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TO THE KNOWLEDGE OF SOME CLOSELY RELATED SPECIES OF THE GENUS *PACHYRHYNCHUS* GERMAR, 1824 (COLEOPTERA: CURCULIONIDAE: PACHYRHYNCHINI) FROM LUZON ISLAND (PHILIPPINES), WITH USAGE OF EVERSION OF ENDOPHALLUS

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Pachyrhynchus pinorum Pascoe, 1871 species group is established. Characteristic feature set, as well as list of members is provided. Faunistic data for each species is included. Eversion of endophallus is used as a main method for species delimitation. Photos of habitus (male) as well as drawings and photos of eversions are compiled. Distribution maps are added.

Key words: *Pachyrhynchini, Pachyrhynchus pinorum*, taxonomy, fauna, eversion, endophallus, Luzon Island, Philippines

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INTRODUCTION

The genus *Pachyrhynchus* Germar, 1824 (Entiminae: Pachyrhynchini) is Oriental genus, distributed mainly in the Philippine Islands, with it's centre of distribution believed to be Luzon Island. More than a half of species within the genus origin from the Luzon Island, never less, relation of some closely related species variations is uncertain. That is the case for megadiverse members of *Pachyrhynchus pinorum* Pacsoe, 1871 species group. In the current study I have observed several different forms and variations for each species within the species group, as a main method for species delimitation using eversion of endophallus. Study revealed, that current method is very useful for species delimitation, yet, if can be effective only with combination of set of morphological and biogeographical features.

MATERIAL AND METHODS

The study was based on specimens deposited at the Daugavpils University Beetle Collecection. Abbreviations of museums and collections used: DUBC – Daugavpils University Beetle Collection, Daugavpils, Latvia (A. Barševskis).

MTD - Senckenberg Natural History Collections

(Dresden, Germany) (O. Jager).
NIAES - Institute of Agro-Environmental Sciences, NARO, Tskuba.
KUM - Kyushu University Museum, Fukuoka.

The laboratory research and measurements have been carried out using Nikon SMZ 745T and NIS – Elements 6D software. The illustrations were made using digital camera Canon EOS 6D with Canon MP-E 65mm macro lens, using stack shot system and Helicon Focus auto montage, subsequently was edited using Photoshop.
Technology for eversion of endophallus follow Janovska et. al. (2013).

RESULTS

Taxonomical notes

Such artificial method for species groupment is consequently and successfully used by many authors in the past (Schultze 1924, Bollino et. all. 2017). To continue, I provide set of morphological features for *Pachyrhynchus pinorum* Pascoe, 1871 species group. Group is restricted to mainland of Luzon Island, the name is given according to first species described. Members of the species group are mainly as provided by Schultze (Schultze 1924) with some minor changes on account of new species described in the recent past years. Additionally, some members of initial *Pachyrhynchus inclytus* Pascoe species group are transferred, on account of descriptive morphological characters listed below.

All species within the group share the following combination of morphological characters:
1. Integument black, surface of prothorax strongly shiny.
2. Eyes small, at least three times as wide as forehead.
3. Apical part of prothorax from apical 1/3 to apical margin straight or slightly widened.
4. Prothorax dorsally with marking at sub-apical part medially.
5. Elytra with extended apices, apex transverse straight.

List of the included species according to year of description, compiled with additional faunistic data:

1. *Pachyrhynchus pinorum* Pascoe, 1871
(Fig. 1.1., 6.1)

TL: Luzon, Benguet Subprovince, Baguio. Type in MTD.

Material examined (42 males, 13 females): Philippines / Luzon, Nueva Vizcaya, Kayapa / VI. 2014 (1); VIII. 2014 (5); VI. 2015 (1); X. 2015 (1); XI. 2015 (2) // Philippines / Luzon, Nueva Vizcaya, Sta. Fe. / III. 2016 (1); III. 2018 (1) // Philippines / Luzon, Nueva Vizcaya, Dupax / VIII. 2013 (1); III. 2014 (1); V. 2014 (2); VI. 2014 (1) // Philippines / Luzon, Benguet, Tublay / XI. 2017 (17); XII. 2017 (3); I. 2018 (2) // Philippines / Luzon, Benguet, Atoc / VII. 2014 (1); VIII. 2014 (1) // Philippines / Luzon, Benguet, La Trinidad / XI. 2017 (5); XII. 2017 (1) // Philippines / Luzon, Ifugao, Banaue / VII. 2016 (1); VIII. 2016 (1) // Philippines / Luzon, Ifugao, Hungduan / X. 2017 (1); VII. 2018 (1) // Philippines / Luzon, Mt. Province, Barlig / XI. 2015 (7); XII. 2015 (1); I. 2016 (1). All by local collectors.

2. *Pachyrhynchus tristis* Heller, 1912
(Fig. 6.3)

TL: Luzon, Benguet Subprovince. Type in MTD.

3. *Pachyrhynchus lacunosus* Heller, 1912
(Fig. 2.1 – 4, 6.2)

TL: Luzon, Benguet Subprovince, Mount Pulogloko. Type in MTD.

Material examined (124 males, 19 females):Philippines / Luzon, Nueva Vizcaya, Ambaguio / VIII. 2013 (1); VIII. 2015 (1) // Philippines / Luzon, Nueva Vizcaya, Belance / IX. 2016 (1); X. 2016 (3); VIII. 2018 (1) // Philippines / Luzon, Nueva Vizcaya, Dupax Del Sur / X. 2012 (1); V. 2014 (1) // Philppines

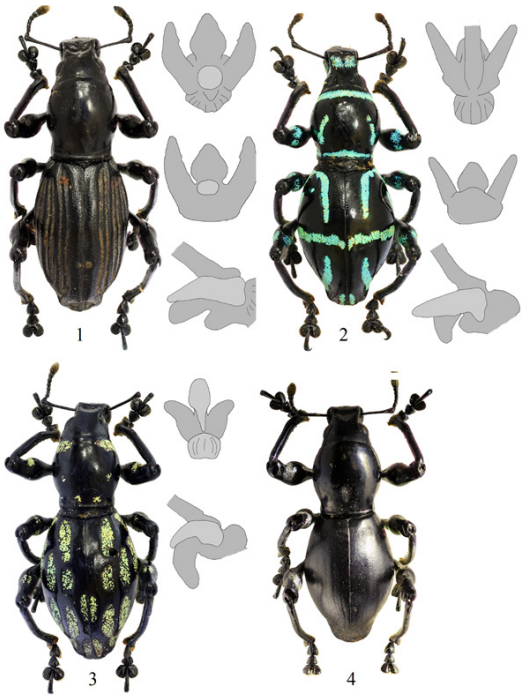

Fig. 1. Dorsal habitus with inflated base of endophallus of certain *Pachyrhynchus* species. 1 – *P. pinorum* Pascoe, 1871; 2 – *P. semperi* Heller, 1912; 3 – *P. loheri* Schultze, 1917; 4 – *P. sumptuosoides* Yoshitake, 2017.

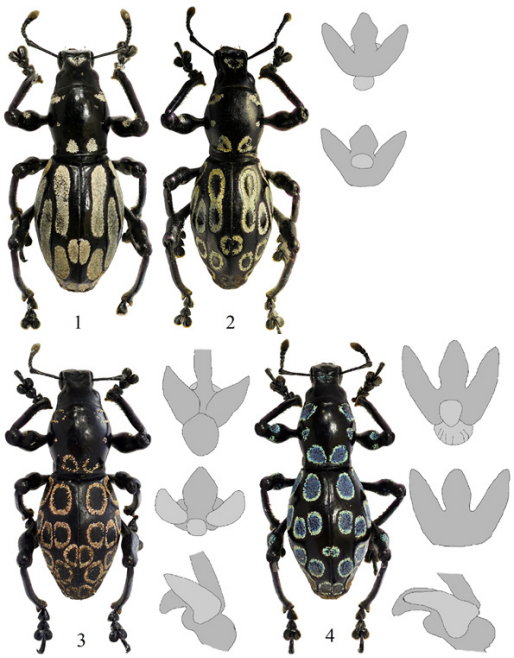

Fig. 2. Different colour variants of *P. lacunosus* Heller, 1912.

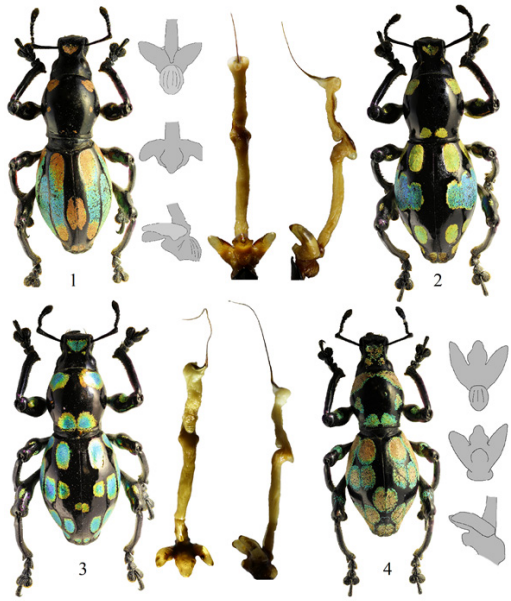

Fig. 4. Different colour variants of *P. barsevskisi* Rukmane, 2016.

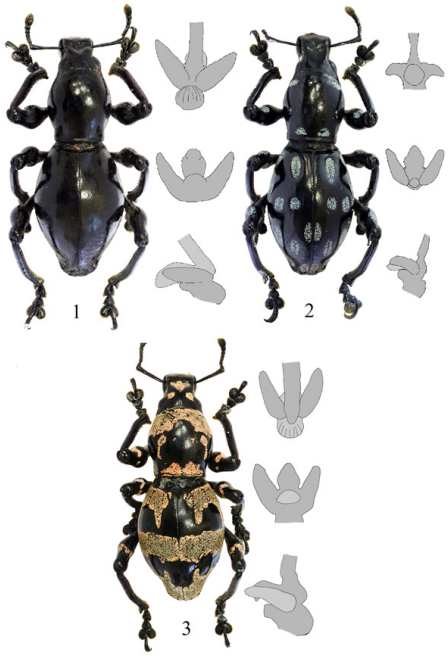

Fig. 3. Dorsal habitus of 1, 2 – *P. consobrinus* Schultze, 1922; 3 – *P. septentrionalis* Yoshitake, 2017.

/ Luzon, Nueva Vizcaya, Kasibu / VII. 2013 (1); VIII. 2013 (2); III. 2014 (1); VI. 2014 (1); VII. 2014 (1) // Philippines / Luzon, Nueva Vizcaya, Kayapa / VII. 2013 (1); VIII. 2013 (1); IX. 2013 (1); III. 2014 (1); V. 2014 (2); VI. 2014 (2); VIII. 2014 (3); IX. 2014 (2); XI. 2014 (4); XII. 2014 (1); II. 2016 (4); VI. 2016 (1); VII. 2016 (1); VIII. 2016 (1); IX. 2016 (4); X. 2016 (6); IV. 2017 (1); VII. 2017 (1) // Philippines / Luzon, Nueva Vizcaya, Malico / VII. 2014 (1) // Philippines / Luzon, Nueva Vizcaya, Sta. Fe. / III. 2016 (1); VII. 2017 (1); III. 2018 (1) // Philippines / Luzon, Nueva Vizcaya, Quezon / X. 2018 (1); I. 2019 (1) // Philippines / Luzon, Nueva Vizcaya, Ifugao / X. 2013 (1) // Philippines / Luzon, Ifugao, Asipulo / VIII. 2017 (3); IX. 2017 (1); VIII. 2018 (9) // Philippines / Luzon, Ifugao, Banaue / VII. 2013 (1); VIII. 2013 (4); III. 2014 (3); V. 2014 (7); VI. 2014 (1); VII. 2014 (3); XI. 2014 (2); II. 2015 (4); V. 2015 (6); VI. 2015 (1); XI. 2015 (1); VII. 2016 (6); VIII. 2016 (3); IX. 2016 (3); XI. 2016 (6); I. 2017 (1) // Philippines / Luzon, Ifugao, Hungduan / X. 2017 (2); VII. 2018 (2) // Philippines / Luzon, Ifugao, Tinok / VIII. 2017 (5) // Philippines / Luzon, Isabela / V. 2014 (10). All by local collectors.

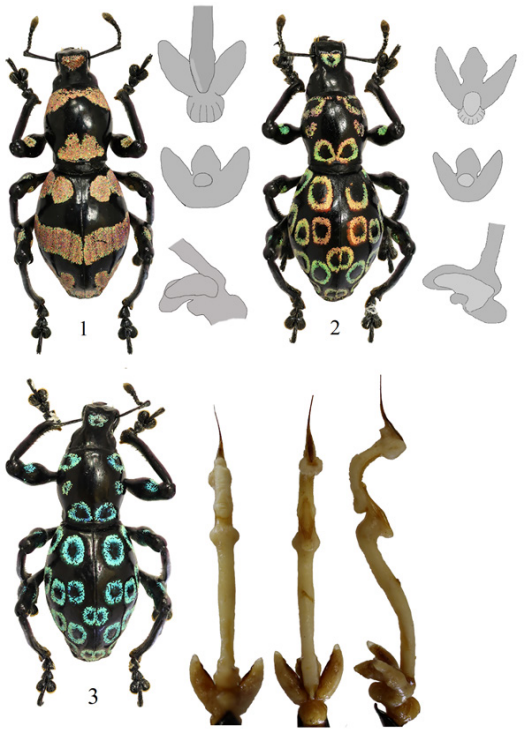

Fig. 5. Different colour variations of *P. niisatoi* Yoshitake, 2017.

4. *Pachyrhynchus semperi* Heller, 1912
(Fig. 1.2.)

TL: Philippines, exact locality unknown. Type in MTD.

Material examined (17 males, 7 females):

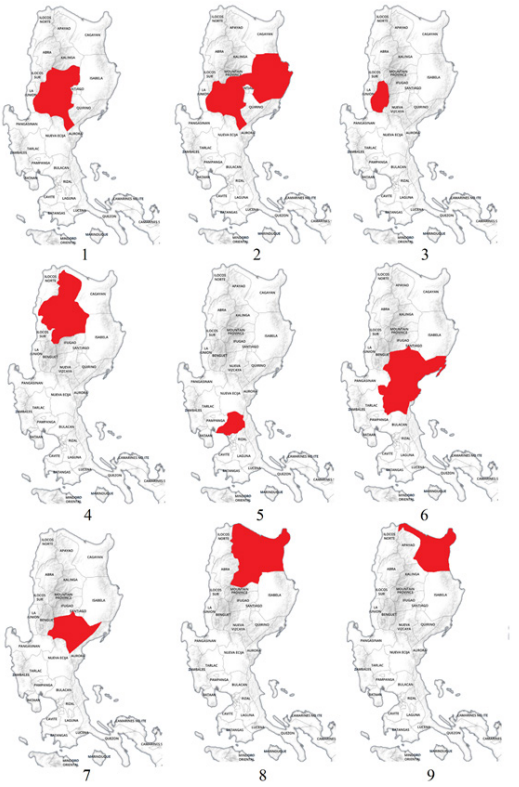

Fig. 6. Distribution of various Pachyrhynchus species. 1 – *P. pinorum* Pascoe, 1871; 2 – *P. lacunosus* Heller, 1912; 3 – *P. tristis* Heller, 1912, *P. dubiosus* Schultze, 1922; 4 – *P. consobrinus* Schultze, 1922; 5 – *P. loheri* Schultze, 1917; 6 – *P. barsevskisi* Rukmane, 2016; 7 – *P. niisatoi* Yoshitake, 2017; 8 – *P. sumptuosoides* Yoshitake, 2017; 9 – *P. callainimaculatus* Yoshitake, 2017, *P. septentrionalis* Yoshitake, 2017.

Philippines / Babuyan Island / III. 2014 (1); VII. 2014 (3); VIII. 2014 (2); XII. 2014 (2); IX. 2015 (1); XI. 2015 (4); VIII. 2016 (5); IX. 2016 (2); XI. 2016 (2); IV. 2017 (1); VIII. 2018 (1). All by local collectors.

5. *Pachyrhynchus loheri* Schultze, 1917
(Fig. 1.3; 6.5)

TL: Luzon, Bulacan Province, Mount Guinisan. Type in MTD.

6. *Pachyrhynchus dubiosus* Schultze, 1922
(Fig. 6.3)

TL: Luzon, Benguet Subprovince, Mount Santo Tomas. Type in MTD.

7. *Pachyrhynchus consobrinus* Schultze, 1922
(Fig. 4)

TL: Luzon, Bontoc Subprovince, Mount Polis. Type in MTD.

Material examined (36 males, 22 females): Philippines / Luzon, Abra, Malibcong / IV. 2016 (3); IX. 2016 (2); V. 2017 (1) // Philippines / Luzon, Abra, Tineg / IX. 2017 (2); X. 2017 (7); XI. 2017 (3); VII. 2018 (9) // Philippines / Luzon, Apayao, Conner / IX. 2015 (1) // Philippines / Luzon, Kalinga, Pinukpuk / VI. 2014 (2); VII. 2014 (1); VI. 2015 (1); VII. 2016 (1); VIII. 2017 (2) // Philippines / Luzon, Mt. Province, Barlig / XI. 2014 (1); I. 2015 (1); XI. 2015 (10); XII. 2015 (1); I. 2016 (2); II. 2016 (2); IV. 2016 (1); VI. 2016 (1); VIII. 2016 (1); IV. 2017 (1); X. 2017 (1); IX. 2017 (2); XI. 2017 (1); XII. 2017 (1) // Philippines / Luzon, Mt. Province, Barlig, Bontoc / IV. 2017 (1). All by local collectors.

8. *Pachyrhynchus barsevskisi* Rukmane, 2016
(Fig. 4.1 – 4, 6.6)

TL: Luzon Isl., Aurora, Dingalan. Type in DUBC.

Material examined (79 males, 32 females): Philippines / Luzon, Quirino / V. 2015 (1); IX. 2016 (1); VIII. 2018 (3) // Philippines / Luzon, Quirino, Madela / IX. 2015 (1); VII. 2016 (2); X. 2017 (1); XI. 2017 (2); IX. 2018 (1); X. 2018 (1); XI. 2018 (2); XII. 2018 (2) // Philippines / Luzon, Quirino, Madela, San Martin / VIII. 2019 (1) // Philippines / Luzon, Aurora, Dingalan / VIII. 2013 (2); III. 2014 (1); VI. 2015 (1); VIII. 2015 (1); XII. 2015 (2); III. 2016 (1); IV. 2016 (3); IV. 2017 (2); VIII. 2017 (6); IX. 2017 (1); X. 2017 (2); XI. 2017 (2); IV. 2018 (6); VI. 2018 (1); IX. 2018 (3); XI. 2018 (5); I. 2019 (1); II. 2019 (2); IV. 2019 (2) // Philippines / Luzon, Aurora, Ditumabao / VIII. 2017 (3); X. 2017 (1); XI. 2017 (1); I. 2018 (2); VI. 2019 (1) // Philippines / Luzon, Aurora, Casiguran / XI. 2018 (1) // Philippines / Luzon, Nueva Ecija, Caranglan / VIII. 2017 (4); IX. 2017 (11); X. 2017 (4); XI. 2017 (6); II. 2018 (1); III. 2018 (2); IX. 2018 (2) // Philippines / Luzon, Nueva Vizcaya, Alfonso Castaneda / VIII. 2017 (4) // Philippines / Nueva Vizcaya, Belance / VIII. 2015 (5). All by local collectors.

9. *Pachyrhynchus callainimaculatus* Yoshitake, 2017
(Fig. 6.9)

TL: Luzon, Cagayan, Sierra Madre. Type in NIAES.

10. *Pachyrhynchus niisatoi* Yoshitake, 2017
(Fig. 5.1 – 5.3, 6.7)

TL: Luzon, Quirino. Type in NIAES.

Material examined (30 males, 14 females): Philippines / Luzon, Quirino, Madela / IX. 2015 (2); X. 2016 (1); IV. 2017 (1); X. 2017 (1); IV. 2019 (1) // Philippines / Luzon, Quirino, Nagtipunan / VIII. 2014 (1); I. 2017 (3); III. 2017 (2); IV. 2017 (4); V. 2017 (1); VI. 2017 (5); X. 2017 (1); II. 2018 (1); IX. 2019 (2). All collected by local collectors.

Philippines / Luzon, Nueva Vizcaya, Kayapa /

IX. 2013 (1); V. 2014 (3); VI. 2014 (1); V. 2015 (4); X. 2016 (2) // Philippines / Luzon, Nueva Vizcaya, Kasibu / X. 2012 (1); IX. 2013 (1); VII. 2014 (1); VIII. 2017 (1) // Philippines / Luzon, Nueva Vizcaya, Dupax Del Sur / VI. 2014 (1) // Philippines / Luzon, Isabela, Aurora / V. 2014 (2). All by local collectors.

11. *Pachyrhynchus septentrionalis* Yoshitake, 2017
(Fig. 3.3, 6.9)
TL: Luzon, Cagayan Valley. Type in NIAES.

Material examined (19 males, 7 females): Philippines / Luzon, Cagayan / VII. 2015 (1); IX. 2015 (1); XI. 2015 (3); XII. 2015 (1); IV. 2018 (3); V. 2018 (1); VIII. 2018 (5); IX. 2018 (6); X. 2018 (1); XI. 2018 (2); VII. 2019 (2). All collected by local collectors.

12. *Pachyrhynchus sumptuosoides* Yoshitake, 2017
(Fig. 1.4, 6.8)

TL: Luzon, Cordillera Administrative Region. Type in KUM.

Material examined (2 males, 2 females): Philippines / Luzon, Apayao, Conner / VII. 2016 (2) // Philippines / Luzon, Kalinga, Pinukpuk / IX. 2014 (1) // Philippines / Luzon, Cagayan, Santa. Ana / XI. 2014 (1).

DISCUSSION

Twelve species within *Pachyrhynchus pinorum* Pascoe, 1871 species complex were observed. A total number of 465 specimens from DUBC were identified, collection comprises eight of twelve species, rest of the four species were analysed from Museum type material (*P. tristis*, *P. dubiosus*, *P.loheri*) or from bibliographic data (*P. callainimaculatus*). Faunistic data revealed, that some of the species are more widely distributed than recorded in original descriptions. Such are: *P. pinorum* Pascoe, 1871 and *P. lacunosus* Heller, 1912 that originally was recorded only from Baguio (Benguet Province), but new faunistic data revealed, that *P.pinorum* is also present at nearly located Nueva Vizcaya, Ifugao and Mountain Provinces while *P. lacunosus* appear also from Nueva Vizcaya, Ifugao and Isabela Privonces; *P. consobrinus* Schultze, 1922 originally from Bontoc (Mt. Province) is present also at northern Abra, Apayao and Kalinga provinces; *P. barsevskisi* Rukmane, 2016 originally from Aurora, is also present at Quirino, Nueva Vizcaya and Nueva Ecija provinces; *P. niisatoi* Yoshitake, 2017 additionally to Quirino is present also at Nueva Vizcaya; *P. sumptuosoides* Yoshitake, 2017 is present also at western Apayao and Kallinga Provinces. Descriptive faunistic data also show set of species present for a certain province. In this way, three species are present at Cagayan: *P. callainimaculatus*, *P. septentrionalis* and *P.sumptuosoides*; four species are fresent at Benguet: *P. pinorum*, *P. tristis*, *P. lacunosus* and *P. dubiosus*; four species are present at Nueva Vizcaya: *P. pinorum*, *P. lacunosus*, *P. P. barsevskisi* and *P. niisatoi*; two species are present at Quirino: *P. barsevskisi* and *P. niisatoi.* Data also showed, that some of the observed species are single to appear in certan province: *P. loheri* for Bulacan, *P. lacunosus* for Isabela, *P. consobrinus* for Abra, *P. barsevskisi* for Nueva Ecija. One species appear from Babuyan Island, part of the greater Luzon: *P. semperi* Heller, 1912, this species originally was described from a single specimen without exact locality. Original type is with markings of pinkish scale lines and tend to differ in colour from specimens available in DUBC, but morphological analyses revealed, that both specimens from MTD and DUBC don't show species significant differences.

Endophallus inflation method revealed, that shape is species specific and can help to define boundaries within closely related species, as well as complete understanding on species variations. Endophallus of *P. lacunosus* Heller, 1912 is with small, evenly rounded first ventral growth, second growth is big, narrowed to apex and slightly curved downwards, two lateral growths are rather big, narrowed to apex and curved downwards; endophallus of *P. consobrinus* Schultze, 1922 is

characterised by narrow, straight lateral growths, second ventral growth thick, very slightly curved downwards; same as *P. consobrinus*, endophallus of *P. septentrionalis* Yoshitake, 2017 is with narrow, but slightly curved downwards lateral growths, first ventral growth is not rounded, with two edges, while second ventral growth is narrow, straight to middle and strongly curved downwards to apex. Three colour variations of *P. barsevskisi* showed same shape as original colour variant, as well as method showed, that additionally to already known form with empty patches, *P. niisatoi* Yoshitake, 2017 also has form with mint blue empty patches. Endophallus of *P. semperi* and *P. loheri* both are characterised by very big, strongly curved downwards second ventral growth, but in *P. semperi* lateral growths are straight, but in *P. loheri* smaller, more narrow and curved.

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