



## First Study of Dinoflagellates Phytoplankton of the Coastal Waters of Haouzia Bay (El Jadida, Doukkala Atlantic Coast, Morocco)

Rachida Bengriche\*, Jamila Chaouite, Mohammed Nafia, Mohammed Moncef

Laboratory of Environmental Study and Analysis, Department of Biology, Faculty of Sciences, Chouaib  
Doukkali University, BP 20, 24000 El Jadida, Morocco

\*Corresponding Author: [rachida.bengriche94@gmail.com](mailto:rachida.bengriche94@gmail.com)

### ARTICLE INFO

### ABSTRACT

#### Article History:

Received: June 22, 2023

Accepted: March 8, 2024

Online: Aug. 16, 2024

#### Keywords:

Phytoplankton  
Dinoflagellates  
Control list  
Microphotography  
Haouzia Bay  
Moroccan Atlantic coast

A taxonomic study was carried out in July 2017 during a sampling campaign at a station in the Haouzia Bay of El Jadida, open on the Moroccan Atlantic coast and located two miles from the port of El Jadida. In this work, we presented for the first time an inventory of the Dinoflagellates phytoplankton of Haouzia Bay, El Jadida. A specific richness of 57 dinoflagellate taxa was noted. Most taxa were illustrated by micrographs based on light microscope observations. The taxonomic list of dinoflagellates was used to identify specific species known to possess potential toxicity effects, including *Dinophysis* spp., *Alexandrium* spp., *Gymnodinium catenatum*, *Lingulodinium polyedra*, *Gonyaulax* spp., or harmful effects, including *Prorocentrum micans*, *Gyrodinium spirale*, *Scripsiella trochoidea*, among others.

### INTRODUCTION

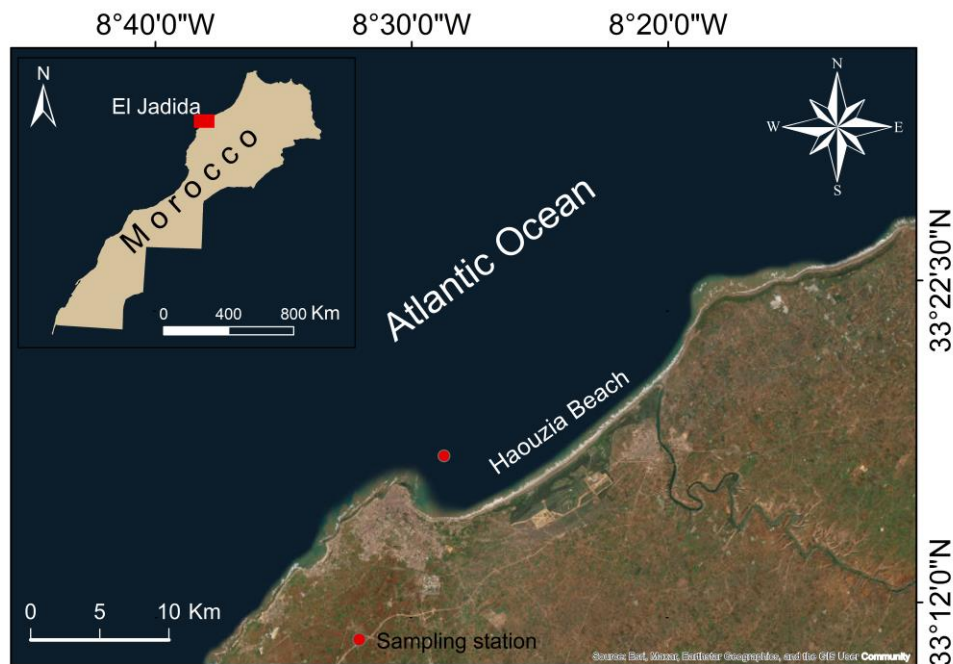
Studies on the taxonomy of the dinoflagellates from the Doukkala coast have focused on the Sidi Moussa-Oualidia lagoon complex, located some sixty kilometers from El Jadida (Bennouna, 1999, 2008; Natij *et al.*, 2014), or the mouth of the lagoon (Akallal, 2001; Akallal *et al.*, 2006). However, the dinoflagellates from the Haouzia Bay coastline have never been reported before. Nevertheless, there has never been any data concerning the dinoflagellates present along the coast of Haouzia Bay (El Jadida). This bay was chosen because of the lack of phytoplankton data from the area. This approach represented the first study to examine the dinoflagellates component of the coastal waters of Haouzia (El Jadida).

Morphological identification of the dinoflagellates collected from the marine waters of Haouzia Bay enabled us to draw up a taxonomic list, the majority of which was illustrated.

## MATERIALS AND METHODS

### Study area

Haouzia Bay, situated along the Moroccan Atlantic coastline, spans from 33°15'00" to 33°21'40" North latitude and 8°18'00" to 8°30'00" West longitude with a north-east to a south-west orientation. The tidal patterns in this area follow a semi-diurnal cycle, characterized by two daily tidal cycles that vary depending on the day, months, and season (Chaibi *et al.*, 2014). Haouzia coast boasts significant socio-economic diversity, with activities such as fishing and tourism thriving in the region. Moreover, the coast is renowned for its extensive and easily accessible wild mussel beds, which are harvested on a small-scale basis (Merzouki *et al.*, 2009). Phytoplankton plays a crucial role in the local ecosystem, serving as a primary food source for both wild and farmed shellfish. Our phytoplanktonic sampling station, focusing on the dinoflagellates, is situated two miles from the port of El Jadida on the Haouzia coast (Fig. 1).



**Fig. 1.** Geographical location of the sampling station - Haouzia Bay (El Jadida)

Physicochemical data (temperature, conductivity, dissolved oxygen, and pH) were measured using a multi 340i multiparameter analyzer model WTW, coupled with an oximeter, a conductivity meter, and a pH meter. Dissolved oxygen concentration was checked using Winkler's volumetric method (Aminot & Chaussepied, 1983). The Lorenzen (1967) method was used to calculate chlorophyll (*a*) concentration.

### Phytoplanktonic study

Phytoplankton material was first collected using a plankton net with a mesh size of 30µm. It was horizontally towed to obtain a sample of the surface layer. Vertical tows were then made using both the net of plankton and a Niskin bottle, two miles from the port of El Jadida (bounded by the cape of Mazagan). Samples were immediately transferred to jars for live observations for exploratory identification, while others were fixed with Lugol and/or formalin solutions and stored in 100ml bottles in the shade for microscopic analysis.

Two microscopes were used to analyze the counting and morphological identification of the samples. After decanting the samples, fixed with Lugol, onto a sedimentation tank, an inverted microscope, Olympus model CK 40, was used to observe and quantify the phytoplankton using the **Utermöhl (1958)** method. A second upright swift microscope was used to observe and determine taxa. Each microscope was equipped with an appropriate camera. Species were recognized based on books and articles on the taxonomy and classification of Dinophyceae (**Trégouboff & Rose, 1957; Sournia, 1986; Ricard, 1987; Fensome et al., 1993; Paulmier, 1994; Nézan & Piclet, 1996; Hasle et al., 1997; Adl et al., 2012; Gómez, 2013**). Numerous other authors and specialist websites were also required (**Guiry & Guiry, 2018**).

The species list is accompanied by microphotographs illustrating several Lugol/Rhode-fixed specimens from observations under an inverted microscope at magnification (x40) or from fresh (unfixed) material examined under an upright light microscope at magnification (x100).

## RESULTS AND DISCUSSION

Sampling was carried out two nautical miles from the port of El Jadida, at surface water level and at a depth of 10 meters. The main temperature between these two points was 23.22°C, with a heat intensity value UTC equivalent to 0.88°C. Conductivity was 53.4ms/cm, and the average pH detected was 8.33. The average dissolved oxygen level was 8.92mg/l, while the recorded chlorophyll (*a*) content was approximately 0.47µg/l (Table 1).

**Table 1.** Physico-chemical readings two miles from the port at surface level and -10m depth

Station	GPS coordinates	Temperature °C	Conductivity ms/cm	pH	Chlorophyll ( <i>a</i> ) µg/l	Dissolved oxygen mg/l
Surface	33°16'01"N	24,9	53,2	8,32	0,67	9,24
-10 m	8°27'30"W	21,55	53,6	8,34	0,27	8,6

An assessment of the species richness of the dinoflagellates was carried out in Haouzia Bay (Moroccan Atlantic). The July 2017 taxonomic inventory revealed a

significant number of the dinoflagellate taxa from this ecosystem. 57 Dinoflagellate taxa were reported for the first time from the Bay of Haouzia (El Jadida), 54 of which were classified at species level and 3 at genus level. In total, these taxa are grouped into 25 genera, which include 15 families and two classes.

### **Dinophyceae class**

#### Order of **Prorocentrales**

Family Prorocentraceae

***Prorocentrum*** Ehrenberg, 1834

*P. arcuatum* Issel

*P. balticum* (Lohmann) Loeblich III

*P. donghaiense* Lu

*P. micans* Ehrenberg

*P. cf. minimum* (Pavillard) Schiller

*P. scutellum* Schröder

*P. sp.*

#### Order of **Dinophysiales**

Familly of Dinophysiaceae

***Dinophysis*** Ehrenberg, 1839

*D. acuminata* Claparède & Lachmann

*D. caudata* Saville-Kent

*D. fortii* Pavillard

*D. sacculus* Stein

***Phalacroma*** Stein, 1883

*P. rotundatum* (Claparède & Lachmann) Kofoid & Michener

#### Order of **Gymnodiniales**

Familie Brachidiniaceae

***Karenia*** Hansen & Moestrup, 2000

*K. mikimotoi* (Miyake & Kominami ex Oda) Hansen & Moestrup

Familly of Gymnodiniaceae

***Amphidinium*** Claperède & Lachmann, 1859

*A. sp.*

***Gymnodinium*** Stein, 1878

*G. catenatum* Graham

***Gyrodinium*** Kofoid & Swezy, 1921

*G. britannicum* Kofoid & Swezy

*G. spirale* (Bergh) Kofoid & Swezy

#### Order of **Gonyaulacales**

Familly of Ceratiaceae

***Tripos*** Bory de St.-Vincent, 1823

*T. candelabrus* (Ehrenberg) Gómez

*T. furca* (Ehrenberg) Gómez  
*T. furca* var. *eugrammus* (Ehrenberg) Gómez  
*T. fusus* (Ehrenberg) Gómez  
*T. macroceros* (Ehrenberg) Gómez  
*T. massiliensis* (Gourret) Gómez  
*T. muelleri* (Cleve) Gómez

Family of Cladopyxidaceae

***Micracanthodinium*** Deflandre, 1937

*M. claytonii* (Holmes) Dodge

Family of Goniodomataceae

***Gambierdiscus*** Adachi & Fukuyo, 1979

*G. cf. excentricus* Fraga

***Goniodoma*** Stein, 1883

*G. cf. sphaericum* Murray & Whitting

Family of Gonyaulacaceae

***Gonyaulax*** Diesing, 1866

*G. grindleyi* Reineke

*G. polygramma* Stein

*G. spinifera* (Claparède & Lachmann) Diesing

*G. turbynei* Murray & Whitting

*G. verior* Sournia

*G. scrippsae* Kofoïde

***Lingulodinium*** Wall, 1967

*L. polyedra* (Stein) Dodge

Family of Ostreopsidaceae

***Alexandrium*** Halim, 1960

*A. cf. minutum* Halim)

***Coolia*** Meunier, 1919

*C. cf. canariensis* Fraga

***Ostreopsis*** Schmidt, 1901

*O. ovata* Fukuyo

*O. cf. siamensis* Schmidt

Family Pyrophacaceae

***Pyrophacus*** Stein, 1883

*P. horologium* Stein

*P. steinii* (Schiller) Wall & Dale

Order of **Peridiniales**

Family of Diplopsalidaceae

***Oblea*** Balech ex Loeblich & Loeblich III, 1966

*O. rotunda* (Lebour) Balech ex Sournia

Family Heterocapsaceae

***Heterocapsa*** Stein, 1883

*H. circularisquama* Horiguchi

*H. psammophila* Tamura, Iwataki & Horiguchi

*H. triquetra* (Ehrenberg) Stein

Family Protoperidiniaceae

***Preperidinium*** Mangin, 1913

*P. meunieri* (Pavillard) Elbrächter

***Protoperidinium*** Bergh, 1882

*P. conicum* (Gran) Balech

*P. depressum* (Bailey) Balech

*P. diabolus* (Cleve) Balech

*P. divergens* (Ehrenberg) Balech

*P. leonis* (Pavillard) Balech

*P. pellucidum* Bergh ex Loeblich & Loeblich

*P. punctulatum* (Paulsen) Balech

*P. steinii* (Jorgensen) Balech

Family Thoracosphaeraceae

***Pentapharsodinium*** Indelicato & Loeblich III, 1986

*P. dalei* Indelicato & Loeblich III

***Scrippsiella*** Balech ex Loeblich, 1965

*S. trochoidea* (Stein) Balech ex Loeblich

Order of **Oxyrrhinales**

Family Oxyrrhinaceae

***Oxyrrhis*** Dujardin, 1841

*O.* sp.

**Class of Noctilucophyceae**

Order of **Noctilucales**

Family Noctilucaceae

***Noctiluca*** Suriray, 1836

*N. scintillans* (Macartney) Kofoid & Swezy.

For the sake of convenience, we have counted around thirty species among all the taxa surveyed, to avoid an excessive number of species in low proportions. A species is considered dominant when it has the highest concentration within a given stand.

According to the quantitative analysis carried out, the dinophyceae stand was dominated by *Protoperidinium steinii*, represented by a density of 8060 cells/L, assessed as the most important taxon in the phytoplankton stand. *Prorocentrum scutellum* was detected at 7113 cells/L. Next, *Gyrodinium spirale* associated with *Gyrodinium britannicum* were counted at an average total of 5547 cells/L and *Heterocapsa circularisquama* was reported at 4107 cells/L.

The species with the lowest densities, among the assessed stand, were represented by *Dinophysis acuminata* (40 cells/L), *Dinophysis sacculus* (20 cells/L), *Triplos macroceros* and *T. massilensis* represented by a similar density (13 cells/L) and *D. caudata* (7 cells/L) (Fig. 2).

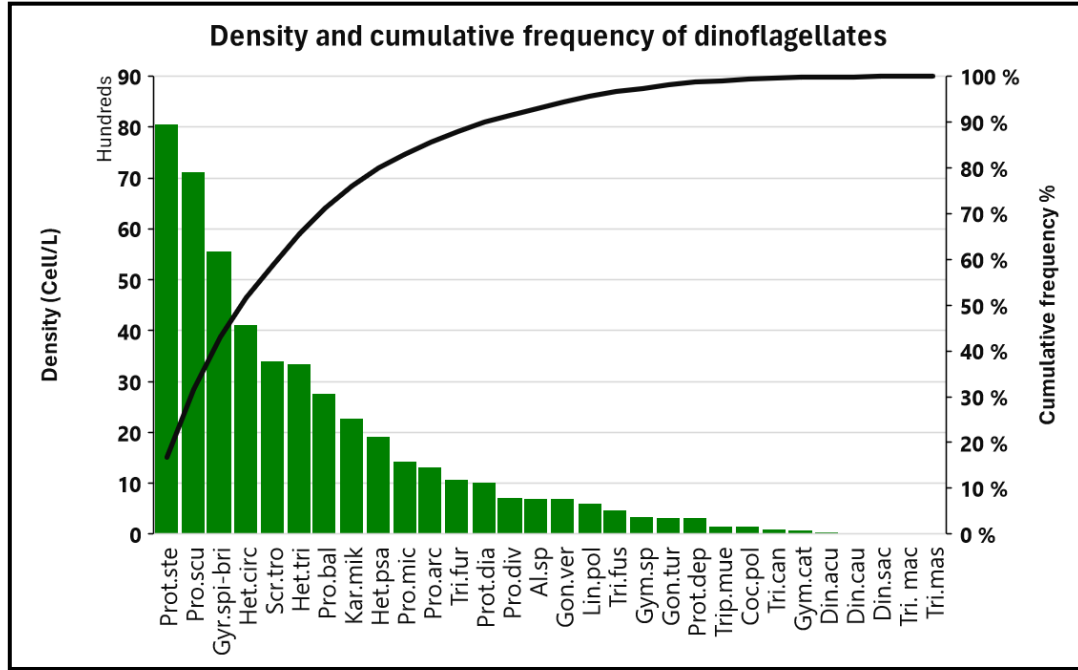


Fig. 2. Diagram of density (Cells/L) and cumulative frequency (%) of dinoflagellate taxa - July 2017

The Pareto plot combines a bar graph showing all taxa in a descending order of abundance with a cumulative curve showing which taxa dominate across all stands. Of the thirty taxa counted, four species (*Protoperdinium steinii*, *Prorocentrum scutellum*, *Gyrodinium spirale* combined with *G. britannicum* and *Heterocapsa circularisquama*) can be considered dominant, accounting for 55.07% of the cumulative frequency (CF) of the total number of cells counted. The remaining portion was distributed among the 25 other taxa included in this taxonomic assessment.

*Protoperdinium steinii* had a relative frequency (fi) of 17.88%, followed by *Prorocentrum scutellum* with 15.78%, *Gyrodinium spirale* and *G. britannicum*, together they had a relative frequency of 12.30%, while *Heterocapsa circularisquama* had a relative frequency of 9.11%. The range of relative frequencies between 6 and 9% included *Scrippsiella trochoidea* (7.56%), *Heterocapsa triquetra* (7.39%), *Prorocentrum balticum*, and *P. cf. minimum* (6.11%). In contrast, the range of values between 0.01 and 6% encompassed the relative frequencies of the twenty-one other taxa identified in the count.

The upwelling zones are very productive. The upwelling phenomena observed along the Moroccan coasts lead to substantial primary production (Franchimont, 1998

and 2001; Penaud, 2009; Elghrib *et al.*, 2012). The study area experiences seasonal upwelling effects during the warmer months. Throughout the sampling campaign, a diverse array of species was identified.

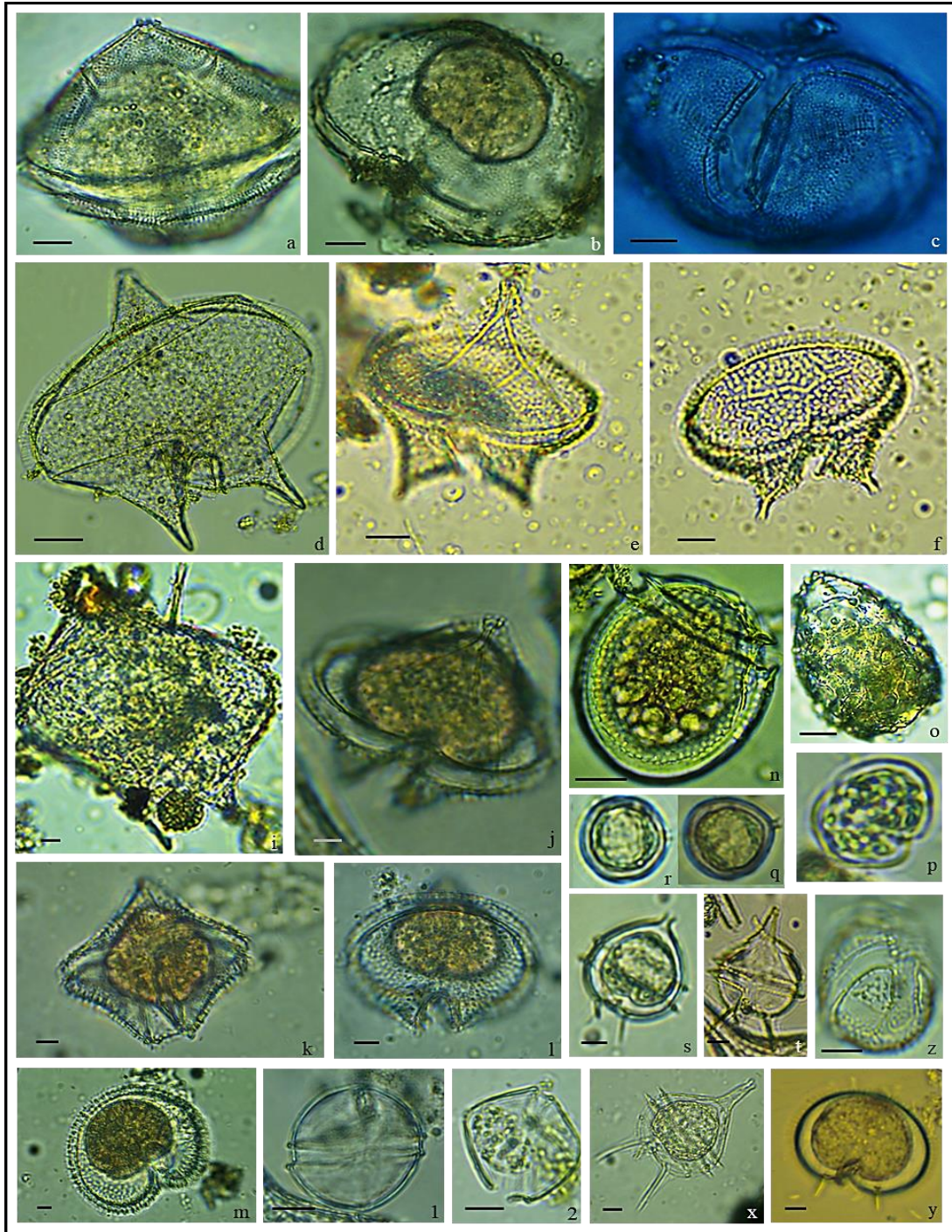
The presence of certain potentially toxic or harmful taxa has been noted. Their appearance is a natural phenomenon that can sometimes be increased by a significant enrichment of the environment in nutritive elements, but without harmful consequences. Nevertheless, under certain conditions, their blooms can have harmful effects through their impact on marine species and/or human health, which seem to have increased in frequency and geographic extent (Hallegraeff *et al.*, 2003).

The species *Alexandrium minimum*, *Gonyaulax* spp. and *Gymnodinium catenatum*, are known to be potentially associated with the production of paralytic toxins through the consumption of PSP-type seafood (Amzil & Motteau, 2000; Herzi, 2013). *Alexandrium minutum* is one of the species that has already led to toxic episodes in the Atlantic (Lassus *et al.*, 2016).

The *Dinophysis* complex contains several species, including *D. acuminata*, *D. caudata*, *D. fortii* and *D. sacculus*, all of which can produce diarrhoeal toxins by eating seafood of the DSP (Diarrheic Shellfish Poisoning) type (Néz & Rocher, 2003; Suzuk *et al.*, 2009). *Dinophysis* never proliferates in high concentrations, but the toxins it produces are capable of contaminating bivalves at a rate of around one hundred cells per liter. *Dinophysis acuminata* is considered an "indicator" species in relation to *D. fortii*. On certain occasions, the appearances of *D. acuminata* preceded that of *Dinophysis fortii* (Lassus, 1984). Four species of *Dinophysis* were identified in the water off the coast of Haouzia coast. *D. fortii* was found with a lower frequency ( $f_i = 0.003\%$ ) compared to *D. acuminata* ( $f_i = 0.09\%$ ). Due its very low frequency ( $f_i$ ), the latter was not included among the taxa selected in Fig. (2).

Other species found in the Haouzia littoral could have detrimental effects if they proliferate. *Karenia mikimotoi*, which typically produces hemolytic toxins affecting marine flora and fauna, has been linked to marine organism mortality (Nézan *et al.*, 1997; Cadour *et al.*, 1997). Additionally, other harmful species have been observed, including *Gyrodinium spirale*, *Prorocentrum micans* and *Lingulodinium polyedra* (formerly *Gonyaulax polyedra*), which produce toxins such as homoyessotoxin, saxitoxin, responsible for shellfish contamination (Charbonnier, 2006), as well as paralytic toxins. *Lingulodinium polyedra* has a wide distribution, and an occurrence of stained water caused by it was documented along the Moroccan Atlantic coast in July 1999. It was observed in the Kenitra region and spread as far south as Safi, affecting areas under health surveillance (Bennouna *et al.*, 2002). This species was also identified on the Haouzia coast during the current study.

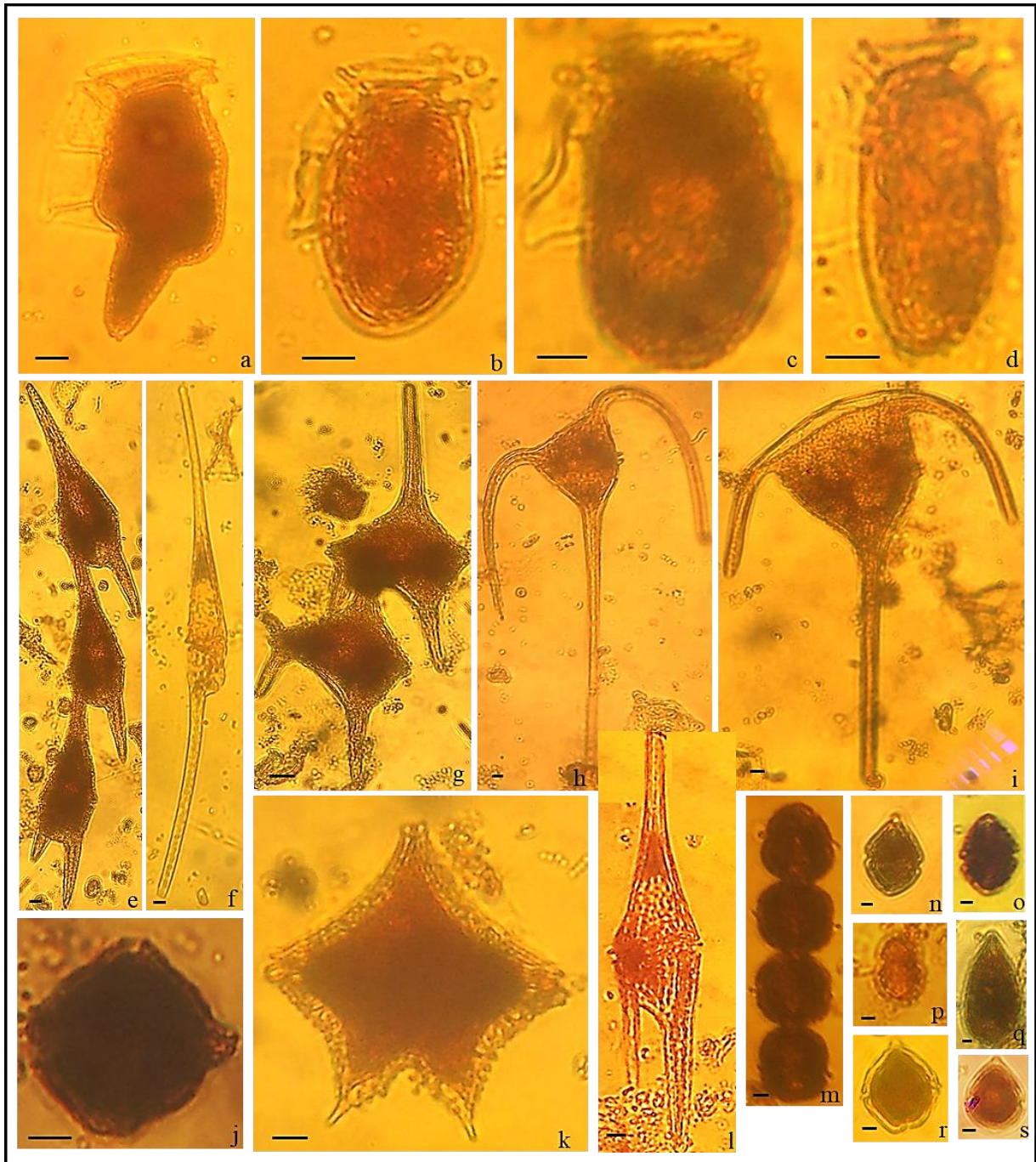




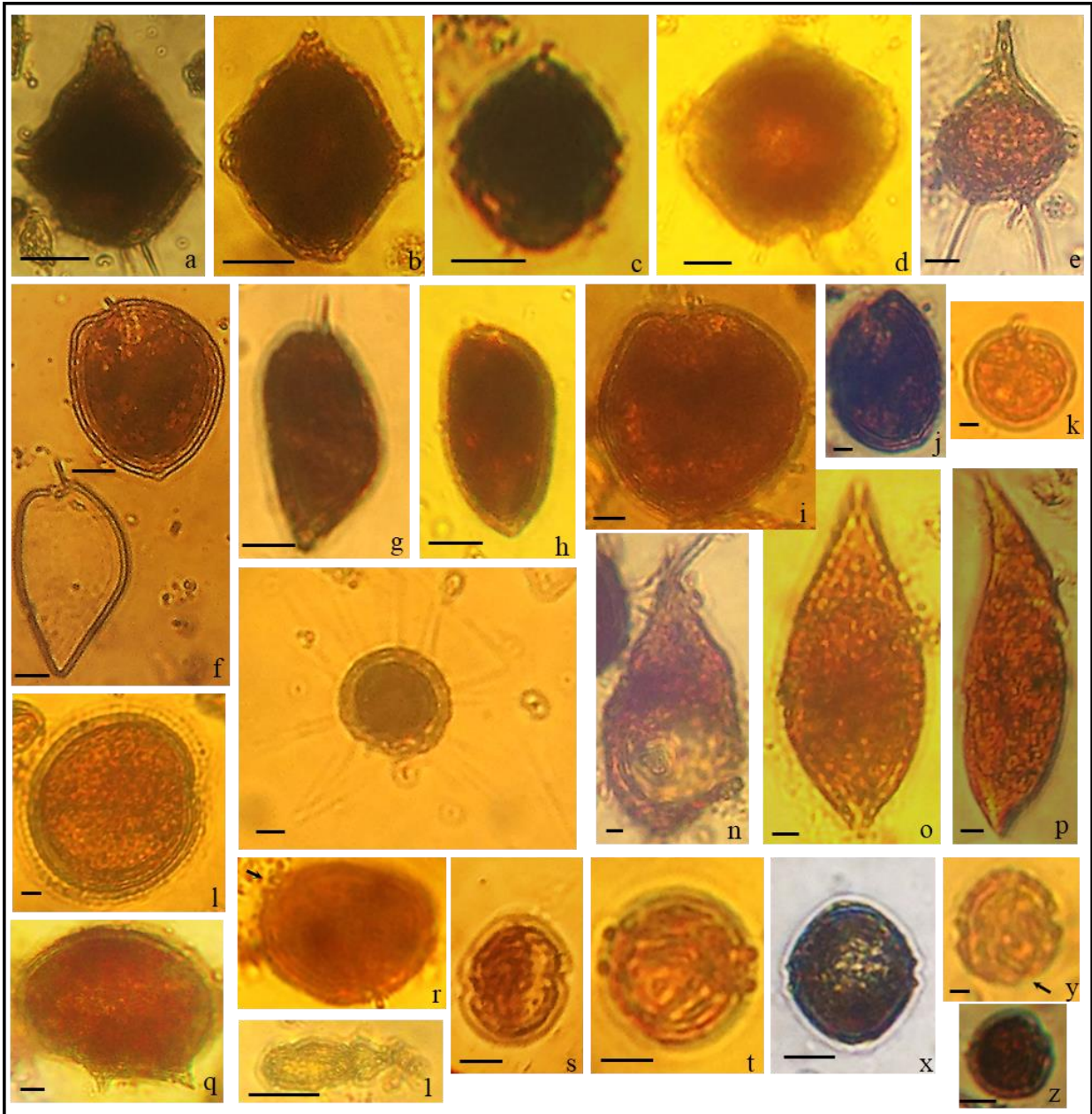
**Plate 1.** Dinoflagellates *in vivo* from Haouzia Bay (El Jadida) (G x100) -July 2017 showing: *Protoperidinium punctulatum* (a-c); *Protoperidinium sp.* (d); *Protoperidinium divergens* (e-f); *Protoperidinium depressum* (i); *Protoperidinium conicum* (j, k, l & m); *Phalacroma rotundatum* (n); *Ostreopsis ovata* (o); cf. *Karina mikimotoi* (p); *Protoperidinium minutum* (q-r); *Protoperidinium steinii* (s); *Protoperidinium diabolus* (t-y); *Gonyaulax scrippsae* (z); *Oblea rotunda* (1); *Scrippsiella trochoidea* (2). All scale bars = 10µm



**Plate 2.** Dinoflagellates *in vivo* from Haouzia Bay (Gx 100)-July 2017 showing: *Tripos muelleri* (a & e); *T. furca* (b); *T. fusus* (c); *T. candelabrum* (d); *T. macroceros* (f); *Gonyaulax spinifera* (g-h); *Prorocentrum micans* cell and empty theca (i-j); *P. scutellum* (k); *Pentapharsodinium dalei* (l); *Pyrophacus horologium* with plates and sulcus (m). All scale bars = 10 $\mu$ m



**Plate 3.** Dinoflagellates from Haouzia Bay (El Jadida) fixed with Lugol / Rhodine (G. x40) -July 2017 showing: *Dinophysis caudata* (a); *Dinophysis acuminata* (b); *Dinophysis fortii* (c); *Dinophysis sacculus* (d); *Tripos furca* var. *eugrammum* (e); *Tripos fusus* (f); *Tripos candelabrus* (g); *Tripos macroceros* (h); *Tripos muelleri* (i); *Lingulodinium polyedra* (j); *Protoperidinium divergens* (k); *Tripos furca* (l); cf. *Gymnodinium catenatum* (m); *Scrippsiella trochoidea* (n); *Heterocapsa circularisquama* (o); *Heterocapsa psammophila* (p); *Ostreopsis* cf. *siamensis* (q); *Gonyaulax polygramma* (r); *Scrippsiella trichoidea* (s). All scale bars = 10µm



**Plate 4.** Dinoflagellates from Haouzia Bay (El Jadida) fixed with Lugol/Rhode (G. x40)-July 2017 showing: *Gonyaulax verior* (a); *Lingulodinium polyedra* (b); *G. cf. turbynei* (c); *Protoperidinium pellucidum* (d); *Protoperidinium diabolus* (e); *Proocentrum scutellum* (up) et *P. micans* thèque vide (bellow) (f); *P. arcuatum* (g); *P. donghaiense* (h); *P. scutellum* (i); *Ostreopsis* sp. (j); *P. balticum* (k); *Preperidinium meunieri* (l); *Micracanthodinium claytonii* in antapical view (m); *Gyrodinium spirale* (n-o); *G. britannicum* (p); *Protoperidinium divergens* (q); cf. *Coolia canariensis* (r); *Gyrodinium cf. lebouriae* (s); *Oblea rotunda* (t); *Gonyaulax grindleyi/minutum* (x); *Gymnodinium* sp. (y); *Gambierdiscus cf. excentricus* (z); unidentified Cell / *Amphidinium* (1). All scale bars = 10µm

## CONCLUSION

This study, conducted at the onset of the dry season (July 2017) in Haouzia Bay on the El Jadida coast, revealed notable diversity in dinoflagellates, which are considered a significant group alongside diatoms. However, the observed taxonomic richness cannot be attributed solely to the abiotic factors mentioned. The abundance of the dinoflagellates in these coastal waters appears to be a response to the seasonal upwelling dynamics in the region.

The presence of potentially toxic or harmful dinoflagellates in the study area poses a risk if consumed by mollusks that can accumulate toxins from these organisms. It is important to note that the toxicity or harmfulness of dinoflagellates can vary depending on environmental conditions and organism concentrations. Therefore, careful monitoring and assessment of these species in their specific context are essential.

Given that the study area serves as a transit zone for the artisanal fishing fleet, ongoing monitoring is recommended to observe interactions between toxic microalgae, other biological components, and abiotic factors. During the study period, however, concentrations of toxic or harmful dinoflagellates did not exceed the alert threshold.

## REFERENCES

- Adl, S.; Simpson, A.; Lane, C.; Lukes, J.; Bass, D.; Bass, D.; . . . and Parfrey, L.** (2012). The Revised Classification of Eukaryotes. *J. Eukaryot. Microbiol.*, 59(5), 429-493. <https://doi.org/10.1111/j.1550-7408.2012.00644.x>
- Akallal, R.** (2001). Contribution à l'étude du phytoplancton de la côte atlantique marocaine. Thèse de Doctorat. Université Ibn Tofail, Faculté des Sciences, Kenitra (Maroc), 1-189.
- Akallal, R.; Riyahi, J.; Billard, C.; Givernaud, T. and Mouradi, A.** (2006). Contribution à l'étude du phytoplancton de la côte atlantique marocaine. III. Les Dinophysiales (Dinophyceae). *Algol. Stud.*, 120, 21-40.  
DOI: 10.1127/1864-1318/2006/0120-0021
- Aminot, A. and Chaussepied, M.** (1983). Manuel des analyses chimiques en milieu marin. Centre national pour l'exploitation des océans, CNEXO, Paris, 1-395.
- Amzil, Z. and Motteau, L.** (2000). Toxines amnésiantes en France. Rapport interne IFREMER/DEL/MP/RST/00/07, France, 1-37.
- Bennouna, A.** (1999). Etude du phytoplancton nuisible et de son environnement dans la lagune de Oualidia et de Sidi Moussa (Maroc). Thèse de Doctorat de 3ème cycle, Université Chouaib Doukkali, Faculté des Sciences El Jadida (Maroc), 1-153.

- Bennouna, A.** (2008). Le phytoplancton du littoral atlantique Marocain Abda-Doukkala : Organisation, Dynamique et impact des taxons potentiellement toxiques. Thèse de Doctorat National, Université Chouaib Doukkali, Faculté des Sciences El Jadida (Maroc), 1-148.
- Bennouna, A.; Berland, B.; El Attar, J. and Assobhei, O.** (2002). Eau colorée à *Lingulodinium polyedrum* (Stein) Dodge, dans une zone aquacole du littoral du Doukkala (Atlantique marocain). *Oceanol. Acta*, 25, 159-170.  
[https://doi.org/10.1016/S0399-1784\(02\)01191-X](https://doi.org/10.1016/S0399-1784(02)01191-X)
- Cadour, G.; Nézan, E.; Kempf, M. and Merceron, M.** (1997). Plancton nocif et pisciculture marine : conseils pratiques. Equinoxe, Ifremer, 1-60.
- Chaibi, M.; Maanan, M.; Sabatier, F.; Charif, A.; Ayt Ougougdal, M. and Ait Malek, H.** (2014). Modélisation du transport éolien dans le système plage-dune de la baie d'El Haouzia (côte atlantique marocaine). *Physio-Géo Géographie Phys. Environ.*, 8, 101-119. <https://doi.org/10.4000/physio-geo.3872>
- Charbonnier, P.** (2006). Évaluation et gestion du risque lié à la consommation de coquillages contaminés par les phycotoxines au sein de l'union européenne. Thèse de doctorat vétérinaire, Faculté de médecine de Créteil, 1-136.
- Elghrib, H.; Somoue, L.; Elkhiaati, N.; Berraho, A.; Makaoui, A.; Bourhim, N.; . . . Ettahiri, O.** (2012). Distribution du phytoplancton dans les zones d'upwelling de la côte atlantique marocaine située entre 32°30'N et 24°N. *C. R. Biologie*, 355 (8), 541-554. <https://doi.org/10.1016/j.crv.2012.07.002>
- Fensome, R.; Taylor, F., Norris, G., Sarjeant, W., Wharton, D. and Williams, G.** (1993). A Classification of Living and Fossil Dinoflagellates. American Museum of Natural History, Sheridan Press, Hanover, Pennsylvania, 1-351.
- Franchimont, J.** (1998). Etude nationale sur la biodiversité, les Algues marines. Rapport de synthèse, avec la collaboration de Saadaoui E., PNUE/Observatoire National de l'Environnement du Maroc, 1-156.
- Gómez, F.** (2013). Reinstatement of the dinoflagellate genus *Tripes* to replace *Neoceratium*, marine species of *Ceratium* (Dinophyceae, Alveolata). *CICIMAR Océánides*, 28(1), 1-22.
- Guiry, M. D., and Guiry, G. M.** (2018). World-wide electronic publication, National University of Ireland, Galway. Récupéré sur <http://www.algaebase.org>.

- Hallegraef, G. M.; Anderson, D.; Cembella, A. D. and Enevoldsen, H. O.** (2003). Manual on Harmful Marine Microalgae. Intergovernmental Oceanographic Commission, UNESCO, 1-793, illus.
- Herzi, F.** (2013). Caractérisation chimique des exsudats du dinoflagellé marin toxique. *Alexandrium catenella* et de la diatomée marine *Skeletonema costatum* et étude de la réponse protéomique d'*Alexandrium catenella* en conditions de stress métalliques. Doctorat en Sciences Biologiques, Université de Carthage (Tunisie) et de l'Université de Toulon (France), 1-320.
- Lassus, P.** (1984). Dinoflagellés toxiques et phénomènes d'eaux colorées. Rapport de mission N° 40, Ifremer, 1-71.
- Lorenzen, C.** (1967). Determination of Chlorophyll and Pheopigments : Spectrophotometric Equations. *Limnol. Oceanogr.*, 12, 343-346.
- Merzouki, M.; Talib, N. and Sif, J.** (2009). Indice de condition et teneurs de quelques métaux (Cu, Cd, Zn et Hg) dans les organes de la moule *Mytilus galloprovincialis* de la côte d'El Jadida (Maroc) en mai et juin 2004. *Bull. Inst. Sci. Rabat, section Sciences de la Vie*, 31(1), 21-26.
- Natij, L., Damsiri, Z., Khalil, K., Loudiki, M., Ettahiri, O. and Elkalay, K.** (2014). Phytoplankton abundance and diversity in the coastal waters of Oualidia lagoon, south Moroccan Atlantic in relation to environmental variables., *J. Adv. Res* 2(6), 1022-1032.
- Nézan, E. and Piclet, G.** (1996). Guide pratique à l'usage des analystes du phytoplancton, Direction de l'Environnement et de l'aménagement Littoral, Ifremer, 1-66.
- Nézan, E., and Rocher, G.** (2003). Les microalgues productrices de toxines, Direction de l'Environnement et de l'aménagement Littoral, Ifremer, 1-49.
- Nézan, E.; Piclet, G. and Grossel, H.** (1997). Guide pratique à l'usage des analystes du phytoplancton. Ifremer, 1-31.
- Paulmier, G.** (1994). Les dinophycées pélagiques et benthiques du golfe de Gascogne sud de la Bretagne à Arcachon. *Annales de la Société des Sciences Naturelles de la Charente-Maritime*, 8(3), 289-357.  
<https://archimer.ifremer.fr/doc/00260/37097/>
- Penaud, A.** (2009). Interactions climatiques et hydrologiques du système Méditerranée-Atlantique au Quaternaire. Thèse de Doctorat en Sédimentologie Marine et Paléoclimats, Bordeaux I (France), 1-372.

- Ricard, M.** (1987). Atlas du phytoplancton marin/Diatomophycees/Volume 2. Éditions Du Centre National De La Recherche Scientifique, Anatole, France , 1-297.
- Sournia, A.** (1986). Atlas du Phytoplancton Marin. Volume I : Introduction, Cyanophycées, Dictyochophycées, Dinophycées et Raphidophycées. Éditions du CNRS, Paris, 1-216.
- Hasle, G. R., Syvertsen, E. E. Steidinger, K. A., Tangen, K, Throndsen, J. and Heimdal, B. R.** (1997). Dinoflagellates in: « Identifying Marine Phytoplankton ». Tomas, C.R. (Ed.), San Diego : Academic Press, Elsevier. Florida, États-Unis, pp. 387-584.
- Suzuki, T.; Miyazono, A.; Baba, K.; Sugawara, R. and Kamiyama, T.** (2009). LC–MS/MS analysis of okadaic acid analogues and other lipophilic toxins in single-cell isolates of several Dinophysis species collected in Hokkaido, Japan. Harmful Algae, 8(2), 233-238. <https://doi.org/10.1016/j.hal.2008.06.001>
- Trégouboff, G. and Rose, M.** (1957). Manuel de planctonologie méditerranéenne, Centre National de la Recherche Scientifique, 2 tomes (Textes 1-587 & Illustrations 1- 207), Paris.
- Utermöhl, H.** (1958). Zur Vervollkommnung der quantitativen Phytoplankton Methodik, Mitt. Int. Ver. Theor. Angew. Limnol., 9(1), 1-38.