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Discus (Canaridiscus) laurisilvae sp. nov., a species from the laurel forest of La Gomera, Canary Islands (Gastropoda: Pulmonata: Discidae)

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A new endemic land snail species of the family Discidae, *Atlantica (Canaridiscus) saproxylophaga* Alonso, G. Holyoak & Yanes 2011, was recently described from La Gomera, Canary Islands (in Yanes *et al.* 2011). According to Rähle & Allgaier (2011) it is provisorily considered as belonging to the genus *Discus*. This species lives in the laurel forest and has the largest shell of all the Discidae hitherto known from Macaronesia. In the same habitat where *D. saproxylophagus* lives, we found individuals of similar size belonging to a second species of the taxon *Canaridiscus*. These two species show clear differences with respect to both shell morphology and genital anatomy, as described herein.

Material and methods

The holotype and nine paratypes were hand-collected at the type locality from the litter and from within the soil. Three more paratypes were hand-collected from another site in the same natural forest. The material on which this study is based is kept in the collections listed under the following abbreviations: SMNS, Staatliches Museum für Naturkunde Stuttgart, Germany; SMF, Forschungsinstitut und Naturmuseum Senckenberg, Frankfurt am Main, Germany; RAE, W. Rähle private collection, Tübingen, Germany; KLE, M. Klemm private collection, Tübingen, Germany. Quantitative shell characters were measured on the basis of large scaled, digital macrophotographs using standard GIS-software (ArcView GIS 3.2a). The statistical analysis was performed with SPSS for Windows, version 10.0.07. Abbreviations for shell characters and calculations are shown in the legend of Table 1. The number of whorls was counted according to Kerney *et al.* (1983). A comparison of quantitative shell characters included 8 shells from *D. laurisilvae* **sp. nov.**, and 7 shells from *D. saproxylophagus* (2 shells collected by M. Klemm, 17th February 1992; KLE and 5 shells collected by W. Rähle and T. Beck, 4th March 2005; RAE). Due to the small sample size, the mean values of the shell parameters of both species were tested with the Mann-Whitney-U-Test. The significance levels were calculated according to the Holm-Bonferroni-method (Holm, 1979). The live specimens were fixed in 70% ethanol and dissected under a stereomicroscope. Digital photographs of the genital tract were taken through a macroscope (Leica M420 with an apozoom 1:6 lens).

Systematics

Class Gastropoda

Subclass Pulmonata

Order Stylommatophora

Family Discidae

Genus *Discus* Fitzinger, 1833

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Subgenus *Canaridiscus* Alonso & Ibáñez, 2011

***Discus* (*Canaridiscus*) *laurisilvae* Allgaier & Klemm, sp. nov.**
Figs. 1 A,D; 2A–D

Diagnosis. A large-sized *Discus* species (shell diameter up to 15.2 mm) if compared to all the Discidae known from Macaronesia, with a striated shell, whorls rounded at periphery, with wide umbilicus and low spire; penis long, but less than half of the length of the penis of *D. saproxylophagus.*

Remarks. The genus *Atlantica* Alonso & Ibáñez, 2011 is based on insufficient evidence, as the anatomical characteristics of the type-species of this genus, *Atlantica gueriniana* from Madeira is unknown (Rähle & Allgaier 2011; Yanes *et al.* 2011). We therefore provisorily herein maintain the status of the genus *Discus* with the subgenera *Atlantica* and *Canaridiscus* (Bank *et al.* 2002).

Description. The shell is comparatively large, rather solid, depressed, with a low spire and rounded periphery or sometimes slightly subangulate periphery when young. The specimens are evenly horn-colored, mature shells are mostly largely denuded. Upper surface weakly ribbed and ribs almost obsolete on the body whorl below the periphery. Fully grown shells have up to 6.5 whorls, slowly increasing. The shell is up to 7.4 mm high and up to 15.2 mm wide. Umbilicus broad, deep, between 35 % and 40 % of the shell, exhibiting all of the whorls inside. The whorls visible inside the umbilicus lack ribs. Spire with convex outlines and deep sutures. Protoconch consists of 1.75 smoothish, horn colored whorls, suture impressed. Aperture rounded oval, the peristome is simple (Figure 1, A).

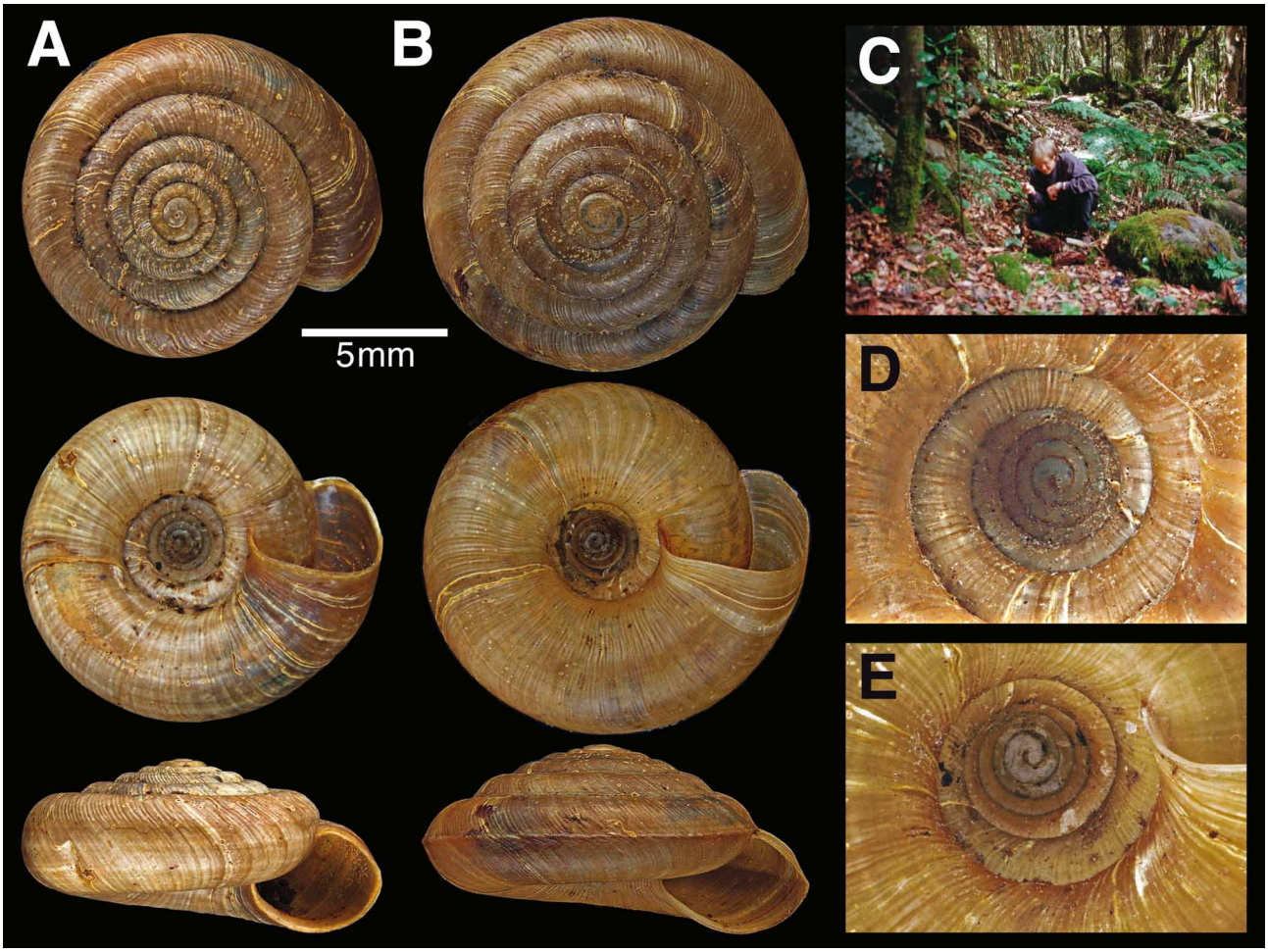

FIGURE 1. A, *Discus* (*Canaridiscus*) *laurisilvae* **sp. nov.**, shell of the holotype; B, shell of *Discus* (*Canaridiscus*) *saproxylophagus* (Alonso, G. Holyoak & Yanes 2011); La Gomera, Bosque del Cedro, leg. M. Klemm, 17th February 1992; C, locus typicus of *Discus laurisilvae* **sp. nov.** near the chapel Ermita de Nuestra Señora de Lourdes; D, *Discus laurisilvae* **sp. nov.**, umbilicus of a paratype (magnified); E, umbilicus of *Discus saproxylophagus* (magnified).

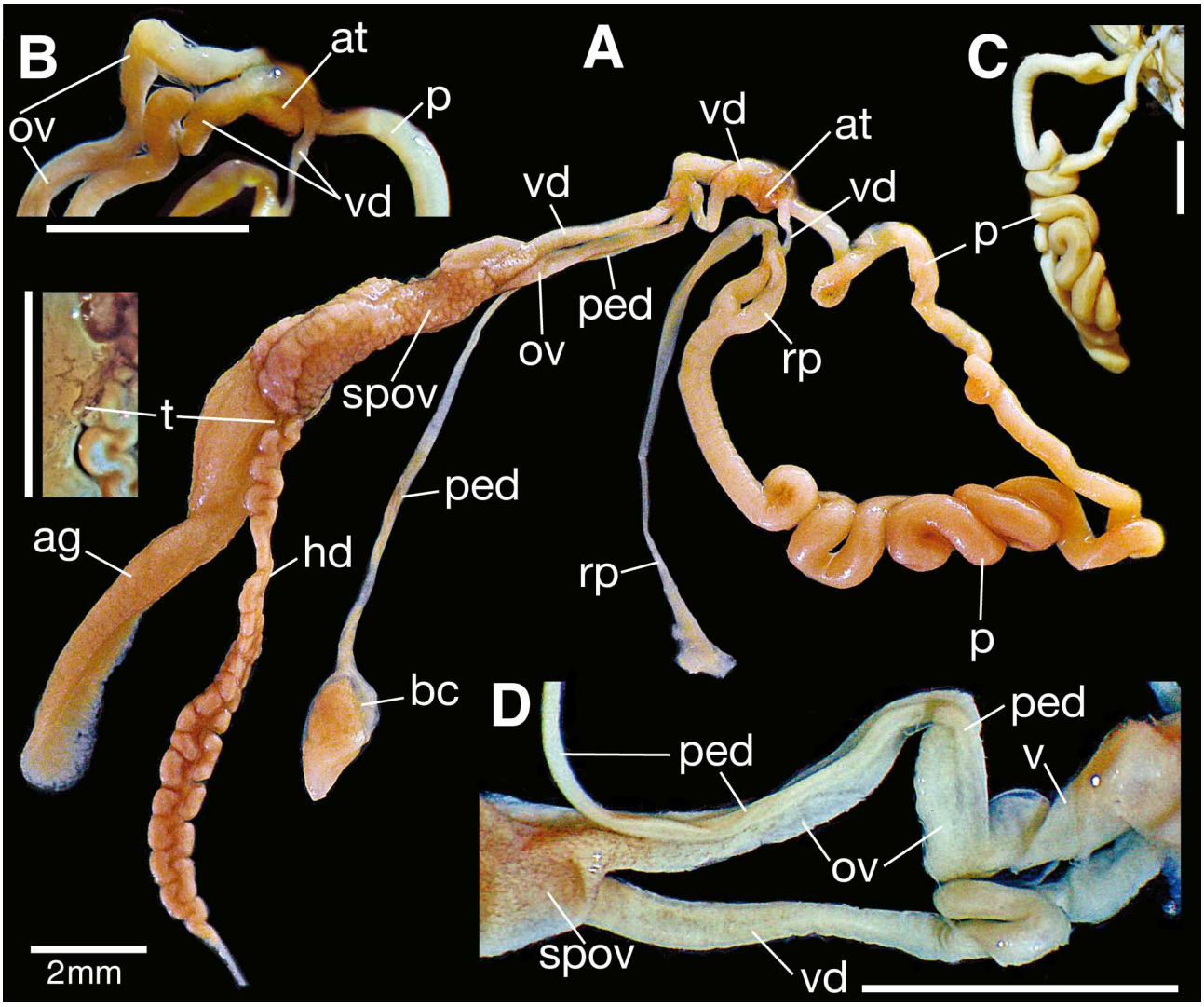

FIGURE 2. *Discus* (*Canaridiscus*) *laurisilvae* **sp. nov.**, dissected genital system; A, genital system unfolded, a connective tissue sheet covers the vas deferens locally at the atrium; B, details of the distal zone of the genital system, the tissue sheet at the vas deferens was partly removed; C, penis at early stage of dissection; D, detail of pedunculus and the oviduct; at, atrium; ag, albumen gland; bc, bursa copulatrix; hd, hermaphroditic duct; ov, free oviduct; p, penis; ped, pedunculus; rp, penis retractor muscle; spov, spermoviduct; t, talon; v, vagina; vd, vas deferens.

Genital system. (Figure 2, A–D; one specimen dissected, deposited in SMNS (ZI0088751); SDi (shell diameter): 13.8 mm; SH (shell height): 6.3 mm)). In the following description, the terms "distal" and "proximal" are used in relation to the hermaphroditic gland. Atrium short (Figure 2, A, B). Penis long and compactly coiled (Figure 2, C). When expanded its length reaches approximately 43 mm. It is 2.3 times longer than the complete female part of the genital system with vagina, oviduct, spermoviduct and albumen gland. Proximally, the penis is thicker than distally. The long penial retractor muscle is quite massive at its insertion site on the penis. The vas deferens is linked to the atrium by a perpendicular connective tissue sheet 2 mm before the vas deferens opens into the penis. The distance of the vas deferens from the penis to the attachment site at the atrium is relatively short, with a remarkably narrow passage, if compared to the three other species of the taxon *Canaridiscus* (Figure 2, B). The pedunculus of the small bursa copulatrix is long and thin. The pedunculus joins the oviduct just in front of the atrium thus resulting in a short vagina. The free oviduct is four times longer than the vagina (Figure 2, D). The albumen gland is well developed and has a short talon (Figure 2, A).

Holotype (Figure 1, A; empty shell): collected by M. Klemm, 17th February 1992, SMNS (ZI0088750).

Paratypes. Same locality, collected by M. Klemm, 17th February 1992; 1 alcohol specimen, SMNS (ZI0088751); 5 empty shells, SMNS (ZI0088752); 2 empty shells, SMF (SMF 336667/2); Bosque del Cedro, near the village El Cedro, collected by W. Rähle and T. Beck, 4th March 2005; 3 empty shells (1 intact, 2 fragmentary), SMNS (ZI0088753).

Type locality. La Gomera, Bosque del Cedro, Laurisilva, approx. 300 m north of the chapel Ermita de Nuestra Señora de Lourdes, in the steeply sloping valley of the Cedro creek at an altitude of 900 m a.s.l., 20–30 m to the west of the creek (28°07'46"N, 17°13'12"W).

Etymology. The species name refers to the habitat of the species.

Habitat and distribution. Up to now, the new species is only known from the type locality. The shells were found between the roots of old trees or underneath stones and rotten leaves. In the same locality, *D. saproxylophagus* (Alonso, G. Holyoak & Yanes) (verified anatomically), and *D. ganodus* (Mabille) were present.

Comparison with the other Discidae species known from Macaronesia. Apart from *D. laurisilvae* **sp. nov.**, there are two more Discidae species of comparable shell size hitherto known from Macaronesia, *D. rupivagus* Rähle & Allgaier 2011 and *D. saproxylophagus*, both from La Gomera. *D. rupivagus* has a smaller, very flattened, sharply keeled shell with strong, regular ribs inside the umbilicus and differs clearly from the new species *D. laurisilvae* **sp. nov.** *D. saproxylophagus* is very similar to *D. laurisilvae* **sp. nov.** in shell size and shell height (Fig. 1A, B). In both species, the shell surface texture is quite similar. Concordantly, the whorls inside the umbilicus are radially striated (Fig. 1, D, E). Nevertheless, there are markedly distinctive morphological features of the shell and of the genital anatomy. The primary shell difference between *D. laurisilvae* **sp. nov.** and *D. saproxylophagus* is the pronounced keel of the latter. Additionally, both species display highly significant differences with respect to the the index-variables UD/SDi (umbilicus diameter / shell diameter) and AH/AB (aperture height) / AB (aperture breadth) and the parameter AB (aperture breadth) [see Table 1]. Significant differences were observed concerning the parameters UD (umbilicus diameter) and NW (number of whorls). *D. saproxylophagus* has a smaller umbilicus, which measures between 25 % and 30 % of the shell diameter, in *D. laurisilvae* between 35 % and 40 % (Tab. 1; Fig. 1, A, B). Obviously, the proportion of UD to SDi provides the best discriminating character for both species (Fig. 3), but also the shape of the aperture of both species is significantly different. In *D. saproxylophagus*, the shell aperture is angularly ovate in contrast to *D. laurisilvae* **sp. nov.**, which has a rounder aperture. Furthermore, the shell outlines in the lateral view exhibit differences of the two species. *D. saproxylophagus* has a more dome-shaped spire and less convex whorls, whereas the spire of *D. laurisilvae* **sp. nov.** is less elevated but the whorls have more convex outlines (Fig. 1, A, B).

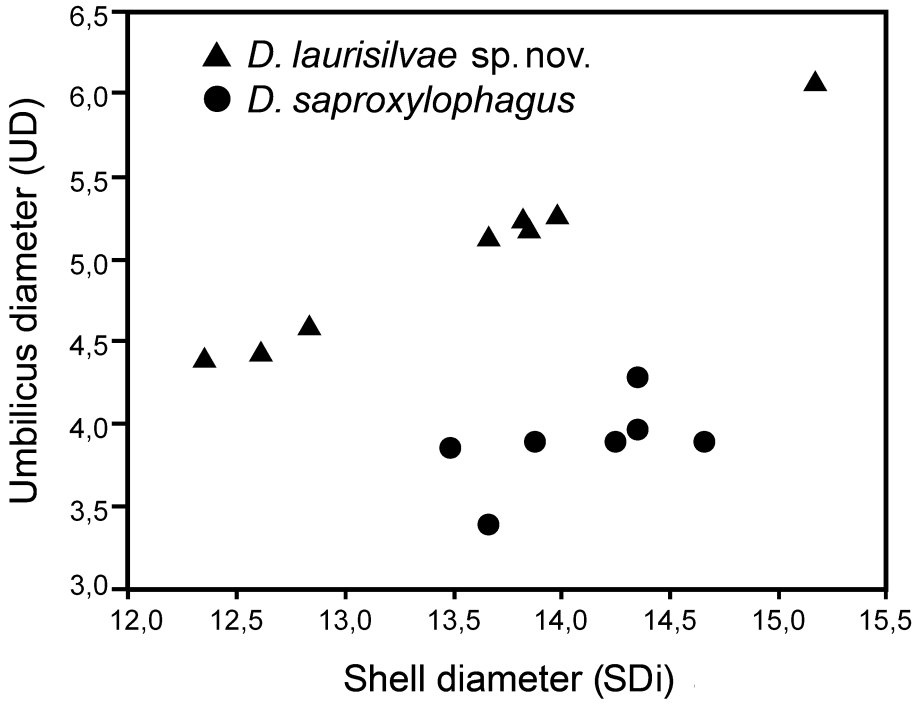

FIGURE 3. Scatter plot of shell characters of *D. laurisilvae* **sp. nov.** and *D. saproxylophagus*. The different symbols represent measurement values of the variables umbiculus diameter (UD) and shell diameter (SDi).

Anatomically *D. laurisilvae* **sp. nov.** has a much shorter penis than *D. saproxylophagus*. Although the dissected specimens are of comparable shell size to each other (dissected specimen *D. laurisilvae* **sp. nov.** SDi: 13.8 mm; *D. saproxylophagus* SDi: 14.2 mm), its penis does not reach half of the length of the penis of *D. saproxylophagus*, but it has a similar diameter. The vas deferens sequence from the penis to the attachment site at the atrium is considerably shorter

in *D. laurisilvae* **sp. nov.**, about one third of the distance in *D. saproxylophagus.* The vas deferens of *D. laurisilvae* **sp. nov.** becomes remarkably thin in this region compared to other Discidae of the taxon *Canaridiscus*, however, this may be a trait that needs further confirmation from more specimens.

TABLE 1. Synopsis of the analysed shell characters; Abbreviations: n, number of measured specimens; min, minimum; max, maximum; mean, arithmetic mean; SD, standard deviation; SEM, standard error of the mean; CV, coefficent of variation (SD^2/ mean); p-value; Mann-Whitney-U-Test; laur, *D. laurisilvae* **sp. nov.**; sapr, *D. saproxylophagus*; SDi, maximum diameter of shell; SH, shell height; AB, aperture breadth; AH, aperture height; UD, umbiculus diameter; NW (number of whorls); SH/SDi (shell height / shell diameter), UD/SDi (umbiculus diameter / shell diameter); AH/AB (aperture height / aperture breadth). * / **: null hypothesis (α = 0,05 / 0,01) rejected according to the Holm-Bonferroni-method.

character /index	species	n	min	max	mean	SD	SEM	CV (%)	p
SDi (mm)	laur	8	12.35	15.17	13.54	0.91	0.32	6.13	0,081
	sapr	7	13.48	14.66	14.09	0.42	0.16	1.28	
SH (mm)	laur	8	6.32	7.43	6.87	0.45	0.16	3.00	0,186
	sapr	7	6.56	7.68	7.08	0.42	0.16	2.49	
UD (mm)	laur	8	4.40	6.08	5.05	0.56	0.20	6.27	0,007*
	sapr	7	3.39	4.28	3.88	0.26	0.10	1.74	
AH (mm)	laur	8	3.62	4.31	3.86	0.26	0.09	1.76	0,023
	sapr	7	3.23	3.75	3.52	0.18	0.07	0.93	
AB (mm)	laur	7	4.06	5.04	4.54	0.33	0.12	2.34	0.001**
	sapr	7	5.07	5.88	5.29	0.32	0.12	1.93	
NW	laur	8	6.13	6.50	6.34	0.13	0.05	0.26	0,002*
	sapr	7	6.50	6.75	6.63	0.13	0.05	0.24	
AH/AB	laur	7	0.75	0.89	0.83	0.05	0.02	0.27	0,001**
	sapr	7	0.60	0.71	0.67	0.04	0.01	0.23	
SH/SDi	laur	8	0.44	0.56	0.51	0.04	0.01	0.33	0,315
	sapr	7	0.46	0.53	0.50	0.03	0.01	0.16	
UD/SDi	laur	8	0.35	0.40	0.37	0.02	0.01	0.07	0,001**
	sapr	7	0.25	0.30	0.28	0.02	0.01	0.09	

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