PHYSIOLOGICAL INDICES AND REPRODUCTION IN THE SEA URCHIN *Paracentrotus .lividus* (Lamarck, 1816) *Echinodermata Echinoïdae* IN THE WEST COAST OF ALGERIA

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ABSTRACT

Our study focuses firstly on the comparison of changes in physiological indices in this invertebrate species living in two different habitats, one being in Ain Franin, an environment rich in photophilous, presence of algae and Posidonia oceanica magnoliophyte and the other in the bay of Oran considered a polluted area, rocky and poor food intake. This is followed by a histological study that allows us to see the evolution of germ cell and tissue reserves and to define the stages of sexual maturity, as well as examining the influence of temperature, salinity, pH on the phenomenon of spawning in this echinoid.

Keywords: *P.lividus, Ain Franin, Port Oran, physiological indices, histology, abiotic factors.*

1. INTRODUCTION

The sea urchin, considered the largest herbivore in the Mediterranean, is very sensitive to environmental changes. Thus this zoological group has remarkable methodological advantages (VERLAQUE 1987; PERES and PICARD, 1964) because of the large number of important works concerning its biology, ethology and growth. In our study we are interested in the annual change of two physiological indices (IRm) and (IGm) and to determine the relationship between dietary ratio (IRm) and reproduction in two populations of urchins from two sampling sites, the port of Oran and Ain Franin. Complementing this work there will be a histological study of the gonads of the regular sea urchin to observe in the evolution of germ cells the fabric subject in order to precisely define the spawning period in P.lividus and see the effect of the temperature factor, salinity, pH of the monthly evolution of the gonad index (IGM).

2. MATERIALS AND METHODS:

The collection of 140 samples is carried out from January 2011 to January 2012 at a depth of 2 to 10 m located at (00 ° N 37 ° 35'43'135 " 675'00 " W) in the port of Oran that is impacted an area of rocky nature (Chahrour, 2013) , and Ain Franin located at (00 ° N 30 ° 35'46'854 " 768'00 " W) considered a non-impacted area with the absence of anthropic action (HEBBAR, 2005) Figure 1.

Figure 1: Location of sampling sites.

All urchins have undergone sorting where we had two size classes i.e. 31 -40mm and 51 -60mm. Once the dissection performed roes and the digestive tract more of its contents are taken separately, they are transposed in foil and steamed at 70°C for 48 h. of weight measurements using a precision balance expressed in grams, done to determine the dry weight of each compartment. To determine the physiological indexes the choice concerns the formula (SAN MARTIN 1995) which gives the dry weight of the intestine on the diameter of the cube samples on gonadal index is the dry weight gonads on the diameter of the cube specimen.

- Index repletion**:** $$IRm = \frac{PS\ Int}{D^3}\ (mg/cm^3)$$

- Gonadal Index**:** $$IGm = \frac{PS\ G}{D^3}\ (mg/cm^3)$$

To this are appended measurements of the abiotic factor, the temperature, salinity and pH of the medium using a multi-parameter (HANNA), to see the influence of these on the spawning period in this echinoid.
The remaining 20 samples (10 males, 10 females) are reserved for histological study namely macroscopic and microscopic study, after dissection ambitus five gonads were removed and emerged in pill containing 10% formalin (Martoja Martoja 1967).

Statistical Processing
All samples on physiological indices were statistically processed using the Statistica 6.0 software.

3. RESULTS AND DISCUSSION
The study on all samples (1440 samples) has allowed the monitoring and determination of changes in two physiological indices namely repletion index (IRm) and the gonad index (IGm) . We note that for IRm monthly variation for the set of two size classes has been recorded where the highest values correspond to the class size (31-40mm) with a maximum of (45.8 ± 2 5mg / cm3) in January for specimens at Ain Franin whereas samples from the port of Oran that is observed in March with a value of (53.6 ± 2.7 mg / cm 3). Such high values are due to the high availability of organic matter suspended in the port of Oran and the richness of the site in Ain Franin with photophilous presence of algae and seagrass.

On the other side the gonad index (IGm) shows monthly changes throughout the study period with a minimum of (0.99 ± 0.03 mg / cm 3) in October and a maximum of (22.7 ± 2 4 mg / cm 3) in August for the class size of 51-60 mm urchins at Ain Franin . Regarding samples at Port of Oran the maximum is 24.8 ± 1.3 mg / cm 3 in June and minimum of 1.0 ± 0.04 mg / cm 3 in October for the class of 31- 40mm size. Samples at Ain Franin records at the class size of 51- 60mm record maximum (32, 6 ± 1.2 mg / cm 3) and minimum (1.08 ± 0.01 mg / cm 3) and that for the same month of October. While for the smaller class size maximum in August is 21.01 ± 1.5 mg / cm 3 and the minimum is (0.9 ± 0.03 mg / cm 3) in October (Figures 2A, 2B, 2C and 2D).
The study of the average index of repletion (IRm) is characterized by a high abundance of food resources related to sizeable algal diversity and the presence of Posidonia, which allows for easy feeding for urchins at Ain Franin, unlike those of the port of Oran where lower trophic resources related to the effect of pollution is noticed (and Dermeche Boutiba 2006; Dermeche et al 2007).
The values clearly show fluctuations depending on the month of the annual cycle and that whatever the class size , the elevation of the repletion index is intended to provide the necessary energy to sexual gametes to maturity and therefore a higher spawning as the more urchin eats the more he develops his gonads (Lawrence,1990).

According to Leighton (1968), gonad development causes a decrease in the physical space of the coelomic cavity, so the space is not sufficient for the digestive tract and its contents which fall in the index of fullness. It moves inversely to the size of the sea urchin, this is in line with the conclusions of many authors who have shown that the relative rates of consumption of regular sea urchins decreases with height (Klinger, 1982; Lumingas 1994; Nedelec 1982, Semroud 1993 Sahnoun, 2008, Dermeche, 2009 Boukhlef, 2011 Kouadri, 2012). The mean gonad index may also be influenced by habitat and environmental conditions. In our work, Paracentrotus lividus, is in feeding conditions difficult (plant resources are low), at the port of Oran. The species in this site manifest scavenger behavior, scraper and use of plants in wrecks (Belkdim, 2010 Dermeche, 2010).
The quality and quantity of food significantly influence on gonadal growth (Fuji, 1967; Gonor 1972, O'Connor et al, 1978; Regis, 1979, Lawrence and Lane, 1982; Keats et al, 1984 b) and this even for population lying in unimportant

distances from each other (Ebert, 1968; Gonor 1973a; Vadas, 1977; Keats et al, 1984b; Byrne, 1990; Lumingas, 1994).

The index of fullness presents monthly changes in the overall population P.lividus, low values of the index correspond to the repletion period when the gonad index rises. In Echinoidea, the feed rate is low, when the gonads are well developed (Lawrence, 1975; Buckle et al, 1980; Lawrence, 1987; Sellem, 1990; Lumingas 1994; Lazano et al, 1995).

Monthly fluctuations of both physiological indexes shows that whatever the size class considered repletion index is intended to provide the necessary energy to sexual gametes. The fall of the gonad index means a gonad development (pre-spawning, spawning) (LAWRENCE, 1975; BUCKLE et al, 1980; SELLEM 1990; LUMINGAS 1994; LOZANO et al, 1995). These falls reflect the existence of spawning in early spring and autumn (Table 6) , as is also the case for urchins in Tunisia (Sellem and Guillou, 2007) and Algiers (Soualili, 2008) (Table 1) .

In general, spawning periods, when the study is spread over one annual cycle are in spring and late summer and early autumn (Semroud and Kada, 1987), it must still specify that annual variations in the spawning period may occur in Echinoidea (Fernandez, 1993). These may be due to many factors, such as variations in water temperature (Guillou and Michel, 1993 a). Indeed in the Mediterranean Fenaux (1980) suggests that spawning would be induced when the water temperature reaches 13-20 ° C , in our case it is clear that the onset of spawning is a function of temperature and is demonstrated in both populations (Fig: 3A, 3D). But this egg is not due solely to this factor and that there are other factors helping this gametic induction , such as turbulence (PEDROTTI 1993; SOUALILI , 2008) , phytoplankton blooms (HIMMELMAN 1975; STRARR et al, 1990, 1993; PEDROTTI,1993) , hydrodynamics (SOUALILI 2008; Dermeche , 2010) and photoperiod (SPRIRLET et al , 1998) According STRARR et al , 1993) the start of spawning in this echinoid is much more induced by the gross increase of the temperature due to salinity and pH (Figures 3B , 3C , 3E and 3F).

For more clarity and to highlight the factors that bridge the histological study of the gonads to enable a qualitative estimate of their maturation, where five microscopic stages were observed in plate 1 (A, B).

The reproductive cycle of P.lividus is similar to that of other echinoderms gonochoric. Germ cells are cells from the coelomic epithelium (outer wall of the gonad) (FENAUX, 1980 DRUMMOND, 1991; GONOR, 1973) noting that in the gonads of the Strongylocentrotus purpuraus presence of spermatogonia and oogonia , grouped in small clusters spaced along the wall gonadal , supposed that some Gonies gonadal epithelium must differentiate into gametes on each reproductive cycle.

Tracking the monthly evolution of macroscopic stages of all samples used for monitoring physiological indexes allows a quantitative study of the maturity of this species at both sampling stations for 12 months (Figures 4, 5 and 6).

In the month of January the size of the gonad is small, despite the presence of some residual eggs in the ovary (plate 1 A, B, Stage 1). This is confirmed by the presence of more than 50% of samples in stage 2 (growth) and stage 1 (post spawning). January and December, Figure 4 (A, B) gonads begin to gain volume from February and September or they reach their maximum in April and October. The fabric reserve begins to develop and tends to fill the gonad, residual gametes were phagocytosed and parallel some of the primary oocytes begin to develop acinis, begin to multiply and mark the beginning of the period of maturation of gametes sea urchins that are then in full activity of maturation. They are marked by the presence of more than 55% of samples in stage 4 (maturation) and over 58% of samples in Stage 5 (spawning) or have observed eggs filled the ovaries plate 1 (A, B) from March to May and September to November (Figure 4) in the two sampling sites.

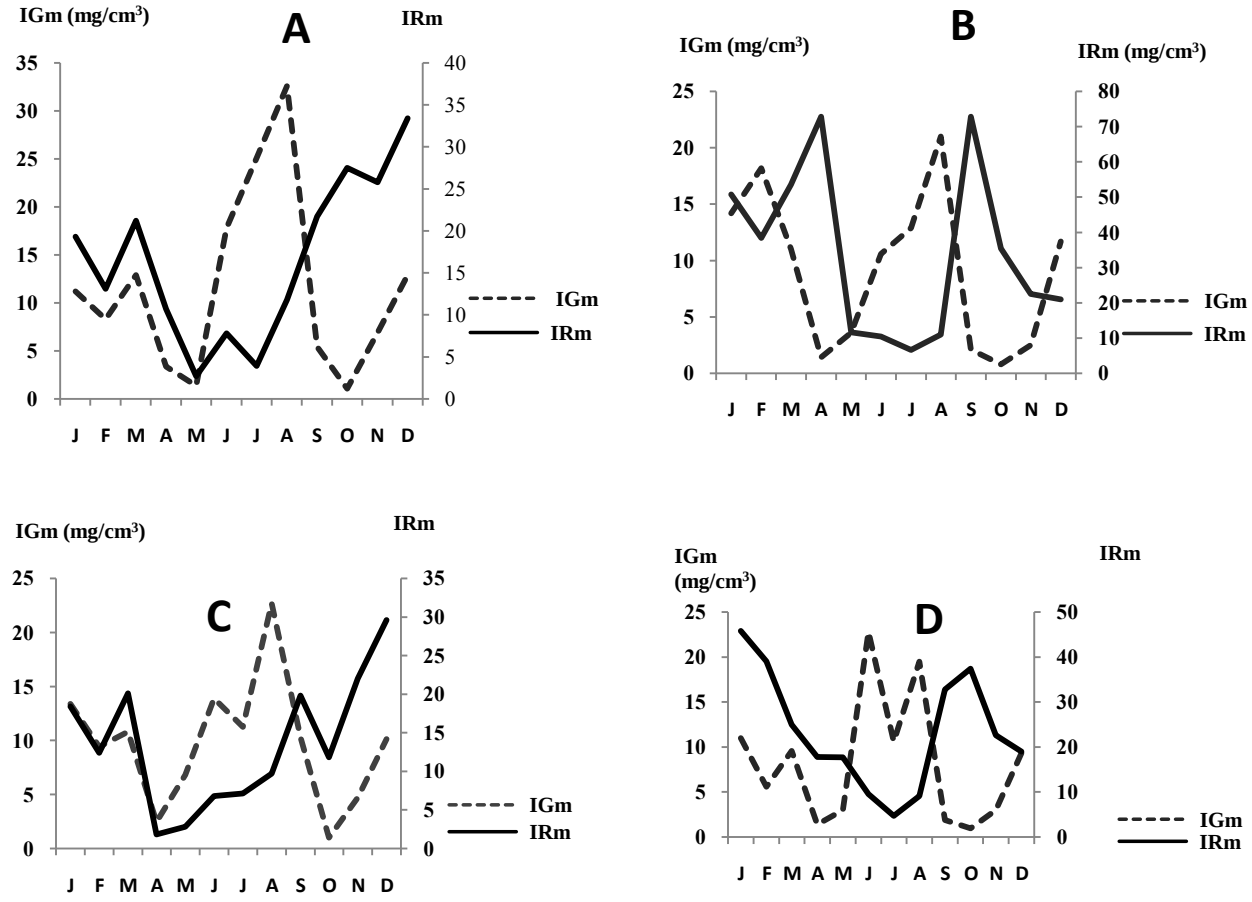

Figure 2: Monthly evolution of physiological evidence and means of P.lividus. For class size (31-40 mm) and class size (51 -60 mm) Port of Oran: A, B and Ain Franin: C,D.

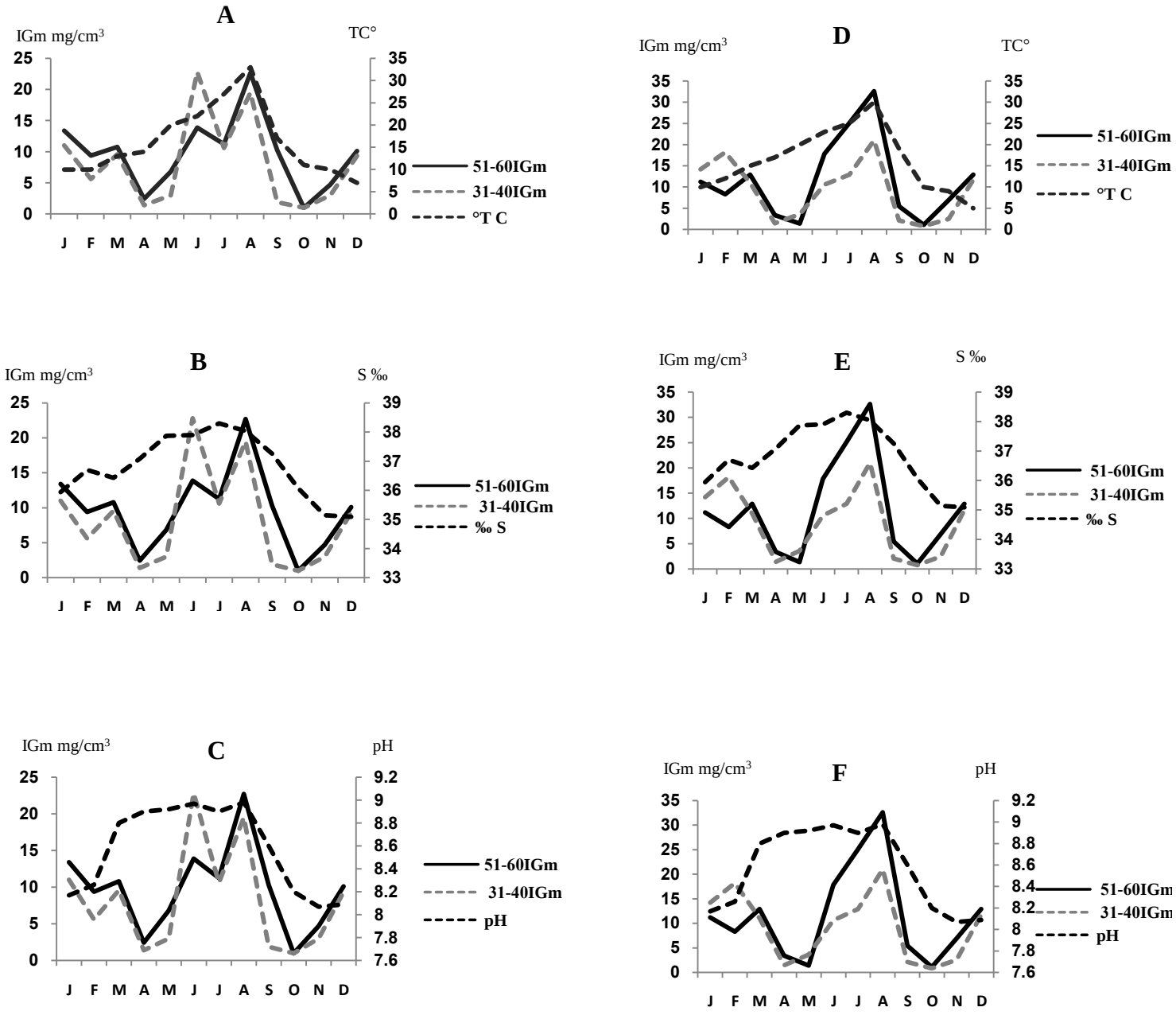

Figure 3: Influence of temperature, salinity and pH on the average gonad index of P. lividus class size (31-40 mm) and class size (51-60 mm) at Port of Oran (A, B, C) and at Ain Franin (D, E, F).

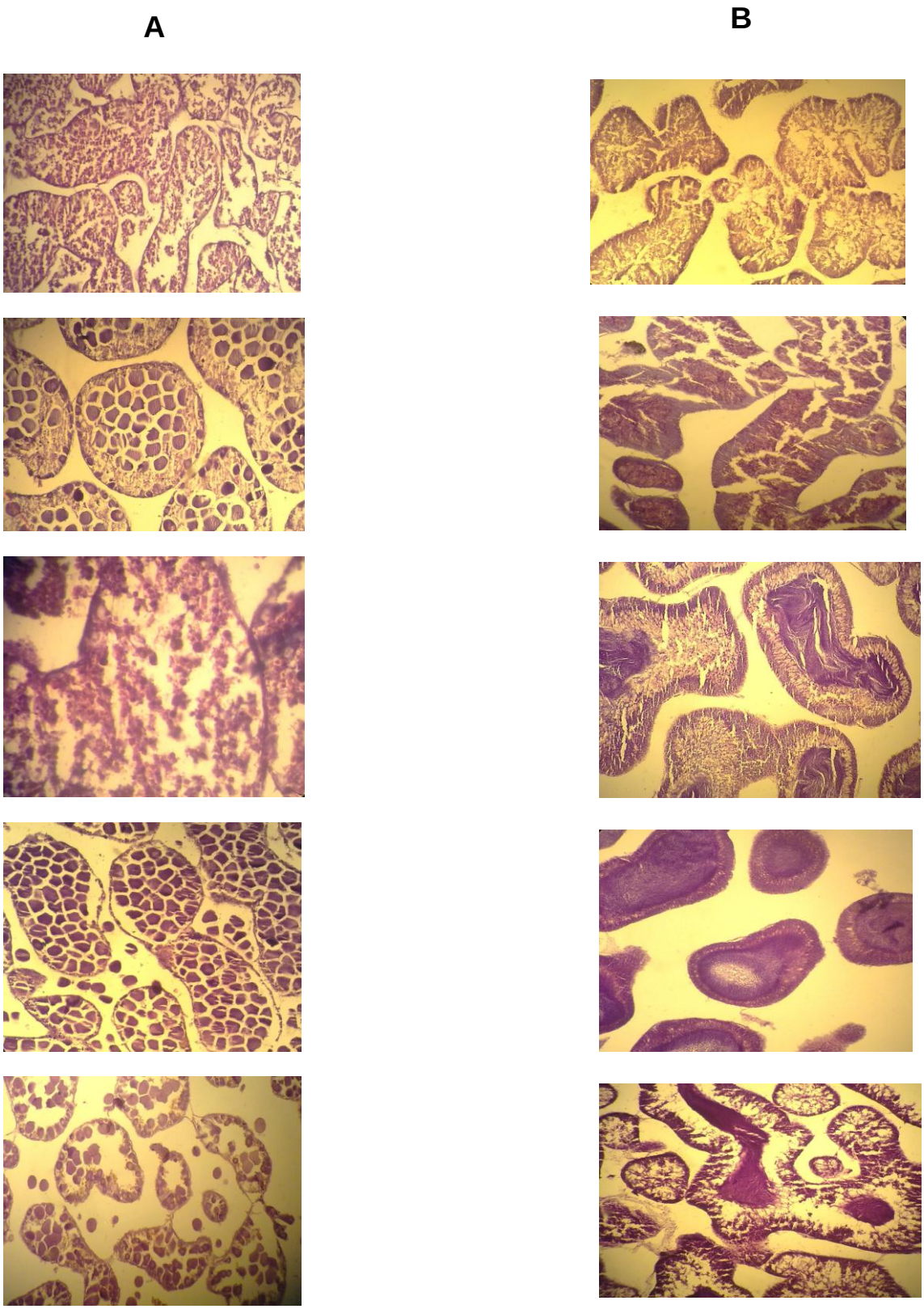

Plate 1: Histology of the ovaries (A) and testicules (B) of Paracentrotus lividus (X100)

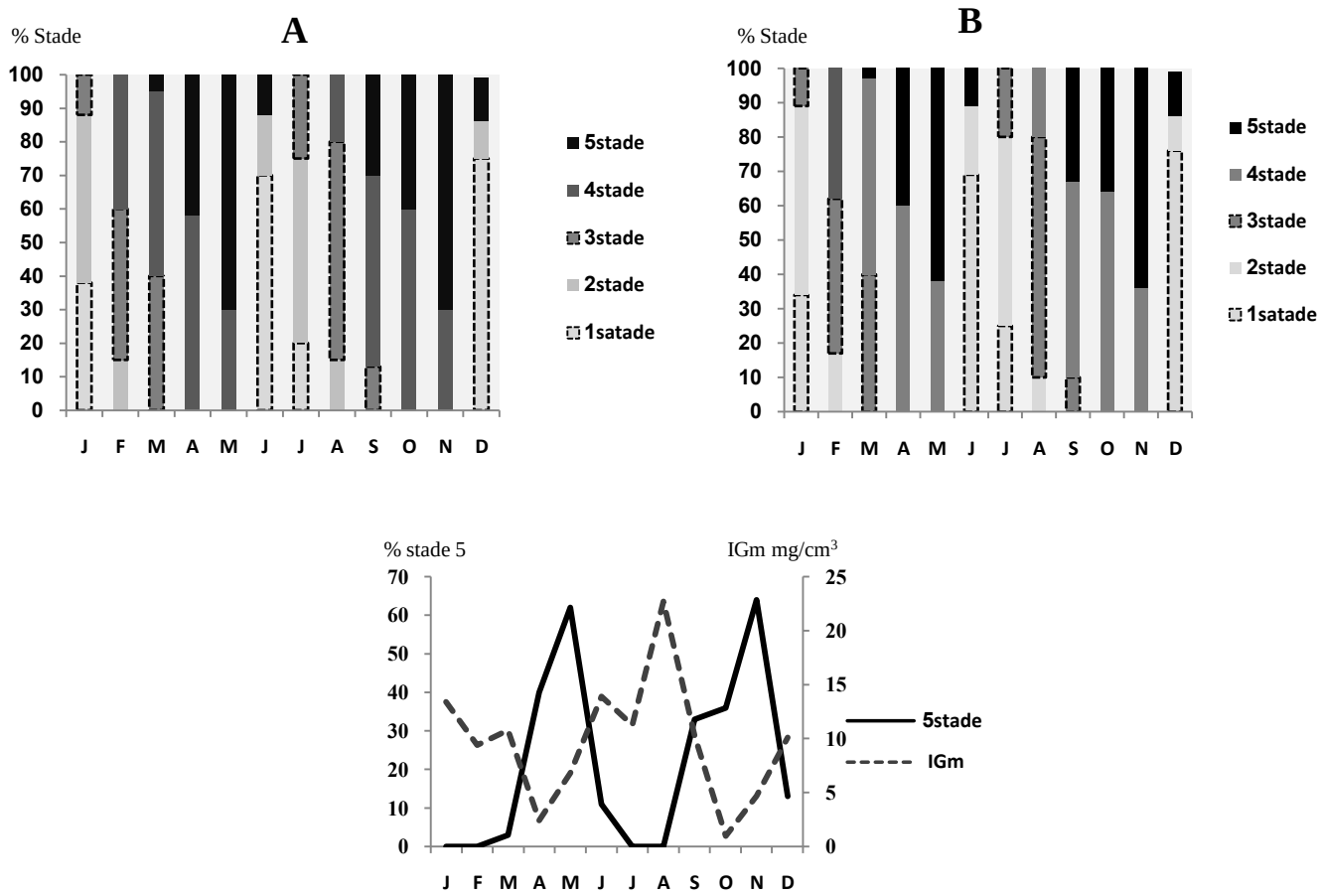

Figure 5: Evolution of monthly means, gonadal index and percentage of samples in Stage 5 of the population in Paracentrotus lividus .

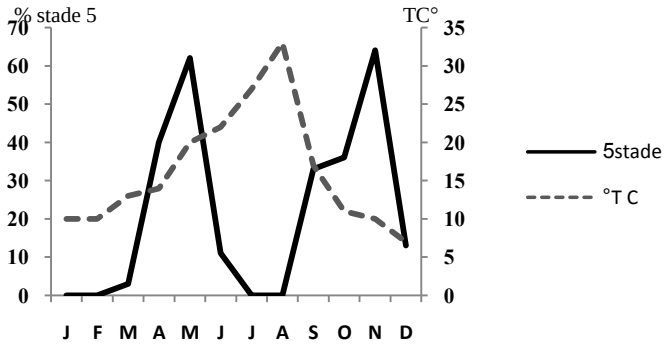

Figure 6: Monthly evolution of the temperature and the percentage of samples in Stage 5 of the Paracentrotus lividus population.

4. CONCLUSION

Monthly observation of changes in physiological indices (IGm, IRm) have permitted to locate the spawning period (spring, autumn) for the two sites and two size classes of urchins attending our coast, the link between these two indices have demonstrated that the period of high consumption is related to the period of maturation of the gonads.

The increase in temporal temperature for the full year of sampling (January 2011-January 2012) emphasizes the role of the latter in the onset of laying and this regardless of the site of study.
Histological examination confirmed the presence of spawning (spring, autumn) in two sites, thus validating the use of gonad index as a descriptor in the reproductive cycle.

Table 1: Period pundits P.lividus in Mediterranean and North Atlantic Ocean.

References	Laying Period	Study Site
Fenaux (1968)	Late Spring (June) and autumn (September-October)	France
Allain (1975)	From March to September	Bretagne Nord, France
Crapps et Willis (1975)	Spring (May- June) and autumn (September-November)	Cote ouest, Irlande
Régis (1979b)	late winter -early spring and late summer	Marseille, France
Verlaque (1984)	spring (May -June) and autumn (September-November)	Corse, France
Byrne (1990)	Summer (July-August)	Irlande
Semroud (1992)	Spring (March- May) and summer (July)	Alger, Algérie
Lozano et al. , (1995)	Spring early summer	Espagne
Fermandez (1996)	Spring (March -June) and late summer autumn (August-September)	Corse, France
Soualili (2008)	(June- July) and autumn (September-November) and winter	Alger, Algérie
Dermeche (2010)	Spring (March- May) and summer (August-July) and fall	Mostaganem, Algérie
Boukhelef (2012)	Spring (March- May) and autumn September-November)	Mostaganem, Algérie
This study	Spring (March -May) and autumn (September- November)	Oran, Algérie

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