

***Pseudo-Nitzschia* sp (Bacillariophyceae), seasonal distribution in the lagoon of Nador (Morocco).**

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Abstract. The goal of this study is to look into the dominance of diatoms, specifically the genus "*Pseudo-Nitzschia* Sp" at the Nador lagoon level and how it relates to the physicochemical parameters of the environment. From the four sampling stations and for two seasons (spring and summer 2018). This diatom of the genus "*Pseudo-Nitzschia* Sp" includes toxic species capable of producing domoic acid (DA), a neurotoxin responsible for amnesic intoxication syndrome in humans. During sampling, the species "*Pseudo-Nitzschia* Sp" showed variable cell densities between stations and seasons. The dominate microalgae were observed during the spring period with a maximum concentration of (4000 Cells / l). And a low viscosity during the summer seasons (140 Cells / l).

1 Introduction

Diatoms (Bacillariophyceae) are the unicellular algae which constitute the most diverse group of eukaryotic phytoplankton, estimated at 12,000 species [1], they produce 40% of the total marine photosynthetic activity and Responsible for about 20-25% of marine primary production [2,3].

Diatoms also play an essential role in climate regulation by absorbing and storing nearly 40% of anthropogenic carbon dioxide. [4]. The photosynthetic apparatus of diatoms consists of two main parts: the collecting antenna that absorbs light energy and the reaction centre (RC) that transforms this light energy into chemical energy. This photosynthetic activity is similar to other eukaryotic algae and all types of plants.

The life cycle of diatoms has two main stages, as in the case of many phytoplanktonic organisms, such as: the vegetative stage where diatoms are diploid and reproduce by mitosis (asexual reproduction) and the relatively short stage of sexual reproduction [5,6].

To date, the genus *Pseudo-Nitzschia* H. Parag. in H. Parag. and Parag 1900 belongs to the order pennate diatoms and is represented by cells, of elongated shape. This genus includes 52 species of which 26 produce a neurotoxin called domoic acid (DA), responsible for the contamination of shellfish with amnesic toxins [7,8,9,10,11].

Domoic acid, an amnesic toxin, is an A low molecular weight amino acid of 311 Da belonging to the kainic acid group of neurotoxins. It has three carboxylic groups, is water - soluble and thermostable. At temperatures above 50°C or under ultraviolet (UV) radiation, domoic acid isomerizes to give mainly epidemic acid and is domoic acids [12]. This tricarboxylic amino acid has a structure similar to glutamate, which is an excitatory neurotransmitter in the mammalian central nervous system. Only domoic acid and its analogue epi- domoic acid are considered toxic [13].

DA poisoning occurs 2 to 24 hours after ingestion of contaminated shellfish and is characterized first by gastrointestinal symptoms such as vomiting, diarrhea and abdominal cramps, followed by neurological symptoms (after 48 hours) such as headaches, convulsions, disorientation, short-term memory loss, and even coma and death in the most severe cases [14,15,16,17]

Pseudo-nitzschia is a genus important of diatoms, regularly present in the phytoplankton community in the Mediterranean Sea, with a tendency to increase in abundance [18]. Recently, 15 species of potentially toxic *Pseudo-Nitzschia* have been reported in the Mediterranean Sea [19], of which at least nine have been identified in the Adriatic [20,21]

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Study area

The Nador lagoon (35°05'N-35°14'N, 2°44'W-2°56'W) is located in northeastern Morocco, between Cap des Trois Fourches and Kariat Arekman on the Mediterranean coast. It has an area of 115 km² and its maximum depth is about 8m. It is also considered as the second largest lagoon complex in North Africa [22,23].

This body of water communicates with the Mediterranean Sea through a new artificial channel, 6.5 m deep, and 300 m wide [24]. The water in the lagoon throughout the basin can be renewed. This lagoon is known as an important activity for fishing and aquaculture, as well as an important site for phytoplankton production [25].

Sampling

The sampling campaigns were conducted at 4 stations, which corresponds to **St A**: Beni Ansar, **St B**: Old Pass, **St C**: Kariat Arakman and **St D**: Oued Bou-Arg, and in a seasonal manner (spring and summer 2018).(Fig.1)

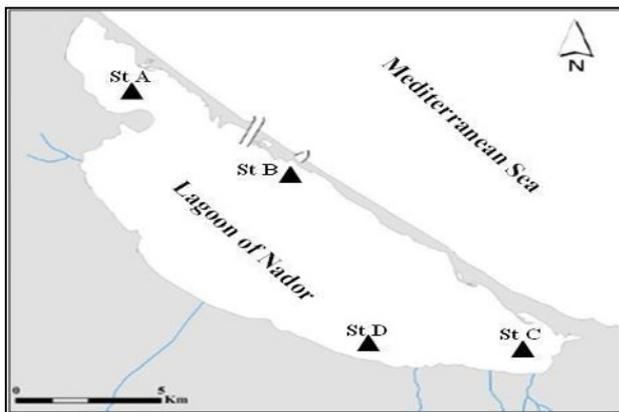


Figure 1: Map of the distribution of the sampling stations

At each station, water samples were taken to perform the identification and enumeration of "*Pseudo-Nitzschia Sp*", using an inverted optical microscope, and physico-chemical analysis of the water of the Nador lagoon such as: (Temperature, Hydrogen potential and Salinity) in-situ using specific probes and (Nitrate, Suspended matter) were carried out ex-situ.

3 Results and discussions

During the period of study, the temperature of the waters of the Nador lagoon at the plane of the four sampled stations oscillated between a value minimum of 18.9°C at station C which corresponds to Kariat Akarman, recorded in the spring period, and a value maximum of 26.7°C at station A recorded during the summer period,

which corresponds to Beni Ansar (Fig.2). Our results are similar to those found by [26,27].

The pH is one of the most essential quality parameters used to evaluate the health of aquatic ecosystems. During the study period, the measured pH varies between a minimum value of 7.9 during the summer period, and a maximum value of 8.6 noted in the spring period, these values are recorded at the same station D which corresponds to Oued Bouarg, our results are similar to those found by [26,28]. (Fig.3)

In the Nador lagoon, the salinity values recorded in the four sampled stations vary between a minimum and maximum value of 36.1 during the spring period at station C, and 38 was reported at station D, and during the summer period. (Fig.4)

The measured suspended matter, reaches a maximum of 0.06 g/l at station A, and D during the summer period. And a minimum of 0.03 g/l at station B during the spring period; this value is comparable to that found by [26]. (Fig.5)

During the study period, nitrate analysis of the Nador lagoon varies between a minimum of 0.25 mg/l at station B in the spring and a maximum of 0.6 mg/l at station A in the summer, and our results are similar to those found by [26]. (Fig.6)

During this current work, and as shown in Figure 7, the maximum density of "*Pseudo-Nitzschia Sp*" in the waters of the Nador lagoon was noted in the station B, which corresponds to the old pass with a density of order 4000 cells/l, followed by a density of order 1200 cells/l at the level of station A, which corresponds to Beni Ansar, in the period of (spring2018).

However, the minimum cell density of "*Pseudo-Nitzschia Sp*" at station C, which corresponds to Kariat Arakman, is of the order of 240 cells/l. The minimum and maximum cell density of "*Pseudo Nitzschia Sp*" Indicated at the level of the four sampled stations in the lagoon of Nador during the period (summer 2018) were 140 cells/l at station C and 800 cells/l at station A.

According to this study, it is visibly noticed that the maximum cell density of "*Pseudo-Nitzschia Sp*" in the lagoon of Nador and during the two periods studied, is recorded during the spring season, the latter is comparable with the french coastal waters, in which "*Pseudo-Nitzschia Sp*" bloom during the spring season [29]. Species toxic of "*Pseudo-Nitzschia Sp*" are noticed in the lagoon of Bizerte (Tunisia) as reported by [30].

The existence of "*Pseudo-Nitzschia Sp*" is frequent in the lagoon of Nador at sometimes very high Concentrations, reaching hundreds of thousands per litre. However, they have never been associated with shellfish contamination of the lagoon in ASP [31].

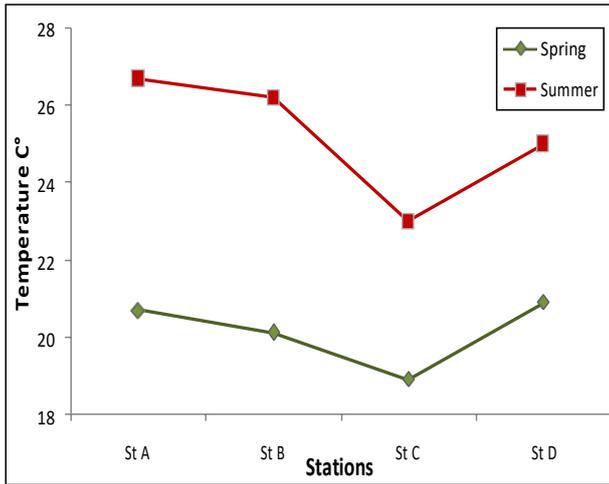


Figure 2: Temperature variation during the two study periods and at the Nador lagoon.

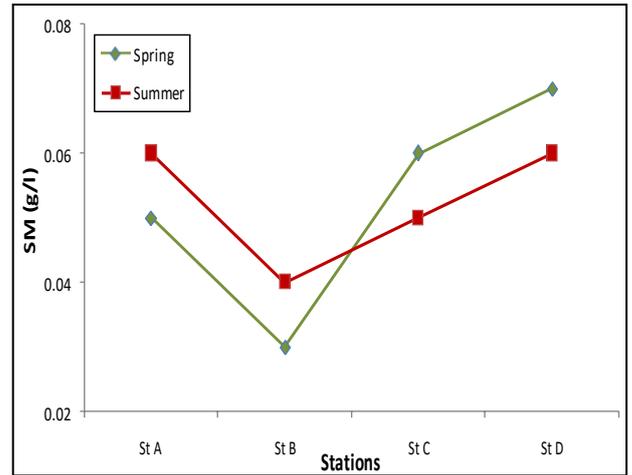


Figure 5: SM variation during the two study periods and at the Nador lagoon.

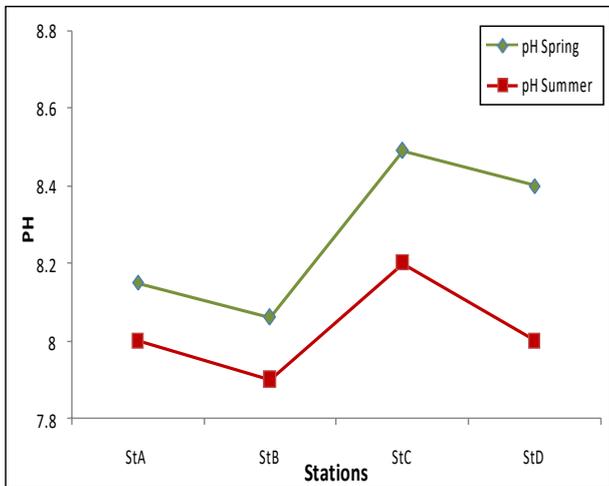


Figure 3: pH variation during the two study periods and at the Nador lagoon.

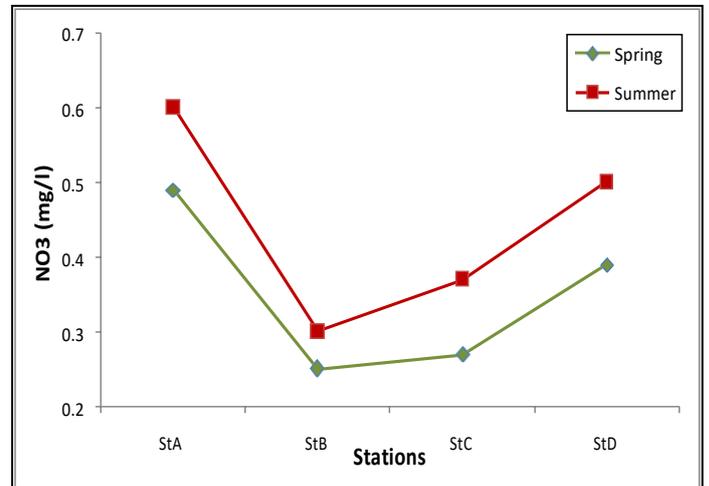


Figure 6: Nitrate variation during the two study periods and at the Nador lagoon.

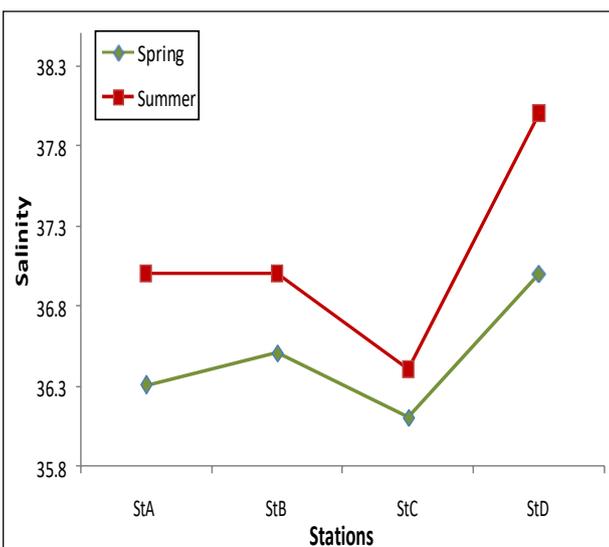


Figure 4: Salinity variation during the two study periods and at the Nador lagoon.

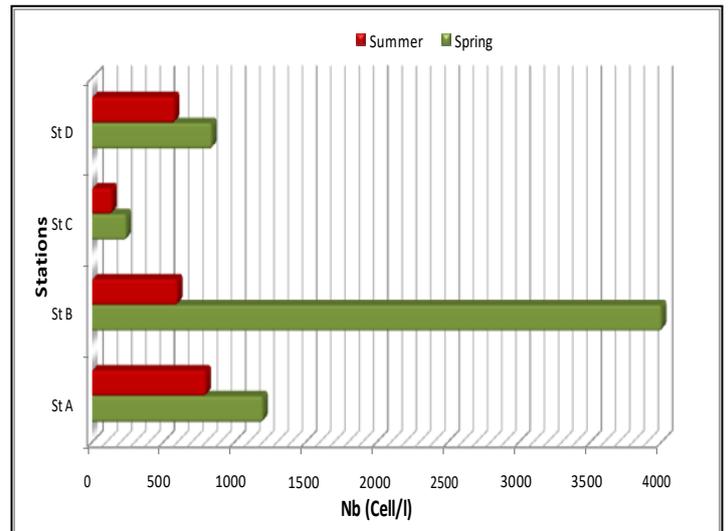


Figure 7: Spatial variation of the density of *Pseudo-Nitzschia Sp* during the two study periods and at the Nador lagoon.

This present study showed that at the level of the Nador lagoon, the species “*Pseudo-Nitzschia Sp*” was present during the periods studied (Spring 2018) (Summer 2018).

According to this study, the maximum number of “*Pseudo-Nitzschia Sp*” (4000 Cells/l) is observed at station B, located in the North of Nador lagoon and near the new pass communicating with the Mediterranean Sea, thus the dominance is under marine influence. followed by station A with an order of (1200 Cells/l) this dominance is due to the importance of Nitrates values, which favors the development of taxa in this stations. But the minimum cell density of “*Pseudo-Nitzschia Sp*” with an order of (140 Cells/l) is found at station C, corresponds to Kariat Arakman located at the extreme east of the lagoon of Nador, thus the subordination of “*Pseudo-Nitzschia Sp*” is under continental influence and in the confined area.

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