OBSERVATIONS ON HOMOLOGIES OF IDIOSOMAL SETAE IN ZERCONIDAE (ACARI: MESOSTIGMATA), WITH MODIFIED NOTATION FOR SOME POSTERIOR BODY SETAE

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CHAETOTAXY
HOMOLOGY
IDIONYMIC ORGANS
NOTATION
ZERCONIDAE

SUMMARY: The holotrichous condition for the idiosomal chaetotaxy of Zerconidae is reviewed. Using ontogenetic patterns of body setation of holotrichous taxa in other families of Gamasina for comparison, the homologies and notation for some of the podonotal and opisthosomal setae of zerconid mites are changed. These modifications lead to new interpretation of some of the apomorphic attributes used to characterize the family Zerconidae and superfamily Zerconoidea. The caudodorsal displacement of a pair of opisthogastric setae, *JV5*, so as to appear to be captured by the opisthonotal shield in deutonymphs and adults, is seen to be a unique characteristic of Zerconoidea. The caudal coalescence of the opisthonotal and opisthogastric shields, and the anterior displacement of setae *J5* to a nearly transverse alignment with setae *Z4* well ahead of the caudal body margin, characterize Zerconidae.

QUETOTÁXIA
HOMOLOGIA
ORGANOS IDIOSÓMICOS
NOTACIÓN
ZERCONIDAE

RESUMEN: Se revisa la condición holotrica de la quetotáxia del idiosoma de Zerconidae. Utilizando por comparación los modelos ontogénicos de la quetotaxia del cuerpo determinada para los taxa holotricos en otras familias de Gamasina, se modifican las homologias y nomenclatura de algunas de las setas podonotales y opistonotales de los ácaros zerconidos. Estas modificaciones llevan a una nueva interpretación de alguno de los atributos apomórficos utilizados en la caracterización de la familia Zerconidae y la superfamilia Zerconoidea. El desplazamiento caudodorsal de un par de setas opistogástricas, *JV5*, que parecen ser capturadas por la placa opistonotal en las deutoninfas y adultos, parece ser una caracteristica única de Zerconoidea. La coalescencia caudal de las placas opistonotal y opistogástrica y el desplazamiento anterior de las setas *J5* hasta alcanzar casi un alineamiento transversal con las setas *Z4*, bien adelantadas respecto al margen caudal del cuerpo, caracteriza a Zerconidae.

CHETOTAXIE
HOMOLOGIE
ORGANES IDIONYMIQUES
NOTATION
ZERCONIDAE

RÉSUMÉ: Nous revoyons l'holotrichie de l'idiosome des Zerconidae. Nous modifions les homologies et la notation de certains poils du podonotum et de l'opisthosoma des zerconides, en les comparant à des modèles ontogénétiques de pilosité dans les taxons holotriches des autres familles de Gamasina. Ces modifications conduisent à une nouvelle interprétation de certains attributs apomorphes dont on se sert pour caractériser la famille des Zerconidae et la superfamille des Zerconoidea. Le déplacement dorsocaudal d'une paire de poils de l'opisthogaster, *JV5*, tel qu'elle parait captée par le bouclier

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opisthonotal des deutonymphes et des adultes, est considéré comme un caractère unique des Zerconoidea. Les Zerconidae sont caractérisés par la coalescence caudale des boucliers opisthonotal et opisthogastrique et par le déplacement antérieur des poils *J5* jusqu'à un alignement transversal avec les poils *Z4* bien en avant du bord caudal du corps.

Introduction

When Sellnick (1958) published his founding revision of Zerconidae 40 years ago, four genus-group taxa were recognized. Since then, an additional 36 genus-group categories have been proposed, most of them during the nine-year period 1976-1984. Many of these genera are defined primarily on chaetotactic distinctions of the idiosoma. These distinctions, however, are sometimes vague, as different systems of setal notation have been used by various authors in description of zerconid mites. Also, interpretations of setal homologies have differed among authors even when using the same system of notation. These disparities have hampered comparisons of the chaetotaxy not only among the genera of this family but also of Zerconidae as a whole with those of other families of Gamasina.

Two systems of notation are currently in widespread use for denoting the idiosomal setae of mesostigmatic mites, one developed by Hirschmann (1957) and the other by Lindquist & Evans (1965). Both systems are modifications of a previous one initiated by Sellnick (1944, 1958) specifically for mites of the family Zerconidae. All three systems are now in use by various authors who continue to describe taxa of Zerconidae. Although the two modified systems are discordant in their notations for setae of the podonotal region, they are largely accordant for setae of the opisthonotal region. Sellnick applied his system primarily to the opisthonotal shield of adult zerconid mites, though he outlined it for the podonotal shield, without notation, in his 1944 paper and with notation in his 1958 paper. His system recognized four longitudinal series of setae: an "Innenreihe" or dorsocentral row, *i-I* (also denoted alternatively by him and some other authors as *j-J* to avoid confusion when used with numerals), a "Zwischenreihe" or mediolateral row, *z-Z*, a "Seitenreihe" or lateral row, *s-S*, and a "Randreihe" or marginal row, *r-R*. For the holotrichous condition on the podonotum of zerconid mites, Sellnick designated six pairs of setae, *i1-i6* (or *j1-j6*), in the dorsocentral series, two pairs, *z1-z2*, in the mediolateral series, six pairs each, *s1-s6* and *r1-r6*, in the lateral and marginal series, respectively, plus two or three pairs, *p1-p3*, designated as "peritrematal" setae, for a total of 22 or 23 pairs of setae. For the holotrichous condition on the opisthonotum of zerconid mites, he designated six pairs of setae, *I1-I6* (or *J1-J6*), in the dorsocentral series, five pairs, *Z1-Z5*, in the mediolateral series, four pairs, *S1-S4*, in the lateral series, and usually seven or eight pairs, *R1-R8*, in the marginal series, for a total of 22 or 23 pairs of setae. Sellnick did not consider whether the opisthonotal setae could be arranged in transverse ranks, which might reflect vestiges of metamerism; therefore, he was not concerned about the different numbers of setae in each row. However, transverse ranks were considered subsequently by Hirschmann (1957, 1959) for the opisthonotal region, and by Lindquist & Evans (1965) for both the podonotal and opisthonotal regions, when they applied their modifications of Sellnick's system to a wide array of other families of free-living Gamasina. For the opisthonotal region, basically five setal pairs were recognized by these authors for each of the *J, Z, S* series. Additional setae were interpreted as "extra" designatable idionymic setae or, if variably numerous and asymmetrical, then as non-designatable, adelonymic setae *sensu* van der Hammen (1975).

The great majority of specialists who have described species of zerconid mites (*e.g.*, Halašková, 1963, 1969 and other papers, Aoki, 1964, and other papers, Błaszak, 1974, and many other papers, Kosir, 1974, Mihelčič, 1963, and other papers, Petrova, 1977a, and other papers, Balan, 1991, and other papers) have opted to follow Sellnick (1944, 1958) in recognizing generally 6 pairs of *J*-setae and 4 pairs of *S*-setae on the opisthonotum. However, Athias-Henriot (1961) and Karg (1965, 1993) followed Hirschmann (1957), while Moraza (1988 and other papers) and Johnston & Moraza (1991) followed

LINDQUIST & EVANS (1965), in recognizing generally 5 pairs each of *J*- and *S*-setae. In doing so, these authors consistently admitted an "extra" pair of setae, denoted *Zx* by HIRSCHMANN (1957, 1959) and *Jx* (or *Ix*) by KARG (1965, 1993), between setae *J3* and *J4*, and they denoted the first pair of setae in a marginal position as *S1*, rather than *R1*. The "extra" pair of setae was recognized as a diagnostic apomorphy of Zerconidae by KARG (1965, 1993).

As noted by LINDQUIST (1994), 6 setal pairs in the opisthonotal *J* (=*I*) series is an exceptional holotrichous number, whether interpreted as *J1-J6* or as *J1-J5* plus a pair *Jx*. This condition is all the more anomalous, as the "extra" pair was found in this study to be present beginning with the protonymphal instar; yet the protonymph has the normal holotrichous number, 15 pairs, of opisthonotal setae characteristic of various families of the mesostigmatic cohort Gamasina. This anomaly has prompted us to review the ontogeny and homology of the idiosomal setae among various taxa of zerconid mites, in order to confirm whether the holotrichous condition in Zerconidae is like that in other families of Gamasina. On that basis, the additional objectives of this paper are to determine whether the notation applied to these setae in Zerconidae needs re-interpretation, and to present a standardized notation that will facilitate accurate homology and designation of idiosomal setae among the variety of taxa in this family.

MATERIAL AND METHODS

This study is based in part on our examination of complete (larva, protonymph, deutonymph, adult) or partial (protonymph linked with adult) ontogenetic series of conspecific, slide-mounted specimens of several species of *Zercon, Parazercon, Prozercon* and *Skeironozercon* at hand in the Canadian National Collection of Insects and Arachnids, Agriculture and Agri-Food Canada, Ottawa, and the Museum of Zoology, University of Navarra, Pamplona. It is also based on our examination of annotated illustrations accompanying descriptions of similarly complete or incomplete ontogenetic series of nearly 30 species in 6 genera of Zerconidae that are available in the literature, including 6 species of *Prozercon* (HALAŠKOVÁ, 1963, 1969, BŁASZAK, 1974, 1979, URHAN & AYYILDIZ, 1996), 1 of *Parazercon* (HALAŠKOVÁ, 1969, BŁASZAK, 1974, 1979), 1 each of *Caurozercon* and *Skeironozercon* (HALAŠKOVÁ, 1977), 1 of *Mixozercon* (BŁASZAK, 1974), and 19 of *Zercon* (HALAŠKOVÁ, 1969, 1977, BŁASZAK, 1974, 1979, MORAZA, 1991). The number, position and ontogenetic expression of idiosomal setae of these taxa were compared with the general pattern found among representatives of a wide variety of other families of free-living, holotrichous gamasine mites that have been studied and illustrated by HIRSCHMANN (1957), KARG (1962, 1965) and LINDQUIST & EVANS (1965) or that have been studied by us. Our decisions made in revision of homologies of certain idiosomal setae are based on comparisons of these patterns and on the rationale of morphological parsimony to account for apparent differences in patterns. Finally, we tested the consistency of our revised notation by applying it to illustrations of adult idiosomal setation that are available in the literature for all 40 genus-group taxa of Zerconidae (Table 4).

Morphological observations of mites mounted in Hoyer's medium on microslides were made using compound microscopes equipped with differential interference contrast and phase-contrast optical systems. Idiosomal setal notation generally follows the system of LINDQUIST & EVANS (1965), with modifications for the posterior region as given by LINDQUIST (1994). Notational equivalents of this system with those of HIRSCHMANN (1957) and SELLNICK (1944, 1958) are given in Tables 1–3. Distinctions between porelike structures of the idiosoma as either gland pores (solenostomes) or poroids (lyrifissures) are based on the morphological observations of ATHIAS-HENRIOT (1969a, 1969b) and subsequent physiological findings of KRANTZ & REDMOND (1987). Notation for these structures, as adenotaxy and poroidotaxy, respectively, follows that of JOHNSTON & MORAZA (1991); using this notation, the prominent two pairs of opisthonotal gland pores *gdZ3* and *gdZ4* are homologous with those denoted as *Po3* and *Po4* by authors for zerconid mites.

Instar	Lind. & Evans	Hirsch. Karg	Halas. Blasz.	Sellnick
lv	*j1*	*i1*	*i1*	*i1*
pn	*j2*	*s1*	*i2*	*i2*
lv	*j3*	*i2*	*i3*	*i3*
lv	*j4*	*i3*	*i4*	*i4*
lv	*j5*	*i4*	*i5*	*i5*
lv	*j6*	*i5*	*i6*	*i6*
dn	*z1*	*rx?*	*s1, px*	–
lv	*z2*	*s2*	*s1, s2*	*s2*
dn	*z3*	*s3*	*s3, r1*	*s3*
lv	*z4*	*z1*	*s3, s4*	*s4*
lv	*z5*	*z2*	*z1*	*z1*
dn	*z6*	*z3*	*z2*	*z2*
dn	*s1*	*r1,s2*	*r1, s1, p1*	*s1*
dn	*s2*	*r3*	*r1, r2*	*r1*
dn	*s3*	*s4*	*r3, r4*	*r3*
lv	*s4*	*s5*	*s4, s5*	*s5*
pn	*s5*	*s6*	*s5, s6*	*s6*
lv	*s6*	*s7*	*r7, r6*	*r6*
dn	*r1*	*r2*	*p1*	*p1*
pn	*r2*	*r4*	*r2, r3, p2, p3*	*r2, p3*
pn	*r3*	*r5*	*p2, p3*	*p2*
dn	*r4*	*r6*	*r4, r5*	*r4*
pn	*r5*	*r7*	*r5, r6*	*r5*
dn	*(r6)*	–	–	–

Table 1: Ontogeny and notational equivalents for podonotal setae in Zerconidae.
First column of sigla follows Lindquist & Evans (1965); second column follows Hirschmann (1957) and subsequent papers by Karg; third column follows many papers of Halašková, Błaszak and subsequent authors; fourth column follows Sellnick (1944, 1958). Abbreviations: lv, larva; pn, protonymph; dn, deutonymph. Disparate usages within one notational system indicated by two sigla in one position. Parenthetical siglum indicates setal homologue of gamasine mites that is absent in Zerconidae.

Observations and results

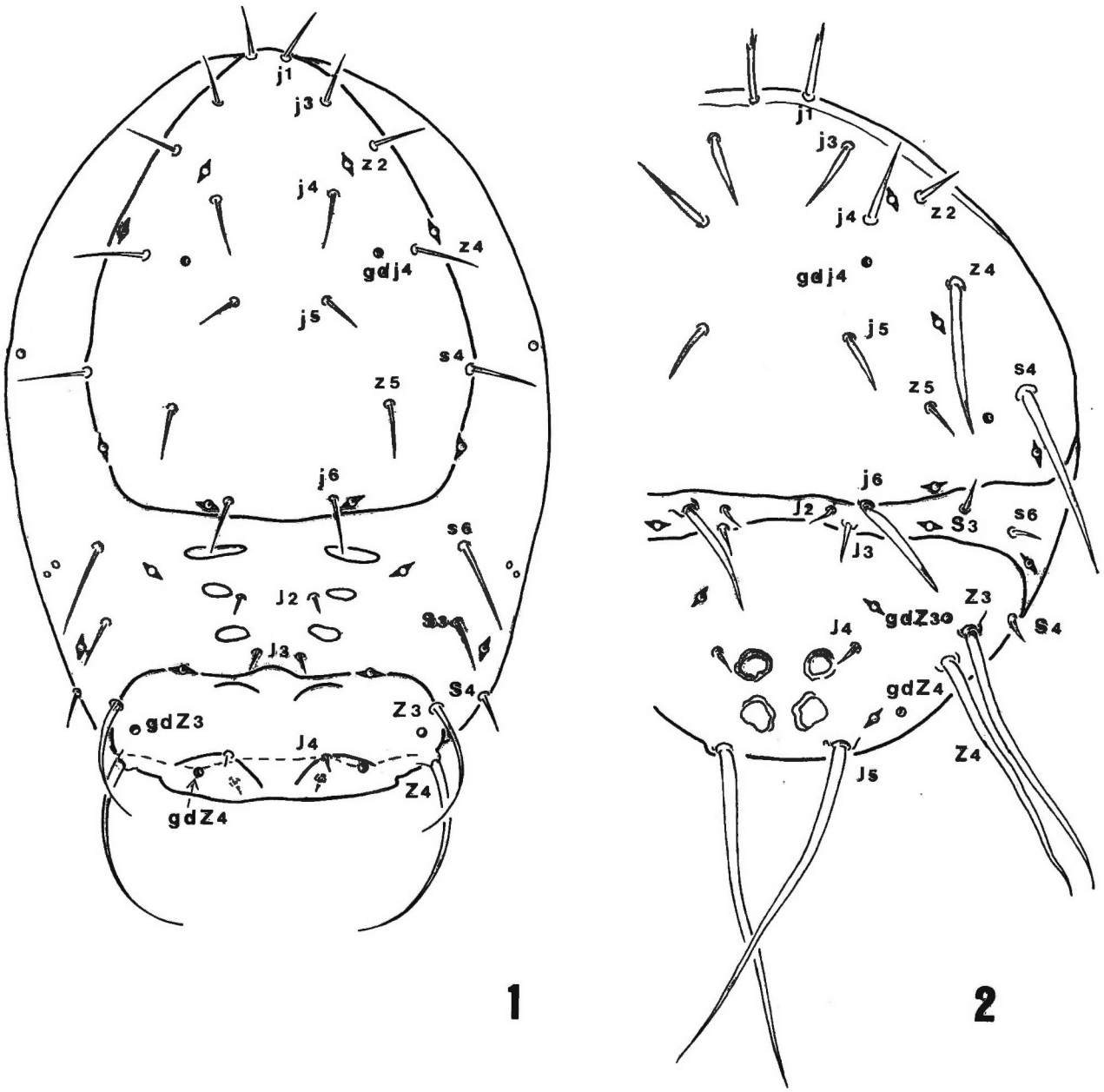
Ontogeny of podonotal setae. *Larva.* The idiosoma of holotrichous larval gamasine mites generally has 10 pairs of podonotal setae, of which 9 pairs (*j1, j3-j6, z2, z4, z5, s4*) are usually on a large podonotal shield and one pair (*s6*) on soft cuticle behind the posterolateral corners of this shield (Fig. 1). The larvae of a variety of zerconid mites (species of *Zercon, Prozercon, Parazercon, Mixozercon*) have the same complement of setae in the same position as in other families of Gamasina and, therefore, the homologies of these setae are confirmed (Fig. 2).

Instar	Lind. & Evans	Hirsch. Karg	Halas. Blasz.	Sellnick
pn	*J1*	*I1*	*I1*	*J1*
lv	*J2*	*I2*	*I2*	*J2*
lv	*J3*	*I3*	*I3*	*J3*
lv	*J4*	*Zx, Ix*	*I4*	*J4*
lv	*J5*	*I4*	*I5*	*J5*
lv	*JV5*	*Z5*	*Z5*	*Z5*
pn	*Z1*	*Z1*	*Z1*	*Z1*
pn	*Z2*	*Z2*	*Z2*	*Z2*
lv	*Z3*	*Z3*	*Z3*	*Z3*
lv	*Z4*	*Z4*	*Z4*	*Z4*
lv	*Z5*	*I5*	*I6*	*J6*
dn	*S1*	*S1*	*R1*	*R1*
pn	*S2*	*S2*	*S1*	*S1*
lv	*S3*	*S3*	*S2*	*S2*
lv	*S4*	*S4*	*S3*	*S3*
lv	*S5*	*S5*	*S4*	*S4*
pn	*R1*	*R1*	*R2*	*R2*
dn	*R2*	*R2*	*R3*	*R3*
dn	*R3*	*R3*	*R4*	*R4*
dn	*R4*	*R4*	*R5*	*R5*
dn	*R5*	*Rx4, R5*	*R6*	*R6*
dn	*R6*	*R5, R6*	*R7*	*R7*
dn	*R7*	*R6, R7*	*R8*	*R8*

Table 2: Ontogeny and notational equivalents for opisthonotal setae in Zerconidae.
See Table 1 for explanation of author subheadings, abbreviations, and double entries.

Instar	Lind. & Evans	Hirsch. Karg	Halas. Blasz.	Sellnick
lv	*JV1*	*V1*	*Vm1*	–
lv	*JV2*	*V2*	*Vm2*	–
dn	*JV3*	*V3*	*Vm3*	–
dn	*JV4*	*V7*	*Vl2*	–
lv	*JV5*	*Z5, V8*	*Z5*	*Z5*
dn	*ZV1*	*V5*	*Vi1*	–
lv	*ZV2*	*V6*	*Vi2*	–
dn	*ZV3*	–	*Vi3*	–
dn	*(ZV4)*	*UR*	*Vl1*	–

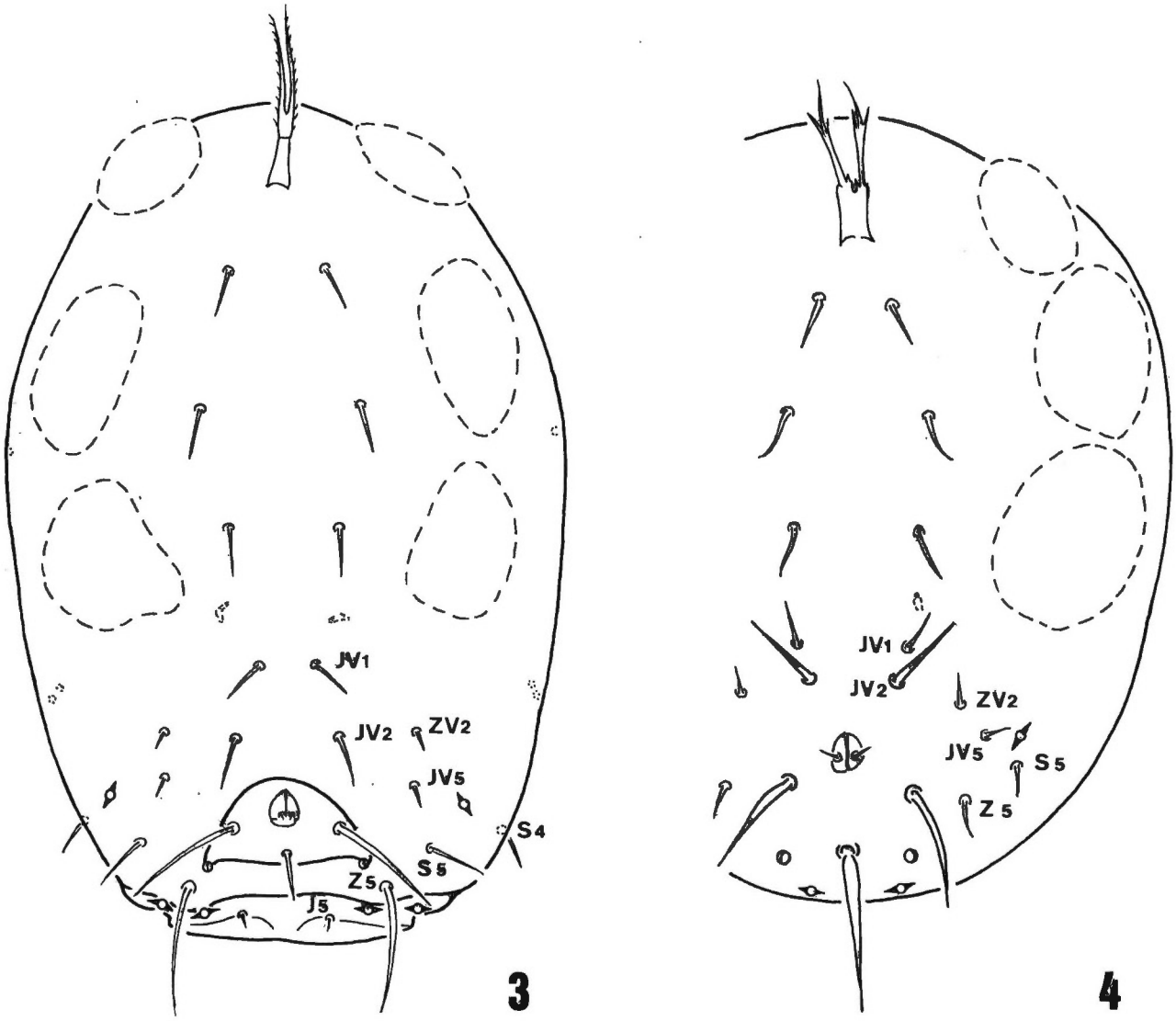
Table 3: Ontogeny and notational equivalents for opisthogastric setae in Zerconidae.
See Table 1 for explanation of author subheadings, abbreviations, and double entries.
Sellnick's system was not applicable to ventral setae. Parenthetical siglum follows modified notation of Lindquist (1994).



FIGS. 1-2: Idiosomal dorsum of larval Gamasina.

1. — Ascidae, *Lasioseius allii* Chant (redrawn and modified from LINDQUIST & EVANS, 1965). 2. — Zerconidae, *Zercon parivus* Moraza (redrawn and modified from MORAZA, 1991).

Protonymph. Five or six pairs of podonotal setae (*j2, s5, r2, r3, r5*, sometimes *z6*) are generally added to the larval complement in the protonymph of holotrichous Gamasina, which then has 15 or 16 pairs of podonotal setae (Fig. 5). Protonymphs retain a separate podonotal shield, but the breadth of this shield varies among families, such that the marginal setae may be off this shield or, as in the case of zerconid mites, on it (Fig. 6). The same complement of setae is added in the same relative positions in zerconids as in other holotrichous gamasine mites, so again we can confirm the homologies of these setae. Setae *r2* or *r3* are not shown in figures by some authors for protonymphs of some species of Zerconidae. As these setae are inserted on the edges of the podonotal shield, which may be curved ventrolaterally, they may have



FIGS. 3-4: Idiosomal venter of larval Gamasina.

3. — Ascidae, *Lasioseius allii* Chant (redrawn and modified from LINDQUIST & EVANS, 1965). 4. — Zerconidae, *Zercon parivus* Moraza (redrawn and modified from MORAZA, 1991).

been overlooked. The "humeral" pair of setae, *r3*, is in a somewhat more ventrolateral than dorsolateral position in zerconid protonymphs than in most other Gamasina, but its ontogenetic expression and position between setae *r2* and *r5* is otherwise typical.

Deutonymph and Adult. The number of podonotal setae on the deutonymph increases to the adult complement in holotrichous gamasine mites, with setae *z1* (when present), *z3, z6* (if not already added), *s1-s3, r1* (when present), *r4, r6* (when present) being added to the previous protonymphal complement. The deutonymph then generally has 21 to 23 pairs of podonotal setae. The deutonymphal podonotal shield remains separate in some families of Gamasina, including Zerconidae (Fig. 10), but it is partly or completely fused to the opisthonotal shield in others (Fig. 9). Again, the same complement of setae is added in the same relative positions in zerconid mites as in other holotrichous Gamasina, such that we can confirm the homologies of these setae as designated herein. Holotrichous zerconid mites generally have 21 to 23 pairs of podonotal setae, with only setae *r6* of the general chaetome of Gamasina consistently absent.

Setae *z1* are absent in many taxa of Zerconidae, including all members of the speciose genus *Zercon*

Koch and of 27 of the 35 other genera described (Table 4). When present, *z1* are generally small and inserted closely beside setae *j1-j2* on the anterolateral margins of the podonotal shield (Figs. 17B, 19A, 24). These margins may be curved ventrally, like a shell, in adults of some genera (*e.g.*, *Parazercon* Trägårdh, *Parhozercon* Błaszak, *Kaikiozercon* Halašková, *Skeironozercon* Halašková). In these cases, setae *z1* are tiny and somewhat ventrally displaced (Fig. 17B), and they have been considered to be an anteriormost pair of either "peritrematal" or lateral setae. Accordingly, with SELLNICK's system, they have been denoted either as *px* for *Parazercon* and *Parhozercon* (BŁASZAK 1979, 1981a), or as *s1* for *Parazercon* and *Skeironozercon* (HALAŠKOVÁ, 1977; BŁASZAK, 1982), or left undenoted in the case of *Kaikiozercon mamillosus* Halašková (HALAŠKOVÁ, 1979), with resultant uncertain homology. Setae *z1* were not noted in descriptions by PETROVA (1977b) and HALAŠKOVÁ (1979) for some species of *Parazercon* and *Kaikiozercon*, but they may have been overlooked. Setae *z1* are more exposed and obvious in *Aspar* Halašková (Fig. 24), in which they were denoted as *s1* (HALAŠKOVÁ, 1977). In members of the genus *Echinozercon* Błaszak, setae *z1* (denoted as *s1* by BŁASZAK, 1976, 1982) are unusual in being moderately long and located in a position similar to setae *z2* in other genera of Zerconidae (setae *z2*and *z3* are in turn displaced further posterolaterally in this genus) (Fig. 19A). Based on their position, setae denotable as *z1* are apparently present, closely laterad setae *j1*, in the monotypic genera *Syskenozercon* Athias-Henriot and *Halozercon* Wiśniewski *et al.* (the latter genus was transferred from Halolaelapidae to Zerconidae by MORAZA & LINDQUIST, in press). Except for the vertex, on which these two pairs of setae are inserted, the idiosomal dorsum of adults of these genera is strongly neotrichous, such that the homologies of other dorsal setae are obscure.

Application of HIRSCHMANN's system has not been clear for the pair of setae denoted by us as *z1* for Zerconidae. In their illustrated notation for Zerconidae, both HIRSCHMANN (1957, 1983) and KARG (1971, 1993) accounted for only 21 of the 23 pairs of podonotal setae known to occur among members of this family. Of the two pairs not accounted for, one is clearly *z1*, and the other is probably *z3* (only one seta, denoted by them as *s2*, was shown in the area usually occupied by the highly stable, ontogenetically larval setae *z2* and the less stable, ontogenetically deutonymphal setae *z3*). HIRSCHMANN (1983) alluded to an "extra" pair, *rx*, in the rhodacarid genus *Rhodacarus* which has 23 pairs of podonotal setae, but this was not noted for Zerconidae.

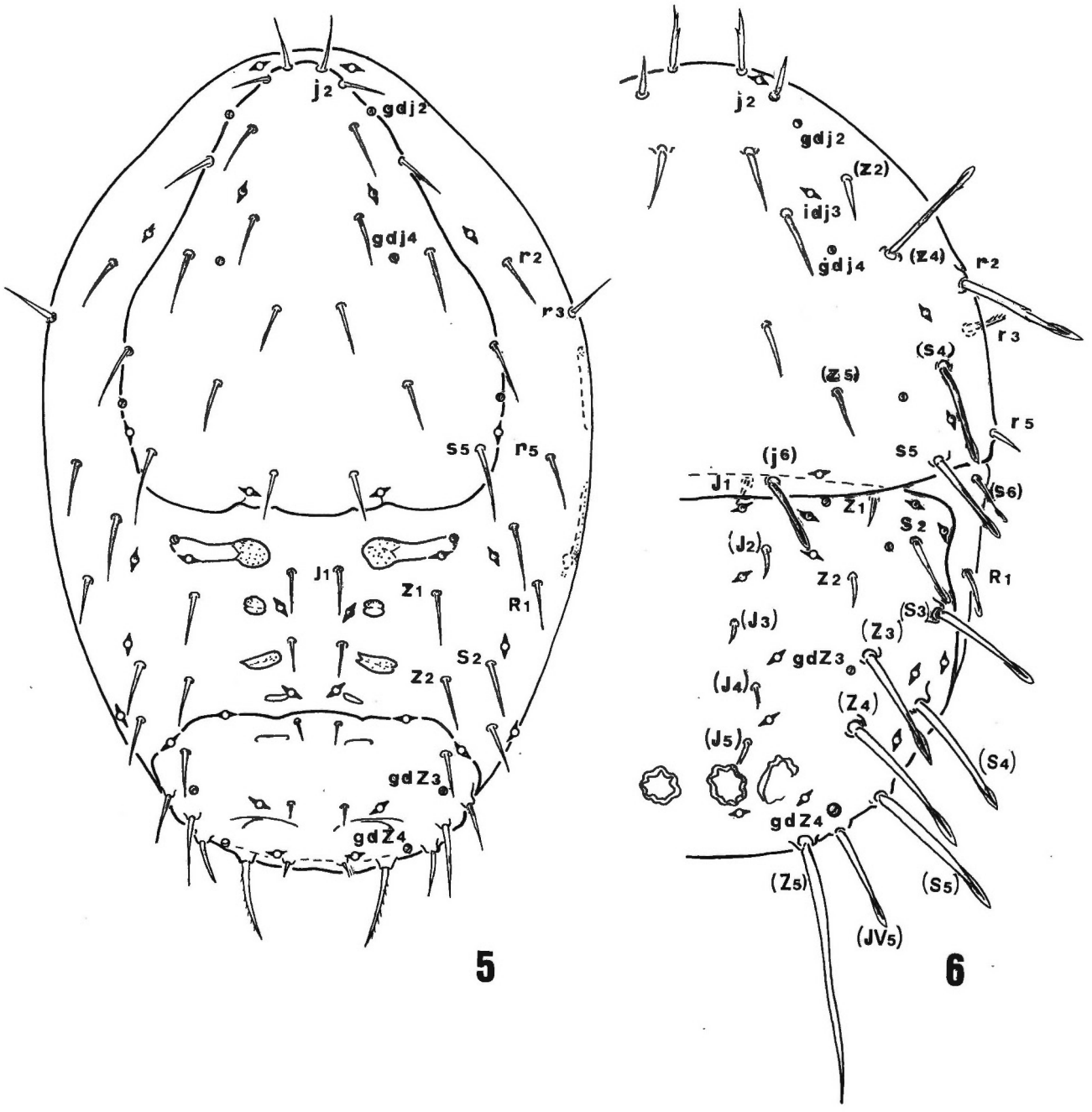
Setae *r1* are generally short, erect, and positioned laterad or ventrolaterad setae *z3*. They are inserted either on the peritrematal shields (Figs. 17B, 20B), or in the area of confluence of these shields with the podonotal shield (Figs. 14, 22), in adults of all known members of Zerconidae except the monotypic genus *Monozercon* Błaszak. Adults of this genus are unique, according to BŁASZAK (1984), in lacking *r1*, and they also lack setae *z1, z3* and *s2* along the anterolateral margins of the podonotal shield (Table 4). Because of their location, setae *r1* have been consistently denoted as "peritrematal" setae *p1* by various authors who have used SELLNICK's system of notation. They have been denoted as *r2* by authors following HIRSCHMANN's system, though KARG (1993) did not denote this pair of setae in any of his figures of Zerconidae.

Setae *r2* are inserted on the peritrematal shields of adults in a few genera (*e.g., Aspar* Halašková, *Parazercon* Trägårdh, *Parhozercon* Błaszak, *Skeironozercon* Halašková) (Figs. 17B, 24), but on the edge of the podonotal shield of those in others (Figs. 14, 18A, 22). As "peritrematal" setae, they were denoted as *p3* by SELLNICK (1958), followed by BŁASZAK (1976), but as *p2* by HALAŠKOVÁ (1977). As marginal setae, the same pair was denoted as *r2* by SELLNICK (1958), followed by KOSIR (1974), but as *r3* by HALAŠKOVÁ (1963, other papers), BŁASZAK (1974, other papers) and PETROVA (1977b, 1978). All of these authors were using SELLNICK's system of notation, but they were implying four different homologies for the same pair of setae (Table 1). Marginal setae *r2-r5* are consistently present in deutonymphs and adults of Zerconidae, but their size and position with respect to the peritrematal shields varies considerably among taxa; it is important to account for and denote them before accounting for some of the adjacent setae. Setae *r2* are close to *r3*, but, as just noted, they may not be inserted as ventrolaterally as *r3*, and instead may be aligned marginally with setae *s2*.

The position of setae *z2*, an ontogenetically stable pair that is present in all known taxa of Zerconidae, is

Genus Name	Podonotal Setae		Opisthonotal Setae		Misc. Attributes
	Number	Absent	Absent	Oddities	
Aleksozercon Petrova 1978	22	z1			shell, fused d.sh.
Allozercon Blaszak 1984	22	z1			
Amerozercon Halaskova 1969	22	z1			
Aquilonozercon Halaskova 1979	22	z1		J5-Z4 aligned	shell
Aspar Halaskova 1977	**23**			J4-Z3-Z4 aligned	shell, r2=p3
Bakeras Blaszak 1984	22	z1			
Bledas Halaskova 1977	22	z1			
Carpathozercon Balan 1991	22	z1			longer perit.
Caurozercon Halaskova 1977	22	z1		duplex R's	shell
Cosmozercon Blaszak 1981a	22	z1			
Echinozercon Blaszak 1976a	**23**		± J2,J4	duplex R's	longer perit.
Eurozercon Halaskova 1979	22	z1			shell
Halozercon Wiśniewski et al. 1992	**>60**			neotrichy	shell, jugularia
Hypozercon Blaszak 1981b	22	z1			
Indozercon Blaszak 1978	22	z1			
Kaikiozercon Halaskova 1979	22-**23**	± z1?			shell
Koreozercon Halaskova 1979	22	z1			shell
Krantzas Blaszak 1981b	22	z1			
Lindquistas Blaszak 1981b	22	z1			
Macrozercon Blaszak 1976a	22	z1			
Mesozercon Blaszak 1976a	22	z1			shell
Metazercon Blaszak 1976a	22	z1			wee perit.
Microzercon Blaszak 1976a	22	z1			
Mixozercon Halaskova 1963	22	z1			
Monozercon Blaszak 1984	**19**	z1,z3,s2,r1	Z2		wee perit.
Neozercon Petrova 1977b	22	z1			
Paleozercon Blaszak et al. 1995 [fossil]	22	z1			
Parazercon Tragardh 1943	22-**23**	± **z6**	± J5		shell, r2=p3
Parhozercon Blaszak 1981a	**23**		J5		shell, r2=p3
Polonozercon Blaszak 1979	22	z1			
Prozercon Sellnick 1943	22	z1			shell
Prozercon (Plumatozercon) Balan 1992	22	z1			
Rafas Blaszak 1979	22	z1			jugularia
Skeironozercon Halaskova 1977	**23**		J2		wee perit., r2=p3
Syskenozercon Athias-Henriot 1976	**>50**			neotrichy	jugularia
Xenozercon Blaszak 1976b	22	z1			
Zercon (Zerconella) Willmann 1953	22	z1	J5		
Zercon (Icozercon) Blaszak 1979	22	z1, ± z3			
Zercon (Isozercon) Karg 1993	22	z1			
Zercon Koch 1841	21-22	z1, ± s1			

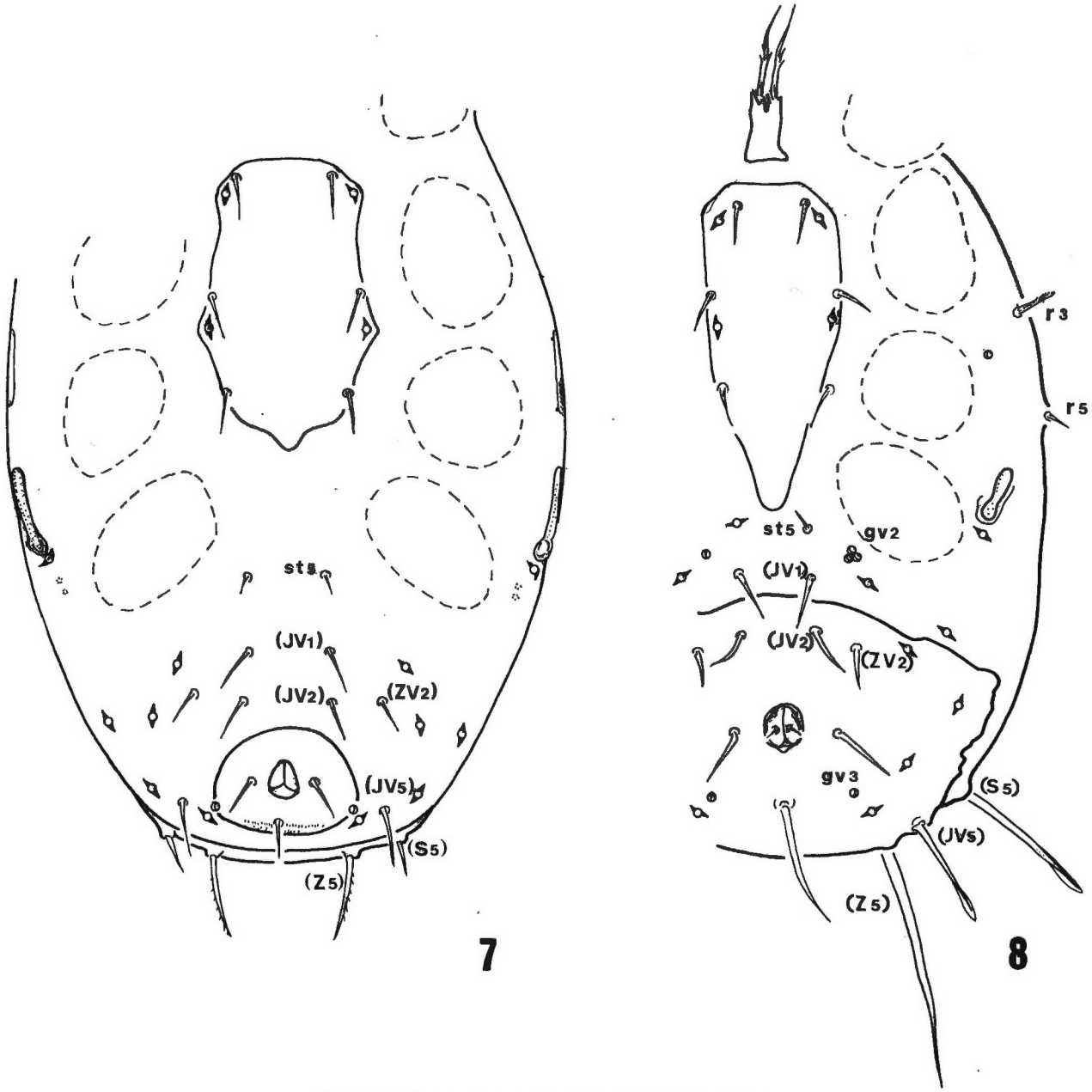
TABLE 4: Dorsal idiosomal setae and miscellaneous attributes of genera (and subgenera) of Zerconidae.
Infrequent numbers of setae indicated in boldface; ± indicates presence or absence. "Oddities" of opisthonotal setae indicate distinctive character states of some genera; "duplex R's" refers to individually duplicate marginal setae. Abbreviations and word meanings under column, Miscellaneous Attributes: fused d.sh., podonotal and opisthonotal shields united; jugularia, separate sternal platelets with sternal setae 1and poroids 1; longer perit., peritremes extending at least to midlevel of coxae II; shell, podonotal shield carapace-like, extended anteroventrally and lateroventrally; wee perit., peritremes abbreviated, not reaching beyond posterior margin of coxae III; r2=p3, setae *r2* inserted so as to appear like 3rd pair of peritrematal setae. See text for further explanation.



FIGS. 5-6: Idiosomal dorsum of protonymphal Gamasina.

5. — Ascidae, *Lasioseius allii* Chant (redrawn and modified from LINDQUIST & EVANS 1965). 6. — Zerconidae, *Zercon parivus* Moraza (redrawn and modified from MORAZA 1991). Labeled setae without parentheses are those first expressed in protonymphal instar.

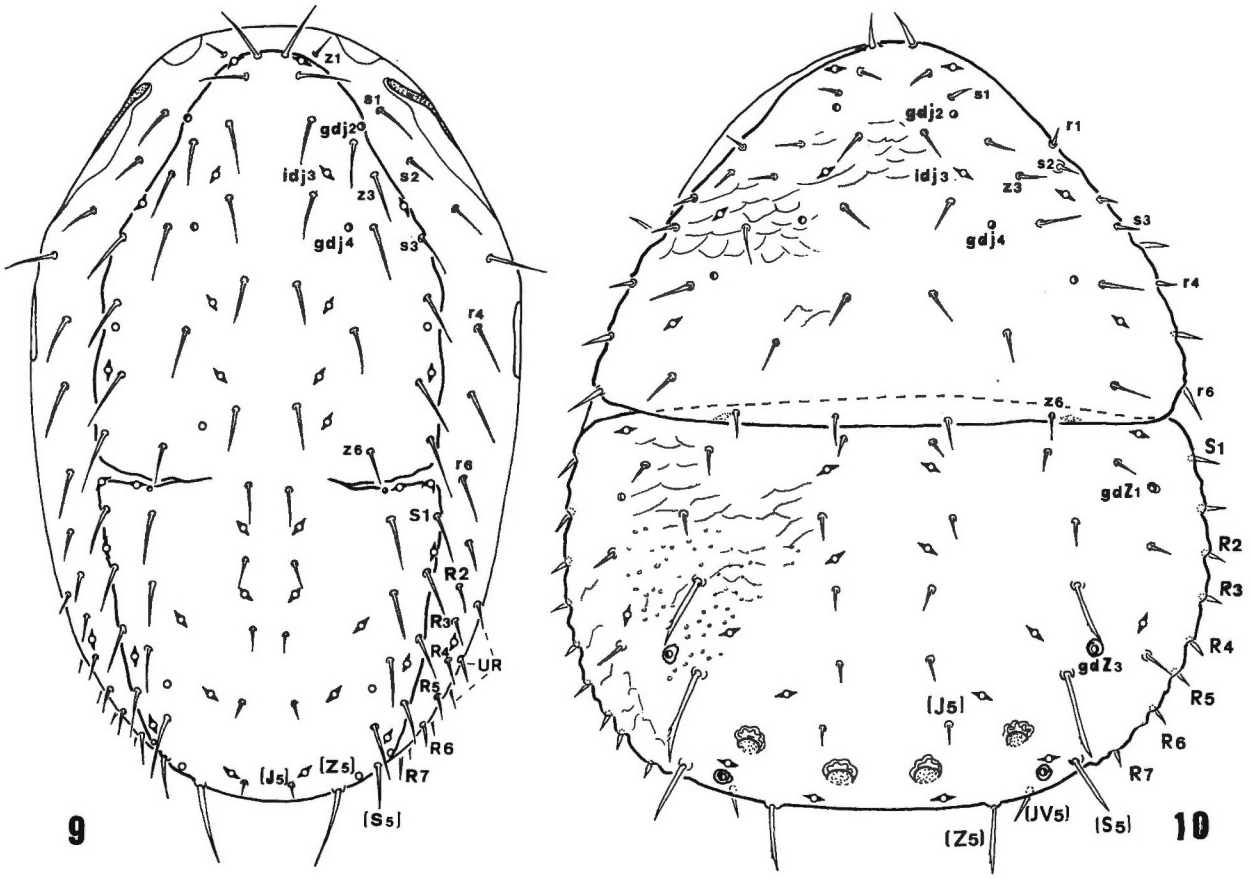
also important to determine before accounting for some adjacent setae. In larvae and protonymphs of Zerconidae, as in other families of Gamasina, this is the first pair of setae encountered posterolaterad gland pores *gdj2* (Fig. 6). That position is maintained in zerconid deutonymphs and adults, in which *z2* are often inserted marginally, laterad oblique alignment between gland pores *gdj2* (prominent structures, denoted as pores *po1* in papers by HALAŠKOVÁ and BŁASZAK) and poroids *idj3* (Figs. 10, 14, 18A). Setae *z2* are denoted as *s2* in the systems of both SELLNICK and HIRSCHMANN (Table 1); however, they were deno-



FIGS. 7-8: Idiosomal venter of protonymphal Gamasina.

7. — Ascidae, *Lasioseius allii* Chant (redrawn and modified from LINDQUIST & EVANS, 1965). 8. — Zerconidae, *Zercon parivus* Moraza (redrawn and modified from MORAZA, 1991). Labeled setae without parentheses are those first expressed in protonymphal instar.

ted as *s1* by BŁASZAK (1976), using SELLNICK's system in description of *Echinozercon orientalis* Błaszak. Setae *z3* are next in line posterolaterad *z2*, where they are nearly transversely aligned with *r1* (Figs. 14, 22). Sometimes they are fully marginal in position, and lie just above *r1*, when the lateral margins of the podonotal shield are curved ventrally, somewhat like a shell (Figs. 17B, 18A, 20A). Authors using either of the systems of SELLNICK or HIRSCHMANN for zerconid mites generally have denoted these setae as *s3*. In many genera of Zerconidae, however, *z3* are larger and more marginal and erect in appearance than *z2* (Fig. 18A), and they have been denoted as *r1*, instead of *s3*, by some of the same authors using the same

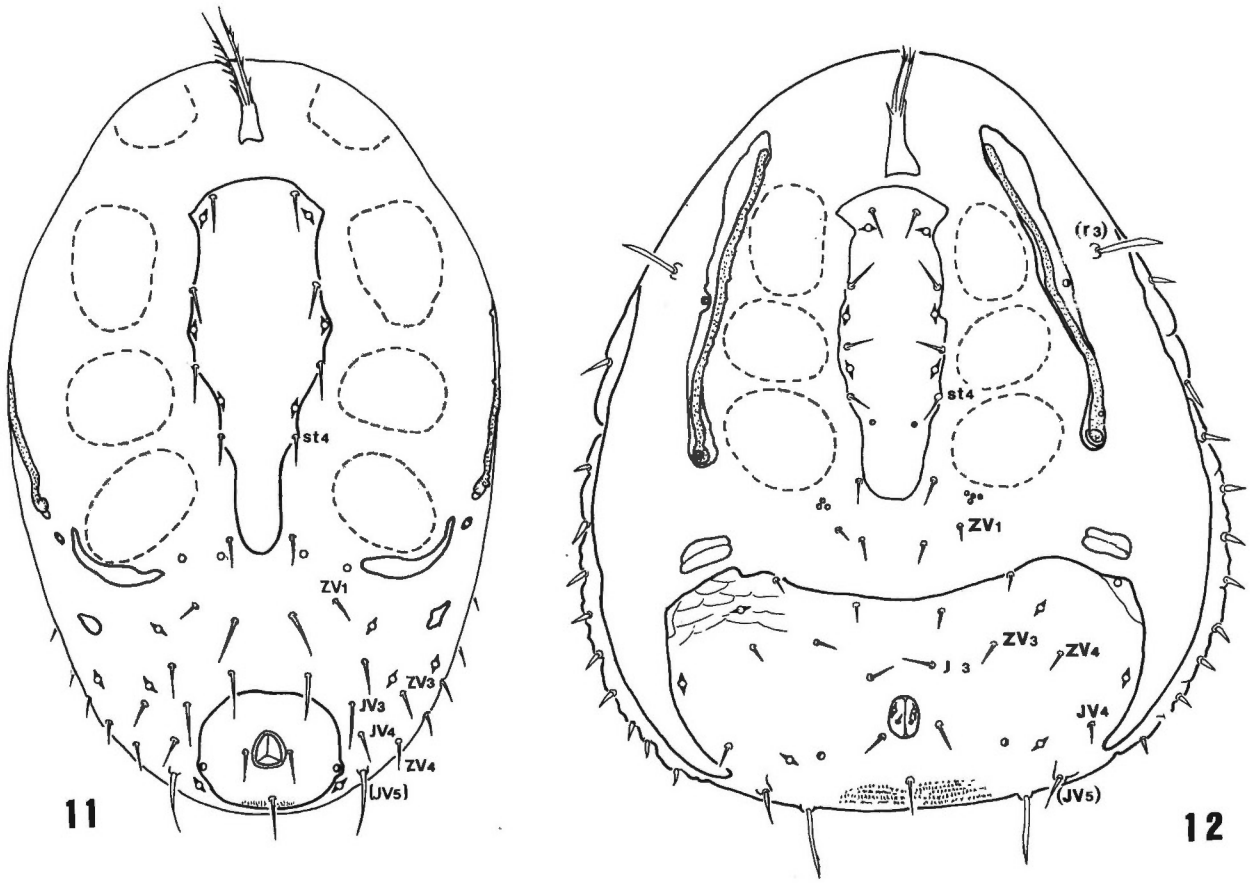


FIGS. 9-10: Idiosomal dorsum of deutonymphal Gamasina.

9. — Ascidae, *Lasioseius allii* Chant (redrawn and modified from LINDQUIST & EVANS, 1965). 10. — Zerconidae, *Zercon* sp. Labeled setae without parentheses are those first expressed in deutonymphal instar.

notational system of SELLNICK (*e.g.*, HALAŠKOVÁ, 1963 and other papers, BŁASZAK, 1974, 1981b and other papers); such notational inconsistencies have obscured the homology of this pair of setae (Table 1).

Setae *z4* constitute another ontogenetically stable pair that is present in all known taxa of Zerconidae; their position, like that of *z2*, is also important to determine before accounting for some other adjacent setae. In larvae and protonymphs of Zerconidae, as in other families of Gamasina, these setae are located laterad gland pores *gdj4* (Fig. 6). That position is maintained in zerconid deutonymphs and adults, in which gland pores *gdj4* are often prominent structures (denoted as pores *po2* in papers by HALAŠKOVÁ and BŁASZAK) (Figs. 10, 14, 18A). The pair of setae denoted by us as *z4* should be denoted as *s4* by authors using SELLNICK's system of notation. But, whenever the preceding pair *z3* have been denoted by some of these authors as *r1* instead of *s3*, as noted above, then in turn pair *z4* has been denoted as *s3* instead of *s4*, again obscuring setal homologies (Table 1). A similar, "domino effect" discrepancy in notation has occured for the lateral setae that we denote as *s4* and *s5*. These setae should be denoted as *s5* and *s6*, respectively, by the various authors who have followed the systems of SELLNICK or HIRSCHMANN. However, BŁASZAK (1974, 1981b and other papers) denoted these pairs as *s4* and *s5*, respectively, in genera such as *Prozercon* and *Krantzas*, but as *s5* and *s6* in others such as *Parazercon* and *Zercon*. Among the same authors who have used SELLNICK's system, the "domino effect" discrepancy has followed with other of the lateral *s-* and marginal *r-* setae, depending on how many of these are in a marginal position, such that our *s3* has been denoted as either *r3* or *r4*, our *r4* as *r4* or *r5*, our *r5* as *r5* or *r6*, and our *s6* as *r6* or *r7* (Table 1). The SELLNICK system of notation itself should not be blamed for these incon-



FIGS. 11-12: Idiosomal venter of deutonymphal Gamasina.

11. — Ascidae, *Lasioseius allii* Chant (redrawn and modified from LINDQUIST & EVANS, 1965). 12. — Zerconidae, *Zercon* sp. Labeled setae are those first expressed in deutonymphal instar.

sistencies, as it can be as readily and consistently used to homologize setae and assign appropriate sigla as the modified systems of either HIRSCHMANN or LINDQUIST & EVANS.

Setae denoted *s3* by us in Zerconidae are nearly transversely aligned with *r3*, as in many other Gamasina. However, on zerconid mites *s3* are strikingly marginal in position, often nearly directly above *r3*, where they sometimes assume a perpendicular, "humeral" aspect in place of the so-called "humeral setae", *r3*, themselves. Setae *s6* occupy the posterolateral corners of the podonotal shield on zerconid mites, much as in early-derivative members of Rhodacaridae.

ONTOGENY OF OPISTHONOTAL SETAE. *Larva.* The idiosoma of holotrichous larval gamasine mites generally has 10 pairs of opisthonotal setae (*J2-J5, Z3-Z5, S3-S5*), a variable number of which may be on a pygidial shield, depending on its size. Fig. 1 shows a typical configuration of these setae relative to the pygidial shield in the Ascidae. According to our observations and those of KARG (1962, 1965), in some families (*e.g.*, Veigaiidae) this complement of setae is present but the pygidial shield is absent; in others (*e.g.*, Ameroseiidae, some Phytoseiidae) some of these setae are vestigial or absent and the pygidial shield is absent. Due to the posteroventral curvature, or "caudal bend" of the opisthosoma (SITNIKOVA, 1978; LINDQUIST, 1984), the caudalmost pair of each of the *J, Z* and *S* series is located caudoventrally, with *Z5* and *S5* on soft cuticle flanking the circumanal setae and *J5* on the posterior margin of the pygidial shield (when present), just behind the circumanal setae (Fig. 3). The larvae of a variety of zerconid mites have the same complement of setae in the same

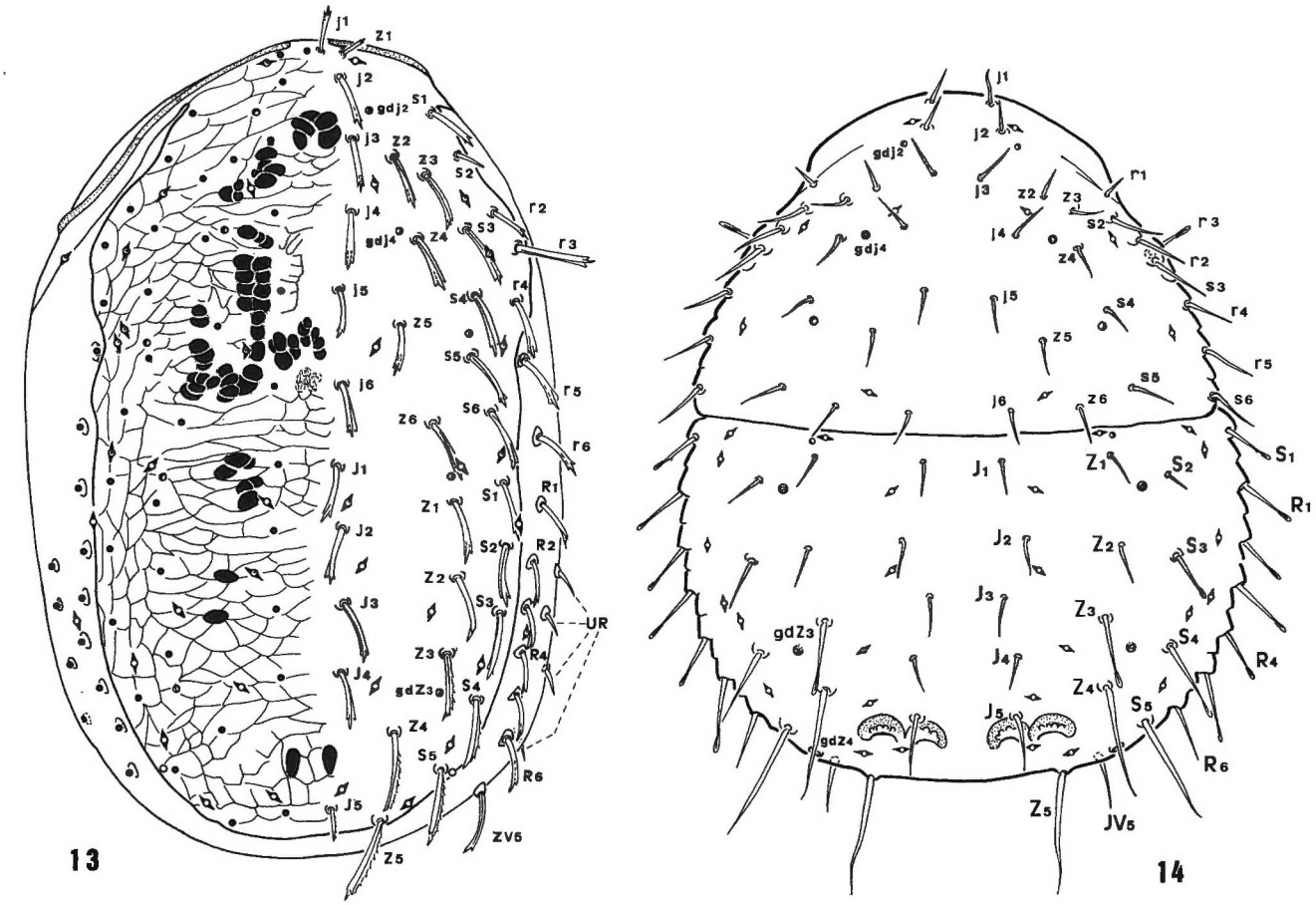


FIG. 13: Idiosomal dorsum of adult female Ascidae, *Lasioseius corticeus* Lindquist (redrawn and modified from LINDQUIST 1971).
FIG. 14: Idiosomal dorsum of adult female Zerconidae, *Zercon parivus* Moraza (redrawn and modified from MORAZA 1991).

position as in those of other Gamasina, though the pygidial shield is sufficiently expanded laterally so as to capture setae *S4* (denoted as *S3* by KARG, 1965), and in a few cases anteriorly, so as to capture setae *J3* and even *J2* (*e.g.*, *Prozercon kochi* Sellnick as illustrated by BŁASZAK, 1974). Thus, the homologies of these setae on larvae of Zerconidae are readily compared and confirmed with those on larvae of other holotrichous families of Gamasina (Figs. 1-4).

As noted below, setae *J2* are absent in postlarval instars of a few taxa of Zerconidae, including *Skeironozercon embersoni* Halašková and *Echinozercon orientalis* Błaszak. Setae *J4* are also absent in *E. orientalis*. Although larvae are not yet known for these taxa, the losses are probably larval setal deficiences, as these setae, when present, are usually part of the larval complement. Setae *J5* are absent in postlarval instars of *Parazercon radiatus* (Berlese). These setae are also elements of the normal larval complement, and we have confirmed their absence in the larva of this species. Setae *J5* are also apparently absent in *Zercon (Zerconella) leitnerae* Sellnick, according to the description and illustration of SELLNICK (1958).

Protonymph. Five pairs of opisthonotal setae (*J1, Z1, Z2, S2, R1*) are generally added to the larval complement in protonymphs of holotrichous Gamasina, which then have 15 pairs of opisthonotal setae (Fig. 5). A variable number of these setae may be on the pygidial shield which, if present, is more variable in size than in the larva. The relative size of this shield and the number of setae borne on it were used as diagnostic attributes in the superfamilial classification of KARG (1965, 1993). The pygidial shield of protonymphs remains separate from the podonotal shield, but it may be expanded enough to coalesce

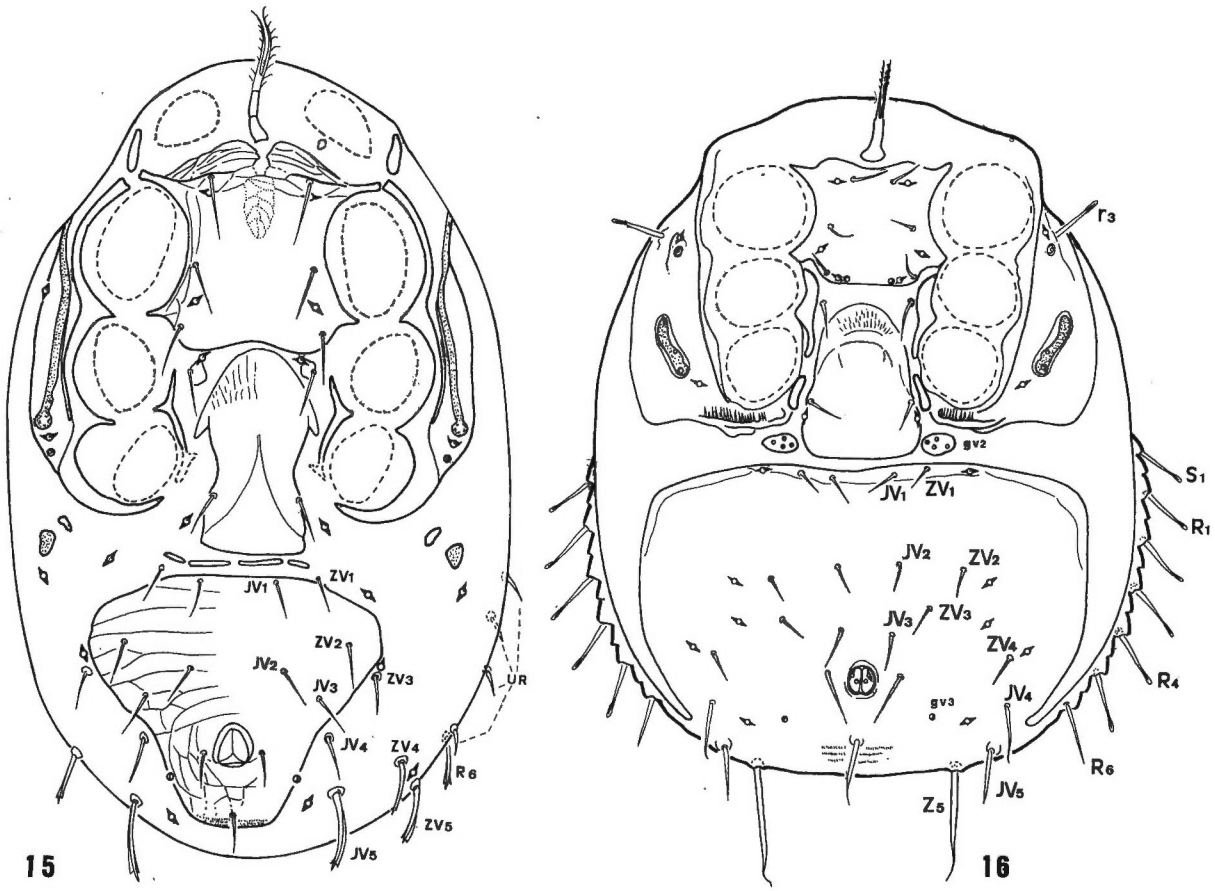


FIG. 15: Idiosomal venter of adult female Ascidae, *Lasioseius corticeus* Lindquist (redrawn and modified from LINDQUIST, 1971).
FIG. 16: Idiosomal venter of adult female Zerconidae, *Zercon parivus* Moraza (redrawn and modified from MORAZA, 1991).

with some or all of the mesonotal platelets and thus be more appropriately termed an opisthonotal shield. As noted by KARG (1965), protonymphs of Zerconidae are extreme in the direction of enlargement of the pygidial shield, such that it assumes the form of an opisthonotal shield and bears 14 to 16 pairs of setae, including *J2-J5, Z1-Z5, S2-S5*, and sometimes *J1* and the single pair of marginal setae present, *R1* (Fig. 6). Apart from the size of the opisthonotal shield, the same complement of setae is added in the same relative positions in zerconid mites as in other holotrichous gamasine mites, enabling us to confirm the homologies of these setae readily, except for either one of two pairs of setae identifiable as an apparent 16th pair of opisthonotal setae. One of the pairs in question was denoted as *Zx* by HIRSCHMANN (1957, 1959, 1983), and as *Ix* (or *Jx*) by KARG (1965, 1993), despite the fact that this pair was originally designated as *J4* by SELLNICK (1944, 1958) when he initiated his system of notation for Zerconidae (Table 2). The other pair in question was designated as *J6* by SELLNICK (1944, 1958), but recognition of a "*J6*" appeared anomalous to HIRSCHMANN (1957) and KARG (1965), who recognized 5 pairs of setae in each of the *J, Z* and *S* series in holotrichous gamasine mites. They opted to denote this pair as *I5* (or *J5*), and to recognize instead an "extra" pair between the setae that they denoted as *J3* and *J4* on zerconid mites.

We question the accuracy of the designation *Jx* (or its equivalent *Ix* or *Zx*), or of any alternative recognition of six pairs of *J*-setae (*e.g.*, designation of *J1-J6* by SELLNICK, 1944, 1958), for three reasons. First, among mites of all other families of free-living, holotrichous gamasine mites with which we are familiar, a single pair of extra or accessory setae does not appear during ontogeny at the protonymphal stage; *i.e.*, only ontogenetically fundamental setae are present. Second, if one accounts for *all* opisthosomal setae

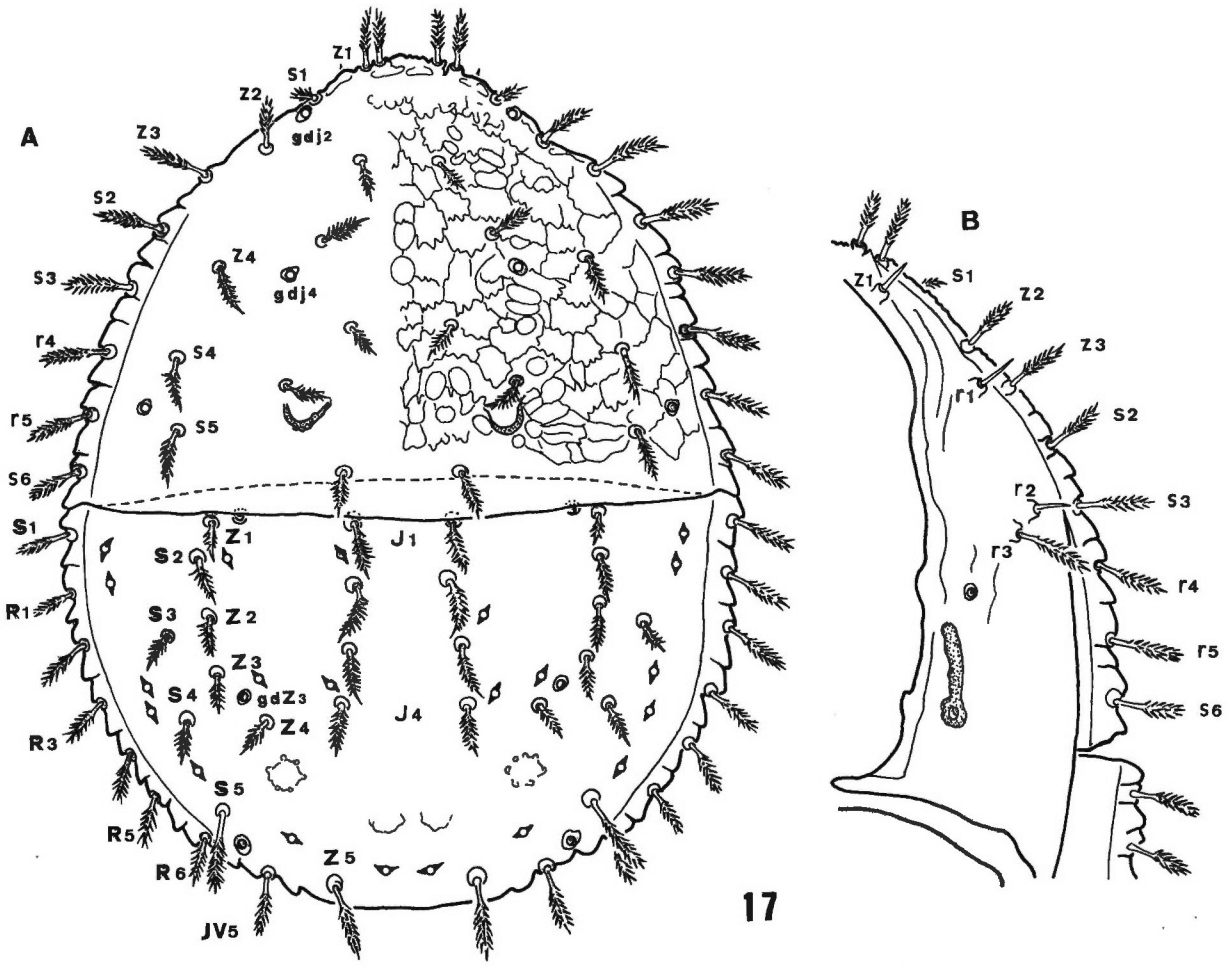


FIG. 17: Idiosomal dorsum, A, and peritrematal shield, B, of adult female *Parazercon radiatus* (Berlese), showing variation in position of setae between genera of Zerconidae (compare with Figs. 14, 18, 19, 20, 22, 24) (redrawn and modified from HALAŠKOVÁ1977).

present both dorsally *and* ventrally, then zerconid protonymphs have the same number that is present in holotrichous protonymphs of other families—20 pairs, excluding the genital pair *st5*, the euanal pair and the unpaired postanal seta (Figs. 5-8). Third, based on the previous two points, it is highly improbable that one of the relatively stable pairs of setae, which is typical of gamasine protonymphs and is amidst a series of setae already present in the larval instar, would be suppressed as a postlarval deficiency (*sensu* LINDQUIST, 1965), and that another pair of setae, which is not typical of gamasine protonymphs, would abruptly appear in the protonymphal stage in Zerconidae. Such an alternative is neither logical nor morphologically parsimonious. Therefore, an accounting for the opisthosomal setae on the *ventral* surface may lead to a re-evaluation of the homologies of setae on the dorsal surface.

As noted by KARG (1965), LINDQUIST & EVANS (1965) and other authors, the number of opisthogastric setae, apart from the genital pair *st5*, does not increase from the holotrichous larva to the holotrichous protonymph among the families of Gamasina. However, the caudal bend of the larva disappears in the protonymph, such that setae *J5, Z5, S5* assume a dorsocaudal, instead of a ventrocaudal, position and setae *JV5* assume a ventrocaudal position in place of where *Z5* are inserted in the larva (compare Figs. 3 and 7, 4 and 8). Zerconid protonymphs are as distinctive in the extent of their opisthogastric shielding as they are of their opisthonotal shielding. As a result, all but one pair (*JV1*) of the 6 pairs of opisthogastric setae are on a ventrianal shield. Equally notable and unusual, this ventrianal shield is broadly coalesced

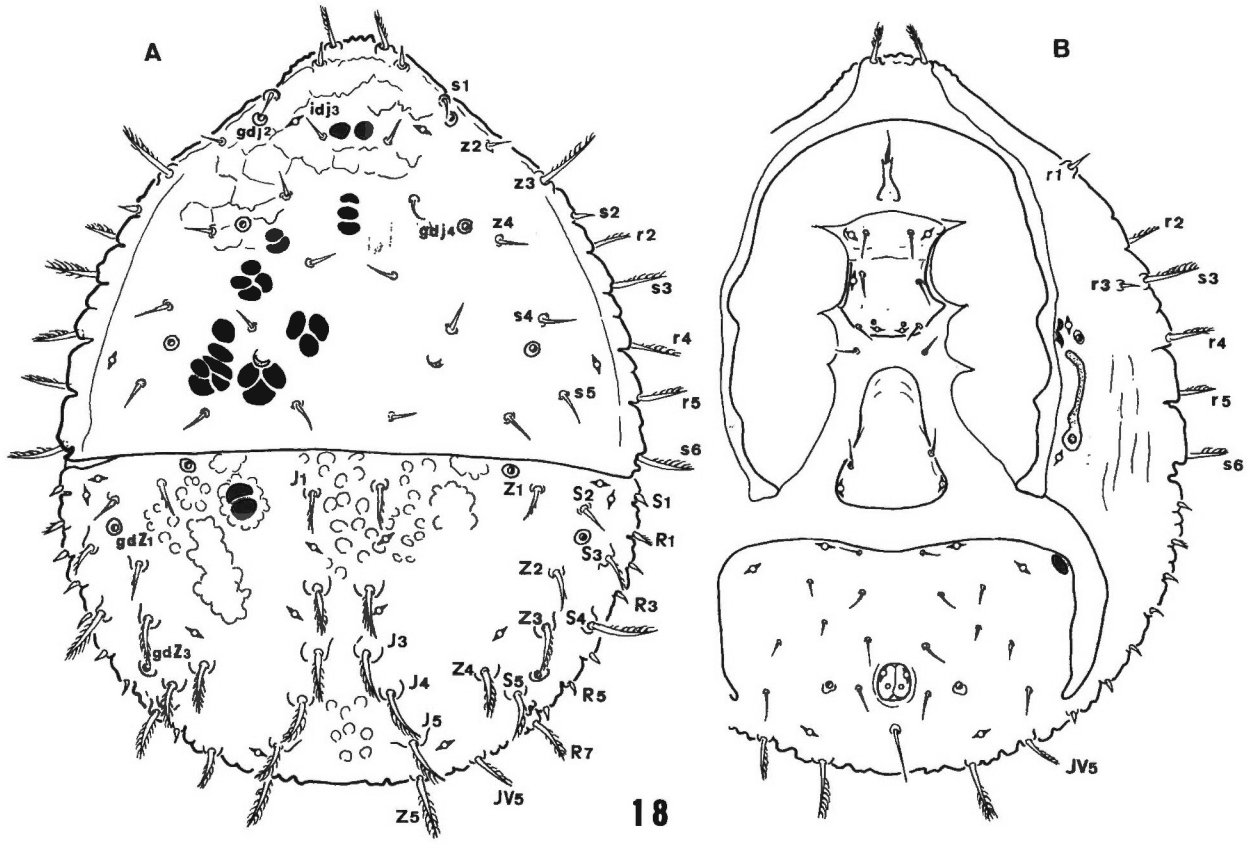


FIG. 18: Idiosomal dorsum, A, and idiosomal venter, B, of adult female *Prozercon juanensis* Moraza, showing variation in position of setae between genera of Zerconidae (compare with Figs. 14, 17, 19, 20, 22, 24) (redrawn and modified from MORAZA, 1988).

caudally with the opisthonotal shield, such that delineation of the posterior margins of these shields is effaced (Figs. 6, 8). Setae *JV5* occupy a nearly marginal position posterolaterad gland pores *gv3* and poroids *ip* (Fig. 8). Setae *JV5* are thus in a somewhat more caudal position in protonymphs of Zerconidae than in those of most other Gamasina, but their ontogenetic expression and position relative to adjacent setae are otherwise typical.

In view of the above characteristics in number, position and ontogeny of opisthosomal setae among the larvae and protonymphs of Zerconidae, the homologies of these setae are clear and their sigla are modified as follows (Table 2). The pair of *J*-setae previously denoted by HIRSCHMANN (1957) and KARG (1965) as "extra" *Zx* or *Jx* is *J4*, and the pair previously denoted by them as *J4* is *J5*, as originally recognized by SELLNICK (1944, 1958). However, there is no need to recognize an anomalous sixth pair of *J*-setae, as the pair denoted *J6* by Sellnick is actually *Z5*. In turn, the other pair of setae on the caudolateral margin, denoted *Z5* by Sellnick and subsequent authors, is *JV5*. The homologies and sigla of all other opisthonotal setae (*J1-J3, Z1-Z4, S2-S5, R1*) and opisthogastric setae (*JV1, JV2, ZV2*) are the same as designated previously, and the entire normal, holotrichous setation of the protonymphal opisthosoma of the Gamasina is thus present and accounted for. Zerconid mites are remarkably conservative in retaining a holotrichous condition on the opisthonotum, though as noted above for the larvae, one or two pairs of setae in the *J*- series may be absent from the protonymphal complement of a few taxa, and these losses persist in their deutonymphs and adults.

Deutonymph and Adult. As with the podosoma, the number of setae on the deutonymphal opisthosoma increases to the adult complement in holotrichous gamasine mites (Figs. 9, 10). Setae *S1*, *R2-R7* and, if present, a variable number of submarginal (*UR*) setae are added dorsally and laterally, and setae *JV3, JV4, ZV1, ZV3, ZV4* and, if present, *ZV5, SV2* are added ventrally to the previous larval-protonymphal com-

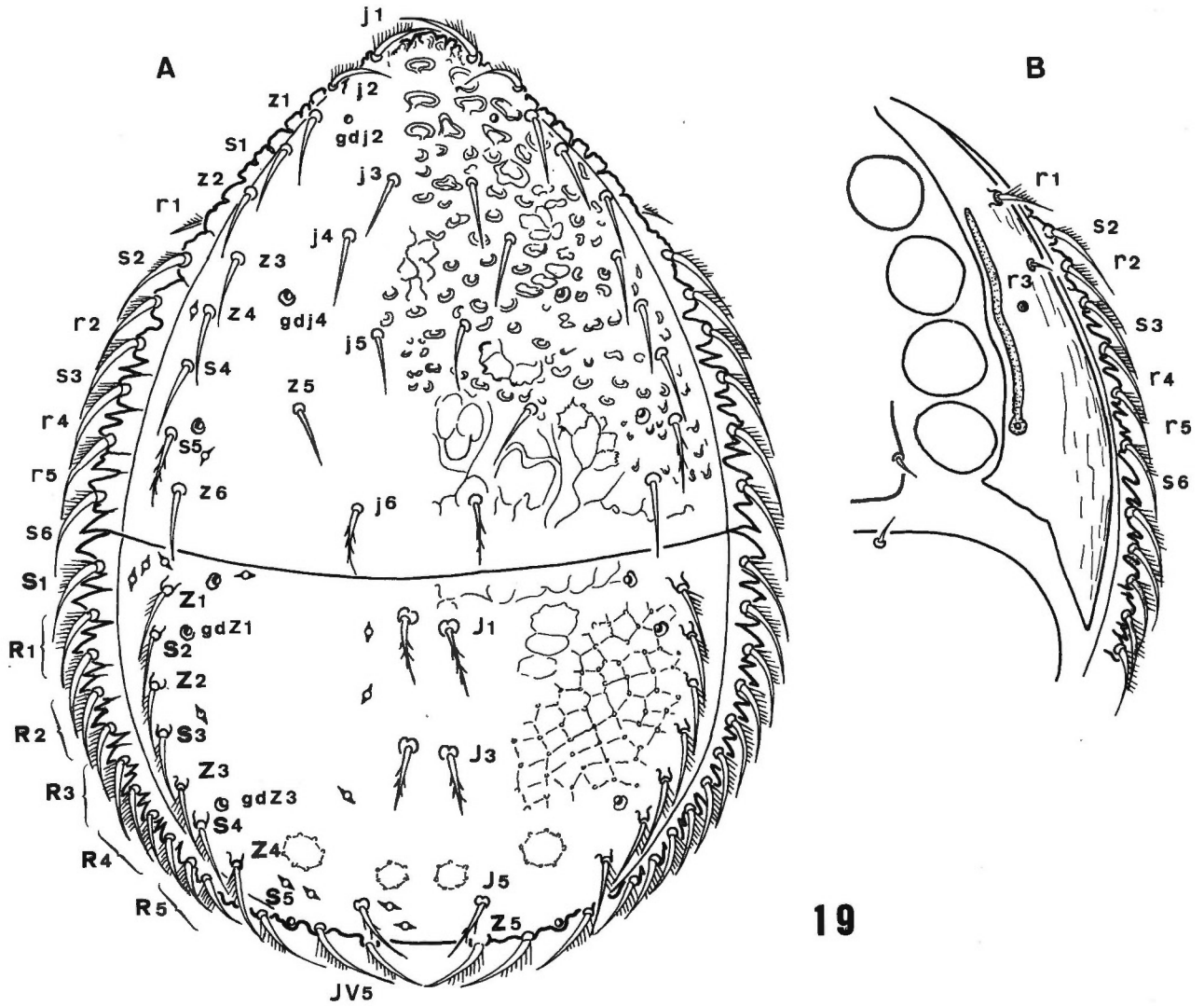


FIG. 19: Idiosomal dorsum, A, and peritrematal shield, B, of adult female *Echinozercon orientalis* Błaszak, showing variation in position of setae between genera of Zerconidae and duplication of opisthonotal marginal setae (compare with Figs. 14, 17, 18, 20, 22, 24) (redrawn and modified from BŁASZAK, 1976).

plement (LINDQUIST & EVANS 1965, LINDQUIST 1994). Deutonymphal dorsal and ventral shielding varies greatly among families of Gamasina. Dorsally, there is usually a well developed opisthonotal shield, which may be separate from or united to the podonotal shield; the opisthonotal shield is usually less expansive laterally than in adults, such that the *R*-marginal series of setae usually remains on soft cuticle flanking it. Ventrally, there is either an anal or an expanded ventrianal shield, which is usually separate caudally from the opisthonotal shield. As in the case of their protonymphs, the deutonymphs of Zerconidae are extreme in the extent of enlargement of their opisthosomal shields. The opisthonotal shield bears all 21 or 22 pairs of holotrichous dorsal setae present, including *J1-J5, Z1-Z5, S1-S5*, and 6 or 7 pairs of *R*-setae; it also superficially bears the somewhat dorsocaudally displaced ventral pair, *JV5*, as in the protonymph (Fig. 10). Careful observations show, however, that the insertions of setae *JV5* generally remain slightly more caudal and ventral than those of the neighboring setae *Z5*, *S5*, and *R6* or *R7*. Although the ventrianal shield in zerconid deutonymphs is not so expansive as to capture the metapodal plates as in adults, it nevertheless captures all opisthogastric setae present, other than *JV5*. In the holotrichous condition, these include *JV1-JV4, ZV1-ZV4,* and the circumanal setae (Fig. 12, Table 3) (setae *ZV5* appear

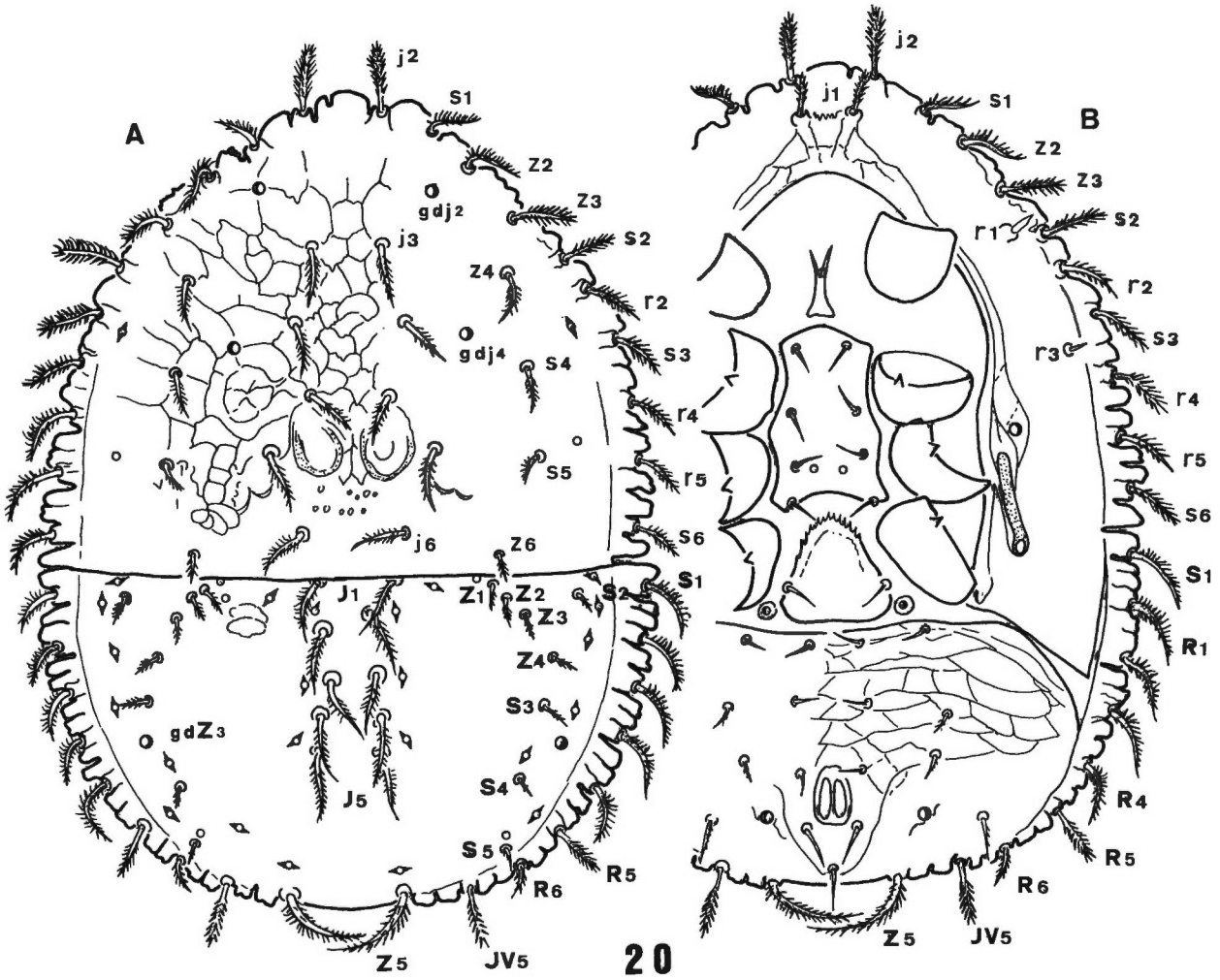
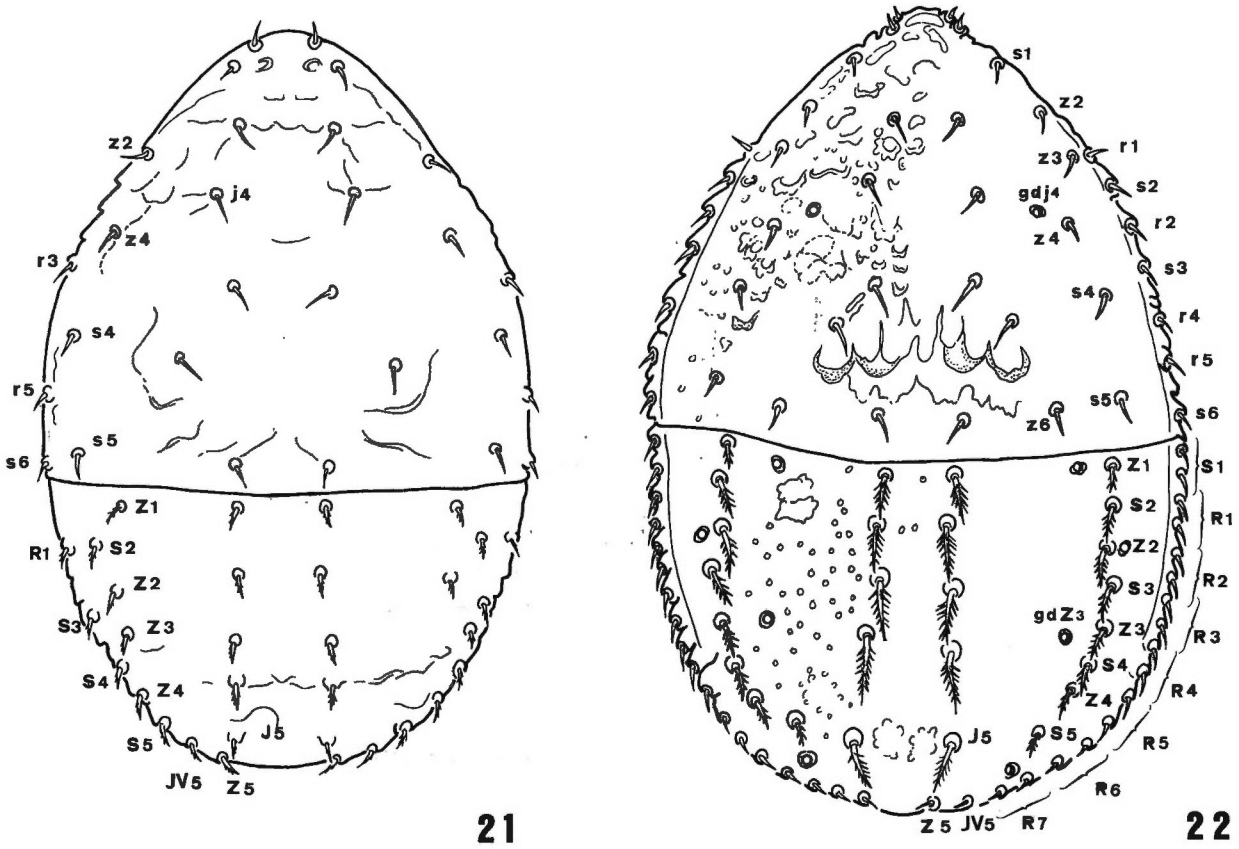


FIG. 20: Idiosomal dorsum, A, and idiosomal venter, B, of adult female *Mesozercon coreanus* Błaszak, showing variation in position of setae between genera of Zerconidae (compare with Figs. 14, 17, 18, 19, 22, 24) (redrawn and modified from HALAŠKOVÁ, 1979).

to be consistently absent in Zerconidae, unless they may be represented by the caudalmost pair of setae in a marginal position, which are denoted as *R7* herein). Apart from the sizes of the opisthosomal shields, the same complement of setae is added in the same relative positions in deutonymphs of Zerconidae as in those of other holotrichous Gamasina. This pattern enables us to confirm the homologies of these setae in deutonymphs and adults, as we have done with protonymphs, of this family with those of other Gamasina (Figs. 9-16).

The anomaly of having only 4 pairs of setae in the *S*-series, in contrast to 5 or 6 pairs in the *Z*- and *J*-series as originally designated by SELLNICK (1944, 1958) for zerconid mites, was resolved by HIRSCHMANN (1957) and KARG (1965), and confirmed by LINDQUIST & EVANS (1965). The anteriormost pair of the *S*-series is often in a more marginal position than other setae of this series in gamasine mites (HIRSCHMANN 1957, and our personal observations). In Zerconidae, pair *S1* is aligned with the marginal series and it was mistaken as *R1* by SELLNICK. This mistaken designation has been followed subsequently by most specialists working on Zerconidae (*e.g.*, BŁASZAK, HALAŠKOVÁ, PETROVA, KOSIR, BALAN—see references noted above). In turn, in some cases (*e.g.*, species of *Parazercon, Mixozercon*) setal pair *S2* is nearly aligned with, and may be mistaken for, an element of the mediolateral or *Z* series. In such cases, *S2* is the second seta in alignment, between *Z1* and *Z2* (Figs. 17A, 19A, 22, 24).

The positions of setae of the *Z*- and *S*- series vary



FIGS. 21-22: Idiosomal dorsum of *Caurozercon duplex* Halašková, showing ontogenetic changes in position of *Z*- and *S*- setae, and duplication of opisthonotal marginal setae (redrawn and modified from HALAŠKOVÁ, 1977). 21. — Protonymph. 22. — Adult female.

remarkably among adults of some taxa of Zerconidae. In some species of *Echinozercon* and *Caurozercon*, setae *Z1-Z4* are completely aligned and interdigitated longitudinally with *S2-S4*, and their sequence is *Z1-S2-Z2-S3-Z3-S4-Z4* (Figs. 19A, 22). In *Mesozercon*, setae *Z1-Z4* are crowded together in the anterior region of the opisthonotal shield, where they are widely separated from *Z5* (Fig. 20A); however, just which setal pair is *Z4*, in distinction to *S3* or *S4*, is problematical based on adults and deutonymphs of this genus. In *Aspar*, setae *Z3-Z4* are displaced posteromedially, in longitudinal alignment between *J4* and *J5* (Fig. 24). The homologies of the setae involved in such cases may be clarified by study of the protonymph and, sometimes, the deutonymph of the same species, or of adults of other species of the same genus in which the setal displacements are less extreme (compare Figs. 21 with 22, and 23 with 24).

DISCUSSION

Re-evaluation of idiosomal setal homologies and their notation based on the above findings offers some new perspectives on characteristics that are diagnostic for the Zerconidae as well as for the superfamily Zerconoidea, which includes Zerconidae and Coprozerconidae (MORAZA & LINDQUIST, in press). Instead of holotrichous members of this superfamily being characterized by having an extra pair of *J*-setae, the normally caudoventral opisthogastric setae *JV5* are displaced to a somewhat caudodorsal position so as to appear to be captured by the opisthonotal shield—an autapomorphy peculiar to this group. Other apomorphic attributes are correlated with this setal displacement in the Zerconidae in distinction to Coprozerconidae, *i.e.*, the coalescence

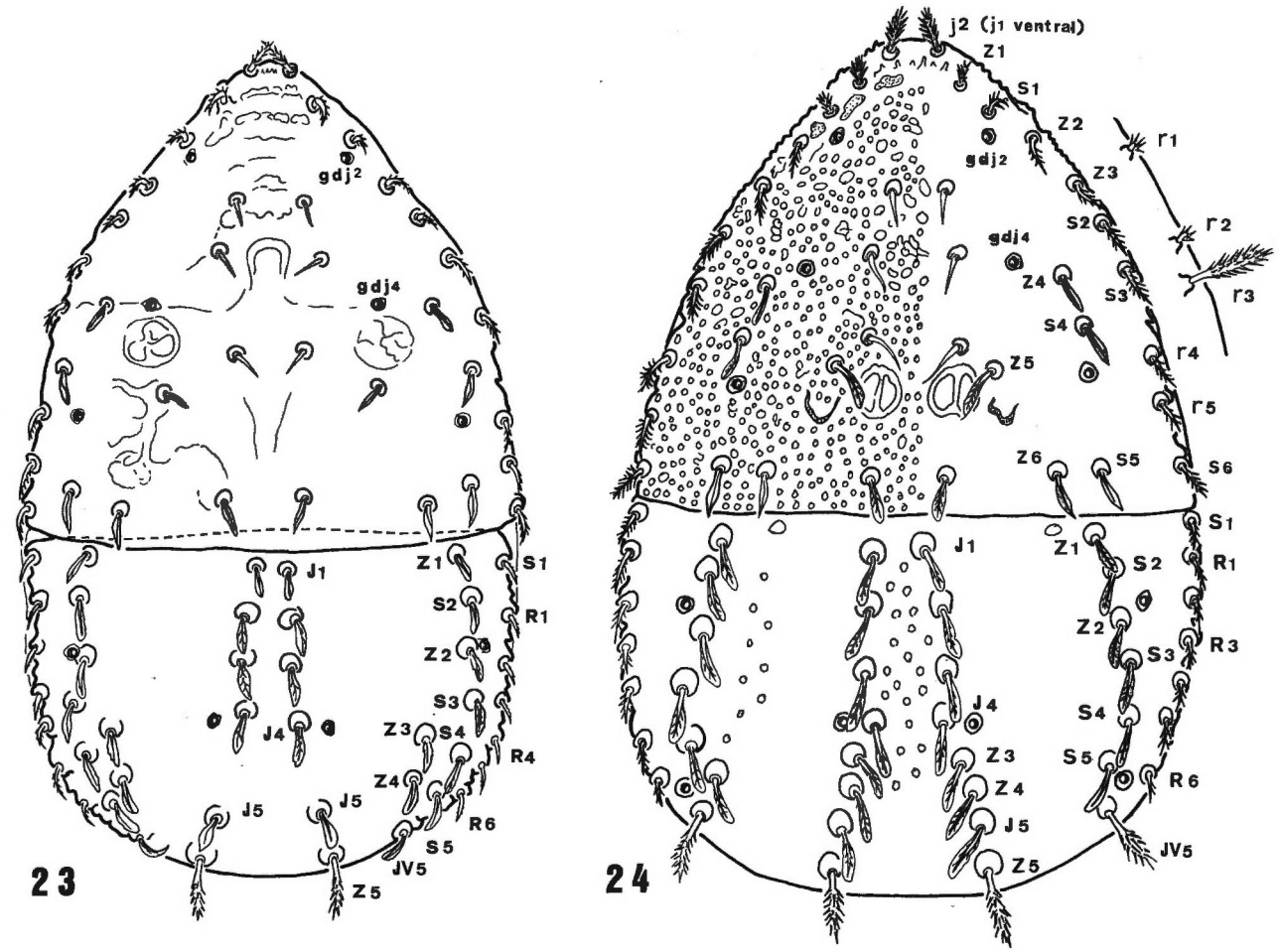
of the posterior margins of the opisthonotal and opisthogastric shields, and the somewhat anterior displacement and crowding of the posterior setae of the *J*-series, *J5*, such that they are usually nearly transversely aligned with setae *Z4* rather than being located well behind the latter. As setae *Z5* are inserted along with *JV5* on the caudal margin of the opisthosoma, both pairs often are included by authors in their figures of the ventrianal shield of adults, and *Z5* may be mistaken for a pair of opisthogastric setae unless they are correctly designated otherwise.

The revised homologies of opisthosomal setae for Zerconidae also are in accord with neighboring pore-like structures and dorsoventral muscle attachment sites (sigilla), which together with setae may be used to delimit "organogerous areas" ("territoires organogères") *sensu* ATHIAS-HENRIOT (1975). For example, in Zerconidae, the setal pair re-designated *J4* is in approximate oblique alignment with poroids *idZ3* (*idm4* of ATHIAS-HENRIOT) and the fourth opisthonotal sigilla (*sa XII* of ATHIAS-HENRIOT); these structures constitute elements of the fourth paraxial, opisthonotal, organogerous area (C12 of ATHIAS-HENRIOT), as in other families of Gamasina. As another example, the positions of the two prominent pairs of gland pores, *gdZ3* near setae *Z3*, and *gdZ5* near setae *S5*, in Zerconidae also are in accord with the positions of these pores (denoted *gd8* and *gd9* by ATHIAS-HENRIOT, 1975) in other families of Gamasina where they are less prominent. These two sets of pores and setae can be seen in Zerconidae to be elements of the same two organogerous areas, denoted *M6* and *L7* by ATHIAS-HENRIOT (1975), as delineated by her for other families of Gamasina.

Setae *J5* of zerconid mites are usually situated just anterior to the transverse row of four, often sclerotized, fossae situated near the posterior margin on the opisthonotal shield. This location may appear to be discordant with their position *behind* the transverse row of four sigilla (the fifth set of opisthonotal sigilla, denoted *sa XIV* by ATHIAS-HENRIOT, 1975) that are near the posterior margin on the opisthonotal shield in other families of Gamasina. However, as noted by ATHIAS-HENRIOT (1970), dorsoventral idiosomal sigilla undergo a high degree of functional adjustment, such that there is considerable variation in their patterns among different families of Gamasina. Even in some Zerconidae, setae *J5* remain inserted slightly behind the row of fossae, as illustrated by PETROVA (1979) and confirmed by our observations for species of *Caurozercon*. Moreover, according to EVANS (1992), the inner surfaces of these fossae may be sites of additional dorsoventral muscles in Zerconidae, rather than sites of the fifth basic set of dorsoventral opisthosomal muscles normally associated with the posterior row of sigilla in other families.

Setal deficiencies. Although the holotrichous condition is prevalent among taxa of Zerconidae, there are some taxa whose deutonymphs and adults are characterized by a few setal losses (Table 4). These losses have often not been recognized or emphasized as apparent apomorphies in the diagnoses of taxa. On the podonotum, setae *z1* are present in a variety of apparently earlier derivative genera such as *Syskenozercon, Halozercon, Parazercon, Parhozercon, Aspar* and *Skeironozercon*, but they are absent in nearly all other genera including *Zercon*. Setae *s1* also are absent in some species of *Zercon*, and setae *r1* (these may possibly be *s1*), *s2* and *z3* are absent in the monotypic genus *Monozercon*. Setal pair *z6* is singularly absent in *Parazercon radiatus*. All of these cases of absences involve setae that first appear in the deutonymph. This is not surprising, as deutonymphal setae are known to be generally less stable than setae that are first expressed in the larva or protonymph among other families of Gamasina (LINDQUIST & EVANS, 1965). The consistent location of setae *r3* on the peritrematal shield of adults and the consistent retention of setae *r1* may be plesiomorphies for the family Zerconidae, though perhaps they are apomorphies for the superfamily Zerconoidea (MORAZA & LINDQUIST, in press).

On the opisthonotum, absences of setae are confined to the *J*- series and to one of the posteriormost pairs of the *R*-marginal series (Table 4). The absence of setae *J5* in *Parazercon radiatus* and the monotypic genus *Parhozercon* may be a synapomorphy between these taxa. Setal pair *Z2* is uniquely absent in the monotypic genus *Monozercon*. Setae *J2* are absent in the monotypic genus *Skeironozercon*, and both *J2* and *J4* are absent in *Echinozercon orientalis* (BŁASZAK, 1976), though they are present in other species described in that genus (BŁASZAK, 1982). As setae *R7*



FIGS. 23-24: Idiosomal dorsum of *Aspar anisotrichus* Halašková, showing ontogenetic changes in position of setae *Z3-Z4* (redrawn and modified from HALAŠKOVÁ 1977). 23. — Deutonymph. 24. — Adult female, with setae inserted on peritrematal shield shown to the side.

may or may not occur in various genera of Zerconidae, their presence or absence seems to be a homoplastic condition of little value in definition of genera.

Neotrichy. Clarification of idiosomal setal homologies among zerconid mites in this study has been based on holotrichous exemplars, *i.e.*, on species characterized by the presence of all, or nearly all, of the setae normally present in the Gamasina, a natural group to which this family belongs. In holotrichous exemplars, these setae are idionymous, *i.e.*, they can be individually recognized and denoted on the basis of homology. In a few taxa of Zerconidae, however, deutonymphs and adults are characterized by a greater or lesser degree of idiosomal neotrichy. In some cases all setae remain idionymous, with the additional setae usually restricted to the opisthonotal shield where they are interspersed with holotrichous elements of the *R*-series and sometimes the *S*-series. Species of *Caurozercon* Halašková and *Echinozercon* Błaszak, with symmetrically doubled numbers of setae along the margins of the opisthonotal shield of deutonymphs and adults, are cases in point (HALAŠKOVÁ, 1977; PETROVA, 1979; BŁASZAK, 1982) (Figs. 19A, 22); these are examples of oligotrichy or cosmiotrichy, as distinguished by GRANDJEAN (1965). In a few other cases neotrichy is more extensive, and additional setae are found on both the podonotal and opisthonotal shields; some setae are paired and others not, such that they are mostly adelonymous *sensu* VAN DER HAMMEN (1975). Species of *Syskenozercon* and *Halozercon* have extensive neotrichy on both shields; the setae are symmetrically multiple marginally but asymmetrical and haphazardly

arranged centrally and midlaterally (ATHIAS-HENRIOT, 1976; WIŠNIEWSKI *et al.*, 1992). These are examples of plethiotrichy *sensu* GRANDJEAN (1965), in which many of the setae show dissymmetry and variability in placement among individuals such that they can not be denoted meaningfully. In all cases published or otherwise known to us among zerconid mites, neotrichy is restricted to the podonotal and opisthonotal series of setae, and it does not involve the truly opisthogastric elements. Neotrichy may be evident to some extent laterally on the opisthogaster in *Syskenozercon*, *Halozercon* and *Caurozercon*, but this may be due to the fusion of the opisthonotal shield with the ventrianal shield, and to extension of the neotrichous *R*-marginal series onto that area. *Syskenozercon* and *Halozercon* are thought to be early derivative members of the family Zerconidae (ATHIAS-HENRIOT, 1976, MORAZA & LINDQUIST, in press). Whether neotrichy is an ancestral state of this family, however, is problematical in that this condition is not evident among other known members of the superfamily Zerconoidea (MORAZA & LINDQUIST, in press).

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