

Further Additions to the Knowledge of the Reproduction of *Zonaria pyrum insularum* var. *nigromarginata* (Deprez & Govaert 2009) in the Atlantic and Western Mediterranean Coast of Spain

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ABSTRACT The family Cypraeidae is represented in the Mediterranean Sea by four native species: *Luria l. lurida*; *Naria s. spurca*; *Schilderia a. achatidea*; and *Zonaria p. pyrum*. These species also inhabit the Atlantic coasts of Europe and Africa beyond the Strait of Gibraltar. Besides these, there are a few Lessepsian immigrants found occasionally throughout the central and eastern part of the *Mare Nostrum* including *Naria turdus* var. *micheloi* and *Purpuradusta gracilis notata*. This article focuses on the subspecies of *Z. pyrum insularum* (Schilder, 1928); var. *nigromarginata* (Deprez & Govaert, 2009), whose populations in the Atlantic have recently been the subject of numerous notes and comprehensive revisions (Goutal, 2008, Bergonzoni, 2013).

KEY WORDS Cypraeidae, *Zonaria*, *Zonaria pyrum insularum* var. *nigromarginata*.

INTRODUCTION

About the taxonomic status of *Zonaria pyrum*.

The most recent work on this popular group of gastropods written by Lorenz, 2017 does not elaborate on the taxonomic rank of the nominal subspecies of *Z. p. pyrum* (Gmelin, 1791) whereas the classic West African subspecies *Z. pyrum insularum* (Schilder, 1928) has been split in two distinct variations: *Z. p. insularum* var. *senegalensis* (Schilder, 1928), typically found from Mauritania to Northern Senegal and *Z. p. insularum* var. *nigromarginata* (Deprez & Govaert, 2009) from the Atlantic coasts of Portugal and Spain. However, according to our knowledge, *Z. p. insularum* var. *nigromarginata* has not previously been reported from the Mediterranean Sea.

Zonaria pyrum insularum var. *nigromarginata* in the Mediterranean.

The distribution of *Z. p. insularum* var. *nigromarginata* along the Atlantic coast of Portugal and Spain has been known for some time but its range must be revised, in the author's opinion, to include the adjacent coast of the Mediterranean Sea between Spain and Morocco. This biogeographical region is better known as the Alboran Sea and extends approximately 200 kilometers east to the Strait of Gibraltar. Specimens from Mediterranean populations obtained in this vast area may show some of the features typically found in the Atlantic (*see* Figure 1).

The specimen illustrated in Figure 2 was observed under a small piece of metal on the sea floor at a depth of 12 meters in July 2008 in the province of Granada (Andalusia, Southeast Spain) by the underwater photographer and



Figure 1. *Zonaria pyrum insularum* var. *nigromarginata*. Live. Atlantic coast. Spain. 2016.



Figure 2. *Zonaria pyrum insularum* var. *nigromarginata*. Live. Atlantic coast. Spain. 2006.

diver Antonio Rodríguez-Medel, who kindly allowed the author to publish his photographs in this article. A more detailed examination of this material allowed the author to identify some distinguishing features of this variation for comparison with shells found in the Atlantic populations. The cowry in Figure 2 is a female brooding an egg-mass (this animal was not disturbed during or collected after taking these photographs). As far as the author currently knows, this is not a unique report of this particular variation in this province; more recently, at least one other female specimen with eggs was reported at a depth 16 meters inside a dead spiny oyster shell of *Spondylus gaederopus* (Linnaeus, 1758) by our friend, colleague and veteran diver Francisco Esteban Ortega during the summer of 2016. The author has learned that this cowry is not common in the area, even though suitable areas with sponges where *Luria l. lurida* (Linnaeus, 1758) and *Naria s. spurca* (Linnaeus, 1758) normally inhabit are relatively abundant.

Notes on the reproduction of *Zonaria pyrum insularum* var. *Nigromarginata*. It is worth noting that in the family Cypraeidae, the habit of spawning their egg-mass inside the shell of a dead bivalve and even under artificial structures (shipwrecks and sunken platforms, and broken pipelines) in moderately or highly altered areas is a common and well known behavior after mating and it has been recorded in many members of this family throughout their distribution. In Angola, for instance, the related species *Zonaria angolensis* (Odhner, 1923) spends about eleven months in an unknown habitat, before gathering in August near Luanda in Mussulo Bay (approximately 10 kilometers south of Luanda in a place called Corimba) at depths of about 15 to 18 meters on an area of 50 to 100 square meters covered by empty shells of the bivalve *Anadara gessei* (Dunker in Kobelt, 1891) and *Pinna* sp. where they lay their eggs

(Lepetit, 1989). Similarly, female *Barycypraea teulerei* (Cazenavette, 1846) off the coast of south Oman, are mainly found in muddy salt marsh environments at low tide inside dead bivalves, such as *Cardidae*, *Glycimeridae* and *Pinidae* (Scali, 2013).

In the Atlantic, the author was able to observe this behavior as well; mating and spawning takes place in the summer, when the temperature of the water easily increases to 20°C. However, female cowries with eggs have also been observed in early October. The dead shells where the cowries laid their eggs are the most common bivalves found on the sea floor, including *Cardiidae*, *Ostreidae*, *Pectinidae* and *Veneridae*.

This information has been confirmed indirectly by others in Portuguese populations and may be the case in the Mediterranean as well, probably because the temperature of the water in these months is generally higher than in the Atlantic.

Figure 1 shows a female *Z. pyrum* var. *nigromarginata* perched upside down, with her foot extended to the inner surface of a piece of metal and covering a compact mass of eggs. This mass is a dense, deep yellow, half hemispherical in shape and rather stratified structure. The egg capsules are ovoid in shape (2 to 3 mm in length) and packed in clusters with each capsule containing between 32 to 34 eggs. The average number of eggs in a given clutch for this species has not been determined. Nonetheless, some authors suggest that the number in other cowries of planktonic development, like the genus *Zonaria*, are between 300 to 600 egg capsules. The complete development of the spawn take no less than five days and the color of the embryos inside the eggs may change substantially from the earlier stages to the last moment just before releasing and dispersal of the larvae. In addition, it is



Figure 3. *Zonaria pyrum insularum* var. *nigromarginata*. Female with eggs. The spawn is completely covered by her foot. Alboran Sea. Spain. 2008.



Figure 4. *Zonaria pyrum insularum* var. *nigromarginata*. Female specimen with eggs. The spawn, densely packed, yellow and somewhat stratified and consisting in clusters joined together by a gelatinous secretion is perfectly visible in the picture. Each cluster contains approximately thirty eggs where embryos develop inside before releasing to the environment. Alboran Sea. 2008.

important to note that the type of larval development (planktonic or direct development) provides valuable information about the natural history and evolution of these mollusks. Planktonic development takes approximately 5 to 30 days following dispersal and drifting with the current in the veliger stage before settling on the bottom in a suitable substrate. This is consistent with the author's observations in the Atlantic. Even though, advanced bulla stage cowries are hard to detect because of their smaller size (less than 10mm) and ability to hide in deep interstices, finding empty bulla and subadult shells are relatively common, especially after storms. For further information about this amazing chapter in the life of cowries, we suggest "Cowries: A Guide to the Gastropod Family Cypraeidae" by F. Lorenz, 2017 Chapter C, titled "Reproduction and Development", pages 58–68.

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