

Revision of the genus *Simplicula* stat. nov. (Stylommatophora: Canariellidae) from the eastern Canary Islands, with the description of seven new taxa

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GROH, K., HUTTERER, R. & MARTÍN GONZÁLEZ, E., 2024. Revision of the genus *Simplicula* stat. nov. (Stylommatophora: Canariellidae) from the eastern Canary Islands, with the description of seven new taxa. – *Basteria*, 88 (1): 6-24. Leiden. Published 20 July 2024.

The subgenus *Simplicula* Ponte-Lira & M. R. Alonso, 1997 in the genus *Canariella* P. Hesse, 1918 is elevated to the rank of a genus and seven new fossil taxa of the group are described from Pliocene and Pleistocene to Holocene deposits from the North of Lanzarote, La Graciosa, and the North, West and Northwest of Fuerteventura, Canary Islands. Their relationship to other taxa of the family Canariellidae on the Canary Islands and in the West-Mediterranean region as well as with fossil species from continental Europe placed in the genus *Canariella* is discussed.

Key words: Pulmonata, extant, fossil, Pliocene, Quaternary, *Canariella*, *Simplicula*, rank elevation, new species

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INTRODUCTION

Schileyko (1991) introduced the family-group taxon Canariellini, which later was ranked as a subfamily within Hygromiidae (Schileyko, 2006) and as a distinct family by Razkin et al. (2015). Its closest and only confirmed familial relatives, with about ten species in two other genera (*Montserratina* Ortiz de Zárate, 1946; *Schileykiella* Manganelli et al., 1989), occur in the northwestern Mediterranean region

(Razkin et al., 2015). The genera *Tyrrheniellina* Giusti & Manganelli, 1992 from Italy and *Debeauxhelix* Bacci, 1941 from East Africa may also belong to the Canariellidae (Schileyko, 2006), but this has not been confirmed by phylogenetic analyses so far.

Actually, only three extant species of the genus *Canariella* P. Hesse, 1918 are known to live on the easternmost and geologically oldest Canary Islands, being Fuerteventura and Lanzarote. These are *Canariella (Majorata) eutropis* (L. Pfeiffer, 1861) and *C. (M.) jandiaensis* Ibáñez & Ponte-Lira, 2006 (cfr. Alonso et al., 2006), which live exclusively on the highest regions of the peninsula of Jandia on Fuerteventura, as well as the widespread *C. (Simplicula) plutonia* (R. T. Lowe, 1861) (biodiversidadcanarias.es/biota/especie/M00018), which additionally lives on Lanzarote and until the late Quaternary also lived on La Graciosa (Yanes et al., 2004 + 2011; Castillo Ruiz et al., 1999 + 2002) and Lobos (Ponte-Lira et al., 2006). The first and oldest fossil Canariellidae described from the Canary Islands, *C. orzola* E. Gittenberger & Ripken, 1985, was recorded from the “Miocene” of Lanzarote (Gittenberger & Ripken, 1985), a second larger *Canariella* sp. from the same layers was left undescribed. Meanwhile most actual results (Lomoschitz et al., 2016) date the type stratum of the type locality, the Valle Chico, between 4.3 to 3.8 My, so to the Lower Pliocene, the era of the Zanclean Stage.

The remarkable lack of extant members of the genus on Gran Canaria, from where four Pliocene species have been described (Hutterer & Groh, 2008), is discussed in that work. A supposed Quaternary fossil species from Tenerife, *Canariella pontelirae* Hutterer, 1994 was found alive in recent years (Ibáñez et al., 2006) and placed in the subgenus *Gara* M. R. Alonso & Ibáñez, 2002 (Ibáñez et al., 2002), whilst an extinct Quaternary species, *C. (Majorata) gerti* Groh, 2021, was actually described from Fuerteventura (Groh, 2021).

The findings of several undescribed species of the *Canariella* subgenus *Simplicula* Ponte-Lira & M. R. Alonso, 1997 (Ponte-Lira et al., 1997) in fossil deposits of the islands of Lanzarote (Lower Pliocene) and Fuerteventura (Lower Pliocene to Upper Pleistocene) led to the conclusion that members of this subgenus belong to the first Canariellidae known from the Canarian Archipelago. They are easily recognizable by their moderate to large size, the rounded periphery and typically overlapping suture, and are restricted to the oldest islands of the Canaries so far. The only extant species of *Simplicula* can be easily distinguished from members of other subgenera of *Canariella* by anatomical characteristics, showing very simple and probably plesiomorph inner structures of the vagina and penis (Ponte-Lira et al., 1997). Ponte-Lira (1992) in her unpublished PhD-thesis already proposed to transfer the taxon *Helix (Macularia) plutonia* R. T. Lowe, 1861 into a separate genus (*Simplicula* MS) and even into a new tribe (*Simpliculini* MS).

Here we present the results of our morphological study of a large number of extant and fossil shells from the eastern Canary Islands.

MATERIAL AND METHODS

The methodology followed was surface collection, without systematic sampling.

The shells were photographed, if not stated otherwise, by Klaus Groh with a camera Nikon Coolpix P 530. The measurements were taken with a calliper to 1/10th of a mm. Photos of the surface sculpture were taken with a Bresser digital hand microscope. Calculations of the number of shell whorls follow Kerney, Cameron & Jungbluth (1983: 21).

The following abbreviations are used: aw = width of the aperture in mm; ah = height of the aperture in mm; CAI = Collection M. Alonso & M. Ibáñez in TFMC_MT; CGD = Collection Klaus Groh, Bad Dürkheim, Germany; CHB = Collection Rainer Hutterer, Bonn, Germany; CR = Carsten Renker; DK = Dietrich Kadolsky; EMG = Esther Martín González; FGT = Francisco García-Talavera; fragm. = fragment(s); h = height in mm; HF = Hanns Feustel; JCR = J.C. Rando; juv. = juvenile(s); KG = Klaus Groh; KTK = Klaus and Theresia Kittel; KvF = Karl von Fritsch; NHM(UK) = Natural History Museum, London, United Kingdom; rel lw = width of the last whorl in relation to the width in %; RH = Rainer Hutterer; SMF = Forschungsinstitut und Naturmuseum Senckenberg, Frankfurt/Main, Germany; TFMC_MT = Museo de Ciencias Naturales de Tenerife, Santa Cruz de Tenerife, Spain, moluscos terrestres; TFMC_FO = Museo de Ciencias Naturales de Tenerife, Santa Cruz de Tenerife, Spain, fosiles; umb = width of the umbilicus in mm; w = width in mm; WL = Wolfram Lobin; wh = number of whorls.

SYSTEMATICS

Order Stylommatophora A. Schmidt, 1855

Suborder Helicina Schileyko, 1979

Infraorder Helicoidei Schileyko, 1979

Superfamily Helicoidea Rafinesque, 1815

Family Canariellidae Schileyko, 1991

Genus *Simplicula* Ponte-Lira & M.R. Alonso, 1997 stat. nov.

Type species (by monotypy): *Helix (Macularia) plutonia* R.

T. Lowe, 1861 (= *Canariella (Simplicula) plutonia* (R. T. Lowe, 1861) = *Simplicula plutonia* (R. T. Lowe, 1861) stat. nov.), extant, Canary Islands, Lanzarote and Fuerteventura, endemic. Quaternary fossils are known from La Graciosa and Lobos.

The genus is characterised by a relatively large size of the shell ($w = 18$ to 29 mm), 4.5 to 5.5 regularly growing whorls, a depressed globose to lenticular shape, a wide aperture with a slightly to significantly expanded and reflected lip, a moderate wide perspective umbilicus which can be covered partly by the reflected columellar part of the lip, and by a very typical suture where the previous whorl narrowly overlaps the following. The only currently known extant species is anatomically characterised by very simple thin tubular male and female genitalia without special structures in the vagina and gametolytic duct or the penis and epiphallus, the latter being very long with a thin flagellum, and further with a very long pedunculus to the horizontal cylindrical bursa copulatrix and four short, branched vaginal glands (Ponte-Lira et al., 1997). In addition, we describe seven new extinct or probably extinct species. The genus is restricted to the eastern Canary Islands.

Comparison with other subgenera of *Canariella*

Canariella (Canariella) P. Hesse, 1918 s. str., with at least six species from Tenerife and La Gomera have a smaller shell (up to 14 mm) without an overlapping suture and have a different genital anatomy.

Canariella (Alvaradoa) Ibáñez & M. R. Alonso in Groh et al., 1994 with three species from La Gomera and El Hierro have a much smaller shell (less than 10 mm) with a very peculiar surface sculpture, without an overlapping suture, and a different genital anatomy.

Canariella (Gara) M. R. Alonso & Ibáñez in Ibáñez et al., 2002, with up to three species from La Gomera and El Hierro are also much smaller (less than 10 mm), their shells have an overlapping suture but are keeled and significantly ribbed, and also have a completely different genital anatomy. It is doubtful whether *Canariella pontelirae* from Tenerife also belongs to that subgenus, as it has a flagellum like members of the subgenus *Salvinia* (see below); its shell has no overlapping suture and is only moderately ribbed.

Canariella (Salvinia) M. R. Alonso, Ibáñez & Ponte-Lira,

2003, with four species from La Gomera which are moderately small to large (12 to 22 mm) but always have a strongly keeled shell, two of them with significant ribbing, have an overlapping suture, but a different genital anatomy.

Canariella (*Majorata*) M. R. Alonso & Ibáñez in Alonso et al., 2006, with three species (one extinct) from Fuerteventura; all have a smaller shell (up to 12 mm), a more or less overlapping suture, and a different genital anatomy.

At least five more extant species from Tenerife and La Gomera have not yet been assigned to any subgenus of *Canariella*. These are all small (6 to 12 mm), two of them keeled with an overlapping suture, but have all very peculiar anatomical characters, differing from all the other species classified before. Further five already described fossil species from Gran Canaria and Lanzarote and several undescribed ones from Fuerteventura and Lanzarote have not been yet assigned to a subgenus, too.

Comparison with other extant European species assigned to the family Canariellidae

The species of the genera *Montserratina* and *Schileykiella* were genetically assigned to Canariellidae (Razkin et al., 2015). Their shells are small (3.5 to 8 mm width), have a poorly developed lip and a wide and not covered umbilicus, and the suture is not overlapping (Ortíz de Zárate, 1946; Manganelli et al., 1989). Even a genetic analysis of *Tyrrheniellina* is not yet available; the shells however are quite similar to *Schileykiella* in size and shape (Giusti & Manganelli, 1989, 1992). For *Debeauxhelix* from East Africa (Bacci, 1941) we have doubts on its familiar relationship, especially based on differing anatomical characters (missing vaginal glands, present “stylophore”) (Schileyko, 2006).

Comparison with other fossil European species so far assigned to the genus of *Canariella*

The list below provides an assessment or confirmation of the possible familial assignment of fossil species, some of which have formerly been assigned to genus *Canariella* or are still assigned to this day:

- † “*Canariella*” *bakonyensis* Kókay, 2006 (Family?) — Middle Miocene: Lower Badenian, Hungary;
- † “*Canariella*” *disciformis* Wenz, 1919 (= nomen novum pro *Helix nummulina* Mayer-Eymar in F. Sandberger, 1874 [non A. Braun, 1851] = *Miodiscula disciformis* (Wenz, 1919) (Trissexodontidae?) — Upper Oligocene: Chattium, Germany;
- † *Canariella* (*Majorata*)? *gerti* Groh, 2021 (Canariellidae) — Pleistocene, probably Holocene, Canary Islands: Fuerteventura;
- † “*Canariella*” *laxecostulata* (F. Sandberger, 1871) = *Laxecostula laxecostulata* (F. Sandberger, 1871) (Hygromiidae?) — Eocene, Spain;
- † “*Canariella*” *lapicidella* Thomae, 1845 (syn. *Helix* (*Gon-*

ostoma) *sublenticula* F. Sandberger, 1858) = *Pachycarocollina bouilletii* (de Boissy, 1839) (Trissexodontidae?) — Upper Oligocene: Chattium, France, Switzerland and Germany;

- † *Canariella lopezjuradoi* Hutterer & Groh, 2008 (Canariellidae) — Pliocene, Canary Islands: Gran Canaria;
- † “*Canariella*” *massiliensis* (Matheron, 1843) (Family?) — Upper Oligocene: Chattium, France;
- † *Canariella mecoi* Hutterer & Groh, 2008 (Canariellidae) — Pliocene, Canary Islands: Gran Canaria;
- † *Canariella molinae* Hutterer & Groh, 2008 (Canariellidae) — Pliocene, Canary Islands: Gran Canaria;
- † *Canariella orzola* E. Gittenberger & Ripken, 1985 (Canariellidae) — Lower Pliocene, Canary Islands: Lanzarote;
- † “*Canariella*” *politula* (de Boissy, 1839) (Trissexodontidae?) — Tertiary: Rupélien, France;
- † “*Canariella*” *sublenticuloides* Łomnicki, 1886 (Family?) — Pleistocene, Ukraine;
- † “*Canariella*” *theodori* (De Stefani, 1880) (Family?) — Pliocene, Italy;
- † “*Canariella*” *tropifera* (F. E. Edwards, 1852) = *Paracanariella tropifera* (F. E. Edwards, 1852) (Trissexodontidae?) — Lower Oligocene: Tongrien, England;
- † “*Canariella*” *vectiensis* (F. E. Edwards, 1852) = *Klikia vectiensis* (F. E. Edwards, 1852) (Elonidae) — Eocene, England.

The mainland Tertiary “*Canariella*”s are a problem, in contrast to the Plio-Pleistocene Canariellidae from the Canaries.

Nordsieck (2014: 168-171) commented on these mainland Tertiary groups. However, his 2014 Helicodontidae were unsustainable. In his book (Nordsieck, 2017: 91) they were broken down into Helicodontidae and Trissexodontidae. He also mentioned that the fossil groups similar to the Trissexodontidae (e.g. „C.” *politula*) were only classified in this family with a question mark. Because of their sculpture, *Praeostophorella* Pfeffer, 1930 and *Pseudostenotrema* Wenz, 1918 fit well with the Trissexodontidae, the rest, which externally resemble *Canariella* (*Paracanariella* Pfeffer, 1930, *Pachycarocollina* Pfeffer, 1930, *Miodiscula* H. Nordsieck, 2014), remains questionable.

However, one cannot assume that they are related to *Canariella*, since this is likely to be a predominantly endemic Macaronesian group. The shape of the shell is not informative, because a sculpture characteristic of *Canariella* could not be identified so far. Therefore, according to Nordsieck (pers. comm., 2022), they should be left with the Trissexodontidae for the time being.

Hygromiidae are characterised by the presence of an inner lip; but these species do not have such, which is why they should not be placed in the Hygromiidae. For *Laxecostula*, Harzhauser et al. (2020) discussed this; however, it is still unclear whether an inner lip exists.

The species *massiliensis*, *sublenticuloides* and *theodori* are still to be assigned to a genus and family in the future, however they hardly resemble the Canariellidae conchologically.

It should be pointed out that the mainland “*Canariella*” may have been a consequence of Boettger & Wenz’s (1921) idea that Macaronesian land snail groups are represented in mainland Tertiary Europe. Other examples of this apparently false hypothesis are the interpretation of *Palaeomastus* H. Nordsieck, 2014 (Enidae) as *Napaeus* Albers, 1850 (Enidae), *Wenzia* Pfeffer, 1930 (Sphincterochilidae) as *Caseolus* R. T. Lowe, 1852 (Geomitridae), *Pseudoleptaxis* Pilsbry, 1895 (Sphincterochilidae) as *Leptaxis* R. T. Lowe, 1852 (Helicidae) and *Palaeotachea* Jooss, 1912 (Helicidae) as *Hemicycla* Swainson, 1840 (Helicidae).

***Simplicula plutonia* (R. T. Lowe, 1861)**

Figs 1-3, 8, 24, 28-29

Type material. — Lectotype NHM(UK)95.2.2.62/a (Fig. 1), paralectotype NHM(UK)95.2.2.62/b. North of Pozo Negro, Fuerteventura (Ponte-Lira et al., 1997).

Further material examined, extant. — **Lanzarote:** CGD 03742/a, Guatiza, Barranco de Tenegüime, 29.0821°N 013.4928°W, leg. KTK 27.xii.2002, width 22.0 mm, Fig. 8, CGD 03742/b, same loc. and data, width 20.1 mm; CGD 03741/a-b, Lanzarote, Risco de Famara near Mirador del Rio, 29°07'35"N 13°31'28"W, leg. WL iv.1983, width 22.3, 24.4 mm, 1

juv.; CGD 03744/6, Embalse W Mala, 29°06'34"N 13°28'44"W, leg. KG 5.iv.1997; TFMC_MT 272, Arrecife, 28°57'59"N 13°32'59"W, CAI; TFMC_MT 8418/2 & 8429/5, Presa de Mala, 100 m a.s.l., 29°06'34"N 13°28'44"W, CAI 6.ii.1996. **Fuerteventura:** CGD 03753/1 [topotype], Pozo Negro, 28°19'28"N 13°53'44"W, leg. WL 27.iii.1981; CGD 03748/18, Jandia, S, upper Valle del Ciervo, 300-500 m a.s.l., 28°05'17"N 14°22'31"W, leg. KG 9.iii.1990; CGD 03757/21, same locality, 340-550 m a.s.l., leg. KG 4.iii.1989; CGD 03711/1 & 03751/23, approx. 2 km N of Vega de Rio Palmas, SW-slope approx. 300 m a.s.l., 28°24'17"N 14°03'54"W, leg. KG 4.iii.1991; CGD 03754/7, Jandia N, Huertas de la Palmas, approx. 250 m a.s.l., 28°06'22"N 14°21'51"W, leg. KG 10.iii.1990; CGD 03759/1, Betancuria near Cruz de la Vieja, 28°25'02"N 14°03'04"W, leg. KG 2.iii.1989; CGD 03708/3, Morro Velosa above Betancuria, approx. 600 m a.s.l., 28°26'16"N 14°03'04"W, leg. KG 3.iii.1990; TFMC_MT 6048/2 & 6053/2, Morrito del Rincón, 28°26'30"N 14°03'13"W, CAI 19.ii.1980; TFMC_MT 6050/1, Barranco de Jacomar, 28°17'52"N 13°55'46"W, CAI 18.ii.1980; TFMC_MT 6051/3 & 8419/1, Betancuria, 437 m, 28°25'33"N 14°03'20"W, CAI 21.ii.1980; TFMC_MT 6052/6, Cofete, 28°06'05"N 14°23'24"W, CAI 21.ii.1980; TFMC_MT 1489 & 8417/8, Vega de Rio Palmas, 300 m a.s.l., 28°23'34"N 14°04'11"W, CAI 4.iii.1990; TFMC_MT 1192 & 1497, Vega de Rio Palmas, 28°23'32"N 14°05'01"W, CAI; TFMC_MT 8418/2, Tacha Blanca, 500 m a.s.l., 28°24'21"N 14°02'19"W, CAI 15.ii.1991; TFMC_MT 1784, Tuineje, 28°19'33"N 14°02'60"W, CAI; TFMC_MT 1496, Cruz de la Vieja, 28°25'02"N 14°03'04"W, CAI; TFMC_MT 1190, Morro del Cavadero, 28°04'11"N 14°21'00"W, CAI; TFMC_MT 1184, Embalse de los

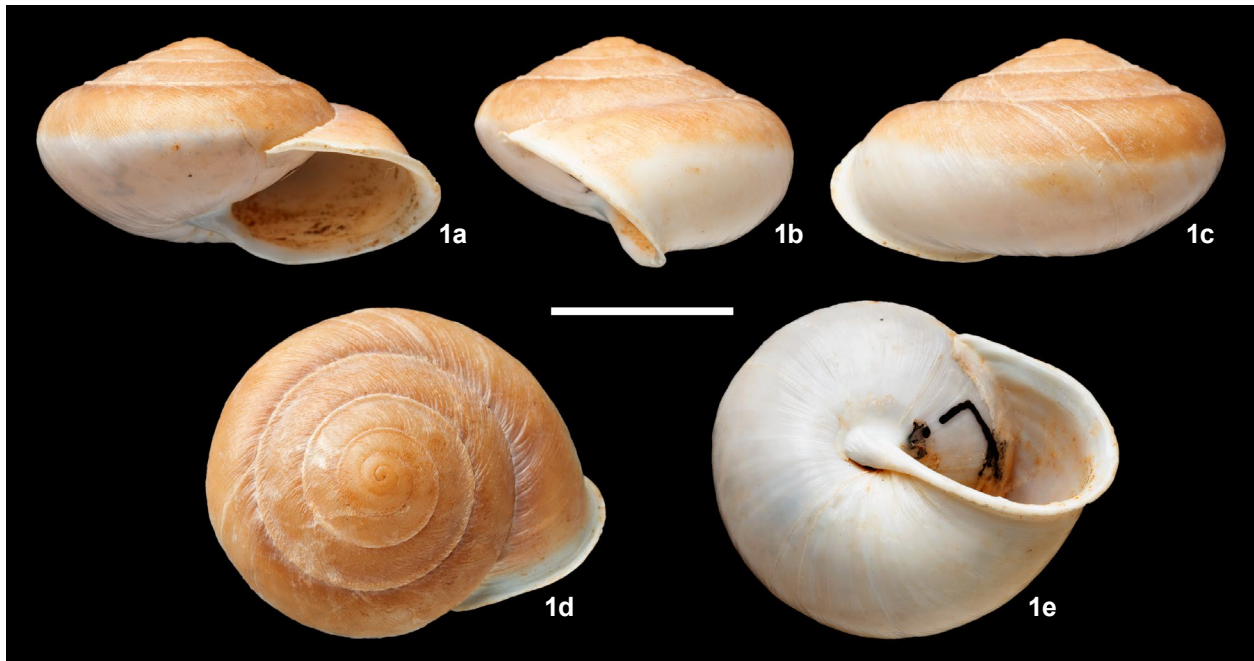
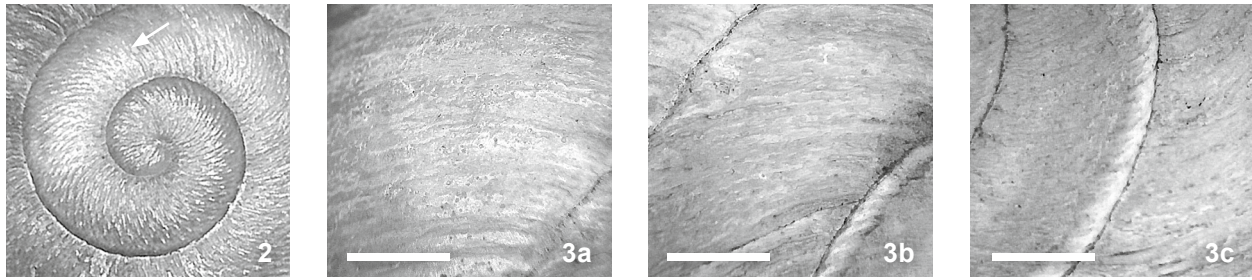


Fig. 1. Lectotype of *Helix (Macularia) plutonia* R. T. Lowe, 1861, NHM(UK) 1895.2.2.61 [paralectotype = 1895.2.2.62], selected by Ponte-Lira et al., 1997, Fuerteventura, Pozo Negro. Photographs by Kevin Webb, NHM.

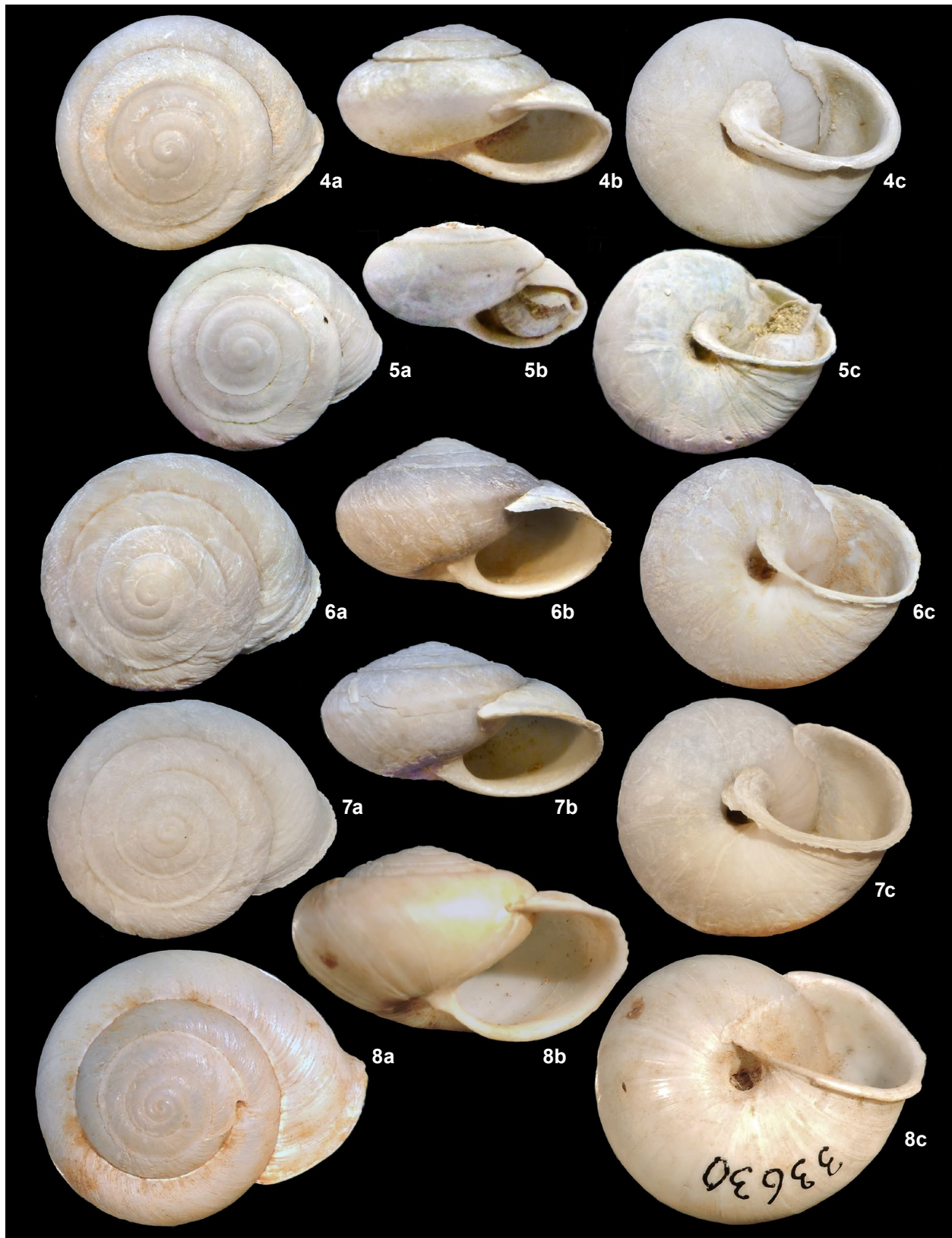


Figs 2-3. Apex and surface sculpture of *Simplicula plutonia* (R. T. Lowe, 1861). **2.** Apex, CGD 03742/a, Lanzarote, Guatiza. Diameter of protoconch = 1.8 mm, border shown by an arrow. **3a-c.** Surface sculpture on the 5th whorl (3a), 4th whorl (3b) and 3rd whorl (3c), SMF 33630/b, Fuerteventura, extant. Scale bars: 1 mm.

Molinos, 28°30'29"N 14°01'45"W, CAI ix.1986; TFMC_MT 1196, Fenduca, 600 m a.s.l., 28°22'22"N 14°05'40"W, CAI viii.1987.

Further material examined, fossil. — **Lobos:** CHB, Malpais, leg. RH 10.iii.1987; CHB, 8 sp, Malpais, leg. RH 17.vii.1988; CHB, 9 sp, Malpais, mountain above village, leg. RH 10.iii.1987. CGD 03734/10, Piso Basal, leg. KG 10.i.2014. **Lanzarote:** CHB, 7 sp, Risco de Famara near Las Bajas, leg. RH 12.vii.1987; CHB, 1 sp, Famara Mirador del Rio, badlands, leg. RH 15.v.2003; CHB, 6 sp, Malpais de la Corona, E Jameos del Agua, leg. RH vii.1987; CHB, 2 sp, N Costa Teguisse, Malpais and basalt rocks, leg. RH 15.vii.1987; CHB, 2 sp, El Charco, old Malpais, leg. RH 31.vii.1990; CHB, 1 sp, La Vegueta, sand pit, leg. RH vii.1987; TFMC FO 7585, Lanzarote, El Berrugo, Upper Pleistocene, 29.0605°N 013.6241°W, deposit is a level of sands of about 1 m and 20 cm thickness, covered by a paleosol of about 40 cm, and all covered by the volcanic materials of the Berrugo Mountain, leg. EMG viii.2020, 1 juv.; Lanzarote: CGD 03735/28, E-slope of Caldera Trasera, Teguisse, Holocene slope deposits, 29°06'27"N 13°36'36"W, leg. KG 3.iv.1997; CGD 03736/9, El Jable S Soo, 149 m a.s.l., 29°04'20"N 13°36'58"W, Quaternary fossil dune, leg. KG & CR 29.xii.2020; CGD 03738, Costa Teguisse, Barranco N of the village, Holocene slope deposits, 29°0'25"N 13°30'58"W, leg. KG & CR 23.xii.2020; CGD 03739, Pass SW Montana Blanca between Tias and San Bartolome, 28°58'28"N 13°38'05"W, leg. KG 17.iv.1995; CGD 03740/1, Morro de los Dises S Femés, 28°53'55"N 13°46'53"W, leg. KG 27.iii.1997; CGD 03743/4, S of Las Breñas, near to the village, 28°53'44"N 13°50'03"W, leg. KG 4.iv.1995; CGD 03745/2, Malpais E El Golfo, 29°58'56"N 13°49'23"W, leg. C. & KG 18.xii.2020; CGD 03746/2, rocks SE Órzola, 29°13'09"N 13°27'00"W, leg. C & KG 5.i.2021; CGD 03756/15, Monte Caracol, approx. 250 m a.s.l., 28°12'02"N 14°05'49"W, leg. KG 14.iii.1989; CGD 03758/15, Malpais Grande approx. 1.5 km S of the road to Pozo Negro, fossil dune, [ES 8922] 28°19'18"N 13°54'09"W, leg. KG 1.iv.1991; CGD 03760/1, Pico Morro Negro, N-slope, approx. 200 m a.s.l., [ES 9223] 28°29'23"N 14°03'26"W, leg. KG 14.iv.1989; CGD 03761/3, Malpais Grande, approx. 150 m a.s.l., [ES 0330] 28°20'20"N 13°57'07"W, leg. KG 3.iii.1989; CGD 03763/2,

Cortijo de Tetuú, approx. 300 m a.s.l. [ES 2036] 28°21'01"N 14°04'41"W, leg. KG 3.iii.1989; CGD 03369/4, Punta del Papagayo, small Barranco W of the village, Quaternary fossils from the high bank of the Barranco, 28°50'40"N 13°47'16"W, leg. CR 25.xii.2020. **Fuerteventura:** SMF 33630/a-e, leg. KvF iii.1863 (Fig. 8), width 24.6 mm; TFMC_FO 5793, Fuerteventura, Cueva del Llano, 28.6530°N 013.9028°W, Holocene, volcanic tube containing a sedimentary fill, leg. FGT v.2004, width 23.8 mm; CHB, 1sp, Vega de Rio Palma, leg. RH 1.xii.2008; CHB, 3sp, Malpais de Arena, cave, leg. RH ii.1987; CHB, 3 sp, Morro Jable, above harbour, leg. RH 30.vii.1989; Fuerteventura, [possibly Jandia peninsula], CHB, 1 sp. Montaña Aceitunal, leg. RH 25.vii.1989; CHB, 1 sp, stony plain at road from Nuevo Horizonte urbanization to Triquivijate, 173 m, 28°24.772N 13° 55.700W, leg. RH 29.xi.2008; CHB, 3 sp, Malpais de la Arena, road from Lajares to La Oliva, leg. RH 2.ii.1990; CHB, 2 sp, Malpais S Corralejo, 28°42.292N 13°52.870W, leg. RH 30.xi.2008; CHB, 2 sp, La Pared, upper dune, lower level, leg. RH 23.vii.1990; CHB, 1 sp, Barranco de la Barca, leg. RH 26.vii.1990; CHB, 1 sp, Jandia, N slope above Cofete, leg. RH 20.vii.1989; CHB, 1 sp, El Quemado pit, leg. RH 15.vii.1990; CHB, 12 sp, Isthmus de la Pared, dunes, leg. RH 7.iii.1987; CHB, 1 sp, Jandia, Cofete, fossil site, leg. RH 20.vii.1989; CHB, 9 sp, Jandia, Cofete, fossil dune near sea, leg. RH 30.vii.1988; CHB, 2 sp, Jandia, road to Cofete, sandstone quarry, leg. RH vii.1989; CHB, 3 sp, Jandia, road to Cofete near pass to Cofete, leg. RH 4.iii.1987; CHB, 1 sp, Jandia, Pico de la Zarza, 700 m, 28°06.059N, 14°21.380W, leg. RH 4.xii.2008; CHB, 16 sp, Malpais Grande, leg. RH 12.iii.1987; CHB, 3 sp, La Costilla, sand pit, leg. RH vi.1992; CHB, 1 sp, sand dune between Lajares and El Cotillo, leg. RH, 18.vii.1988; CHB, 1 sp, Jandia, piste to Faro, leg. RH 12.iii.2008; CHB, 3 sp, Jandia, N, piste to Cofete, fossil slope dune, c. 200 m, leg. RH iii.1987; CHB, 3 sp, Jandia, N, Barranco near to the sea, subfossil dune, leg. RH 7.iii.1987; CHB, 5 sp, Jandia, Cofete, slope above Villa Winter, leg. RH 8.xii.2010; CHB, 7 sp, mouth of the Barranco de la Peña, leg. RH 21.vii.1988; CHB, 10 sp, Barranco de los Molinos, Pleistocene slope deposit, leg. RH 29.vii.1990; CGD 03747/30, Bar-



Figs 4-7. *Simplicula kittelorum* Groh & Hutterer, spec. nov. in comparison to extant *S. plutonia* (**Fig. 8**) from Fuerteventura. **4a-c.** Paratype, TFMC_FO 5800, Fuerteventura, Barranco de los Encantados, calcareous arenites, Upper Pleistocene, width 20.0 mm. **5a-c.** Paratype, TFMC_FO 5706, Fuerteventura, Barranco de los Encantados, calcareous arenites, Upper Pleistocene, width 18.2 mm. **6a-c.** Paratype, SMF 350518 ex CGD, Fuerteventura, sandpit near Cotillo, calcareous arenites stratum 2, c. 9 m below surface level, c. 81 m a.s.l., Upper Pleistocene, width 21.2 mm. **7a-c.** holotype, TFMC_FO 7034, Fuerteventura, Montaña de la Costilla, calcareous arenites, Upper Pleistocene, width 21.7 mm. **8a-c.** *Simplicula plutonia* (R. T. Lowe, 1861), SMF 33630/a, Fuerteventura [possibly Jandia peninsula], extant, width 24.6 mm.

rango de los Molinos, Quaternary sediments on the bottom of the Barranco, 28°32'40"N 14°03'32"W, leg. KG 12.iii.1990; CGD 03749/20, coastal dunes NE El Cotillo, Holocene sands, 28°42'02"N 14°00'47"W, leg. KG 7.i.2014; CGD 03765/1, approx. 1 km S Corralejo without exact data, leg. HF 27.iii.1962 (see also Fischer 2003); CGD 03770/1, Jandia peninsula, N-coast without exact data, leg. DK ix.1971; CGD 03771/1, sand pit S Lajares, stratum 1, 3 m below surface level, 28°10'06"N 14°14'43"W, leg. KG 3.iii.1989; CGD 03762/1, same locality, leg. KG 10.iii.1990; CGD 03750/17, Barranco de las Salinas, approx. 100 m a.s.l., [FS 1367] 28°37'57"N 13°50'40"W, leg. KG 7.i.2014; CGD 03752/17, Isthmus de la Pared, approx. 100 m a.s.l., [ES 7720] 28°37'57"N 13°50'40"W, leg. KG 3.iii.1989; CGD 03762/1, same locality, leg. KG 10.iii.1990; CGD 03755/14, Jandia W, S-slope of the Montaña Manza, approx. 450 m a.s.l., 28.09205°N 14.36914°W, leg. KG 29.iii.1991; CGD 03764/5, Jandia peninsula, E Cortijo de Cofete, NE-slope, approx. 250 m a.s.l., [ES 0862] 28°06'08"N 14°22'02"W, leg. KG 14.iv.1989.

Measurements. — Lectotype $w = 22.8$ mm, $h = 12.5$ mm, $aw = 14.0$ mm, $ah = 6.6$ mm, $umb = 2.4$ mm (95 % covered), $wh = 5.5$, $rel\ lw = 63.5$ %. Extant Fuerteventura and Lanzarote: $w = 23.9$ mm (19.9–26.5; $n = 25$); Quaternary Fuerteventura and Lobos: 24.5 mm (21.7–28.8; $n = 68$); Quaternary Lanzarote: 22.0 mm (20.3–22.9; $n = 14$).

Diagnosis. — Shell large in extant ($w = 19.9$ –26.5 mm) and fossil (20.3–28.8 mm) specimens, 4.5 to 5.5 regularly growing whorls, a depressed globose to lenticular shape, a wide aperture with a slightly to significantly expanded and reflected lip, a moderate wide perspective umbilicus partly covered by the reflected columellar part of the lip, and by a very typical suture where the previous whorl narrowly overlaps the following (Figs 1–3, 8, 24). Anatomically characterised by very simple thin tubular male and female genitalia without special structures in the vagina and gametolytic duct or the penis and epiphallus, the latter being very long with a thin flagellum, and further with a very long pedunculus to the horizontal cylindrical bursa copulatrix and four short, branched vaginal glands.

Distribution. — Extant species known from northern and southern Lanzarote (www.biodiversidadcanarias.es) and from various places in Fuerteventura (Ponte-Lira et al., 1997). Fossil shells are known from Pleistocene to Holocene shells from Lobos, Lanzarote and Fuerteventura.

Description (mostly following Ponte-Lira et al., 1997). — Shell large and strong (mean 23.9 mm in extant specimens), brown, dull on the dorsal side and slightly shiny and lighter on the ventral side, with the periphery provided with a whitish, narrow and clear band (Figs 1, 24). The first turns of the coil have a keel on the periphery, which gradually decreases until it disappears completely in the last one. The suture is impressed and in the first three body whorls crenulated keeled, overlapping the previous whorls. Large opening, wider than long; ends of the peristome distant from each

other on the parietal side and separated by an area normally provided with a faint callus. Whitish and reflected peristome, with a lip up to 1.5 mm wide, which can partially or completely cover the umbilicus (Figs 1, 8, 24). Dorsal surface ornamented with a very soft radial stitching in the first turns of the spiral and slightly more marked in the following ones, c. 8 ribs/mm. On the protoconch and in the first turns of the whorl there are protuberances arranged regularly on the costulations which give it a gently granulated appearance. Superimposed on this ornamentation is another, formed by very fine and numerous spiral crests. Ventral side with softer ornamentation. Pilosity evenly distributed over the periphery and dorsal side of the shell; the periostracal hairs are fine and come off easily, reaching their greatest length in the suture area and their shortest length in the navel.

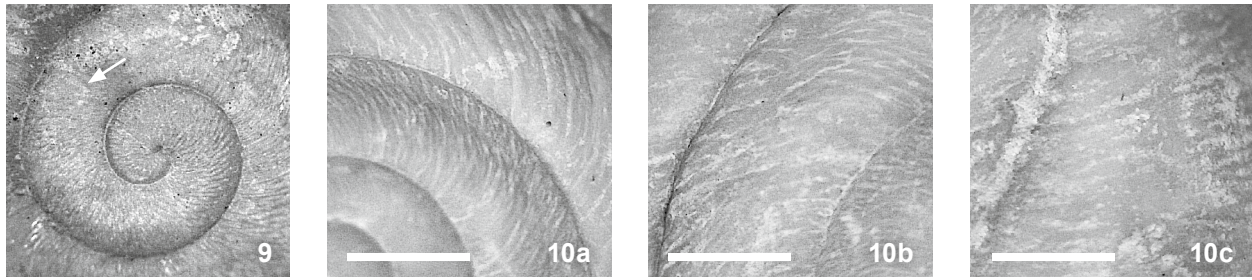
Mandible odontognathus, with 10–13 ribs. The radula (formula: $C + 44-46L \times 150-165$) has the central tooth with two small ectocones at its base. The first lateral teeth are larger and more robust, and are provided with a small ectocone; towards the sides, the size of the teeth decreases while that of their ectocone remains almost constant.

Mantle collar with five lobes. The pallial complex occupies the final $\frac{3}{4}$ of the last turn of the coil, presenting the epithelium that lines the roof of the lung with a series of dark spots, irregular in shape and size. Sigmurethric kidney, with the secondary ureter very short, continuing in an open groove bordered by the rectum to the region of the pneumostoma.

Genital anatomy. — Reproductive system with a short atrium, a very long and tubular penial complex, with uniform thickness between the atrium and the insertion of the retractor muscle, while it gradually thins from this insertion to the end of the flagellum. No penile papilla or anatomical differentiation between the penis and the epiphallus; Its internal wall has 5–6 longitudinal folds, which are only slightly undulated in the areas of connection with the atrium. Vagina tubular, with 6–7 internal longitudinal folds. Near its proximal end four vaginal glands flow into it, forming a crown; they are small and branched, without any branching that stands out over the others. Hammer-shaped gametolytic gland: almost cylindrical, arranged transversely with respect to its duct and connected to it in its middle part. Duct of the gametolytic gland with internal anatomy similar to the vaginal one (Ponte-Lira et al., 1997).

Comparisons. — Shells from Fuerteventura are larger than shells from Lanzarote (Ponte-Lira et al., 1997). The anatomy is only known from five specimens collected in Fuerteventura, therefore the status of the Lanzarote populations remains unsolved.

Etymology. — Derived from the Old Greek name Plutonion (Πλουτώνιον), a name for a sacred place, either a cave or a site where toxic gases escape from the earth.



Figs 9-10. Apex and surface sculpture of *Simplicula kittelorum* Groh & Hutterer, spec. nov. **9.** Apex, juvenile, TFMF FO_5800/d, Fuerteventura, Barranco de los Encantados. Diameter of protoconch = 1.9 mm, border shown by an arrow. **10a-c.** Surface sculpture on the 3rd whorl (10a), 4th whorl (10b) and 5th whorl (10c), holotype TFMF FO 7034. Scale bars: 1 mm.

***Simplicula kittelorum* Groh & Hutterer, spec. nov.**

Figs 4-7, 9-10, 28

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Type material. — Holotype, TFMF FO 7034, Fuerteventura, Montaña de la Costilla, calcareous arenites, 28.6883°N 013.9703°W, Upper Pleistocene, accumulations of eolian sands of organogenic origin, intercalated with paleosols, which are several metres thick, leg. EMG, iv.2017, width 21.8 mm, Fig. 7. Paratypes. — TFMF FO 5706, Fuerteventura, Barranco de los Encantados, calcareous arenites, 28.6514°N 013.9833°W, Upper Pleistocene, accumulations of eolian sands of organogenic origin, intercalated with paleosols, which are several metres thick, leg. EMG, x.2005, width 18.2 mm, Fig. 5; TFMF FO 5800/a-b, same loc. and data, width 20.0 mm, Fig. 4, width 19.0; SMF 350518 ex CGD, Fuerteventura, sandpit near El Cotillo, calcareous arenites, stratum 2, c. 9 m below surface level, c. 81 m a.s.l., Upper Pleistocene, 28.6708°N 013.9540°W, leg. KG, 7.i.2014, width 21.2 mm, Fig. 6; CGD 03768/a-f, same loc. and data, width 20.4, 20.4, 20.7, 20.6, 20.8, 21.0 mm.; CGD 03769a-b, Fuerteventura, sandpit SW Lajares, stratum 3, c. 23 m below surface level, Quaternary fossil sand dune, 28.6706°N 013.9529°W, leg. KG, 9.i.2014; CHB 5 sp [together with a typical large *S. plutonia*], sand pit La Costilla, leg. RH 26.vii.1989; CHB 2 sp [together with a typical large *S. plutonia*], Jandia peninsula, Cofete, site 2a, leg. RH 21.vii.1989.

Further material examined. — TFMF FO 5800c-d, same loc. and data as TFMF FO 5706 above, 1 subad., 1 juv.; CGD 03769c-d, juv., Fuerteventura, sandpit SW Lajares, stratum 3, c. 23 m below surface level, Quaternary fossil sand dune, 28.6706°N 013.9529°W, leg. KG, 9.i.2014.

Measurements. — Holotype w = 21.7 mm, h = 11.7 mm, aw = 13.0 mm, ah = 7.0 mm, umb 2.3 mm (50% covered), wh 5.20, rel lw 30.2%.

Diagnosis. — Small depressed conical shell with a very

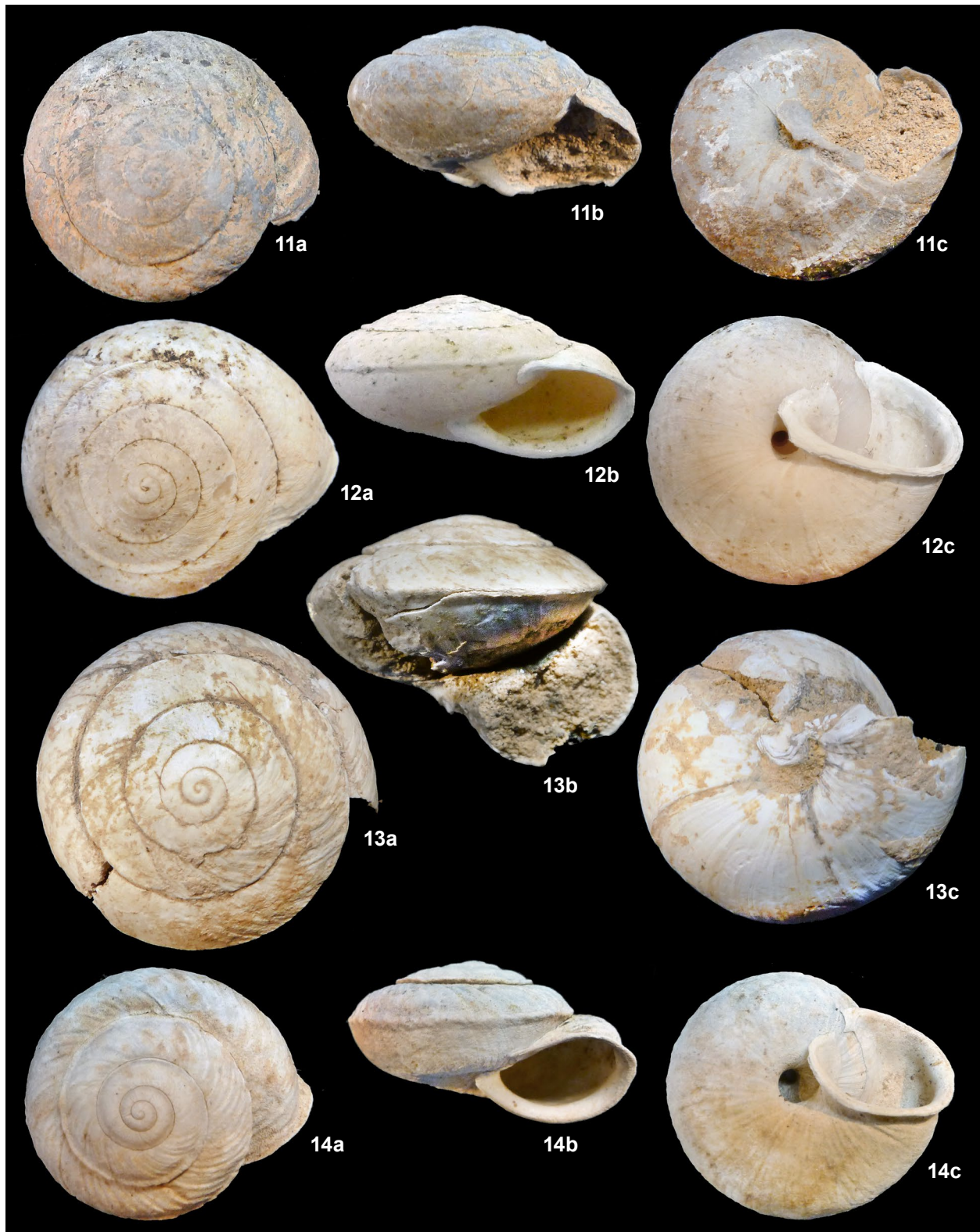
low proportion of the last whorl in the total diameter and a teleoconch sculptured with rough riblets.

Distribution. — Pleistocene and Quaternary sites of northern Fuerteventura.

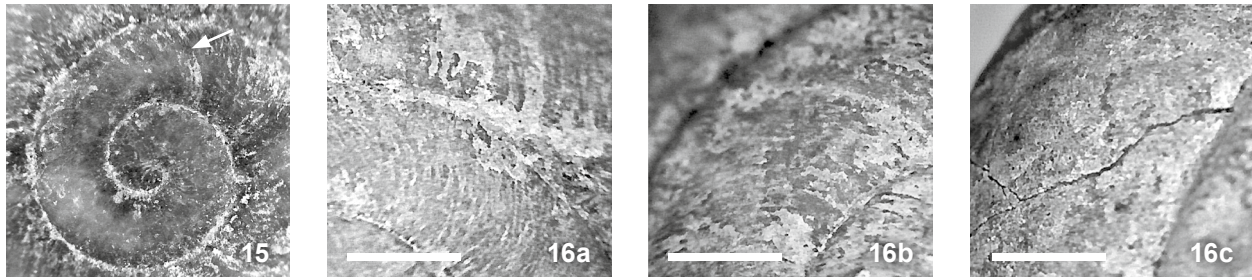
Description. — Relatively small (18.2 to 21.8 mm) depressed conical shell with 5.10 to 5.25 regularly growing whorls with an in its upper third slightly angled periphery and with a huge, flat-ovate aperture. The protoconch (Fig. 9, border shown by an arrow) has 1.2 to 1.5 whorls, in not corroded shells with a sculpture of dense radial set rows of longitudinal granules, very similar to *S. plutonia*. Sculpture of the teleoconch with numerous coarse radial riblets (c. 8/mm on the body whorl), partly with additional small rounded granules in between (Fig. 10). The narrow lip is slightly reflected and broadest near the columella where it covers the narrow umbilicus in a different amount between 20 and 90 percent. Small shells referable to *S. kittelorum* spec. nov. were found in the same deposit as large sized *S. plutonia*, thus supporting the species status of the new taxon.

Comparisons. — The shell is smaller on average than in *S. plutonia* and the share of the last whorl in the diameter of the shell is significantly lower, as well as the height of the aperture. The sculpture of the body whorl is rougher than in *S. plutonia*. Similar sized *S. justusi* spec. nov. is distinctly keeled, has a less wide aperture and shows fewer but broader and more elevated ribs, *S. juliae* spec. nov. from the Pliocene of Lanzarote shows also a distinct keel, has a much lower aperture and a narrower umbilicus.

Etymology. — Named for our friends Theresia and Klaus Kittel of Wiesthal, Germany, to acknowledge the collecting and documenting of the terrestrial mollusc fauna of the Canary Islands since the 2000s and for sharing their knowledge and material with us.



Figs 11-14. Fossil *Simplicula* taxa from Fuerteventura and Lanzarote. **11a-c.** *Simplicula marconeiberi* Groh, Hutterer & Martín, spec. nov., holotype, TFMF_FO 5813/a, Fuerteventura, Barranco de Esquinzo, S slope c. 500 m to sea, calcareous arenites layer below oldest basaltic flow, Lower Pliocene, width 20.3 mm. **12a-c.** *Simplicula juliae* Groh, spec. nov., holotype, TFMF_FO 5715/a, Lanzarote, Fuente de Gusa SW Punta Fariones, approx. 30 m a.s.l., calcareous arenites layer below oldest basaltic flow, Lower Pliocene, width 21.3 mm. **13a-c.** *Simplicula carsteni* Groh & Hutterer, spec. nov., holotype, SMF 350511 ex CGD, Fuerteventura, N coast of Jandia peninsula, [Lower?] Pleistocene deposits in coastal terrace, width 23.0 mm. **14a-c.** *Simplicula justusi* Groh, spec. nov., holotype, SMF 350512 ex CGD, Fuerteventura, N coast of Jandia peninsula, Cortijo de Cofete, c. 200 m a.s.l., Quaternary [Holocene?] slope deposits, width 19.3 mm.



Figs 15-16. Apex and surface sculpture of *Simplicula marconeiberi* Groh, Hutterer & Martín, spec. nov. **15.** Apex, TFMF_FO 5813/c, sub-adult, Fuerteventura, Barranco de Esquinzo. Diameter of protoconch = 2.55 mm, border shown by an arrow. **16a-c.** Surface sculpture on the 3rd whorl (16a), 4th whorl (16b) and 5th whorl (16c). Scale bars: 1 mm.

Simplicula marconeiberi

Groh, Hutterer & Martín, spec. nov.

Figs 11, 15-16

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Type material. — Holotype, TFMF_FO 5813/a, Fuerteventura, Barranco de Esquinzo, S slope c. 500 m to sea, very compacted clayey level with sands, located several metres below Lower Pliocene basaltic flow, 28.6342°N 014.0230°W, leg. FGT, ix.2005, width 20.3 mm, Fig. 11. Paratype, TFMF_FO 5813/b, same loc. and data, width 21.5 mm.

Further material examined. — TFMF_FO 5813/c-f, same loc. and data, 1 subad., 1 juv., 2 fragm.

Measurements. — Holotype w = 20.3 mm, h = 11.3 mm, aw = 11.7 mm, ah = 7.0 mm, umb 1.7 mm (75 % covered), wh 4.70, rel lw 25.0 %.

Diagnosis. — Small-sized shell with depressed globose shape, a large and smooth protoconch and a rough surface sculpture.

Distribution. — Only known from the Lower Pliocene of Barranco de Esquinzo, Fuerteventura.

Description. — Medium sized (c. 21 to 22 mm) depressed globose shell with c. 4.7 regularly growing whorls (Fig. 11). The protoconch (Fig. 15, border shown by an arrow) has 1.6 to 1.75 whorls, a diameter of 2.4 to 2.55 mm, its surface is smooth. The aperture is missing but was probably huge, with a flat-ovate shape. The sculpture of the teleoconch is on the 3rd and 4th whorl marked with dense radial riblets (about 8 /mm) which occasionally look like to be formed by rows of roundish granules (Fig. 16). This sculpture is vanishing mostly on the body whorl. The lip was probably narrow and only slightly reflected, its columellar section covering the narrow umbilicus by c. 75 percent.

Comparisons. — In contrast to *S. rainerhuttereri* spec. nov., *S. carsteni* spec. nov. and *S. juliae* spec. nov., which are from layers of geologically similar ages, the periphery of the body whorl is not angled or keeled, the shell is smaller, with a differing shape of the aperture. The surface sculpture is less rough as in *S. rainerhuttereri* spec. nov. but

coarser than in *S. juliae* spec. nov. and *S. carsteni* spec. nov. From the similar shaped but larger *S. spec. 2* it differs by the coarser overlapping of the suture and the missing granulation of the surface.

Etymology. — Named for our friend and colleague Dr. Marco Thomas Neiber of Sehnde, Germany to acknowledge the collecting and documenting of the terrestrial mollusc fauna of the Canary Islands since the 1990ies and for sharing his knowledge and material with us.

Simplicula juliae Groh, spec. nov.

Figs 12, 17

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Type material. — Holotype, TFMF_FO 5715/a, Lanzarote, Fuente de Gusa SW Punta Fariones, about 2 m high layer of calcareous arenites at about 30 m a.s.l., below Lower Pliocene basaltic flow (4.3 - 3.8 My; Lomoschitz et al., 2016), 29.2283°N 013.4772°W, leg. JCR, ix.2009, width 21.7 mm, Fig. 12. Paratypes, TFMF_FO 5715/b-e, same loc. and data, width 21.3, 21.9, 22.8, 23.7 mm.

Further material examined. — TFMF_FO 5715/f, same loc. and data, 1 juv.; cf. CGD 03737/a-j, Lanzarote, W Orzola, S Valle Chico, Pleistocene slope deposits, 29.2208°N 013.4690°W, leg. KG, 14.iv.1995, width 20.5, 20.8, 20.9, 22.6, 21.4, 21.8, 22.0, 22.5 mm, + 3 juv.; CHB 1 sp, El Jable, El Llano Grande, fossil reddish layer, SW of road to Playa Famara, UTM 28R 3818, leg. RH 8.v.2003; 22 sp, Arrieta, construction pit, leg. RH 18.vii.1987; CHB 4 sp, Orzola, subfossil slope deposits Playa de las Canteras, leg. RH 20.vii.1987; 1 sp, Malpais de la Corona, Baja de Guineje, leg. RH vii.1987; CHB 5 sp, La Graciosa, Montaña Roja, NW slope, leg. RH 3.v.1991.

Measurements. — Holotype w = 21.3 mm, h = 10.7 mm, aw = 12.0 mm, ah = 6.3 mm, umb = 1.7 mm (20 % covered), wh 5.20, rel lw 26.5 %.

Diagnosis. — Medium-sized depressed conical shell with slightly ribbed protoconch, a fine sculpture of numer-

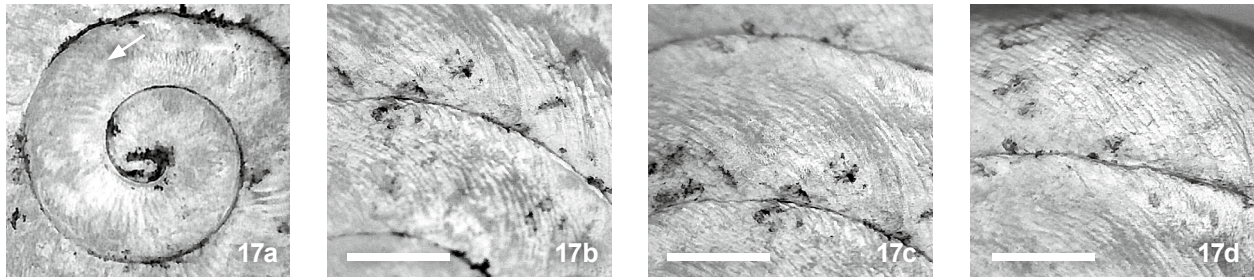


Fig. 17. Apex and surface sculpture of *Simplicula juliae* Groh, spec. nov., TPMC_FO 3715/a, Lanzarote, Fuente de Gusa. **17a.** Apex, diameter of protoconch = 2.1 mm, border shown by an arrow. **17b-d.** Surface sculpture on the 3rd whorl (17b), 4th whorl (17c) and 5th whorl (17d). Scale bars: 1 mm.

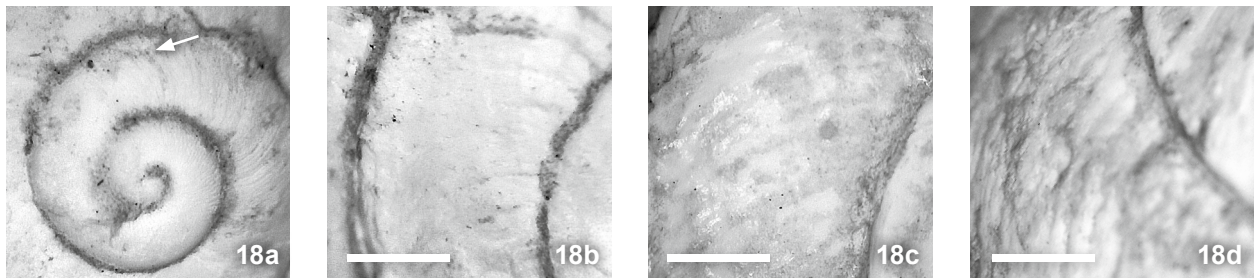


Fig. 18. Apex and surface sculpture of *Simplicula carsteni* Groh & Hutterer, spec. nov., SMF 350511, Fuerteventura, Jandia peninsula near Playa de Cofete. **18a.** Apex, diameter of protoconch = 2.9 mm, border shown by an arrow. **18b-d.** Surface sculpture on the 3rd whorl (18b), 4th whorl (18c) and 5th whorl (18d). Scale bars: 1 mm.

ous bowed radial riblets, a clearly overlapping suture and a characteristic keel in the upper fifth of the last whorl.

Distribution. — Known from Lower Pliocene, Pleistocene and younger, undated deposits of northern Lanzarote and La Graciosa.

Description. — Medium sized (20.5 to 22.6 mm) depressed conical shell with 5.2 to 5.5 regularly growing whorls. The protoconch (Fig. 17a, border shown by an arrow) has 1.5 to 1.7 whorls, is densely radial ribbed but without clearly recognizable granules. The aperture has a flat-ovate shape, the narrow lip is reflected, broadest in the columellar section where it covers the small umbilicus by 30 to 70 percent. The sculpture of the teleoconch consists of curved densely set radial riblets (about 12 /mm) which are overlaid by rows of small roundish granules (Fig. 17b-d). The suture is clearly marked, slightly bowed up at the insertion to the following whorl. In its upper third the body whorl is characterised by a sharp keel, set off like a hoop.

Comparisons. — Similar sized extant and Pleistocene *S. plutonia* s. lat. have a granulated protoconch, no keel on the body whorl, a higher aperture, a wider umbilicus and a differently ribbed surface sculpture. *S. justusi* spec. nov. from the Quaternary of Fuerteventura has a less wide aperture, a wider open umbilicus and a very rough ribbing.

Etymology. — Named for the daughter of the first author, Julia Susanne Heilig of Weisenheim am Sand, Germany.

***Simplicula carsteni* Groh & Hutterer, spec. nov.**

Figs 13, 18

urn:lsid:zoobank.org:act:60585BB4-492A-4734-A600-A67FoF7445A2

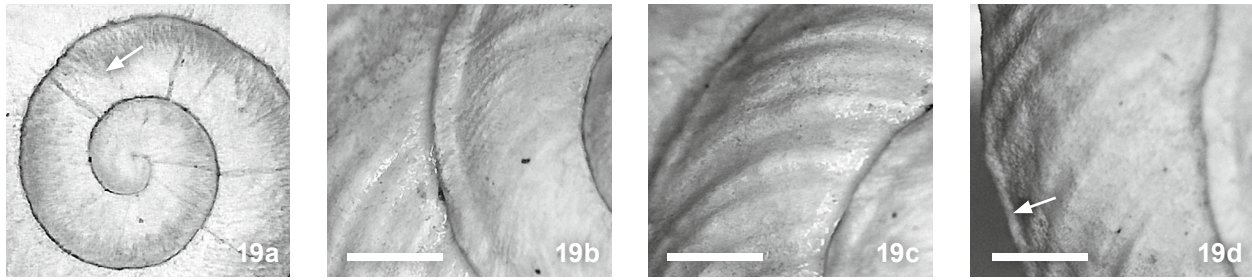
Type material. — Holotype, SMF 350511 ex CGD, Fuerteventura, N coast of Jandia peninsula, [Lower?] Pleistocene deposits in coastal terrace, leg. DK c. 1990, width 22.8 mm (Fig. 13).

Measurements. — Holotype w = 23.0 (est. 24.3) mm, h = 16.7 mm, aw = 14.3 (est. 15.7) mm, ah = 10.7 mm, umb 2.0 mm (open), wh 5.25, rel lw 20.5 (est. 24.7) %.

Diagnosis. — Large conical shell with a significant keel on the last narrow whorl and a large aperture flared downwards; almost smooth protoconch clearly sculptured by a deep suture.

Distribution. — Known only from Pleistocene deposits at the N coast of Jandia peninsula, Fuerteventura.

Description. — Medium sized (23 mm) conical shell with 5.25 regularly growing whorls. The protoconch (Fig. 18a, border shown by an arrow) has 1.6 whorls, 2.9 mm diameter, nearly smooth with numerous very tiny granules and short radial wavy riblets towards the suture. The lip of the huge semicircular shaped aperture is only preserved at its columellar section where it is narrow and probably does not covers the medium sized umbilicus. The sculpture of the teleoconch consists of radial ribs which are becoming



Figs 19a-d. Apex of and surface sculpture of *Simplicula justusi* Groh, spec. nov., SMF 350512, Fuerteventura, Jandia peninsula, Cortijo de Cofete. **19a.** Apex, diameter of protoconch = 1.9 mm, border shown by an arrow. **19b-d.** Surface sculpture on the 3rd whorl (19b), 4th whorl (19c) and 5th whorl (19d); pay attention to the shape of the peripheral keel (arrow). Scale bars: 1 mm.

progressively looser (about 4 /mm on the body whorl) and rougher towards the aperture (Fig. 18b-d). The suture is clearly marked, slightly bowed up at the insertion to the following whorl. In its upper quarter the body whorl is characterised by a blunt keel.

Comparison. — The species is incomparable with all other species of the genus because of its large size and different shape.

Etymology. — Named for our friend and colleague Dr. Carsten Renker of Harxheim, Germany, vivid zoologist and botanist, curator of the Zoological Collections in the Mainz Natural History Museum, for long-lasting friendship with the first author and his fruitful collecting on the Canary Islands.

***Simplicula justusi* Groh, spec. nov.**

Figs 14, 19

urn:lsid:zoobank.org:act:BB0A74B2-5C04-430C-BC8F-FF58EC48445B

Type material. — Holotype, SMF 350512 ex CGD, Fuerteventura, N coast of Jandia peninsula, Cortijo de Cofete, c. 200 m a.s.l., Quaternary [Holocene?] slope deposits, 28.0936°N 014.4310°W, leg. K. & C. Groh, 11.iii.1989, width 19.3 mm (Fig. 14).

Measurements. — Holotype w = 19.3 mm, h = 11.0 mm, aw = 10.3 mm, ah = 9.0 mm, umb 3.0 mm (open), wh 4.75, rel lw 32.8 %

Diagnosis. — Small depressed conical shell with a tire-like offset keel on the last whorl and a strong radial ribbing on the top of the teleoconch.

Distribution. — Known only by a single specimen collected in a Quaternary deposit near Cofete, N coast of Jandia peninsula, Fuerteventura.

Description. — Small sized (19.3 mm) depressed conical shell with 4.75 regularly growing whorls. The protoconch (Fig. 19a, border shown by an arrow) has 1.6 whorls, 1.9 mm diameter, nearly smooth with very few unobtrusive bumps.

The aperture has an ovate shape, the broad lip is reflected, nearly of the same width till to the columellar section where it doesn't cover the relatively wide umbilicus. The sculpture of the teleoconch consists of radial ribs which are becoming progressively looser (about 2 /mm on the body whorl) and rougher towards the aperture (Fig. 19b-d). The suture is clearly marked, clearly bowed up at the insertion to the following whorl. In its upper quarter the body whorl is characterised by a sharp keel, set off like a hoop.

Comparisons. — Similar sized extant and Pleistocene *S. plutonia* s. lat. have a granulated protoconch, no keel on the body whorl, and a differently ribbed surface sculpture. *S. juliae* spec. nov. from the Pliocene of Lanzarote has a wider aperture, a narrower umbilicus and a less rough ribbing.

Etymology. — Named for the grandson of the first author, Justus Heilig of Weisenheim am Sand, Germany.

***Simplicula rainerhuttereri* Groh & Martín, spec. nov.**

Figs 20, 25

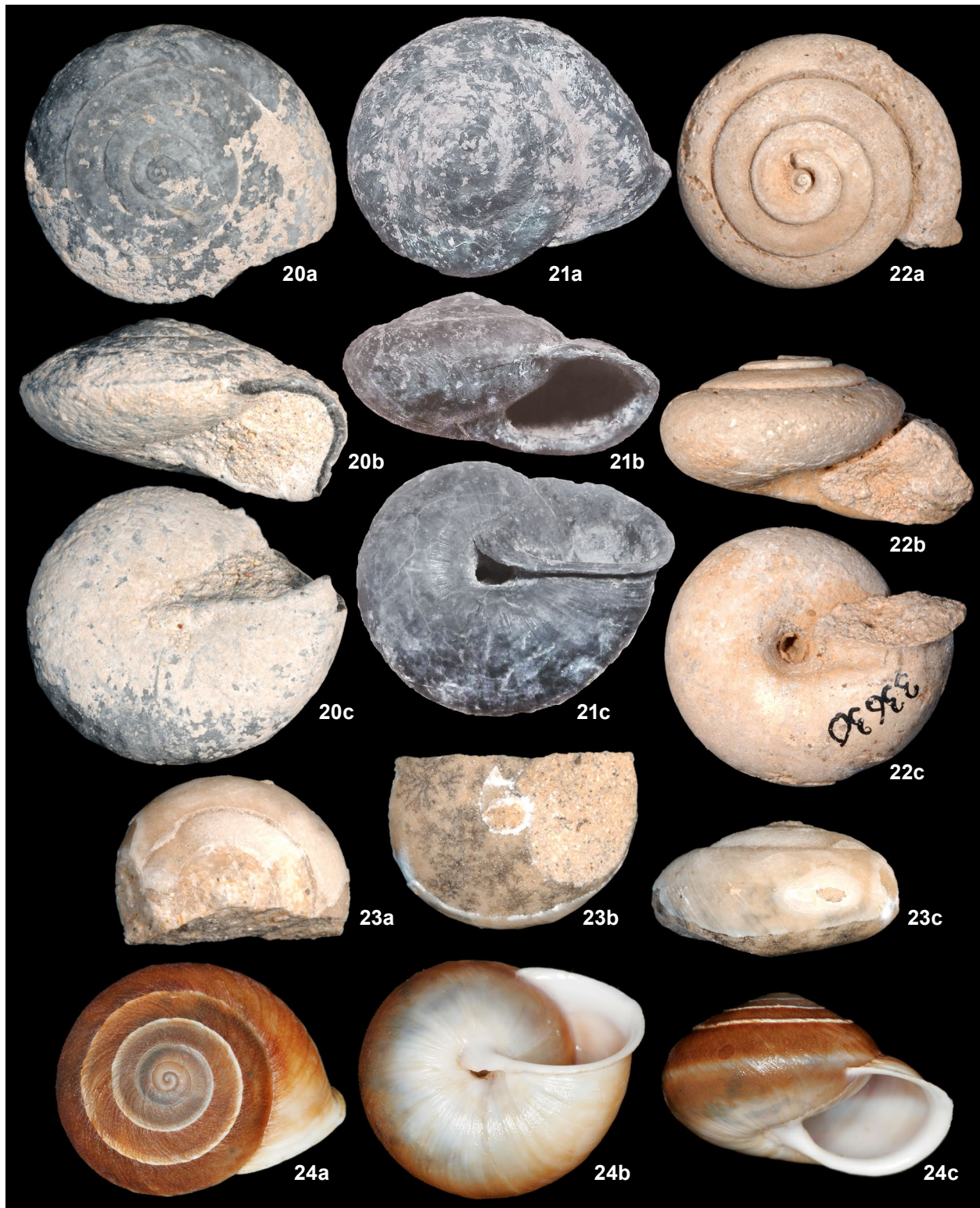
urn:lsid:zoobank.org:act:5E5B5E5F-E7CA-470A-AA98-3454B845DEED

Type material. — Holotype, SMF 350509 ex CHB, Fuerteventura, Barranco de los Molinos, calcareous arenite between oldest volcanic formation and top basalt layer, Lower Pliocene, 28.5453°N 014.0569°W, leg. RH, iii.1987, width 26.3 mm (Fig. 20).

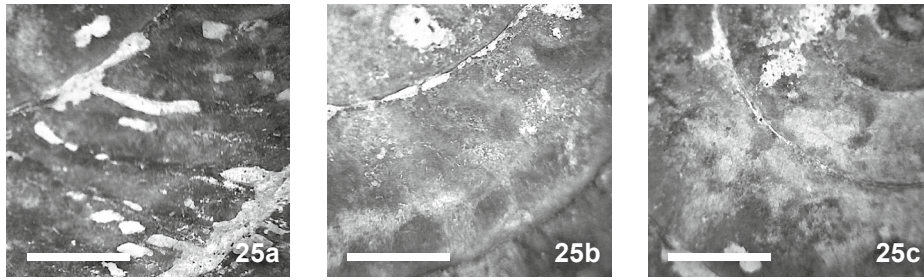
Measurements. — Holotype w = 26.3 mm, h = 14.6 mm, aw = 13.8 (est. 14.5) mm, ah = 10.4 mm, umb c. 2.9 mm (partly covered), wh 5.15, rel lw 28.6%.

Diagnosis. — Large depressed conical shell with angled periphery and a keel on the last quarter of the teleoconch, a very rough sculpture of radial ribs crossed by spiral strips, forming square indentations.

Distribution. — Known only by the holotype collected from the Lower Pliocene calcareous arenite layers in the Barranco de Molinos, W Fuerteventura.



Figs 20-24. *Simplicula* taxa from Fuerteventura and Lanzarote. **20a-c.** *Simplicula rainerhuttereri* Groh & Martín, spec. nov., holotype, SMF 350509 ex CHB, Fuerteventura, Barranco de los Molinos, calcareous arenite between oldest volcanic formation and top basalt layer, width 26.3 mm. **21a-c.** *Simplicula roja* Hutterer & Groh, spec. nov., holotype, SMF 350514 ex CHB, Fuerteventura, Barranco Montaña Roja, sediment below basalt flow, Lower Pleistocene, width 26.9 mm. **22a-c.** *Simplicula* spec. 1, SMF 33630/f, Fuerteventura, [possibly Jandia peninsula], stone cast, possibly Pleistocene, width 26.2 mm. **23a-c.** *Simplicula* spec. 2, SMF 350510 ex CHB, Fuerteventura, Ajuy, heavily cemented fossil dune under second marine beach terrace, fragment of stone cast with thin remnants of the shell, possibly Lower Pleistocene, width 24.5 mm. **24a-c.** *Simplicula plutonia* (R. T. Lowe, 1861), CGD 03742, Lanzarote, Guatiza, Barranco de Tenegüime, extant, width 22.0 mm. Photos 24a-c: Gerhard Weitmann.



Figs 25a-c. *Simplicula rainerhuttereri* Groh & Martín, spec. nov., holotype, SMF 350509, Fuerteventura, Barranco de los Molinos Surface sculpture on the 3rd and 4th whorl (25a), 4th whorl (25b) and 2nd and 3rd whorl (25c). Scale bars: 1 mm.

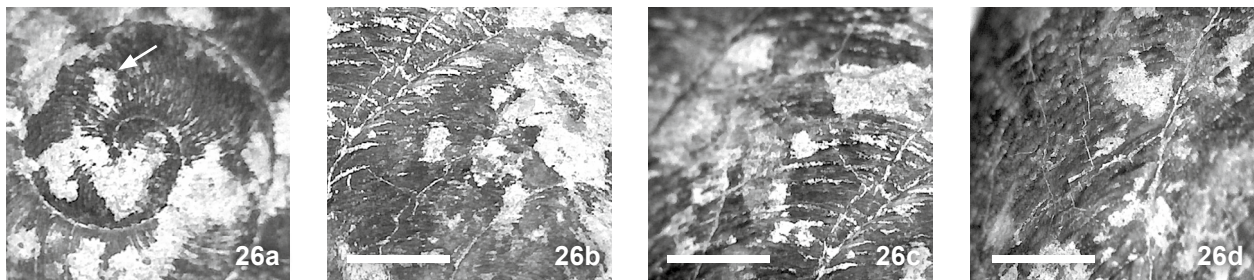


Fig. 26a-d. Apex and surface sculpture of *Simplicula roja* Hutterer & Groh, spec. nov., holotype, SMF 350514, Fuerteventura, Montaña Roja. **26a.** Apex, diameter of protoconch = 2.1 mm, border shown by an arrow. **26b-d.** Surface sculpture on the 3rd and 4th whorl (26b), 4th whorl (26c) and 5th whorl (26d). Scale bars: 1 mm.

Description. — Large (> 26.3 mm) depressed conical shell with c. 5.15 regularly growing whorls. The protoconch has c. 1.5 whorls (nucleus broken off), 2.8 mm diameter, the microsculpture smoothed due to erosion. The periphery of the last whorl is slightly angled, the last whorl increasingly sharply keeled on a fifth of its height. The aperture is mostly missing but was wide and high, so probably huge, pear-shaped. The sculpture of the teleoconch is on the 3rd and 4th whorl marked with sparsely set thick radial ribs (about 2/mm), on the last whorl additionally overdrawn with at least two jagged spiral edges, so that in combination with thick knots rectangular indentations arise (Fig. 25). The apertural lip was probably narrowly reflected, its columellar section covering the relatively wide umbilicus in part.

Comparisons. — In respect to size and angled periphery and in the upper fifth keeled body whorl only comparable to *Simplicula* spec. 1 from which it differs by the size and the shape of the aperture. From all other *S.* species clearly differing by the coarse sculpture.

Etymology. — Named for the friend and colleague Dr. Rainer Hutterer of Bonn, Germany, emeritus curator of Theriology at the Museum Koenig, Bonn, and knowledgeable malacologist, working on the Canary Islands and in North Africa since the 1980's.

***Simplicula roja* Hutterer & Groh, spec. nov.**

Figs 21, 26

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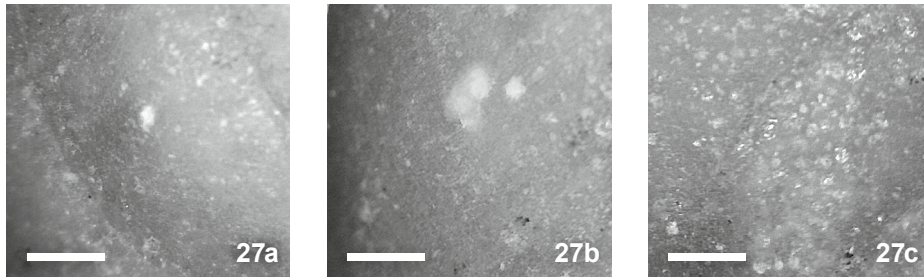
Type material. — Holotype, SMF 350514 (ex CHB), Fuerteventura, Barranco Montaña Roja, sediment below basal flow, Lower Pleistocene, leg. RH, 30.vii.1990 (Fig. 21).

Holotype measurements. — w = 26.9 mm, h = 14.6 mm, aw = 16.8 mm, ah = 12.6 mm, umb c. 3.3 mm (partly covered), wh 5.2, rel lw 45%.

Diagnosis. — Depressed conical shell. Periphery slightly angled. Shell large with a very large last whorl; apex predominantly ribbed with a sparse granulation. Teleoconch with coarse irregular ribs.

Distribution. — Known only by the holotype collected in Lower Pleistocene levels in the Montaña Roja, W Fuerteventura.

Description. — Large (26.9 mm) depressed conical shell with c. 5.2 increasingly growing whorls. The protoconch has 1.5 whorls, 2.1 mm diameter microsculpture finely ribbed with irregular granulae. The periphery of the last whorl angled. The aperture is wide, ovate and with a relatively broad and distinctly reflected lip. Columellar section of the lip very broad but covers the wide umbilicus only marginally. The sculpture of the teleoconch is on the 3rd and



Figs 27a-c. *Simplicula* spec. 2, SMF 350510, Fuerteventura, Ajuy. Surface sculpture on the 4th whorl (27a), 5th whorl (27b) and 3rd whorl (27c). Scale bars: 1 mm.

4th whorl marked with broad radial ribs (about 5/mm), on the last whorl additionally a multitude of granulae are present (Figs 26b-d).

Comparisons. — The new species resembles in size only *S. plutonia* and *S. rainerhuttereri* spec. nov. Compared to both species, the proportion of the body whorl of the new taxon is much larger (45%). Additionally, the protoconch is relatively small and is both ribbed and granulated.

Etymology. — Named for the type locality, Montaña Roja.

Simplicula spec. 1

Fig. 22

Material examined. — SMF 33630/f, Fuerteventura, [possibly Jandia peninsula], stone cast, probably Pleistocene, leg. KvF, iii.1863, width 26.2 mm (Fig. 22).

Measurements. — w = 26.2 (est. 27.5) mm, h = 12.5 (est. 13.2) mm, aw = 12.9 (est. 14.0) mm, ah = 8.3 (est. 9.5) mm, umb 2.9 mm (est. 2.5, open), wh 4.50, rel lw 27.9 %

Distribution. — Locality not exactly provided by K. von Fritsch, probably Pleistocene of Fuerteventura.

Description. — Stone cast of a large specimen of depressed conical shape with regularly growing whorls, the last whorl slightly angled at the periphery, at the aperture even slightly keeled, aperture relatively small with a reflected and significantly expanded lip, umbilicus moderate wide, open.

Comparisons. — Compared to similar sized *Simplicula rainerhuttereri* spec. nov. and *Simplicula* spec. 2 more flattened, with less whorls and a smaller and more tapering aperture. With 28 percent of the width a much less space-occupying ultimate whorl which in contrast is between 33 and 38 percent in Holocene and extant specimens.

Simplicula spec. 2

Figs 23, 27

Material examined. — SMF 350510 ex CHB, Fuerteventura, Ajuy, heavily cemented fossil dune under a second marine beach terrace, fragment of stone cast with thin remnants of the shell, possibly Lower Pliocene (4.8 My, see Meco et al., 2007), 28.4007°N 014.1571°W, leg. RH, iii.1987, width 24.5 mm, Fig. 23; CGD 03767 ex CHB, same loc. and data, width 21.3 mm.

Measurements. — w = 24.5 mm, h = 13.2 mm, wh > 4.50.

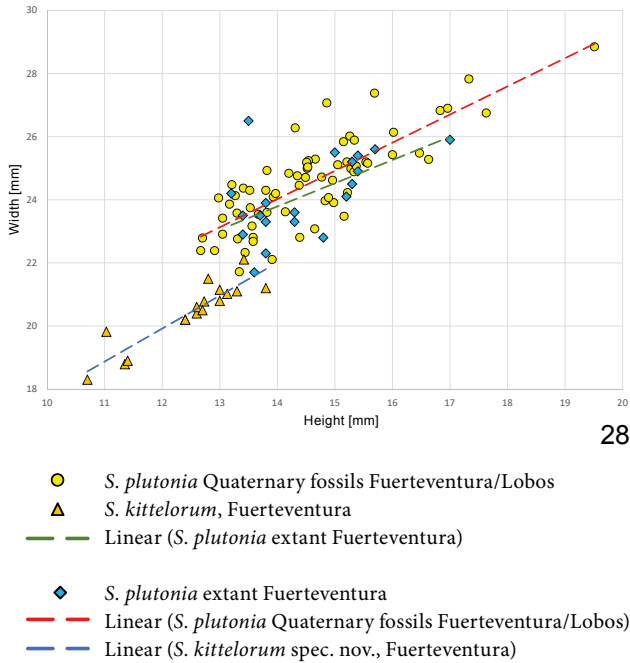
Distribution. — Only known from a possibly Lower Pliocene beach terrace near Ajuy, western Fuerteventura.

Description. — Part of stone cast (Fig. 23) of a large specimen of depressed globose shape with regularly growing whorls, the last whorl with a wellrounded periphery, aperture missing, but probably relatively wide, umbilicus probably moderately wide, surface sculpture consists of fine shallow radial riblets (c. 2.5/mm on last whorl), irregularly or in radial rows overlaid by numerous tiny rounded granules (Fig. 27).

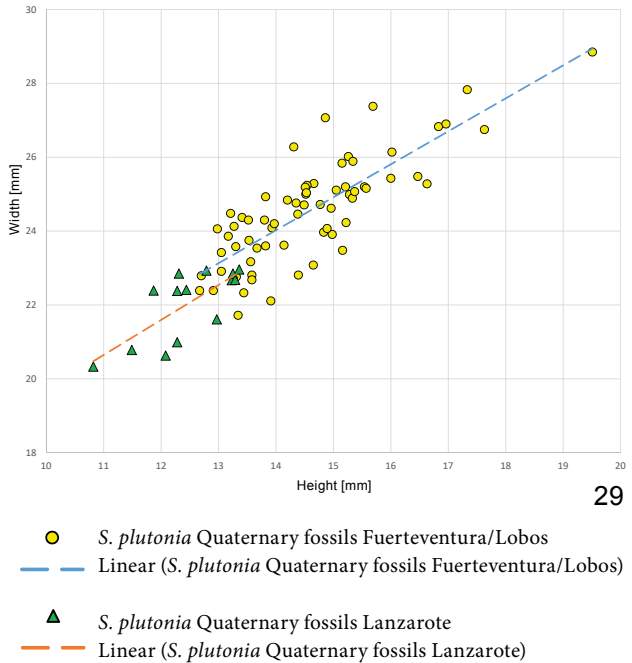
Comparison. — Compared to similar sized *Simplicula rainerhuttereri* spec. nov. and *Simplicula* spec. 1 more globose, with a more rounded last whorl, the last two whorls wider than in the both others. The surface sculpture is less rough, much shallower but widely ribbed and with more discernible granulae as in *S. rainerhuttereri* spec. nov. and the overlapping of the suture less significant with shallow border. Further the periphery of the body whorl is neither angled nor the beginning of the last whorl sharply keeled.

DISCUSSION

Our result may be surprising if one considers that until recently only one taxon of *Simplicula* was recognized. Ponte-Lira et al. (1997) described the subgenus *Simplicula*, based on a number of anatomical specimen from Fuerteventura. In their paper, the variation of the shell was not inten-



28



29

Figs 28-29. Analysis of shell size. **28.** Relation of shell height and shell diameter in Quaternary populations of *S. plutonia* from Fuerteventura and Lobos (yellow dots) and extant populations from Fuerteventura (blue diamonds), and of Pleistocene/Quaternary (orange triangles) populations of *S. kittelorum* Groh & Hutterer, spec. nov. **29.** Same diagram with Quaternary populations of *S. plutonia* from Fuerteventura + Lobos (yellow dots) and of Quaternary populations from Lanzarote (green triangles).

sively examined. In our study we included a large number of recent and fossil shells from four islands (La Graciosa, Lanzarote, Lobos and Fuerteventura). These included shells from Early Pliocene to Holocene sites; however, most fossils were from Quaternary sites. Pliocene and Pleistocene fossils are still very rare and often represented by single specimens only, despite 160 years of collecting efforts.

The Quaternary and Recent specimens show a large range of variation which we interpret as a result of speciation. *S. kittelorum* spec. nov. and *S. justusi* spec. nov. are described from Quaternary shells, while *S. juliae* spec. nov. survived possibly from the Pliocene to the Quaternary. The remaining new species were found in Pliocene sites only, mostly as single shells. The distribution range of the extant species *S. plutonia* is constricted to only parts of Lanzarote and Fuerteventura (other than shown in Ponte-Lira et al., 1997 and www.biodiversidadcanarias.es), as some of these populations were described by us as new species (*S. kittelorum* spec. nov. and *S. juliae* spec. nov.). Even the extant and subfossil populations of *S. plutonia* from Fuerteventura and Lanzarote show quite some variation in size and shape (Fig. 29).

We performed a tentative analysis of measurements taken from 117 shells from Lanzarote and Fuerteventura + Lobos (Figs 28-29) in order to analyse the size and shape of the shells. The first graph (Fig. 28) shows the relation of shell

diameter and height in *S. kittelorum* spec. nov., differing by its small size, and in Quaternary and extant populations of *S. plutonia* from Fuerteventura and Lobos, which also differ in their size spectrum. Fig. 29 shows that Quaternary shells from Fuerteventura + Lobos (yellow dots) are generally larger than Quaternary shells from Lanzarote (green triangles). This may indicate that the two populations are also anatomically and genetically different. Because anatomical details are currently only known from specimens obtained in Fuerteventura (Ponte-Lira et al., 1997), this problem must be left unresolved until specimens from Lanzarote have been studied.

ACKNOWLEDGEMENTS

We are thankful to the late Hartmut Nordsieck (discussion on fossils), Renate Benz-Heinbücher, Hochheim/Main (graphics), Kevin Webb (figures of the lectotype of *Helix plutonia*), Dr. Ronald Janssen & Sigrid Hof, SMF and the late Dietrich Kadolsky (loan of material), Dr. Jonathan Ablett (search for material), and to Christina Groh and Dr. Miguel Ibáñez (field collecting), Dr. Ruud Bank, Hoogezand, The Netherlands (literature hints and editing) and Jan Johan ter Poorten, Hilversum, The Netherlands (editing and layout), who all helped us to improve the manuscript.

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