

Morphological and anatomical data on some populations of *Helix (Helix) pronuba* Westerlund, 1879 (Gastropoda Helicidae) from North Africa

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ABSTRACT New morphological and anatomical data on some populations of *Helix (Helix) pronuba* Westerlund, 1879 (Gastropoda Helicidae) are provided. In particular, the populations from North Africa are examined morphologically and compared with the topotype from Crete (Greece). The genital organs of a population of Libya are also described.

KEY WORDS Helicidae; shell morphology; genital organs; systematics; Mediterranean; Lybia.

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INTRODUCTION

In the past literature the *Helix* Linnaeus, 1758 (Gastropoda Helicidae) with dark-mouthed shells from Crete and North Africa have been wrongly classified as *Helix nucula* Pfeiffer, 1859 (Sturany, 1908; Hesse, 1920, 1934; Kaltenbach, 1950a, b; Blume, 1952; Jaeckel, 1963; Psonis et al., 2015).

Recently Neubert (2014) remarks how Pfeiffer (1859) did not describe a new species but tried to re-define the white-mouthed *Helix nucula* Mousson, 1854 (locus typicus: Smyrna = Izmir, Turkey) using specimens from Alexandria (Egypt), which belonged to a different species with dark-mouthed shell.

Neubert (2014), therefore, proposes the name *H. pronuba* Westerlund & Blanc, 1879 (locus typicus “Messarà”, Crete, Greece) for the dark-mouthed *Helix* living in Crete, some East Aegean islands (Greece), Northern Egypt, Northern Libya and Southeast Tunisia. Subsequently, these two *Helix* species were morphologically differentiated by Neubert & Korábek (2015) as follows:

“*Helix (Pelasga) nucula* Mousson, 1854: shell small to moderately sized, thin, spherical, protoconch small, teleoconch with coarse axial riblets and surface granulation, aperture always white; flagellum as long as epiphallus + penis, long diverticulum surmounting bursa copulatrix in length.

Helix (Helix) pronuba Westerlund & Blanc, 1879: shell small to very small, spherical, white or with up to five spirals, teleoconch with fine and densely spaced riblets and a prominent granulation, aperture deep chocolate brown. Morphology of genital organs unknown”.

For a better knowledge of *Helix pronuba* we will provide in the following work some new morphological and anatomical information on North African populations, Libya in particular.

MATERIAL AND METHODS

Empty shells and living specimens were collected on the field sighting on the soil and under the

stones and debris. Observations on the ecology of these organisms were made directly on the field. The shells have been immersed for less than two minutes in a solution with 60% of water (H₂O) and 40% of NaClO, and subsequently cleaned with water and a flat tipped with hard bristles paintbrushes. Dry shells have been studied regarding size, colour and morphology. In order to study and illustrate genital organs, some specimens were fixed in 80% ethanol. The bodies were isolated from the shells and dissected under the Optika stereomicroscope using a very fine pointed scalpel, scissors and needles. Photos were taken with a Canon EOS 100D camera. Height and maximum diameter of the shell along with some parts of genitalia were measured (in millimeters) by a digital caliper.

Taxonomical references are based on MolluscaBase (2022). The anatomical study follows what was proposed by Neubert (2014).

The materials used for this study are deposited in the following Museums and private collections: Zoology Department, University of Tripoli, Libya (UOT); Marco Calò collection, Milano, Italy (CC); F. Liberto collection, Cefalù, Italy (CL); Museo Regionale di Storia Naturale e Mostra permanente del Carretto siciliano di Terrasini, Italy (MRSNT). Museo Civico di Storia Naturale di Genova, Italy (MSNG); I. Sparacio collection, Palermo, Italy (CS).

ABBREVIATIONS AND ACRONYMS. A: atrium; AS: atrial stimulator; BC: bursa copulatrix; DBC: duct of bursa copulatrix; DG: digitiform glands; DS: dart sacs; DSO: dart sac opening; E: epiphallus; F: flagellum; FO: free oviduct; FP: first pedunculus; H: height; P: penis; PP1: proximal penial papilla; PP2: distal penial papilla. PR: penial retractor muscle; SP: second pedunculus; UO: uterine ovispermiduct; V: vagina; VD: vas deferens; VSS: V-shaped structure.

RESULTS

Systematics

Ordo STYLOMMATOPHORA A. Schmidt, 1855
 Superfamilia HELICOIDEA Rafinesque, 1815
 Familia HELICIDAE Rafinesque, 1815
 Subfamilia HELICINAE Rafinesque, 1815
 Genus *Helix* Linnaeus, 1758
 Subgenus *Helix* Linnaeus, 1758

Helix (Helix) pronuba Westerlund, 1879

Helix thiesseana var. *pronuba* - Westerlund & Blanc, 1879: 80, 82. Locus typicus: Crete, Messarà.

Helix melanostoma - Martens, 1879: 70. Tripoli, Gebirge Tarhuna, Gharian, Berges Bu-Sellem.

Helix melanostoma - Martens, 1883: 147. Cyrenaika, Bengazi

Helix malanostoma - Martens, 1885: 188. Cyrenaikam, Bengazi

Pomatia melanostoma - Kobelt, 1898: 362. In der Umgebung von Benghazi in der Cyrenaika

Helix (Helicogena) grothei - Kobelt, 1905: 201, Pl. 349, Figs. 7, 8. Regentschaft Tripolis, Libyen

Helix (Helicogena) grothei - Kobelt, 1906: 20, Pl. 310, Fig. 1974. In der Tegentschaft Tripolis

Helix (Pomatia) nucula - Sturany, 1908: 294, 310. Im Innern der Regentschaft Tripolis, Bengasi und Dernah

Helix (Pomatia) grothei - Sturany, 1908: 308. Im Innern der Regentschaft Tripolis

Helix melanostoma - Ghigi, 1913: 269. Bengasi

Helix grothei - Ghigi, 1913: 269. Dintorni di Tripoli

Helix nucula - Ghigi, 1913: 269. Bengasi e Derna

Helix nucula - Hesse, 1920: 181–183, Taf. 654, Figs. 3–5

Helix (Pomatia) melanostoma - Stefanini, 1921: 142, Pl. 18, Fig. 13. Calcari di duna, Derna; Tolmetta (Quaternay fossils)

Helix (Helicogena) melanostoma - Gambetta, 1924: 27–29. Derna, Um Erzem, Merg, Ghemines

Helix (Helicogena) melanostoma - Gambetta, 1925a: 560 (Map)

Helix (Helicogena) melanostoma - Gambetta, 1925b: 26. Zania, Sidi Abd El-Gelil, Sidi Abd El-Gelil, Tripoli, Sud del ridotto Ettom, Homs e Tarhuna, Merghel Dacla Trig Gefara. (fossil)

Helix (Helicogena) melanostoma - Gambetta, 1925c: 2. Derna, Zuetina nella Sirtica orientale.

Helix (Helicogena) melanostoma - Gambetta, 1929: 251. Porto Bardia

Helix (Helicogena) melanostoma - Bisacchi, 1932: 355. Strada che congiunge Soluch ad Agedabia

Helix melanostoma - Hesse, 1934a: 109. Bengasi, Um Erzem, Merg, Ghemines, Derna, Zuetina, Porto Bardia, zwischen Soluch und Agedabia

Helix nucula - Hesse, 1934b: 107, 109. Bengasi, Derna

Helix (Pomatia) melanostoma - Alzona, 1940: 146. Gheddahia

Helix nucula - Kaltenbach, 1950a: 55–63, Pl. 10, Figs. 1–11. Von meinem ersten Fundplatz (zwischen Bardia und Tobruk) ab ist die Besiedelung nahezu geschlossen durch die ganze Cyrenaika sowohl im Halbwüstenwie auch im Steppengebiet und im Fruchtländ. Nur n. Agedabia fehlt *H. nucula* stellenweise, reicht aber mindestens 20 km s. Agedabia in Richtung Giallo. 1) Km 7 n. Bengasi. 2) Zwillingssteiche 2 km ö. Fundplatz 1. 3) Ostlich el Califa am Gebirgsrand etwa 30 km n. Bengasi. 4) Km 10 n. Tocra = 74 km n. Bengasi. 5) Km 20 n. Tocra. 6) Km 30 n. Tocra. 7) Ruinengebiet von Ptolomais (jetzt Tolmette) 40 km n. Tocra. 8) Gebirgsfuß bei Tolmette. 9) Gebirgshang ö. Tolmette nach Barce. 10) Oben im Gebirge von Tolmette nach Barce. 11) Km 5 ö. Tocra. 12) Hügel n. und s. der Straße bei Tocra in 150 m Höhe. 13) Km 6,8 ö. Tocra. 14) Km 8 n. Baracca. 15) n. Barca kurz vor dem Gebirgsabfall. 16) Km 3,5 ö. Maddalena. 17) Km 10,2 ö. Maddalena. 18) Km 3,5; 20,1; 21; 28,1; 33,5; 40; 45 ö. D'Anuncio (D'Anuncio liegt 27 km ö. Maddalena). 19) Cyrene beim Apollotempel (Cyrene liegt etwa 210 km n. Bengasi, 620 m hoch). 20) Abhänge unterhalb des Apollotempels etwa 600 m hoch. 21) Plateau unterhalb des Apollotempels. 22) Oberes Gräberfeld von Cyrene etwa 580 m hoch. 23) Unterhalb des Gräberfeldes von Cyrene. 24) Abzweigung nach Alba. 25) Hügel oberhalb Alba. 26) Km 4; 7; 10 w. Apollonia. 27) Hügel w. Wadi Beied bei Apollonia. 28) Wadi Beied. 29) w. Apollonia in der Ebene. 30) Apollonia beim Apollotempel unmittelbar am Meer. 31) Km 9; 20; 26 w. Berta (Berta liegt 39 km w. Derna). 32) Km 1–2 w. Der Abzweigung nach Mameli von der Via Balbia. 33) Km 10,26 ö. Berta. 34) Derna = 300 km n. Bengasi, am Meer. 35) Wadi Bu Naga = 10 km w. Derna, östl. Talhänge. 36) Wadi Bu Naga vom Ausgang des Tales. 37) Plateau ö. Oberhalb Wadi Bu Naga. 38) Berg s. des alten Weges von Derna nach Berta = 12 km w. Derna. 39) Km 8 w. Derna, Hügel am Meer. 40) Derna, Plateau s. der östl. Kaserne. 41) n. und s. Hang und Kuppe des Berges s. der östl. Kaserne. 42) Plateau 1 km ö. Derna. 43) Serpentina von Derna auf die Höhe nach Tobruk. Km 5; 7; 11; 23; 30; 42; 50,3; 86; 103 ö. Derna nach Tobruk. 45) Km 130 ö. Tobruk. 46) Km 4,5 ö. Lethe. 47) Abhänge der 1. Plateaustufe zw. Benina und Regina ö.

Bengasi. 48) Km 37 n. Regina. 49) Hügel bei Abiar Km 60 ö. Bengasi. 50) Km 1 s. Abiar nach Mechilli. 51) Km 5; 6; 10; 14 ö. Abiar. 52) Steppe bei Berka s. Bengasi. 53) Km 12; 12,3; 21; 26; 43 s. Bengasi nach Ghemines. 54) Km 13 n. Agedabia = 141,7 km s. Bengasi. 55) Km 20; 25; 30 s. Bengasi. 56) An den Ufern beider Seen n. Solluch. 57) Dünengebiet bei el Coëfia Km 13 n. Bengasi. 58) Im Sebeckengebiet der Ain es Selamie bei Bengasi. 59) Km 7 w. El Magrun (im S von Bengasi). In der Syrte ist die Verbreitung von *H. nucula* nicht durchgehend, ... Bedingungen ist hier die Verbreitung also inselförmig und hält sich stets an das unmittelbare Küstengebiet. 1) Km 51 und 58,5 w. Agedabia. 2) Km 118,5 w. Agedabia = bei dem Ort Agheila. 3) Km 203 w. Agedabia = Km 12 w. Des Arco. 4) Km 210 w. Agedabia. 5) Km 214 w. Agedabia = Km 9 ö. Der Abzweigung nach en Nofilia. 6) Km 217,8 w. Agedabia. 7) Km 220 w. Agedabia = Km 9 ö. Der Abzweigung nach en Nofilia. 8) Km 238,5 w. Agedabia = Km 27,5 ö. Der Abzweigung nach en Nofilia. 9) Km 238 w. Agedabia = Km 130 w. Agheila. 10) Km 247,8 w. Agedabia = Km 139 w. Agheila. 11) Km 266 w. Agedabia = bei en Nofilia. 12) Km 325,3 w. Agedabia = Km 58,5 w. Der Abzweigung nach en Nofilia. 13) Km 340,8 w. Agedabia = 74 w. Der Abzweigung nach en Nofilia. 14) Km 377,8 w. Agedabia = 111 w. Der Abzweigung nach en Nofilia. 15) Km 500,8 w. Agedabia = Km 12 w. Buerat. In Tripolitani ist die Verbreitung wieder geschlossener und ausgedehnter. Sie beginnt etwa bei Tauorga, etwas westlich der Syrtengrenze, doch nur von Zliten ab ist sie durchgehend bis Tripolis. 1) Km 2 s. Azisia bei Tripolis. 2) Km 24 und 52 s. Tripolis. 3) Am Fuß des Gebel Garian, etwa 100 km s. Tripolis. 4) Gebel Garian und Gebel Jeffren. 5) Unterhalb Jeffren. 6) Tarhuna ö. Gebel Garian. 7) Tigrano bei Gebel Garian. 8) Corradini 100 km ö. Tripolis an der Via Balbia. 9) Araberdorf n. Corradini. 10) Km 7,5 von Horns nach Casabat ö. Tripolis. 11) Cassabat. 12) Leptismagna. 13) Wadi Gam bei Homs. 14) Km 14 w. Zliten. 15) Km 13 ö. Zliten. 16) Km 17,2 w. Missurata. 17) ö. Missurata marina. 18) Km 4 und 8 s. Crispi (bei Missurata). 19) n. Crispi bei der Sebecka Tauorga. 20) Bei einem Kastel zw. Missurata und Bir Dufan. 21) Obelisko el

- Messelten, etwa 60 km ö. Missurata. 22) Km 40 ö. Missurata. 23) Gebel Haman s. Homs.
- Helix (Helix) nucula f. incultarum* - Kaltenback, 1950a: 62, Pl. 10, Fig. 9. In den Steppengebieten von Agypten, der Cyrenaika und Tripolitanien
- Helix (Helix) nucula f. semidesertorum* - Kaltenback, 1950a: 62, Pl. 10, Figs. 10-11. Vorkommen: in allen Halbwüstengebieten der Cyrenaika, der Syrte und von Tripolitanien, ebenso im Gebiet der dortigen Seebecken. Fehlt im Fruchtländ und der Steppe.
- Helix nucula* - Kaltenback, 1950b: 155. 50 km w. Der Stadt Syrete - in jungalluvialen Ablagerungen (fossil)
- Helix nucula* - Küiper, 1961: 975. Cyrenaica, Cyrene, ruines
- Helix melanostoma* - Hunt et al., 2011: 82. Cyrenaika, Susah, Wadi Bottamsa (†)
- Helix (Helix) pronuba* - Neubert, 2014: 121, 122-126, Figs. 190-196, 197 (Map.). Libya. Cyrenaica: Cyrene, Roman bath. Derna. Tokra pass. Tokra, castle. 6 km S Agedabia [Adschabiya]. Tobruk. Apollonia. Wadi Garhar, 12 km S Derna (Gahham?). steppe below Benina pass. Cami close to El Kish, Bengasi. Wadi Bu Msaper [Wadi Bu Musafir?], close Derna. Wadi Bu Msefer S Derna = [Wadi Bu Musafir?]. Driana [Daryanah], E of lighthouse. Wadi El Gattara [Wadi al Qattarah]. Zuetina [Az Zuwaytinah]. Wadi Scaliun close to El Labiat. Derna, 6 km S Fort Marabuta. Rues Mlella. Wadi Sakal w Tobruk. Marsa Breza [Marsa Brega (al-Buraiqa)]. Wadi Fil. 13 km S Magrun [Al Maqrun]. Hoses Zuama SE Bengasi [Hawsh, Ḥawsh Shatwān?]. El Kisch [Dar el Kish]. Ain Mara. Wadi Mradem [Wadi el Maradim]. Fiorita. Wadi el Maalegh, Martuba [Wādī al Mu'allaq]. Haua Zeiana, Benghasi [Ayn Zayyānah?]. Sirte: 9 km E Sirte city. 21 km S Mesrata along the coast. 99 km W Agedabia from Sirte. 7 km W Agedabia from Sirte. 18 km E Sirte city. E Buerat [Bwayrat al Ḥasūn]. 84 km W Sirte. 32 km E Buerat. 3 km E crossroads (from coastal road?) to Nafilia [An-Nufalija]
- Helix nucula* - Psonis et al., 2015: 383–391, Tables 1, 2, Figs. 1, 2
- Helix (Helix) pronuba* - Neubert & Korábek, 2015: 2261, fig. 1D
- Helix pronuba* - Korábek et al., 2015: 4, 8, 10, figs. 1, 2
- Helix pronuba* - Ali, 2017: 132–133. Cyrenaica, Syrte, Tripolitania
- Helix pronuba* - Korábek et al., 2022: 23, 26, fig. 2
- MATERIAL EXAMINED. EGYPT. El Alamein, dunes, VIII.2011, ex coll. S. Bertoli (CC); “Ovest di Alessandria, lungo la costa”, 31.12.1976–7.1.1977, 13 exx., legit V.E. Orlando (MRSNT / coll. V.E. Orlando 16798–16807; 16829–16830) (Fig. 8).
- LIBYA. Between Agedabia and Soluch, labelled: “Missione zoologica A Cufra, *Helix (Helicogena) melanostoma* Drap., tra Agedabia e Soluch, Luglio 1931”, 2 ex. (MSNG); Cyrenaica, Benina Pass, labelled: “*Helix nucula f. incultarum* Kalt., Benina Passo”, 3 exx (MSNG, ex coll. R.A. Brandt) (Figs. 6, 7); Cyrenaica, Darnah, Wadi Al_Khalig Estuary (Al Khabta), 32°39'59.9"N, 22°55'32.1"E (UOT) (Fig. 9); Cyrenaica, Apollonia, Haua Fteach, legit C. Hunt, IX.2012, 1 spec. juven., 1 ex, (CL L2–3); Cyrenaica, Benghazi, Alhwari, 32°03'08.3"N 20°06'30.9"E, leg. A. Abusneina, 8.XI.2018, 1 ex (CL L166); Cyrenaica, Benghazi, Boras, Almabna, 32°27'37"N, 20°29'34"E, 9 m, leg. A. Abusneina, 28.XI.2018, 4 exx (CL L209–212); Cyrenaica, Bengasi, Benina, 32°04'12.6"N 20°16'27.9"E, 137 m, leg. A. Abusneina, 1.II.2019, 20 spec. juven. (CL L259–278); Buerat surroundings, X.2020, 2 exx (CS6020) (Figs. 1–5); Tripoli, Tripoli University, Olive farm college of Agriculture, 32°50'45.4"N, 13°13'21.1"E, 2022, 12 exx, leg. N. Abushaala (UOT, CS6021); Tripoli, Tripoli University, Citrus farm college of Agriculture, 32°50'44.5"N, 13°13'16.1"E, 2022, 24 exx, leg. N. Abushaala (UOT, CS6022) (Fig. 10); Zawiyat Umm Hufayn, 32°32'09.9"N, 23°06'06.6"E, 2022, 2 exx, leg. N. Abushaala (UOT, CS6023); Wadi Al-Khalij Estuary (Al-Khabta, 32°39'59.9"N, 22°55'32.1"E, 2022, 2 exx, leg. N. Abushaala (UOT, CS6024); Al-Murgub, Al-Khums, Tree forest, 32°38'02.3"N, 14°11'21.3"E, 2022, 2 exx, leg. N. Abushaala (UOT, CS6025).
- TUNISIA. Djerba, 1.4.2012, legit A. Corso, 1 ex (CL T205) (Fig. 11); Djerba, coll. Pocaterra, 1 ex. Road Zarzis-Gabes, near Boughrara, 33°29'59.0"N, 10°40'57.0"E, 30.IX.2019, 3 exx, legit I. Sparacio (CS6026).
- GREECE. Crete (Kissamos, Chania), Paralia Elafonisi, 35°16'29.0"N 23°32'24.2"E, 30.V.2016, 38 exx, legit I. Sparacio (CS2027). Crete (Kissamos, Chania), Xiropotamos Potamos, 30.V.2016,

35°19'35.5"N 23°33'03.4"E, 8 exx, legit I. Sparacio (CS6028) (Figs. 12, 13). Karpathos, Finiki, 35°29'47,54"N, 27°07'03,53"E, 23 m, legit M. Grano and C. Cattaneo, 31.07.2019, 3 exx (CL G1685–1687) (Fig. 14).

DESCRIPTION OF THE SHELL (North-African examined material). Dimensions: shell maximum diameter = 29.6 mm (21–30.3); shell maximum height 26.2 mm (22.5–26.5); aperture maximum diameter 15.8 mm (1.4–16.3); aperture maximum height 1.96 mm (1.7–2.1). Shell of small to very small size for the genus; spherical; spire conical, with 4–4½ convex and regularly increasing whorls; deep sutures; apex rounded; basic shell colour greyish-white with five slightly marked chestnut brown spiral bands; the upper bands, 2 and 3, are sometimes fused into a single brown band, frequently indistinct; sometimes the five bands is absent or indistinct; mouth black-brown; protoconch 4–5 mm wide, smooth, and white; teleoconch of 3–3½ whorls, sculptured by fine and densely spaced ribs incised by spiral furrows, producing prominent granules; last whorl large, slightly descending towards the aperture; wide, rounded, aperture, oblique in lateral view; umbilicus closed; columella shiny and thickened; labial callus weak.

GENITALIA. Two specimens were examined from Libya, Buerat surroundings. Penis tubular, long (6.3–6.5 mm); epiphallus shorter than the penis (1.8–1.85 mm), total length penis + epiphallus (8.1–8.4 mm); flagellum slender and very long, three times the length of epiphallus+penis (25 mm); penial retractor muscle attached about halfway along epiphallus; internally penial chamber with a few elongate folds, a ring-like pilaster in the middle and two penial papillae in the proximal part; both papillae conical with a central perforation; distal penial papilla (pp2) bigger than proximal penial papilla (pp1); atrial stimulator as a short raised lamella, it arises in front of the penial opening into the atrium. Female distal genitalia consists of a long vagina (13 mm), two digitiform glands with short basal stem, branching in tubules with 11 and 16 apex, respectively; dart sac club-shaped, strongly developed; a short free oviduct and a rather long first pedunculus (8 mm) arise proximally from the vagina; second pedunculus slightly longer (8.6 mm) and thinner than the first pedunculus; bursa copulatrix oval-elongated; diverticulum of the bursa copulatrix

slightly shorter than first pedunculus (6.2 mm). Vagina internally with some longitudinal folds and with a V-shaped structure where the dart sac opens.

REMARKS. The study of some populations of *H. pronuba* from North Africa allows to highlight a certain degree of variability in the morphology and coloring of the shell. As highlighted by Neubert (2014), in these populations “*there is an interesting shift of character sets from east to west*”. In Egypt, the shells have the typical marked spirally granulation and the 2 and 3 brown bands are frequently fused together. In the city of Syrte (Libya) the shells are smaller, almost smooth, with obsolete granulation, whitish to cream without spiral bands. In western Libya and southern Tunisia, the shells are larger again, with marked granulation but weak ribs; with four or five spiral bands but bands 2 and 3 are frequently separate and not very marked.

Kaltenbach (1950a, b) reports *H. pronuba* (sub *H. nucula*) from many locations along the Mediterranean coast of Libya and Egypt. He also describes two ecological forms from Libya, (*incultarum, semidesertorum*) without taxonomic value (Neubert, 2014).

Hesse (1920 sub *H. nucula*) describes radula, mandible, genital organs and dart of four specimens from Egypt (Ramleh) and a specimen from southern Tunisia (Djerba). His descriptions fit well the features of the Libyan specimens described in this work, although, in our specimens, the vagina is longer (13 mm Libyan specimens; 6.5 mm Tunisian specimen. 9 mm Egyptian specimens); the number of tubules is greater (up to 16); the lengths of the first and second pedunculus, diverticulum and penial flagellum of our Libyan specimens are similar to those reported for the Tunisian specimen, while the lengths of the Egyptian specimens are greater (Hesse, 1920). The dart is slightly curved, 5.4 mm long and with 4 more or less lateral wings; the genitals of *H. pronuba* from Crete are unknown, while the shell compared to the North African one as a whole, is less globose, on average smaller, with a more conspicuous color determined by the more extensive and well-defined spiral bands.

Psonis et al. (2015, sub *H. nucula*) and Korabek et al. (2015; 2022) published molecular data on *H. pronuba* from the islands of Crete and Anfi (Greece), Cyrenaica (Libya) and Djerba (Tunisia). In those works, within the *H. pronuba* clade some lineages were statistically distinguished, but with

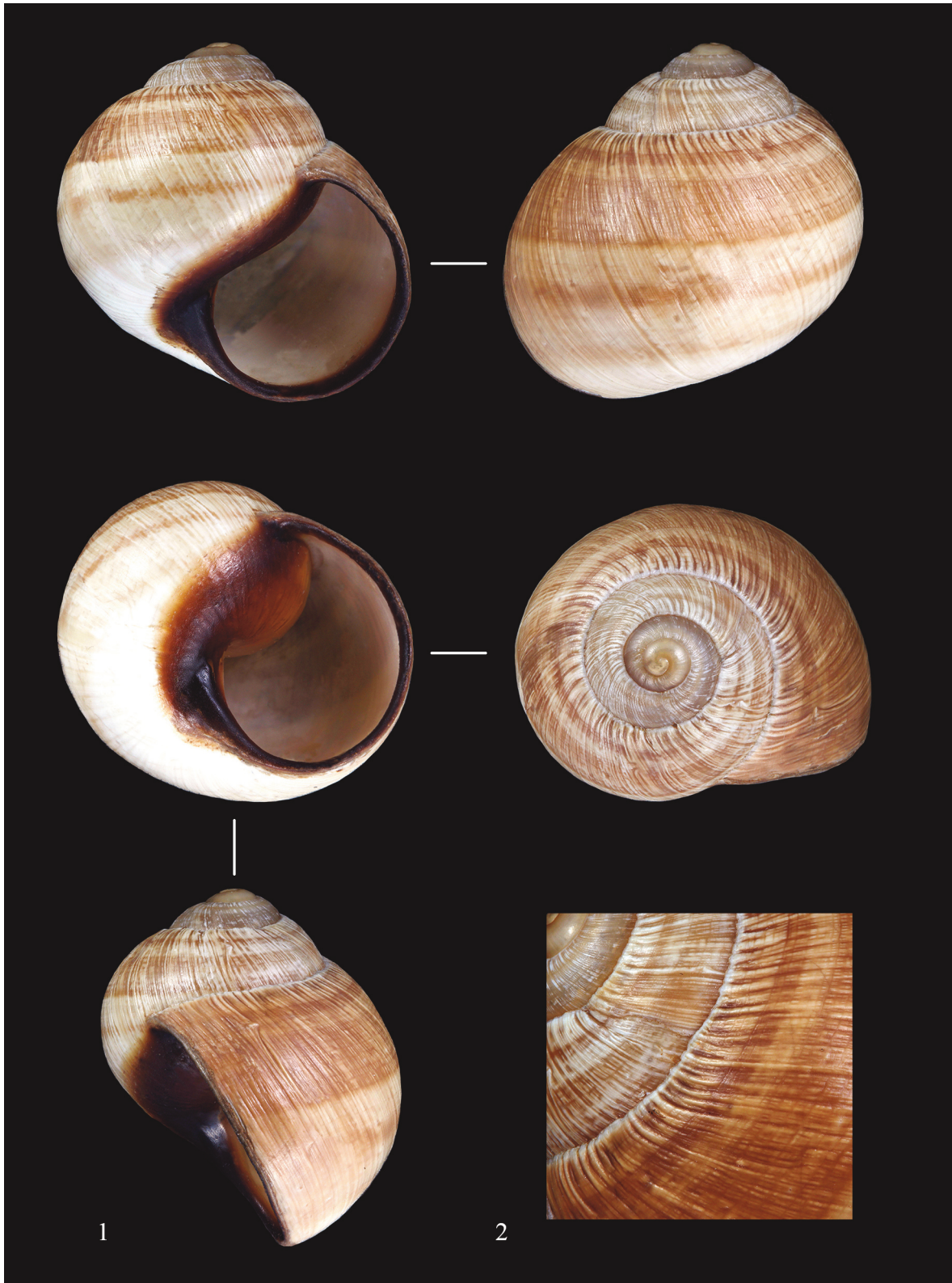
unresolved relationships. It will be necessary to incorporate more samples from North Africa in the analyses to clarify these relationships. The oldest available name for the North African populations as a whole is *H. rueppelli* Kobelt, 1904, locus typicus “Egypten” (Kobelt, 1904).

Finally, compared to the similar *H. melanostoma* Draparnaud, 1801 widespread in France, Morocco, Algeria, Tunisia and introduced in Spain and central Italy (Neubert, 2014; Sparacio et al., 2019), the shell of *H. pronuba* differs in the sculpture. *Helix pronuba* has a characteristic teleoconch granulation, while *H. melanostoma* has coarse ribs, only occasionally incised by thin spiral furrows near the suture. However, in southern Tunisia where these two species occurs sympatrically, the conchological distinction is sometimes difficult (Neubert,

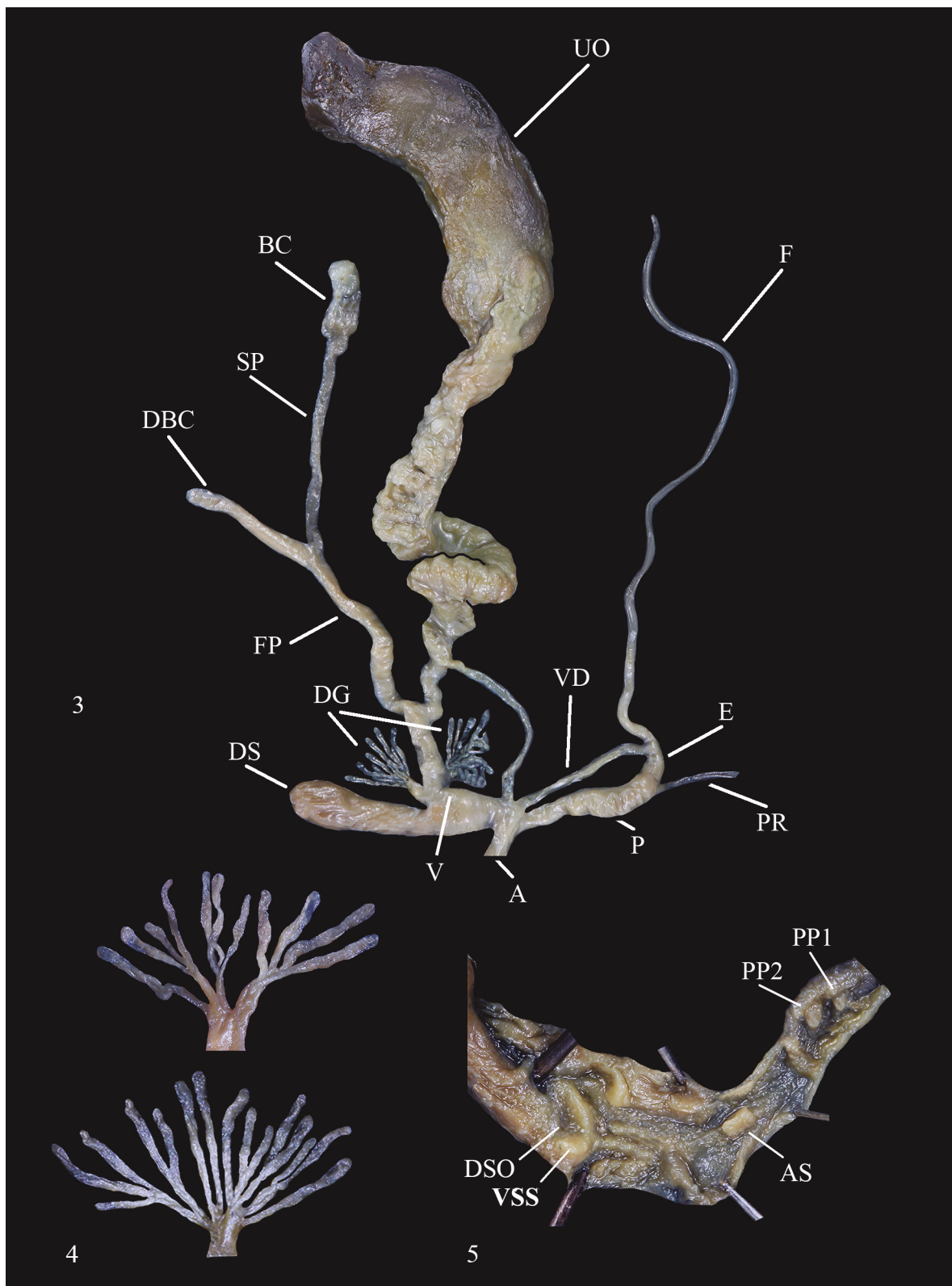
2014). The study of the genital organs (Hesse, 1920, Neubert, 2014, Sparacio et al., 2019, present paper) allows us to highlight further differences between *H. pronuba* and *H. melanostoma*. In particular, *H. pronuba* from North Africa has a greater number of tubules for digitiform gland, 5/16 *H. pronuba*, 9/20 *H. melanostoma*; shorter first and second penduculum of the bursa copulatrix, average 10 mm and 11 mm *H. pronuba*, 15 mm and 20 mm *H. melanostoma* respectively; internally, *H. pronuba* shows a different arrangement of the penial papillae with pp1 and pp2 closer and penial chamber does not have many elongated folds but an evident annular pad; the atrial stimulator in both species is similar with an elongated raised lamella that in *H. melanostoma* end with a small terminal knob (Neubert, 2015) or a slight dilation (personal observation).

<i>Helix pronuba</i>	P	E	F	pp1 - pp2		
Libya: Buerat, 1 (present paper)	6.28	1.82	24.3	pp2 bigger		
Libya: Buerat, 2 (present paper)	6.45	1.85	24.9			
Tunisia: Djeiba (Hesse, 1920)			22.5			
Egypt: Ramleh, 1 (Hesse, 1920)			29			
Egypt: Ramleh, 2 (Hesse, 1920)			38			
<i>Helix melanostoma</i>						
France: Marseille - Tunisia (Hesse, 1920)			19–35			
Tunisia: Sbeitla (Neubert, 2014)				pp2 bigger		
Tunisia: Bizerte (Sparacio et al., 2019)	7.8	1.3	30–40			
<i>Helix pronuba</i>	V	DG	FO	FP	SP	DBC
Libya: Buerat, 1 (present paper)	13	11–16		8	8.5	6
Libya: Buerat, 2 (present paper)	13.1			8.2	8.7	6.1
Tunisia: Djeiba (Hesse, 1920)	7	9–11	1	7	8.5	4
Egypt: Ramleh, 1 (Hesse, 1920)	6.5	5–8	2	16	15	13
Egypt: Ramleh, 2 (Hesse, 1920)	9		4	14	16	10
Egypt: Ramleh, 3 (Hesse, 1920)				9.5	9	6
Egypt: Ramleh, 4 (Hesse, 1920)				8	10.5	6.5
<i>Helix melanostoma</i>						
France: Marseille, 1 (Hesse, 1920)	7	9–10	2	15	24.5	9
France: Marseille, 2 (Hesse, 1920)	7	19–20	10	13	15	7
France: Marseille, 3 (Hesse, 1920)				15	18	9
France: Marseille, 4 (Hesse, 1920)				18	22	9
France: Marseille, 5 (Hesse, 1920)				12	16	6
Tunisia: Djeiba, 1 (Hesse, 1920)				15	21	9
Tunisia: Djeiba, 2 (Hesse, 1920)				19	24	11
Tunisia: Djeiba, 3 (Hesse, 1920)				15	22.5	16.5
Tunisia: Djeiba, 4 (Hesse, 1920)				11	19	8
France (Moquin-Tandon, 1855)		12–13				
Tunisia: Bizerte (Sparacio et al., 2019)	7–9	10–10	2			6.6

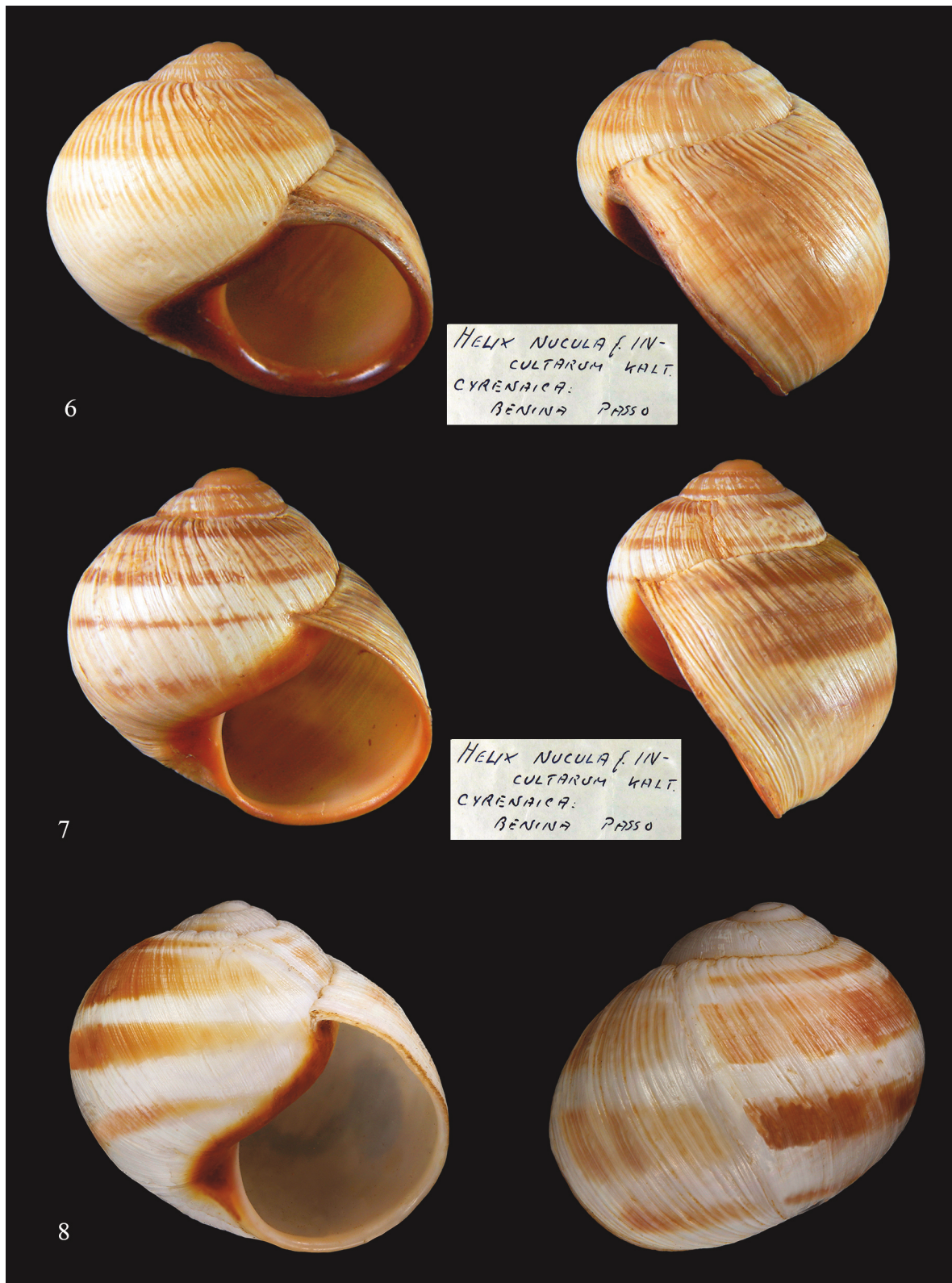
Table 1. Genital organs measurements (millimeters - number of DG) of *Helix pronuba* and *H. melanostoma*.



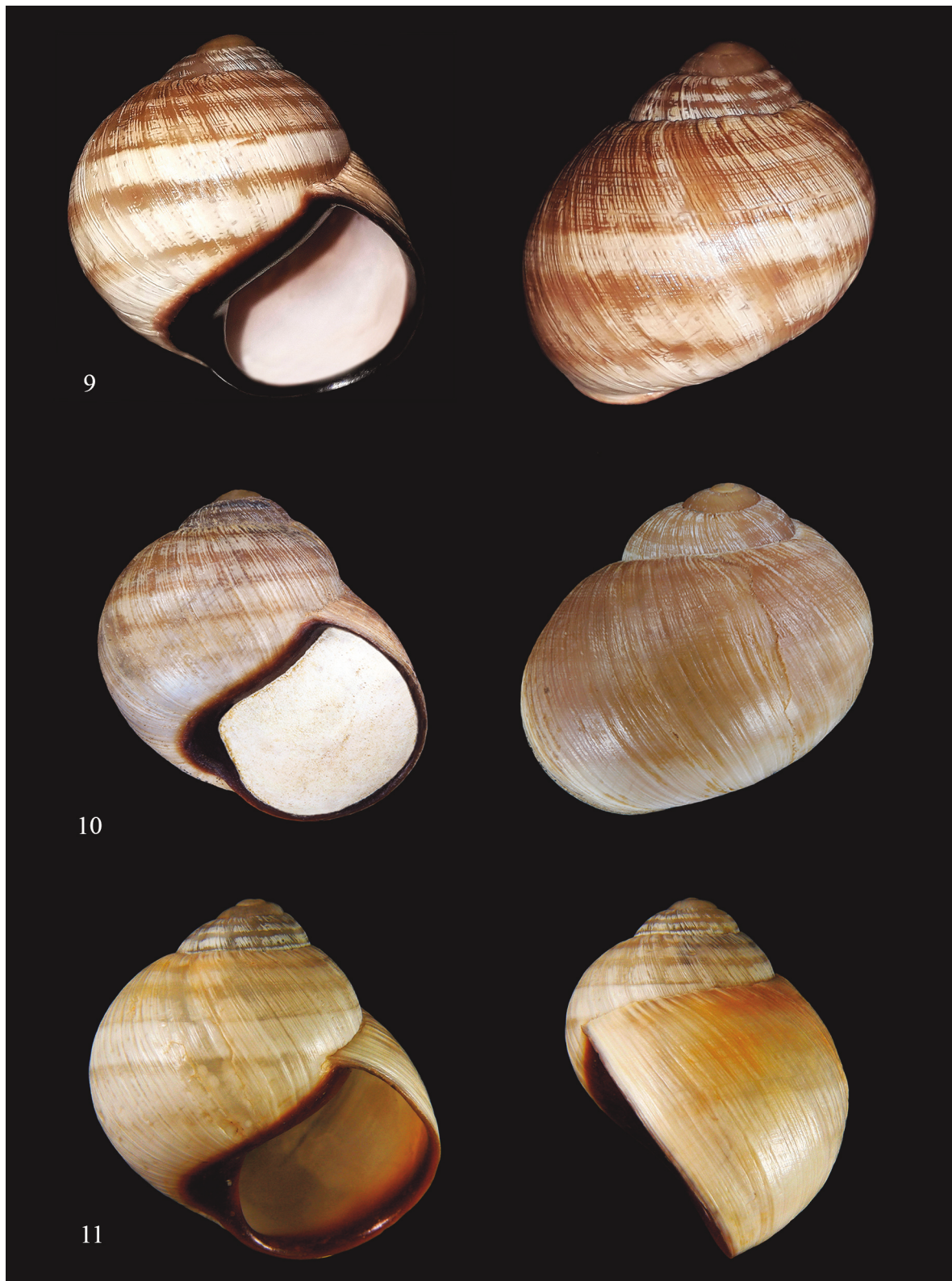
Figures 1, 2. *Helix pronuba*, Libya, Buerat surroundings. Fig. 1: shell (H = 26 mm).
Fig. 2: detail of the teleoconch granulation.



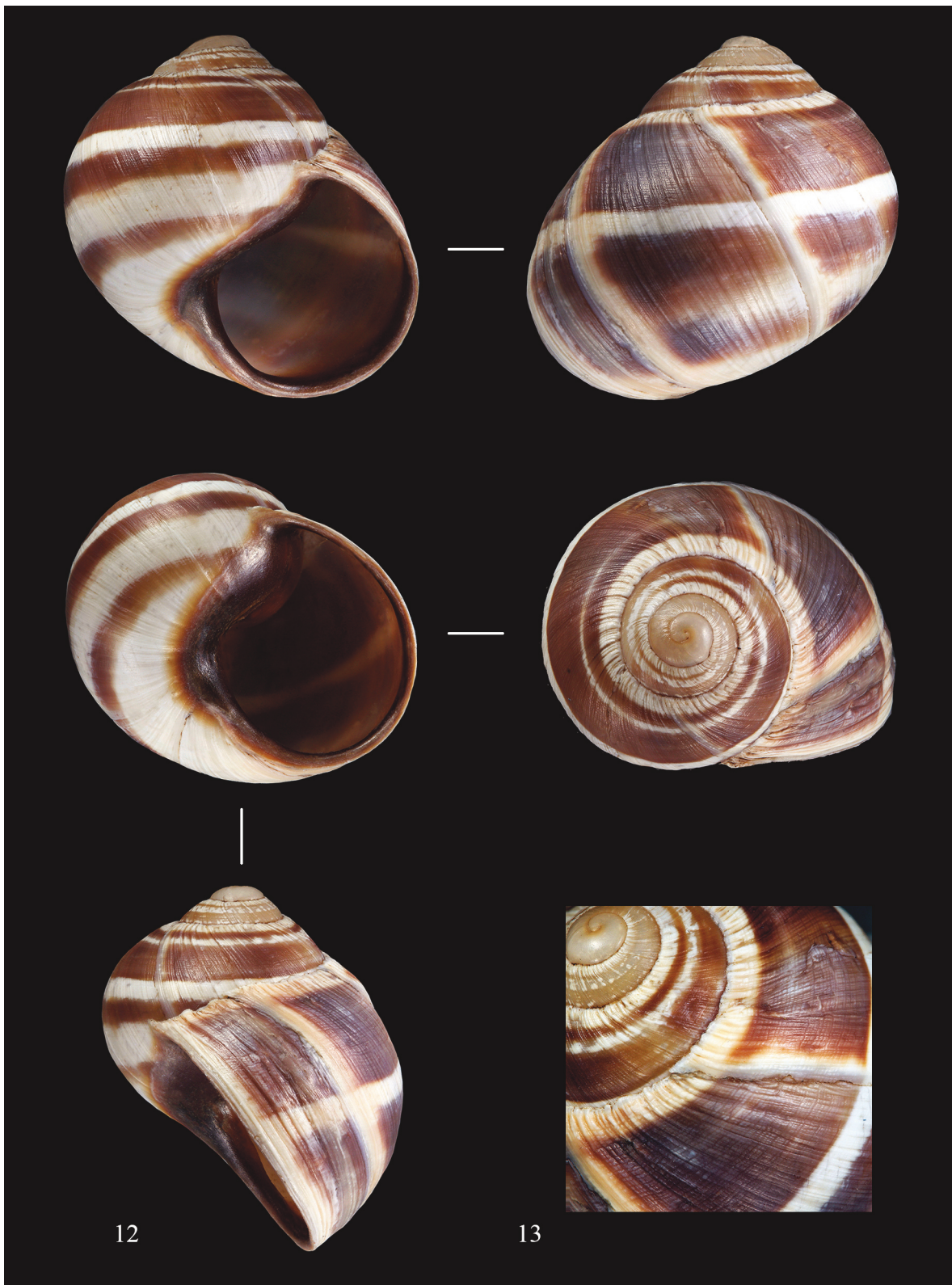
Figures 3–5. *Helix pronuba*, Libya, Buerat surroundings. Fig. 3: genital organs. Fig. 4: digitiform glands. Fig. 5. internal morphology of the distal genital organs.



Figures 6–8. *Helix pronuba*. Fig. 6: Libya, Cyrenaica, Benina Pass, H = 22.7 mm. Fig. 7: idem, H = 22.9 mm. Fig. 8. Egypt, Western Alexandria along the coast, H = 24.5 mm.



Figures 9–11. *Helix pronuba*. Fig. 9: Cyrenaica, Darnah, Wadi Al Khalig Estuary, H = 27 mm.
Fig. 10. Libya, Tripoli, H = 22 mm (left), H = 22.5 mm (right). Fig. 11. Tunisia, Djerba, H = 28.4 mm.



Figures 12, 13. *Helix pronuba*, Greece, Crete, (Kissamos, Chania), Paralia Elafonisi.
Fig. 12: shell, H = 24 mm. Fig. 13: detail of the teleoconch granulation.



Figure 14. *Helix pronuba*, Greece, Karpathos, Finiki, H = 21 mm.

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