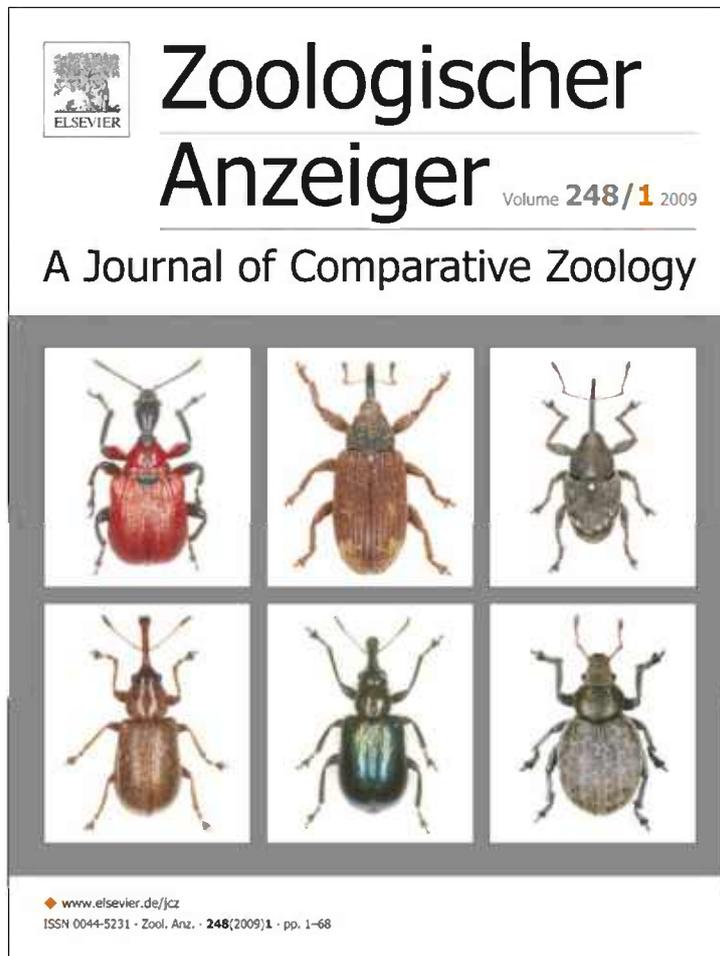


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Remarks on the “Subcoxa” hypothesis from Bäckert et al. (2008)

Bäckert et al. (2008) suggest that sets of pleural sclerites on some myriapods and hexapods are homologous to and derived from two semi-lunar pleural sclerites observed on basal myriapods and hexapods. They propose that the semi-lunar sclerites correspond to one proximal limb segment, specifically the insect “subcoxa”. They also believe that the two semi-lunar sclerites correspond to the so-called coxopodite and anterior pleurite of a remipedian crustacean, and that remipedians are the sister group of tracheates.

Limb development of some copepod crustaceans, however, does not support the idea that a protopodal segment is expressed in a semi-lunar shape when subsumed into its somite. Each of seven copepod thoracopods begins development as a simple setose bud that initially appears one stage after the formation of the somite bearing the thoracopod (Ferrari and Dahms 2007). The bud of the second to fifth thoracopods, copepod swimming legs 1–4, changes into a transformed limb with a clearly recognized protopod, exopod and endopod; this transformed swimming leg usually bears a dorsal seta on the basis (e.g. Ferrari 2000, Fig. 1A and B).

The transformed 6th thoracopod, leg 5, of some copepods belonging to the family Cyclopidae is a diminutive swimming leg-like limb with only one ramus, the exopod, and a dorsal seta on the basis (Fig. 1A). However, on a number of cyclopids both the exopod and a dorsal seta originate directly on thoracic somite 6 rather than on an articulating basis (Fig. 1B). The basis of leg 5 of these species lacks a proximal arthrodial membrane so that, in effect, it has been subsumed into the well-sclerotized sixth thoracic somite (Rocha and Bjornberg 1988, Figs. 16 and 19; Reid and Spooner, 1998, Figs. 1B and 2I). Semi-lunar structures resulting from this fusion have not been reported on these adult copepods, nor are semi-lunar structures present on the transformed limb of juvenile copepodids IV–V (unpublished observations of *Microcyclops rubellus* (Lilljeborg, 1901) and *Halicyclops aberrans* Rocha, 1983 on which the exopod articulates with thoracopod 6, or *Alloicylops silvaticus* Rocha and Bjornberg, 1988

and *Stolonicyclops heggiensis* Reid and Spooner, 1998 on which it does not). The identity of the basis of this leg 5 is well-supported not only by the location of the exopod but also by the location of the dorsal seta of the basis.

Support for the idea that a limb segment is made up of two semi-lunar structures parallel to the proximodistal limb axis is not provided by Bäckert et al. (2008). If the two semi-lunar pleural sclerites of some hexapod and myriapod limbs are to be equated with segments, a more satisfying explanation is that each ring represents a protopodal segment, e.g. coxa and distal praecoxal segment. Praecoxal endites of some crustaceans are hypothesized to represent a series of segments in the ancestral crustacean (Borradaile 1926). Three praecoxal endites have been proposed for the maxilliped of calanoid copepods (e. g. Ferrari and Ivanenko 2008) and at least 5 protopodal segments proximal to the basis, viz. coxa and up to 4 praecoxal segments, may be present on antenna 1 of some larval decapods (e. g. Choi and Hong 2001, Figs. 3B, 4B, 5B, 7A, 8A, 9A, and 11A).

Transformation of a protopodal segment into semi-lunar pleural sclerite also does not appear well-supported. Although exopodal segments of antenna 2 of larval branchiopods like *Artemia salina* are not completely sclerotized ventrally (Maruzzo et al., in press), the extent to which this morphology is exceptional or can be extrapolated to protopodal segments remains undetermined. A protopodal segment that has been divided into an anterior, a dorsal and a posterior fragment is not an intuitive outcome. If one considers a segment as a simple cylinder whose circular cross-section will be divided, the end product might be an anterior and a posterior fragment, or a dorsal and ventral fragment, or an anterior, a dorsal, a posterior and a ventral fragment. However, a divided circular cross-section yielding an anterior, a dorsal, and a posterior fragment does not account for the ventral part of the cylinder. Aside from rather imprecise positional information, no other observations, such as shape or first appearance during development, are presented to support the homology of fragments of pleural sclerites from a pair of semi-lunar pleural sclerites. A promised study of musculature, therefore, is much anticipated.

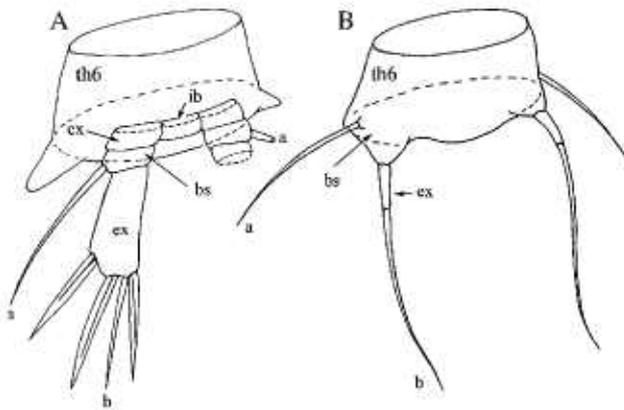


Fig. 1. Sixth thoracic somite and leg 5 of: (A) *Euryte longicauda* (from Ferrari and Ivanenko 2005); (B) *Microcyclops rubellus* (unpublished observations), posterolateral and not to scale. Exopod, first present at CIII, and dorsal seta, first present at CIV, articulate with the basis of *E. longicauda* and with the basis fused to its somite of *M. rubellus*. th6 – sixth thoracic somite; ib – interpodal bar; cx – coxa; bs – basis; ex – exopod; a – dorsal seta of basis; b – 1 of 3 crown seta of exopod.

References

- Bäcker, H., Fanenbruck, M., Waegele, J.W., 2008. A forgotten homology supporting the monophyly of Tracheata: the subcoxa of insects and myriapods re-visited. *Zoologischer Anzeiger* 247, 185–207.
- Borradaile, L.A., 1926. Notes upon crustacean limbs. *Annals and Magazine of Natural History* 17 (9), 193–213.
- Choi, J.H., Hong, S.Y., 2001. Larval development of the kishi velvet shrimp, *Metapenaeopsis dalei* (Rathbun) (Decapoda: Penaeidae), reared in the laboratory. *Fishery Bulletin* 99, 275–291.
- Ferrari, F.D., 2000. Patterns of setal numbers conserved during early development of swimming legs of Copepoda (Crustacea). *Hydrobiologia* 417, 81–90.
- Ferrari, F.D., Dahms, H.-U., 2007. Post-Embryonic Development of the Copepoda. *Crustaceana Monographs* 8, i–vi, 1–226pp.
- Ferrari, F.D., Ivanenko, V.N., 2005. Copepodid stages of *Euryte longicauda* (Cyclopoida, Cyclopidae, Euryteinae) from the White Sea associated with the bryozoan *Flustra foliacea*. *Journal of Crustacean Biology* 25, 353–374.
- Ferrari, F.D., Ivanenko, V.N., 2008. Identity of protopodal segments and the ramus of maxilla 2 of copepods (Copepoda). *Crustaceana* 81, 823–835.
- Maruzzo, D., Minelli, A., Fusco, G., in press. Segmental mismatch in crustacean appendages: the naupliar antennal exopod of *Artemia* (Crustacea, Branchiopoda, Anostraca). *Arthropod Structure & Development* 38.
- Reid, J.W., Spooner, J.D., 1998. *Stolonicyclops heggiensis*, new genus, new species, from Georgia, USA (Copepoda: Cyclopoida: Cyclopidae). *Journal of Crustacean Biology* 18, 405–411.
- Rocha, C.E.F., Bjornberg, M.H.G.C., 1988. *Allocyclops silvaticus* sp. n. (Copepoda, Cyclopoida, Cyclopidae), the first representative of the genus in South America. *Hydrobiologia* 167–168, 445–448.

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