

First Record of the Sea Urchin *Sphaerechinus Granularis* (Lamarck, 1816) in a Coastal Lagoon (Tunisia - Western Mediterranean)

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Abstract

This work presents the first record of the regular sea urchin *Sphaerechinus granularis* in a coastal lagoon in the Mediterranean. *S. granularis* (Echinoidea: Echinodermata) was found for the first time in Bizerte lagoon (North Western Tunisia) associated with a population of the sea urchin *Paracentrotus lividus* at 5,5 m deep and on sandy mud substratum with *Cymodocea nodosa* beds. This finding demonstrates that the species can live in a semi enclosed Mediterranean ecosystem where the environmental conditions (i.e. temperature and salinity) are very variable.

Keywords: Sea Urchin; *Sphaerechinus granularis*; First Record; Mediterranean Lagoon; Tunisia

Introduction

Coastal lagoons are one of the most productive ecosystems in the world, and they support many economic activities that contribute to the development of the coastal communities, such as fishing, aquaculture and farming [1]. Lagoons are dynamic systems characterized by fluctuating physical parameters that depend on the exchange of water between the lagoon and the ocean, and the atmospheric conditions (rain and evaporation). Therefore, only tolerant species to these high environmental variations can inhabit there.

Regular Echinoidea, which includes more than 1000 species of sea urchins, are well distributed throughout diverse coastal environments, including coastal lagoons [2]. Along the Tunisian coast, *Paracentrotus lividus* is the most abundant sea urchin [3]. This species is particularly frequent in marine shallow waters, where cohabit with two other species of sea urchins: *Arbacia lixula* and *Sphaerechinus granularis* (Sellem, personal observation). However, whereas *P. lividus* is commonly found in coastal lagoons in the Mediterranean, the other two species have not been recorded so far in these highly fluctuating environments.

This study is focused on the violet sea urchin *S. granularis*. The species has a large geographic distribution that extends throughout the western Mediterranean and the eastern Atlantic, from Gulf of Guinea to the English Channel. It is particularly common in Brittany, where it is found in different types of habitat and it has been commercially exploited since 1980s [4]. In the Mediterranean, *S. granularis* occupies mostly coralligenous habitats, seagrass beds, and sandy and rocky bottoms, from shallow waters to 130 m of depth. *S. granularis* is a grazer and consumes generally incrusting coralline algae *Lithophyllum incrustans* and dead leaves rhizomes and scales of *Posidonia oceanica* [5,6].

The present paper reports the first evidence of the species *S. granularis* in a lagoon environment. We also provide several data about the specimen and the habitat where it was found and discuss potential explanations for this finding.

Material and Methods

The study was carried out in Bizerte lagoon, a semi-enclosed coastal system located in the North of Tunisia (Figure1). The lagoon has an extension of 128 km² and an average depth of 7 m, and it connects with the Mediterranean Sea through a 8-km channel long and 12 m deep [7]. It also communicates with diverse streams that provide freshwater into the lagoon, especially during the rainy season. The annual balance of water exchange shows that around 534 Mm³ of fresh water flows from the lagoon into the Mediterranean Sea in the winter. Conversely, there is an incursion of 84 Mm³ of seawater towards the lagoon during the summer

because of the lack of precipitation and strong evaporation [8]. Given this hydrological pattern, the environmental conditions in Bizerte lagoon fluctuate throughout the year, being the average temperature range 15-27 °C and the salinity range 20-40 [9,10].

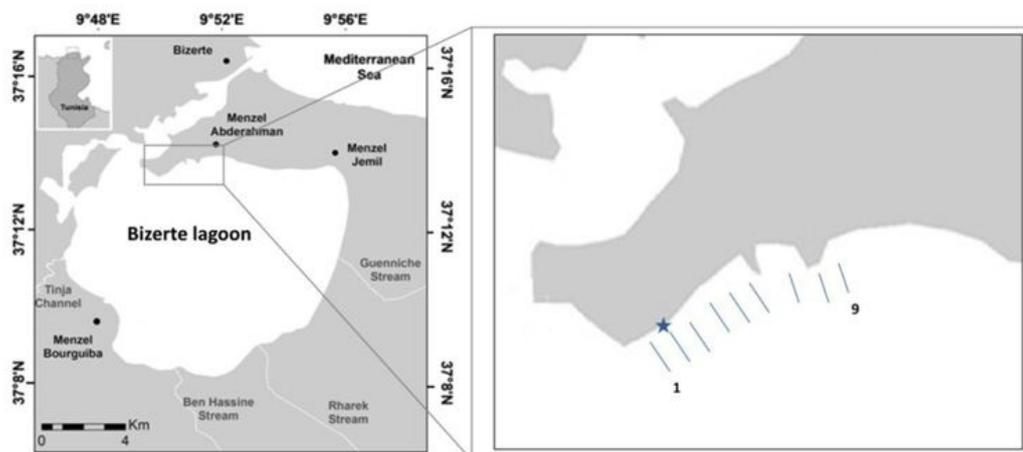


Figure 1: Map showing the location of Bizerte lagoon and the 9 sampled transects. The star shows the area where *Sphaerechinus granularis* was found

Diverse human activities affect the environmental quality of the lagoon. Farming, aquaculture and agriculture, are important economic activities surrounding the lagoon that supply an additional source of minerals and organic matter. The discharge of wastewater is especially high in the northern part of the lagoon, where most of the population and industrial activities are concentrated [11]. Although high metal pollution was found in some areas, a recent environmental assessment suggests that its negative impact is not highly alarming for benthic fauna [9].

The INSTITUTE NATIONAL DES SCIENCES ET TECHNOLOGIES DE LA MER (INSTM) conducts a monitoring program to assess the populations of *P. lividus* in the Bizerte lagoon. Twice a year, scuba divers collect all sea urchins found in 9 transects (25x3 m) perpendicular to the coast and located between 5 and 7 m (Figure 1). Sea urchins are then transported to the laboratory for further analyses. During the sampling of April 2017, an individual of *S. granularis* was found among *P. lividus* species in transect 2. Identification was confirmed using traditional taxonomic characters of regular sea urchins, on the basis of the original descriptions of with additional taxonomic contribution of Natural History Museum¹ (Andrew B. Smith, 2010) [12].

Results

Systematic

Class ECHINOIDEA Leske, 1778
 Order CAMARODONTA Jackson, 1912
 Family TOXOPNEUSTIDAE Troschel, 1872
 Genus *Sphaerechinus* Desor, 1856
Sphaerechinus granularis Lamarck, 1816

Description

A specimen of *S. granularis* was found in the northern western coast of Bizerte lagoon at 5.5 m of depth (see position in Figure 1). The individual was found with a population of *P. lividus* on sediment composed by mud and sandy mud with fragments of mollusk shells. *C. nodosa* was the major marine plants encountered, although a few tufts of algae were also present, such as *Caulerpa prolifera* and *Enteromorpha sp.* The specimen has a purple and sub-spherical shape test, protected by a high density of robust and

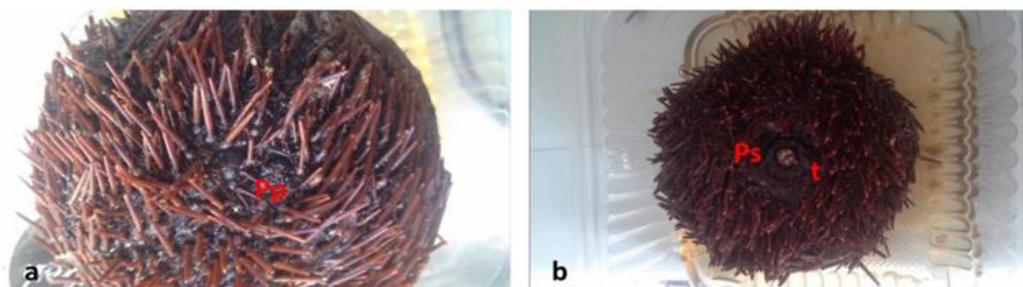


Figure 2: *Sphaerechinus granularis* found in the Bizerte lagoon. a) Aboral surface of *S. granularis*. The periproct (Pp) is located in the middle. b) Oral surface of *S. granularis*. Peristome (Ps), five teeth (t) of Aristotle's lantern

¹<http://www.nhm.ac.uk/our-science/data/echinoid-directory/>

equal spines of purple color with sometimes a white point (Figure 2). The sea urchin weighted 102 g and measured 67,3mm of diameter and 41mm of height. *S. granularis* is a regular sea urchin. The periproct is found on the upper face called also aboral surface; and it contains a variable number of plates. The anus is situated in the middle part of this face (Figure 2 A). The mouth is located in the center of the buccal or oral surface named also the peristome, and it includes five teeth connected to the masticator Aristotle's lantern (Figure 2B).

Discussion

S. granularis is a typical marine species commonly found in the northern Tunisia coast, sharing food and space with the sea urchin *P. lividus* [3]. As far as we know this is the first time *S. granularis* has been sighted outside of a marine ecosystem. There has been evidence proving that this species habits in a small enclosed sea in the Atlantic, referred as a lagoon by Guillou and Michel due to the calm waters [5]. However, the environmental conditions are very different in both areas, and whereas the salinity in this 'coastal lagoon' in the Atlantic is around 35% throughout the year, in the Bizerte lagoon salinity varies between 20 and 40% [9].

Two hypotheses could explain our discovery. The first one is the environmental characteristics of the lagoon have changed and they become suitable for the settlement of *S. granularis* larvae. This hypothesis is also supported by Gueroun *et al.* and Alves-Martins *et al.* who recently reported the presence of new species of cnidarians and foraminifera in the Bizerte lagoon [9,13]. Additionally, the population density of *S. granularis* in the marine habitats nearby is very low, especially in shallow waters, and this fact could explain why we only found a specimen.

Because the migration of adult sea urchins through the channel does not seem feasible, the other potential explanation to the finding is the individual was accidentally transplanted from the coast and it has survived in the new habitat. In any of the cases, this study demonstrates *S. granularis* has large temperature and salinity tolerance ranges and therefore it can be found in highly fluctuating environments. A long-term monitoring program in Bizerte lagoon is required to conclude if the species finally colonize the lagoon and if so, to identify the ecological consequences.

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Authors' contributions

FS identified and reported the specimen. AO and MH carried out the sampling. FS, RO and BB prepared and wrote the manuscript. All authors approved the final manuscript. Finally the authors thank ACD for the English revision.

Competing interests

The authors declare that they have no competing interests.

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