S. 89–94

Redescription of *Anisus septemgyratus* (Rossmässler, 1835) and *Anisus leucostoma* (Millet, 1813) (Gastropoda: Planorbidae)

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> Abstract

In the present paper we give a redescription of *Anisus septemgyratus* (Rossmässler, 1835) and *A. leucostoma* (Millet, 1813), and compare both these species with *A. spirorbis* (Linnaeus, 1758). In addition, we designate a neotype of *A. leucostoma*. The shells of not fully-grown specimens under discussion can be confused with each other because the distinguishing shell features are very weekly developed, however, in doubtful cases the three species can be determined by means of the number of prostate diverticles.

> Kurzfassung

Wiederbeschreibung von *Anisus septemgyratus* (Rossmässler, 1835) und *Anisus leucostoma* (Millet, 1813) (Gastropoda: Planorbidae). – In der vorliegenden Arbeit geben wir eine Wiederbeschreibung der Arten *Anisus septemgyratus* (Rossmässler, 1835) und *A. leucostoma* (Millet, 1813) und vergleichen diese mit *A. spirorbis* (Linnaeus, 1758). Außerdem designieren wir einen Neotypus von *A. leucostoma*. Die Gehäuse nicht vollständig ausgewachsener Tiere, die hier zur Diskussion stehen, können untereinander verwechselt werden, da die Unterscheidungsmerkmale sehr schwach ausgebildet sind, aber im Zweifelsfall können sie anhand der Prostatadivertikel determiniert werden.

> Key words

Anisus septemgyratus, *Anisus leucostoma*, *Anisus spirorbis*, redescription, neotype.

Introduction

The taxonomy of the genus *Anisus* s. str. has been under discussion for a long time. The separation of the two species *Anisus spirorbis* (Linnaeus, 1758) and *A. leucostoma* (Millet, 1813) seems to be problematic (e. g. ANDERSON 2005), and in HUBENDICK's opinion (1951) they are conspecific. One of HUBENDICK's arguments was the anatomy, being indistinct in both species, as depicted by BAKER (1945). According to HUDEC (1967) *A. septemgyratus* (Roßmäßler, 1835) is a subspecies of *A. leucostoma*, while LOŽEK (1964) regarded these species as being distinct because they prefer different habitats. BERAN & HORSÁK (2002) presented anatomical differences in *A. septemgyratus* from *A. spirorbis* as well as from *A. leucostoma*. Only in regions where all three species live together, the distinctness of these could be pointed out by the authors of identification keys (e. g. EHRMANN 1933: 168–169, SÓOS 1943: 103–106, LOŽEK 1964: 182–184, GROSSU 1955: 134–139, GLÖER 2002: 255–260, GLÖER & MEIER-BROOK 2003: 60–61, RICHNOVSKY & PINTÉR 1979: 104–107).

FALKNER collected topotypes of *A. septemgyratus* and assigned this species, by means of their shells, to *A. leucostoma*. Thus *A. leucostoma* has to be named *A. septemgyratus* because of priority, whereas for *A. septemgyratus* FALKNER et al. (2002), found *A. calculiformis* (Sandberger, 1875) to be the next valid name.

The present paper attempts to solve the problem of taxonomical confusion in this genus.

Material and methods

We studied materials fixed in ethanol from several European regions and Siberia, too. Three specimens of any lot were dissected to make sure that the ana-

tomical features were constant within one population. For further conchological measurements we also used samples that contained dried materials.

We tried to borrow the syntypes from the Museum of Natural Science in Angers, where Millet's collection is housed, according to a description of this Museum (http://fr.federal-hotel.com/monument-museum-des-sciences-naturelles-angers_1672.htm), but the numerous lots of freshwater molluscs are stored in bags, and the bags in boxes, and neither the syntypes, nor any other lots of Millet's collection (Benoît Mellier, in litt.) could be found. Thus we used materials of *A. leucostoma*, collected 150 km SW from Angers.

The dissections of the genital organs and measurements of the shells were carried out using a ZEISS stereo microscope with an eyepiece-micrometer; the photographs were made with a Leica R8 digital camera system.

The starting point of our investigations was to check the original descriptions and to compare these with the materials collected. As far as possible we studied topotypes of the *Anisus* species under discussion.

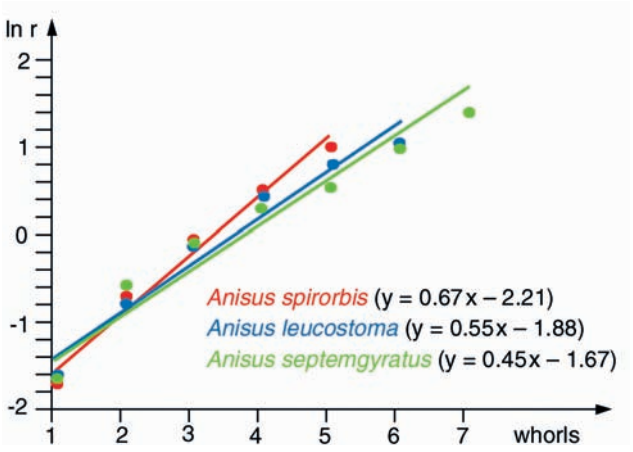

Fig. 1. Linear regression of ln r as a function of the number of whorls. Dots = mean values of measured shells (n = 20/ specimens).

Results

As not only *Anisus leucostoma* and *A. septemgyratus* are very similar in shell shape, particularly in juvenile state, but in addition *A. spirorbis*, too, we deemed it adequate to include the latter species in our consideration.

The shell of the species grows along a logarithmic helix following the function $r = a \cdot e^{n\phi}$, so we get a linear function if we take the logarithm of the radius (r). The curves show that the ratio of number of whorls to diameter is very similar, with an overlap in all three species, and the only visible difference is the maximum in the number of whorls. Therefore, it is very hard to determine juveniles of these *Anisus* species.

Shells of equal size of the three species (fig. 4.1–3) can be distinguished by means of the height of their shell. In addition, the whorls of *Anisus spirorbis* are rounded to a higher degree than is found in the other ones, and the whorls of *A. septemgyratus* are slightly angled. The body whorl in *A. leucostoma* is broader than in *A. septemgyratus*, and in *A. spirorbis* it is broader than in *A. leucostoma*. But at least it is hard to tell apart non-adult specimens of these species without reference material.

The proportions of the preputium to penis sheath is variable in all three species under discussion. Additionally the bursa in all species is slim and elongated (fig. 4.7–9), and also the prostate duct is equal in all three species. The only feature that is suitable to distinguish these *Anisus* spp. is the number of prostate diverticles. This feature is relatively constant: 10–15 in *A. spirorbis*, 20–25 in *A. leucostoma*, and 30–50 in *A. septemgyratus*. The number of prostate diverticles, however, is independent of the age of the individuals and e. g. in *A. leucostoma* collected in France, Hamburg and Siberia in the same order of magnitude.

Anisus spirorbis (Linnaeus, 1758)

Helix spirorbis Linnaeus (1758, p. 770).

In 1746 LINNAEUS (p. 373, no. 1305) already mentioned this species from Sweden (terra typica) but it is at present very rare in this country. NILSSON et al. (1998) found *A. spirorbis* only in one sampling site where HUBENDICK (1947: 448) collected it but the authors (1998, appendix 4) mentioned it as *A. leucostoma*. Ted von Proschwitz (Goeteborg) did not find *A. spirorbis* in Sweden in recent years, either (pers. comm.). It is hard to find *A. spirorbis* from Sweden in the collection of Goeteborg Museum because all lots have been labelled by Hubendick as *A. spirorbis*, all *A. leucostoma*, too (von Proschwitz, pers. comm.). Thus we could only study materials from Ireland, Germany, Poland, Czech Republic, and Serbia.

Distinguishing features: The shell consists of 4–4.5 slightly convex whorls. The body whorl is broader than in *A. leucostoma*. The aperture is rounded. The maximum of diameter is 5–6 mm, shell height 1.4–1.5 mm.

Male copulatory organ: The prostate gland bears 10–15 diverticles.

Distribution: *Anisus spirorbis* is distributed from Sweden in the north, Ireland in the west, France and N-Italy in the south, Serbia, Romania, Hungary, Czech Republik, Poland and Siberia in the east. *A. spirorbis* could not be found in the Balkans.

(16)

fossés voisins des rivières ; parmi les plantes aquatiques.

A Angers : les fossés des prairies de la Baumette et de S.t-Serges, etc.

7. P. leucostome. *P. leucostoma.*

Planorbis vortex , var. b. *Drap. Hist. des Moll. p.* 44. — *Planorbis rotundatus ? Poir. Prodr. p.* 93.

Testa suprà umbilicata , subtùs plana. Apertura ovalis. Peristomate marginato albo. Anfractibus quinque , suprà subrotundatis , subcarinatis inferiùs.

A. d'un brun-rougeâtre en dessus , rose en dessous. Tentacules roses.

C. jaunâtre ou brunâtre , transparente (1), légèrement striée en travers, ombiliquée des deux côtés, concave en dessus, plane en dessous. Ouverture ovale; bord supérieur dépassant l'inférieur. Péristôme garni intérieurement d'un bourrelet blanc qui paroît au travers de la coquille. Cinq tours de spire , arrondis en dessus , légèrement carénés en dessous ; le dernier n'est guère plus ample que les autres. Diam. 5 à 6 millim.

En comparant cette espèce avec la précédente , on reconnoîtra facilement les différences qui doivent les séparer : différences qui sont trop fortes pour ne faire de celle-ci qu'une variété , et bien assez marquées pour caractériser une espèce.

(1) Elle est souvent salie par une incrustation limoneuse , de couleur brune.

(17)

En effet , le nombre des tours de spire , la situation de la carène et le péristôme garni d'un bourrelet blanc , différencient assez cette espèce de la précédente. Les sutures sont aussi plus profondes ; de plus , elles habitent rarement ensemble.

Habite les fossés aquatiques ; parmi les étoiles et lentilles d'eau.

A Angers : les fossés en Pierre-Lize , en S.t-Laud , etc.

8. P. spirorbe. *P. spirorbis.*

Mull. Verm. Hist. 347. — *Drap. Hist. des Moll. p.* 45. — *Poir. Prodr. p.* 91. — *Helix spirorbis. Linn. Syst. nat.* 672. — *Le petit Planorbe à cinq spirales rondes. Geoff.* 87.

A. blanchâtre.

C. blanchâtre , plane et un peu ombiliquée en dessus , concave et fortement ombiliquée en dessous. Cinq tours de spire convexes ; le dernier plus ample. Ouverture ovale , à bords épaissis. Diam. 4 à 5 millim.

Habite les rivières , les fossés voisins des rivières.

A Angers : la Mayenne , les fossés des prairies de la Baumette et de S.t-Serges.

2.

Fig. 2. Facsimile of the original description of *Anisus leucostoma* (Millet, 1813)

Anisus leucostoma (Millet, 1813)

Planorbis leucostoma Millet (1813, pp. 16–17).

Regarding the original description (Fig. 2) of *A. leucostoma* by Millet (1813), he refers to Draparnaud (1805: 45, pl. 2, fig. 6, 7), who mentioned this species as *A. vortex* var. *β* and depicted a regularly growing shell with a diameter of 6 mm and approximately 6 whorls. This drawing clearly shows *A. leucostoma*.

In order to clarify the identity of *A. leucostoma*, Falkner collected topotypes of this species at "Les chapelles near Angers". According to Bank et al. (2007: 53) the ditches mentioned by Millet no longer exist and in the surroundings only *A. spirorbis* could be found. The latter species was collected by Millet in Angers at "les fossés des prairies de la Baumette" (fig. 5), so both species live in this region. On the other hand Boulord et al. (2007: 193) mentioned, in addition to *A. spirorbis*, findings of *A. leucostoma* (mentioned as *A. septemgyratus* sensu Falkner) in their distribution maps also from the region of Angers.

Ehrmann (1933, p. 169) pointed out that forms of *A. leucostoma* that possess more prominent last whorl can be confused with *A. spirorbis*. Hubendick (1951) argued on the ground of measurements of whorl numbers to diameter and breadth of the last whorl to diameter in *A. spirorbis*, but the species he measured had six whorls (p. 553, fig. 2) and so should be *A. leucostoma*. His measurements are not appropriate to show the distinctness of the species under discussion because they differ in the height of the shell, which is, however, almost independent of the shell's diameter, the proportion of the width of the last two whorls, and the number of whorls. The other argument of Hubendick that *A. spirorbis* and *A. leucostoma* are conspecific is the "identical anatomy" (Hubendick 1951, p. 556) "there are not known any significant anatomical features which can motivate a specific separation of the forms (cf. Baker 1945, p. 57 ff.)". But Baker (1945, p. 57) mentioned differences in the prostate diverticles ("in *spirorbis* about twenty and in *leucostoma* over 20"), different length in prostate duct, different length of prostate, and prostate diverticles. But the drawings

of the anatomies of *A. spirorbis* (pl. 6, fig. 12) and *A. leucostoma* (pl. 7, fig. 2) possibly refer to the same species, and the number of prostate diverticles in the figures does not correspond to BAKER's text.

Distinguishing features: The shell consists of 6–6.5 slightly convex whorls. The body whorl is broader than in *A. septemgyratus*, the aperture is rounded, the maximum of diameter is 6–7 mm, shell height 1.4–1.5 mm.

Male copulatory organ: The prostate gland bears 20–25 diverticles.

Distribution: *Anisus leucostoma* is distributed from South Norway in the north, Ireland in the west, France and N-Italy in the south, to Siberia in the east of the distribution area. It could not be found in the Balkans so far.

Remarks: The syntypes of *A. leucostoma* could hitherto not be found in Millet's collection. As the identity of *A. leucostoma* is under debate (FALKNER et al. 2002: 99, BANK et al. 2007: 53), we designate a neotype of *A. leucostoma* with its type locality at St. Georges du Bois (Charente-Maritime, France), ca. 150 km apart from Angers, which is the same zoogeographical region (Atlantic), and because it is a common species in this region (BOULORD et al. 2007: 193). This neotype is deposited in the Zoological Museum Hamburg (ZMH 51204).

Anisus septemgyratus
(Rossmässler, 1835)

Planorbis septemgyratus Rossmässler (1835, p. 106, pl. 2, fig. 64)

Formerly there was confusion as to the authorship of this species' name. EHRMANN (1933, p. 168) mentioned E. A. Bielz, 1863 as the author but according to ZILCH (1962) the author is Rossmässler 1835. ROSSMÄSSLER (1835) as well as BIELZ (1863) mentioned Ziegler as being the author of this species, but this was only a manuscript name by Ziegler.

The topotypes collected by Falkner are not fully-grown specimens, so they look exteriorly similar to *Anisus leucostoma* (however with 35 prostate diverticles), but 10 km south of Bolzano (Fosso Grande di Caldaro a valle di Rio Largo, leg. 28.07.2002), the type locality, Marco Bodon (Italy) found fully grown adults of *Anisus septemgyratus*.

Distinguishing features: The shell consists of 7.5–8.5 whorls, which are slightly angled at the functional under side. The whorls are growing regularly. The aperture is rounded to slightly rectangular. The maximum diameter is 7–8 mm, shell height 1.0–1.2 mm.

Male copulatory organ: The prostate gland bears 30 to more than 50 diverticles.

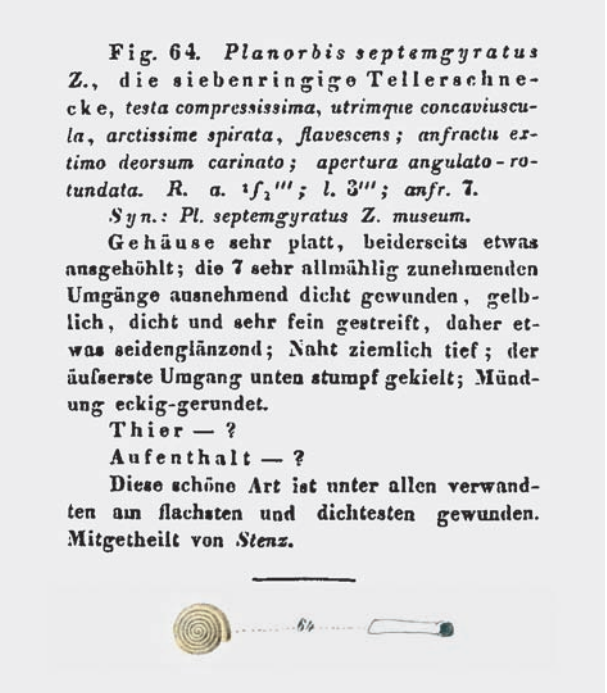

Fig. 64. *Planorbis septemgyratus* Z., die siebenringige Tellerschnecke, *testa compressissima, utrimque concaviuscula, arctissime spirata, flavescens; anfractu extimo deorsum carinato; apertura angulato-rotundata. R. a. 1f$_2$‴; l. 3‴; anfr. 7.*

Syn.: Pl. septemgyratus Z. museum.

Gehäuse sehr platt, beiderseits etwas ausgehöhlt; die 7 sehr allmählig zunehmenden Umgänge ausnehmend dicht gewunden, gelblich, dicht und sehr fein gestreift, daher etwas seidenglänzend; Naht ziemlich tief; der äußerste Umgang unten stumpf gekielt; Mündung eckig-gerundet.

Thier — ?

Aufenthalt — ?

Diese schöne Art ist unter allen verwandten am flachsten und dichtesten gewunden. Mitgetheilt von *Stenz.*

Fig. 3. Facsimile of the original description of *Anisus septemgyratus* and of the depicted drawing no. 64 on plate 2.

Distribution: *Anisus septemgyratus* is distributed from Northeast Germany at the northwest, France and N-Italy in the south, Romania, Hungary, Czech Republik, and Poland in the east. The eastern border of the distribution area is unknown. It could not be found in the Balkans.

Discussion

According to HUDEC (1967) his descriptions of the shell shape of the three *Anisus* species under discussion agree with our results. But the distinguishing feature pointed out by HUDEC (1967): the different ratio of praeputium (prp) to phallotheca (pht), 2:1 in *A. spirorbis* and 1:1 in *A. leucostoma* as well as in *A. septemgyratus*, not reconcilable with our results. Already BERAN & HORSÁK (2002) found proportions between prp and pht in the *Anisus* species under discussion, different from those mentioned by Hudec (1967). Our investigations showed us, that the ratio of prp : pht is variable and thus not suitable to distinguish *Anisus* spp. from each other. The only constant feature is the number of prostate diverticles, which varies in a small range in every *Anisus* spp. dicussed here.

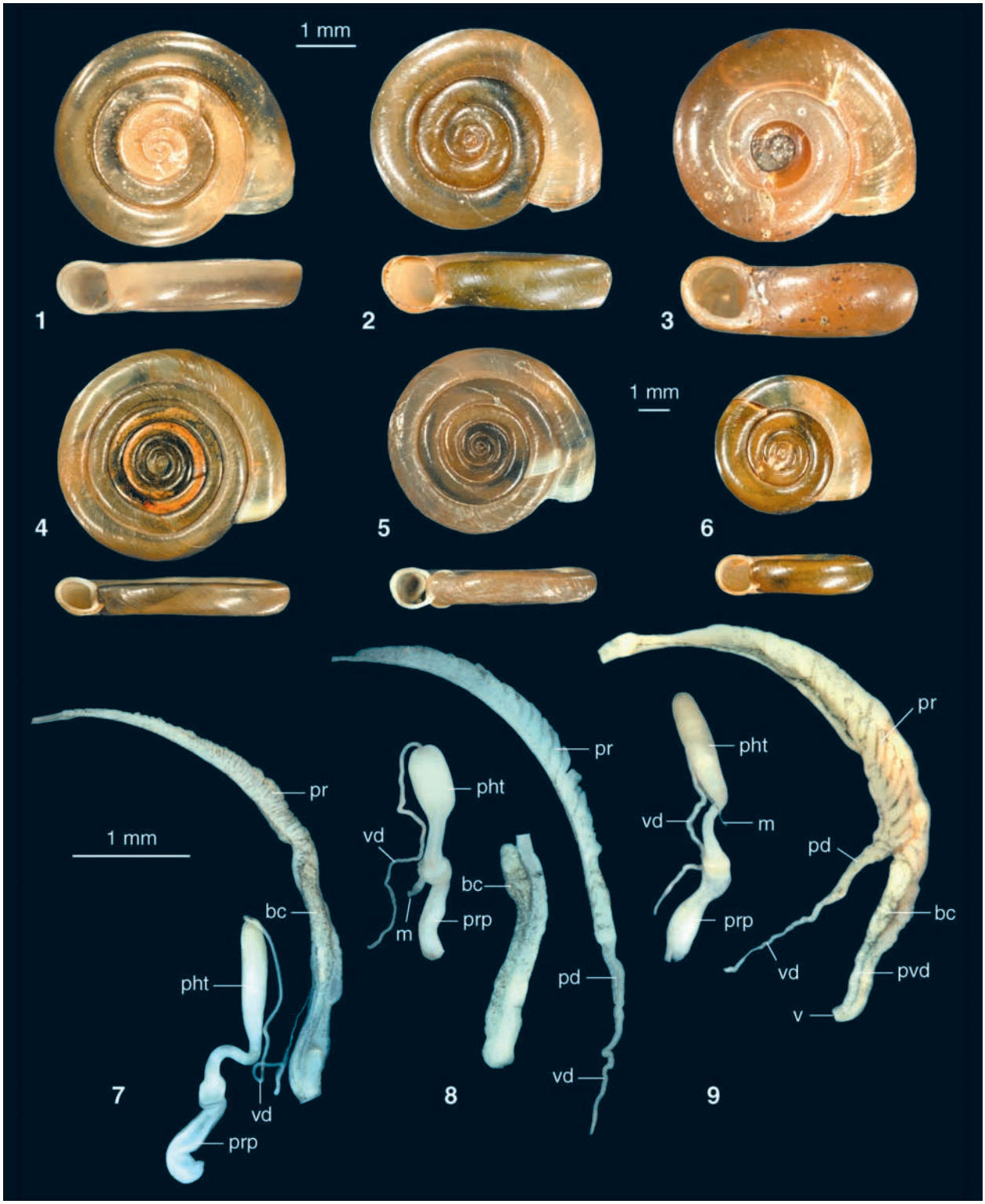

Fig. 4. *Anisus* species. **1-3:** shells not full-grown: **1:** *A. septemgyratus* (loc. typ.), **2:** *A. leucostoma* (Hamburg), **3**: *A. spirorbis* (Czech Republic). Each shell (1–3) has a diameter of 4.2 mm. – **4–6**: adult specimens: **4**: *A. sptemgyratus* (Güstrow, Mecklenburg-Vorpommern), **5**: *A. leucostoma* (Charante Maritime, France, neotype), **6**: *A. spirorbis* (Pester Plateau, Serbia). – **7–9**: Male sex tract: **7**: A. *septemgyratus* (Topotype, Italy). **8:** *A. leucostoma* (neotype), **9:** *Anisus spirorbis* (Pester Plateau, Serbia). – **bc** = bursa copulatrix, **bd** = bursa duct, **m** = muscle, **pd** = prostata duct, **pht** = phallotheca, **pr** = prostata, **prp** = preputium, **pvd** = provaginal duct, **v** = vagina, **vd** = vas deferens.

Tab. 1. The distinguishing features of the *Anisus* species under discussion.

Taxon	No. of whorls	No. of prostate diverticles	Shell width [mm]	Shell height [mm]
A. spirorbis	4 – 4.5	10 – 15	5 – 6	1.4 – 1.5
A. leucostoma	6 – 6.5	18 – 22	6 – 7	1.4 – 1.5
A. septemgyratus	7.5 – 8.5	30 to >50	7 – 8	1.0 – 1.2

Conclusion

Summarising, we can state that the shells of not fully-grown *Anisus* species under discussion are hard to assign to species without reference materials. The fully-grown adults can be distinguished by means of the shells' height and the number of whorls. In addition the *Anisus* spp. can be recognised by the number of prostate diverticles in any case (Tab. 1).

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We would like to express our thanks to Gerhard Falkner for the topotypes of *Anisus septemgyratus*, Marco Bodon who lent us *A. septemgyratus* from the region of Bozen, Maxim Vinarski for specimens of *Anisus leucostoma* collected in Siberia, Wolfgang Wrawzinek for the neotype of *A. leucostoma* from France, Luboš Beran for the *Anisus* materials from the Czech Republic, and Benoît Mellier who searched Millet's collection. In addition, we are thankful to David Walker who smoothed our English.

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