

AN UNDESCRIBED SECOND SPECIES OF *PLAGYRONA* FROM PORTUGAL (GASTROPODA, PULMONATA: VALLONIIDAE)

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Abstract Two species of *Plagyrona* are recognised in western-central Portugal, *P. placida* Shuttleworth and *P. angusta* sp. nov.; the latter differs in its narrower shell with a smaller umbilicus. The microhabitats of both species are described. *P. placida* was found in humid woodland with living animals collected mainly from tree trunks and branches, often among mosses, but a few from moss on low rocks. *P. angusta* occurs in woodland and also in drier sites with few trees; it was found living on tree trunks, amongst mosses on low rocks and on vertical concrete in a garden. Their geographical ranges overlap and both species were found living together at two localities.

Key words *Plagyrona angusta*, *Plagyrona placida*, *Valloniidae*, taxonomy, Portugal, microhabitats, distribution

INTRODUCTION

The genus *Plagyrona* was named by Gittenberger (1977) for *Helix debeauxiana* Bourguignat 1863, which he assigned to the Valloniidae on the basis of characters of the shell and radula. Waldén (1983) showed that *P. placida* Shuttleworth 1852 is an earlier name for the same species. The genus is currently regarded as monospecific, with *P. placida* being known from Madeira and the Canary Islands eastwards disjunctly through Portugal, Corsica and N. Algeria to Greece (Ionian Islands) (Gittenberger, 1989; Ripken & Bouchet, 1998).

Shells of *P. placida* bear a superficial resemblance to those of *Pyramidula* spp. (Pyramidulidae), although the latter differ, *inter alia*, in their usually darker, strongly purple or reddish colouration, less regular ribbing and lack of fine spiral ridges on the early whorls. Our recent studies of Portuguese specimens nevertheless met with difficulties in separating some old and corroded shells of *Plagyrona* from those of the rather variable *Pyramidula* spp., until we realised that two distinct kinds of *Plagyrona* shell were represented by our specimens. One kind matches topotypical *P. placida* from the Canary Islands. The other has a smaller, relatively narrower shell with deeper sutures and a smaller umbilicus. There are no intermediates among samples of mature shells and the two kinds appear to have partly different ranges and microhabitat preferences, so the narrow shelled taxon is named here as a new species. Consequently, the morphology, range

and microhabitats of *P. placida* in Portugal are also reassessed.

METHODS

Field collections were made by direct searching and by use of paired sieves (mesh sizes 2.0 mm and 0.5 mm) to collect “fines” which were closely searched later using a stereo-microscope. Localities and altitudes were recorded using a Garmin Etrex High Sensitivity hand-held GPS, accurate to within <10 m; grid references are based on the U.T.M. grid. Sites were given consecutive serial numbers (e.g. P38). Habitat notes (including bedrock type and vegetation) and associated Mollusca were also recorded at all sites.

Shells and external features of the body were studied using a Meiji RZ series stereo-microscope. Drawings were made with a Meiji drawing tube. Measurements of shell breadth and height, and counts of whorls followed the methods described by Kerney & Cameron (1979). Adult shells have a thin mouth edge and do not show any clear characters confirming that they are fully mature. Samples of shells were therefore selected for measurement on the basis of medium to large size, lack of damage and fresh condition of the periostracum. All measurements were made using Infinity Analyze© software on images taken with an Infinity 1 camera on a Meiji RZ series stereo-microscope, from shells positioned carefully on a small piece of Bostik Blu Tack®. The measurements were reproducible

to $\pm < 0.005$ mm, but unavoidable slight tilting of the shells almost certainly caused minor additional loss of precision.

The material studied is listed in the Appendix. Abbreviations: B breadth of shell; CGAH Collection of G.A. & D.T. Holyoak; CRM Collection of Rui Mendes (Mafra, Portugal); DTH D.T. Holyoak, GAH G.A. Holyoak; H height of shell; MHNG Bourguignat Collection housed at the Muséum d'Histoire Naturelle, Ville de Genève, Switzerland; N number (sample size); NHMUK The Natural History Museum, London; NMBE Naturhistorisches Museum, Bern, Switzerland; NMW.Z. Department of BioSYB, National Museum and Gallery of Wales, Cardiff, U.K.; U maximum width of umbilicus of shell. Most specimens studied are in CGAH, with a few also in CRM, NHMUK and NMW.Z.

TAXONOMY, DESCRIPTIONS AND DISTRIBUTION

Family Valloniidae Morse 1864

Subfamily Valloniinae Morse 1864

Genus *Plagyrona* E. Gittenberger 1977

Type species: *Plagyrona debeauxiana* (Bourguignat) by original designation

Plagyrona placida (Shuttleworth 1852)

Fig. 1A–C

Helix placida Shuttleworth 1852, *Mittheilungen Naturforschende Gesellschaft in Bern*, **241/242**: 140 [separate p. 6]. Type locality: prope Guimar, Teneriffa. Syntypes in NMBE (*vide* Bank *et al.*, 2002).

Helix [*Euromphala*] *pusilla* var. β *sericina* R.T. Lowe 1855, *Proceedings of the Zoological Society of London* **24** (270): 176. Type locality: "in Madera et in Ins. Des. Majore" [inclusion of the Desertas presumably being an error].

Helix debeauxiana Bourguignat 1863, *Malacologie de l'Algérie* **1**: 183, pl. 19, figs. 13–16. Type locality: forêt de l'Édough, W. of Annaba [= Bône, Algeria]. Lectotype in MHNG-Bgt (designated by Gittenberger, 1977: 297).

Helix luseana Paiva 1866, *Journal de Conchyliologie* **14**(4): 342–343, pl. 11, fig. 9. Type locality: *in insula* Madeira.

Helix bussacona Castro 1887, *Jornal de Ciencias Mathematicas, Physicas e Naturaes* **11**(44): 246 [separate p. 15]. Type locality: au bois de Bussaco [= Buçaco, Portugal]. Types perhaps lost

(Gittenberger, 1977: 297 listed "Material vom Originalfundort studiert, keine Typen", and illustrated a shell from Coimbra on p. 298, despite Locard, 1899: 73 noting only "Bussaco (Castro, collect. Bourguignat)").

Description of shell Shape low-conical (H/B 0.586–0.711, mean 0.651, s.d. 0.030, N=59), with up to 3.3 rounded whorls that are slightly shouldered towards the suture and somewhat flattened below; sutures rather deep. Umbilicus moderately wide (U/B 0.171–0.290, mean 0.229, s.d. 0.028, N=61), symmetrical, exposing all whorls of spire. Mouth almost round, except where penultimate whorl interrupts the outline. Mouth edge unthickened, slightly expanded and often descending slightly. Shell weakly calcified (often somewhat corroded), translucent, light brown to brown. Periostracum glossy, on top and sides of shell from whorl 1.2 onwards with radial ribs that are closely spaced, low, somewhat irregular; protoconch with low, parallel, spiral ridges that remain obvious up to whorl 1.3, being present as faint spiral lines on later whorls; underside of shell with lower ribs than upperside and faint spiral lines often visible. Shells from Portugal were indistinguishable from near-topotypes from Tenerife (Figs 1A–C, 2).

External features of body Six living snails from SE. of Livramento (site P224A: Appendix) were studied in detail in order to describe external features of the body and one of them was photographed (Fig. 3E,F). Although the body was not especially long or slender, the foot appeared relatively wide. Paired ommatophores arose from the front dorsal surface of the head, each of them having a bulbous, rounded tip containing a round black eye; the lower tentacles were very short and conical. The ommatophores, top of head and dorsal surface of the exposed body were black or blackish, whereas the lower sides of the body, the tail, foot-fringe and sole of foot were pale greyish and translucent, with a rather abrupt demarcation from the blackish dorsum. The protoconch and first two whorls of the spire appeared brown through the translucent shell apex.

Behaviour The living snails appeared to retreat or turn away from bright lights and withdrew into their shells as they became dry, making it difficult to photograph them while they were active. The ommatophores were mainly fully

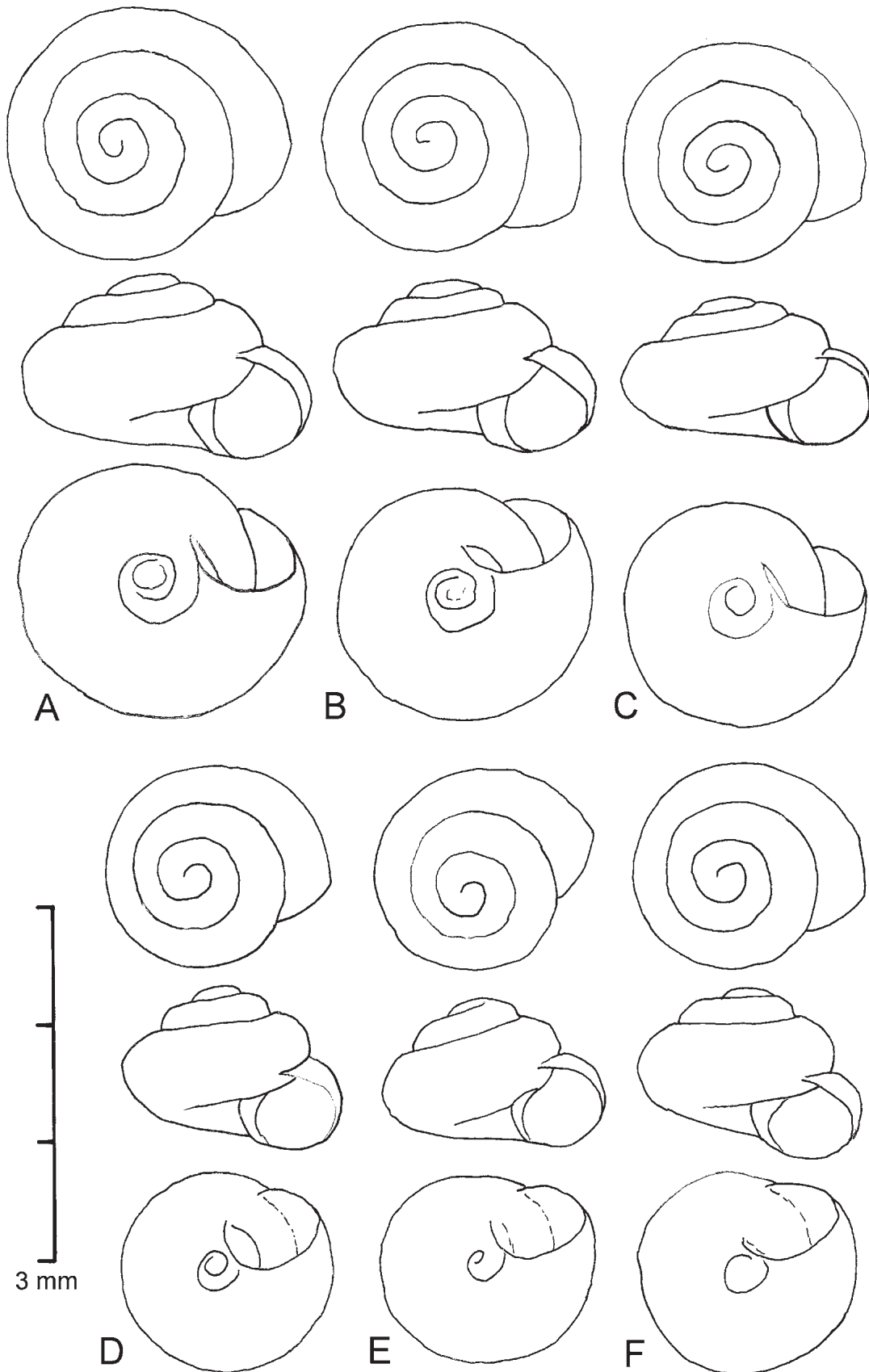


Figure 1 Shells of *Plagyrona* from Portugal and Tenerife: **A–C** *P. placida*; **D–F** *P. angusta* sp. nov.; **A, B** from south-east of Livramento, Estremadura, Portugal (site P224); **C** from S. of El Draguillo (NE. of San Andrés), Tenerife; **D** holotype; **E, F** paratypes, from ca 1 km south-east of Condeixa-a-Velha, Beira Litoral, Portugal (sample P178).

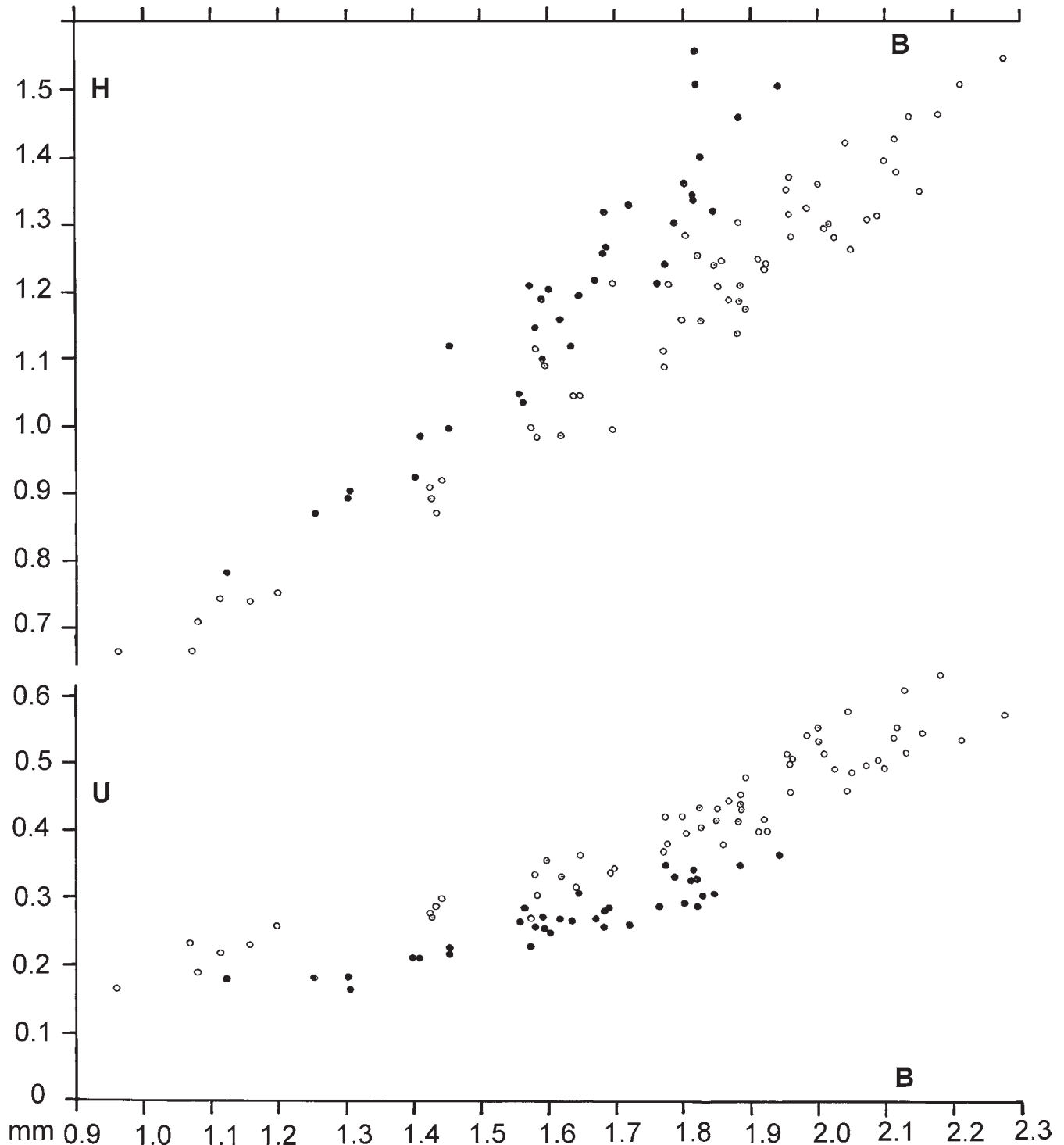


Figure 2 Graphs of shell measurements of *Plagyrona placida* and *P. angusta*. Upper graph shows relationship between shell height (H) and breadth (B), lower graph shows relationship between umbilicus width (U) and shell breadth (B); ○: open circles, *P. placida* (with central dot: Tenerife; lacking central dot: Portugal); ●: filled circles, *P. angusta*.

extended when the snails were crawling in air, but fully withdrawn when crawling on the bottom of shallow water, although the lower tentacles were visible extruded under water.

Geographical range Canary Islands (La Palma, El Hierro, La Gomera, Tenerife: Wollaston, 1878; Bank *et al.*, 2002: 102), Madeira (Wollaston, 1878; Waldén, 1983; Bank *et al.* 2002: 102; Seddon,

2008), Porto Santo (Seddon, 2008), Portugal (Servain, 1880; Castro, 1887; Locard, 1899; Gittenberger, 1977), N. Algeria (Bourguignat, 1863; Gittenberger, 1977), Corsica (Ripken & Bouchet, 1998: 15; Falkner, Ripken & Falkner, 2002: 107), Greece (Ionian Islands of Kerkyra, Ithaki and Kephallinia: Gittenberger, 1989).

In Portugal (Fig. 4A) recorded by the authors from four localities in Beira Litoral and Estremadura (see Appendix). Illustrations of a shell from Coimbra (presumably Bussaco i.e. Buçaco) by Gittenberger (1977: 298, fig. 3; 302, pl. 1, fig. 1) leave no doubt that *P. placida* s. str. was figured. These illustrations of apparent topotypes might also imply that *Helix bussacona* Castro 1887 is a synonym of *P. placida*, despite some ambiguity in the original description (Castro, 1887: 246 stated “spire plus bombée; ... dernier tour moins grande, plus cylindrique” which are suggestive of *P. angusta*, but the “ombilic plus grand” is appropriate for *P. placida* and not for *P. angusta*). However, Nobre (1941: 80) regarded *H. Debeauxiana* and *H. bussacona* as synonyms of the “pouco variável” *Helix pygmaeum* Draparnaud [i.e. *Punctum pygmaeum*], which might have been based on named material he had seen in Portuguese collections, although other possible explanations are that he used an extraordinarily broad species concept, or was merely careless.

Plagyrona angusta sp. nov.

Fig. 1D–F

Types Holotype reg. no. 20120026 and two figured paratypes reg. no. 20120027 at NHMUK, collected 10 August 2011, GAH & DTH P178; additional paratypes from type locality in CGAH (ca 315 shells, 2 specimens in alcohol). See Appendix for list of paratypes from other localities.

Type locality Portugal, Beira Litoral [Coimbra District], by Rio de Mouros ca 1 km SE. of Condeixa-a-Velha, 29T 054359/443850, low mossy limestone rocks on bank of small dried river in deciduous woodland with some olives and pines (see below for more detailed account), 125 m alt.

Description of shell Shape conical (H/B 0.658–0.854, mean 0.729, s.d. 0.045, N = 35) with up to 3.2 rounded whorls that are shouldered towards the suture and slightly flattened below; sutures very

deep, especially between later whorls. Umbilicus rather narrow (U/B 0.125–0.198, mean 0.164, s.d. 0.016, N=35), symmetrical, deep, so exposing all whorls of spire. Mouth almost round, except where penultimate whorl interrupts the outline. Mouth edge unthickened, slightly expanded, not or slightly descending. Shell weakly calcified (often somewhat corroded), translucent, brown. Periostracum glossy, on top and sides of shell from whorls 1.0–1.2 onwards with radial ribs that are closely spaced, low, somewhat irregular; protoconch with low, parallel, spiral ridges that remain obvious up to whorl 1.3, being present as faint spiral lines on later whorls; underside of shell with lower ribs than upperside and faint spiral lines often visible.

Species recognition The shells of *P. angusta* differ from those of *P. placida* most clearly in the following characters.

- shell does not grow as large, reaching breadth of nearly 1.95 mm, compared to nearly 2.3 mm
- shells average higher in relation to breadth, mean H/B being 0.729 (s.d. 0.045), compared to 0.651 (s.d. 0.030); this difference is greater when only the large shells of *P. angusta* are considered, due to their markedly descending body whorl causing a disproportionate increase in height (for shells with B >1.7 mm, H/B 0.754, s.d. 0.048, N = 13; for shells with B < 1.7 mm, H/B 0.713, s.d. 0.039, N = 23)
- the umbilicus is smaller relative to shell breadth, mean U/B being 0.164 (s.d. 0.016), compared to 0.229 (s.d. 0.028)
- the suture between body whorl and penultimate whorl is much deeper (cf. Fig. 1A–C and 1D–F). Fig. 2 suggests there is little overlap in relative shell height and relative size of the umbilicus in mature shells of the two species.

Using a combination of these and the other characters listed above, it was possible to identify all intact shells exceeding 1.5 mm in breadth.

External features of body Two living adults were studied from sample P178, allowing description of external features of the body, which were mainly similar to those described above for *P. placida*. The front dorsal surface of the head had a pair of rather thick ommatophores, each with a round black eye near the tip. Beneath the base of each ommatophore was a short, conical lower

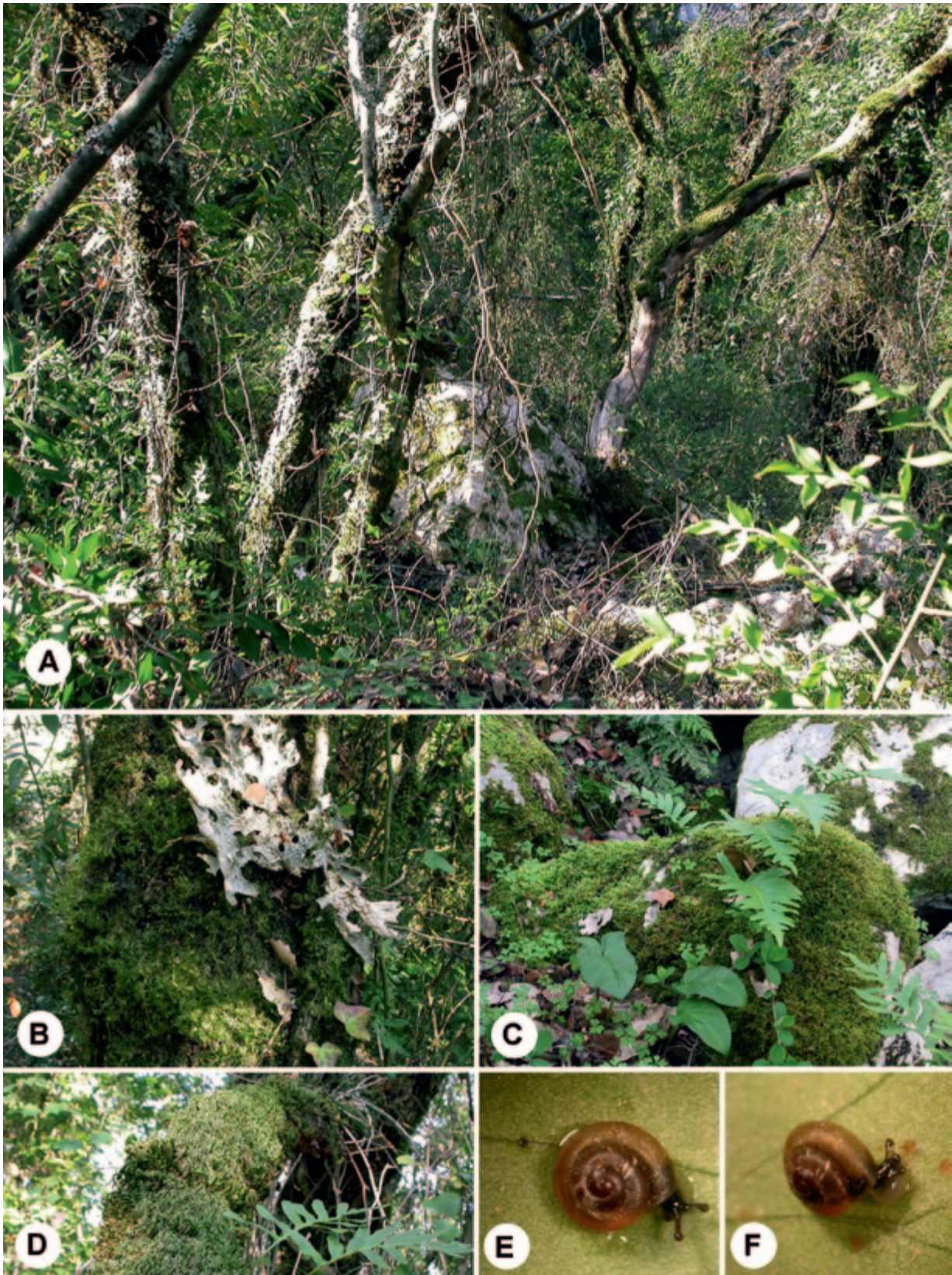


Figure 3 Habitats of *Plagyrona placida* (A–D) and a living snail (E, F), south-east of Livramento, Estremadura, Portugal, 25 Jan. 2012: **A** *Quercus faginea* woodland rich in epiphytes; **B** trunk with epiphytic mosses and lichen (*Lobaria*); **C** low rocks with cover of mosses (mainly *Hypnum cupressiforme*); **D** horizontal branch with epiphytic mosses (mainly *Pterogonium gracile*, some *Leucodon sciuroides*), from which living *P. placida* was collected; **E, F** living snail to show body colouration.

tentacle, wider than long, appearing as a mere papilla. The top of the head and forepart of the body and the tentacles were blackish-grey; the lower sides of the exposed body, foot-fringe and top of tail were translucent, colourless, the lower sides having small and inconspicuous blackish marks that decreased downwards; the sole of the foot was grey, slightly paler at the tail, with tiny white spots. The snails sealed the aperture of the shell with a translucent epiphragm when the body was withdrawn and dormant.

Geographical range Western central Portugal, from the southern edge of Coimbra in Beira Litoral southwards through western Ribatejo and Estremadura to a southern limit in the Serra da Arrábida (Fig. 4B, Appendix).

Etymology *Plagyrona* is an anagram of *Planogyra* Morse 1864 (“Die vermuteten näheren Beziehungen zu *Planogyra* kommen im Namen *Plagyrona* gen. nov. zum Ausdruck”: Gittenberger, 1977: 300). As an “invented” word *Plagyrona* does not have an inherent gender, but authors using *Plagyrona debeauxiana* and *Plagyrona placida* have clearly regarded it as a feminine noun, so any additional species should be named on the same basis (ICZN Art. 30(d)). The epithet *angusta* is therefore the feminine form derived from the latin adjective (Declension A) *angustus*, meaning narrow, in reference to the narrower shell shape compared to *P. placida*.

Plagyrona sp. undet.

Geographical range The following reports attributed to *Plagyrona placida* from mainland Portugal now require reexamination of specimens to establish the species identity (see Fig. 4C).

- a. Castro (1887: 246) recorded *Helix debeauxiana* from Cintra, Coimbra, Praia da Granja, Porto and Famalicão. In view of the comments above on Nobre’s (1941: 80) treatment of these records, it cannot be safely assumed that these all belong with *Plagyrona* spp., so we map them (Fig. 4C) only as “?”.
- b. The report from floodline debris of the Rio Tejo [“alluvions du Tage”] at “la tour de Belem” near Lisbon from Servain (1880: 62) [cited merely as Lisbonne by Castro, *loc. cit.* and by Locard, 1899: 72] was mapped by Gittenberger (1977: 298), but it is not mapped here because the shell(s) could have drifted to Belem from

anywhere in the large catchment of the R. Tejo in Spain and central Portugal.

- c. *Planogyra sororcula* was reported from Sintra by Palazzi (1988: 17), but Gittenberger (1989: 15) reidentified this as “most probably” *Plagyrona placida*, apparently without seeing the specimens. This report is not mapped here, but a subsequent record from Sintra is given below.
- d. A record new to the Algarve by Seddon & Tattersfield (1992) (see Appendix) was based on a single shell that is too small for reliable species determination.
- e. Three records from Coimbra: Quinta das Lágrimas (29TNE4849) (Oliveira, 2008: 41, 2010: 42–43), a locality from which we have collected both *P. placida* and *P. angusta* (see Appendix); Jardim Botânico (29TNE4950) (Oliveira, 2010: 42–43); Jardim de Santa Cruz (29TNE4951) (Oliveira, 2009: 55–56).
- f. Castelo do Mouros, Sintra (29SMC6693) (Torres & Oliveira, 2010: 32).

HABITATS AND ECOLOGY

Plagyrona placida In the Canary Islands, the original description noted that it occurred “Ad truncos arb. prope Guimar, Teneriffa” (Shuttleworth, 1852: 140). Wollaston (1878: 331) recorded that it “occurs in precisely similar situations throughout the Canarian archipelago as it does at Madeira [see below], its normal range being within the wooded districts of intermediate altitudes”. Our specimens from Tenerife (see Appendix) include some found alive among those from moss on trunks and at base of laurels in laurel forest near a ridge, two alive from bracken *Pteridium aquilinum* (L.) Kuhn fronds in a ravine with a small stream in laurel forest on north-facing slopes, and a shell from laurel forest and scrub of *Erica arborea* L.

On Madeira, Paiva (1866) reported it (as *H. luseana*) “Ad laurorum muscos lichenisque ... haud rara”. Wollaston (1878: 87) noted it was “attached normally to the sylvan districts of a higher altitude, where it congregates beneath the bark of trees, as well as amongst moss and lichen on the damp trunks of the old laurels. Under such circumstances it is universal throughout the wooded portions of Madeira proper”. Seddon (2008: 37) noted that it occurs “Under leaves in humid and shady places; amongst hypnoid mosses covering trees, preferring uppersides of

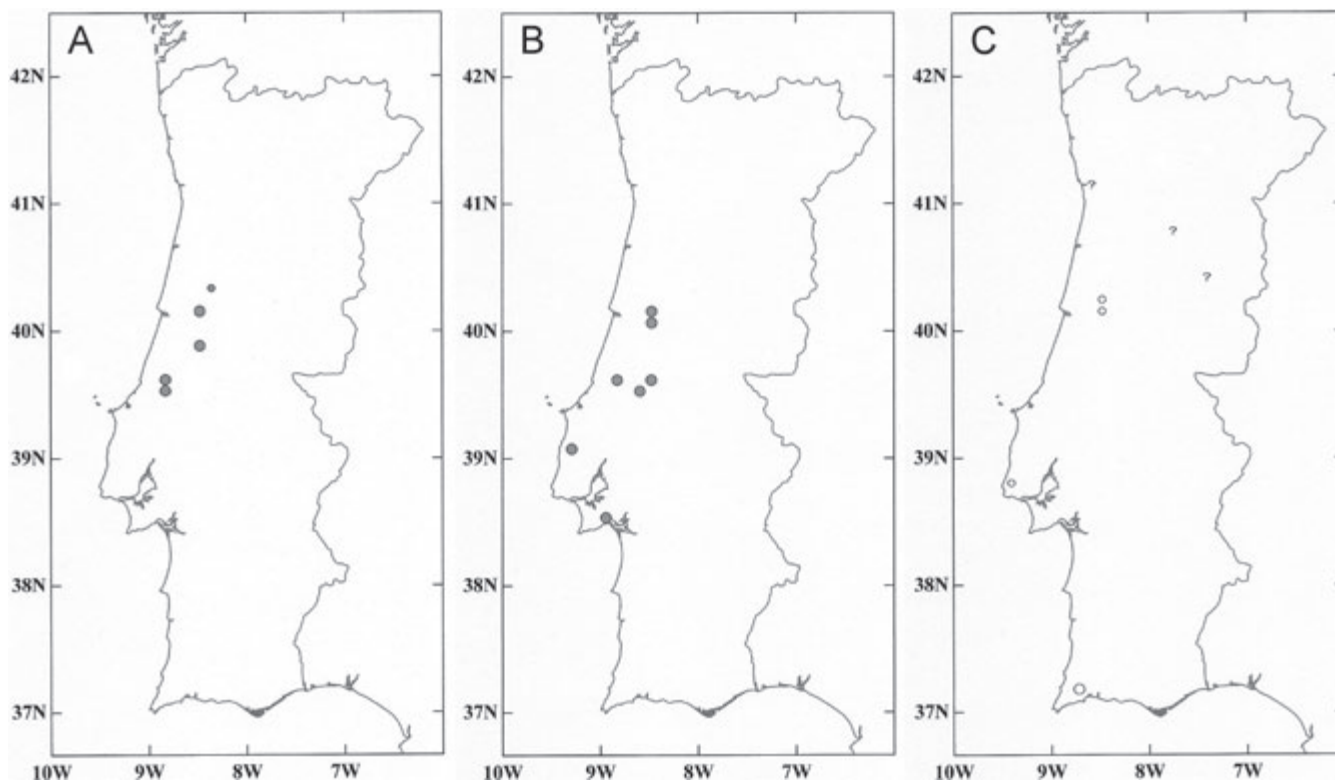


Figure 4 Distribution of *Plagyrona* in Portugal, mapped in 10 km squares of the U.T.M. grid: **A** *P. placida*; **B** *P. angusta*; **C** additional records of *Plagyrona* sp. undet.

● collected by authors, 2009–2012; ● from Gittenberger (1977); ○ shells or photos seen by authors; ○ records from literature; ? old records from literature for which generic identity uncertain.

large horizontal branches. Frequently present at low density”.

During fieldwork in Portugal from 2009–2011 we found empty shells at three sites in sievings from leaf litter in rocky limestone habitats underneath deciduous woodland. The three localities involved (Appendix) were all humid sites with exceptionally rich land-snail faunas and semi-natural vegetation, two of them in deep valleys (SE. of Almoester; Fórnea), the third on a slope below large crags (SE. of Livramento). At the last of these sites, large samples of “fines” sieved from leaf-litter produced 107 dead shells but none living. On 25th January 2012 the locality was therefore revisited in order to sample other microhabitats extensively in search of living snails and describe those where they were found. Trunks and branches covered with epiphytic mosses, etc., were sampled mainly at 0.5–2.0 m above the ground by variously beating, brushing and combing epiphytes over large sieves (sample P224A) or mainly by direct inspection of bark, lichens and mosses (sample P224D), resulting in a total of 178 *P. placida* being found, 26 of them

living (Table 1). Low limestone rocks with cover of mosses were also searched, by sieving moss (P224B) and by a combination of direct searching and sieving (P224C), resulting in a smaller total of 82 *P. placida* of which 2 were living (Table 1).

The locality SE. of Livramento evidently supports a large population of *P. placida*, so the general habitat and most productive microhabitats are described in detail here, for comparison with other sites where *P. angusta* was found in larger numbers (see below). The woodland at Livramento consists mainly of oaks (*Quercus faginea* Lam. subsp. *broteroi* (Coutinho) A. Camus) 8–13 m tall, with a sparse admixture of smaller *Laurus nobilis* L., mainly saplings. It has a patchy shrub layer including *Hedera* sp., *Rosa* sp., *Ruscus aculeatus* L., *Smilax aspera* L. and locally *Vinca difformis* Pourr. (Fig. 3A), the understory forming dense tangles locally amongst limestone block-scree. Trunks and branches of the oaks have abundant cover of epiphytes, the microhabitat that produced most of the living *P. placida* (samples P224A, P224D). Here, cover of mosses predominates (e.g. Fig. 3B, D) (those common or frequent

Table 1 Microhabitats of *Plagyrona* in Portugal

Species	Locality	Sample No.	Microhabitat	N dead	N living
<i>P. placida</i>	SE. of Livramento	P63**	leaf-litter (mainly)	70	0
		P193*	leaf-litter	37	0
		P224B*	moss on low rocks	60	1
		P224C†	moss on low rocks	20	1
		P224A**	moss etc. on trees	136	20
		P224D†	moss etc. on trees	16	6
		P231 & P246†	tree bark	5	10
<i>P. angusta</i>	SE. of Livramento S. of Condeixa-a-velha	P193*	leaf-litter	1	0
		P38**	leaf-litter	15	0
		P178A**	leaf-litter	22	0
		P178B*	moss on trees	5	0
		P178C*†	moss on low rocks	330	2
		P231 & P246†	tree bark	9	19
		P231 & P246†	vertical concrete in garden area	1	7

**Large samples sieved; *smaller samples sieved; †found mainly by direct searching in field.

being *Hypnum cupressiforme* Hedw. var. *cupressiforme*, *Pterogonium gracile* (Hedw.) Sm., *Leptodon smithii* (Hedw.) F.Weber & D.Mohr, *Neckera complanata* (Hedw.) Huebener, *Leucodon sciuroides* (Hedw.) Schwägr. var. *morensis* (Schwägr.) De Not., *Homalothecium sericeum* (Hedw.) Schimp., *Cryphaea heteromalla* (Hedw.) D.Mohr, accompanied by some liverworts (*Radula complanata* (L.) Dumort., *Porella* sp., *Lejeunea* sp.), lichens locally (including strong patches of *Lobaria* sp.), scattered patches of the fern *Polypodium cambricum* L., and *Hedera* sp. on some trunks. Flat or sloping vegetated tops of low limestone rocks (e.g. Fig. 3C) produced fewer *P. placida*, but these included two alive (samples P224B, P224C). Moss cover again predominated on the rock (at P224B mainly of *Hypnum cupressiforme* var. *cupressiforme*, with smaller amounts of *H. cupressiforme* var. *lacunosum* Brid., *Ctenidium molluscum* (Hedw.) Mitt. var. *molluscum*, *Bryum capillare* Hedw., *Neckera complanata*, *Homalothecium sericeum*, bits of *Leucodon sciuroides*, *Pterogonium gracile*, etc., and scattered seedlings of *Geranium robertianum* L. or patches of *Sedum album* L.; at P224C the smaller and more shaded rocks had mainly the moss *Scorpiurium circinatum* (Bruch) M.Fleisch. & Loeske).

Other Mollusca found with *P. placida* on trunks and branches were *Lauria cylindracea* (Da Costa) (commonest), *Clausilia bidentata* (Ström) (common), *Balea heydeni* von Maltzan (frequent), and smaller numbers of *Columella aspera* Waldén (9

shells), *Punctum pygmaeum* (Draparnaud) (6), *Vitrea contracta* (Westerlund) (3) and *Leiostylia anglica* (A. Férussac) (1). The sievings from mosses on low rocks again produced many *Lauria cylindracea* associated with *P. placida*, with smaller numbers of other Mollusca (*Balea heydeni* 10, *Pyramidula* sp. 10, *Vitrea contracta* 6, *Punctum pygmaeum* 4, *Acanthinula aculeata* (O.F. Müller) 4, *Columella aspera* 3, *Clausilia bidentata* 2, *Oxychilus* sp. 1, *Truncatellina callicratis* (Scacchi) 1). Snails that were much commoner in leaf-litter of the woodland than in either of these microhabitats included *Leiostylia anglica* and *Carychium cf. ibazoricum* Bank & Gittenberger.

Subsequently, visits to the vicinity of the Fonte das Lágrimas on the southern edge of Coimbra in February and May 2012 concentrated on searching for *Plagyrona* on trees. Both *P. placida* and *P. angusta* were found living together there on bark of *Sequoia* and other trees in shady mixed coniferous and deciduous woodland of this arboretum, which has limestone rock exposures and walls beneath the trees. Both *Plagyrona* species were found on bark with little or no cover of mosses or lichens, mainly 1–2 m above the ground.

Plagyrona angusta We have found the new species at five localities, all of which have Mesozoic limestone exposed or present as old masonry debris, at 40–303 m altitude. *Plagyrona* collected near Torres Vedras (Estremadura) by R. Mendes

(pers. comm.) in 2012 are also this species, found alive on vertical concrete of large pipes used as flower beds, shaded by mature *Fraxinus* trees in a public garden. Shells collected in 1984 at the Serra da Arrábida, on limestone at 10 m altitude, are also reidentified as *P. angusta* (Appendix).

The microhabitats at some of the sites investigated from 2010–2012 appear to be drier than at sites with *P. placida*. This difference was especially obvious at Convento de Cristo (just W. of Tomar, site P175) where the two shells were found amongst limestone rubble below old walls of the mediaeval convent, on an open sunny slope, almost unshaded by the few trees nearby. Similarly, SE. of Moitas Venda (site P41), there were only a few small trees on the dry limestone crags and rocky slopes where six shells were obtained from sieved “fines”, although their exact provenance is unknown. However, near the Fonte das Lágrimas the two species occurred together on the same trees in shady arboretum woodland. The single shell of *P. angusta* from SE. of Livramento came from a humid locality that produced hundreds of shells of *P. placida* (see above and Table 1) but the exact spot from which it was collected is unknown.

Most of our *P. angusta* came from a locality in Beira Litoral (site P178: by Rio de Mouros ca 1 km SE. of Condeixa-a-Velha) with semi-natural vegetation at which the microhabitats of the species were investigated in more detail. The habitat was inside mixed deciduous woodland (*Quercus*, *Laurus*, *Crataegus*, *Ficus*), with some *Pinus pinaster* Aiton and *Olea europaea* L., within 5 m of the banks of a small river channel that is dry for much of each year. Here it was found mainly on small, low, dry, limestone rocks with flat or rounded tops and an incomplete cover of low pleurocarpous mosses (mostly *Scorpiurium circinatum*) and the liverwort *Lejeunea* sp. The rocks must occasionally be flooded, because old freshwater shells occur in small numbers. There were no closely adjacent tree trunks, taller rocks, tall ground vegetation, or other surfaces on which the snails could climb. Shells of *P. angusta* were collected by searching in the field (ca 30), but mainly from sieved “fines” (ca 300, including 2 live adults) (Table 1). The associated Mollusca were mainly (in decreasing order of abundance): *Lauria cylindracea*, *Leiostyla anglica*, *Vitrea contracta*, *Punctum pygmaeum* and *Acanthinula aculeata*, with a few shells of *Carychium* cf. *ibazoricum* and *Testacella*

maugei Férussac. Another five shells of *P. angusta* were collected from moss on trunks and branches of trees near and overhanging the dry river channel (Table 1), by beating and brushing the moss cover, but the snail was evidently scarce in this microhabitat. Very much larger samples of “fines” from leaf-litter overlying soil and tree roots in the woodland produced 22 shells of *P. angusta* (none living), so it is undoubtedly rather scarce in that microhabitat and the shells may occur there mainly from river drift or as fallen or wind-blown debris.

CONCLUSIONS

The specific distinctness of *P. angusta* and *P. placida* is emphasised by the lack of specimens with intermediate shell morphology among large numbers studied from western-central Portugal (see Appendix: totals of 366 *P. angusta* and 413 *P. placida*), although about half of the shells were too immature to be decisively identified. Their overall geographical distributions overlap in this region (Fig. 4A, B), their general habitat preferences appear to differ somewhat in that *P. placida* is restricted to moist, humid woodland sites, whereas *P. angusta* sometimes lives with it but also extends into drier places with few trees or perhaps merely scrub. As discussed above, living *P. placida* apparently occur mainly on tree trunks and branches, often amongst mosses, less often amongst moss on low rocks. Living *P. angusta* were found at three sites: at the type locality amongst moss on low rocks (along with large accumulations of dead shells), near Torres Vedras on vertical concrete of large pipes used as flower beds and partly shaded by mature *Fraxinus* trees, and near the Fonte das Lágrimas (Coimbra) on bark of trunks of *Sequoia* and other trees 1–2 m above the ground in arboretum woodland. The two species were found living together at two sites: in moderate numbers near the Fonte das Lágrimas (totals of 28 *P. angusta*, 15 *P. placida*, 6 undetermined juveniles) and at 1.5 km SE. of Livramento. The latter locality is described in detail above; at this humid site with rocky woodland only one shell of *P. angusta* was found, compared to 367 of *P. placida* (Table 1).

More study is needed to establish the full geographical ranges of both species in Portugal and the extent to which their habitats differ or overlap.

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APPENDIX

Material studied Data are listed in sequence for each species as country, province, locality name, latitude and longitude or U.T.M. grid reference, habitat description, altitude, date, collectors' initials, collector's field number, collection where housed, registration number if any, number of

shells or specimens (immature or adult), additional comments (if any). To save space, identical information on species, country and province is not repeated; a semi-colon is used only to separate each sample. Abbreviations: CGAH = Collection of G.A. and D.T. Holyoak, CRM = Collection of R. da Costa Mendes, DTH = D.T. Holyoak, GAH = G.A. Holyoak, MH = M. Holyoak, MBS = M.B. Seddon, NMW.Z. = Department of BioSYB, National Museum and Gallery of Wales, Cardiff, U.K., RM = R. da Costa Mendes, sh = number of shells; sp = number of specimens in alcohol.

Plagyrona placida Beira Litoral, Portugal, by Fonte das Lágrimas on S. edge of Coimbra, 29T 054805/444976, from bark 1–2 m up on trunks of trees in mixed deciduous and coniferous wood (arboretum), with limestone rocks and walls (living with *P. angusta*), ca 40 m alt., 29 Feb. 2012, GAH & DTH P231, CGAH, 10 sh; same locality, trunks of *Sequoia* and other trees in mixed deciduous and conifer wood (arboretum) with limestone rocks (living with *P. angusta*), 12 May 2012, GAH & DTH P246, CGAH 3 sh, CRM 2 sh; near N348 SE. of Almoster, 29S 05499/44102, rocky slopes of limestone valley, with low woodland, ca 315 m, 10 July 2009, GAH & DTH P6, CGAH, 7 sh; Estremadura, ca 1.5 km SE. of Livramento by N243 (S. of Porto de Mós), 29S 05170/43809, limestone crags and wooded slope, ca 270 m alt., 1 Nov. 2009, GAH, CGAH 2 sh; ca 1.5 km SE. of Livramento by N243, 29S 05170/43809, wooded slopes with limestone outcrops, 247 m, 30 July 2010, GAH P63, CGAH 70 sh; ca 1.5 km SE. of Livramento by N243, 29S 051710/438061, leaf-litter of deciduous woodland on S.-facing slope with limestone blocks below crags, 303 m, 11 Sept. 2011, GAH & DTH P193, CGAH 37 sh (1 shell of *P. angusta* found with these); ca 1.5 km SE. of Livramento by N243, 29S 05170/43806, S.-facing rocky limestone slope with *Quercus faginea* woodland, ca 290 m, 25 Jan. 2012, GAH & DTH P224, CGAH 232 sh, 28 sp [microhabitats sampled separately, see Table 1, with P224A at 29S 051709/438062, 288 m; P224B at 29S 051709/438060 at 285 m; P224C & P224D at 29S 051705/438067 at 282 m]; Fórnea (SE. of Alcaria), 29S 05170/43789, limestone crags, screes & slopes, patchy scrub (woodland near stream), ca 275 m, 2 May 2010, GAH & DTH P43, CGAH 22 sh; SPAIN, Islas Canarias, Tenerife: La Ensillada, El Pijaral, NE. of San Andrés, 28°34'N.,

16°11'W., from moss on trunks and at base of laurels in laurel forest near ridge, 08 Feb. 2002, GAH, CGAH 10 sh; S. of El Draguillo (NE. of San Andrés), 28°34.2'N., 16°10.2'W., laurel forest and scrub of *Erica arborea*, ca 798 m, 13 Feb. 2002, GAH, CGAH 1 sh; El Pijaral, NE. of San Andrés, 28°33'N., 16°11'W., from bracken fronds in ravine with small stream in laurel forest on N.-facing slopes, ca 800 m, 15 Feb. 2002, GAH, CGAH 2 sh.

Plagyrona angusta Beira Litoral, Portugal, by Fonte das Lágrimas on S. edge of Coimbra, 29T 054805/444976, from bark 1–2 m up on trunks of trees in mixed deciduous and coniferous wood (arboretum), with limestone rocks and walls (living with *P. placida*), ca 40 m alt., 29 Feb. 2012, GAH & DTH P231, CGAH, 19 sh, paratypes; same locality, trunks of *Sequoia* and other trees in mixed deciduous and conifer wood (arboretum) with limestone rocks (living with *P. placida*), 12 May 2012, GAH & DTH P246, CGAH 7 sh (paratypes), CRM 2 sh (paratypes) [plus 6 juvenile sh in CGAH not identified to species, not paratypes]; by Rio de Mouros, S. of Condeixa-a-Velha, 29T 05436/44386, deciduous woodland with rocky limestone banks beside stream, ca 117 m, 27 Apr. 2010, GAH & DTH P38, CGAH 15 sh, paratypes; by Rio de Mouros ca 1 km SE. of Condeixa-a-Velha, 29T 054359/443850, low mossy limestone rocks on bank of small dried river in deciduous woodland with some olives & pines, 125 m alt, 10 Aug. 2011, GAH & DTH P178, holotype (reg. no. 20120026) & 2 figured paratypes (reg. no. 20120027) at NHMUK, CGAH ca 300 sh & 2 sp, all paratypes; Estremadura, ca 1.5 km SE. of Livramento, 29S 051710/438061, leaf-litter of deciduous woodland on S.-facing slope with limestone blocks below crags, 303 m, 11 Sept. 2011, GAH & DTH P193, CGAH 1 sh, paratype (found with 37 sh of *P. placida*); Termas dos Cucos, Torres Vedras, 29SMD72, on vertical concrete of large pipes used as flower beds, partially shaded by *Fraxinus* trees [encontrado vivo em canteiros de flores], 11 Feb. 2012, RM, CGAH 3 sh (paratypes), CRM 5 sh (paratypes); 7 km NE. of Portinho da Arrábida (SW. of Setúbal), NC1 [=29S NC06], rocky limestone slope by stream, shaded by *Pinus*, evergreen *Quercus* & bushes, ca 10 m, 24 Aug. 1984, DTH, MH & MBS 1984.419.3, NMW.Z.1993.052.10348 4 sh, paratypes; Ribatejo, Convento de Cristo, just W. of Tomar, 29S 05499/43839, limestone rubble below

convent & castle walls & ruins, 126 m, 5 Aug. 2011, GAH & DTH P175, CGAH 2 sh, paratypes; SE. of Moitas Venda, 29S 05311/43717, limestone crags & rocky slopes with scrub, ca 195 m, 2 May 2010, GAH & DTH P41, CGAH 6 sh, paratypes.

Plagyrona sp. Algarve, Portugal [D. Faro]: W. of N120 at ½ km SSE. of church at Bensafrim, NB2

[=29S NB21], limestone crags & rocky slopes, partly shaded by bushes, elsewhere grasses & herbs, ca 50 m, DTH, MH & MBS 1984.412.5, NMW.Z.1993.052.10271 1 sh, published as record of *P. placida* new to the Algarve by Seddon & Tattersfield (1992), but single shell is too small for reliable species determination.

