

A new *Canariella* species (Gastropoda: Helicoidea: Hygromiidae) of the new subgenus *Majorata*, both endemic to the Jandía Peninsula (Fuerteventura, Canary Islands)

MARÍA R. ALONSO¹, CARMEN E. PONTE-LIRA¹, CAROLINA CASTILLO¹,
YURENA YANES¹, KLAUS GROH² & MIGUEL IBÁÑEZ^{1,3}

¹Department of Animal Biology, La Laguna University, E-38206 La Laguna, Tenerife, Canary Islands, Spain.
E-mail: mibanez@ull.es

²Mainzer Straße, 25, D-55546 Hackenheim, Germany

³Corresponding author

Abstract

Canariella jandiaensis **sp. nov.** and *Canariella (Majorata)* **subgen. nov.** are described from the Jandía Peninsula mountains (Fuerteventura Island). The new subgenus, which includes *C. jandiaensis* and *C. eutropis*, is characterized mainly by the following synapomorphies: The shell is without hairs and there is a large penial papilla present arising from all the five epiphallar folds. *C. jandiaensis* differs from *C. eutropis* in the unkeeled, almost globular shell, which is smaller but taller than that of *C. eutropis* and has more numerous but smoother radial ribs. Also, *C. jandiaensis* has a pseudopapilla in the distal penial cavity instead of the thick longitudinal pilaster present in *C. eutropis*.

The range of *Majorata* is small, declining from 30,000 years ago and the new species should be classified as “Critically Endangered” based on the very small size of its distribution area (smaller than 1 km²) and the very abundant and free-range livestock present. Mainly goats, grazing freely destroy the habitat in the entire Jandía mountains. Protection of their habitat is recommended, mainly by means of strict livestock control.

Key words: Gastropoda, Hygromiidae, *Canariella jandiaensis* **sp. nov.**, *Majorata* **subgen. nov.**, taxonomy, conservation, Jandía Peninsula, Fuerteventura, Canary Islands

Introduction

Canariella Hesse, 1918 is one of the four species-rich land snail genera present in the Canarian Archipelago. Its oldest fossil record is from the Miocene of Lanzarote Island (Gittenberger & Ripken 1985). Eighteen living species have been described, being present

in almost all the islands, with the noteworthy exception of Gran Canaria, where the genus only has a fossil representation known. A reference list of the main *Canariella* data was presented by Ibáñez *et al.* (2006).

All living *Canariella* species are endemic to the Canary Islands, one of the mid-Atlantic Macaronesian archipelagos. Each *Canariella* species is usually restricted to a single island, with a relatively small distribution. Only *Canariella plutonia* (Lowe, 1861) is found on two islands, Fuerteventura and Lanzarote, probably because these islands were joined together in the past when the sea-level was lower. Both islands form part of the same insular shelf and are separated by a narrow strait less than 40 m in depth. The last, significant descent in sea-level took place during the last glacial period, in which ice covered large parts of Europe and the sea dropped more than 100 meters (Carracedo *et al.* 2005).

Fuerteventura (Fig. 1) has a surface area of 1,731 km² and a dry, desert-subdesert climate. The most distinctive malacofauna of Fuerteventura was found on the small, southern part of the island, the Jandía Peninsula. This zone is mountainous and more humid than the rest of the island, the Jandía massif reaching 807 m in altitude (the La Zarza peak). The steep slopes, facing north, directly receive the humidity of the trade winds, with an annual rainfall of approximately 300 mm, twice or three times that of the remainder of the island.

The land snails of the Jandía mountains are isolated from the rest of the island by "El Jable", a desert-like barrier of sand dunes occupying the northern area (La Pared isthmus) of the Jandía Peninsula. This peninsula harbours eight known, endemic land snail species, four of which live only on the Jandía mountain crests: *Sculptiferussacia clausiliaeformis* Alonso & Ibáñez, 1992, *Obelus moratus* (Mousson, 1872), *Canariella eutropis* (L. Pfeiffer, 1861) and *Hemicycla paeteliana* (L. Pfeiffer, 1859).

In this paper a new *Canariella* species from the Pico de la Zarza is described, its relationships are discussed and a new subgenus is also described. Conservation data of the species belonging to the new subgenus are included.

The shell and genital system of *C. eutropis*, from the Jandía mountains, as well as the shell of *C. plutonia*, the other *Canariella* species living on Fuerteventura, are illustrated for comparison. We only describe the distal genitalia (excluding the spermooviduct, albumen gland and gonad).

Methods

The shells (Fig. 4) were photographed with a digital camera (Olympus DP70) coupled to a stereomicroscope (Olympus SZX12). The genital drawings (Fig. 5) were made with a camera lucida coupled to a stereomicroscope (Zeiss Jena Citoval), from specimens of the AIT ethanol collection. "Proximal" and "distal" refer to the position in relation to the

gonad.

Standardized measurements of shells were taken as shown in Figure 2. The measurements (Fig. 3) were obtained following Alonso *et al.* (2006a,b) and Castillo *et al.* (2006). All the shells were oriented with the shell axis (columella) to the Y axis of coordinates and the maximum shell breadth represented accurately in plane view, the straight linear shell measurements being obtained with the software analySIS® (Soft Imaging System GmbH 2002) as the projections on the X and Y axes of the respective structures. Calculation of number of shell whorls follows Kerney & Cameron (1979: 13).

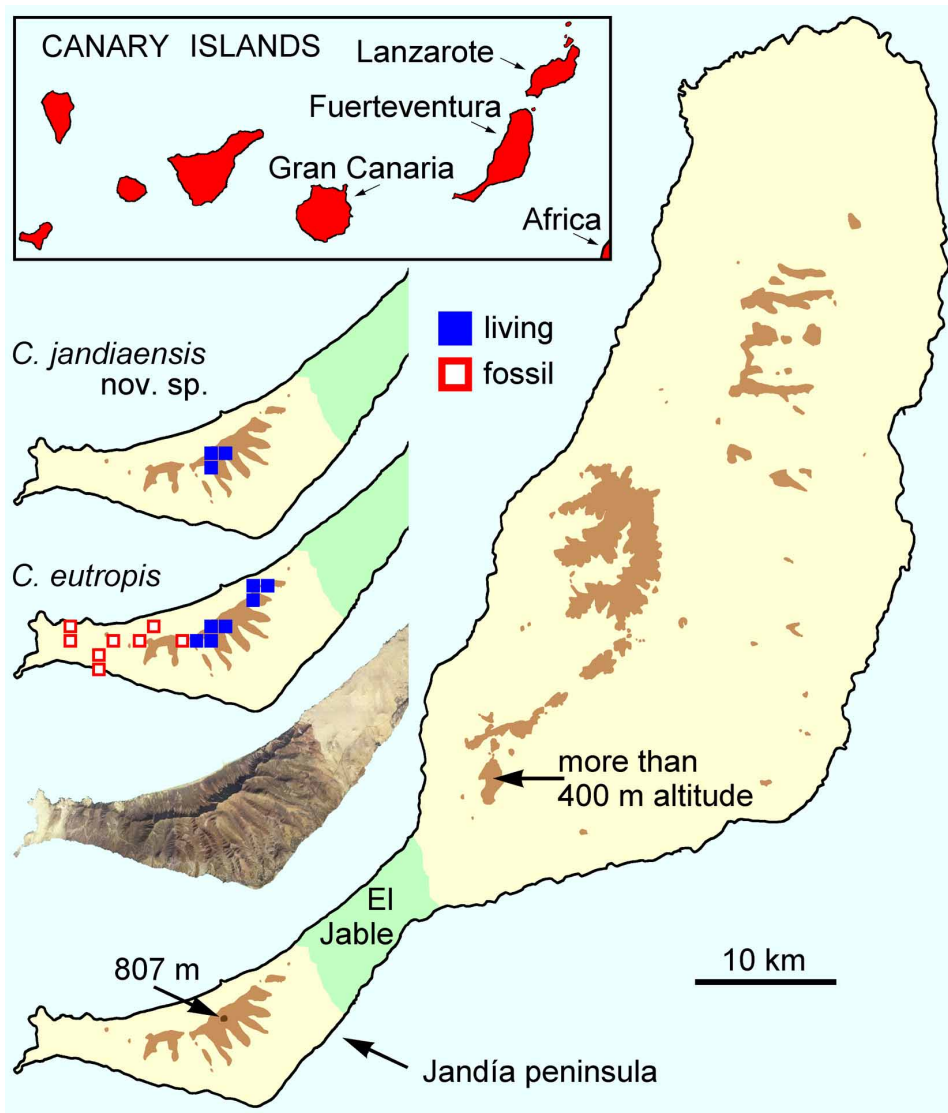


FIGURE 1. Distribution of *Canariella jandiaensis* sp. nov. and *C. eutropis*. Symbols represent 1 x 1 km UTM squares.

Abbreviations

- AIT Alonso & Ibáñez collection, Department of Animal Biology, University of La Laguna, Tenerife, Canary Islands, Spain
- CEC Commission of the European Communities
- CGH K. Groh private collection, Hackenheim, Germany
- CGS F. Giusti private collection, Siena, Italy
- CHB R. Hutterer private collection, Bonn, Germany
- CKW Klaus Kittel private collection, Wiesthal, Germany
- CRJ Carsten Renker private collection, Jena, Germany
- IUCN International Union for Conservation of Nature and Natural Resources
- MNHN Muséum National d'Histoire Naturelle, Paris, France
- NHM The Natural History Museum, London, England
- NMB Naturhistorisches Museum, Bern, Switzerland
- NMW National Museum of Wales, Cardiff, UK
- SMF Natur-Museum Senckenberg, Frankfurt/Main, Germany
- SMNS Staatliches Museum für Naturkunde, Stuttgart, Germany
- TFMC Museo de Ciencias Naturales de Tenerife, Canary Islands, Spain
- UTM Universal Transverse Mercator, cartographic projection system
- ZMZ Zoologisches Museum der Universität Zürich, Switzerland

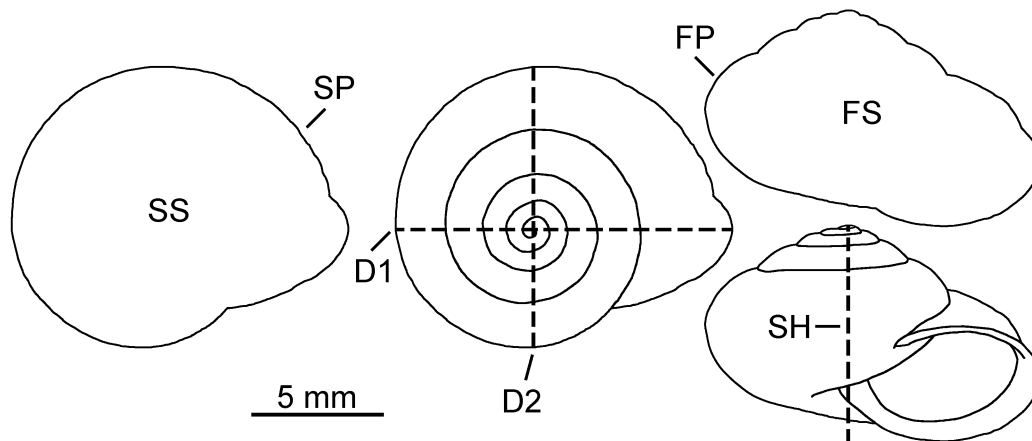


FIGURE 2. Drawings of the *Canariella jandiaensis* **sp. nov.** holotype shell, showing the placement of the measurements obtained (in mm or mm²). D1, maximum shell diameter; D2, shell diameter perpendicular to D1; FP, shell frontal perimeter; FS, shell frontal surface (plane view); SH, shell height; SP, shell perimeter (dorsal plane view); SS, shell surface (dorsal plane view).

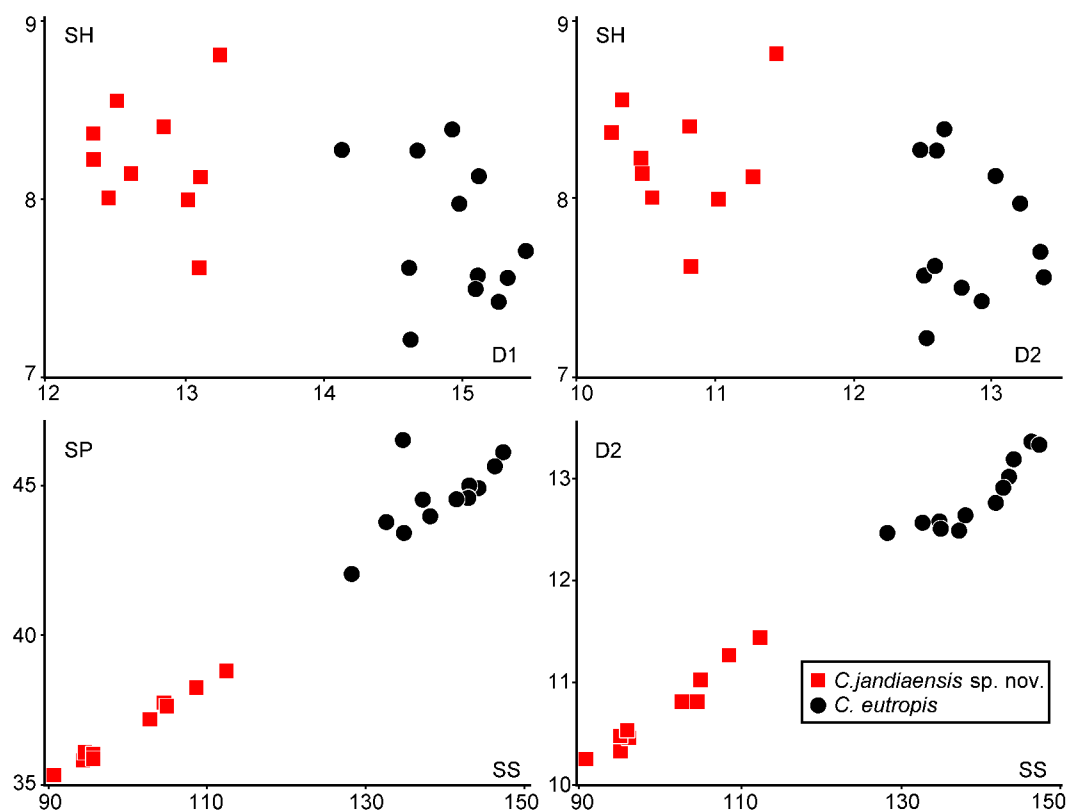


FIGURE 3. Scatter plots of some shell measurements for *Canariella jandiaensis* sp. nov. and *C. eutropis*. Abbreviations same as in Fig. 2.

Systematics

Family Hygromiidae Tryon, 1866

Genus *Canariella* Hesse, 1918

Type species: *Carocolla hispidula* Lamarck, 1822 (designation by monotypy: Hesse 1918: 106–107).

Canariella jandiaensis Ibáñez & Ponte-Lira new species

Type locality. Morro del Cavadero (Fuerteventura; U.T.M.: 28RES6207, 720 m altitude).

Holotype (Fig. 4B): TFMC (MT 0388); leg. K. Groh, M. Ibáñez and C.E. Ponte-Lira, 8-03-1990.

Paratypes. 430 paratypes (mainly shells), collected between 1989 and 2006: CGH (16

ethanol specimens and 44 shells), CGS (4 ethanol specimens and 4 shells), CHB (92 shells), CKW (10 ethanol specimens and 64 shells) CRJ (20 shells) MNHN (1 shell), NHM (1993053/1 shell), NMB (753.30/1 shell), NMW (Z.1992.089.03/1 shell), SMF (309933/1 shell), SMNS (3 shells), TFMC (MT 0283/1 shell), ZMZ (573823/1 shell) and AIT (12 ethanol specimens and 157 shells).

Etymology. The name *jandiaensis* refers to the locality, the Jandía mountains.

Distribution and habitat (Fig. 1): The species is endemic to the Jandía Peninsula (southern Fuerteventura), restricted to the highest ground, living mainly on the crests and on the nearly inaccessible cliff-tops of the northern slopes at an altitude of 550–807 m. *C. jandiaensis* is mostly active at night or in wet weather, remaining for the rest of the time in cracks and under rocks. It has been found in an area smaller than 1 km², distributed in three 1 km UTM square points. In this area the vegetation mainly consists of some plants of a thermophilous forest, considered as the ancient type by botanists, and also substitution bushes.

Diagnosis: A medium-sized *Canariella* with slightly depressed globular, umbilicate shell, without hairs. Penis with a proximal, large penial papilla arising from all the five epiphallar folds, overlapping distally a pseudopapilla.

Description: Body (Fig. 4C) normally clear brown with dark brown spots which merge in the back forming longitudinal lines; some specimens have a uniform brown body.

Shell (Fig. 4B) dextral, conic-ovate, dorsally low conical and ventrally ovate, with a small to medium-sized diameter and 4½–5 convex, roundish whorls with deep sutures; umbilicus medium-sized and deep, slightly obscured by the reflected lip. Aperture oblique, ovate to rounded; peristome whitish, discontinuous, a little expanded as a lip more developed in the lower part of the palatal edge and reflected in the columellar edge, covering partially the umbilicus. Peristome edges inserted next mutually in the parietal zone.

Shell colour yellowish brown, slightly glossy, with thin radial, whitish streaks in the last two whorls, more visible near the aperture. The shell also has up to three dark spiral bands, two dorsal and one less clear, ventral; these spiral bands are not exhibited in some specimens. Ornamentation characterized by sinuous, numerous radial ribs irregularly undulating, very weak on the protoconch and first whorls and well marked in the other whorls; ventral ribs smoother than dorsal ones.

Pallial region extended over last three quarters of the body whorl. Jaw odontognathous, with 6–9 very weak ribs. Radula (formula 24 + C + 24) with last teeth having a small endocone and the ectocone with two cusps.

Genital system (Fig. 5A; eight specimens dissected): Distal male duct (between atrium and retractor muscle insertion) shorter than proximal part of epiphallus (between retractor muscle insertion and flagellum) and almost twice as long as flagellum. These three regions are tubular and taper gradually from the atrium to the flagellum top.

Epiphallus with five thin, waved longitudinal folds which extend into the penial

cavity, their distal ends merging, giving rise to a large, grooved, spoon-like penial papilla (Fig. 5A—c,d) of about 1/3 of penis length.

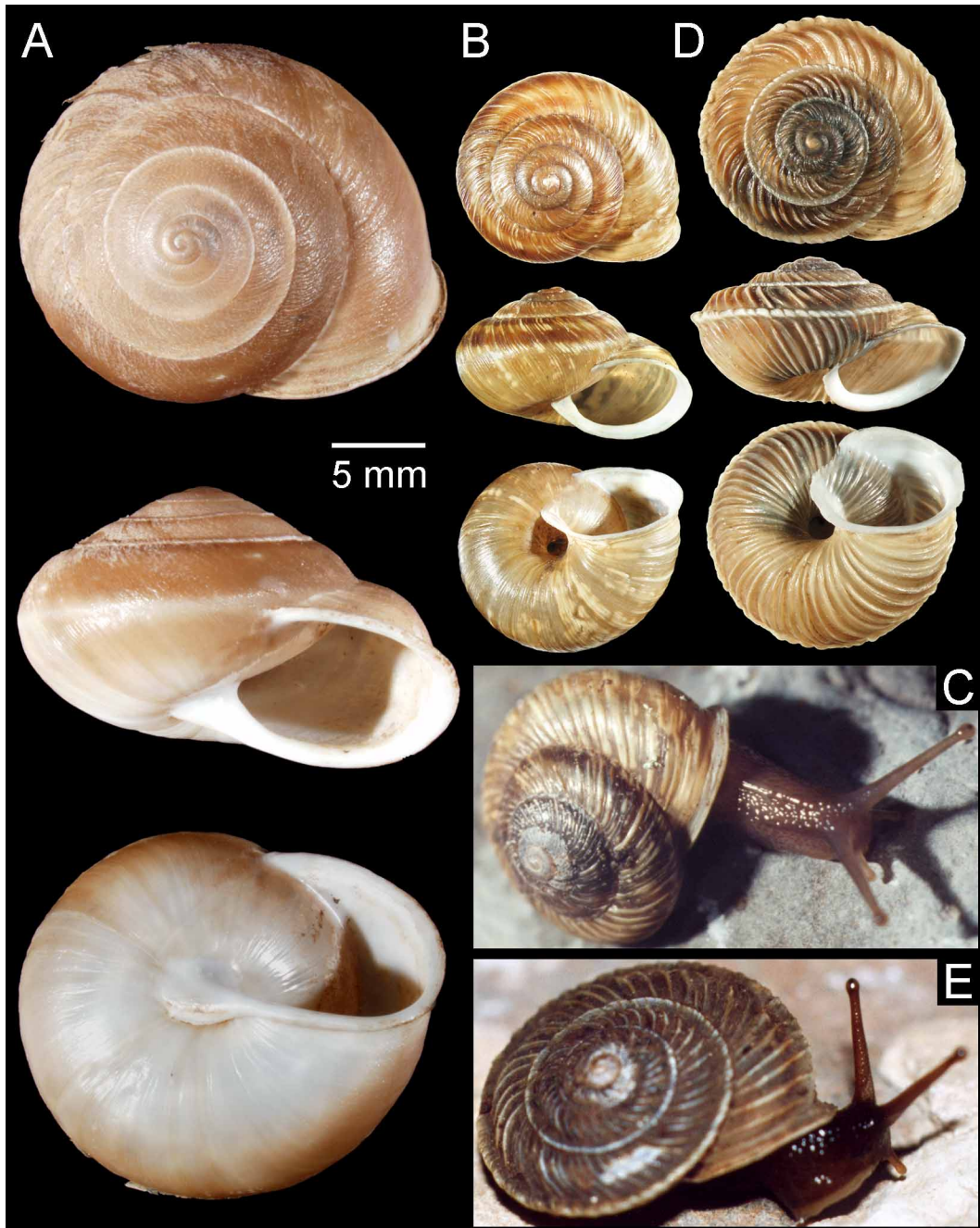


FIGURE 4. Shells and living specimens. A. *Canariella plutonia*, from Vega de Río Palmas; B–C. *C. jandiaensis* **sp. nov.**, from Morro del Cavadero; B. Holotype. D–E. *C. eutropis* from Solana del Ciervo. Scale bar applies to A, B, D.

Moreover, the penis exhibits a grooved pseudopapilla (Fig. 5A—c,d), also spoon-like, partially covered proximally by the penial papilla. When penis evaginates, the pseudopapilla appears forming a pair of oblique folds behind the papilla (Fig. 5A—f), probably for anchorage in the partner's genital system during the coitus. The proximal inner penis wall is smooth (except in the pseudopapilla insertion), while the distal one has five longitudinal, small and thin folds.

Vagina (Fig. 5A—a,b,e) with three digitiform vaginal glands which open near the oviduct orifice. The vaginal glands are short and broad, each one with a slender independent initial portion. Inner vaginal wall with a variable number of irregular longitudinal folds, which are isolated from those of the beginning of the bursa copulatrix duct; in this last area the folds are irregular and anastomosed.

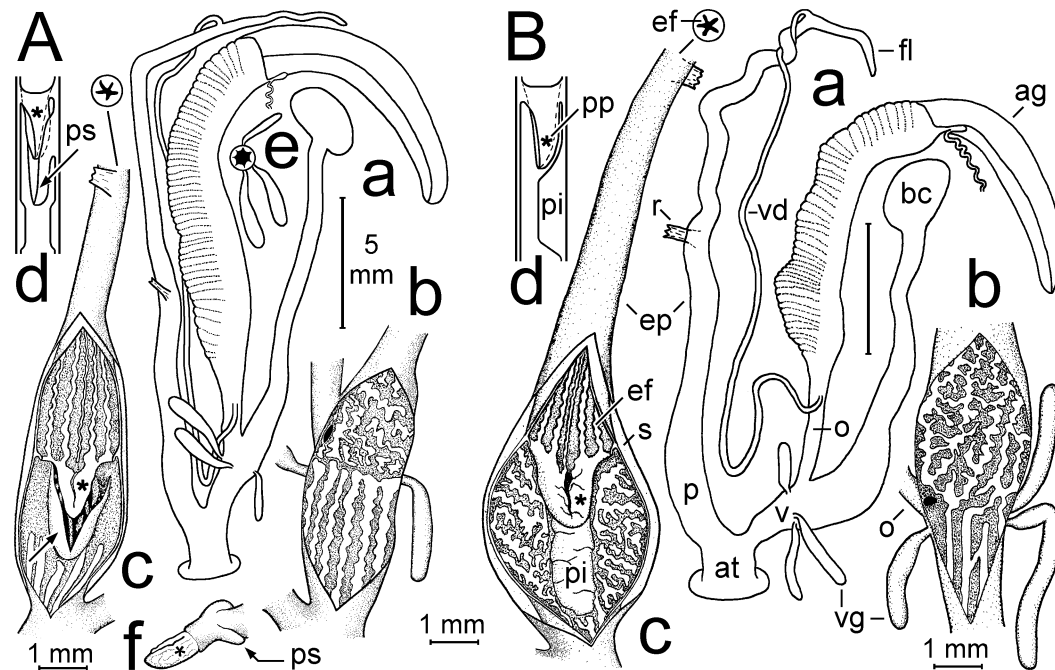


FIGURE 5. Genital system and details. A. *Canariella jandiaensis* sp. nov., from Morro del Cavadero (an AIT paratype). B. *C. eutropis*, from Morro del Cavadero (taken from Ibáñez *et al.* 1995, fig. 38). a, general appearance of the whole genital system; at, atrium; ag, albumen gland; b, detail of the distal female duct; bc, bursa copulatrix; c, detail of the distal male duct; d, epiphallus-penis diagram (without scale); e, vaginal cross-section diagram; with arrangement of vaginal glands (without scale); ef, epiphallar fold; ep, epiphallus; f, detail of the evaginated penis; showing the penial papilla; fl, flagellum; o, free oviduct; p, penis; pi, pilaster; pp, penial papilla (also marked with asterisk); ps, pseudopapilla (also marked with arrow); r, retractor muscle; s, sheath; v, vagina; vd, vas deferens; vg, vaginal gland.

Remarks. *C. eutropis* and *C. jandiaensis* are the only *Canariella* species without hairs on the shell, even in the umbilicus. Both species are also the only *Canariella* species with

the penial papilla arising from all five epiphallar folds; in the two subgenera with a penial papilla, *Canariella* and *Salvinia*, this papilla derives from only two of the epiphallar folds. Thus, both species represent a distinct supraspecific taxon, which will be described in this study as a new subgenus.

C. jandiaensis is easily distinguished from *C. eutropis* by the unkeeled, almost globular shell (Figs. 3, 4B–E), which is smaller but taller than that of *C. eutropis* and has more numerous yet smoother radial ribs. Also, the *C. eutropis* penial cavity has a thick longitudinal pilaster instead of the pseudopapilla present in *C. jandiaensis* (Fig. 5).

C. eutropis and *C. jandiaensis* appear to be sympatric species, with the latter occupying a subset of the former's range. *C. eutropis* is not as much specialised in the habitat as *C. jandiaensis*, the former being able to live also in more dry habitats. The *C. eutropis* shell is nearly discoid and has stronger ornamentation than that of *C. jandiaensis*. These characteristics could represent a better adaptation of the former to get refuge with enough humidity under big stones or in rock fissures of the driest habitats.

Canariella (Majorata) Alonso & Ibáñez new subgenus

Type species: *Helix eutropis* L. Pfeiffer 1861.

Etymology. The name of the subgenus derives from the ancient name “majoreros” given to the inhabitants of the island of Fuerteventura.

Diagnosis: *Canariella* without hairs on the shell. All five epiphallar, longitudinal folds extend into the penial cavity and merge at their distal ends, giving rise to a large, grooved, spoon-like penial papilla. Penial papilla partially covers the main structure of distal penis (pseudopapilla or pilaster, respectively). Vagina with two-three digitiform vaginal glands, short and broad.

Remarks. Until now five *Canariella* subgenera are known, all with hairy shell, their main genital system distinguishing character states are shown in the appendix. *Majorata subgen. nov.* differs in the absence of hairs on the shell and in the origin of the penial papilla from all the epiphallar folds.

Conservation

The distribution of *Majorata* is a protected area because it belongs to the Jandía Natural Park, one of the sites of interest for biodiversity and nature protection to be designated a Special Area of Conservation: the ES7010033 Site, compiled within the framework of Natura 2000, EU Habitats and Birds Directives (CEC 2002). This park harbours several other living species endemic to Jandía (plants and arthropods) in addition to several extinct ones, such as the snail *Ferussacia valida* (Mousson, 1872).

However, unfortunately, all these living species are threatened by the very abundant livestock present (goats, and also sheep) grazing freely and destroying the habitat in the entire peninsula, but mostly in the mountains, even on the Jandía cliffs. Tourism also has a

significant impact on the entire zone. Consequently, the species endemic to Jandía are currently under threat and some are in danger of extinction.

The two *Majorata* species have a limited distribution (Fig. 1). It is very small for *C. jandiaensis* (about 1 km²) whereas that of *C. eutropis* is a little larger (up to 10 km², between 350 and 807 m altitude) although decreasing. In the past the *C. eutropis* area was larger, as is shown by the fossil records, from approximately 30,000 years ago (aminozone 4: Ortiz *et al.* 2006); this species probably inhabited almost the whole southwestern area of the Jandía Peninsula. *C. jandiaensis* is more threatened by its very small distribution area, which could still diminish for the destruction of the habitat above mentioned. Thus, we propose for *C. jandiaensis* the "Critically Endangered" category, in accordance with IUCN (2001) **CR B2ab(iii)** criteria. The species should be included in the Habitats Directive Annexes II and IV of the European Union. *C. eutropis* is also threatened and we therefore propose in this case the "Endangered" category, in accord with IUCN (2001) **EN B2ab(iii)** criteria.

The main measure necessary for the conservation of both species as well as that of the other endemic species from the Jandía mountains is appropriate habitat protection, mainly by strict livestock control.

Acknowledgements

We are grateful to Dr. Bernhard Ruthensteiner (Munich) and two anonymous reviewers for their revision of the manuscript and to P. Agnew (Instituto de Productos Naturales y Agrobiología, Consejo Superior de Investigaciones Científicas) for linguistic revision. This research was supported by the scientific projects BOS2003-00374 and CGL2006-01586/BTE, of the Spanish Ministerio de Ciencia y Tecnología and Ministerio de Educación y Ciencia, respectively.

Literature cited

- Alonso, M.R., Ibáñez, M. & Ponte-Lira, C.E. (2003) *Canariella* (*Salvinia*), new subgenus, and three new species of *Canariella* Hesse, 1918 (Gastropoda: Pulmonata: Hygromiidae). *The Veliger*, 46, 69–76.
- Alonso, M.R., Goodacre, S.L., Emerson, B.C., Ibáñez, M., Hutterer, R. & Groh, K. (2006a) Canarian land snail diversity: conflict between anatomical and molecular data on the phylogenetic placement of five new species of *Napaeus* (Gastropoda, Pulmonata, Enidae). *Biological Journal of the Linnean Society*, 89, 169–187.
- Alonso, M.R., Nogales, M. & Ibáñez, M. (2006b) The use of the computer-assisted measurements utility. *Journal of Conchology*, 39, 41–48.
- Carracedo, J.C., Pérez, F.J. & Meco, J. (2005) La Gea: Análisis de una isla en estado post-erosivo de desarrollo. In: Rodríguez, O. (Ed.), *Patrimonio natural de la isla de Fuerteventura*. Cabildo de Fuerteventura, Consejería de Medio Ambiente y Ordenación Territorial del Gobierno de

- Canarias, y Centro de la Cultura Popular Canaria, pp. 27–44.
- Castillo, C., Yanes, Y., Alonso, M.R. & Ibáñez, M. (2006) *Napaeus lajaensis* sp. nov. (Gastropoda: Pulmonata: Enidae) from a Quaternary Aeolian Deposit of Northeast Tenerife, Canary Islands. *Zootaxa*, 1307, 41–54.
- Commission of the European Communities (2002) Commission Decision of 28 December 2001 adopting the list of sites of Community importance for the Macaronesian biogeographical region, pursuant to Council Directive 92/43/EEC (notified under document number C(2001) 3998) (2002/11/EC). Available from <http://www.legaltext.ee/text/en/T71165.htm> (last accessed 9 August 2006).
- Gittenberger, E. & Ripken, Th.E.J. (1985) Seven Late Miocene species of terrestrial gastropods (Mollusca: Gastropoda: Pulmonata) from the island of Lanzarote, Canary Islands. *Proceedings of the Koninklijke Nederlandse Akademie van Wetenschappen*, B 88, 397–406.
- Groh, K., Ponte-Lira, C.E., Alonso, M.R. & Ibáñez, M. (1994) Revision of the genus *Canariella* P. Hesse 1918. *Alvaradoa* n. subgen., with description of one new species from El Hierro (Gastropoda Pulmonata: Hygromiidae). *Archiv für Molluskenkunde*, 123, 89–107.
- Hesse, P. (1918) Die Subfamilie Helicodontinae. *Nachrichtsblatt der Deutschen malakozoologischen Gesellschaft*, 50, 99–120.
- Ibáñez, M., Alonso, M.R. & Ponte-Lira, C.E. (2002) A new subgenus and two new species of *Canariella* Hesse 1918 (Gastropoda: Pulmonata: Hygromiidae). *American Malacological Bulletin*, 17, 85–90.
- Ibáñez, M., Ponte-Lira, C.E. & Alonso, M.R. (1995) El género *Canariella* Hesse, 1918, y su posición en la familia Hygromiidae (Gastropoda, Pulmonata, Helicoidea). *Malacologia*, 36, 111–137.
- Ibáñez, M., Siverio, F., Alonso, M.R. & Ponte-Lira, C.E. (2006) Two *Canariella* species (Gastropoda: Helicoidea: Hygromiidae) endemic to the Northwest Tenerife (Canary Islands). *Zootaxa*, 1258, 33–45.
- IUCN (2001) *IUCN Red List Categories: Version 3.1*. Prepared by the IUCN Species Survival Commission. IUCN, Gland, Switzerland and Cambridge, UK., 23 pp.
- Kerney, M.P. & Cameron, R.A.D. (1979) *A field guide to the land snails of Britain and North-West Europe*. William Collins Son & Co., Ltd., London, 288 pp.
- Ortiz, J.E., Torres, T., Yanes, Y., Castillo, C., de la Nuez, J., Ibáñez, M. & Alonso, M.R. (2006) Climatic cycles inferred from the aminostratigraphy and aminochronology of Quaternary dunes and paleosols from the eastern islands of the Canary Archipelago. *Journal of Quaternary Science*, 21, 287–306.
- Pfeiffer, L. (1861) Beschreibung neuer Heliceen. *Malakozoologische Blätter*, 7 [1860], 231–240.
- Ponte-Lira, C.E., Alonso, M.R. & Ibáñez, M. (1997) *Canariella (Simplicula)* n. subgen. (Gastropoda, Pulmonata, Hygromiidae), de las Islas Canarias. *Bollettino Malacologico*, 31, 221–230.
- Soft Imaging System GmbH (2002) *AnalySIS®*. Olympus Soft Imaging Solutions GmbH, Münster, Germany, Available from http://www.olympus-europa.com/medical/4427_7355.htm (last accessed 9 August 2006).

Appendix. Diagnosis of the genus *Canariella* and genital system comparison of the *Canariella* subgenera, based on the descriptions of Hesse (1918), Groh *et al.* (1994), Ponte-Lira *et al.* (1997), Ibáñez *et al.* (2002) and Alonso *et al.* (2003).

Genus *Canariella*: Mantle collar with five lobes, left lateral lobe almost indistinguishable in several species. Kidney sigmurethric, without secondary ureter. Central and first lateral radular teeth with small but evident ectocones. Right ommatophore retractor passing between penis and vagina. Dart-sac complex absent. One or several crown-shaped vaginal glands, each with an independent, slender initial portion. Distal male duct, between atrium and penis retractor muscle insertion, with a sheath. Differentiation of penis and epiphallus sometimes impossible externally. Penis retractor muscle with an epiphallar insertion. Penial nerve originating from the right cerebral ganglion.

Subgenus *Canariella* Hesse, 1918: Two of the epiphallar, longitudinal folds extend into the penial cavity and merge at their distal ends, giving rise to a spoon-like, grooved, penial papilla. Distal portion of the penis with longitudinal folds. Vagina with several digitiform vaginal glands.

Subgenus *Salvinia* Alonso, Ibáñez & Ponte-Lira, 2003: Penis with a small spoon-like, grooved, penial papilla similar to that of the subgenus *Canariella*. Near the oviductal orifice, inner distal vaginal wall thickened like a cushion with two crossed furrows, one longitudinal and the other transverse, the cushion occupying almost the entire vaginal cavity.

Subgenus *Alvaradoa* Ibáñez & Alonso, 1994: Penis without penial papilla and differentiated from the epiphallus only by a thickening of its longitudinal folds. Vagina with a large digitiform vaginal gland, simple or branched.

Subgenus *Simplicula* Ponte-Lira & Alonso, 1997: Differentiation of penis and epiphallus indistinguishable. Penial papilla absent. Vagina with several non-digitiform vaginal glands, short and branched.

Subgenus *Gara* Alonso & Ibáñez, 2002: Penis without penial papilla, with an eccentric orifice connecting the epiphallus, and with a thick longitudinal pilaster opposite to the penis retractor muscle insertion. Penial pilaster with two portions, a proximal soft short ending in the epiphallus and an anklebone-like toughened long distal section. Penis wall with a thickened ring-shaped portion joined to the distal penial pilaster portion. Epiphallar longitudinal folds ending distally as small papillae at the orifice connecting the penis. One of the papillae situated over the proximal pilaster portion. Vagina with longitudinal folds and 1–2 digitiform vaginal glands.