Biodiversity Journal, 2021, 12 (2): 495–500 https://doi.org/10.31396/Biodiv.Jour.2021.12.2.495.500

Composition and distribution of Patellidae (Mollusca Gastropoda) in the Algerian east coast: the case of Jijel

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ABSTRACT This study is a contribution to the knowledge of the ecology and biology of Patellidae in the Jijel region in the East of Algeria. These gastropods colonizing the supralittoral and mid-littoral stage are considered as excellent indicators of coastal marine pollution. The qualitative study of Patellidea's familly in Jijel reveals the existence of four species: *Patella caerulea*; *P. rustica*; *P. ulyssiponensis*, and *Cymbula safiana* at Beni Belaid Station. Nevertheless, in Zaway Rabta we have found only two species: *Patella caerulea* and *P. rustica*. The station of Beni Belaid presente the highest values of density with 92 ± 4 ind./m² compared to the Zaway Rabta station up to 64 ± 8 ind./m². We recorded a predominance of *Patella caerulea* in Beni Belaid station (65.26%) and an important presence in Rabta Zaway station with 40%.

KEY WORDS Inventory; Patellidea, density; dominance; Jijel coast; east of Algeria.

Received 13.12.2020; accepted 08.06.2021; published online 30.06.2021

INTRODUCTION

The preservation and safeguarding of marine biodiversity requires both: a knowledge of the endangered species as well as some qualitative and taxonomic skills. As a matter of fact, indicator species, as per the biodiversity concepts, are used in assessing and detecting pollution to preserve nature (Grimes, 2011). Algeria sits at the top of the highest marine biodiversity in the Mediterranean Sea for the abundance of its species on an ecological and economic levels (Grimes et al., 2004).

Gastropods play a major role in regulating the ecological balance of their habitat. Moreover, they are classified as exceptional bioindicators due to their capacity for filtration and bioaccumulation. They also enjoy a crucial ecological importance for their sedentary lifestyle, distribution, longevity, abundance and their ease of sampling (Huang et al., 2006; Espinosa et al., 2007).

This work is a continuation of the previous work on the distribution of limpets in Annaba and El-Kala region (Beldi et al., 2012; Boumaza, 2014; Boumaza et al., 2016; Zegaoula, 2018) with the aim of studying the impact of pollution on the Patellidae community in the North-East of Algeria and more specifically in the Jijel region. The city of Jijel with its 120 km of almost virgin coast (1/10th of the Algerian coastal strip), with its cornices, among the most beautiful in the world, its mountainous reliefs, with a fauna and a flora as rich as varied, of wetlands and natural parks containing many rare species and still other sites, is unquestionably a city richly endowed with environmental potentialities likely to be the object of an environmental tourist activity (Grimes, 2004). In this context, limpets were harvested during the spring of 2019 at two stations based on their accessibility and availability of limpets. A first reference is the Beni Belaid station while the second station Rabta Zaway is close to the urban center of the city of Jijel.

MATERIAL AND METHODS

Sampling sites

The city of Jijel is located in the North East of Algeria at 357 km east of the capital Algiers, between the cities of Bejaia in the west, Setif in the southwest, Constantine in the south and southeast, Skikda to the east and the Mediterranean Sea to the north (Fig. 1).

The resort Beni Belaid (36°53'34" N - 6°08'45" E) was chosen as a reference station because of its location far from any source of pollution. Rabta Zaway (36°49'31" N - 5°44'20" E) located west of the city of Jijel, near the harbor (≈ 3 km), too close to the rejections of the manufacturing plant leathers and derivatives. It also receives urban discharges from the city of Jijel via the Ayemmam valley.

Limpet collection, identification and counting

A sampling of the limpets colonizing the mediolittoral stage was realized during spring 2019. The collection was made with a knife on a quadrat of 1 m^2, with 3 limpets taken by station. The harvested limpets are identified from morphological and anatomical (color of feet and tentacles). Limpets are identified using a specialized documentation (Parenzan, 1970; Poppe & Goto, 1991) and then counted by species.

Statistics

The normality of data was verified using the Kolmogorov–Smirnov test, and the homogeneity of variances was checked by Levene's test. Data have been expressed by the mean ± standard error. Data were subjected to one-way analysis of variance (ANOVA), followed by a Tukey test to compare the density values between sampling sites. The statistical analyses was performed using MINITAB software (Version 16, Penn State College, PA, USA), and $p<0.05$ was considered to be a statistically significant difference.

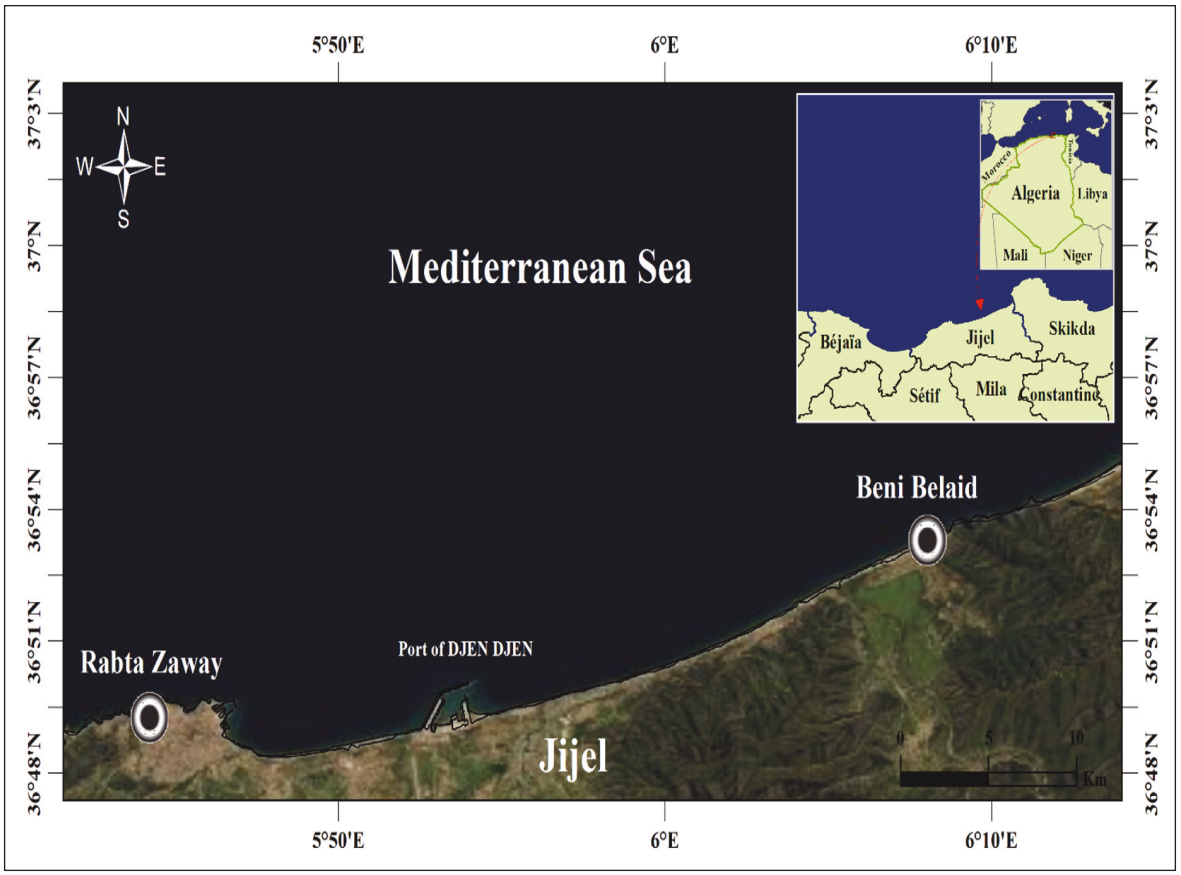

Figure 1. Geographical position of Jijel coast and location of the sampling sites.

RESULTS

The inventory of Patellidae in the Beni Belaid station allowed us to identify 4 species: *Patella caerulea* (Linnaeus, 1758), *Patella rustica* (Linnaeus, 1758), *Patella ulyssiponensis* (Gmelin, 1791) and *Cymbula safiana* (Lamarck, 1819) known before under the names *Patella nigra* and *Cymbula nigra* (Da Costa, 1771). While in the Zaway Rabta resort we only listed 2 species: *Patella caerulea* and *Patella rustica*.

Patella caerulea: maximum size: 32 mm. Oval, flat shell sometimes thin, off-centered summit. Striated surface. Iridescent blue interior color. Dark grey foot color. Intertidal.

Patella rustica: maximum size: 34 mm. Conical, thick shell. Dark interior with double light rays. Dark rays on the inner edge. Brown foot color Intertidal.

Patella ulyssiponensis: maximum size: 29 mm. Elongated, flat form. Jagged and irregular edge. Porcelain white interior with blue highlights and a yellow - orange central spot. Yellow foot color. Intertidal.

Cymbula safiana (Fig. 2): maximum size 30 mm. Flattened, large shell. Sculpture and coloring

Figure 2. *Cymbula safiana* from Beni Belaid station.

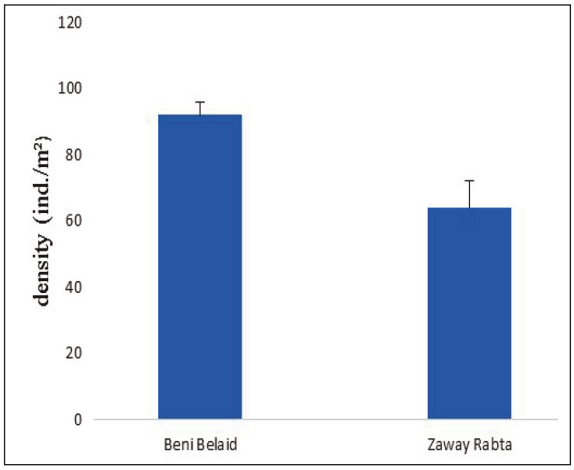

Figure 3. Spatial variation in density (ind./m²) of limpets in the Jijel.

show little variability for a limpet. Some forms of *P. ulyssiponensis* are distinguished at first by the colors, large size and more regular oval shape. Live on large rocks between 50 cm and 5 m.

The evolution of the numerical importance of the limpets at the level of the prospected stations is studied through the analysis of the density (Fig. 3). Beni Belaid offers the highest density with an average of 92 ± 4. While the station Zaway Rabta is home to the lowest density of about 64 ± 8, one-way ANOVA revealed a high significant effect, between the sites during the study period (Table 1).

The data on dominance of Patellidae are presented in Fig. 4. Indeed, *P. caerulea* occupies the first place at the Beni Belaid station with a dominance of 65.26%. The second place is occupied by *P. rustica* with 31.57% of the limpets, followed by *P. ulyssiponensis* with a rate of 2.12%. *Cymbula safiana* occupies the last position with a very low rate that does not exceed 1.05%, however in the Zaway Rabta station *P. rustica* occupies the first place with a dominance of 60%, followed by *P. caerulea* with 40%.

Sources of variation	DDL	SCE	CM	F	P
Station	1	1176	1176	29.40	0.006
Error	4	160	40		
Total	5	1336			

Table 1. One-way ANOVA.

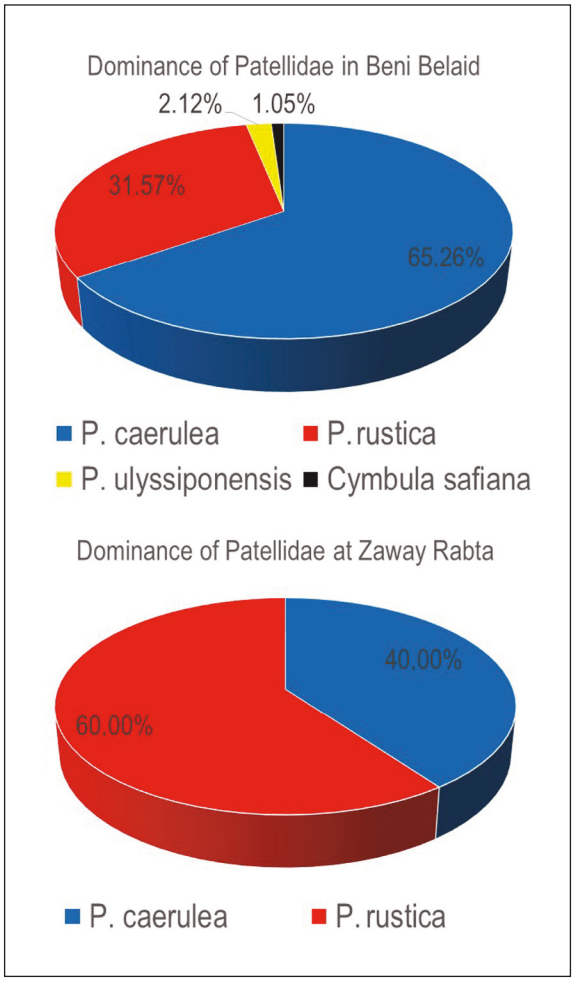

Figure 4. Dominance of different species of limpets in Jijel.

DISCUSSION

The presence of the common *Patella caerulea* has already been reported in the region of Oran (Seddik, 2008) and in the coastal areas of Annaba (El Kala Beldi et al., 2012; Boumaza et al., 2016).

According to Davies (1969), *P. caerulea* is endemic in the Mediterranean Sea and is the most resistant to pollution, and therefore the most abundant. While Grimes et al. (2004) specify that *P. rustica* settles mainly in the lower mediolittoral, this species is abundant both at this level and at the level of the Algerian east coast (Beldi et al., 2012; Boumaza et al., 2016). Sella & Bacci (1971), Simunovic (1970) and Della Santina et al. (1993) report that the two species *P. caerulea* and *P. rustica* coexist along rocky shores along the Italian coasts, while Mauro et al. (2003) mention the presence of three species belonging to the genus *Patella*: *P. caerulea*, *P. rustica*, and *P. ulyssiponensis* inhabiting the Italian coasts. However, according to Culioli (2003), *P. ulyssiponensis* is the least abundant species compared to the two aforementioned species. Templado et al. (2004) reports that *Cymbula safiana* (= *P. nigra*) is endangered in the western Mediterranean Sea as it is a species that is also susceptible to pollution problems. Indeed, in our samples we report the absence of this species in the station of Zaway Rabta, while it is weakly present at the level of the reference station of Beni Belaid.

Faunistic analysis carried out on the limpet community reveals that the Beni Belaid station has the highest values with a maximum density of 92 ± 4 ind./m². While the Zaway Rabta resort is home to the lowest density with 64 ± 8 ind./m². This situation could be linked to the existence of urban discharges (wastewater from neighboring agglomerations) at the beach level, thus enriching the whole area with nutrient salts. The densities of limpets in Jijel are consistent with those reported in the Algerian East Coast (Beldi et al., 2012; Boumaza et al., 2016) recorded similar strongest values at the Cap de Garde reference stations and the beach, respectively. Indeed, one of the most recent studies in the world of South Africa (Laura Suzanne, 2000) shows limpets densities between 40 and 230 ind./m² (see also Bosman & Hockey, 1988).

The strong presence of *P. caerulea* in the Zaway Rabta station, despite their high exposure to wastewater, confirms its status as a bioindicator of pollution. Indeed, according to Davies (1969), *P. caerulea* is the most resistant to pollution, and therefore the most abundant species. With regard to the dominance of *P. rustica* to Zaway Rabta, this state can be explained from a geomorphological and hydrodynamic point of view. Templado et al. (2004) reports that *Cymbula safiana* is endangered in the western Mediterranean because it is a species that is also sensitive to pollution problems, so the Beni Belaid station once again confirms its special status as a reference station with the presence of *Cymbula safiana*. It is evident that the fac-

tors influencing the abundance, distribution, and population structure of this species are complex, and to date no study has been able to give the accuracy of these factors.

CONCLUSIONS

Our study allowed us to know the specific diversity of these gastropods and the effect of pollution on their distribution. The inventory of this sessile gastropod at the BeniBelaid station reveals that the resort is home to 4 species: *Patella rustica, P. caerulea, P. ulyssiponensis* and *Cymbula safiana; the latter is* a very sensitive species to pollution problems, according to the literature. While the Zaway Rabta station presents two species belonging to the genus *Patella*: *P. rustica* and *P. caerulea*. In terms of density, the Beni Belaid station confirms its special status as a reference station with the highest values compared to the Zaway Rabta station. These fluctuations could be related to environmental conditions such as food availability and pollution.

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