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A TAXONOMIC NOTE ON *PSEUDIBERUS* ANCEY, 1887 (GASTROPODA: PULMONATA: BRADYBAENIDAE)

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ABSTRACT: Two subgenera of *Pseudiberus* Ancey, *Pseudiberus* s. str. Ancey and *Platypetasus* Pilsbry, are synonymised, based on the fact that the snails cannot be distinguished based on shell or genital characters, and their distribution ranges largely overlap. Examining the type specimens resulted in synonymisation of *Platypetasus cixianensis* Chen et Zhang, 2000 and *Pseudiberus chentingensis* (Yen, 1935). Possible reasons for the conchological differences between the Cixian County population and the Zhengding population of the species are discussed.

KEY WORDS: Helicoidea, Bradybaenidae, subgenera, *Pseudiberus*, *Platypetasus*, *P. cixianensis*, new synonym

INTRODUCTION

Thirty eight species and subspecies have been described so far in the genus *Pseudiberus* Ancey, 1887: 19 in *Pseudiberus* s. str. (type species *P. tectumsinense* (Martens, 1873)) and 19 in *Platypetasus* Pilsbry, 1894 (type species *P. innominatus* (Heude, 1885)), according to the arrangement of RICHARDSON (1983) (Table 1). Examination of the original diagnoses of the subgenera, and of the characters of their component species, induced us to re-consider their status and to synonymise two species names in *Pseudiberus*.

SUBGENERIC CLASSIFICATION

Diagnoses of the subgenera of *Pseudiberus*: *Pseudiberus* s. str. given by ANCEY (1887: "Shell depressed-trochoidal, keeled, narrowly umbilicated, rudely striated; heavy cretaceous and whitish; whorls about 5, the last deflexed. Aperture rhombic, oblique, the lip straight above, deeply arched, expanded and much thickened within, below. Type *E. tectumsinense* Mts.") and *Platypetasus* given by PILSBRY (1934: "Shell lens-shaped, acutely keeled, thin umbilicated; whorls 4 1/2, the last descending in front. Surface smoothish. Aperture sub-horizontal, oval; peristome expanded, reflexed below, the ends approaching and connected across the parietal wall. Type *E. innominata* Hde."), show only very minor differences. All members of the two subgenera have lens-shaped shells, with a peripheral keel, which ranges from very sharp to somewhat blunted. *Pseudiberus* s. str. has 5 to 5.5 whorls; the range for *Platypetasus* is wider (4–6.5), and the extreme values given for *Pseudiberus* s. str. fit within it, so that the two taxa cannot be distinguished on this basis. Furthermore, the usage of the terms "rhombic" and "oval" for the apertures shape is confusing. No member of *Platypetasus* has a truly oval aperture, which is the case in *Bradybaena*, *Cathaica* or many other known bradybaenid genera. It is better to describe the aperture as "rhombic". Likewise, no species of *Pseudiberus* s. str. has a continuous aperture, that is aperture with insertions connected by a well-developed callus, forming a free abapertural edge between the two insertions – a situation found in *Cathaica dejeana* (Heude, 1882) (The generic position of this species will be discussed elsewhere). It is also impossible to distinguish between the subgenera based on the shell size (height and/or diameter), shape (height/diameter ratio), relative umbilical size (ratio umbilicus diameter/shell diameter). With respect to their main conchological characters contained in the original diagnoses the two subgenera are very similar (Table 1).

Table 1. Members of *Pseudiberus*, mainly according to the arrangement of RICHARDSON (1983). Twelve subspecies of *Pseudiberus* (s. str.) *plectotropis* are not listed. (***: type species; /, ? – unclear; + – aperture continuous; – – aperture discontinuous) (data from ADAMS 1870, HEUDE 1882, 1885, TRYON 1888–1889, PILSBRY 1892, 1893, 1934, ANCEY 1897, MÖLLENDORFF 1899, STURANY 1901, ANDREAE 1925, BLUME 1925, ODHNER 1925, 1963, YEN 1935, 1939, ZILCH 1968, CHEN & ZHANG 2000)

Species	Whorl number	Height	Diam. (maj.)	Umb. Diam./ Diam. (maj.)	Aperture continuous
P. (s. str.) *anisopleurus* Ancey, 1897	5	8	14.5	medium-sized	–
P. (s. str.) *chitralensis* (Odhner, 1963)	5	7.5	15.5	ca. 1/9	–
P. (s. str.) *futtereri* (Andreae, 1903)	5	7–8	15–16	ca. 1/7	–
P. (s. str.) *mataianensis* (Nevill, 1878)	5.5	?	13.5	ca. 1/5	–
P. (s. str.) *plectotropis* (Martens, 1864)	5.5	?	19	ca. 1/4	–
P. (s. str.) *tectumsinense* (Martens, 1873)***	5.5	?	16.5–21	tiny	–
P. (s. str.) *zenonis* (Gredler, 1882)	5.5	7–8	17–20	ca. 1/7	–
P. (*Pl.*) *anderssoni* Odhner, 1925	5.25	11	18	ca. 1/7	–
P. (*Pl.*) *anderssoni depressa* Yen, 1935	5	8.6–8.9	19.1–21.7	ca. 1/4–5	–
P. (*Pl.*) *castanopsis* (Möllendorff, 1899)	5	11	24	1/5	–
P. (*Pl.*) *causius* (Möllendorff, 1899)	6.5	5.75	15.5	ca. 1/5	+
P. (*Pl.*) *chentingensis* Yen, 1935	$5^{2/3}$	9.7–11.1	19.4–22.3	1/7–7.5	–
P. (*Pl.*) *chentingensis latispira* Yen, 1935	$5^{2/3}$	7.1–12.3	14.1–21	1/6.6–7.5	–
P. (*Pl.*) *encaustochilus* (Möllendorff, 1899)	5.5	5.25	13.5	ca. 1/3	+
P. (*Pl.*) *innominatus* (Heude, 1885)***	4–4.5	6–9	12–17	ca. 1/7–8	–
P. (*Pl.*) *innominatus aquilus* (H. Adams, 1870)	/	/	/	/	/
P. (*Pl.*) *innominatus duplicatus* (Möllendorff, 1899)	/	5–7.25	16.5–21.5	/	/
P. (*Pl.*) *lancasteri* (Gude, 1919)	6	4.25	14.5	ca. 1/2.5	–
P. (*Pl.*) *mariellus* (H. Adams, 1870)	4.5	7.5	18	ca. 1/5	+
P. (*Pl.*) *mariellus submariellus* (Pilsbry, 1893)	/	/	/	1/5	/
P. (*Pl.*) *obrutschewi* Sturany, 1901	5–6	4.1–7	17–21	?	+
P. (*Pl.*) *strophostomus* (Möllendorff, 1899)	8.5	6.25	5	tiny	+
P. (*Pl.*) *trochomorphus* (Möllendorff, 1899)	6	8	21.5	1/4	–
P. (*Pl.*) *trochomorphus microtrochus* (Möllendorff, 1887)	/	/	/	/	/
P. (*Pl.*) *trochomorphus wentschuanensis* Blume, 1925	6–6.5	7–9.5	20–24	ca. 1/4	+
P. (*Pl.*) *cixianensis* Chen et Zhang, 2000 syn. nov.	4.5	7	21.5	tiny	–

The subgenera do not differ in their genital systems; both show a combination of "a bundle of mucous glands + a piece of love dart + absence of flagellum" (WU unpublished).

Members of *Pseudiberus* s. str. are distributed in Middle Asia (only one species, *P. plectotropis*), N. and NW. China; species of *Platypetasus* are found within this area, so that the two distribution ranges overlap in their mid- to eastern parts. The distribution pattern provides no support for the subdivision of the genus *Pseudiberus*.

The split of *Pseudiberus* into *Pseudiberus* s. str. and *Platypetasus* is not justified and the subgenera should be synonymised.

STATUS OF *PSEUDIBERUS CIXIANENSIS* CHEN ET ZHANG AND *P. CHENTINGENSIS* (YEN)

MATERIAL EXAMINED

Types of *Pseudiberus cixianensis*: Pengcheng Town (36°24'N, 114°06'E), Cixian County, Hebei Prov., leg. TANG SHANKANG, ZMIZ [=Zoological Museum of Institute Zoology, Chinese Academy of Sciences, Beijing, China]-types-08710;

Platypetasus cixianensis, Lufeng Mt., Cixian County, Hebei Prov., leg. LIU, June 1st, 1936, ZMIZ-types--010722, two empty shells;

Pseudiberus chentingensis (Yen, 1935), ZMIZ00163, Jiaozuo, Henan Prov., leg. CHEN GUANGWEN, 1999. VII.22.

PSEUDIBERUS (*PLATYPETASUS*) *CIXIANENSIS* CHEN ET ZHANG 2000, NEW SYNONYM

In the original description (CHEN & ZHANG 2000), *P. cixianensis* was compared to *P. tectumsinense* (Martens, 1873). Actually, the population on which the description of *P. cixianensis* was based is morphologically and geographically the closest to *P. chentingensis* (Yen, 1935).

Re-examining the types of *Pseudiberus* (*Platypetasus*) *cixianensis* Chen et Zhang 2000, we found that it was not a distinct species and should be regarded as a synonym of *Pseudiberus chentingensis* (Yen, 1935). The species did not depart from the original description of *P. chentingensis* (YEN 1935) in almost any conchological characters. The only difference between *cixianensis* and *chentingensis* is the whorl number of protoconch, the latter species with a 2-whorl protoconch. In the original description of *cixianensis*, the so-called "double-lip" structure on the upper part of the lip was regarded as the most important diagnostic character. However, examination of the whole type series revealed that it could be subdivided in three groups of different lip morphology: 1 – with a clearly double-lip structure; 2 – with normal lip; 3 – intermediates between 1 and 2 (Fig. 1). The character is obviously variable and thus not sufficient to describe a new species.

The results of the principal component analysis (PCA), including six metric characters and one coefficient (Tables 2, 3): number of embryonic whorls, number of whorls, shell height, shell diameter, aperture width, aperture height and shell height/diameter ratio, in 62 shells of *cixianensis* and two shells of *chentingensis*, also confirm the synonymisation. In the scatter plot two solid diamonds denoting the two shells of *chentingensis* are within the *cixianensis* group, and the *cixianensis* shells with different aperture characters also show a good consistency (Tables 4, 5, Fig. 2).

Table 2. Measurements of *Pseudiberus chentingensis* (Yen 1935), two adult specimens of ZMIZ00163

	Sp1	Sp2
embryonic whorls (ewh)	1.625	1.625
number of whorls (whorl)	4.875	4.875
shell height (height)	9.56	9.86
shell diameter (width)	20.73	19.16
aperture width (aw)	10.23	9.40
aperture height (ah)	11.37	9.61
shell height/diameter ratio (rhd)	0.46	0.51

Table 3. Measurements of *Pseudiberus* (*Platypetasus*) *cixianensis*, 62 type specimens

	N	Minimum	Maximum	Mean	S. D.
ewh	62	1.375	1.625	1.502	0.036
whorl	62	4.500	5.125	4.748	0.125
height	62	7.03	12.19	8.92	0.97
width	62	16.86	22.67	18.94	1.22
aw	62	7.46	11.18	9.04	0.80
ah	62	8.50	12.78	10.06	0.86
rhd	62	0.41	0.56	0.48	0.04

Table 5. Rotated component matrix. Factor loadings of shell parameters on the first two PC. Extraction method: Principal Component Analysis. Rotation method: Quartimax with Kaiser normalization

	Component	
	1	2
EWH	0.044	0.344
WHORL	0.395	0.716
HEIGHT	0.508	0.822
WIDTH	0.933	0.222
AW	0.903	0.205
AH	0.957	0.067
RHD	–0.079	0.947

Table 4. Total variance explained. Extraction method: Principal Component Analysis

Compon.	Initial eigenvalues			Extraction sums of squared loadings			Rotation sums of squared loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
ewh	3.817	54.528	54.528	3.817	54.528	54.528	3.025	43.214	43.214
whorl	1.507	21.535	76.063	1.507	21.535	76.063	2.299	32.850	76.063
height	0.935	13.357	89.420						
width	0.426	6.087	95.507						
aw	0.200	2.864	98.371						
ah	0.113	1.614	99.985						
rhd	0.001	0.015	100.000						

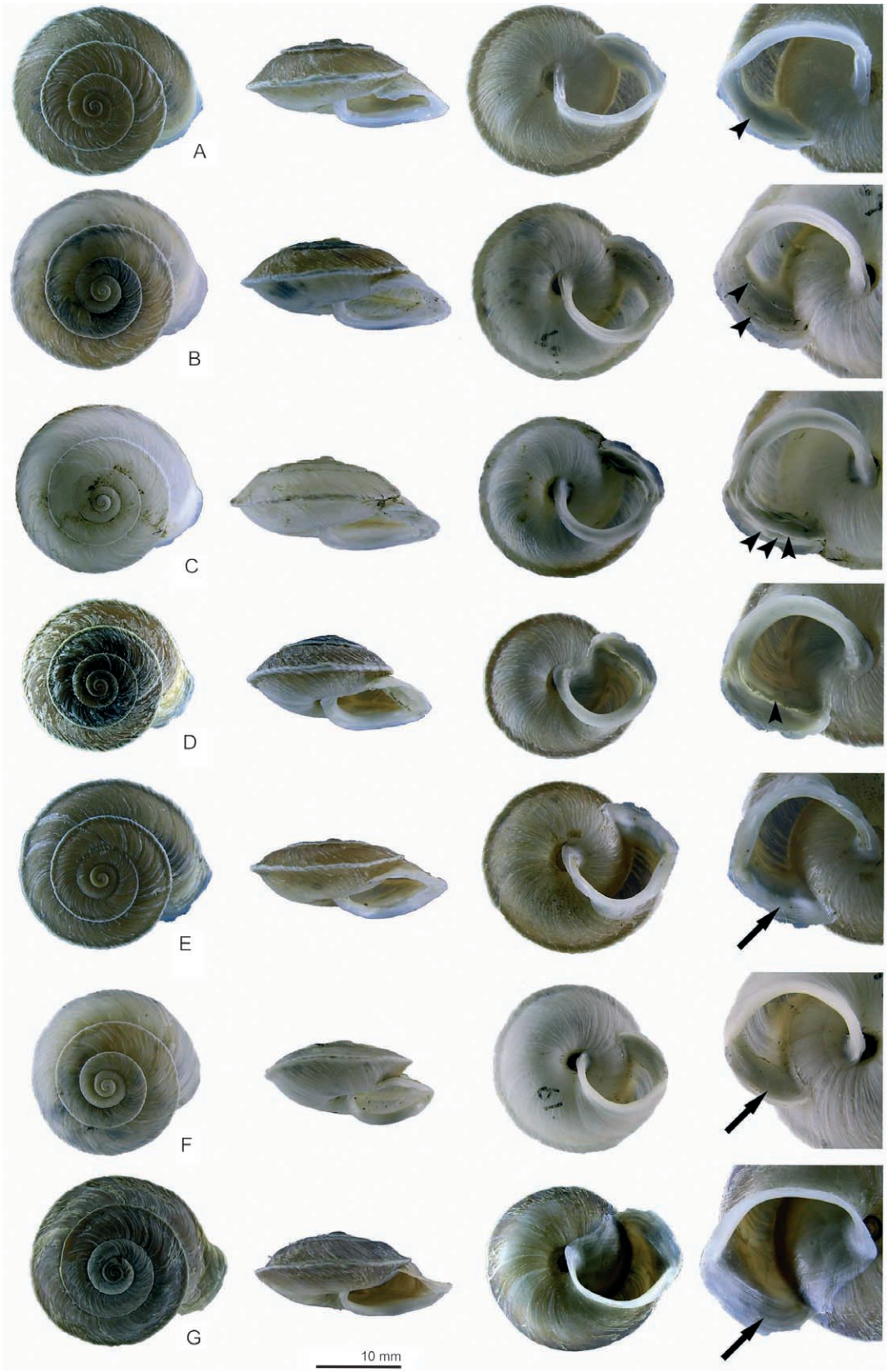

Fig. 1. A–F: *Pseudiberus* (*Platypetasus*) *cixianensis* new synonym, paratypes: A – ZMIZ-types-08710, specimen 55, aperture slightly double-lipped; B – ZMIZ-types-08710, specimen 60, aperture slightly double-lipped; C – ZMIZ-types-08710, specimen 3, aperture double-lipped; D – ZMIZ-types-08710, specimen 18, aperture double-lipped; E – ZMIZ-types-08710, specimen 62, aperture normal; F – ZMIZ-types-08710, specimen 61, aperture normal; G – *Pseudiberus chentingensis*, ZMIZ00163, specimen 1., aperture normal. Scale bar for the first three columns – 10 mm; 4th column shows details of aperture: arrowheads – double-lip; arrows – normal lip

The double-lipped aperture, although very rare not only in *Pseudiberus* but also in all bradybaenids, should be regarded as an aberration of normal lip morphology which forms in some particular environmental conditions; it only occurs in a part of individuals within a local population of *P. chentingensis*. This kind of variation may be provisionally regarded as an adaptation to arid environment, though further evidence is needed. It may reduce the aperture surface area, which is thought to be associated with either limiting water loss or reducing predation (GOODFRIEND 1986). However, the type locality of *P. chentingensis*, Zhengding [=Chengding] in Hebei Prov., has almost the same annual rainfall (ca. 600 mm) as the localities in Cixian County and Jiaozuo (ca. 635 mm). Such data appear to be insufficient to explain why the apertures of the Cixian County snails differ greatly from those from Jiaozuo. Another notable difference between the Chengding population and the Cixian County population is the number of whorls of their shells. The number of whorls is higher in Chengding (5 2/3) than in Cixian County (4 3/4). Considering that the snails from both populations have a similar shell size, it appears to agree well with GOODFRIEND's (1983) hypothesis: "Snails producing shells with a larger whorl number relative to body size would be able to retract deeper and, thus, would be expected to lose water slower".

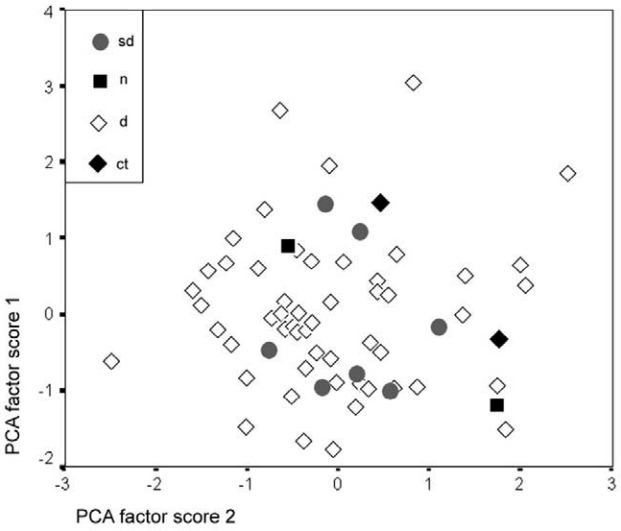

Fig. 2. Principal component analysis. The two axes explain ca. 43.2% and ca. 32.9% variance, respectively. Sd – slightly double-lipped shells of *cixianensis*; n – normally lipped shells of *cixianensis*; d – double-lipped shells of *cixianensis*; ct – shells of *chentingensis*

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