pilose. Setae j1 situated on anteroventral part of podonotal shield. Glands *gdj2* (po1) situated below line connecting insertions of j3 and s1; *gdj4* (po2) lying on line connecting j5 and z4; *gds4* (po3) outside line connecting s4 and s5. Surface of podonotum covered by reticulations of small, pearl-like drops (Fig. 19); a pair of well-sclerotized, horseshoe-shaped elevations visible

on posteromedial region of shield. Opisthonotum with 21 pairs of setae (J1-5, Z1-5, S1-5, R1-6). Setae J1-5 elongate, pointed, densely plumose; J1-4 reaching beyond bases of next setae of series. Setae Z1-4 and S2-4 similar in shape to J-setae, but significantly shorter. Setae S2, Z2, S3, S4, and Z4 forming a row on lateral side of opisthonotum; Z1 and Z3 shifted medially from latter row. S2 situated anterolaterally to Z1. Setae Z5, S1, S5, and marginal R-setae elongate, brush-like, plumose; members of R-row decreasing in length posteriorly. Glands *gdZ1* (Po1) situated anteromedially to Z1; Po2 absent; *gdJ4* (Po3) positioned on line connecting insertions of J4 and Z3; *gdS5* (Po4) on line connecting Z5 and S5. Marginal serration of dorsal idiosoma deep and relatively obtuse. Anteromedial and lateral parts of opisthonotum covered by drop-like and spine-like protuberances. Large, distinct depressions visible in area of J-series. Dorsal cavities clearly conspicuous, 1/2-moon shaped, well-sclerotized. Medial fossae situated very close to each other, with axes parallel to that of body; lateral pair situated anterolaterally to them, with oblique axes

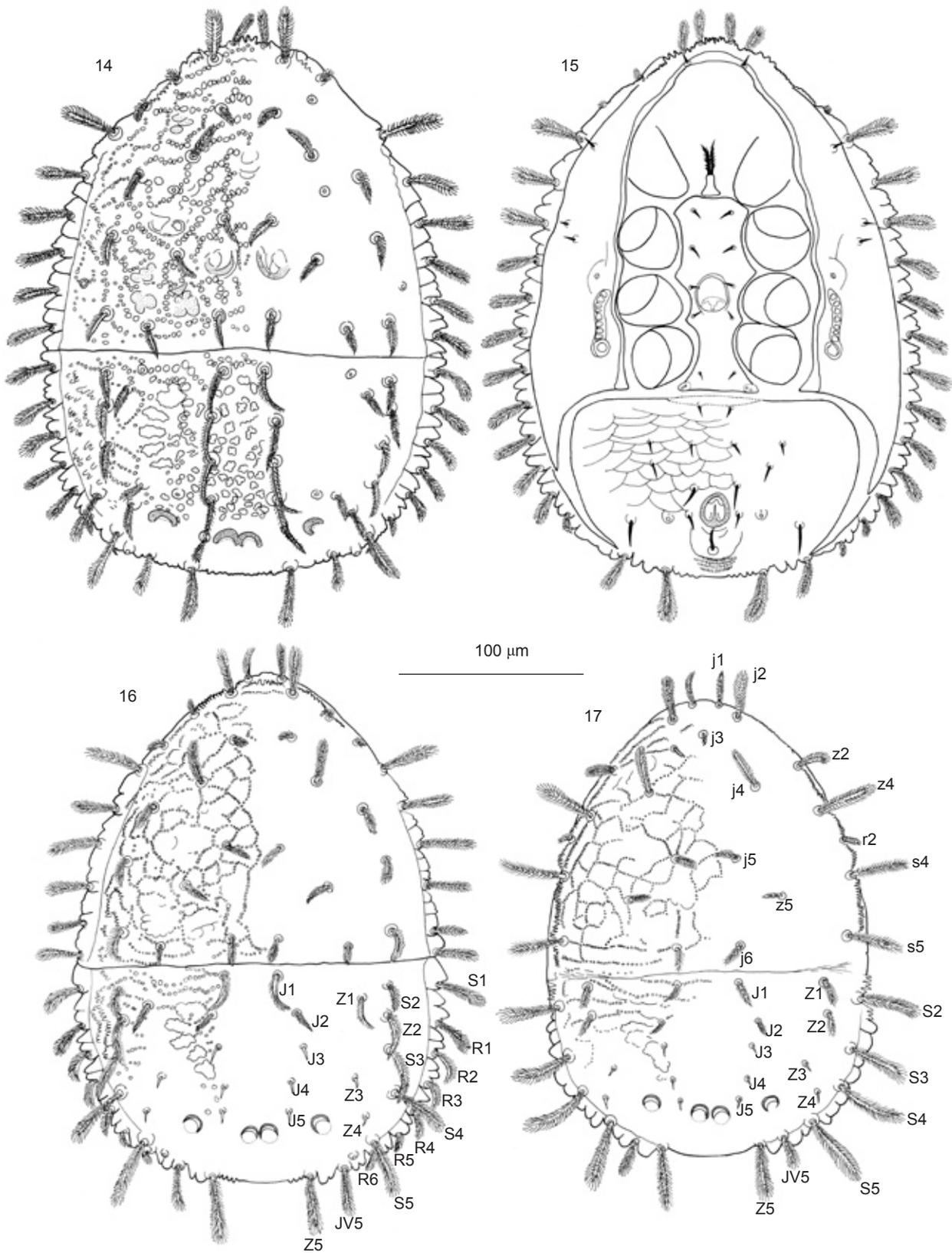
converging anteriorly. Size of setae and distances between their insertions given in table 3.

Venter: (Figs. 12, 20) Posterolateral tips of peritrematal shield expanded beyond level of R3, not connected to ventrianal shield. Three pairs of peritrematal setae short, smooth, and pointed (Fig. 21); r1 situated at level of z3; r2 and r3 at level of s3. Peritremes straight. Sternal shield 50 μm long, 30 μm wide at level of setae st2, posterior margin straight. Glands *gv2* present, with 2 openings, surrounded by conspicuous adgnital platelets. A pair of postgenital sclerites usually present. Anterior margin of ventrianal shield with 1 pair of setae (setae ZV1 absent). All sternal and preanal setae smooth, simple; postanal seta apically feathered. Ventrianal pores *gv3* situated laterally to adanal setae. Setae JV5 brush-like, plumose. Sternal shield with reticulate ornamentation; ventrianal shield covered by tile-like pattern.

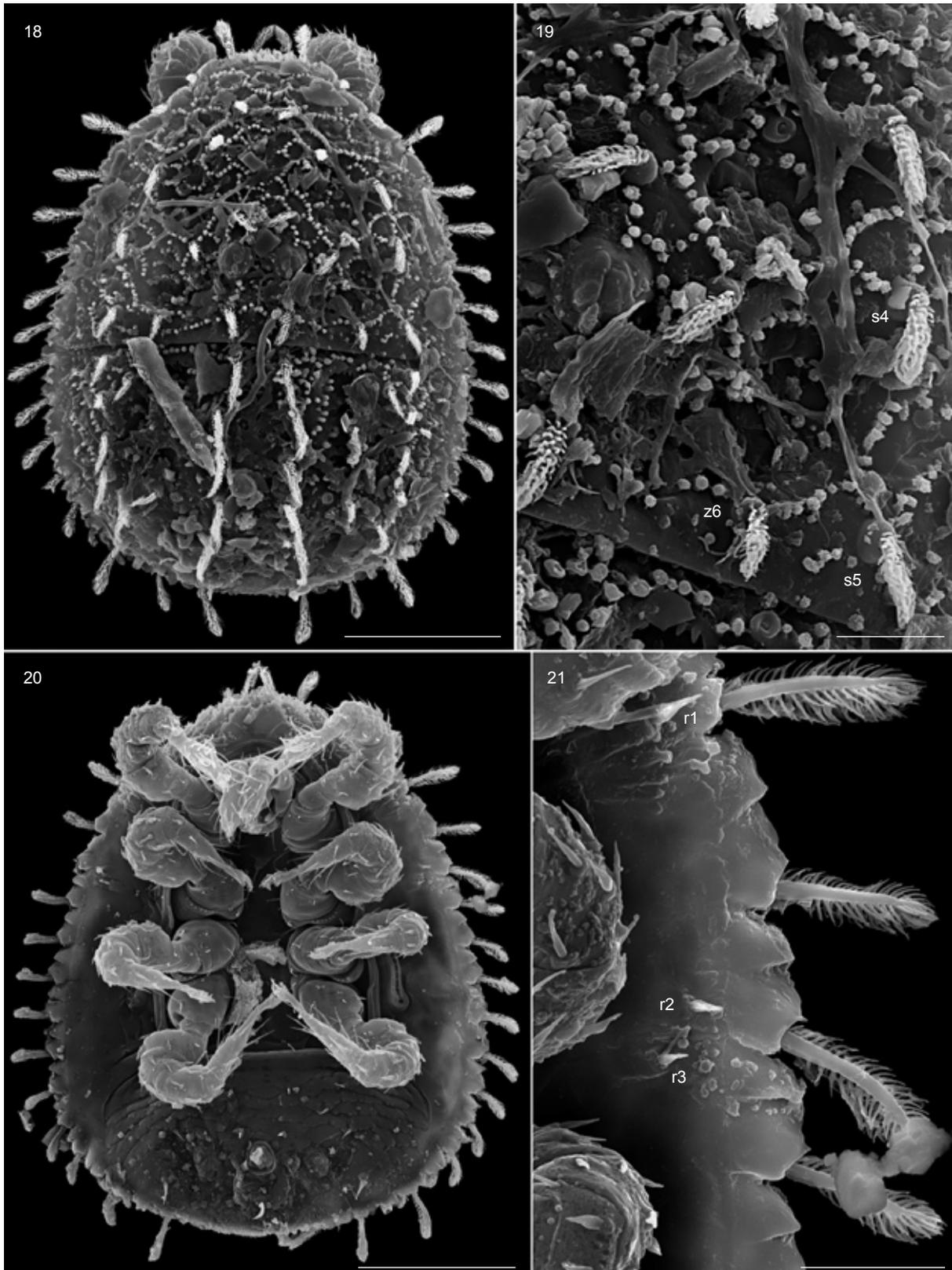
Male: Length of idiosoma 286-297 μm , width 218-225 μm ($n = 10$). Chaetotaxy, poroidotaxy, and sculpturing pattern of dorsal (Fig. 14) and ventral shields (Fig. 15) similar to those of female. Medial pair of dorsal cavities often fused. Marginal



Figs. 11-13. *Parazercon (Formosella) mirabilis* Ujvári, sp. nov., female. 11. Dorsal view; 12. ventral view; 13. epistome.



Figs. 14-17. *Parazercon (Formosella) mirabilis* Ujvári, sp. nov. **14.** Dorsal view of male; **15.** ventral view of male; **16.** dorsal view of deutonymph; **17.** dorsal view of protonymph.



Figs. 18-21. *Parazercon (Formosella) mirabilis* Ujvári, sp. nov., SEM photos. **18.** Dorsal view of female; **19.** setae and ornamentation of podonotal shield; **20.** ventral view of female; **21.** ventral view, peritrematal setae on peritrematal shield. Scale bars: 18, 20 = 100 μm ; 19, 21 = 25 μm .

serration of idiosoma more acuminate than in female. Sternigenital shield with 5 pairs of short setae. Posterolateral tips of peritrematal shield free, not connected to ventrianal shield. Size of setae and distances between their insertions given in table 3.

Deutonymph: (Fig. 16) Length of idiosoma 252-287 µm, width 195-204 µm (n = 14). Chaetotaxy of podonotum as in adult stages. On opisthonotum, setae J1 as in adults; J2 shorter, plumose; J3-5 short, smooth, and thorn-like. Distance between setae J2 significantly larger than that between setae J1. Setae Z1-2 and S2-3 similar in shape to J1, increasing in length posteriorly. Z3-4 short, smooth, and thorn-like; S4-5 elongated, brush-like, plumose, reaching beyond margin of idiosoma. Other chaetotactic characters of opisthonotum as in adult stages. Dorsal cavities uniform, clearly conspicuous, situated in a row. Podonotal pattern similar to that of the adults, horseshoe-shaped ornamentation weakly developed. Anterolateral parts of opisthonotum covered by reticulations of small, pearl-like and spine-like protuberances, central and posterior surfaces smooth. Size of setae and distances between their insertions given in table 3.

Protonymph: (Fig. 17) Length of idiosoma 245 µm, width 170 µm (n = 1). Podonotal setae densely plumose. Shape of J- and Z-setae as in deutonymphs; Z2 situated posteriorly to Z1. Setae S2 situated posterolaterally to Z1; all S-setae elongate, brush-like, plumose, expanded beyond margin of idiosoma. Shape and situation of dorsal cavities, and sculpturing pattern of podo- and opisthonotum as in deutonymphs. Size of setae and distances between their insertions given in table 3.

Known *Parazercon* species can be distinguished according to the following key:

1. Peritrematal setae r3 similar to r1 and r2, short, smooth, and thorn-like; postgenital sclerites present (subgenus *Formosella*, Ujvári, subgen. nov.)
*Parazercon (Formosella) mirabilis* Ujvári, sp. nov.
- Peritrematal setae r3 plumose, 2-3 times longer than smooth r1 and r2; postgenital sclerites absent (subgenus *Parazercon*, Trägårdh 1931)..... 2
2. Opisthonotum without conspicuous sculpturing pattern 3
- Opisthonotum with spot-like ornamentation..... 4
3. All dorsal setae plumose; J5 absent; setae Z1, S2, Z2, and Z3 forming a row; S3 and S4 shifted laterally to latter row
 *Parazercon (Parazercon) radiatus* (Berlese 1910)
- Podonotal setae j5 and z5 smooth; J5 present; setae Z1, S2, Z2, S3, and S4 forming a row; Z3 and Z4 shifted medially to latter row.....
*Parazercon (Parazercon) sergienkoeae* Balan 1991
4. Setae Z1, S2, Z2, S3, S4, and Z4 forming a single row; J-series with 6 pairs of setae; a pair of supplementary setae (Jx) between J4 and J5 present; opisthonotum ornamented by irregular depressions
*Parazercon (Parazercon) sichotensis* Petrova 1977
- Z- and S-setae constituting 2 well-separated setal-rows; J-series with 5 pairs of setae; opisthonotum ornamented by small, round protuberances
 *Parazercon (Parazercon) floralis* Ma 2002

Genus *Zercon* C. L. Koch, 1836

***Zercon tsoi* Ujvári, sp. nov.**

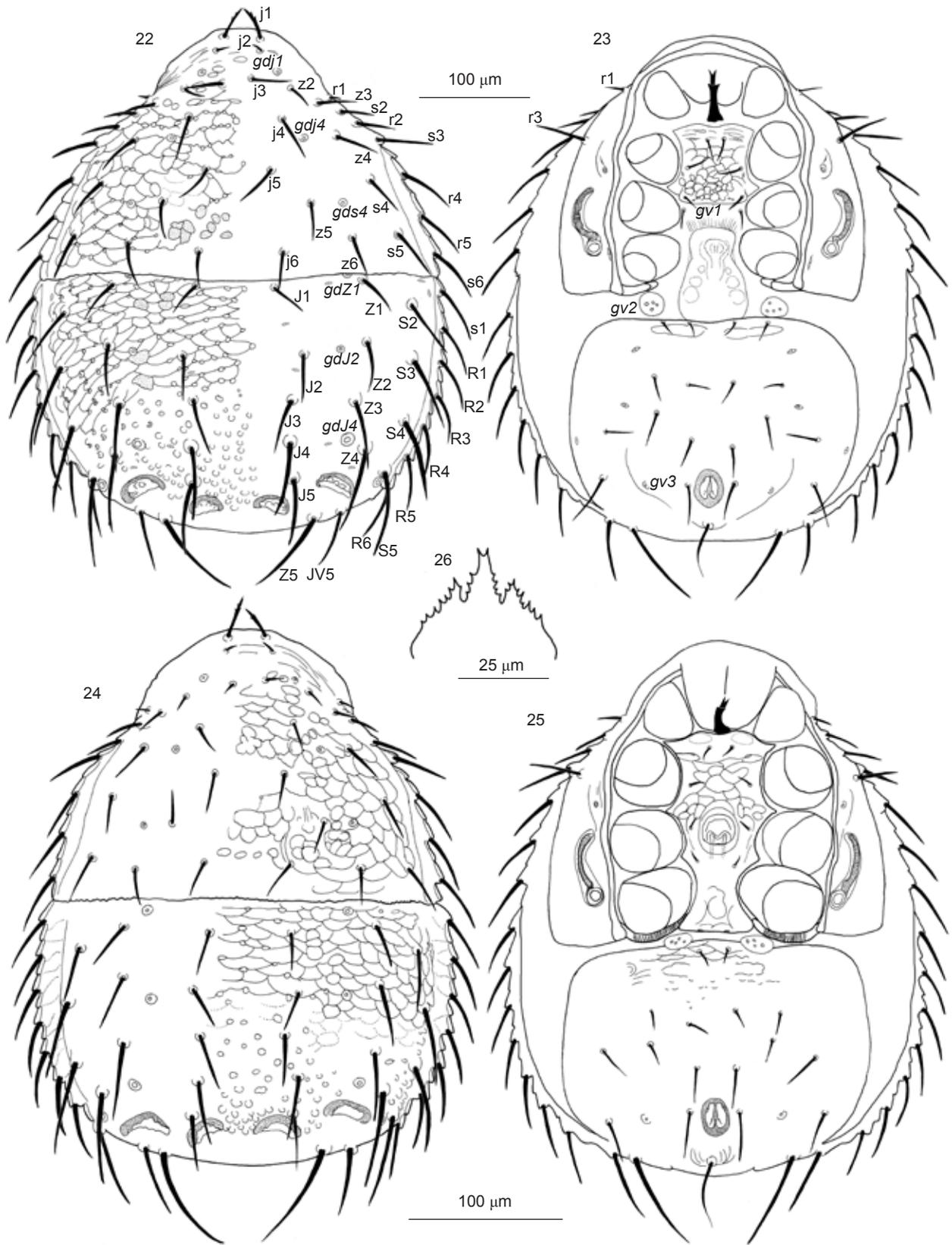
(Figs. 22-29)

Material examined: Holotype: ♀: AS-865, Taiwan, Hualien Co., Taroko NP, Hohuan Mt., Siafoukung ESRI High Elevation station, high-mountain arrow bamboo (*Yushania niitakayamensis*), leaf-litter, 24°09.704'N, 121°17.230'E, 3008 m elev., 22 May 2008, leg. L. Dányi, Z. Korsós, E. Lazányi (deposited in HHNM).

Paratypes: Same locality and date as for holotype (8 ♀♀, 2 ♂♂, deposited in HHNM);

Table 3. Lengths of opisthonotal setae and distances between setal bases within longitudinal rows in *Parazercon (Formosella) mirabilis* Ujvári, sp. nov. (units: µm)

Setae	Female	Male	DN	PN	Setae	Female	Male	DN	PN	Setae	Female	Male	DN	PN
J1	32	25	21	14	Z1	20	16	18	14	S1	31	26	25	-
J1-J2	32	27	23	23	Z1-Z2	20	15	16	17	S1-S2	29	27	24	-
J2	36	29	13	9	Z2	24	21	25	33	S2	17	18	16	34
J2-J3	28	24	18	13	Z2-Z3	61	44	38	31	S2-S3	43	37	36	27
J3	33	30	9	5	Z3	20	14	6	6	S3	22	20	28	13
J3-J4	27	20	21	18	Z3-Z4	17	11	21	16	S3-S4	25	23	21	20
J4	32	23	7	5	Z4	20	17	6	6	S4	25	20	35	39
J4-J5	22	20	15	12	Z4-Z5	64	46	45	41	S4-5	38	26	29	24
J5	27	15	7	6	Z5	35	30	35	32	S5	35	31	35	40



Figs. 22-26. *Zercon tsoi* Ujvári, sp. nov. 22. Dorsal view of female; 23. ventral view of female; 24. dorsal view of male; 25. ventral view of male; 26. epistome of female.

AS-875, Taiwan, Hualien Co., Taroko NP, Pulu Mt. Sacred Tree logging road, primary broadleaf forest, from moss, 24°10.840'N, 121°24.189'E, 2200 m elev., 22 May 2008, leg. L. Dányi, Z. Korsós, E. Lazányi (1 ♀, deposited in HNHM); AS-874, Taiwan, Hualien Co., Taroko NP, Pulu Mt. Sacred Tree, parking place, from leaf-litter, 24°10.840'N, 121°24.189'E, 2200 m elev., 22 May 2008, leg. L. Dányi, Z. Korsós, E. Lazányi (1 ♀, deposited in NMNS); AS-876, Taiwan, Nantou Co., Kunyang, logging road, primary broadleaf forest, from leaf-litter, 24°06.705'N, 121°11.977'E, 2200 m elev., 22 May 2008, leg. L. Dányi, Z. Korsós, E. Lazányi (6 ♀♀, 1 ♂, deposited in NMNS).

Etymology: The species is dedicated in honor of Dr. I-Min Tso (Tunghai Univ., Taichung, Taiwan), a spider specialist, who took a leading part in the Taiwanese-Hungarian collaboration, organizing the expedition in the course of which the presently described species were collected.

Diagnosis: Podonotal setae smooth, simple, except j1 which is apically barbed. Setae s1 absent. All opisthonotal setae relatively long, growing in length posteriorly. Longest setae delicately pilose apically, others simple. Setae J1 and Z1-2 not reaching bases of next setae in series; other J-, Z-, and S-setae reaching following insertions. Setae J5, Z4, and S2-5 extending beyond margins of idiosoma. Glands *gvJ2* (Po2) situated on line connecting insertions of J2 and Z2; *gdJ4* (Po3) above line connecting J4 and Z4. Anterior part of opisthonotum with reticulate pattern and distinct depressions, posterior 1/2 with large, bulging spots. Dorsal cavities large, strongly sclerotized, with oblique axes. Anterior margin of ventrianal shield with 2 pairs of setae in female, bearing only 1 pair in male. Adgenital plates unusually large, with 4 pores.

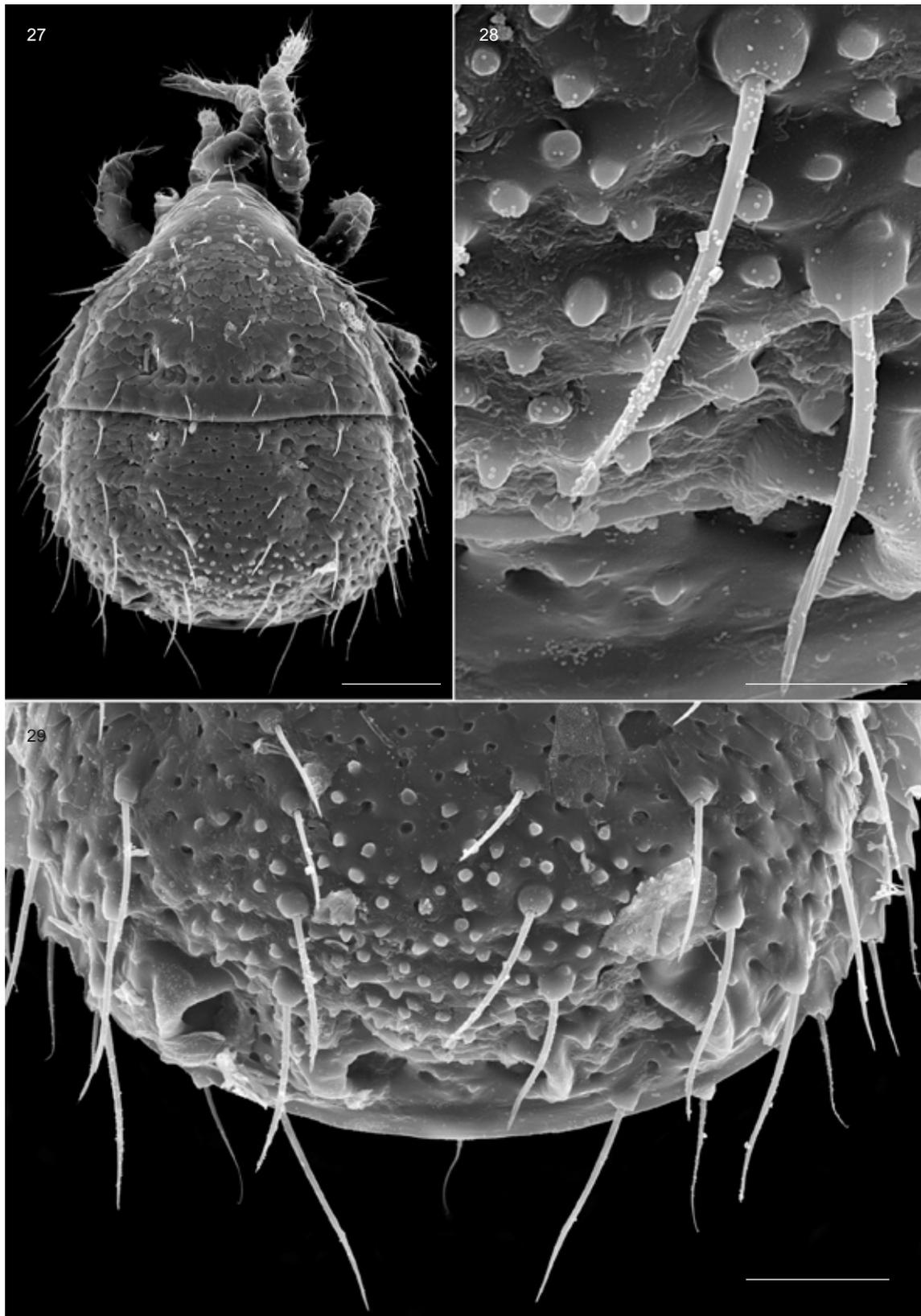
Description: Female. Length of idiosoma

434-462 μm, width 367-378 μm ($n = 17$).

Dorsum: (Figs. 22, 27) Podonotum with 21 pairs of setae (j1-6, s2-6, z2-6, r1-5). Setae j1 apically barbed, other podonotal setae smooth, simple. Setae s1 absent. Marginal setae elongate, pointed, smooth. Glands *gdj1* (po1) situated on line connecting insertions of j2 and z2; *gdj4* (po2) positioned below line connecting j4 and z4; *gds4* (po3) below line connecting z5 and s4. Central and lateral surface of podonotum with tile-like pattern; posteromedial area with several irregular depressions. Opisthonotum with 21 pairs of setae (J1-5, Z1-5, S1-5, R1-6). J-, Z-, and S-setae growing in length posteriorly, thickened, smooth, and setiform; however J4-5, Z4, and S4-5 often finely serrate apically. J1, Z1, and Z2 not reaching bases of next setae. S-series extruded laterally, setae J5, Z4, and all S-setae extending beyond margin of idiosoma. Marginal R-setae similar to podonotal r-setae, elongate, strong, and pointed. Glands *gdZ1* (Po1) situated anterolaterally to Z1; *gdJ2* (Po2) lying on line connecting insertions of setae J2 and Z2; *gdJ4* (Po3) above line connecting J4 and Z4, near Z4; *gdS5* (Po4) near insertions of S5, in posteromedial position. Marginal serration of dorsal idiosoma relatively deep and sturdy. Anteromedial and anterolateral areas of opisthonotum covered by tile-like sculpturing pattern; small cavities visible in crossing points of reticulate ornamentation. Posteromedial surface bearing large, bulb-like protuberances (Figs. 28, 29). Dorsal cavities (Fig. 29) uniform, strongly sclerotized, relatively large, with smooth anterior and undulate posterior margins, their axes converging posteriorly. Epistome typical for genus *Zercon*, with 1 long, bifurcate medial process, and 2 shorter lateral processes (Fig. 26). Size of setae and distances between their insertions given in table 4.

Table 4. Lengths of opisthonotal setae and distances between setal bases within longitudinal rows in *Zercon tsoi* Ujvári, sp. nov. (units: μm)

Setae	Female	Male	Setae	Female	Male	Setae	Female	Male
J1	33	28	Z1	40	31	S1	50	38
J1-J2	65	39	Z1-Z2	55	36	S1-S2	29	27
J2	42	28	Z2	46	39	S2	56	39
J2-J3	42	30	Z2-Z3	55	43	S2-S3	50	37
J3	51	36	Z3	62	49	S3	71	52
J3-J4	41	30	Z3-Z4	45	27	S3-S4	55	39
J4	67	43	Z4	74	63	S4	77	59
J4-J5	33	24	Z4-Z5	75	56	S4-5	50	30
J5	63	37	Z5	83	73	S5	79	61



Figs. 27-29. *Zercon tsoi* Ujvári, sp. nov., SEM photos. 27. Dorsal view of female; 28. opisthonotal setae, sculpturing pattern, and dorsal cavity; 29. caudal part of opisthonotum. Scale bars: 27 = 100 μm ; 28 = 20 μm ; 29 = 50 μm .

Venter: (Fig. 23) Shape of peritrematal shield typical for genus *Zercon*: laterally separated from dorsal shield by a broad slit of interscutal membranous cuticle, truncate posteriorly between level of s6 and S1. Peritrematal setae r1 short, smooth, r3 3-times longer than r1, with a position typical for genus *Zercon*, but atypically smooth. Peritremes hook-shaped. Sternal shield 71 μm long, 59 μm wide at level of setae st2; posterior margin straight or slightly arcuate. Four gland-openings of gv2 situated on large, round adgenital plates. Anterior margin of ventrianal shield with 2 pairs of setae (setae ZV1 present). All sternal and ventrianal setae smooth, simple. Ventrianal pores gv3 situated posterolaterally to adanal setae. Sternal shield with squamous ornamentation, ventrianal shield without sculpturing pattern.

Male: Length of idiosoma 347-355 μm , width 268-274 μm ($n = 3$).

Chaetotaxy, poroidotaxy, and sculpturing pattern of dorsal shields (Fig. 24) similar to those of female; however, setae J4-5 of male shorter in proportion to Z4 and S4-5 than in female. On ventral side (Fig. 25), sternigenital shield with 4 pairs of short setae. Anterior margin of ventrianal shield with 1 pair of setae (ZV1 absent). Peritremes less bent than in female. Size of setae and distances between their insertions given in table 4.

Immature stages: Unknown.

Remarks: The new species resembles *Z. alaskaensis* Sellnick, 1958 by the similar pattern of the body, the long and thickened setae of the opisthonotum, and the extraordinary position of pores Po2; but the 2 species can easily be distinguished according to the following features: setae s1 absent in *Z. tsoi* (present in *Z. alaskaensis*); setae J3 present in *Z. tsoi* (absent in *Z. alaskaensis*); opisthonotal setae of *Z. alaskaensis* much longer in proportion to the body length than in *Z. tsoi*; dorsal cavities with axes converging posteriorly in *Z. tsoi* (with axes parallel to that of the body or converging anteriorly in *Z. alaskaensis*); pores Po2 situated on a line connecting J2 and Z2 in *Z. tsoi* (Po2 on a line connecting Z1 and Z2 in *Z. alaskaensis*); and opisthonotal ornamentation presumably also differing. However, this cannot be judged correctly on the basis of the original description of *Z. alaskaensis*.

Genus *Mesozercon* Blaszak, 1975

Mesozercon plumatus (Aoki, 1966)

(Fig. 30)

Prozercon plumatus Aoki 1966: 64-66, figs. 2, 3.

Mesozercon plumatus: Blaszak, 1976c: 548-551, figs. 15-17; Halašková, 1979: 7-9, fig. 2; Lim and Lee, 2001: 199-200, fig. 7.

Material examined: AS-864, Taiwan, Taitung Co., Southern Cross I. Highway, Wulu, secondary mixed forest, 23°08.496'N, 121°02.669'E, 1631 m elev., 28 May 2008, leg. L. Dányi, Z. Korsós, E. Lazányi (5 ♀♀, 2 deutonymphs).

Diagnosis: All podonotal and opisthonotal setae densely pilose. J-setae uniform, bilaterally pilose, medium-sized. Z1-4 and S2-5 similar in shape and length, pilose, shorter than J-setae. Setae Z2 situated laterally to Z1; setae Z2, Z3, Z4, and S3 forming a row. Glands gdS3 (Po3) positioned outside line connecting Z4 and S4. Marginal setae densely plumose, brush-like. Dorsal cavities poorly developed. Body length 270-285 μm , width 210-225 μm .

Distribution: Japan, Korean peninsula, Taiwan.

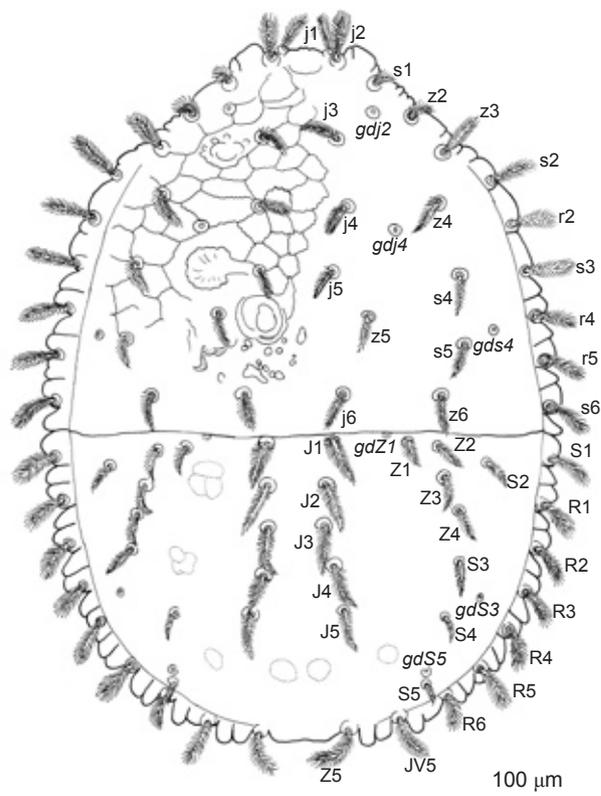


Fig. 30. *Mesozercon plumatus* (Aoki, 1966), dorsal view of female.

Remarks: The species is new to the fauna of Taiwan.

DISCUSSION

The family Zerconidae is known as a widespread Holarctic group of mesostigmatid mites, inhabiting both cold- and warm-temperate climate zones, and thought to be missing from subtropical and tropical territories. Some species; however, were found in the Oriental zoogeographical region (Petrova and Taskaeva 1968, Ma and Yin 1999), as proof of a wider distribution of the family. The new Taiwanese records presented are the southernmost known localities of Zerconidae so far. It seems that the group spreads southwards along the temperate forests of high mountains far below the Tropic of Cancer; however, they are missing from the subtropical and tropical rainforests. The presence of *Mesozercon*, a genus with a presumably east-Palaearctic distribution, on Taiwan strengthens the zoogeographical connection with the Japanese islands. However, the relatively high number of new taxa which differ in a great degree from the ones of the Asian mainland suggests that speciation processes on these isolated areas resulted in numerous examples of unique endemism, at the level of species and genera. It is worth mentioning that the newly described genus shows such generic characters which were only observed in some Nearctic groups of Zerconidae.

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REFERENCES

- Aoki I. 1964. Der erste Bericht über die Familie Zerconidae aus Japan (Acarina, Mesostigmata). *Pac. Insects* **6**: 489-493.
- Aoki I. 1966. Nachtragsarten der Familie Zerconidae aus Japan. *Bull. Nat. Sci. Mus. Tokyo* **9**: 61-68.
- Athias-Henriot C. 1976. *Syskenozercon kosiri* n. g., n. sp. Zerconidae, Dorsoneotrichie des Alpes et de L'Himalaya (Arachnides, Gamasides). *Bull. Soc. Zool. Fr. Paris* **101**: 433-444.
- Balan PG. 1991. New genus and species of mites (Acari, Mesostigmata) from the Ukrainian Carpathians. *Zool. Z.* **70**: 70-75. (in Russian)
- Bei NX, CM Shi, SG Yin. 2002. A new species of genus *Prozercon* Sellnick (Acari: Zerconidae) from China. *Entomotaxonomia* **24**: 223-226.
- Berlese A. 1910. Lista di nuove specie e nuovi generi di Acari. *Redia* **6**: 242-263.
- Błaszak C. 1975. A revision of the family Zerconidae (Acari, Mesostigmata). Systematic studies on family Zerconidae - I. *Acarol. Paris* **17**: 553-569.
- Błaszak C. 1976a. *Xenozercon glaber* gen. nov., sp. nov. (Acari, Zerconidae) from North Korea. *Bull. Acad. Polonaise Sci. (Sér. Sci. Biol. Cl. II.)* **24**: 33-36.
- Błaszak C. 1976b. Contribution to the knowledge of Zerconidae fauna from North Korea (Acari, Mesostigmata). *Folia Entomol. Hung.* **28**: 263-268.
- Błaszak C. 1976c. Systematic studies on family Zerconidae II. North Korean Zerconidae (Acari, Mesostigmata). *Acta Zool. Cracov. Kraków* **21**: 527-552.
- Błaszak C. 1977. *Echinozercon nipponicus* sp. nov. (Acari, Zerconidae), a new species of mite from Japan. *Bull. Acad. Polonaise Sci. (Sér. Sci. Biol. Cl. II.)* **25**: 663-666.
- Błaszak C. 1978a. Systematic studies on family Zerconidae III. Mongolian Zerconidae (Acari, Mesostigmata). *Acta Zool. Acad. Sci. Hung.* **24**: 301-320.
- Błaszak C. 1978b. *Indozercon janinae* gen. nov., sp. nov. (Acari, Zerconidae) from India. *Bull. Acad. Polonaise Sci. (Sér. Sci. Biol. Cl. II.)* **26**: 483-487.
- Błaszak C. 1979. Systematic studies on the family Zerconidae IV. Asian Zerconidae (Acari, Mesostigmata). *Acta Zool. Cracov. Kraków* **24**: 3-112.
- Błaszak C. 1981. Three new genera of zerconid mites (Acari, Gamasida: Zerconidae) from the United States of America. *Can. J. Zool.* **59**: 2038-2047.
- Halašková V. 1977. A revision of the genera of the family Zerconidae (Acari: Gamasides) and descriptions of new taxa from several areas of Nearctic region. *Stud. ČSAV Praha* **7**: 1-77.
- Halašková V. 1979. Taxonomic studies on Zerconidae (Acari: Mesostigmata) from the Korean People's Democratic Republic. *Acta Sci. Nat. Acad. Sci. Bohemicae Brno* **13**: 1-41.
- Ishikawa K. 1969. Taxonomic investigations on free living mites in the subalpine forest on Shiga heights IBP area. I. Mesostigmata. Part I. *Bull. Nat. Sci. Mus. Tokyo* **12**: 39-64.
- Ishikawa K. 1972. The fauna of the Lava Caves around Mt. Fujisan. XI. Mesostigmata (Acarina). *Bull. Nat. Sci. Mus. Tokyo* **15**: 445-451.
- Lee WK, JW Lim. 2004. Two new species of the family Zerconidae (Acari: Mesostigmata). *Korean J. Soil Zool.* **9**: 29-31.
- Johnston DE, ML Moraza. 1991. The idiosomal adenotaxy and poroidotaxy of Zerconidae (Mesostigmata: Zerconina). In F Dusbábek, V Bukva, eds. *Modern acarology*. Vol. 2. Prague: Academia, pp. 349-356.
- Lindquist EE, GO Evans. 1965. Taxonomic concepts in the Ascidae, with a modified setal nomenclature for the idiosoma of the Gamasina (Acarina: Mesostigmata). *Mem. Entomol. Soc. Can.* **47**: 1-64.
- Lindquist EE, ML Moraza. 1998. Observations on homologies of idiosomal setae in Zerconidae (Acari: Mesostigmata), with modified notation for some posterior body setae. *Acarologia* **39**: 203-226.
- Lim JW, WK Lee. 2001. A taxonomic study of the family Zerconidae (Acari, Mesostigmata) in the Korean

- peninsula. Korean J. Syst. Zool. **17**: 191-205.
- Ma LM. 2002. Two new species of the family Zerconidae from China (Acari: Mesostigmata). Acta Zootax. Sin. **27**: 479-482.
- Ma LM. 2003a. Descriptions on a new species and larva of a known species of *Zercon* (Acari: Mesostigmata: Zerconidae). Entomotaxonomia **25**: 73-76.
- Ma LM. 2003b. A new species of the genus *Dinychus* and a new species of the genus *Mesozercon* (Acari, Prodirinychidae, Zerconidae). Acta Zootax. Sin. **28**: 464-468.
- Ma LM, XQ Yin. 1999. Two new species of the genus *Zercon* (Acari: Mesostigmata). Entomotaxonomia **21**: 228-234.
- Petrova AD. 1977. New species and new genus of gamasoid mites of the family Zerconidae (Parasitiformes, Gamasoidea). Biol. Nauki Moscow **3**: 56-61.
- Petrova AD, AZ Taskaeva. 1968. Gamasoid mites (Parasitiformes, Gamasoidea) from Southern China. Zoologicheskii Zh. **46**: 1179-1191.
- Sellnick M. 1958. Die Familie Zerconidae Berlese. Acta Zool. Acad. Sci. Hung. **3**: 313-368.