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Larval description of the *Pterostichus* subgenera *Myosodus* FISCHER von WALDHEIM, *Eurymelanius* REITTER and *Orthomus* CHAUDOIR (Coleoptera: Carabidae)

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Abstract

Larvae of species of the *Pterostichus* subgenera *Myosodus* FISCHER von WALDHEIM, *Eurymelanius* REITTER and *Orthomus* CHAUDOIR are described. Larvae of these subgenera are morphologically compared with those of other *Pterostichus* groups.

Key words: Carabidae, *Pterostichus*, *Myosodus*, *Eurymelanius*, *Orthomus*, larval descriptions.

Pterostichus BONELLI is one of the best known Carabid genera in larval stage. Among others BOUSQUET (1984, 1985, 1989), HABU & SADANAGA (1961, 1963, 1965), THOMPSON (1979) and ARNDT & HURKA (i. p.) bring detailed larval descriptions and keys of many *Pterostichus* groups of Central Europe, East Asia and North America. Here we describe the larvae of three subgenera which are endemic in the Caucasus and North Africa for the first time. As BOUSQUET (1985: 223 f.) already gives a detailed characteristic of the genus *Pterostichus* BONELLI, we concentrate our studies mainly on characters of subgeneric and specific value.

We have to acknowledge Dr. L. Penev (Moskau) and D.W. Wrase (Berlin) for leaving larval material.

Material and methods

The descriptions are based on the following material.

- Pt. (Myosodus) starcki* HEYDEMANN: 5 L₁, 6 exuviae L₁, 5 L₂ reared ex ovo by the senior author in summer of 1989 (adults from west Caucasus, Mt. Acishcho).
- Pt. (Myosodus) lacunosus* CHAUDOIR: 1 L₁ reared ex ovo by the senior author in summer of 1989 (adults from northwest Caucasus, Lago-Naki) and 7 L₃ field collected at the same locality.
- Pt. (Myosodus) filipjevi* LUTSHNIK: 5 L₁, 5 L₂, 5 L₃ reared ex ovo by the junior author in spring and summer of 1975 (adults from central Caucasus, Anau).
- Pt. (Eurymelanius) chydaeus* TSCHITSCHERIN: 3 L₁, 2 L₂ reared ex ov by the junior author in spring and summer of 1975 (adults from central Caucasus, Anau); 2 L₃ field collected together with adults by Penev (Caucasus, Karbardino-Balkaria, Balungu in summer of 1986).
- Pt. (Eurymelanius) goriense* TSCHITSCHERIN: 1 L₁, 5 L₂, 3 L₃ field collected together with adults by Wrase (Caucasus minor, Bakuriani, summer of 1987).
- Pt. (Eurymelanius) ?caucasicus* MENETRIES: 2 L₃ field collected together with adults by Meyer (Caucasus, Mt. Kasbek in summer of 1989).
- Pterostichus (Orthomus) barbarus barbarus* DEJEAN: 8 L₁, 5 L₂, 6 L₃ reared ex ovo by the junior author in autumn and winter of 1979/80 (adults from western coastal Libya, Závija).
- Pt. b. trapezicollis* CHAUDOIR 5 L₁, 4 L₂, 5 L₃ reared ex ovo by the junior author in autumn and winter of 1984/85 (adults from West-Algeria, Tlemcen).

Pt. b. atlanticus FAIRMAIRE 29 L₁, 6 exuviae L₁, 13 L₂, 6 exuviae L₂, 8 L₃ reared ex ovo by the senior author in winter of 1990/91 (adults from Morocco, Taroudannt and Tiznit).

For comparative purposes larvae of 48 further *Pterostichus* species (28 subgenera), *Poecilus* BONELLI (8 species), *Abax* BONELLI (4 species), *Molops* BONELLI (2 species), *Cyclotrachelus* (*C. seximpressus* LE CONTE), *Abacetus* DEJEAN (*A. villiersianus* STRaneo), *Tapinopterus* SCHAUM (*T. balcanicus* GANGLBAUER), *Xenion* TSCHITSCHERIN (*X. ignitum* KRAATZ) and of 33 further Carabid tribes were studied.

All larvae studied are deposited in the collections of the authors. The larvae were examined after preparation in Canada balsam or after impregnation with glycerin on a microscope slide using Zeiss Jena microscopes (magnification 50 - 400x). Terminology after BOUSQUET & GOULET (1984) and BOUSQUET (1985, for later instars). The method of rearing was described by GOULET (1976) and HURKA (1972).

Subgenus *Myosodus* FISCHER von WALDHEIM

Instar I:

M i c r o s c u l p t u r e: Head and nota with flat meshes, abdominal tergites multipointed, pygidium pointed to multipointed, urogomphi pointed.

C h a e t o t a x y: Ancestral chaetotaxy, typical for *Pterostichus* larvae, all seta and pores except seta LA₄ on prementum present; on ligula near the base of seta LA₆ an additional pore; setal group gMX with 80 - 110 setae, length of seta MX₆ 0.2 - 0.4 times that of MX₅.

H e a d: Head capsule nearly as long as wide (Fig. 1); nasale little produced, straight or slightly concave (Fig. 4); egg bursters consisting of two rows of fusing microspines, coronal suture well developed, about as long as antennomere IV, cervical groove on dorsal and lateral side of parietale, ocellar groove and 6 stemmata of normal size apparent; mandible slender with large retinaculum (Fig. 8).

A b d o m e n: Urogomphi long and slender, 1.8 - 2.7 times longer than tergum IX wide.

Instars II and III:

Same character states as in instar I, except for following:

M i c r o s c u l p t u r e: Abdominal tergites meshed to multipointed, pygidium and urogomphi multipointed.

C h a e t o t a x y: Secondary setae MN_α on outer side of mandible and AN_α on inner side of antennomere II, ST_α on sternites and UR_α on tergum IX present; in the last two instars some further little seta on antennomeres I, II and III; some speciemens with a further seta near MN_α; 2 secondary setae ventral on tibia, 6 - 8 secondary seta on femur; urogomphi with 9 long seta (UR₄₋₈, α-θ).

H e a d: Egg bursters lacking; cervical groove extended on ventral side of parietale.

Remarks: Subgenus *Myosodus* is very similar to subgenus *Morphnosoma* LUTSHNIK (= *Eufersonia* CASEY) in larval stage. In the higher instars it is possible to distinguish *Myosodus* from *Morphnosoma* by the larger retinaculum and different shape of mandible only. *Pterostichus* (*Morphnosoma*) *melanarius* (ILLIGER) which also occurs in the Caucasus has reduced setae PR₁₂ and ME₁₃ in first instar contrary to *Myosodus*. The large similarity of larvae of both subgenera is based on plesiomorphic character states generally, but a closer relationship is not excluded.

Pterostichus (*Myosodus*) *starcki* HEYDEMANN

Instar I:

C o l o r a t i o n: Head capsule and pronotum golden brown to brown, abdominal tergites and urogomphi dark brown.

Head width: 1.16 - 1.18 (\bar{x} = 1.17) mm, n = 5.

Chaetotaxy: Setal group gMX with 90 - 110 setae.

Head: Nasale straight, slightly produced, about 1.2 times wider than each adnasale (Fig. 4), egg bursters consisting of two rows of 40 - 50 fusing microspines; membranous area on stipes restricted to the lateral margin, stipes 2.8 - 2.9 times longer than wide; antennomere I longest.

Abdomen: Urogomphi long and slender, 2.1 - 2.3 times longer than tergum IX wide (Fig. 11).

Instar II:

Head width: 1.51 - 1.71 (\bar{x} = 1.62) mm, n = 5.

Head: Membranous area on stipes extended to ventral side.

Pterostichus (Myosodus) filipjevi LUTSHNIK

Instar I:

Coloration: Head capsule and pronotum golden brown to brown, abdominal tergites and urogomphi dark brown.

Head width: 1.20 - 1.30 (\bar{x} = 1.26) mm, n = 5.

Chaetotaxy: Setal group gMX with 87 - 91 setae.

Head: Anterior margin of nasale slightly concav, nasale about 1.7 - 1.8 times wider than each adnasale; coronal suture as long as or longer than antennomere IV; stipes 3 times longer than wide with membranous area indistinct.

Abdomen: Urogomphi about 1.8 times longer than tergum IX wide.

Instar II:

Head width: 1.68 - 1.86 (\bar{x} = 1.80) mm, n = 5.

Chaetotaxy: Little secondary setae on antennomeres I, II and III.

Head: Nasale 1.3 - 1.4 times wider than each adnasale; coronal suture about 1.5 times longer than antennomere IV; stipes 3.6 times longer than wide with a small membranous area ventrolateral.

Instar III:

Head width: 2.68 - 2.78 (\bar{x} = 2.75) mm, n = 5.

Chaetotaxy: Most specimens with two secondary setae on outer margin of mandible.

Head: Coronal suture about 1.8 times longer than antennomere IV.

Remarks: Larvae of *Pt. (Myosodus) lacunosus*, which are very similar to those of *Pt. filipjevi*, were also studied. These larvae are to distinguish from *Pt. starcki* by having a more concav nasale, membranous area on stipes extended on ventral side and urogomphi shorter in L_1 and by having two secondary setae on outer margin of mandible (only in some specimens) in higher instars. The head width of *Pt. lacunosus* $<L_1$ 1.21 mm, n = 1, L_3 2.9 - 3.3 (\bar{x} = 3.1) mm, n = 7 is larger as in *Pt. starcki*.

Subgenus *Eurymelanius* REITTER

Instar I:

Microsculpture: Head capsule and nota with meshed microsculpture, abdominal tergites multipointed, urogomphi and pygidium pointed.

Chaetotaxy: Ancestral setae and pores except that of LA_4 present on prementum, lateral sides of prementum with about two pairs of additional setae, small additional setae on parietale near cervical groove, on discal area of pronotum and on pygidium. On ligula near the base of seta LA_6 an additional pore; setal group gMX with 70-90 setae; length of MX_6 on lacinia about 0.2-

0.3 times that of MX_5 ; setae PR_{12} , ME_{13} and TE_{10} reduced, barely longer than TE_{11} , on abdominal tergites only one long seta (TE_9); UR_2 small, about as long as UR_3 or of normal length.

H e a d: Head capsule about as long as wide (Fig. 2); coronal suture long, about as long as antennomere III; egg bursters consisting of two rows of fusing microspines, anterior reaching level of seta FR_2 ; cervical groove distinct, 6 little stemmata apparent; membranous area on stipes extended on ventral side; mandible long and slender with small retinaculum (Fig. 9); nasale slightly produced, barely wider than each adnasale (Fig. 5).

A b d o m e n: Urogomphi about 2 times longer than tergum IX wide, articulated in 4 articles (Fig. 13).

Instars II and III:

Same character states as in instar I, except for following:

M i c r o s c u l p t u r e: Abdominal tergites meshed to pointed, urogomphi and pygidium indistinct multipointed or with not apparent microsculpture.

C h a e t o t a x y: MN_α present, AN_α present or absent, small additional setae on parietale, frontale, antennomeres I and II, notal and abdominal tergites; urogomphi \pm densely haired, with 5 long setae (UR_{4-8}), secondary setae $UR_{\alpha-\theta}$ not apparent.

H e a d: Nasale distinctly wider than each adnasale, egg bursters lacking.

A b d o m e n: Urogomphi with 4 articles, \pm densely pubescent (Fig. 14).

Remarks: Subgenus *Eurymelanius* has an apomorphic state within the genus *Pterostichus*. Articulated and haired urogomphi are unique among known *Pterostichus* larvae. Only some groups of the subtribe Molopina (*Abax* BONELLI, *Percus* BONELLI) and *Tapinopterus* SCHAUM show similar characters. A relationship between these groups and *Eurymelanius* seems possible, because *Eurymelanius*, *Tapinopterus* and some Molopina bear following larval characters which have to be considered as apomorphic: sickle-shaped mandibles, a light area on base of antennomere I, a very big lacinia with small seta MX_6 and a large extended membranous area on stipes in all instars. Within genus *Pterostichus* the next relatives of *Eurymelanius* are probably the *Steropus* group. On one hand the relationship of the *Steropus* group and the subtribe Molopina was already proposed by ARNDT (1989) and BOUSQUET (1984), on the other hand both, larvae of the *Steropus* group and *Eurymelanius*, share further typical apomorphies: a flat, not produced nasale, small stemmata, a long head capsule with an extended coronal suture and a reduced number of secondary urogomphi setae (all these characters are also similar in *Tapinopterus* larvae!). A detailed larval description of the *Eurymelanius* species will be given later. On one side the taxonomy of this group has to be revised, on the other side the larval material studied was mostly field collected.

Subgenus *Orthomus* CHAUDOIR

Instar I:

M i c r o s c u l p t u r e: Head capsule and pronotum without microsculpture; meso-, metanotum and abdominal tergites multipointed, urogomphi and pygidium pointed.

C h a e t o t a x y: Chaetotaxy ancestral, all setae and pores except that of LA_4 on prementum present; on ligula near the base of seta LA_6 an additional pore apparent; setal group gMX with 35 - 55 setae; length of seta MX_6 on lacinia 0.8 - 0.9 times that of MX_5 .

H e a d: Head capsule about as long as wide (Fig. 3); nasale produced, anterior straight, slightly serrate (Fig. 6); hind angles of frontale wide, egg bursters consisting of two rows of slightly spines, separated from each other; mandible little curved with short retinaculum (Fig. 10); antennae about as long as mandible, antennomere II shortest; cervical groove on dorsal and lateral side of parietale well developed, 6 stemmata of normal size and ocellar groove apparent.

A b d o m e n: Urogomphi stout, slightly incurved (Fig. 15).

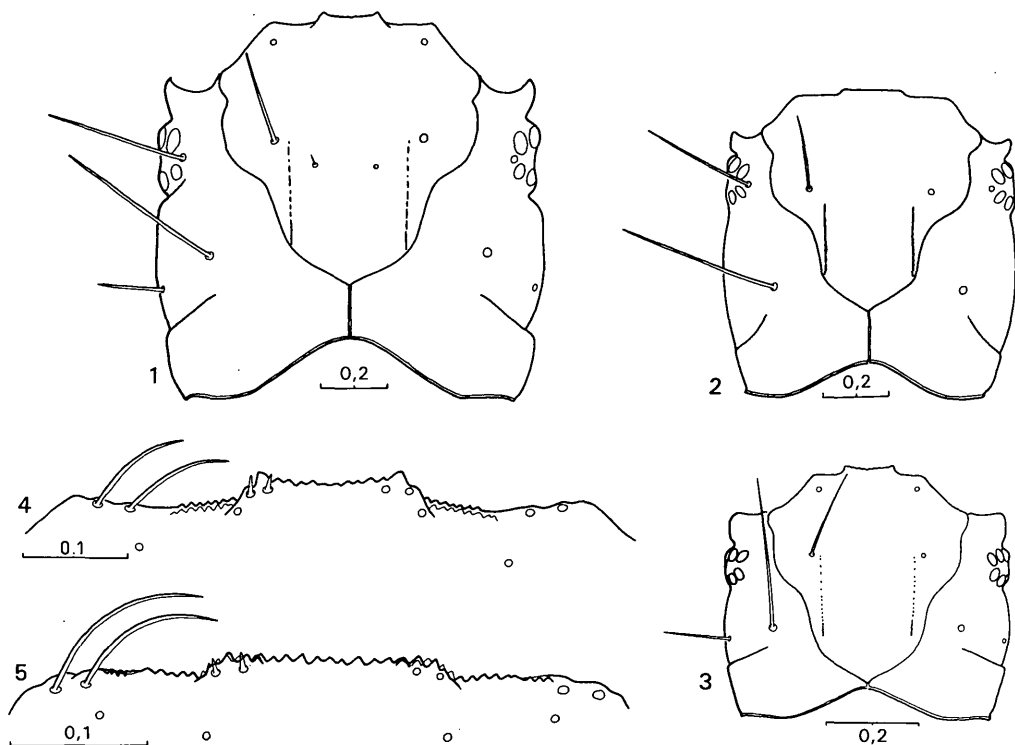


Fig. 1 - 3: Head capsule, L_1 of (1) *Pt. (Myosodus) starcki*, (2) *Pt. (Eurymelanius) goriense* and (3) *Pt. (Orthomus) barbarus* (ssp. *atlanticus*).

Fig. 4 - 5: Nasale and adnasale of (4) *Pt. starcki*, L_1 and (5) *Pt. goriense*, L_1 .

Instars II and III:

Same character states as in instar I, except for following:

Microsculpture: Urogomphi and pygidium pointed to multipointed.

Chaetotaxy: Secondary setae MN_α and ST_α present, AN_α absent; setal group gMX with 50 - 70 setae; ventral on femur 4 - 6 secondary bristles; 9 long setae on urogomphi (UR_{4-8} , $\alpha-\theta$).

Head: Membranous area on stipes extended on ventral side; egg bursters lacking.

Abdomen: Urogomphi slender (Fig. 16).

Remarks: The relationship of *Orthomus* is a hitherto unsolved problem. Like those of *Orthomus* larvae of subgenus *Argutor* DEJEAN (= *Lagarus* CHAUDOIR) have a produced and anteriorly straight nasale and a long seta MX_6 (both unusual for other *Pterostichus* larvae). Both groups like *Phonias* GOZIS (= *Argutor* STEPHENS auct. nec DEJEAN) have comparatively stout larvae with sides of head capsule slightly rounded. First instar larvae of *Phonias* and *Orthomus* exhibit (unlike that of *Argutor*) rows of egg bursters with spines separated from each other. It seems possible that all three groups are closely related. The caryotype analysis of NETTMANN (1986) prompts also a probable relationship between *Orthomus* and *Phonias*, whereas the position of *Argutor* remains unclear. JEANNEL (1942) united (among others) *Orthomus*, *Argutor* and *Phonias* in one group, CSIKI (1930) grouped *Orthomus* together with *Argutor* at the beginning of his *Pterostichus* series. On the other hand the larvae of *Phonias* are similar to that of *Pseudomaseus* CHAUDOIR (in widest sense) because of a very small seta MX_6 , a serrate inner margin of mandible

and a convex nasale with outer dents (plesiomorphic characters?). All four groups (*Orthomus*, *Phonias*, *Argutor*, *Pseudomaseus* in widest sense) have larvae with lacking seta AN_{α} (an apomorphic state within *Pterostichus*); a relationship could be possible.

***Pterostichus (Orthomus) barbarus* DEJEAN**

Instar I:

C o l o r a t i o n: Head capsule yellowish brown, other sclerites brown.

H e a d w i d t h: 0.54 - 0.73 mm.

H e a d: Head capsule about 1.1 times wider than long (Fig. 3); nasale about 1.6 times wider than each adnasale (Fig. 6); each row of egg bursters with 12 - 29 spines, separated from each other; coronal suture short, shorter than diameter of antennomere IV; stipes 2.2 - 2.4 times longer than wide.

A b d o m e n: Urogomphi about 1.3 - 1.5 times longer than tergum IX wide (Fig. 15).

Instar II:

Same character states as in instar I, except for following:

H e a d w i d t h: 0.78 - 1.27 mm.

H e a d: Nasale about 1.6 - 1.8 times wider than each adnasale; coronal suture as long as diameter of antennomere IV; last antennomere shortest.

A b d o m e n: Urogomphi about 1.5 - 1.7 times longer than tergum IX.

Instar III:

Same character states as in instar II, except for following:

H e a d w i d t h: 1.14 - 1.80 mm.

H e a d: Coronal suture slightly longer than diameter of antennomere IV.

Remarks: There are distinct morphological differences between larvae from different localities, but adults of different subspecies breed without problems (PAARMANN, verbal communication). *Pterostichus barbarus* ssp. *atlanticus* FAIRMAIRE (adults from Morocco) has only 12 - 15 spines in each row of egg bursters, secondary seta UR_{α} is very small. *Pterostichus barbarus barbarus* DEJEAN (adults from Libya) has about 16 - 23 spines in each row of egg bursters, head capsule distinctly wider in all instars and UR_{α} apparent, *Pt. barbarus trapezicollis* CHAUDOIR has 25 - 29 spines, head capsule widest and seta UR_{α} small.

Zusammenfassung

Die Larven von Arten der *Pterostichus* Untergattungen *Myosodus* FISCHER von WALDHEIM, *Eurymelanius* REITTER und *Orthomus* CHAUDOIR werden beschrieben. Die Untergattungen werden mit anderen *Pterostichus*-Gruppen larvalmorphologisch verglichen.

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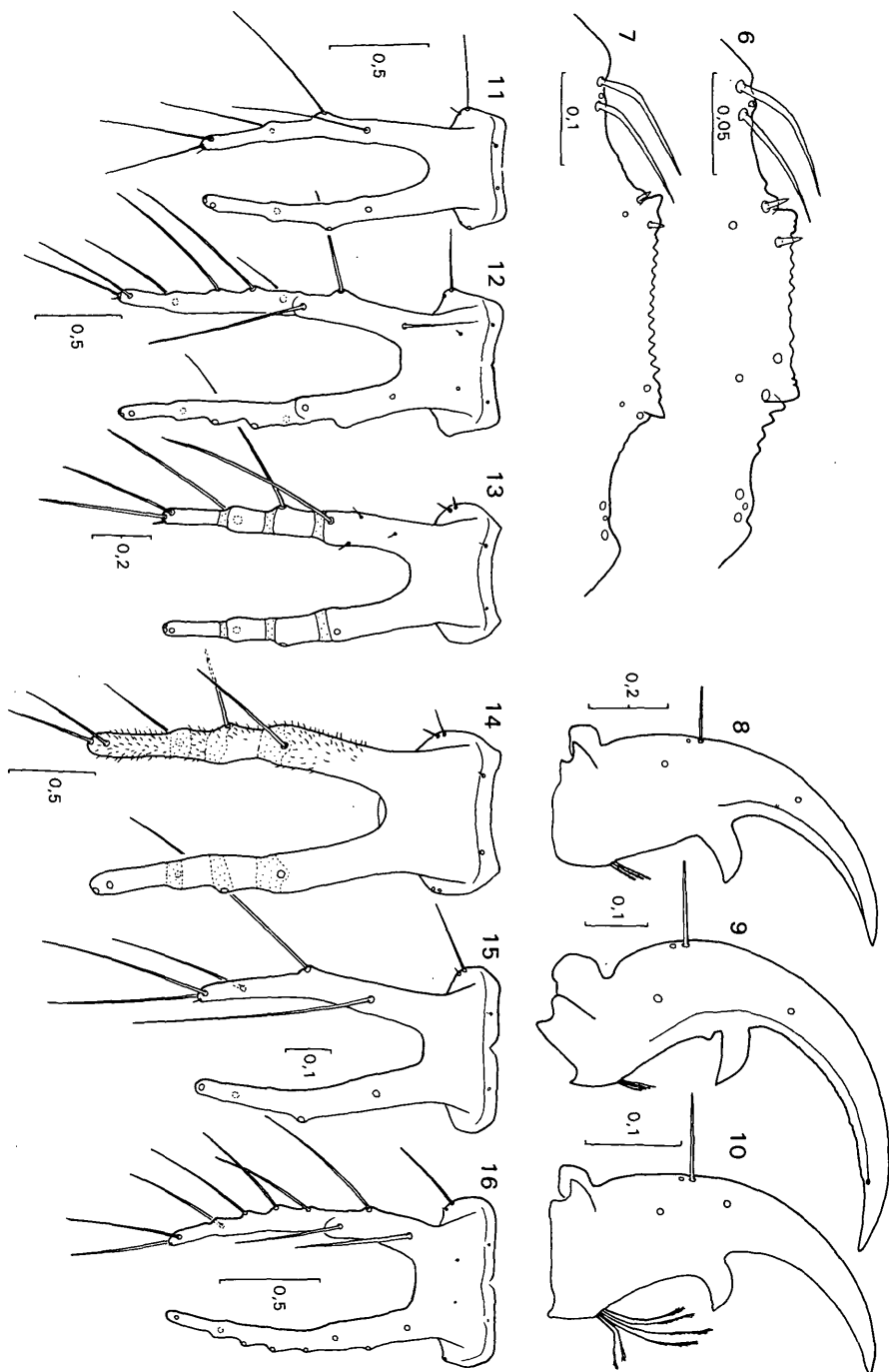


Fig. 6 - 7: *Pt. barbarus* (ssp. *atlanticus*) L₁ (6), L₃ (7).
 Fig. 8 - 10: Mandible, L₁ of (8) *Pt. starcki*, (9) *Pt. goritense*, (10) *Pt. barbarus* (ssp. *atlanticus*).
 Fig. 11 - 16: Urogomphi of *Pt. starcki*, L₁ (11), L₂ (12), *Pt. goritense*, L₁ (13), L₃ (14) and *Pt. barbarus* (ssp. *atlanticus*), L₁ (15), L₃ (16).

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