

# THE *PLANORBIS* SPECIES OF THE BALKANS WITH THE DESCRIPTION OF *PLANORBIS VITOJENSIS* N. SP. (GASTROPODA: PLANORBIDAE)

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*Abstract* New samples from Greece revealed a *Planorbis* sp. which could be identified as *Planorbis atticus* by comparing these specimens with topotypes of Bourguignat's collection. The anatomy of *P. atticus* has been compared with that of *Planorbis* spp. living in neighbouring countries and revealed that *P. atticus* is distinct from *P. planorbis*, *P. macedonicus*, *P. presbensis*, and *P. intermixtus*, as well. Because the syntypes of *P. atticus* could not be found in Bourguignat's collection in Geneva nor in Paris we designate a neotype.

In addition new samples from Montenegro revealed an unknown *Planorbis* species, which we describe here as *P. vitojensis* n. sp., which seems to be closely related with *P. carinatus* O.F. Müller 1774, and *P. kubanicus* Soldatenko & Starobogatov 1998.

A distribution map of the *Planorbis* spp. under discussion is given.

*Key words* *Planorbis atticus*, *Planorbis planorbis*, *Planorbis intermixtus*, *Planorbis carinatus*, *Planorbis kubanicus*, *Planorbis vitojensis* n. sp., neotype

## INTRODUCTION

There are 4 species of *Planorbis* known from Greece: *Planorbis atticus* Bourguignat 1852, *P. carinatus* O. F. Müller 1774, *P. planorbis* (Linnaeus 1758), and the endemic species *Planorbis presbensis* Sturany 1894, which occurs in Lake Prespa (Bank 2006: 86). In addition, in the neighbouring Lake Ohrid, the endemic species *P. macedonicus* Sturany 1894 occurs.

When Meier-Brook (1976) studied the generic position of *Planorbis intermixtus* Mousson 1874, he stated that this species name is possibly a younger synonym of *P. atticus*, but he could only examine two specimens of *P. atticus* from Mykonos and one specimen from Crete, but no topotypes or syntypes.

The conchological differences between the sibling species *Planorbis planorbis*, *P. atticus* and *P. intermixtus* are very slight and can only be reliably determined by the shell's size combined with the number of prostate diverticules, an important feature to distinguish species of the Planorbidae.

In addition to the *Planorbis* species mentioned above, which are closely related to *Planorbis planorbis*, an additional species *Planorbis kubanicus*, which Soldatenko & Starobogatov (1998: 60) believe is distributed from Königsee (Bavaria,

Germany) to its type locality (Kuban river), seems to be closely related to *P. carinatus*. Both species also differ in their prostate diverticules.

This paper is intended (i) to elucidate the taxonomic status of *Planorbis atticus*, (ii) to describe the new species *P. vitojensis* n. sp., and (iii) to provide a distribution map of the *Planorbis* spp. mentioned above.

## MATERIAL AND METHODS

V. Pešić collected freshwater molluscs in Iran and Greece in 2005 and 2007. The samples were fixed in 75% ethanol. The dissections and measurements of the genital organs and the shells were carried out using a Zeiss stereo microscope and the photographs were made with a Leica R8 digital camera system.

The material examined was collected in Greece (June/July 2007): **GR1:** Evia Island., the region of Ochi, Lala stream (downstream) near Karystos, **GR2:** Evia Island, the region of Ochi, Metochi spring (GPS 540871 4208827) 600 m asl., **GR3:** Evia Island, the region of Ochi, Aetos stream near Aetos village (near Karystos town), **GR4:** River Evrotas near Sparti, **GR5:** Region of Sparti town, Sentenikos spring (close to Zoros spring), **GR6:** Region of Sparti town, Evrotas river near Vivari spring, **GR7:** Region of Githio city, Vasilopotamus river near Skala town, **GR8:**

Region og Githio city, Evrotas river near Skala town city. In addition we were able to examine three lots from Meier-Brook's collection: **GRM1**: ditch near the road Larissa-Trikala, and **GRM2**: Island Mykonos (well in the east part of the hotel Aphrodite), **GRM3**: Lividia, as well as four lots of Rähle's collection: **GRR1**: Zakynthos, brook near Keri, **GRR2**: Kephallina, small pond near Kouzourata SE Sami, **GRR3**: Korfu, brook near Sidari, **GRR4**: Sparti, banks of river Evrotas.

To compare these lots of *Planorbis atticus* with *P. intermixtus* we used material from Iran (June 2005): **IR1**: Markazi Province, Ashtian to Arak road (ca. 5 km after Ashtian), 50°01'E 34°34'N,

ca. 1800 m asl., **IR2**: Markazi Province Aman Abad spring in Anjedan road before Aman Abad village (ca. 5 km to Aman Abad village) 49°48'E 33°55'N, ca. 1700 m asl., and samples collected in August 2007: **IR3**: Iran, Fars Province, Shiraz to Sepidan road (10 km to Sepidan), 1391 m asl., stream, 30°12'N 52°05'E, **IR4**: Iran, Fars Province, Shiraz to Sepidan road (1 km to Sepidan), 1098 m asl., rheocrenic spring, 30°15'N 52°55'E, **IR5**: Iran, Markazi Province, Aman Abad (near Arak city), pool, 1775 m asl., 33°59'N 49°52'E.

From every sample we dissected two to three specimens, and counted the prostate diverticules. In samples which contained specimens

**Table 1** The studied features of the *Planorbis* spp. under discussion.

Sampling site	Species' name	No. of specimens	Shell diameter [mm]*	Body whorl	Prostate diverticules
GR1	<i>P. atticus</i>	38	5.5–7.8	rounded	22/22/23
GR2		18	4.3	rounded	16/17
GR3		15	5.5–5.8	rounded	17/17
GR4		37	5.5–7.5	rounded/angled	23/24/26
GR5		15	6.5–8.0	rounded	20/21
GR6		20	4.5–6.5	tounded	16/18
GR7		16	5.8–6.4	angled, keeled	21/23
GR8		14	4.8–5.5	rounded	17/18
GRM1	<i>P. intermixtus</i>	10	6.0–6.8	rounded	23
GRM3		37	5.6–6.0	rounded	22–26
GRR1		17	6.9–6.3	rounded	16/17
GRR2		56	5.0–5.6	rounded	17/18
GRR4		12	4.9–5.0	angled	26
GRM2		54	6.5–8.5	rounded	35
GRR3		5	6.8–6.9	angled	30
IR1		4	6.3–8.5	rounded	31
IR2		11	6.7–7.5	rounded	28/30
IR3		13	5.6–6.0	keeled	24/26
IR4		18	7.0–8.0	rounded	23/24
IR5		8	7.0–8.5	rounded	31/32
TR, Bingöl**		2		angled	36
MB***					20–36
MB***		<i>P. planorbis</i>			
Hamburg****	1			keeled	46
		12	11.5–12.0	rounded	41
Ohrid Lake	<i>P. macedonicus</i>	13	7.5–8.6	rounded	29–32
Prespa Lake	<i>P. presbensis</i>	3	3.2	rounded	23
MB***	<i>P. carinatus</i>		9.0–15.0	keeled	23–32
S. & S. *****	<i>P. kubanicus</i>		14.2–19.0	keeled	35–37
M1	<i>P. vitojensis</i> n. sp.	24	8.5–10.2	keeled	42–47

\* only shells with four or more whorls were measured

\*\* sample from Turkey, collection of Meier-Brook

\*\*\* results of Meier-Brook (1976)

\*\*\*\* samples from Hamburg, collection of P. Glöer

\*\*\*\*\* results of Soldatenko & Starobogatov

with a distinct periphery we dissected both forms. In addition, we used the results of Meier-Brook (1976), and examined samples of *P. atticus* of Bourguignat's (BGT) collection, housed in Geneva (MNHG): **BGT 7429**: 12 specimens, "environs d'Athenes", topotypes (Fig. 2) [1 specimen slightly angled, all other with a rounded body whorl, max. diameter 7.0 mm], **BGT 7430**: numerous specimens, "marais de Cressida, près de Corfou", [rounded and keeled], **BGT 7431**: 5 specimens "fontaine de Kardachi, Corfou", [rounded and angled], **BGT 7432**: 5 specimens, "Ile d'Eubee", [all rounded].

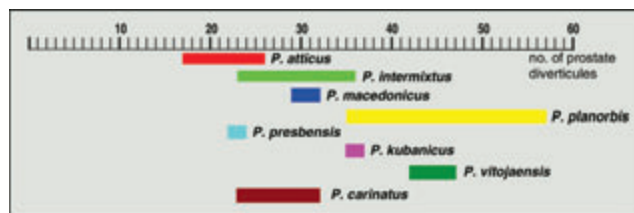
To compare the anatomy of rounded and keeled forms of *Planorbis planorbis* we dissected specimens from a population collected by R. Diercking in Hamburg (a small ditch in Hamburg-Volksdorf).

In 2008 V. Pešić collected new samples of *Planorbis* species from Lake Skadar area. To count the prostates diverticules exactly, the specimens were preserved in a relaxed condition obtained by freezing the specimens down to  $-20^{\circ}\text{C}$  and afterwards defrost them in ethanol.

Voucher material and type material is kept in the Zoological Museum of Hamburg (ZMH, *Planorbis atticus* ZMH 51288, *P. intermixtus* ZMH 51289) and the Zoological Institute of the Russian Academy of Science, Sankt-Petersburg (ZIN).

## RESULTS

Most of the shells of *Planorbis atticus* and *P. intermixtus* had a rounded body whorl, a feature which is also known from *P. planorbis*, others had



**Figure 1** No. of prostate diverticules of *Planorbis* spp.

an angled, or a keeled last whorl. All three forms could be found syntopically. Previously Meier-Brook (1976) had discussed the distinctness of these species, and pointed out that the only distinguishing feature between these species is the number of prostate diverticules, and this is known from other Planorbidae, too, e.g. the species of the genus *Anisus* (Glöer & Meier-Brook, 2008).

The three species *P. atticus*, *P. intermixtus*, and *P. macedonicus*, which look similar to *P. planorbis*, show only a slight overlap in their numbers of prostate diverticules. However, there is no overlap between the number of prostate diverticules between the species *P. kubanicus* and *P. vitojaensis*, the shells of which look similar to *P. carinatus*. The endemic species *P. macedonicus* and *P. presbensis* can be distinguished by their shells from the other *Planorbis* spp. Thus, we suggest that all seven species mentioned in Fig. 1 are good species.

However, no significant differences could be found, between the number of prostate diverticules in rounded, angled or keeled forms of the *Planorbis* spp. nor any zoogeographical or ecological distinctions. Our results also agree with



**Figure 2** Topotypes of (1) *Planorbis atticus* Bourguignat 1852 (BGT 7429, neotype) and (2) *P. graecus* Clessin, 1878.



1° *Planorbis atticus*.

Testa depressa, pellucida, nitida, cornea, argutissime striatula, supra infraque umbilicata; anfractibus  $4\frac{1}{2}$  convexis, infra carinatis, celeriterque accrescentibus; apertura subovali; labro simplice, supra extenso; marginibus ultimo anfractu parum separatis, tenui callo junctis.

Diam. . . . . 8 millim.  
Crass. . . . .  $2\frac{1}{2}$  id

Atticum. prope Athenas in Ilisso flumine ac in rivulis prope Pentelici monasterium, habitat.

Figure 3 Facsimile of the original description.

Meier-Brook (1976) who pointed out that the number of prostate diverticules is not dependent on the age of a specimen. An overall view of the species mentioned above is given in Fig. 8.

Family *Planorbidae* Rafinesque 1815

Genus *Planorbis* O.F. Müller 1773

Type species *Planorbis planorbis* (Linnaeus 1758)

*Planorbis atticus* Bourguignat 1852

Syn.: *P. atticus* var. *arethusae* Clessin 1879; *Planorbis umbilicatus* var. *heterodoxa* Westerlund & Blanc 1879.

*Redescription* Similar to *Planorbis planorbis* but smaller in diameter, shell horn-coloured, 4.5 whorls regularly increasing in size, suture deep, surface glossy with close transverse growth lines, aperture oval, body whorl rounded, angled, or keeled, first whorls on both sides depressed. Largest diameter 8.0 mm, height 2.5 mm.

*Animal* The mantle pigmentation is light grey (Fig. 4), the tentacles are dark grey or whitish. The prostate gland bears 17–26 diverticules (Fig. 4).

Because the syntypes could not be found in Bourguignat's collection in Geneva and in Paris, neither, we designate the specimen, depicted in Fig. 2.1, as the neotype.

*Planorbis vitojensis* n. sp.

*Material examined* 24 specimens from type locality.

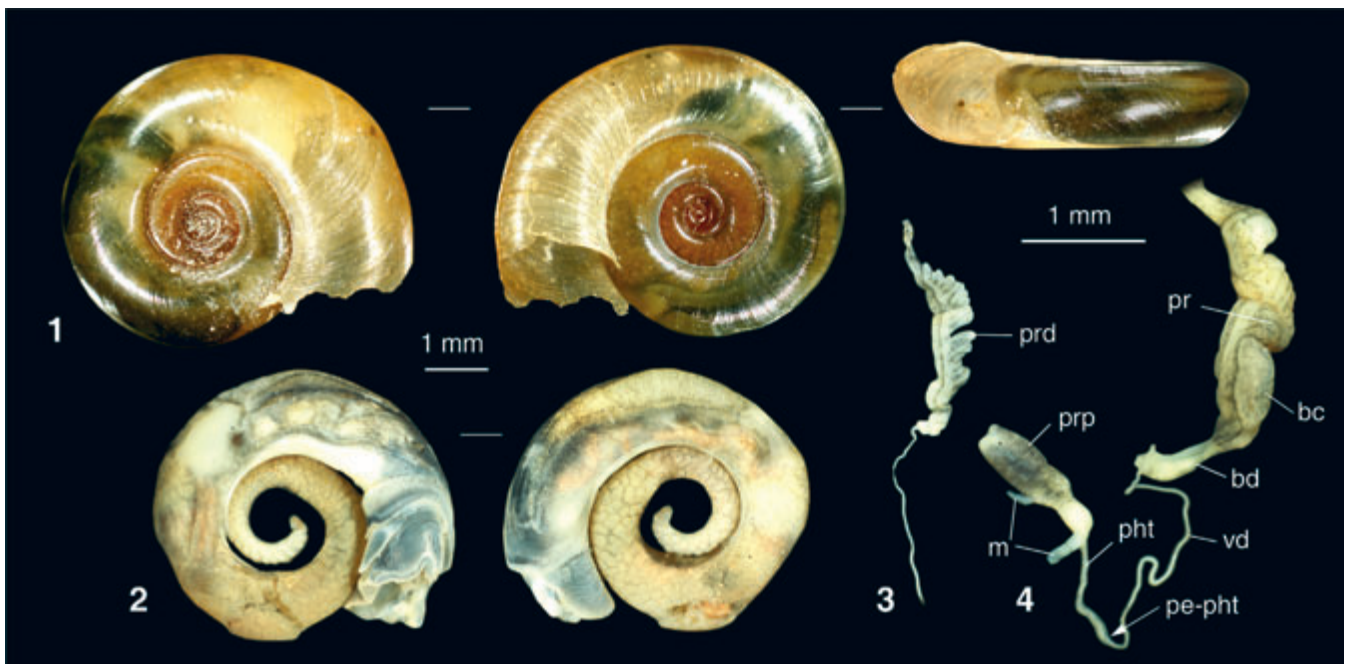


Figure 4 *Planorbis atticus* from Region of Sparti, Greece (GR5). 1: shell, 2: mantle pigmentation, 3: prostate gland with vas deferens, 4: sexual tract. – bc = bursa copulatrix, bd = bursa duct, m = muscle, pe-pht = proximal end of phallotheca, pht = phallotheca, pr = prostata, prd = prostata diverticules, prp = preaputium, vd = vas deferens.



**Figure 5** Left: The sampling site of *Planorbis atticus* from the region of Sparti, Greece (GR5). Right: The type locality of *P. vitojensis* n. sp. (Photos: V. Pešić)

*Holotype* Diameter 10.5 mm, shell height 1.3 mm (ZMH 51290).

*Paratypes* 3 specimens: Diameter 8.9–10.0 mm, shell height 1.3–1.5 mm plus copulatory organ in ethanol (ZMH 51291), 3 specimens ZIN RAS 1/508–2009, rest in the collection Glöer.

*Locus typicus* Lake Skadar area, lake and connected small ponds, Vitoja near Bozaj (Montenegro), 15.03.2008, V. Pešić leg.

*Habitat* Discovered in the pools, near the Lake Skadar's bank (connected with the lake water, in the winter and spring period). Lives in emergent vegetation consisting of *Ceratophyllum* and *Myriophyllum*, or in emergent (*Phragmites communis*) and floating (*Nymphaea alba*, *Nuphar luteum*) vegetation. Associated with *Bithynia radomani*, *Lymnaea fragilis*, and *Gyraulus meier-brooki*.

*Etymology* Named after the sampling site.

*Description* The shell is discoid, brown, glossy, finely striated, and the 4.5–5 whorls grow regularly. The whorls on both sides are slightly convex with a deep suture, which is deeper on the upper side. The periphery is keeled in the middle of the body whorl, in juveniles basal. Dimensions [mm]: diameter 8.5–10.2, height of the last whorl near the aperture 1.3–1.5 mm.

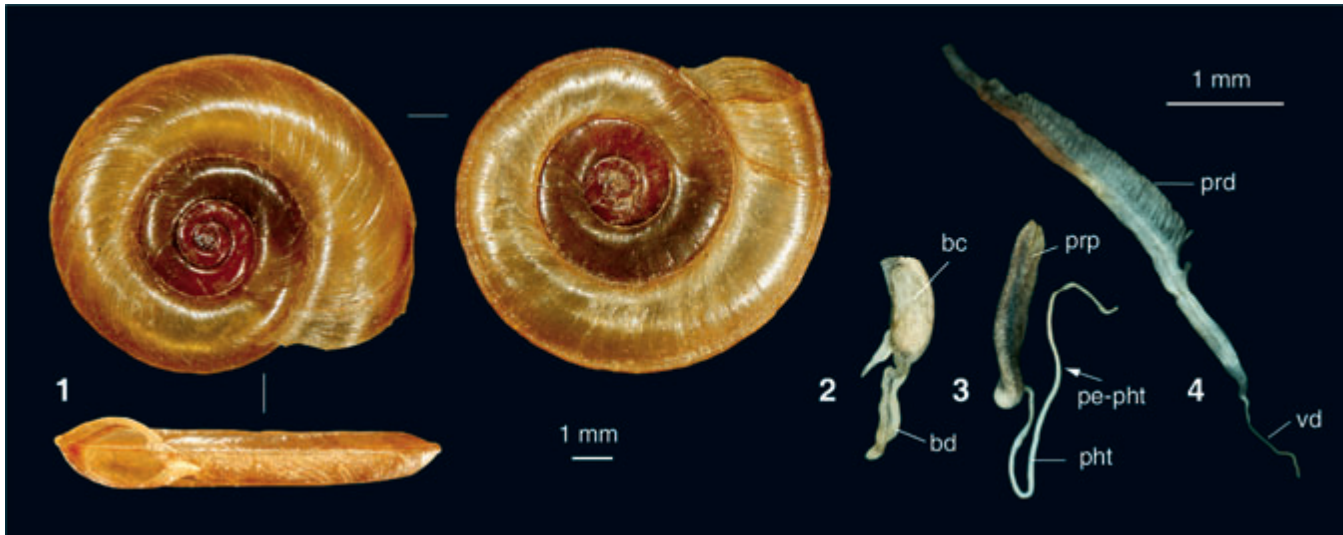
*Animal* Mantle pigmentation dark grey, tentacles light grey. The phallotheca is a little longer than the praeputum (Fig. 6.3), the praeputum is dark pigmented at the dorsal side, the 42–47 diverticules of the prostate are slim and long (Fig. 6.4). The bursa is elongated oval (Fig. 6.2).

*Distribution* At present, this species is known only from the type locality. Because species of the genus *Planorbis* are rare in Montenegro we cannot say if this species is endemic to the Lake Skadar.

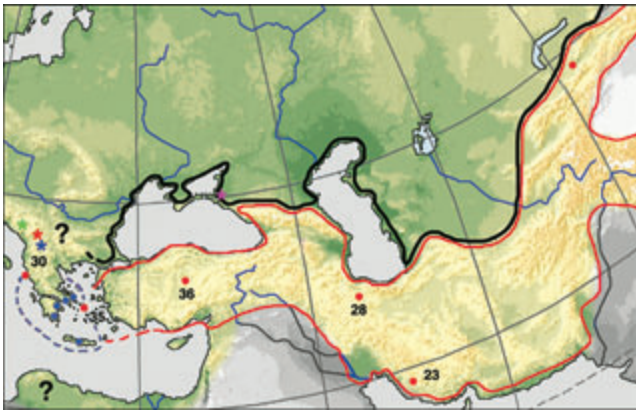
## DISCUSSION

According to Soldatenko & Starobogatov (2000: 28) *Planorbis planorbis* is distributed from Europe to W. Siberia and probably Kazakhstan. In Germany this species prefers the lowlands (not more than 250 m asl., Jaeckel (1962: 64), in Switzerland it prefers also the lowlands (200 m asl.) but, however, occurs up to an altitude of 1860 m asl. (Turner *et al.*, 1998: 116). If we follow Meier-Brook (1983: 92), *P. planorbis* also inhabits N-Africa. *Planorbis atticus* was collected from the lowlands of Greece, but we do not know if it occurs in the mountain regions too.





**Figure 6** *Planorbis vitojensis* n. sp. **1:** The shell (holotype), **2:** Bursa copulatrix, **3:** male copulatory organ, **4:** Prostate gland. – bc = bursa copulatrix, bd = bursa duct, pe-pht = proximal end of phallotheca, pht = phallotheca, pr = prostata, prd = prostata diverticules, prp = preaputium, vd = vas deferens.



**Figure 7** The distribution area and the sampling sites of the *Planorbis* spp. under discussion. – *Planorbis planorbis* (black line), *P. atticus* (blue dashed line), and *P. intermixtus* (red line). The sampling sites of the examined species are marked by dots. The distribution limit of *P. planorbis* in Greece is unknown (?). Red asterisk = *P. macedonicus* (endemic to Lake Ohrid), blue asterisk = *P. presbensis* (endemic to Lake Prespa). The southern distribution limit of *P. planorbis* in the Balkans is unknown (marked by a question mark), as well as the occurrence in N. Africa (marked by a question mark). The numbers show the minimum of prostate diverticules of *P. intermixtus* populations (see discussion). – *Planorbis carinatus* (black line), *P. kubanicus* (magenta asterisk), *P. vitojensis* (green asterisk = Lake Skadar, Montenegro).

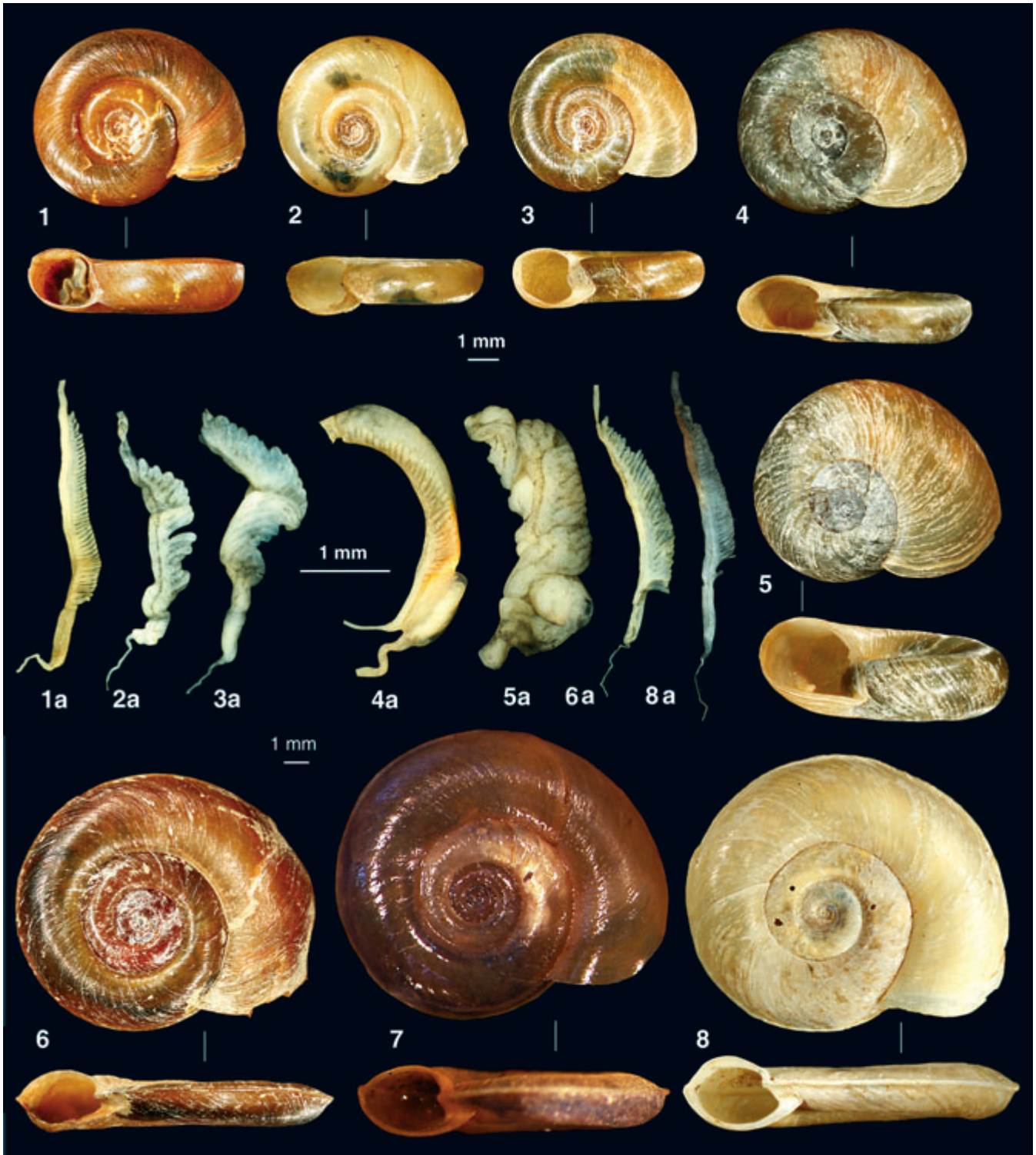
In contrast *P. intermixtus* was found in islands of Greece, the mountains of Turkey and the Iran. The most eastern finding was in the lake Issyk-

Kul (Kyrgyzstan, leg. U. Jueg, det. P. Glöer). Thus *P. intermixtus* inhabits preferably the mountains from Turkey to Kyrgyzstan, though the type locality is Mesopotamia. But in this region it seems to be rare and could not be found in the last years (M. D. Naser, Basrah, *in litt.*).

There is a phenotypical plasticity in the shell shape of the species similar to *Planorbis planorbis* (rounded, angled or keeled body whorl), but a well defined range of prostate diverticules which allow us to distinguish the sibling species *P. planorbis*, *P. atticus*, and *P. intermixtus*. The range of prostate diverticules in *P. intermixtus* is remarkable, because there is a gradient from W to E, with a higher number in the West (35 vs. 23, Fig. 6). There is a gap of about 10 prostate diverticules between *P. atticus* and *P. intermixtus* in Greece which allows separation of both species. Overlapping of the number of prostate diverticules is only visible between *P. atticus* and populations of *P. intermixtus* which live more than 3000 km away in Iran.

The range of prostate diverticules in *P. macedonicus* and *P. presbensis* is much smaller than in the other discussed *Planorbis* spp., maybe because these are endemic populations. The prostate diverticules of the other *Planorbis* spp. of one population, however, also show a smaller range of diverticule numbers.

The *P. cf. atticus* collected in Mykonos which was studied by Meier-Brook (1976: 110) had 27



**Figure 8** The shells and prostate glands of the *Planorbis* spp. under discussion. 1: *Planorbis planorbis* (Hamburg), 2: *P. atticus* (Euboea), 3: *P. intermixtus* (Markazi Province), 4: *P. macedonicus* (Lake Ohrid), 5: *P. presbensis* (Lake Prespa), 6: *P. vitojensis* (Lake Skadar, paratype), 7: *P. kubanicus* (ZIN, paratype, photo: E. Soldatenko), 8: *P. carinatus* (Hamburg).

to 30 prostate diverticules, so he believed that *P. atticus* was a junior synonym of *P. intermixtus*. On the basis of the number of prostate diverticules we believe that this species from

Mykonos belongs to *P. intermixtus* because our results showed, that *P. atticus* is distinct from *P. intermixtus*. The species from Crete, mentioned by Meier-Brook (*ibid.*), which had 19 prostate



diverticules belongs, however, to *P. atticus*. Thus both species, *P. atticus* and *P. intermixtus* occur in islands of Greece, also found in Corfu by W. Rähle. Whether these species live syntopically in islands or are separated by distinct altitudes of their habitats is not known.

Because of the phenotypical plasticity of the shells of the *Planorbis* spp., other species have also been described but it is not possible to identify these *Planorbis* spp. from dried specimens. In Greece, the largest shell of *P. atticus* had a diameter of 8.0 mm, and *P. intermixtus* of 8.5 mm, both with four whorls. But *P. planorbis* can be distinguished from *P. atticus* and *P. intermixtus* by its larger size (up to 18 mm) and a higher number of whorls (up to six). The *Planorbis* spp. we found in Greece could be determined as *P. atticus* or *P. intermixtus*, while *P. planorbis* could not be found there. Thus we synonymise formerly described species from Greece with *P. atticus* or *P. intermixtus*, respectively. These species are:

***Planorbis graecus* Clessin 1878** – loc. typ.: Corfu. The original description states that it is a keeled form with a diameter of 9.5 mm. The syntypes could not be found (Hans-Jörg Niederhöfer, Museum Stuttgart, pers. communication) and are possibly destroyed in the 2<sup>nd</sup> world war. A sample from Corfu could be identified as *P. intermixtus*. Thus we state that *P. graecus* is a younger synonym of *P. intermixtus*.

We could examine three samples from Euboea (GR1–GR3) which revealed only the plastic species *P. atticus*. Thus we synonymise the two subspecies described from Euboea: ***P. atticus* var. *arethusa*** Clessin 1879, and ***Planorbis umbilicatus* var. *heterodoxa*** Westerlund & Blanc 1879 with *P. atticus*.

Subba-Rao (1989: 152, Figs 353–355) mentioned *P. planorbis tangitarenensis* Germain 1918 and he reported that this species is distributed in Kashmir and Tingitar. If we take the drawing as well as zoogeographical aspects into consideration, this species is, in our opinion, conspecific with *P. intermixtus*.

*Planorbis sieversi* Mousson 1873 has been listed by Soldatenko & Starobogatov (2000) from Armenia and Issyk-Kul Lake. However, this species' name seems to be also a younger synonym of *P. intermixtus*, as the shells of one syntype (photographed by Eike Neubert, Senckenberg Museum)

and measurements are identically with our Fig. 7.3. But no topotypes of both species mentioned above have been available to us to study the prostate diverticules.

The *Planorbis* species under discussion which are similar to *P. carinatus* (Figs 8.6–8.8) can be distinguished by the shell height, and also by the prostate diverticules. Soldatenko & Starogatov (1998: 59) believed that *P. kubanicus* is possibly described from Königsee by Clessin in 1873 under the name *Planorbis carinatus* var. *dilatatus*. Four years after the original description Clessin (1877: 402) himself mentioned his var. *dilatatus* as belonging to *P. dubius* Hartmann 1841. The syntypes of *Planorbis dubius* have been studied by the senior author with the result that the type series contains two species: *P. planorbis* and *P. carinatus*. A lot of *P. dubius* (Westerlund's collection, Göteborg, sampling site: Königsee, Bavaria, Germany) revealed also these two *Planorbis* species mentioned above. Thus we can say that *P. kubanicus* is not a younger synonym of *P. dilatatus* or *P. dubius*.

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