

FIRST RECORD OF THE EXOTIC SEMINOLE RAMS-HORN *HELISOMA DURYI* (WETHERBY, 1879), (GASTROPODA: PLANORBIDAE) IN MOROCCO

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ABSTRACT

The exotic freshwater mollusc *Helisoma duryi* is a popular ornamental freshwater snail used to control microalgae in aquariums which occurs now as an introduced species in aquatic habitats of Europe, Africa and South America. We report the first finding of an acclimated population of *H. duryi* in Morocco and discuss the possible role of the trade of aquatic species in its introduction. While currently located in a single locality out of > 100 localities sampled, further studies are required to monitor its presence and expansion and to improve our knowledge about their possible impact on native freshwater communities.

Keywords: Alien invasive species, Aquarium trade, Freshwater habitats, North Africa, Planorbidae.

RESUMEN

Primera cita del caracol exótico *Helisoma duryi* (Wetherby, 1879), (Gastropoda: Planorbidae) en Marruecos

El molusco exótico *Helisoma duryi* es un popular caracol ornamental de agua dulce que se utiliza para controlar las microalgas en los acuarios. Ahora se presenta como una especie introducida en hábitats acuáticos de Europa, África y América del Sur. Presentamos el primer hallazgo de una población aclimatada de *H. duryi* en Marruecos y el norte de África. A pesar de ubicarse en una única localidad de las más de 100 muestreadas por nosotros, las investigaciones en curso podrían revelar pronto más citas de la especie en el país y el resto del continente. Se deben establecer políticas y procedimientos estrictos de aplicación de la ley en el comercio de especies acuáticas como medida preventiva para preservar la biodiversidad nativa.

Palabras clave. Especies exóticas invasoras, comercio de especies de acuario, hábitats dulceacuícolas, norte de África, Planorbidae.

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Introduction

Invasive species are recognized as the second leading cause of extinctions around the world (Wilcove *et al.*, 1998). In fact, some of these invasive exotic species have deeply impacted the environment,

human health and the economy worldwide (Kettunen *et al.*, 2008; Mazza *et al.*, 2014). In this regard, trade in aquarium and ornamental species is emerging as major source for species likely to invade aquatic habitats worldwide (Padilla & Williams, 2004). This trade moves thousands of species around the globe, opening

the door to unwanted organisms being released into freshwater and marine ecosystems, with considerable adverse economic and ecological impacts (Taylor *et al.*, 1984; Mazza *et al.*, 2015).

Despite their relatively small size and low mobility, some continental gastropods are defined as successful invasive species and have already drawn the attention of global specialists in the field of biological invasions (Vinarski *et al.*, 2015). The acute bladder snail *Physella acuta* (Draparnaud, 1805) and the New Zealand mud snail *Potamopyrgus antipodarum* (J.E. Gray, 1843) are good examples of biological invaders in Class Gastropoda (Alonso *et al.*, 2019; Butkus *et al.*, 2019). Another successful freshwater gastropod invader is *Helisoma duryi* (Wetherby, 1879), a medium-sized planorbid endemic to Florida (Baker, 1945) which has migrated from its native range to South America, Europe, Africa, and adjacent islands (Alexandrowicz, 2003; Bank & Neubert, 2017; Gherardi, 2007; Glöer, 2019).

Helisoma duryi was first introduced in the African continent in South Africa and Namibia (Brown, 1967; Appleton, 1977), to be recorded later in various other countries (Grano, 2022). In this paper, we report the first finding of an acclimated population of the

exotic snail *Helisoma duryi* in Morocco. Moreover, we discuss the possible mechanisms of introduction and call for an increased awareness of the impacts associated with the aquarium trade in Morocco's native freshwater fauna.

Material and methods

In order to promote knowledge on the freshwater molluscs of Morocco, several field expeditions have been conducted since 2014 in the northern part of the country. More than 100 localities have been investigated and most of these sampling sites were visited at least three times (e.g., Taybi *et al.*, 2017; Mabrouki *et al.*, 2020a for more details on the localities). Benthic invertebrate samples (including molluscs) were taken with a "Surber" sampler. The quantitative samples (of an order of eight) for the different microhabitats present on the site are taken against the current of water. The choice of microhabitats selected is based both on their biogenic capacity (favourable to aquatic life). The mainly qualitative benthic fauna samples were taken by nets, dip nets and forceps. For each sample, a first sorting was carried out on

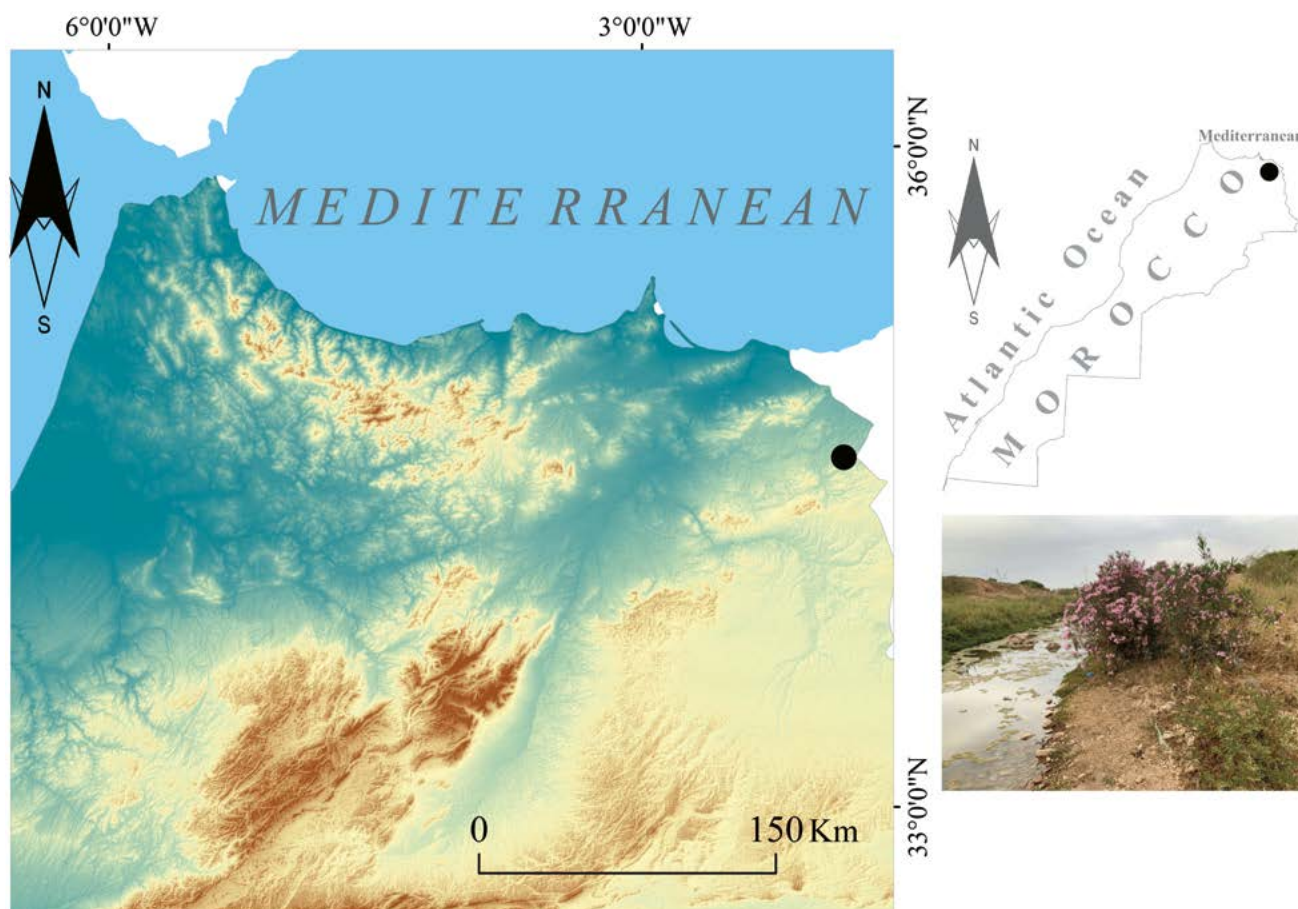


Fig. 1.– Distribution and habitat of *Helisoma duryi* collected in Morocco.

Fig. 1.– Distribución y hábitat de *Helisoma duryi* recolectado en Marruecos.

the field during which the fauna was preserved in a jar containing 70° alcohol. A second and finer sorting was performed in the laboratory under a binocular loupe in which all remaining macroinvertebrates were recovered and stored in 70° alcohol.

Water conductivity, pH, and dissolved oxygen were measured *in situ* with a multiparametric measuring device (WTW, Multi-Line P4). Other parameters (ammonium and BOD₅ -Biological oxygen demand-) were measured in the laboratory. Photographs were made with a digital camera system (Leica Microscope M205C with digital camera Leica DMC5400). The map was made using ArcGIS software. Voucher specimens were deposited in the collections of the authors. Identifications were made using the identification key of Glöer (2019).

Results

About thirty individuals of *Helisoma duryi* were collected in the Ain Talba spring and its emissary (34°32'41.0" N, 1°56'44.8" W), south Oujda, on 19/10/2021 and 20/02/2022 (Figs 1–2). The shell size of the collected juvenile specimens varied between 4 and 7 mm, whereas adult specimens reached a diameter of about 20 mm. The shells of *Helisoma duryi* are a pale, translucent brown colour. The 4.5 whorls are coiled in a

plane, rapidly increasing, the left side is flat, and the right side is deeply umbilicated. These criteria distinguish it from the native Planorbidae species (Glöer, 2019).

The abundance of *H. duryi* was about 11 individuals per 0.5 m². *Helisoma duryi* was found with different invertebrate aquatic species, including: *Physella acuta* (Draparnaud, 1805) (Gastropoda); *Hygrotus confluens* (Fabricius, 1787), *Deronectes fairmairei* Lepieur, 1876, *Laccophilus hyalinus testaceus* Aubé, 1837, *Helochares lividus* (Forster, 1771), and *Laccobius atrocephalus atrocephalus* Reitter, 1872 (aquatic Coleoptera); *Caenis luctuosa* (Burmeister, 1839) and *Baetis* sp. (Ephemeroptera, larvae); *Corixa affinis* Leach, 1817, *Parasigara favieri* (Poisson, 1939), *Micronecta scholtzi* (Fieber, 1860), *Nepa cinerea* Linnaeus, 1758 (aquatic Hemiptera); *Anax imperator* Leach, 1815, *Orthetrum cancellatum* (Linnaeus, 1758) and *Crocothemis erythraea* (Brullé, 1832) (Odonata, larvae and imago); *Mesophylax* sp. (Trichoptera, larvae). The aquatic vertebrates comprised amphibians (*Pelophylax saharicus* (Boulenger in Hartert, 1913)), and aquatic reptiles (*Natrix maura* (Linnaeus, 1758) and *Mauremys leprosa leprosa* (Schweigger, 1812)).

The analysis of the physicochemical parameters of the water (ammonium and BOD₅) revealed a good environmental quality of the habitat (Table 1), according to the Moroccan standards of the quality of the surface waters (SD).

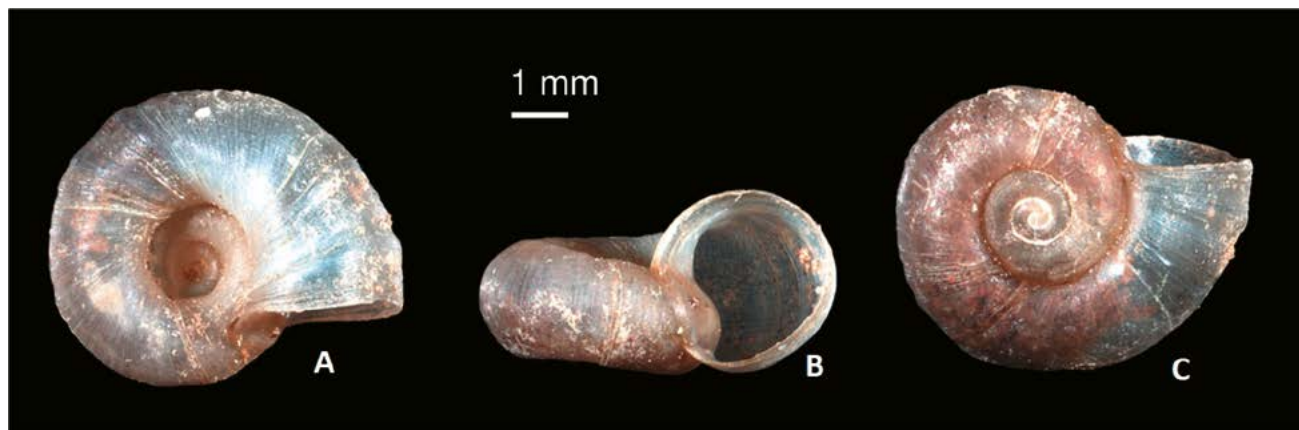


Fig. 2.– The shell of *Helisoma duryi* collected in Morocco. **A.** Umbilical view. **B.** Apertural view. **C.** Apical view.
 Fig. 2.– Concha de *Helisoma duryi* recolectada en Marruecos. **A.** Vista umbilical. **B.** Vista de apertura. **C.** Vista apical.

Table 1.– Mean values of the physical and chemical water parameters measured at the sampling locality (Ain Talba and its emissary). M (Mean), SD (Standard deviation), Min (Minimum value), Max (Maximum value).

Tabla 1.– Valores medios de los parámetros físicos y químicos del agua medidos en la localidad de muestreo (Ain Talba y su emisario). M (Media), SD (Desviación estándar), Min (Valor mínimo), Max (Valor máximo).

Parameter	pH	Conductivity (mg·L ⁻¹)	Dissolved oxygen (mg·L ⁻¹)	Ammonium (mg·L ⁻¹)	BOD5 (mg·L ⁻¹)
M	7.9	650	7.5	0.03	1.5
SD	6.5–8.5	<1300	>5	<0.5	<5
Min	7	550	6.5	0.02	1
Max	8.2	750	8.5	0.04	2

Discussion

The Seminole rams-horn *Helisoma duryi* has successfully spread through the southwestern Palearctic (Glöer, 2019). Our finding provides the first record from Morocco and North Africa, increasing the known biodiversity of planorbid snails to six genera in Morocco (Mabrouki *et al.*, 2022). The number of individuals of *H. duryi* collected was relatively low in this first study. This suggests the invasion could be in its initial stage, but further investigations could reveal more occurrences of the species in the country and the rest of the continent. The species seems to require habitats with good water quality, such as the waters of Ain Talba and its emissary, as judged by the Moroccan standards of the quality of the surface waters (Barakat *et al.*, 2016; Taybi *et al.*, 2020a).

Regarding the introduction of *H. duryi* in Morocco, one of the most accredited hypotheses suggests an intentional release of this gastropod, which is a very popular ornamental snail among aquarists (Appleton, 1977; Alexandrowicz, 2003; Grano 2022). *Helisoma duryi* can be introduced into a new region through other mechanisms: escapes from artificial irrigation channels, reservoirs in parks, botanical gardens, fish farms and greenhouses (Alexandrowicz, 2003; Vimpère, 2004). Intentional release may be related with its use as a biological control agent of schistosomiasis by controlling the populations of *Bulinus* O.F. Müller, 1781 (Appleton, 1977).

Biological invasions and the pathways of introduction and spread of alien species are not thoroughly documented in Morocco, but recently, an increasing number of invasive aquatic species has been documented (Mabrouki *et al.*, 2019a, 2019b, 2021; Taybi & Mabrouki 2020; Taybi *et al.*, 2020b, 2020c). The aquarium trade is increasingly considered as an important pathway for the introduction of freshwater alien aquatic species in the country. For example, it is the main route of introduction into freshwaters in Morocco of the mummichog *Fundulus heteroclitus* (Linnaeus, 1766), the green swordtail *Xiphophorus hellerii* Heckel, 1848, and for other successful freshwater gastropod invaders such as the New Zealand mudsnail *Potamopyrgus antipodarum*, the American limpet *Ferrissia californica* (Rowell, 1863), the Red-rimmed melania *Melanoides tuberculata* (O.F. Müller, 1774), and the acute bladder snail *Physella acuta* (Mabrouki *et al.*, 2020b, 2023; Taybi *et al.*, 2017, 2020b, 2021).

Freshwater gastropod invasions through human help can bring huge impacts on the native biodiversity and many snail species have proved to be very successful invaders in the last years, able even to cross-oceans and continents (Karatayev *et al.*, 2009; Vinarski, 2017). With the continuous deterioration in water quality of the freshwater ecosystems, acting synergically with the effects of global warming can potentially favour the expansion of *H. duryi* in Morocco or North Africa

as a whole. Therefore, monitoring the presence and expansion of the species within invaded areas and studies improving our biological and ecological knowledge of the species are crucial to mitigate their possible impact on native communities.

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