

# NEW ANATOMICAL DATA ON THE IBERIAN ENDEMIC *ATENIA QUADRASI* (HIDALGO, 1885) (PULMONATA, HELICODONTIDAE)

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*Abstract* Living *Atenia quadrasi* (Hidalgo, 1855) were collected from Pego (Alicante) giving new data about the reproductive system, shell, radula and jaw. This data suggests that the genus *Atenia* Gittenberger, 1968 should be placed in the Subfamily Lindholmiolinae Schileyko, 1978 within the Family Helicodontidae Kobelt, 1904. The small range of this species and the threat to the habitat both suggest that *A. quadrasi* should be considered threatened.

*Key words* *Atenia quadrasi*, *Helicodontidae*, *Lindholmiolinae*, *systematic position*, *Iberian Peninsula*.

## INTRODUCTION

*Helix quadrasi* (Hidalgo, 1885) is an Iberian Peninsula endemic helicodontide, whose type locality is Tavernes de la Valldigna (Valencia, Spain). Gittenberger (1968) was the first to study the genitalia and the radula of this species using two specimens from the Altimira collection, from the locality of La Riba (Tarragona). He assigned it to a new monotypic genus, *Atenia*, thus establishing the new combination *Atenia quadrasi*. Poor fixation prevented Gittenberger (1968) from examining the right ommatophore's retractor muscle's position and the insertion of the penial retractor muscle. As a consequence he provisionally assigned *Atenia* to the Helicodontinae within the Helicidae Rafinesque, 1815. Nordsieck (1987) and Puente (1994) included it in the Family Hygromiidae Tryon, 1866 while Schileyko (1991), Prieto, Puente, Altonaga & Gómez (1993) and Bank, Bouchet, Falkner, Gittenberger, Hausdorf, Proschwitz & Ripken (2001) placed it in Helicodontidae Kobelt, 1904.

Shells of *A. quadrasi* are abundant at Pego and after 15 years of searching a living specimen was found. This paper reports on the anatomy of this material, presents data on the distribution of the species and evaluates its state of conservation.

## DESCRIPTION

*Shell* Hidalgo (1885), Gittenberger (1968), Gasull (1975) and Puente (1994) report that the shell is dark grey, however, the live specimen displays a

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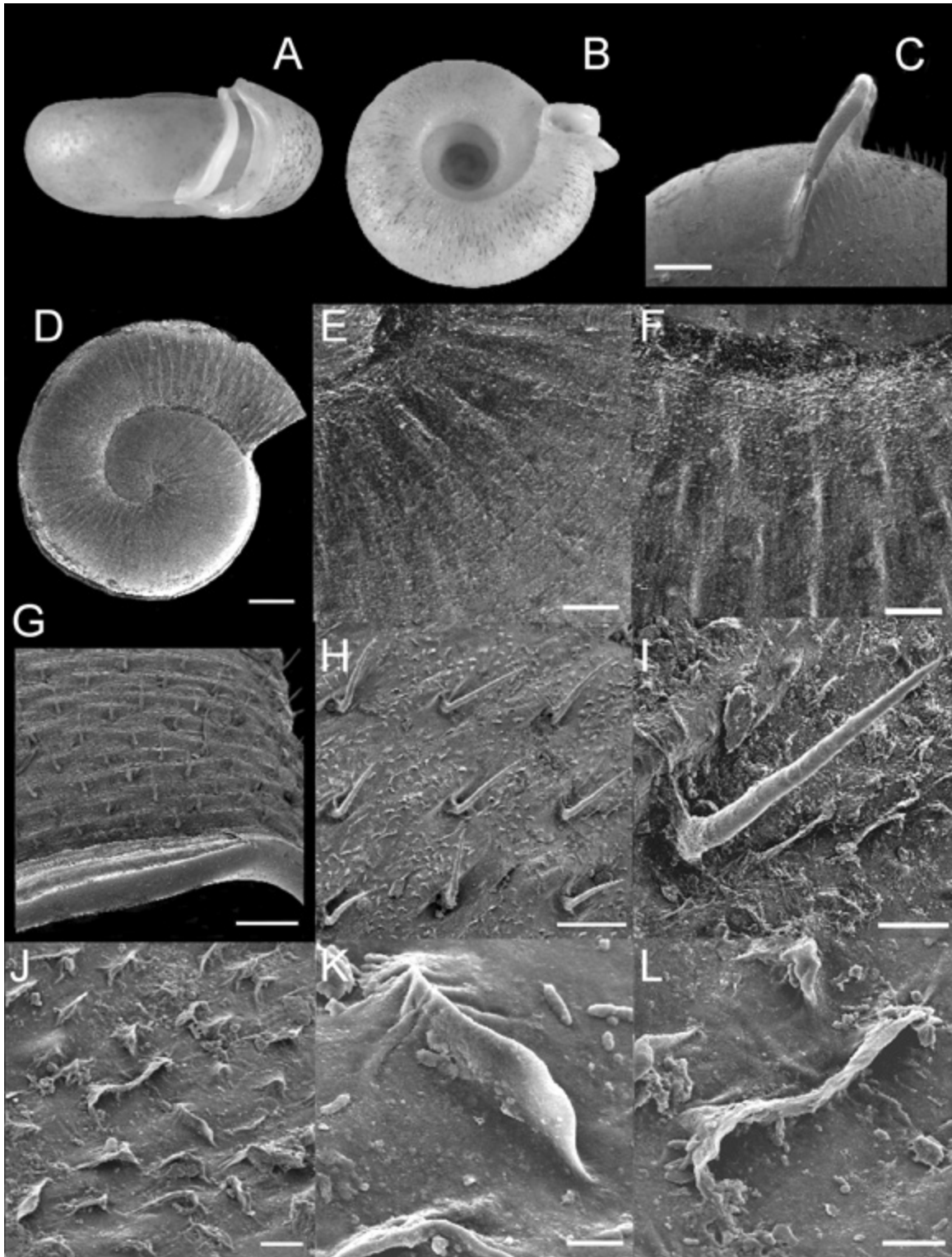
hyaline shell without a characteristic colour that allows the internal organs and even the ventricle movements of the heart to be seen through it.

A longitudinal sculpture is formed by discontinuous ribs and there is also a micro-sculpture formed by numerous minute tubercle-like calcareous formations of a variable morphology (Figs 1j-l). Long, strong and sharp hairs cover the entire shell (Figs 1g-i). In the aperture a well developed, laminar parietal callosity is present (Fig. 1c), that permits it to close the opening nearly fully (Figs 1a-c), shutting face on to the strongly reflected and sinuous peristome. The protoconch has a spiral micro-sculpture formed by continuous cordons, that together form parallel lines, and which is more evident closer to the suture (Figs 1d-f). Schileyko (1991) shows that the Helicodontidae do not exhibit spiral sculpture, which differentiates that family from our observations.

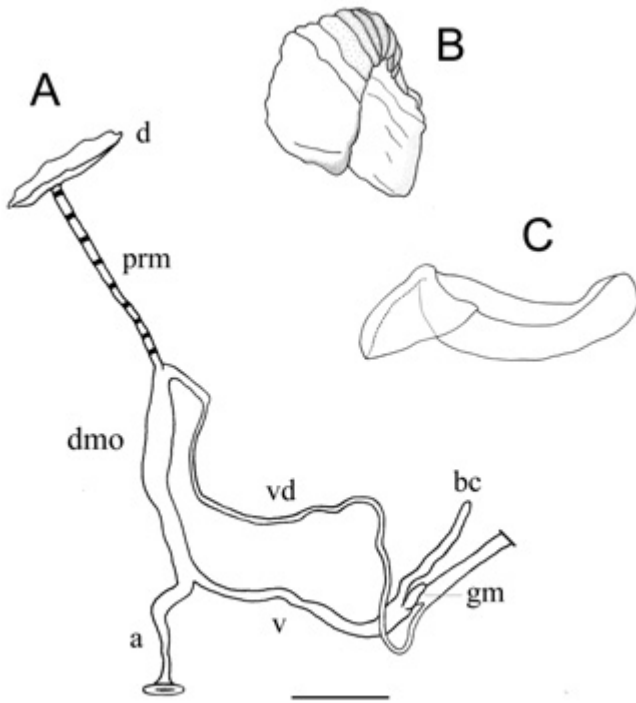
*Body* It is an off-white colour with an elongated, thin sole of the holopoda type.

*Reproductive system* The right ommatophore's retractor muscle is situated between the vagina and the penis, a common and plesiomorphic character in the Palaeartic Helicoidea that cannot be employed to define suprageneric taxa within the Helicoidea (Families and Subfamilies) (Nordsieck, 1987). Germain (1930) shows that Helicodontinae also show this character.

The collected individual is an immature specimen, since it does not present totally developed reproductive organs, although one can differentiate the majority of them with clarity. In general the description of the genitalia of *A. quadrasi*



**Fig 1** Shell of *Atenia quadrasi* (Hidalgo, 1885) **A** Specimen from “Barranco de los Frailes”, Pego (Alicante) (Martínez-Ortí coll., MVHN n°1198) (4.8 mm diameter). **B** Umbilical view **C** Parietal lamella (b= 500  $\mu$ m). **D** Protoconch (b= 250  $\mu$ m). **E-F** Detail of the protoconch micro-sculpture (b= 50  $\mu$ m). **G** Peristome (b= 250  $\mu$ m). **H** Teloconch hairs (b= 100  $\mu$ m). **I** Detail of the hair (b= 25  $\mu$ m). **J** Teloconch tubercles (b= 10  $\mu$ m). **K-L** Details of the small tubercle-like calcareous formations (b= 2.5  $\mu$ m; b= 5 $\mu$ m).



**Fig 2** **A** The genitalia of the *Atenia quadrasi* specimen collected at the "Barranco de los Frailes" (Pego, Alicante) ( $b = 0.5$  mm). **B** Jaw of *A. quadrasi* ( $175 \mu\text{m}$ ). **C** Radula drawing of *A. quadrasi* ( $0.7$  mm). (abbreviations: a= atrium genital; bc= bursa copulatrix; d= diaphragm; dmo= distal male organs; gm= mucous gland; prm= penial retractor muscle; v= vagina; vd= vas deferens).

carried out by Gittenberger (1968) coincides with our observations (Fig. 2a). It does not possess an accessory sac or a flagellum, as already shown by Gittenberger (1968). Neither the penial caecum nor the transition of the penis with the epiphallus, where the penial retractor muscle is situated, could be observed with clarity. The penial retractor muscle is inserted distally in the diaphragm (Fig. 2a). The simple mucous gland and the bursa copulatrix' duct are shorter than those figured by Gittenberger (1968), due to immaturity. The penis, without papilla and with internal walls that seem to be straight, and the genital atrium, are both longer, due to immaturity as well (Fig. 2a).

**Discussion** Gittenberger (1968) showed that the reproductive systems of *Atenia* and *Lindholmiola* Hesse, 1931 are similar and provisionally grouped them together in Helicodontinae of

Helicidae, following the classification carried out by Hesse (1918). Schileyko (1978) elevated Helicodontinae to the rank of Family, Helicodontidae, in Helicoidea and created the new Subfamily Lindholmiolinae, among others. Subsequently, Nordsieck (1987) and Puente (1994) included the genus *Atenia* in the Tribu Lindolmiolini Schileyko, 1978 due to similarities in genitalia with *Lindholmiola*, in Helicodontinae of Hygromiidae. However, Puente (1994) showed that it could also be included in the Tribu Helicodontini because of the shell's morphology, tubular type mucous gland and geographical distribution. Schileyko (1991) included the genus *Atenia* Gittenberger, 1968 in Lindholmiolinae Schileyko, 1978 while Prieto *et al.* (1993) and Bank *et al.* (2001) put it in Helicodontinae Kobelt, 1904, both from Helicodontidae.

The subfamily Helicodontinae is characterised by the possession of a shell of planorboid morphology, a reproductive system with an accessory sac, a divided tubular mucous gland, the penial retractor muscle inserted in the columellar muscle and the interior of the penis with folds or conical spines (Schileyko, 1991; Prieto *et al.*, 1993). Prieto *et al.* (1993) indicated that *Atenia* seems to be related to Helicodontinae due to the shell morphology, the presence of the tubular mucous gland and its geographical distribution, but the absence of the accessory sac and, above all, the lack of knowledge regarding the penial retractor muscle's insertion makes its systematic positioning difficult.

On the other hand, Lindholmiolinae is principally characterised by possession of a lenticular shell, the genital system with a corrugate mucous gland and no accessory sac, the penial retractor muscle inserted in the diaphragm and the inner penis with small flaccid folds (Schileyko, 1991; Prieto *et al.*, 1993). Schileyko (1991) points out that the reproductive system scheme shows a close relationship between *Atenia* and *Lindholmiola* and indicates the direct succession of both and, although the shells of these species are quite different, that probably the initial form possessed the shell of the *Lindholmiola* type and the genitalia of the *Atenia* type.

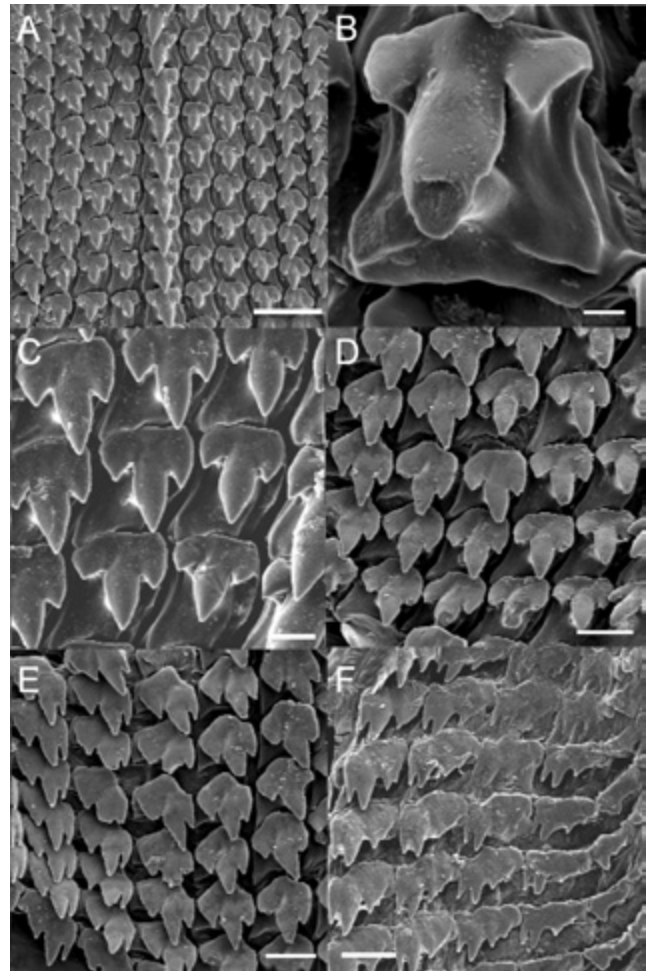
Finally, the results obtained in this report on the study of the reproductive system of the specimen captured in Pego, allow us to include the genus *Atenia* in the Subfamily Lindholmiolinae,

in agreement with Schileyko's criteria (1991) and agree with the tendency to group *Atenia* and *Lindholmiola* (Gittenberger 1968).

*Jaw* Arched, with 12 central, thin, cuticular ribs with dentate edges and towards both its sides it is more membranaceous and less ribbed and not dentate (Fig. 2b).

*Radula* Gittenberger (1968) reports on the radular morphology of *A. quadrasi* and shows the existence of at least 14 rows of teeth. The radula of the specimen from Pego (Figs 2c, 3), has a length of 0.7 mm, possesses a total of 86 lines and its radular formula is 16L+C+16L, allowing for some rows to be less than 16L. The central monocuspid tooth (Figs 3a-b), is a little over three times longer than the two ectocones, which are well constituted, sharp and symmetrical, on both sides of the mesocone. In Fig. 3b one can observe the mark to where the mesocone's cusp of the central tooth has worn away, situated in the zone anterior to the radula. Either side of the central tooth 16 lateral teeth are situated (Figs 3c-e), with asymmetric ectocones, where the mesocone becomes shorter as one moves towards the extremes of the radula, the endocone approaches and fuses with the mesocone, while the ectocone expands becoming flatter and increasing in the number of cusps (Fig. 3e).

*Habitat* *Atenia quadrasi* is a lucifugous species whose behaviour is hypogaeal. It was found living beneath limestone rock in a ravine at the base of a gorge where the humidity was high and the light dim. Vegetation was also scarce and the climbing plants *Hedera helix* L. and *Smilax aspera* L. predominated. Vilella (1967) and Martínez-Ortí & Robles (2003) have suggested that *H. helix* can widen cracks in rocks using its roots to create an environment favourable for the survival of *A. quadrasi*; however, it seems that the relationships between *H. helix*, *S. aspera* and *A. quadrasi* correspond more to them sharing the same bio-geographical typology. The Province Balearic-Catalano-Provenzal, Sub-province Catalano-Valencian (Rivas-Martínez *et al.* 2002), has two characteristic dry periods, has littoral limestone mountains that retain humidity in the winds coming off the Mediterranean and that, subsequently, bring a significant amount of crypto-precipitation. Shells have also been found in pine, rocky, mossy and caved environments (Bech, 1990; Puente, 1994; Martínez-Ortí, 1999) at localities of an altitude between 200 and 300 m.



**Fig. 3** Radula of *A. quadrasi* (S.E.M.). **A** General view of the central and lateral teeth (b= 25  $\mu$ m). **B** Central tooth (b= 2.5  $\mu$ m). **C** Detail of the first lateral teeth (b= 5  $\mu$ m). **D-F** Lateral teeth (b= 10  $\mu$ m).

*Geographical distribution* Iberian endemism is demonstrated throughout the communities of Valencia and Catalonia in coastal areas of both (Fig. 4). In Catalonia it is present in all the coastal provinces, where it has been cited in various localities in the foothills of the mountain ranges of Puig del Moro (Girona and Barcelona) and in the Prades mountains in Tarragona (Bech, 1990; Puente, 1994). The same happens in the Valencian community as it has been collected in all three provinces; in the regions of La Marina Alta in Alicante province, in those of La Safor, La Ribera Alta and La Ribera Baixa in the province of Valencia (Martínez-Ortí, 1999; Martínez-Ortí & Robles, 2003) and in that of Castellón, where it had not been found until now, in the cave at Miravet (Cabanes, UTM: 31TBE44, 144 m), in the Plana Alta region.



**Fig. 4** Geographical distribution of *Atenia quadrasi* (Hidalgo, 1885).

*Conservation* *Atenia quadrasi* is included in the IUCN (2003) list in the category of low risk/near threatened (LR/nt). Alonso, *et al.* (2001) and Martínez-Ortí & Robles (2003) consider that *A. quadrasi* is an endangered species that should be included in the Spanish National Catalogue of Endangered Species with the category of vulnerable and recommend its habitat's protection and the elaboration of a Conservation Plan. The principal threats to the habitat are fires, urbanisation, quarries and roadworks.

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