Spira 6 (2016) 81–83

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The genus *Stagnicola* Jeffreys, 1830 in Catalonia

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Rebut el 22 de gener de 2016
Acceptat el 28 de maig de 2016

The family Lymnaeidae Rafinesque, 1815 is a group of freshwater gastropods inhabiting rivers, lakes and ponds of all continents except Antarctica. They are mainly hermaphroditic with a dextrogyrus shell, and eat aquatic vascular plants, algae and organic debris (Jackiewicz, 1998).

One of the main characteristics of the Lymnaeidae is their shell shape plasticity, resulting in a high degree of polymorphism in many species. As an example of the high intraspecific variation of the shell and the complex taxonomy of the family, more than 1,800 forms or species names and up to 34 different genus names have been described for its extant members, despite the fact that only about 40–50 valid species are currently recognized worldwide (Hubendick, 1951; Jackiewicz, 1998; Bargues *et al.*, 2001). Recently, anatomical and molecular analyses have proved to be the only way to safely identify species of this family. Particularly, the anatomy of their reproductive organs and the sequence of their ITS-2 ribosomal DNA are much more valuable than shell morphology for taxonomic purposes (Jackiewicz, 1998; Bargues*et al.*, 2003). These data have provided new classifications, validating genera such as *Ladislavella* B. Dybowski, 1913 (junior synonym: *Catascopia* Meier-Brook et Bargues 2002; see Vinarski, 2012) and further clarified the status of some dubious taxa, even leading to the description of new species (e.g., Glöer & Yıldırım, 2006).

On the basis of the anatomical structure of their reproductive organs, eleven lymnaeids were found to inhabit Europe (Jackiewicz, 1998), although a few new species have been described afterwards, such as *Stagnicola montenegrinus* Glöer & Pešić, 2009 (Schniebs *et al.*, 2012) and *Radix lilli* Glöer et Beckmann, 2007. In Europe, there are still many specimen identification problems, mainly concerned with species of the "stagnicoline" and "*Radix*"-type groups (Glöer & Meier-Brook, 1998; Alba *et al.*, 2011).

Figure 1. Location map of the studied localities of *Stagnicola* in Catalonia (right), and situation of the latter within the Iberian Peninsula (left). Legend: **1,** Espluga de Francolí, shores of the Francolí River; **2,** Tivenys, shores of the Ebro River; **3,** Amposta, rice fields (Ebro Delta).

In Catalonia, Alba *et al.*(2011) recognized a total of five species in this family: *Galba truncatula* (O.F. Müller, 1774), *Stagnicola palustris* (O.F. Müller, 1774), *Radix auricularia* (Linnaeus, 1758), *Radix balthica* (Linnaeus, 1758) and *Lymnaea stagnalis* (Linnaeus, 1758). However, most—if not all—of the articles dealing with the family in which this list is based considered only the morphology of the shell. This casts some doubts on the true identity of some taxa, as shell morphology is not enough for a correct identification of some of these species.

A particular case of study is the genus *Stagnicola*, which includes two species already cited in the Iberian Peninsula. *Stagnicola palustris* is the only species reported in Catalonia (Alba *et al.*, 2011) and the most frequently cited species in Iberia, while other authors suggest that *Stagnicola fuscus* (Pfeiffer, 1821) is also present, at least in the Valencian Community (Martínez-Ortí & Robles, 2003), indeed based on molecular analysis (Bargues *et al.*, 2001). So it is likely that a misidentification may have occurred in the past in the determination of these taxa only on the basis of shell morphology criteria. To clarify this issue, we analyzed specimens of the genus *Stagnicola* from three different Catalan populations (Figures 1–3) in the province of Tarragona, which had been already studied in the past (Escobar, 1985; Bros & Bech, 1989; Bech 1990):

- Amposta (el Montsià, Tarragona) [31T BF9505], 2 m; 2/7/2014 JLS & SQS *leg.* Alive specimens were collected in a rice field, some of them out of the water, partially buried in the mud.
- Tivenys (el Baix Ebre, Tarragona) [31T BF8833], 6 m; 23/5/2015 JLS & SQS *leg.* Alive specimens were collected in the shores of the Ebro River, in an area with low flow and aquatic vegetation. Some specimens were hidden under rocks.
- Espluga de Francolí (la Conca de Barberà, Tarragona) [31T CF4985], 411 m; 8/2012 SQS *leg.* Alive specimens were collected in the shores of the Francolí River, in an area with low flow and aquatic vegetation.

The anatomical analysis of these populations identifies all the specimens as belonging to *S. fuscus*. This can be observed by comparing the analyzed specimens with specimens of *S. palustris* from Germany (Figure 4). *Stagnicola fuscus* has two (sometimes three) prostate folds, while *S. palustris* has only one (Figure 4). In addition, the praeputium in *S. fuscus* is short, while in *S. palustris* it is as long as the phalloteca (Jackiewicz, 1998, in which *S. fuscus* was referred to as *Lymnaea vulnerata* Küster, 1862). Overall, our observations match with those reported by Jackiewicz (1998) regarding the general shape of the genitalia of both species (Figure 4).

Our results therefore suggest that the true identity of most, if not all, Catalan populations of genus *Stagnicola* might correspond to *S. fuscus*. Specimens of the Francolí River (La Riba) were attributed to *S. palustris* by Bech (1990), and the same applies to specimens from the Ebro Delta reported by Escobar (1985) and Bros & Bech (1989).

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Figure 2. Alive specimen of *Stagnicola fuscus* from Amposta.

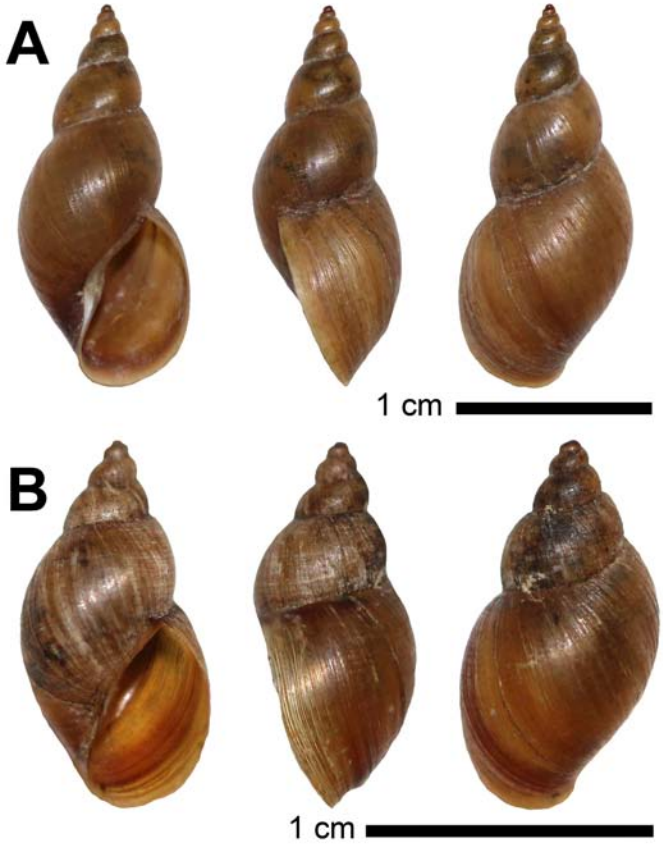

Figure 3. Shells of *Stagnicola fuscus* from Amposta (Ebro Delta, Tarragona province). **A,** Adult shell. **B,** Juvenile shell.

However, the specimens studied here come from the very same populations and have been instead anatomically identified as *S. fuscus*. Thus, a revision of all the citations of *S. palustris* in the Catalan territory (outside the scope of this paper) is urgently needed, and probably this further applies to the Iberian Peninsula as a whole, since the only population studied until now on molecular grounds confirms our results (Bargues *et al.*, 2001). Glöer & Yıldırım (2006) already suggested that all the populations of the genus *Stagnicola* in southern Europe likely belong to *S. fuscus*, and the same was concluded by Pavon & Bertrand (2005) for southern France, consequently raising doubts about the presence of *S. palustris* in the Iberian Peninsula. *Stagnicola palustris* is thus probably rare or even absent in Catalonia, and we therefore advocate for omitting this species from the checklist of Catalan malacofauna until new findings, verified either with anatomies and/or molecular analyses, confirm its presence.

A particular situation that rather complicates this scenario is the

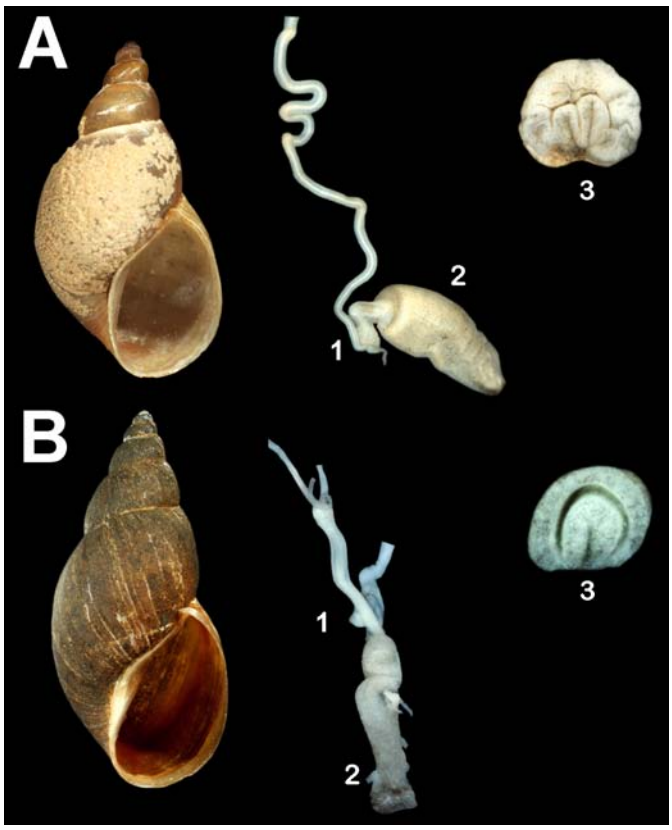

Figure 4. Comparison of the anatomies of specimens of *Stagnicola.* **A,** *Stagnicola fuscus* from Espluga de Francolí (la Conca de Barberà, Tarragona, Spain). **B,** *Stagnicola palustris* from Hamburg (Germany). Legend: 1, phalloteca; 2, praeputium; 3, prostate.

study by Beckman (2007) of *Stagnicola* in the Balearic Islands, since both species seem to live there (this was confirmed by anatomical analyses), thus suggesting that the coexistence of both species in the same localities is possible. Whether the situation in the Iberian Peninsula (and in particular, Catalonia) is similar or not should be clarified by exhaustive analyses of other populations by means of anatomical and/or genetic studies. Thus far, only de Oliveira (2007) has anatomically confirmed the presence of *S. palustris* in Portugal, although he only showed pictures of the shell.

Acknowledgements

We thank Marco Pla for information and field trips to the Tivenys population, and Jordi Corbella, Dilian Georgiev and David M. Alba for suggestions to improve a previous version of this manuscript.

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