

Redescription of *Paludina rufescens* Küster, 1852 (Gastropoda, Caenogastropoda, Rissooidea)

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Boeters (1988) and Bernasconi (2000) treated *Paludina rufescens* Küster, 1852, as a valid species of *Bythinella* Moquin-Tandon, 1856, but their understanding of Küster's taxon was different. This "imbroglio taxonomique" was analysed by Falkner et al. (2002: 88-89) without presenting a solution and *Bythinella rufescens* was still treated as a valid species of uncertain identity. In the present paper we conclude that *Paludina rufescens* is a junior synonym of *Bythinella reyniesii* (Dupuy, 1851). For *P. rufescens* a lectotype is selected.

Key words: Gastropoda, Caenogastropoda, Hydrobiidae, Amnicolinae, *Bythinella*, nomenclature.

INTRODUCTION

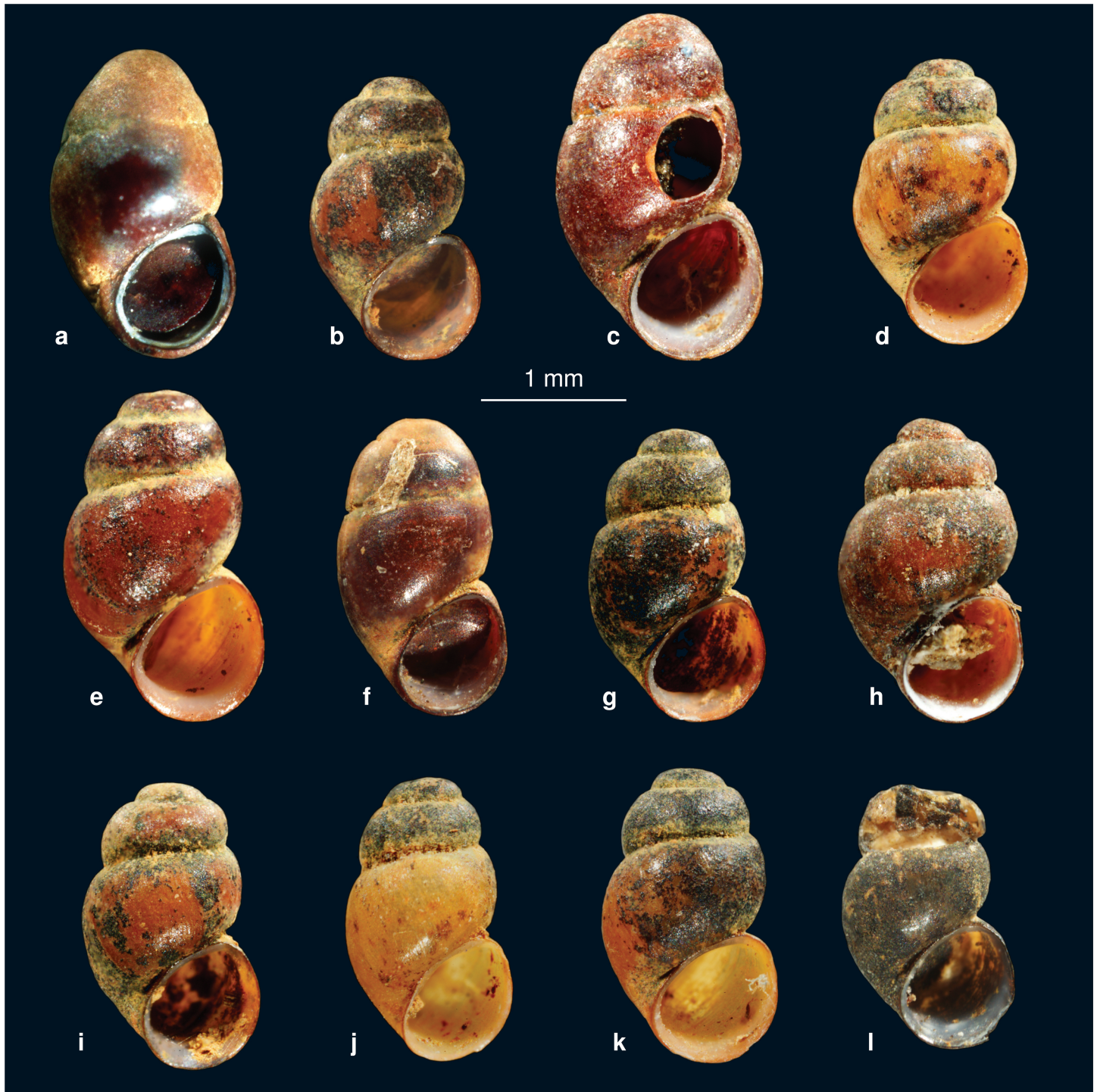
The French-Spanish Pyrenees are inhabited by several species of the hydrobiid spring snail genus *Bythinella* Moquin-Tandon, 1856. The by far oldest nominal taxa are *Paludina rubiginosa* Boubee, 1833, *Hydrobia reyniesii* Dupuy, 1851, and *Paludina rufescens* Küster, 1852, all of which are nowadays attributed to *Bythinella*. Because of the priority of these three taxa, an adequate understanding of their identity is important. Whereas in recent literature a stable interpreta-

tion of *Paludina rubiginosa* Boubee, 1833, and *Hydrobia reyniesii* Dupuy, 1851, has been achieved, this does not apply to *Paludina rufescens* Küster, 1852 (Falkner et al., 2002: 88-89).

When describing *Paludina rufescens*, Küster (1852: 41) added as type locality only the Pyrenees ("in den Pyrenäen"). According to Fischer (1856: 158) the material of Küster's description was collected about two km from Luchon (Haute-Garonne) ("à deux kilomètres environ de Luchon"). Boeters (1988: 233), based on material from Bagnères-de-Luchon, considered *Paludina rufescens* a senior synonym of *Bythinella artiasensis* Fagot, 1887, but Bernasconi (2000: 15) did not accept this view. Because of the vague type locality and missing syntypes, Bernasconi based a redescription of *Paludina rufescens* on two samples from a ferrous spring at Bagnères-de-Bigorre (Hautes-Pyrénées) ["d'une fontaine ferrugineuse à Bigorre (Hautes-Pyrénées)"] from the collection Bourguignat (MHNG-Bgt).

Thus Boeters (1988) used material from Bagnères-de-Luchon, accepting Fischer's (1856: 158) reference to the type locality, whereas Bernasconi (2000) ignored Fischer's data and used material from Bagnères-de-Bigorre instead, since -in his opinion- that fits Küster's description more precisely. Anyway, both authors shared the view that Küster's type locality has to be looked for in the French Pyrenees.

Here we examine this discrepancy in order to improve the understanding of *Paludina rufescens* and to stabilize the



nomenclature of the nominal taxa that are involved. Küster's original description (1852: 41) is dealt with first, after which Fischer's comments (1856: 158) regarding the type locality are discussed, new data about original material are provided, and eventually a lectotype is selected.

MATERIAL

Abbreviations. – BOE, colln H.D. Boeters (München); MHNG-Bgt, colln J.R. Bourguignat, Muséum d'Histoire Naturelle (Genève); MNHN, Muséum National d'Histoire Naturelle (Paris); NMW-Frd, colln Frauenfeld, Naturhistorisches Museum (Wien).

Material. *Bythinella reyniesii* (Dupuy, 1851). – France, Hautes-Pyrénées. (i) – (v) Bagnères-de-Bigorre, Parc-du-Salut. (i) Fontaine Rieune; Boeters leg. 29.ix.1968 (BOE 0195/animals & BOE 2232/shells), Boeters leg. 07.ix.2003 (BOE 2005/animals). (ii) Between Fontaine Rieune and Source-du-Salut, at left Salut bank at road level, captured spring; Boeters leg. 29.ix.1968 (BOE 0196/shells). (iii) Uphill Fontaine Rieune, small captured spring; Boeters leg. 29.ix.1968 (BOE 0197/shells). (iv) (Uncaptured?) spring at left Salut bank at road level; Boeters leg. 07.ix.1983 (BOE 1161/animals). (v) Left border of Salut river 350 m upstream from Fontaine Rieune, uncaptured spring [presumably identical with (iv)]; Boeters leg. 07.ix.2003 (BOE 2006/animals & BOE 2405/shells). (vi) Source St. Lary [-Soulan]; Marazanof leg. 20.ii.1968 (BOE 0221/animals). (vii) Bagnères-de-Bigorre, mountainous brook; Geissert leg. 1960 (BOE 0288/shells). (viii) Towards Bagnères-de-Bigorre at road 2 km behind Col du Tourmalet; Geissert leg. 1960? [not later than 1971] (BOE 0397/shells [identical with BOE 0288?]).

Bythinella artiasensis Fagot, 1887. – France, Haute-Garonne, Bagnères-de-Luchon.

(i) MHNG-Bourguignat/1 shell, “*Paludinella reyniesii* Frauenfeld Bagnères de Luchon (Hte Garonne)”. (ii) 300 m S Pont-de-Ravi towards

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Fig. 1. *Bythinella reyniesii* (Dupuy, 1851). **1a**, Lectotype of *Paludina rufescens* Küster, 1852 (NMW-Frd); **1b–l**, 11 shells of the original material of *Paludina rufescens* Küster, 1852 (MNHN), first group (remaining 6 shells of first group of 17 shells see Fig. 2a-f); cf. Table 1.

Hospice-de-France, 920 m; Boeters leg. 07.vii.1981 [BOE 1074/animals & 2239/shells (Boeters 1988: 233, pl. 4 fig. 48)]. (iii) Uphill from cable-car station, Boeters leg. 21.vi.2006 (BOE 2757/animals). (iv) Uphill from Etablissement Thermale; Boeters leg. 21.vi.2006 (BOE 2758/animals).

RESULTS

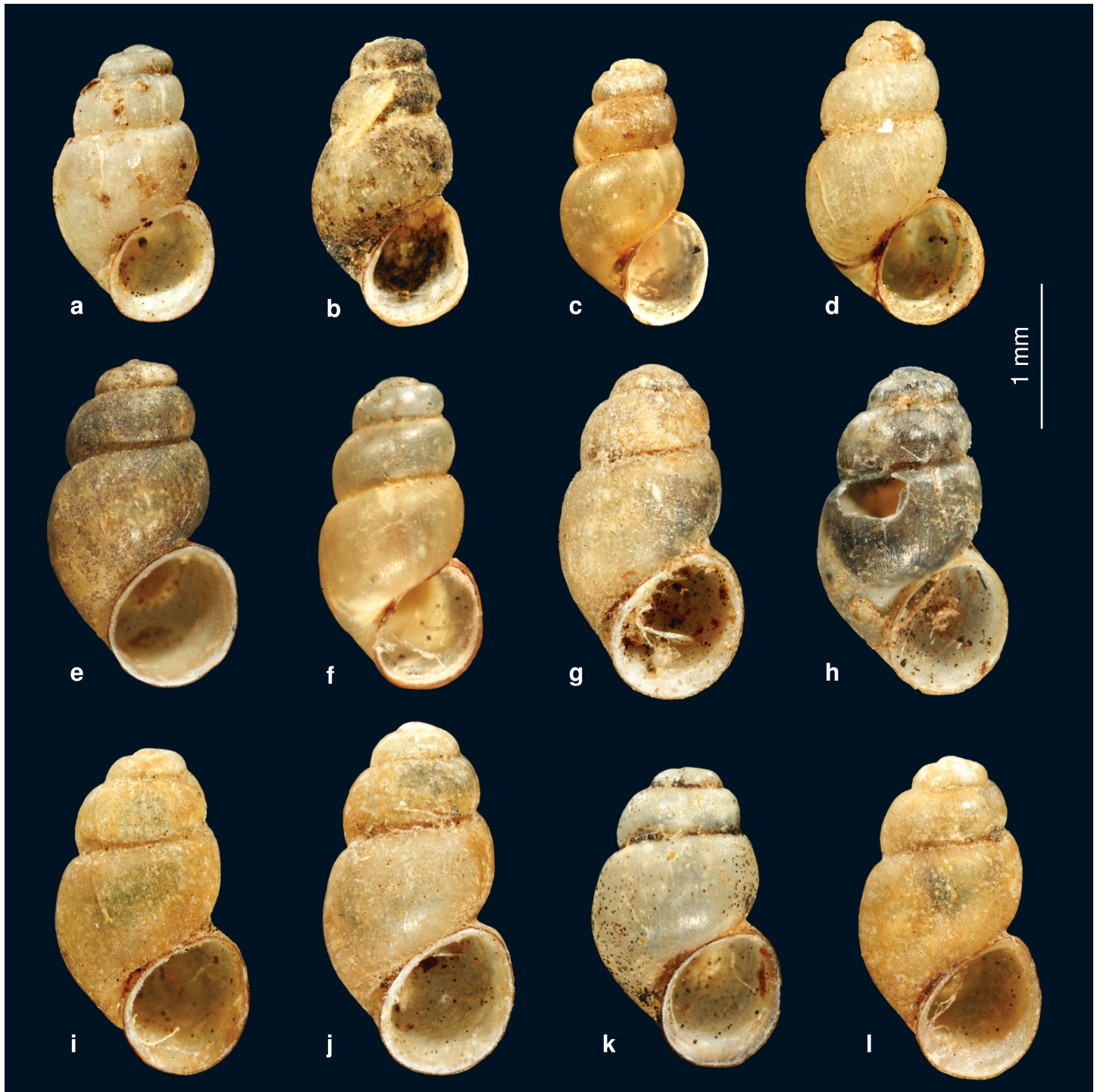
Introduction. – The following parts of Küster's (1852: 41) original description of *Paludina rufescens* are most relevant: very similar to the preceding [*Paludina Schmidtii* Charpentier] but of half its size [$1\frac{1}{3}''/2 = 1.35$ mm], coloured differently. Shell – lighter or darker yellow-reddish to dark rust red. Height $3/4$ [1.52 mm] to hardly $1''$ [2.03 mm], width $1/2''$ [1.01 mm], height of the aperture $2/3''$ [1.35 mm]... in the Pyrenees. [“Der vorigen [*Paludina Schmidtii* Charpentier] sehr ähnlich aber nur halb so gross [$1\frac{1}{3}''/2 = 1,35$ mm], anders gefärbt. Gehäuse .. heller oder dunkler gelbröthlich bis zum Dunkelrothro. .. Höhe $3/4$ [1,52 mm] bis kaum $1''$ [2,03 mm], Breite $1/2''$ [1,01 mm], Höhe der Mündung $2/3''$ [1,35 mm]. .. in den Pyrenäen.“]

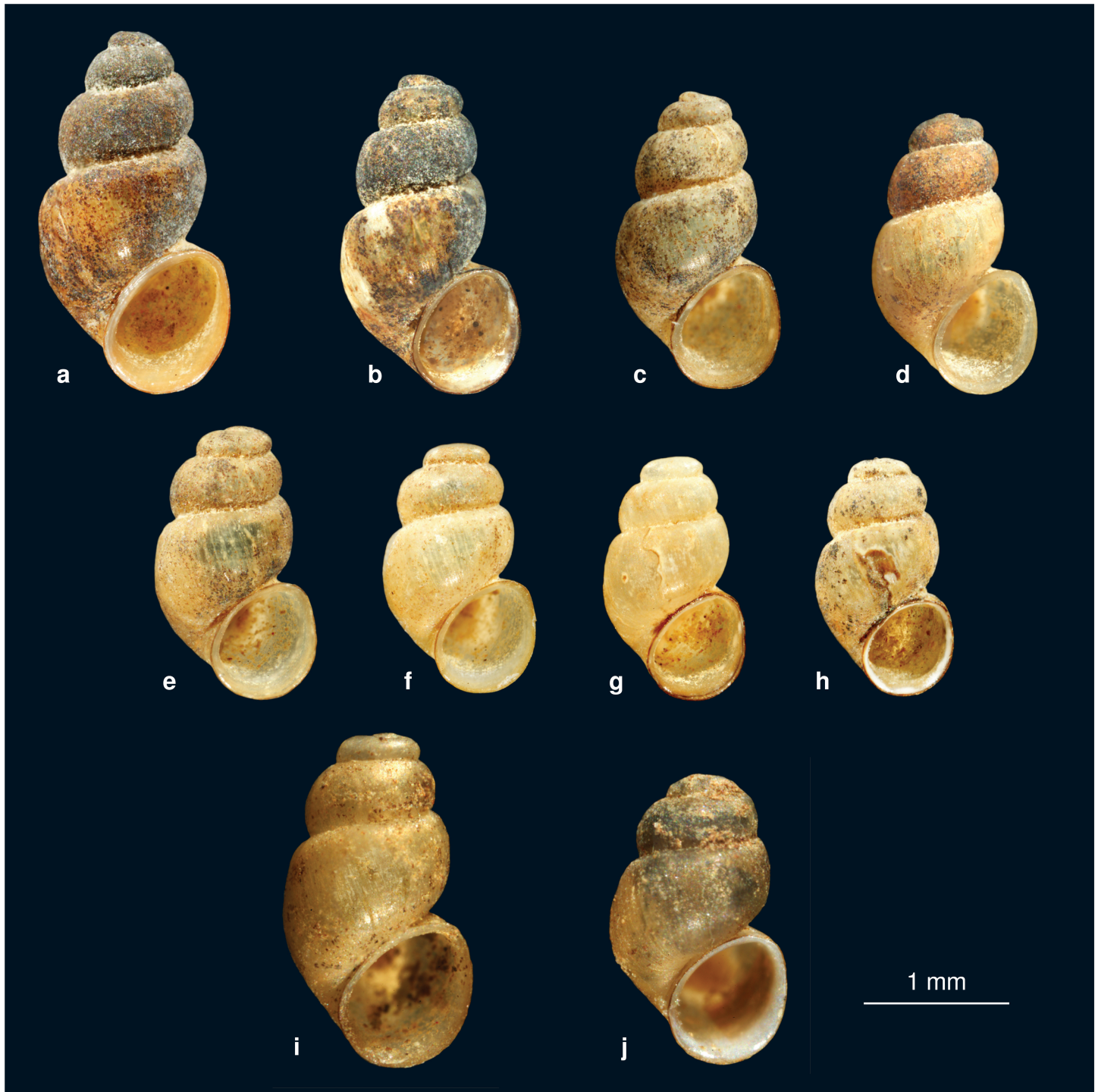
According to Fischer (1856: 158) Küster's material was collected by Soubervie [sic; corr.: Souverbie] in ferrous water, leaking out of rocks, about two kilometers from [Bagnères-de-]Luchon (“filet d'eau ferrugineuse qui suintait de la roche, à deux kilomètres environ de Luchon”).

Bythinella from Bagnères-de-Luchon. – Boeters (1988) interpreted a species from Bagnères-de-Luchon as *Bythinella rufescens*, with *B. artiasensis* Fagot, 1887, as a junior synonym. Here we accept Bernasconi's (2000) view that *Bythinella artiasensis* differs from *B. rufescens*. A shell illustrated as *B. rufescens* by Boeters (1988: pl. 4 fig. 48) is 3.10 mm high, whereas the shell of Küster's *Bythinella* measures only 1.52–2.03 mm. Recently collected samples from the surroundings

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Fig. 2. *Bythinella* spec., shells of the original material of *Paludina rufescens* Küster, 1852 (MNHN). **2a–f**, *Bythinella reyniesii* (Dupuy, 1851), first group (additional 11 shells of first group of 17 shells see Fig. 1b-l); **2g–l**, *Bythinella* spec., second group of the original material; cf. Table 1.





of Bagnères-de-Luchon represent *Bythinella artiasensis* only [see Material (2) (iii)-(iv)].

Bernasconi (2000) referred to a sample from Bagnères-de-Luchon, in MHNG-Bgt, labelled: “*Paludinella reyniesii* Frauenfeld Bagnères de Luchon (Hte Garonne)”. This concerns a single shell, measuring 2.80 mm in height, which belongs to *Bythinella artiasensis*, as was published by Boeters (1988).

Summarizing we have to conclude that *B. rufescens* is not known from Bagnères-de-Luchon and its surrounding.

A syntype and original material. – The Forschungsinstitut Senckenberg (SMF) keeps more type specimens of Küster’s taxa than any other institute (Zilch 1967: 13), but syntypes of *Paludina rufescens* are missing there. However, Boeters found a single syntype in NMW-Frd (see Frauenfeld, 1864: 669). The original label (Fig. 5f) is in Küster’s handwritig, the curatorial label (Fig. 5g) with “Frauenfeld’s Orig. Ex.” is written by the former custodian Sturany. This specimen (see Table 1) is heavily coated by a presumably ferrous layer. Here we select this syntype as lectotype of *Paludina rufescens* Küster, 1852 (NMW 108 118).

Additionally, a sample of ‘original material’ from which Küster may have received his type series was located by Falkner in MNHN (general collection). We cannot give convincing evidence that Fischer has seen this sample with 23 shells, but at least one of the accompanying labels (Fig. 5b) refers to Souverbie, who is mentioned by Fischer as the collector of Küster’s type series. These shells cannot be considered syntypes but it may be hypothesized that the specimens described by Küster had the same origin. Morphologically, two groups can be distinguished, with 17 (Figs 1b-l and 2a-f) and 6 shells (Fig. 2g-l), respectively (Table 1).

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Fig. 3. *Bythinella reyniesii* (Dupuy, 1851) from Bagnères-de-Bigorre, Parc-du-Salut. 3a–h, 8 shells from spring at left border of Salut river 350 m upstream from Fontaine Rieune (BOE 2405); 3i–j, 2 shells from Fontaine Rieune (BOE 0195).

The sample in MNHN is accompanied by the following five labels: (1) *Hydrobia* (*Palud.*) / *Fusca* [overwritten and corrected as *Rufescens*] / Kuster / Pyrénées / Rufescens; (2) *Paludinella rufescens* Kust. [sic] / Souverbie; (3) *Hydrobia rufescens* / Ach[at] Marie N. 30 1883; (4) *Bythinella rufescens* Küster; (5) *Bythinella rufescens* Küst. / Pyrénées / Thiele p. 139.

We assume that Küster received his material as “... *Fusca*” [see label (1), Fig. 5a]. In view of his description of *Paludina rufescens*, *Fusca* was overwritten by *Rufescens* and “Kuster” was added (and perhaps the following two words and the two foregoing words). The name *Fusca* is in the handwriting of Édouard-Auguste Marie (1835-1888). This applies to all other words on labels (1) and (2) (Fig. 5b). We compared a handwritten letter from Marie (1835-1888) in MNHN (Paris), dated May 24th, 1886, and found the capital F as in “*Fusca*” (see 1st label). Furthermore, Marie did not connect the letter “s” if followed by a letter which starts anticlockwise, like “c” as in “Fus ca” [gap added] or “Rufescens” and “rufescens” (see 1st and 2nd label). When comparing “*Palud.*” and “Kuster” of label (1) with “*Paludinella*” and “Kust.” on label (2) it becomes obvious that also the latter label is in Marie’s handwriting. The generic name *Paludinella*, as on label (2) (Fig. 5b), became usual only after Frauenfeld (1857). Label (3) (Fig. 5c) refers to Marie as a merchant, with “1883” as the year of acquisition; it uncritically repeats the generic name *Hydrobia* from label (1). Dupuy (1851) classified *Bythinella* species in *Hydrobia* whereas Küster (1852) used the generic name *Paludina*. Labels (4) and (5) (Figs 5d and 5e) are of a more recent date.

Identification as *Bythinella reyniesii*. – In a spring at Bagnères-de-Bigorre a population of *Bythinella* was found (BOE 2006, 2405) with shells varying in a range which comprises

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Fig. 4. *Bythinella reyniesii* (Dupuy, 1851). 4a–c, 3 shells of the original material of *Paludina rufescens* Küster, 1852 (cf. Fig. 1i and Fig. 2e–f); 4d–f, 3 shells of *Bythinella reyniesii* (Dupuy, 1851) from Bagnères-de-Bigorre, Parc-du-Salut. spring at left border of Salut river 350 m upstream from Fontaine Rieune (BOE 2405)



Height	Diameter	Colour	sqrt (height*diameter/2)
Lectotype (Fig. 1a)			
2.20*	1.24	ochreous	1.17
Original material (Fig. 1b-l and Fig. 2a-f; first group)			
2.00	1.20	black and ochreous	1.10
2.10	1.20	black and ochreous	1.12
2.10	1.25	black and ochreous	1.15
2.15**	1.25	black	?
2.15	1.25	black and ochreous	1.16
2.15	1.25	black and ochreous to brownish red	1.16
2.20	1.25	black and ochreous	1.17
2.20	1.25	black and ochreous	1.17
2.20	1.25	brownish red	1.17
2.20	1.35	brownish red and ochreous	1.22
2.45	1.45	brownish red	1.26
2.30	1.25	translucently coloured like horn	1.20
2.30	1.30	translucently coloured like horn	1.22
2.35	1.40	translucently coloured like horn	1.28
2.40	1.25	black, otherwise translucently coloured like horn	1.22
2.45	1.25	black, otherwise with traces of ochre	1.24
2.60	1.50	translucently coloured like horn	1.40
Original material (Fig. 2g-l; second group)			
2.50	1.55	translucently coloured like horn	-
2.75	1.60	with traces of ochre	-
2.75	1.60	with traces of ochre	-
2.80	1.65	translucently coloured like horn	-
2.85	1.60	with traces of ochre	-
3.00	1.60	with traces of ochre	-

Table 1. Measurements and colour of all 23 shells of the original material (MNHN) plus lectotype of *Paludina rufescens* Küster, 1852 (NMW-Frd).

* with an intensive coating; ** estimated (apex destroyed).

the lectotype and all 17 shells of the first group (11 shells: Figs 1b-l; 6 shells: Figs 2a-f) of the original material in MNHN. The shells from Bagnères-de-Bigorre (Fig. 3a-h) have a black or ochreous coating, which is only less intensive than in the lectotype and some shells of the MNHN material. For comparison, 3 shells of the population from Bagnères-de-Bigorre (Fig. 4d-f) are illustrated next to 3 of the 17 shells of the MNHN material. Obviously, all these shells belong to the same species, together with the lectotype of *Paludina rufescens* Küster, 1852 (NMW 108 118) (Fig. 1a).

As can be concluded by comparing the shells from Bagnères-de-Bigorre (Fig. 3a-h) with those of the second group in the original material (Fig. 2g-l), the latter specimens are different. Their identity remains unclear.

The population from Bagnères-de-Bigorre (BOE 2006, 2405) belongs to *Bythinella reyniesii* (Dupuy, 1851). At that village the snails live in the Parc-du-Salut, in springs which are tributary to the brook Salut which emerges inside the park. Bagnères-de-Bigorre is one of the original localities of *B. reyniesii*. Boeters (1973: 275 fig. 11; 1988: pl. 4 fig. 47; see



Fig. 5. Labels of material of *Paludina rufescens* Küster, 1852. 5a–e, 5 labels of the original material in MNHN; 5f–g, Labels of the lectotype in NMW. See explanations in the text.

also Fig. 3i–j) figured shells from one of the springs in the Parc-du-Salut, i.e. the Fontaine Rieune, as *Bythinella reyniesii* (BOE 0195). Bernasconi (2000) also mentioned this species from Bagnères-de-Bigorre, but without any further details (2000: 14 table, line 1). On the basis of shell measurements, Bernasconi (2000) still accepted *Bythinella rufescens* and *B. reyniesii* as separate species. In contrast, we consider *Bythinella reyniesii* (Dupuy, 1851) a conchologically very variable species, with *B. rufescens* (Küster, 1852) as a junior synonym, since we cannot determine any morphological gap in the population from Bagnères-de-Bigorre. This results in the following synonymy.

Bythinella reyniesii (Dupuy, 1851)

Hydrobia reyniesii Dupuy, 1851: 567, pl. 28 fig. 6 “Habit. Les eaux pures des Hautes-Pyrénées, dans les sources et les petits filets d’eau des environs de Cauterets, au Four à chaux (Paul de Reyniés), près de Mahourat, près du lac de Gaube, etc., etc., dans la vallée du lac d’Estom où je l’ai plusieurs fois recueillie [,] aux environs de Bagnères-de-Bigorre (M. Philippe).” Syntypes: unknown.

Paludina rufescens Küster, 1852: 41 pl. 8 figs 31–33 “Aufenthalt: in den Pyrenäen.”

Bythinella reyniesii; Boeters, 1973: 274 (partim), figs 11a–11b, 30; 1988: 232, figs 247, 267, 275, pl. 4 fig. 47; Bernasconi, 2000: 12, 98 figs 7–10, 114 figs 8, 9; Bichain, 2001: 5, pl. 1 fig. 12, pl. 2 fig. 6a–b; Bichain et al., 2007: 938 fig. 5.

Bythinella rufescens; Bernasconi, 2000: 15, 98 figs 13–14.

Notes. — Syntypes of *B. reyniesii* are not known (Bichain, 2001: 5), but the designation of a neotype does not seem to be necessary. All type localities are situated in the department Hautes-Pyrénées, and there is consensus with regard to the understanding of the species (Boeters, 1973, 1988; Bernasconi, 2000; Bichain, 2001; Bichain et al., 2007).

The striking variability of this species in even a single spring as illustrated by Fig. 3a–h is reason enough for Fischer’s (1856: 158) statement that the specimens which he examined are dimorphic, i.e. either short and bulbous or somewhat elongated (“Les individus que nous avons examinés présentent deux formes, ... ils sont courts et ventrus, ou légèrement allongés.”). Apparently, Küster’s sample was also not uniform so that he (1852: 41) described the shells as on the one hand thinwalled and translucent (“dünnwandig und durchscheinend”) and on the other hand as lighter or darker yellow-reddish to dark rust red (“heller oder dunkler gelbröthlich bis zum Dunkelrothroth”).

Males have been described by Boeters (1973: 279 figs 30, 32; 1988: 236 fig. 267) and Bernasconi (2000: 114 figs 8–9) and females by Boeters (1973: 279 fig. 31; 1988: 236 fig. 275) and Bernasconi (2000: 114 fig. 8). For enzymatic and genetic data see Bichain (2001) and Bichain et al. (2007).

Bythinella reyniesii is not known from the neighbouring department Haute-Garonne. Apparently, Küster (1852) did

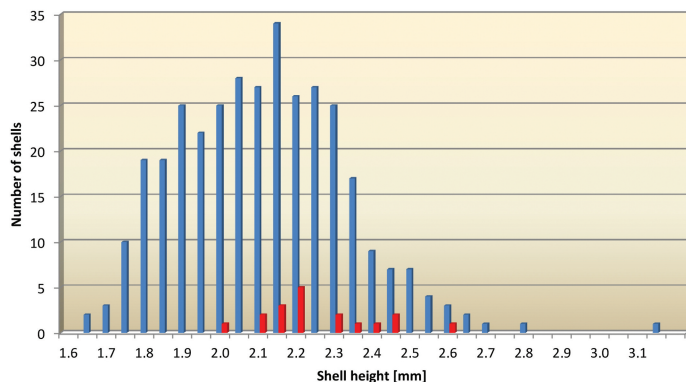


Fig. 6. Number of shells versus shell height [mm] of *Bythinella reyniesii* (Dupuy, 1851). Blue bars: 344 shells from Bagnères-de-Bigorre, Parc-du-Salut, spring at left border of Salut river 350 m upstream from Fontaine Rieune (BOE 2006 and 2405). Red bars: 17 shells of the first group of the original material (MNHN; see Table 1) plus lectotype of *Paludina rufescens* Küster, 1852 (NMW-Frd).

not know this species.

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In addition to *Bythinella reyniesii*, Bernasconi (2000: 17, 19, 23, 26) reported four more *Bythinella* species from the department Hautes-Pyrénées, viz. *B. simoniana* (Moquin-Tandon, 1856), *B. pyrenaica* (Bourguignat, 1861), *B. eurystoma* (Paladilhe, 1870) and *B. utriculus* (Paladilhe, 1870).

The identity of *Bythinella simoniana* is still uncertain (Boeters & Falkner, 2008: 128) and in our view the differentiation versus *Bythinella reyniesii* by Benke et al. (2007: fig. 2) and Wilke et al. (2010: 559 fig. 3) must be seen critically. *Bythinella pyrenaica* (Bourguignat, 1861) was also described from Bagnères-de-Bigorre; it can be distinguished by a remarkably elongated conical shape of the shell (Boeters 1973: 275 fig. 8). Boeters & Bertrand (2001: 11 figs 17-18, 12 figs 26-28) and Boeters & Falkner (2008: 127) regard *Bythinella eurystoma* as a separate species, which Benke et al. (2007: fig. 2) and Wilke et al. (2010: 557 fig. 2 and 559 fig. 3) distinguished genetically. However, Wilke et al. (2010) did not examine material from the type locality in the department Hérault but identified material from St.-Julien-de-la-Nef in the department Gard as *Bythinella eurystoma*. The type locality of *Bythinella utriculus* (Paladilhe, 1870) is “les environs de la

Bastide de Sérou” in the department Ariège. Bernasconi (2000: 26) redescribed this species with material from “La Bastide de Sérou (Ariège). Tour de Loly” as different from *Bythinella reyniesii*. Benke et al. (2007: fig. 2) and Wilke et al. (2010: 559 fig. 3) distinguished both species genetically, without presenting any illustration of a shell or an animal, and without locality data.

For the sake of completeness may be added that *Bythinella rubiginosa* (Boubee, 1833), described from “les eaux minérales d’Audinac, près de Sant-Girons (Ariège)” is an endemic species restricted to that locality and characterised by an elongated ovoid shell (Bernasconi, 2000: 97 fig. 3; Bichain, 2001: 9 fig. 1a-b, 22 fig. 4a-b). Bichain (2001) and Bichain et al. (2007) have differentiated this species versus *Bythinella reyniesii* by conchological, enzymatic and genetic characters. *Bythinella artiasensis* is known only from Spain and in France from the department Haute-Garonne (Boeters, 1988: 235; Bernasconi, 2000: 16).

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