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The digitalization of Acarologia papers prior to 2000 was supported by Agropolis Fondation under the reference ID 1500-024 through the « Investissements d’avenir » programme (Labex Agro: ANR-10-LABX-0001-01)

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PARAPIRNODUS (ACARI: ORIBATIDA: SCHELORIBATIDAE) OF CANOPY HABITATS IN WESTERN CANADA

By V. M. BEHAN-PELLETIER 1, M. CLAYTON 2 & L. HUMBLE 2

(Accepté Novembre 2000)

SUMMARY: Two species of the oribatid mite genus Parapirnodus represent a significant component of the arboreal fauna in canopy habitats in western Canada, including the canopy of Amabilis fir (Abies amabilis), Western hemlock (Tsuga heterophylla) and Sitka spruce (Picea sitchensis). One of these species, P. coniferinus n. sp., shows distinct sexual dimorphism, with differences in size of notogastral pore areas. This species also has a larger male spermapositor than the second species, P. hexaporosus n.sp., which lacks sexual dimorphism. The two species are described and the family placement of Parapirnodus in Scheloribatidae, rather than in Oripodidae, is confirmed based on analysis of adult and immature characters.

INTRODUCTION

Oribatid mites are species rich in arboreal habitats, where they often are the numerically dominant arthropods after aphids or ants (WALTER & BEHAN-PELLETIER, 1999, BEHAN-PELLETIER & WALTER, 2000). Study of their diversity in such habitats in western Canada is comparatively recent and is the subject of ongoing research as part of canopy biodiversity assessments in ancient Sitka spruce (WINCHESTER, 1997; BEHAN-PELLETIER & WINCHESTER, 1998; WINCHESTER et al., 1999), and in montane Amabilis fir and Western hemlock (FAGAN & WINCHESTER 1999). Among Oribatida, two undescribed species of the genus Parapirnodus often are among the most numerically dominant mites collected in these forest canopies. The purpose of this paper is to describe these species, and to discuss the family placement of Parapirnodus.

Morphological terminology used in this study
follows that developed by F. Grandjean (see Trave & Vachon, 1975 for references). The following conventions of measurement and description are used; pro
dorsal setae: measured on dissected, slide
mounted specimens; ro: rostral seta; le: lamellar seta;
interlamellar seta; ex: exobothridial seta; ss: sen
sillus; total length: measured from tip of rostrum to
posterior edge of notogaster, on specimens in cavity
slides; leg setal formula: is included in tarsal setal count on leg I
and shape in female with Aa positioned well poste
rily of seta c; Aa longer than A2 in male, and Aa
positioned medially to seta c; humeral tectum absent;
tarsal setation (I to IV) 14-13-12-9, setae (pv) absent
from tarsi I to IV.

Adult Measurements. Mean total length: female
(n = 10) 298 \mu m (range 280-312 \mu m); male (n = 10)
271 \mu m (260-288). Mean notogastral width: female (n
= 9) 166 \mu m (range 152-180); male (n = 9) 140 \mu m
(128-148).

Integument. Integument microtuberculate over
total length to width ratio: measured when viewed perpendicular to circumgastric scissure,
on specimens in cavity slides; leg setal formula: famul
us is included in tarsal setal count on leg I and
olenidial counts are in parentheses.

The unidentifiable nomenclature for notogastral
setae is used herein. Synonymies of this nomenclature
with the holotrichous nomenclature, based on proba
bleness among GRANDJEAN’s notogastral
setal nomenclatures, are outlined by R.A. Norton in

Abbreviations for collections of Acari are: CNC:
Canadian National Collection of Insects and Arach
nids, Agriculture and Agri-Food Canada, Ottawa,
Canada; RAN: collections of Roy A. Norton, Syra
cuse, USA; PFC: collections of the Pacific Forestry
Centre of the Canadian Forestry Service, Natural
Resources Canada, Victoria, Canada.

Specimens for scanning electron microscopy were
critical point dried, mounted on Al-stubs with double
sided sticky tape, and gold-coated in a Hummer
sputter apparatus.

Parapirnodus coniferinus n. sp.

Figs. 1-20

Diagnosis: Adult. Total length 260-312 \mu m; lamella ridge-like, usually weakly developed in female, well-developed in male; prolatala weakly
developed in female, weakly to well-developed in
male; sublamella absent; two pairs of notogastral
porose areas, Aa and A2, present, subequal in size
and shape in female with Aa positioned well poste
rily of seta c; Aa longer than A2 in male, and Aa
positioned medially to seta c; humeral tectum absent;
tarsal setation (I to IV) 14-13-12-9, setae (pv) absent
from tarsi I to IV.

Adult Measurements. Mean total length: female
Figs. 1-4.—*Parapirnodus coniferinus* n.sp., 1, adult ♀ dorsal aspect; 2, adult ♂ dorsal aspect; 3, adult ♀ ventral aspect; 4, tritonymph, dorsal aspect. Scale bar represents 50 μm.
Figs. 5-8. — *Parapirnodus coniferinus* n.sp., adult ♀ legs I to IV, antiaxial aspect; 5, leg I, trochanter removed; 6, leg II, trochanter removed; 7, leg III, 8, leg IV. Scale bar represents 10 μm.
phism: in female (Fig. 1) Aa round, about 8 µm in diameter, positioned well posteriorly of seta c, A2 round, about 8 µm in diameter, positioned anteromedially to seta h₂; in male (Fig. 2) Aa long oval, 12-18 µm long, 8 µm wide, positioned medially to seta c, extending or not anteriorly of level of seta c, A2 round, about 8 µm in diameter, positioned posteriorly to seta h₂. Five pairs of lyrifissures present; im and ip longer than others. Posterior notogastral tectum absent.

Ventral Region. Epimeral setal formula 3-1-2-2, setae 3c and 4c absent; setae smooth, about 14 µm long. Sternal groove not evident. One pair of genital and aggenital setae (2 aggenital setae unilaterally in one specimen), two pairs of anal, and three pairs anal setae in all specimens examined; genital setae positioned anteriorly on genital plate (Figs. 3, 13). Spermapositor of male large, cross-sectional length about four-fifths length of genital plate; ratio cross-sectional length of spermapositor to genital plate (n = 5) 0.81:1.0 (0.78-0.82:1.0). Genital, aggenital and anal setae smooth, about 16 µm long; adanal setae smooth, about 24 µm long.

Gnathosoma. Subcapitulum, chelicera and palp normal for Scheloribatidae (Grandjean, 1958). Axillary saccule of subcapitulum absent. Palp setation (0-2-1-3-9) includes both ventral setae (vt) of tarsus. Palptarsal solenidion fused with eupathidia acm and, along with eupathidia ul', ul", su, positioned distally near plane of symmetry, similar to that described for Siculobata sicula by Grandjean (1953, Fig. 5C). Chelicera with 2 setae; cheliceral digits toothed (Fig. 16).

Legs. Femora without ventral keel. Porose areas present on femora I to IV and trochanters III and IV, but not evident on tibiae or tarsi I to IV. Setation (I to IV): trochanter 1-1-2-1; femora 4-4-3-2; genua 2(1)-2(1)-0(1)-1; tibiae 4(2)-4(1)-3(1)-3(1); tarsi 14(2)-12-9 (Figs. 5-8). Setae d and l' on femora I and II extending distolaterally over segment (Fig. 11). Only proral setae (p) of tarsi I eupathial, non-eupathial seta s positioned proximally of anterolateral setae (a). Famulus small, rounded distally. Leg setation reduced (Table 1), with primiventral (pv) setae absent from tarsi I to IV and a'' absent from tarsus IV. Solenidion o₂ absent from tarsus II. Solenidion of tibiae III and IV long, terminating in a flattened disc, similar to, though smaller than, that of Nasozetes sumatrensis (Grandjean, 1959; Fig. A and B). Tarsi monodactylous.

Immatures: Measurements. Mean length: larva (n = 4) 190 µm (188-194); protonymph (n = 4) 221 (range 214-227); deutonymph (n = 6): 263 µm (range 252-280); tritonymph (n = 10) 310 (range 280-337).

Prodorsum. Aspis faintly microporose, well-developed and forming complete rostral tectum anteriorly, with small medial dens. Paired porose areas on aspis posterior to bothridia. Setae ra, le, and in barbed, tapered, directed anteriorly; in tritonymph about 20, 20, and 24 µm long, respectively, with their mutual distances about 8, 22, and 42 µm, respectively. Seta ex about 4 µm long, thin, smooth. Sensillus capitate, denticulate, as in adult, about 20 µm long in tritonymph, head barbed, globose, directed anterolaterally.

Gastronotic Region. Integument smooth medially of setae c₁, da, and dm. Lateromarginal depression (cvm) present (Fig. 4), extending lateral to these setae; integument with irregular plications laterally of depression cvm (Fig. 18). Integument posteriorly to setae dm and lp forming pygidial region, faintly sclerotized in tritonymph (Figs. 4, 18). Seta c₁ positioned posteriorly to setae c₂ and c₃. Larval setae c₂, c₃, dm; protonymphal and deutonymphal setae c₂, c₃, c₄, c₅, dm, lp, h₂; and tritonymphal setae c₂, c₃, dm, l₁, h₂, p₁ with small excentro sclerites. All gastronotal setae barbed, tapered, about 18-22 µm long in tritonymph. Ontogenetic setal formula 11-15-10, normal for Scheloribatidae (Grandjean 1958), with seta h₂ absent from larva. Humeral organ absent. Opisthosomal gland unsclerotized, contents brownish yellow in some specimens. Integumental sclerite absent in region of gland opening.

Ventral Region. Ontogeny of ventral setae (larva to adult): epimeral, 3-1-2; 3-1-2-1, 3-1-2-2, 3-1-2-2; genital, 0-1-1-1; aggenital, 0-0-1-1-1; anal, 0-0-2-2; adanal, 0-0-3-3-3. Paraproctal atrichosy in larva, protonymph and deutonymph.

Legs. Development of setae and solenidia given in Table 1. On tarsus I ω₁ not falcate.

Material Examined. Holotype: adult female. CANADA: BRITISH COLUMBIA: Vancouver Island, Campbell River, Montane Alternative Silvi-
Figs. 9-14.—Parapirnodus coniferinus n.sp., adult, 9, ♂ dorsal aspect; 10, ♀ lateral aspect; 11, ♂ dorsal aspect of prodorsum; 12, ♀ dorsolateral aspect of prodorsum; 13, genital region; 14, anal region. Figs. 9, 10, scale bar represents 100 µm; figs. 11-14, scale bar represents 10 µm.
TABLE 1. Development of leg setae and solenidia in Parapirnodus coniferinus n. sp. (Setae are noted opposite the instar in which they first appear; parentheses indicate setal pairs).

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Etymology: The specific epithet means “of fir” and refers to the type of tree from which specimens have been collected.

Remarks on Leg Setation: Leg setation and its ontogeny have been described for few species in the Oripodoidea, and this has limited analyses of relationships within the superfamily. The setation of Parapirnodus is reduced in comparison with that of described Oripodoidea, as noted below:

Tarsus I: Seta v' is absent from tarsus I in P. coniferinus, as it is in Dometorina species (Grandjean, 1951).

Tarsus II: Solenidion w2 is absent from this segment in P. coniferinus, though it is present in the congener P. prosopus (Martínez et al. 1996).

Tarsus III: Seta ft' is absent from all stages in Parapirnodus coniferinus, as in Dometorina species (Grandjean, 1951) and Pirnodus cryophilus (Fernandez, 1989). As Grandjean (1941) noted the
absence of this seta is not unusual in Oribatida, but it is rare in the Brachypylina.

**Tarsus IV:** In the protonymph this segment has six setae, rather than the usual seven setae: \(f" \) (p), \(u \) and \(pv \) (Grandjean, 1941; Norton, 1977). This reduced setation generally results from absence of the paraxial seta \( p" \) (e.g., Lohmanniidae) (Grandjean, 1946b), but setae \( p \) are clearly present on tarsus IV of protonymphal Parapirnodus coniferinus, and there is a single antiaxial seta present in the ventral position. It is possible that this seta is \( pv' \), but the position of setae on tarsus IV of adult *P. coniferinus* (Fig. 8), the presence of setae \( a \) and \( s \) on tarsus IV of adult Parapirnodus hexaporosus (described below) and *P. prosopis* (Martínez et al. 1996), and the absence of setae \( pv \) from tarsi I to III of *P. coniferinus* suggest that setae \( pv \) also are absent from tarsus IV. Thus, the ventral seta present on the protonymphal tarsus IV is \( a' \), and seta \( s \) is added in the deutonymph.

**Tarsi I to III:** Setae \( pv \) are absent from these segments in *P. coniferinus*. Similarly, these setae are absent in *P. prosopis*, one or both of these setae are absent from these tarsal segments in *Dometorina* species, and \( pv \) are absent from tarsus II in *Pirnodus cryophilus* (Fernández, 1989). Grandjean (1950) noted that loss of these fundamental setae is unusual in Oribatida. Seta \( s \) is setiform on tarsi I to III, as on tarsus IV, and positioned proximal to setae \( a \) in *P. coniferinus* as in *P. prosopis*, *Pirnodus cryophilus* and *Dometorina* species. However, seta \( s \) is eupathidial unilaterally on tarsus I of a single *P. coniferinus* deutonymph, and has moved distal to setae \( a \).

**Tibiae III and IV:** The distal expansion of solenidia of tibiae III and IV has been found in the arbororeal genera *Nasozetes* (Scheloribatidae), *Micreremus* (Micreremidae), and *Siculobata* (Oribatulidae), and may enhance chemosensory functions in habitats exposed to wind (Grandjean 1959). The expanded tip to the solenidion is small, but evident, on protonymphal tibia III, and deutonymphal and tritonymphal tibiae III and IV.

**Genua I to IV:** Adult *P. coniferinus* have the same genual setation as *P. prosopis* (Martínez et al., 1996; Fig.2) (the solenidion illustrated by these authors on genu IV is probably a mistake; all other Oribidoidea whose setation is described have a seta in this position on genu IV, as is normal for Brachypylina (Grandjean, 1946a)). Seta \( l' \) is also absent from genua III and IV in *Pirnodus soyeri* (Travé, 1969).

In comparison with the ontogeny of leg setation in the scheloribatid *Cryptozetes usnea* (Norton & Palacios-Vargas, 1987), in *P. coniferinus*: seta \( v \) is delayed to the adult on trochanter I, II, and IV, to the tritonymph on trochanter III; seta \( l' \) is delayed to the tritonymph on femora I and II, and is delayed to the adult on femur III; seta \( v' \) is delayed to the adult on femora I and II; seta \( v'' \) is delayed to the adult on tibia I; setae \( l'' \) and \( v'' \) are delayed to the adult on tibia II, seta \( l' \) and \( v'' \) are delayed to the adult on tibiae III and IV (\( l' \) is absent unilaterally on one specimen); setae \( t(t) \) are delayed to the adult on tarsi I to III, and are absent from tarsus IV.

**Parapirnodus hexaporosus** n. sp.

Figs. 20-23

**Diagnosis:** Adult. Total length 296-340 \( \mu m \); lamellae narrow, similarly developed in male and female; prolamella weakly developed, sublamella absent; three pairs of notogastral porose areas, Aa, A2, and A3, subequal in size and shape in female and male; humeral tectum weakly to well-developed, or absent; tarsal setation (I to IV) 16-13-12-10, setae \( pv' \) absent from tarsi II to IV; seta \( s \) present on tarsus IV.

**Adult measurements.** Mean total length: female \((n = 3) 338 \mu m \) (range 337-340 \( \mu m \) ); male \((n = 4) 312 \mu m \) (296-324). Mean notogastral width: female \((n = 3) 155 \mu m \) (range 152-160); male \((n = 3) 155 \mu m \) (133-168).

**Integument.** Integument microtuberculate over entire body and leg segments, forming vermiform rugosity, most evident on notogaster, in epimeral region and on ventral plate. Microtubercles forming longitudinal striae on femora I to IV and trochanters III and IV. Cerotegument weakly developed in acetabular region.

**Prodorsum.** Rostrum truncate, but with large, rounded, medial projection. Seta \( ro \) directed anteromedially, barbed, about 35 \( \mu m \) long. Lamella narrow, about 44 \( \mu m \) long, almost parallel (Fig. 21). Lamellar seta weakly barbed, about 40 \( \mu m \) long, arising ante-
Figs. 15-17. *Parapirnodus coniferinus* n.sp. 15. adult, male. Sensillus and cerotegument lateral to sensillus; 16. adult, male. Anteroventral region of gnathosoma; 17. adult, female. Lateral aspect of adult with egg extruding from ovipositor.

Figs. 18-19. *Parapirnodus coniferinus* n.sp., tritonymph 18. dorsal aspect; 19. tritonymph to adult molt.

Fig. 20. *Parapirnodus hexaporosus* n.sp. adult, dorsal aspect. Fig. 15, scale bar represents 1 μm; Fig. 16, scale bar represents 10 μm; figs. 17-20, scale bar represents 100 μm.
riorly on lamellae. Prolamella weakly developed, extending from anterior of lamella to seta ro; sublamella absent. Seta in smooth, about 16 μm long. Mutual distance of setal pairs ro, le and in approximately 40, 56 and 52 μm, respectively. Sensillus capitatus, with denticulate head and smooth stalk, about 30 μm long from base of bend in bothridium to tip, directed anteriorly or anterolaterally (Fig. 21). Seta ex thin, smooth, attenuate, about 6 μm long.

**Lateral Aspect of Podosoma.** Carina kf weakly developed. Pedotecta I and II very small. Discidium absent, circumpedal carina absent to partially developed. Humerosejugal porose areas Am and Ah and sublamellar porose area A1 present.

**Notogaster.** Longer than wide, ratio about 1.6:1. Pteromorph absent, development of humeral tectum variable among specimens: almost absent (Fig. 21), to well-developed and distally dentate (Fig. 22). Dorsosejugal scissure absent. Dorsophragmata about 30 μm long. Ten pairs of smooth, accumulate notogastral setae, about 16 μm long. Three pairs of porose areas, Aa, A2 and A3 present, subequal in size, about 4-6 μm in diameter, or A3 smaller than Aa and A2; not showing sexual dimorphism, positioned as in Fig. 21. Five pairs of lyrifissures present; im and ip longer than others. Posterior notogastral tectum absent.

**Ventral Region.** Epimeral setal formula 3-1-2-2, setae 3c and 4c absent; setae smooth, about 11 μm long. Sternal groove not evident. One pair of genital and aggenital setae, two pairs of anal, and three pairs anal setae in all specimens examined; genital setae positioned anteriorly on genital plate (Fig. 23). Spermapositor of male normal in size, ratio spermapositor to genital plate about 0.5:1. Genital, aggenital and anal setae smooth, about 16 μm long; anal setae smooth, about 16 μm long.

**Gnathosoma.** Subcapitulum, chelicera and palps normal for Scheloribatidae (Grandjean 1958). Axillary saccule of subcapitulum absent. Palp setation (0-2-1-3-9) includes both ventral setae (vt) of tarsus. Palptarsal solenidion fused with eupathidium acm, and along with eupathidia ul', ul", su, positioned distally near plane of symmetry, similar to that described for *Siculobata sicula* by Grandjean (1953, Fig. 5C). Chelicera with 2 setae; cheliceral digits toothed.

**Legs.** Femora without ventral keel. Porose areas present on femora I to IV and trochanters III and IV, not evident on tibiae or tarsi I to IV. Setation (I to IV): trochanters 1-1-2-1; femora 5-5-3-2; genua 2(1)-2(1)-0(1)-1; tibiae 4(2)-4(1)-3(1)-3(1); tarsi 16(2)-13(1)-12-10. Only proral setae (p) of tarsus I eupathidial, non-eupathidial seta s positioned proximal to antelateral setae (a). Famulus small, rounded distally. Leg setation as for *P. coniferinus* (Table 1), except proral ventral (pv) setae present on tarsus I, s present on tarsus IV, and seta p*"* present on femora I and II. Solenidion ol2 absent from tarsi II. Solenidia of tibiae III and IV long, terminating in a flattened disc, as in *P. coniferinus* (Figs. 7, 8). Tarsi monodactylous.

**Immatures.** Unknown.

**Material Examined.** Holotype: adult male. CANADA: BRITISH COLUMBIA: Vancouver Island, Mt. Cain, 1200m, 22 May -22 June 1998 (L. Fagan) from litter bags with *Abies amabilis* on *Abies amabilis* branch, deposited in the CNC; type number 22742. Paratypes: 6 with same data as holotype, except 3 from 22 May to 22 July; BRITISH COLUMBIA: Vancouver Island, Campbell River, Montane Alternative Silvicultural Systems (MASS) site 49° 50' 53"N; 125° 26' 27"W, elevation 740-850m, 28 May and 26 June 1996 (L.M. Humble and N.N. Winchester) 3 from twig wash in *Abies amabilis* lower canopy; Vancouver Island, Upper Carmanah Valley drainage, 48° 44'N; 124° 37'W, 3 July -27 October, 1991 (N.N. Winchester) 2 from malaise traps in canopy of *Picea sitchensis* (approx. 700 years old). Paratypes deposited in the CNC and the PFC.

**Etymology:** The specific epithet "hexaporosus" refers to the octotaxic system with three pairs of porose areas, which is unique to this species among known species of *Parapirnodus.*

**DISCUSSION**

**Systematic Relationships**

There are discrepancies in the recent literature about the familial relationships of *Parapirnodus.* The genus was proposed by Balogh & Mahunka (1968) with *P. longus* as type species, and placed in the Oripodidae on the basis of its reduced genital seta-
Figs. 21-23. *Parapirnodus hexaporosus* n. sp. adult ♂; 21, dorsal aspect; 22, variation in shape of humeral tectum; 23, ventral aspect. Scale bar represents 50 μm.

Aoki & Ohkubo (1974) erected a subfamily for the genus and noted that though similar to *Pirnodus* in its reduced genital setation, it differs in that the genital plates of female *Parapirnodus* are smaller than the anal plates. Furthermore, *Parapirnodus* is monodactylous and tarsus I is normal in shape, whereas *Pirnodus* is tridactylous and has a truncated tarsus I.

Norton & Poinar (1993) were the first to note the similarity between *Parapirnodus* and the oripodoid lineage which includes *Gerloubia*, considered a member of the Oribatulidae. These authors also suggested
that both genera may be more closely related to Scheloribatidae.

Availability of both adult and immature specimens of *Parapirnodus coniferinus* allowed evaluation of the systematic placement of this genus. We compared character states of *Parapirnodus* with those of Scheloribatidae, Oribatulidae and Oripodidae. We based our analysis of scheloribatid and oribatulid character states on the treatment of Grandjean (1958) in which character states differentiating these families are presented, and the description of the scheloribatid *Cryptozetes usnea* Norton & Palacios Vargas, 1987. Oripodid character states are based on the diagnosis of Grandjean (1956) for Truncopidae, a synonym of Oripodidae sensu Balogh (1972), Aoki & Ohkubo (1974), Balogh & Balogh (1990) and Balogh & Balogh (1992), and descriptions of oripodid mites such as Fernandez (1989) and Fernandez et al. (1995). Aoki & Ohkubo (1974) presented a history of the genera included in Oripodidae in diagrammatic format from which it is evident that the family concept has changed significantly since the taxon was first proposed, a fact also noted by Grandjean (1965).

Defining character states of Oripodidae include:

(a) chelicera with one seta (lacking antiaxial seta chh); and (b) adult tarsal segments truncated anteriorly, especially tarsus I, and (c) tridactyly. These states are absent in the following species of *Parapirnodus*: *P. coniferinus* and *P. hexaporosus* described herein, the type species, *P. longus* Balogh & Mahunka, and *P. prosopis* (Martinez et al., 1996). Also, as noted by Norton & Poinar (1993), who examined type material of *P. longus*, the octotaxic system is expressed as porose areas (usually two pairs, except for *P. hexaporosus*), whereas all other known Oripodidae have sacculi.

*Parapirnodus* shares some character states with members of the Oripodidae, including the reduced genital setation, the short prodorsum relative to the length of the notogaster, absence or weak development of pedotecta, and absence of a sublamella, but these character states appear subject to convergence in oripodoid families. For example, Travé (1967), in his analysis of the oribatulid genus *Pseudodoppia*, found considerable variation in genital setation (from 1 to 4 pairs), as did Grandjean (1951) in the scheloribatid genus *Dometorina* (2 to 4 pairs).

Most of the defining apomorphies of Scheloribatidae (Grandjean 1958) are shared by *Parapirnodus*, including: (1) paraproctal atrichosy in the larva, (2) coupling and fusing of the palpal solenidion with eupathidium *acm* to form the double horn in the larva; (3) distal, almost comb-like arrangement of the other palpal eupathidia in immatures and adult; (4) terminal position of palpal seta *su* in the larva. Adults of *Parapirnodus* lack the sternal groove commonly present in Scheloribatidae. The systematic relationships between genera and families in the Oripodoidea need further evaluation, and the polarities of character states used in the current classification are poorly defined, however, based on present knowledge of character states of oripodoid immatures and adults, *Parapirnodus* is a member of the Scheloribatidae.

Within Scheloribatidae, *Parapirnodus* shares many character states with *Dometorina* and *Siculobata*, including absence of pteromorphs, absent or reduced humeral tectum, Tibial solenidia with expanded tip and reduced leg setation. However, the systematic relationships between genera in the Scheloribatidae have not been studied, and a thorough phylogenetic analysis is needed to establish a well-supported classification.

Sexual Dimorphism

Among described species of *Parapirnodus* sexual dimorphism is known only in *P. coniferinus* n. sp. Sexual dimorphism of the octotaxic system, evident in *P. coniferinus*, is common in the Oripodoidea (Norton & Alberti, 1997) and, as these authors noted, in all known examples it is the male whose porose organs are modified. Sexually dimorphic modifications of prodorsal structures are also known in the Oripodoidea, e.g., in *Symbioribates papaensis* (Symbioribatidae), lamellae are better developed in the male than in the female (Aoki, 1966), as in *P. coniferinus*. However, the prodorsal tubercle bearing seta *le*, common in male *Parapirnodus coniferinus*, and rare in females, is unique among known Oripodoidea.

The relatively large size of the male spermapositor in the sexually dimorphic *Parapirnodus coniferinus*,

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compared to that in the non-dimorphic *P. hexaporosus* and *P. longus* is striking, and suggests that aspects of reproductive behavior may differ between these species. A large spermapositor relative to the length of the genital plate has been recorded in all species of the ceratozetoid family Zetomimidae (BEHAN-PELLETIER, 1998). However, this difference has not been looked for in other genera which include both sexually dimorphic and non-sexually dimorphic species, such as *Zachvatkinibates* (Mycobatidae) (BEHAN-PELLETIER, 1988). The unusually large spermapositor may be a fixed trait (Zetomimidae) or variable trait (*Parapirnodus*) among families and genera of Oripodoidea and Ceratozetoidea, and this convergent development warrants caution in its use in establishing relationships between taxa.

**Habitat.**

Both *Parapirnodus coniferinus* and *P. hexaporosus* coexist on branches of Amabilis fir, and both species have been found in litter bags placed on branches of this conifer. Only *P. coniferinus* has been collected so far from the canopy of Sitka spruce and Douglas fir. Neither species has been collected from soil or litter at the base of these conifer species.

**Acknowledgements**

We thank Professor Sandor MAHUNKA, Hungarian Natural History Museum, Budapest, for the loan of type material; Mr. Barry FLAHEY, of the Research Branch, Agriculture and Agri-Food Canada, Ottawa for inking the line drawings; and our colleagues Dr. Evert LINDQUIST of the Research Branch, Agriculture and Agri-Food Canada, and Dr. Roy NORTON, State University of New York, Syracuse, for their many helpful comments on this manuscript. Funding for oribatid research on the Montane Alternative Silviculture System (MASS) project on Vancouver Island was provided by Forest Renewal British Columbia and the Canadian Forest Service of Natural Resources Canada.


