BALEA HEYDENI VON MALTZAN, 1881 (PULMONATA: CLAUSILIIDAE): AN OVERLOOKED BUT WIDELY DISTRIBUTED EUROPEAN SPECIES

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Abstract Balea (Balea) heydeni *was originally described by von Maltzan (1881) on the basis of material from Portugal. Since that time this species has either been completely overlooked or regarded as a synonym of* Balea (B.) perversa. *However, the two species may occur sympatrically, clearly demonstrating their specific distinctness, a conclusion also supported by molecular phylogenetic data. Comparative descriptions of the two species are given here, together with illustrations of a newly designated neotype for* Balea (B.) perversa *and a lectotype of* Balea (B.) heydeni. *It is hoped that this taxonomic clarification will stimulate further research. The distribution of* B. heydeni *is as yet poorly known but it occurs on the Azores and the Madeiran archipelago (Porto Santo), from where it has for many years been reported incorrectly as* B. (B.) perversa. *Elsewhere* B. heydeni *has been recognized from Portugal, Spain, France, Belgium, The Netherlands, Denmark, Britain and Ireland.*

Key words *Gastropoda, Pulmonata, Clausiliidae,* Balea*, Azores, Madeira, W Europe*

INTRODUCTION

This preliminary note draws attention to the validity of a long forgotten species of *Balea* s.str. The species in question was formally described as *Balea heydeni* by von Maltzan (1881) using specimens from Sintra ("Cintra") and on the basis of notes by Von Heyden (1869) on a single shell (now lost) from Buçaco ("Bussaco"). This species from Portugal has been overlooked by virtually everyone ever since. Within the last few years, *B. (B.) heydeni* has been 'rediscovered' on two occasions. On the first occasion, Messrs H. Nordsieck and Th. E. J. Ripken discovered the existence of two similar *Balea* species from Portugal while revising clausiliids in the collection of the Muséum National d'Histoire Naturelle, Laboratoire de Biologie des Invertébrés Marins et de Malacologie, Paris. They recognized the validity of *B. (B.) heydeni* von Maltzan, 1881, reinstating it next to *B. (B.) perversa* (L., 1758). The first use of the revived name *B. heydeni* was by Bank, Groh & Ripken (2002: 107) in a list of the non-marine Mollusca of Macaronesia. On the second occasion, the validity of *B. heydeni* emerged as the result of investigations into the molecular phylogeny of *Balea* from Europe and islands in the North and South Atlantic (cf. Preece & Gittenberger, 2003; Gittenberger, Gronenberg, Kokshoorn & Preece 2006). Quite unexpectedly, the British sample did not cluster in a clade with Dutch, Italian and Spanish *B. (B.) perversa*, but next to *B. (B.) nitida* Mousson, 1858, an endemic known from the Azorean island of Flores (Backhuys, 1975: 196). Prompted by that result, the first author re-examined the juvenile shells of the British sample, now using a binocular microscope, and confirmed the occurrence of *B. (B.) heydeni* in the British Isles. A survey in the collection of the National Museum of Natural History, Leiden, also revealed that all samples from the Azores, labelled as *B. (B.) perversa*, were in fact *B. (B.) heydeni*, so the occurrence of *B. perversa* on the Azores requires confirmation. Further specimens of *B. heydeni* were also represented from Portugal, Spain, France, Belgium, The Netherlands, Denmark, Britain and Ireland. Shells from the Madeiran archipelago (Porto Santo), collected by Dr K. Groh and Dr M.B. Seddon, have also been studied.

Below we present nomenclatural data relating to *Balea* (*Balea*) *perversa* and *Balea (B.) heydeni* and formally designate a neotype for the former and a lectotype for the latter. Short diagnoses are given of the shell characters of *B. perversa* and *B. heydeni*, as well as illustrations of both species (Figs 1-11). Notes on their incompletely known distributions are included as a basis for further research.

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SYSTEMATICS

Family Clausiliidae J.E. Gray. 1855
Subfamily Baleinae A.J. Wagner, 1913
Genus *Balea* J.E. Gray, 1824
Subgenus *Balea* J.E. Gray, 1824

Type species (designated by Herrmannsen, 1846: 103): *Turbo perversus* Linnaeus, 1758.

Balea (Balea) perversa Linnaeus, 1758 (Figs 1-4)

Turbo perversus Linnaeus, 1758: 767. Neotype, registration number RMNH 103468 (Fig. 1), here selected, from Sweden, Öland, Eketorp (7.5 km N of Ottenby); G. Falkner leg. 31.07.1992.
Pupa fragilis Draparnaud, 1801: 64. Replacement name for *Turbo perversus*.
Balea lucifuga Gray, 1824: 61.

From the meagre original description and distributional data published by Linnaeus (1758: 767), i.e. "Habitat in Europae muscosis; terrestris", which includes a reference to its occurrence in Britain (according to Kennard & Woodward, 1926: 267), i.e. "List. angl. 124. t. 2. f. 11.", *Turbo perversus* may have been based on a mixture of two species. Dance (1967: 22) reported that *T. perversus* is not represented by specimens in the Linnaean collection in London (Burlington House) and Kathie Way (Curator of the Linnaean shell collection) has confirmed that it is not represented in the University Zoological Museum in Uppsala, Sweden. Therefore, we here select a neotype for *Balea perversa* to stabilize the nomenclature of both *B. perversa* and *B. heydeni*.

Draparnaud (1801: 64) introduced *Pupa fragilis* as an unnecessary substitute name for *Turbo perversus* Linnaeus, 1758. The species described from "Scarborough" as *Balaea lucifuga* by Bourguignat (1857: 557) can almost certainly be recognized as *B. heydeni*. However, by adopting "*Balaea lucifuga*, Leach, Mss." as the name of a species, "*Balea lucifuga*. Leach Mss." published by Gray (1824: 61) as a junior synonym of *Balea fragilis*, was made available (ICZN Art. 11.6.1) with Gray (1824) as its author (ICZN Art. 50.7). According to ICZN Art 58.1, the spellings ending with *ae* and *e* should be considered identical. Acting as first revisers (ICZN Art. 24), we here designate *Balea lucifuga* Gray, 1824, as a synonym of both *Pupa fragilis* Draparnaud, 1801 and *Turbo perversus* Linnaeus, 1758.

Balea (Balea) heydeni von Maltzan, 1881 (Figs 5-11)

Balea nov. spec.; Von Heyden, 1869: 136.
Balea heydeni von Maltzan, 1881: 162 ("Cintra"), 163 ("Bussaco"). Lectotype (Fig. 8), here designated, from Sintra (= Cintra); Muséum National d'Histoire Naturelle - Laboratoire de Biologie des Invertébrés Marins et de Malacologie, Paris.

To conserve the recently reintroduced name *Balea heydeni* for this species, *Balaea lucifuga* is made a synonym of *Turbo perversus*.

MATERIAL EXAMINED

The following samples of *B. (B.) heydeni* were studied in the collections of the National Museum of Natural History, Leiden (RMNH), the University Museum of Zoology, Cambridge (UMZC) and the National Museums and Galleries of Wales (NMGW) unless stated otherwise:

Azores 18 samples, from the islands of San Miguel, Santa Maria, Pico, Faial, San Jorge and Terceira (RMNH). Specimen (RMNH 96584) sequenced from Ilha Graciosa (A.M. Frias Martins leg.).

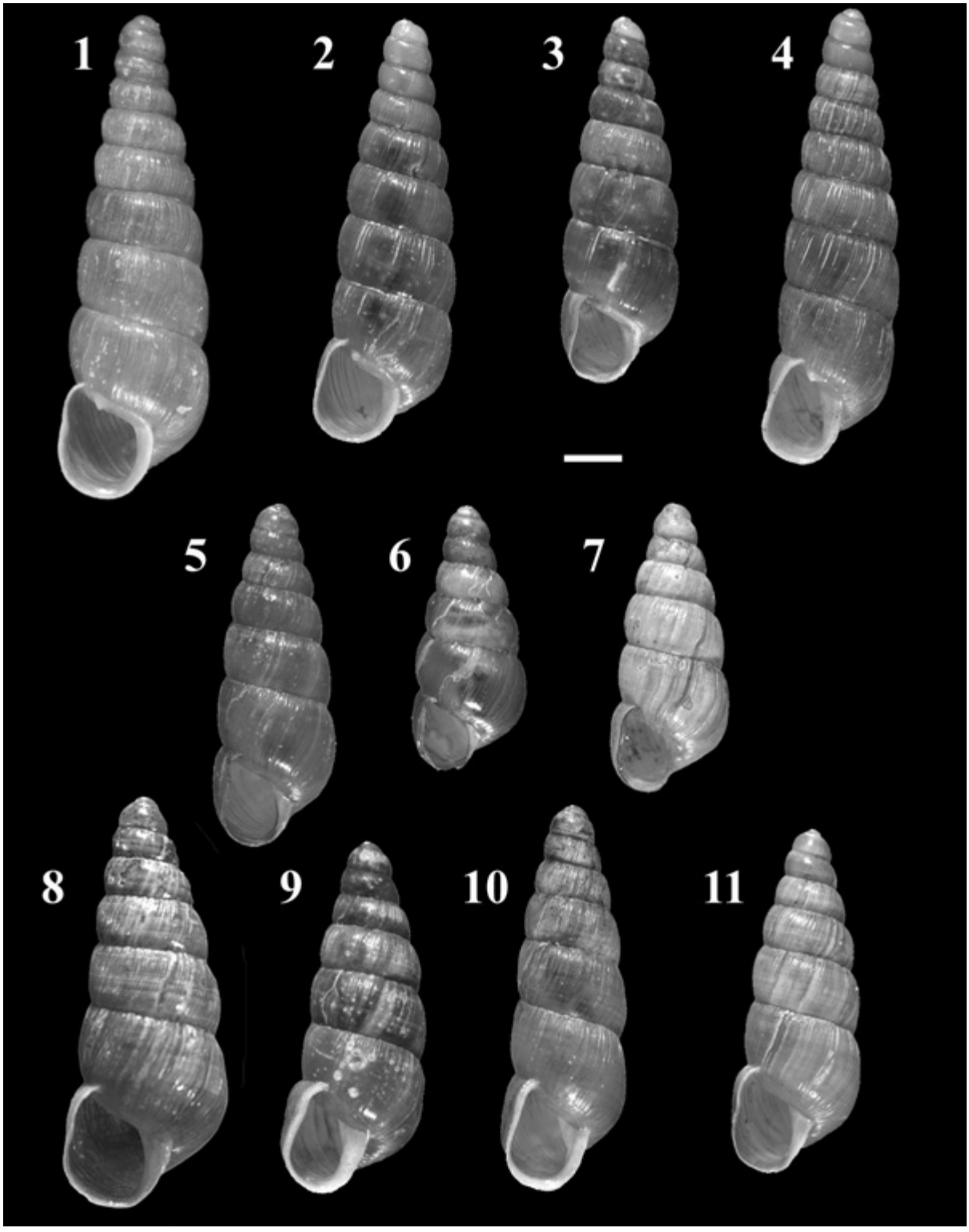
Madeiran archipelago Porto Santo, N-slope Pico do Facho (K. Groh leg., vii.1983; coll. Groh); Porto Santo (The Natural History Museum, London, reg. no. 1895.2.2.438-40 [with one *B. (B.) perversa*, reg. no. 1865.11.18.189]). Specimen (RMNH 100914) sequenced from Pico do Facho, Porto Santo (M.B. Seddon, coll.).

Belgium West Vlaanderen, De Panne (W.H. Neuteboom leg.). RMNH.

France Finistère, 8 and 15 km W of Morlaix (J.P.M. Clerx leg.); Manche, Mont St. Michel (P.J. van Nieuwenhoven leg.); Pas-de-Calais, 3 km W of Guines, Forêt de Guines (E. G. leg.); dto., Ambleteuse (Th. Loosjes leg.); dto., Wissant (W.H. Neuteboom leg.). All RMNH.

Denmark Møn Island, Møn Klint (B. Kokshoorn coll.); one specimen (RMNH 100912) sequenced.

Ireland Kerry, Dingle peninsula, Murreagh (A.J. de Winter leg.); Galway, Connemara, Roundstone (A.D.J. Meeuse leg.); Dublin,



Figures 1-11 *Balea (B.) perversa* (figs 1-4) and *B. (B.) heydeni* (figs 5-11) from various European localities. **1** *B. perversa*, neotype (RMNH 103468), Sweden, Öland, Eketorp (about 7.5 km N of Ottenby) **2**. Westmorland, Shap Abbey near Shap **3** Belgium, West Vlaanderen, de Panne **4** France, Pas-de-Calais, Boulogne **5** *B. heydeni*, UK, Devon, Slapton Ley Field Centre **6** UK, Cumbria, Low Crag, Crook **7** & **11** Belgium, West Vlaanderen, de Panne **8** lectotype, Portugal, Sintra (Muséum National d'Histoire Naturelle, Paris) **9** Scotland, Orkney Islands, Finstown **10** Portugal, Minho, Valença do Minho. Scale bar represents 1 mm. All photographs by J. Goud, except Fig. 8 taken by E. Neubert.

Newlands Cross, 1 km NW of Tallaght (R.C. Preece leg.); one specimen (RMNH 96277) sequenced. All RMNH. Belfast (R. MacAndrew coll.); Kerry, Glanbethy Bridge (R.C. Preece coll.). Both UMZC. Galway, Inishbofin (R.A.D. Cameron coll.).

The Netherlands see Boesveld, Maassen & Gittenberger (2005) for localities and a distribution map. Specimen (RMNH 100913) sequenced from Oostvoorne.

Britain Cumbria, Low Crag, Crook near Kendal (B. Colville leg.); one specimen sequenced (RMNH 94990); Devon, Torquay (J.J. ter Pelkwijk leg.); Devon, Slapton (R.C. Preece leg.); one specimen (RMNH 96279) sequenced; Scotland, Orkney Islands, Finstown (A.D.J. Meeuse leg.). All RMNH. Cambridge, Grantchester (H. Watson coll.); Kent, Dover Castle (R.C. Preece coll.); Scotland, Ayrshire, Largs (F.C. Morgan coll.); Scotland, Elgin [with 2 *B. perversa*] (R. MacAndrew coll.); Northamptonshire, Ring Haw Nature Reserve (R.C. Preece coll.); Isle of Wight, Freshwater (R.C. Preece coll.). All UMZC. Cumbria, Kirby Stephen (R.A.D. Cameron coll.). Scotland, Argyll, near Dunollie Castle, Oban; East Sussex, Seaford (several localities); West Sussex, Newtimber Hill; Dorset, Durweston; Wales, Caerns, SW of Llanaelhaern (all Holyoak-Seddon collection, NMGW, Cardiff).

Portugal Minho, Valença do Minho (J. Goud leg.) (RMNH 100911); Cintra (R. MacAndrew coll.). UMZC.

Spain Ponte Vedra, Tuy (K. H. Beckmann leg. & coll.). RMNH. See Martínez-Ortí (2006) for further records from Spain.

DISCRIMINATION BEWEEN *BALEA (B.) HEYDENI* AND *B. (B.) PERVERSA*

Balea (B.) heydeni can be distinguished from *B. (B.) perversa* by its (1) less slender shells, with (2) apical whorls increasing in width more quickly; (3) a more wrinkled sculpture, resembling coarse growth-lines rather than distinct riblets; and usually (4) a yellowish rather than brownish colour. The most useful diagnostic character is the shape of the apical whorls, which is close to cylindrical in *B. (B.) perversa* but more conical in *B. (B.) heydeni* (Figs 5-11). As a consequence, juvenile shells can exhibit more conspicuous differences than fully-grown specimens. In *B. (B.) perversa* the sculpture may be indistinct, but in *B. (B.) heydeni* regular, sharp, axial riblets are never present. Under high magnification the riblets of *B. perversa* are uneven, many thickening and becoming paler in their upper parts beneath the suture (Figs 2 and 4). A weak parietal denticle may occur but only in fully-grown specimens of *B. (B.) perversa* (Figs 1-4). In shells of *B. (B.) heydeni,* an irregular spiral pattern in the colouring may occur, a feature clearly expressed in the lectotype (Fig. 8). The maximum shell height of *B. (B.) heydeni* is usually below 7 mm, whereas *B. (B.) perversa* may be somewhat larger. Both Ellis (1969: plate VII, fig. 15) and Kerney & Cameron (1979: 172) illustrate typical *B. perversa,* from Oxford and Galashiels, Selkirk, respectively.

In a limited number of animals that have been observed, the soft parts of the crawling snails differed. In *B. (B.) heydeni* the tentacles, the head and the neck are dark, in contrast to the light, nearly transparent flanks and tail, whereas in *B. (B.) perversa* the entire animal has a dark colour.

ECOLOGY

Boycott (1921) has described the ecology of '*B. perversa*', noting its occurrence in crevices of walls, rocks and trees and the fact that it rarely lives on the ground. On walls and buildings it seems indifferent to lime, occurring on acid unmortared walls, as well as on those constructed of limestone (Boycott, 1934). It has a particular liking for certain trees, especially those which afford suitable crannies into which it can retire, mostly elms (*Ulmus*), apple (*Malus*) and willow (*Salix*), or which are covered in moss or lichen. Holyoak (1978) also recorded it commonly on hawthorns (*Crataegus*) and elder (*Sambucus nigra*), noting that these shrubs (and those trees listed above) have bark that is strongly basic, in contrast to the acidic bark of trees such as pines (*Pinus*), birches (*Betula*) or oaks (*Quercus*), on which *Balea* is seldom found. However, it has occasionally been found on oak (lichen-covered branches brought down by gales), as well as beech (*Fagus*), hazel (*Corylus*), maple (*Acer*), alder (*Alnus*), holly (*Ilex*), spruce (*Picea sitchensis*) and *Sorbus* (R. Anderson, personal communication). In addition, *Balea* occasionally occurs on old gorse bushes and on heather (R.C. Preece, personal observation). The record from *Picea* is very unusual but

several hundred specimens were collected by beating from a site in Co Fermanagh, Ireland. On *Picea* the only identifiable food source was abundant foliose lichens (mainly *Usnea*) on the finer branches. Both *Balea* species appear to be lichen feeders (cf. Baur & Baur, 1997; Baur, Baur & Fröberg, 1994) and their occurrence may be governed entirely by the availability of food. All these habitats are invariably dry, usually away from the ground (*Balea* sometimes occurs in wood and leaf litter) and inhabited by few (or no) other molluscs. Under bark it is often found with woodlice, but does not occur under large pieces of loose bark where there is a dense mass of woodlice frass.

It is not yet clear whether *B. perversa* and *B. heydeni* exhibit significant differences in ecology. Both have been found in typical '*Balea* habitats' described above and mixed populations are known from the British Isles, The Netherlands, Belgium and France. Examination of specimens in the Holyoak collection in Cardiff suggests that most (if not all) of the material he studied from Sussex is actually *heydeni*. In the Netherlands, *B. heydeni* is almost always found on bark of shrubs and trees, in particular hawthorn (*Crataegus monogyna)*, buckthorn (*Rhamnus catharticus*) and more rarely black poplar (*Populus nigra)*, elder (*Sambucus nigra*), crack willow (*Salix fragilis*) and white willow (*Salix alba*). See Boesveld *et al*. (2005) for further site details and the associated species.

Distribution and origins

The distribution of these two species of *Balea* is still incompletely known. *Balea (B.) perversa* is thought to be widespread in Europe extending eastwards to the Crimea (Kerney & Cameron, 1979: 248, map 204; Likharev & Rammel'meier, 1952: 250) but its mapped distribution is almost certainly based on a conflation of data relating to both species. Its occurrence in Iceland has been confirmed by conchological and molecular data (Gittenberger *et al*., 2006), but further south on the Atlantic islands *B. perversa* seems to be absent. A single shell from Porto Santo (Paiva Colln, see above) clearly belongs to this species, but more recently only *B. heydeni* has been found there. In the Netherlands the range of *B. (B.) heydeni* is concentrated in the coastal area, where it may be sympatric with *B. (B.) perversa*, which is distributed all over the country. In Belgium and France, a similar pattern seems to exist, whereas in Portugal and in the British Isles and Ireland, *B. (B.) heydeni* is also known from more inland localities. *B. perversa* appears to be far more widespread in continental Europe, occurring from the lowlands to high altitudes in montane regions, attaining 2400 m in Switzerland (Kerney & Cameron, 1979: 173). Conversely, in the British Isles *B. (B.) heydeni* appears to be more common than *B. (B.) perversa.*

Molecular phylogenetic data (Gittenberger *et al*., 2006) suggest that *B. (B.) heydeni* has descended from an ancestral Atlantic species, which evolved in the Azores. From there it subsequently colonized the British Isles and mainland Europe, where it apparently arrived relatively recently. This is suggested by the molecular similarity in the six individuals that were sequenced for the mtDNA marker CO1 (cytochrome oxidase subunit I), which proved to be identical in all nucleotides, despite the fact that they originated from widely scattered localities across Europe (see details above). It remains unclear whether the population on Madeira originated in the Azores or came from Europe.

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