

**Additional file 9: Phylogenetic distribution of characters among panarthropods and cycloneuralians.**

	<b>Character in Onychophora</b>	<b>Comparison with Arthropoda</b>	<b>Comparison with Tardigrada</b>	<b>Comparison with Cycloneuralia</b>
<i>Overall morphology</i>				
Integrity of cuticle	Decay resistant integument or cuticle	Homologue	Homologue	Homologue
Anterior	Differentiated region in front of anterior-most walking legs	Nature of the homology unclear	Nature of the homology unclear	-
Limbs	Lobose walking limbs	Homologue – arthropodized limbs derived	Homologue	-
Posterior	Differentiated region behind of posterior-most limbs	Homologue	Absent in modern forms, possible plesiomorphy	-
<i>Head structures</i>				
Antennae	Autapomorphy, possibly homologous to arthropod labrum	Analogous structure	-	-
Slime papillae	Autapomorphy	-	-	-
Jaws	Autapomorphy	-	-	-
Mouth (with tongue)	Ventral mouth	Analogous ventral mouth	Sub-terminal mouth	Analogous terminal mouth
Eyes	Ocellus-like eyes	Likely homologous with the median ocelli, but not compound eyes <sup>17</sup>	Homology disputed – eye spots	-
<i>Trunk structures</i>				
Dermal papillae	Autapomorphy or possible plesiomorphy (homologous to “tubercles” of e.g. <i>Aysheaia</i> )	-	-	-
Pigment	Autapomorphy	Analogous pigments not housed in granules	Analogous pigments not housed in granules	Analogous pigments not housed in granules

Trunk annuli (dermal plicae)	Autapomorphy	-	-	-
<i>Limbs</i>				
Transverse leg rings	Autapomorphy, possible plesiomorphy (cf. annulations of limbs of e.g. <i>Onychodictyon ferox</i> and <i>Aysheaia pedunculata</i> )	-	-	-
Dermal papillae on limbs	Autapomorphy, possible plesiomorphy (cf. limbs of <i>Orstenotubulus evamuelleriae</i> )	-	-	-
Foot claws	Two claws per limb	-	Multiple claws	-
Feet	Autapomorphy	-	-	-
<i>Posterior body region</i>				
Anus	Present	Homologue	Homologue	Homologue
Gonopore	Present	Homologue	Homologue	Homologue
<i>Internal anatomy</i>				
Epidermis	Present	Homologue	Homologue	Homologue
Slime glands	Autapomorphy	-	-	-
Gut	Symplesiomorphy	Homologue	Homologue	Homologue
Gonads	Symplesiomorphy	Homologue	Homologue	Homologue
Nerve cords	Ventral nerve cords	Ventral chain of ganglia linked by somata-free connectives	Ventral chain of ganglia linked by somata-free connectives	Analogous nerve cords
Body wall musculature	Symplesiomorphy	Homologue	Homologue	Homologue