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Redescription of *Pseudobenedenia lauriei* Szidat 1965 (Monogenea: Capsalidae) from *Notothenia neglecta* in Laurie, Peterman, and South Orkney Islands, South Antarctica

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Abstract

While reviewing museum collections of *Pseudobenedenia* Johnston, 1931, we found five deposited slides marked by Dr. Lothar Carlos Guillermo Szidat as *Pseudobenedenia lauriei* Szidat, 1965 from *Notothenia neglecta* Nybelin, 1951. We have removed the synonymization of *Pseudobenedenia lauriei* Szidat, 1965 as a junior synonym of *Pseudobenedenia nototheniae* Johnston, 1931 and restored its identity as a valid species that we redescribe herein. We added never-published data on the ovary, testes, bursa, haptor diameter, and egg of *P. lauriei*. As well, we added data on body size, measurements of sclerotized structures of haptor (accessory sclerites, anterior and posterior hamuli), oral suckers, pharynx and anterior hamulus to accessory sclerite ratio. A comparison of the measurements the presently recognized species of *P. lauriei* shows that it differs from all known species of *Pseudobenedenia* Johnston, 1931 and corresponds to the data of its original description. We provide photomicrographs of *P. lauriei* for the first time in addition to more informative line drawings of this species.

Keywords: *Pseudobenedenia lauriei*; Redescription; *Notothenia neglecta*; South Antarctica

Introduction

The first species of *Pseudobenedeniae* – *Pseudobenedenia nototheniae* Johnston, 1931 was described in 1931 and 1937 [1,2] from the body surface of *Notothenia microlepidota* Hutton, 1875 and *Paranotothenia magellanica* (Forster, 1801). In 1965, Szidat described *Pseudobenedenia lauriei* Szidat, 1965 from the pectoral fins and body surface of *Notothenia neglecta* Nybelin, 1951 [3]. No type material was designated by Szidat [3] and information on the number of specimens used for the description was missing [3]. In 1968 Hargis, et al. [4] described *Pseudobenedenia shorti* Hargis et Dillon, 1968 from nototheniid fish of the genus *Trematomus* [4] and Yamaguti [5] described *Pseudobenedenia elongate* Yamaguti, 1968, *Pseudobenedenia merinthe* Yamaguti, 1968 and *Pseudobenedenia ovalis* Yamaguti, 1968 from Hawaiian fish [5]. In 1976, Gibson [6] revised the genus *Pseudobenedenia* and transferred *P. shorti* to the genus *Pseudobenebenoides* Szidat, 1969 [6,7]. He established the new genus *Parabenedenia* Gibson, 1976 and transferred to

it *Pseudobenedenia nototheniae, Parabenedenia noblei* [8], *Pseudobenedenia elongate*, *Pseudobenedenia merinthe* and *Pseudobenedenia ovalis*. The same year Gibson corrected himself by replacing the name of the genus *Parabenedenia* with *Menziesia* Gibson, 1976, and transferring to this genus *P. noblei*, *P. elongate*, *P. merinthe,* and *P. ovalis*. He also transferred *Pseudobenedenia nototheniae* back to the genus *Pseudobenedenia* Johnston [9]. Gibson [6] also synonymized *Pseudobenedenia lauriei* with *Pseudobenedenia nototheniae* without studying any collections of this species. Later on, Timofeeva, et al. [10] described *Pseudobenedenia gibberifrons* Timofeeva, Gaevskaja, Kovaleva, 1987 from *Gobinotothen gibberifrons* (Lönnberg, 1905) and *Pseudobenedenia dissostichii* Timofeeva, Gaevskaja, Kovaleva, 1987 from *Dissostichus eleginoides* Smitt, 1898. More recently, a new species *Pseudobenedenia coriicepsi* Rubtsova, Chaudhary, Salganskiy, Kuzmina, 2023 was described from *Notothenia coriiceps* [11].

This work aimed to redescribe *P. lauriei* using museum collections of *P. lauriei* from the Argentine Museum of Natural Sciences Bernardino Rivadavia, Buenos Aires, Argentina, collected by Szidat, Bellizio in 1963 and Szidat and Groussac in 1968. We intended to provide additional information on this species, designate lectotype and paralectotypes, and establish that *P. lauriei* is a valid species.

Materials and Methods

Our study based on five whole-mounted museum specimens, fixed in Canada balsam. Measurements and microphotographs were made in the Ichthyoparasitology Laboratory, Institute of Marine and Coastal Research (IIMyC), Faculty of Exact and Natural Sciences, National University of Mar del Plata, Argentina, with microscope Leica LED2500, x10, x40 magnification). Microphotographs made by Leica DFC 295 camera. Line drawing and analysis of data made in the Institute of Parasitic Diseases (IPD) Scottsdale, AZ, USA.

Results

The Argentine collection at hand included two specimens collected in 1963 by Szidat and Bellizio near Laurie Island. These two specimens possibly were used for the original description of *P. lauriei* published two years later. Szidat and Groussac collected three other specimens of *P. lauriei* in 1968 in other locations – Peterson and South Orkney Islands. All this information we revealed by studying hand-written inscriptions on labels of the museum specimens.

In Table 1, we present the results of our measurements of five specimens of *P. lauriei* from *N. neglecta* – two collected by Dr. Lothar Szidat together with Dr. N. Bellizio (full name of researcher unknown) near Lauriei Island in 1963 and four collected by Szidat and Groussac (full name unknown) in 1968 at Peterman and South Orkney Islands (Table 1). For comparison, we added existing measurements of the type species of genus *Pseudobenedenia* (*P. nototheniae*) and a few other species described from other nototheniid fish from Antarctica. We excluded from this table records that we consider to represent mixed data from a few hosts that were measured together or misidentifications (except for *P. nototheniae*, that we consider a species complex [11].

Host	***Paranotothenia magellanica* (Forster 1801), *Notothenia microlepidota* Hutton 1875**	***Notothenia neglecta Nybelin* 1951**	***Notothenia neglecta Nybelin* 1951**	***Gobionotothen gibberifrons* (Lönnberg 1905)**	***Dissostichus eleginoides* Smitt 1898**	***Notothenia coriiceps* Richardson 1844**
Parasite	*Pseudobenedenia nototheniae**	*Pseudobenedenia lauriei*	*Pseudobenedenia lauriei*	*Pseudobenedenia gibberifrons*	*Pseudobenedenia dissostichii*	*Pseudobenedenia coriicepsi*
Authority	Johnston, 1931 Johnston, 1937	Szidat, 1965	Our measurements from museum whole mounts deposited by Szidat, Bellizio 1963 and Szidat, Groussac 1968	Timofeeva et al. 1987	Timofeeva et al. 1987	Rubtsova et al. 2023
Locality	Sub-Antarctic islands of New Zealand, Macquarie Isl.	Scotia Bay, Laurie Isl., South Orkney Isl.	Laurie Isl, Peterman Isl, South Orkney Isl.	Georgiy Isl., Mordvinov Isl.	Georgiy Isl., Mordvinov Isl.	Galindez Isl.

Site of infection	Body surface	Pectoral fin, body surface	Pectoral fin, body surface	Pectoral fins	Body surface	Body surface
Body length	4.7–7.0	4.5	**4.06 (3.56-4.26)**	5.6 (4.7-6.2)	8.7 (7.1-10.8)	6.03 (4.75–7.0)
Body width	2.3–4.0	2.5	**2.31(2.19-2.46)**	2.6 (2.1-3.7)	3.9 (3.3-4.8)	2.73 (2.0–3.70)
Oral suckers diameter	0.8	0.4	**0.57 (0.45-0.71) × 0.53 (0.35-0.67)**	0.76 (0.67-0.88)	1.04 (0.81-1.24)	0.45 (0.33–0.52) × 0.48 (0.44–0.52)
Pharynx	0.5 × 0.6	0.3	**0.31 (0.27-0.34) × 0.45 (0.40-0.53)**	0.59(0.46-0.62) × 0.70(0.48-0.80)	0.88 (0.67-1.12) ×1.07 (0.75-1.28)	0.46 (0.33–0.6) × 0.48 (0.35–0.7)
Ovary	0.3 × 0.5–0.7	n/a	**0.58 (0.48-0.73) × 0.43 (0.34-0.51)**	0.48(0.37-0.55) ×0.67(0.43-0.75)	0.76 (0.67-0.80) ×1.05 (0.91-1.15)	0.47 (0.38–0.55) × 0.50 (0.44–0.6)
Testes	1.2–1.6 × 0.8–1.0	n/a	**0.34 (0.29-0.45) × 0.47 (0.41-0.51)**	0.68(0.58-0.75) ×0.61(0.44-0.75)	1.62 (1.38-1.95) × 0.91 (0.86-1.38)	0.91 (0.73–1.04) × 0.60 (0.49–0.78)
Bursa	0.8 × 0.3	n/a	**0.52 (0.40-0.67)**	0.53(0.48-0.64) ×0.22(0.19-0.24)	1.16 (0.98-1.39) × 0.34 (0.26-0.37)	0.55 (0.50–0.59)
Haptor diameter	2.0–2.4	n/a	**1.56 (1.41-1.77)**	2.04(1.85-2.38)	2.78 (2.46-3.40)	1.44 (1.14–1.57) × 1.57 (1.40–1.75)
Anterior hamulus length	0.38–0.53	0.4	**0.46 (0.38-0.55)**	0.58(0.55-0.64)	0.80 (0.72-0.86)	0.51 (0.41–0.60)
Posterior hamulus	0.13–0.17	0.1	**0.22 (0.17-0.25)**	0.27(0.22-0.32)	0.26 (0.21-0.32)	0.16 (0.13–0.23)
Accessory sclerite	0.23	0.28	**0.27 (0.20-0.36)**	0.39(0.33-0.45)	0.53 (0.44-0.59)	0.38 (0.24–0.46)
Egg	0.2 × 0.1	n/a	**0.17 (0.21-0.22) × 0.13 (0.11-0.15)**	0.24(0.22-0.27) ×0.14(0.10-0.15)	0.22 (0.19-0.24) × 0.14 (0.10-0.16)	0.31 (0.31–0.31) × 0.13 (0.13–0.14)

*Type species of the genus; we consider it a species complex [11].

Table 1: Comparative morphometric data on Pseudobenedenia species from its different specific hosts.

Redescription of *Pseudobenedenia lauriei* Szidat, 1965 (Figures 1 & 2, Table 1).

Type host: *Notothenia neglecta* Nybelin, 1951.

Site of infection: pectoral fin, body surface.

Type locality: coastal waters of Lauriei (60^{0}28′S, 43^{0}84′W) and South Orkney Islands (60^{0}47′S, 45^{0}55′W); other locality: Peterman Island 64^{0}93′S, 65^{0}05′W (West Antarctica).

Material studied for redescription: five Canada balsam mounted specimens.

Designated specimens: lectotype (27.977 d) and paralectotypes (27.977 a, b, c, e), Argentine Museum of Natural Sciences Bernardino Rivadavia, Buenos Aires, Argentina.

Based on five mature egg-bearing specimens and the original description information. Information below in mm, average (min-max). In square brackets we provided data from the original description of *P. lauriei*, N/A – data in the original description were not available: body length 4.06 (3.56-4.26) [4.5], body width at the widest part 2.31 (2.19-

2.46) [2.5] (Figures 1 & 2, Table 1). Prohaptor with two lobes and slight [to deep] cleft (Figures 1 & 2). Oral suckers well developed, occupying most prohaptor and part of trunk 0.57 (0.45-0.71) x 0.53(0.35-067) [0.4]. Pharynx 0.31 (0.27-0.34) x 0.45(0.40-0.53) [0.3]. Intestine branches obscured. Bursa 0.52 (0.40-0.67) [N/A] opens on left ventral side of the body, under middle part of the left oral sucker. Ovary central 0.58(0.48-0.73) x 0.43 (0.34-0.51) [N/A]. Genital opening not visible [less to the left in comparison with *P. nototheniae*]. Two testes 0.34 (029-0.45) x 0.47 (0.47 (0.41-0.51) [N/A] posterior to ovary, longitudinal oval, side-by-side, not lobulated, occasionally with pointed upper part adjacent to ovary, with moderate perforations. Single egg 0.17 (0.21-0.22) x 0.13 (0.11-0.15) [N/A], with long coiled filament. Haptor 1.56 (1.41-1.77) [N/A] divided by six septa. Sclerotized parts of haptor in three pairs of structures: accessory sclerites 0.27 90.20-0.36 [0.28] closer to central part of haptor, and anterior hamuli 0.46 (0.38-0.55) [0.4] at distal part of haptor with adjacent posterior hamuli 0.22 (0.17-0.25) [0.1]. Marginal hooks inconspicuous.

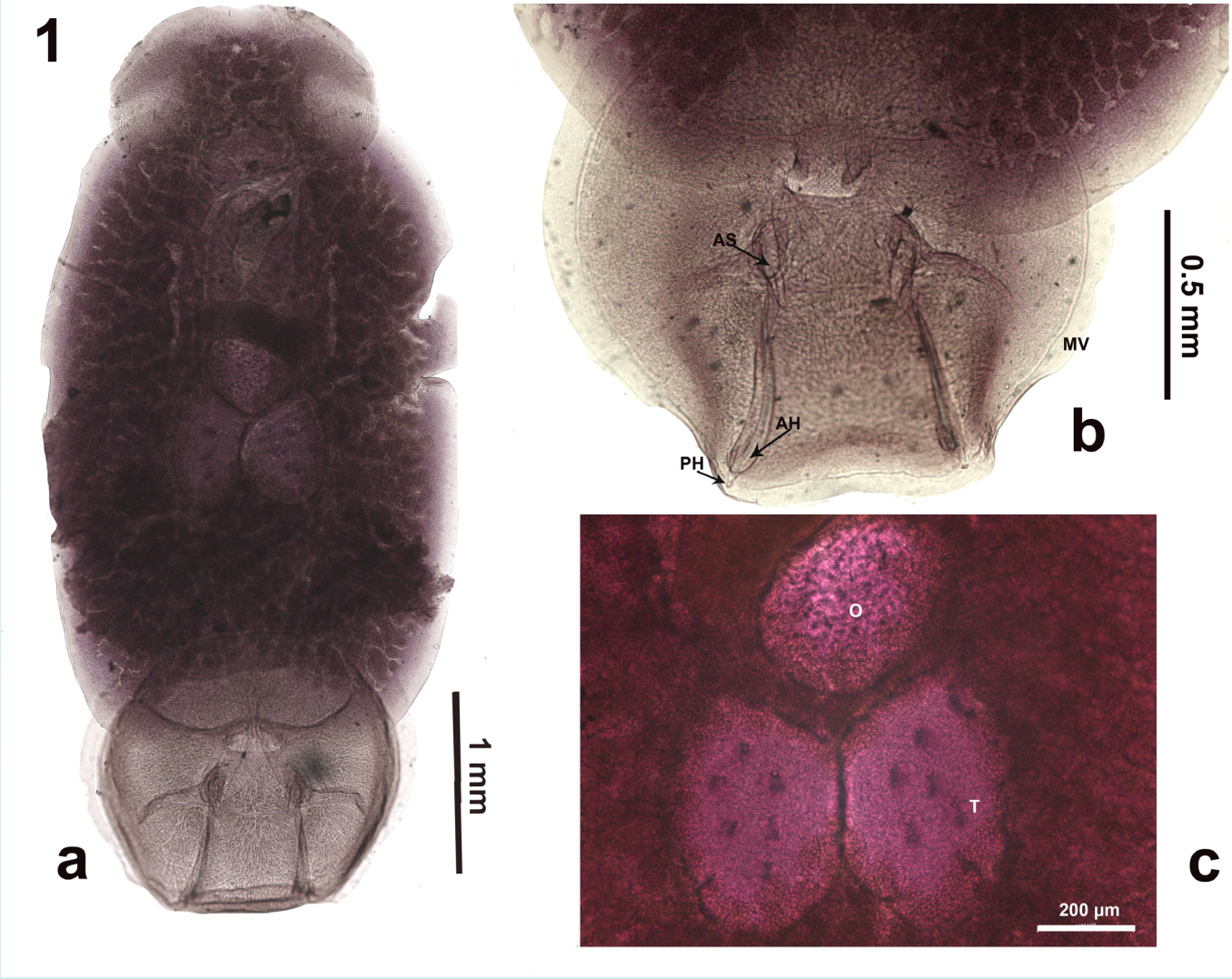

Figure 1: Total view microphotography of *Pseudobenedenia lauriei* Szidat 1965. Note slightly pointed shape of ovaries and well-seen septae and commissures of haptor; 1b: enlarged haptor of other specimen of *P. lauriei*, MV – marginal valve, AS – accessory sclerite, AH – anterior hamulus, PH – posterior hamulus; 1c: close view ovary (O) and testes (T) complex of the other specimen of *P. lauriei*.

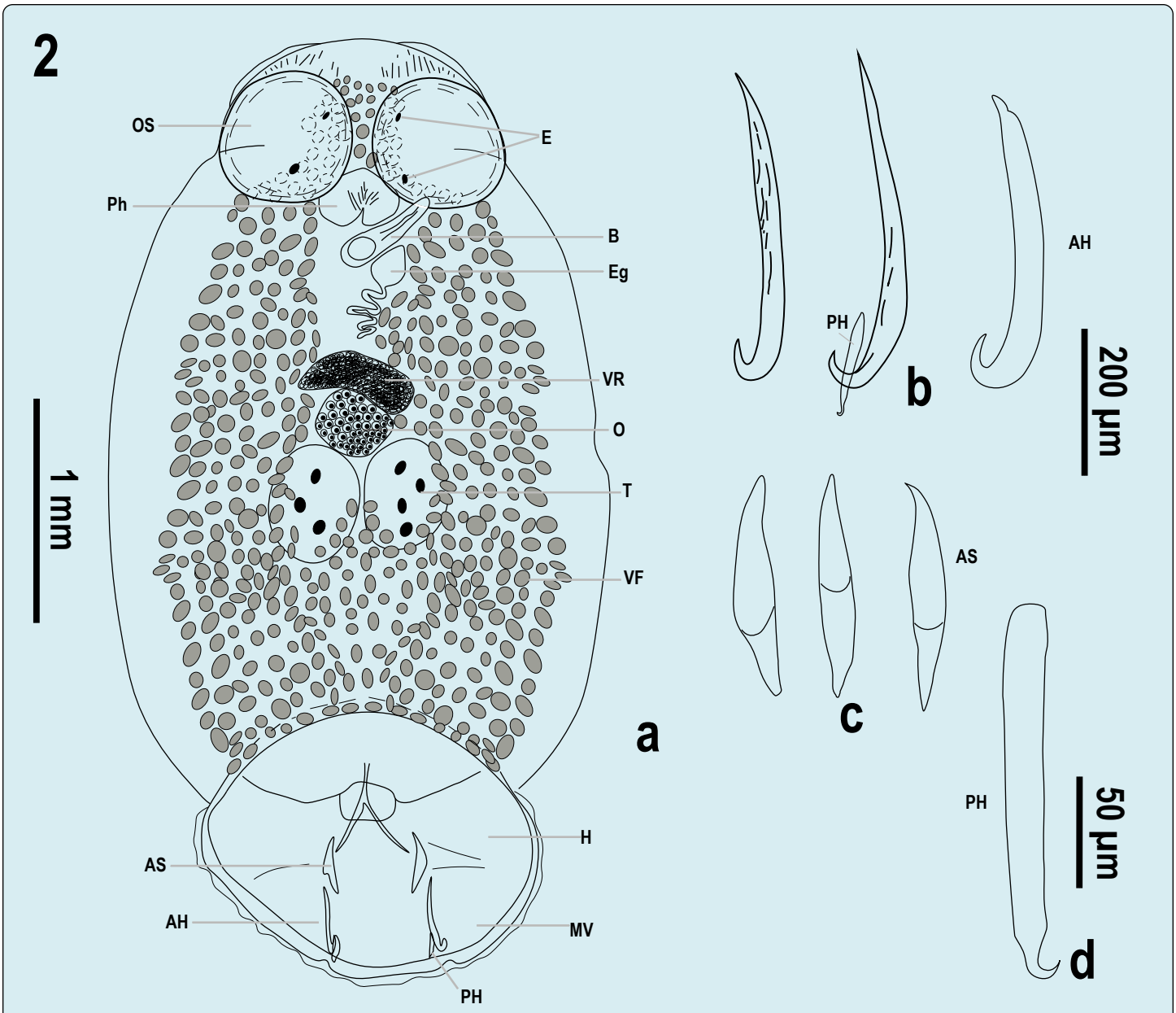

Figure 2: Total view of *Pseudobenedenia lauriei* Szidat 1965: E – eyes, OS – oral sucker, Ph– pharynx, B – bursa, Eg – egg, VR – vitelline reservoir, O – ovary, T – testes, VF –vitellaria filed, H – haptor, MV – marginal valve, AS – accessory sclerite, AH – anterior hamulus, PH – posterior hamulus. 2b: AH – anterior hamuli (not in profile, from three different specimens, PH – posterior hamulus in its natural adjacent position to anterior hamulus; 2c: accessory sclerites; 2d posterior hamulus, in profile.

Remarks

Because the description of *P. lauriei* lacked detailed graphic information, we provided additional information extracted from the museum collection. Fig. 1 shows a light microscopy photograph of *P. lauriei*. Fig 2 shows a line drawing based on all available whole mounts (Fig. 2a). We made drawings of sclerotized parts of haptor (Fig. 2 B-C). As for anterior hamuli (2B), none of them was perfectly positioned in profile, which was impossible to correct in Canada balsam, we found informative accessory sclerites (2 C) and posterior hamulus (2 D).

Differential Diagnosis

Pseudobenedenia lauriei differs from *P. nototheniae* by smaller oral suckers diameter, pharynx, testes, and haptor diameter, by shape of the anterior hamulus (Table 1), anterior hamulus to accessory sclerite ratio 1.7 (versus 2.1 in *P. nototheniae*) and by the host species. We consider *P.*

nototheniae a species complex, so this comparison is relative.

Pseudobenedenia lauriei differs from *P. coriicepsi* by smaller body length and width, larger diameter of oral suckers and ovary, smaller diameter of pharynx, anterior hamulus, and accessory sclerite (Table 1), anterior hamulus to accessory sclerite ratio 1.7 (versus 1.4 in *P. coriicepsi*) [11] and by type of host.

Pseudobenedenia lauriei differs from *P. gibberifrons* and from *P. dissostichii* by all smaller metric parameters, and by different hosts (Table 1).

Discussion

Some specimens from the museum that we studied were in a very poor state, but we tried to measure them as precisely as possible. There was a sixth specimen marked as *P. lauriei* from *N. neglecta* in the museum collection that was completely unsuitable for research. If we took into account only two specimens collected in 1963 by Szidat and Bellizio, they still differed from the published material by Szidat in 1965 in the original description. The diameter of pharynx differs (0.5 and 0.46 from 0.3 in the original description as well as accessory sclerite and anterior hamuli are slightly longer than in the description of *P. lauriei* [3], while other measurements correspond to those published in the description). This indicates that the original description was based on more than these two specimens collected in 1963 or (less likely) that the author did not use these specimens for the description at all. What matters is that they were collected by the author in the same location and the same host and were never designated for this species deposited in the museum until the present.

According to our data, we can see that the original measurements of *P. lauriei* lay in the range of our measurements of the *P. lauriei* collected by the author [3]. The original description was missing data on the ovary, testes, bursa, haptor diameter, and egg. The only parameter that was out of the range is the length of the tiny sclerotized structure - the posterior hamulus that was 0.1 in Szidat`s description [3] and 0.22 in ours. Therefore, by the metric parameters and by host specificity our data and Szidat's description form the harmonic unity. Despite the somewhat poor quality of these 60-year-old specimens, we tried to create a more detailed drawing of the whole view of *P. lauriei* together with more detailed images of sclerotized structures of haptor (Fig. 2, b-d). In the studied whole mounts, sclerotized structures never appeared perfectly in profile, as needed for taxonomical studies, and extremely difficult to achieve while working with such big monogeneans as Capsalidae are [11].

Our results suggest that synonymizing *P. lauriei* with *P. nototheniae*, [6] was in error. Intuitively Gibson [6] may have detected that something with his synonymy was not right. He wrote about the surprisingly low degree of host-specificity of *P. nototheniae,* which markedly contrasts with the related *Entobdella solae* Kearn, 1967, which has strict host specificity. He also had the right notion that there is something wrong with such a wide range of hosts, emphasizing that *P. nototheniae* being a skin parasite should be susceptible to any immune factors present in the mucus of its host [6].

The host of *P. lauriei, Notothenia neglecta* Nybelin, 1951 is a valid fish species, the closest sister species to *Notothenia coriiceps* Richardson, 1844 [12,13]. *Notothenia neglecta* is spread along the coast of the Antarctic continent, Antarctic Peninsula, South Georgia, South Shetland, South Orkney Islands, and Peter I Island, according to Fish Base [14].

While studying Capsalids from twenty-three species of notothenoid fish, including fourteen representatives of family Nototheniidae, over few years in Atlantic part of Antarctica, Timofeeva, et al. [10] have formulated few patterns that are common for these monogeneans. All *Pseudobenedeniae* specimens collected from one species of host were different from ones from other fish species by body size, size of haptor, sizes of its sclerotized attachment structures of haptor and by their shape, sizes and relative position of sexual organs [10]. The localization on the body of the individual hosts was often different, and there was a difference in parameters of infection [10]. That corresponds with our published data [11] and our data that are in press. Thus, different notothenid fish harbor close but different species of *Pseudobenedenia*, as well as two other genera of *Pseudobenedeniella* Timofeeva, Gaevskaja, Kovaleva, 1987 and *Pseudobenedenoides* Szidat, 1969 [1,7,10]

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