

EXTENDED PARENTAL CARE IN THE FRESHWATER SHRIMP GENUS  
DUGASTELLA BOUVIER, 1912 (DECAPODA, ATYIDAE, PARATYINAE)

BY

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Parental care and extended parental care are known behaviours in decapod crustaceans (see Thiel, 2000, 2003). While parental care before hatching, which involves incubation of the eggs (carrying, cleaning, and aeration) by females, is a common behaviour in the majority of decapod taxa (with the exception of Dendrobranchiata), extended parental care is a rare behaviour in decapods, restricted only to some species of brachyuran crabs (Diesel, 1989, 1992, 1997; Diesel & Horst, 1995; Ng & Tan, 1995), hermit crabs (Hazlett, 1983; López Greco et al. 2004; Calado et al., 2006), astacid crayfishes (Johnston & Fiegel, 1997; Vogt & Tolley, 2004), and caridean shrimps (Duffy, 1996). In the majority of these cases, the parental female presents different types of parental activity towards the offspring after hatching, like habitat control, elimination of predators, or sharing meals. Also, there are some cases in which larvae develop transient structures that allow them to remain fixed to the pleopods of the female abdomen, like in astacids (see Vogt & Tolley, 2004) and several species of the genus Sclerocrangon Sars, 1883 (see Makarov, 1968; Lacoursière-Roussel & Sainte-Marie, 2009). However, the most infrequent cases of extended parental care in decapods are those where females carry their juvenile offspring under their abdomen after the hatched larvae develop there (cf. abdominal brood pouches, or incubation chamber). These cases have only been reported in one species of Brachyura, Tunicotheres moseri (Rathbun, 1918) (see Bolaños et al., 2004), and one caridean, the kangaroo shrimp Dugastella valentina (Ferrer Galdiano, 1924) (see Cuesta et al. 2006). Taking into account this last case, and considering that there are only two species in the genus Dugastella Bouvier, 1912, the objective of the present study was to corroborate whether the other species, D. marocana Bouvier, 1912, also presents the same behaviour. These two species have a a restricted distribution, D. valentina occurs in the Gulf of Valencia (southern Europe) and D. marocana is found in some localities of Morocco (northwestern Africa) (see fig. 1).

Females of Dugastella marocana with few, large eggs have been observed by the first author in 1975 but those observations were not published at that time (lecitotrophic eggs about 1.0 mm in length, 0.60 mm width; number of eggs varying from 16 to 24). D. marocana was only known from its topotypic population of Settat (Morocco) (see fig. 1). After its description by Bouvier (1912) there have no more data been reported on its distribution, biology, or ecology until recently. For this reason, the objective of the present work was to collect ovigerous females of this species and study larval development. Different field sampling campaigns were carried out in Morocco, with unequal success. Those samplings in Settat show that, due to the transformation of this area through urbanization, the species is not longer present there. The last specimens, which were collected in the vicinity of Settat (at about 35 km distance) by the first author, in June 1975 at three stations, represent the last available samples from the proximity of the topotypic locality.

The locality data of the material collected by the first author are as follows: (1) in the Kihane River next to Aïn-Belmesk, not very far from the Oum er Rbia River; (2) in a separate spring (resurgence) next to Aïn-Belmesk; (3) in the As Sila River, N.W. of Aïn-Belmesk (see fig. 1). This region was facing a great drought during the last years, so a recent expedition (20 May 2007) to the same localities did not find any shrimps. Some specimens were collected together with individuals of Atyaephyra desmarestii (Millet, 1831) near the Oum er Rbia River (at Bzou, N.E. of Marrakech, Morocco) by J.E. Garcia Muñoz and J.E. Garcia Raso on 24 October 2007 (Garcia Muñoz et al., 2009).

According to mitochondrial gene data (genes 16S and COI) Dugastella marocana is a valid species, well separated from D. valentina (cf. Garcia Muñoz et al., 2009). Unfortunately, there were no ovigerous females in the sample from Bzou, but a female was observed with larvae (zoea II) in its incubation chamber, demonstrating that in D.

marocana, as in D. valentina, females bore larvae in their abdominal brood pouches. An extended parental care behaviour is thus presented here as a common feature of the species in the genus Dugastella. The same observation was made earlier by the first author, who has found females with larvae attached in the population captured in the spring next to Aïn-Belmesk.

Later, a revision of the material deposited at the Muséum national d'Histoire naturelle, Paris, allowed us to locate among the material collected by M. Pallary in 1914 in the spring of Settat, topotypic locality, a female specimen of D. marocana with larvae (zoea I and II) inside its incubation chamber. This confirms the breeding mechanism observed in the specimen collected in the proximity of the Oum er Rbia River (at Bzou) and in that from the spring next to Aïn-Belmesk.

Species of Atyidae have been described with a wide range of types of larval development, ranging from direct development to long, planktonic larval development (10-12 zoeal stages) (see Walsh, 1993). Until now, however, the two species of the genus Dugastella are the only ones showing this peculiar extended parental care. Probably re-examination of ovigerous females of other atyid species, i.e., those with reported direct development, might reveal other cases of similar extended parental care, since without detailed observation of the abdominal enclosure, one cannot confirm the presence of larval stages instead of eggs. A female releasing juveniles could constitute evidence for direct development, without larval stages at all, or actually could be showing a true case of extended parental care.

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## CAPTION

Fig. 1. Geographic distribution of: 1, Dugastella marocana Bouvier, 1912; and, 2, D. valentina (Ferrer Galdiano, 1924) according to literature reports and present collection data. a, Settat, topotypic locality of D. marocana; b, Almenara ponds, topotypic locality of D. valentina; w, Kihane River; x, spring next to Ain-Belmesk; y, As Sila River; z, Oum er Rbia River.