

ENCYSTMENT OF DINOFLAGELLATE IN TIDAL COASTS OF GABES GULF: ANALYSE OF LONG TERM OBSERVATIONS

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ABSTRACT

In phytoplankton monitoring survey in Gulf of Gabes, detection and study of cysts were averred to be as essential as those of toxic species. The cysts can't only provoke blooms, but some toxic responses related for presence of these forms are detected in our coasts. In order to understand the bloom dynamics and occurrences of encystment, we analyzed 20 years of harmful algae data acquired a monitoring program of toxic phytoplankton in Gabes gulf. Encystment phenomenon is regular and frequent in more stations in Gabes gulf, but it affected low variety of species. For 20 years of monitoring we detect only 8 different group of cysts in this area. Also, cysts distribution showed a synergy with blooms. Spring seems to be the season were diversity of cysts is recorded and higher densities are observed in North of Gabes gulf. Encystment may be induced with abrupt variation in temperature and salinity. Presence of an important hydrodynamic mouvement (tide) can be responsible of reappearing particules.

Key Words: cysts of dinoflagellate, spatio-temporal variation, Gabes gulf.

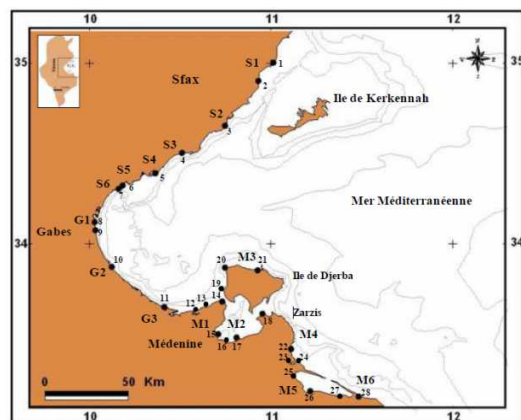
INTRODUCTION

During their life cycle, many dinoflagellates are capable of producing resting cysts prevalently through sexual reproduction. Ten per cent of the 2000 known dinoflagellate species produce resting cysts (ZAKARIA et al.,2011) Pollution and eutrophication that be known are factor affected the encystment. Moreover cyst assemblage composition generally reflects temperature, salinity, productivity, and nutrient conditions. Resting cysts have considerable ecological importance for cyst-producing species, as they ensure survival, favor dispersion, provide a source of genetic diversity, and promote bloom initiation and its recurrence (AYDIN et al.,2015). The coasts of Gabes Gulf are characterized by specific parameters and eutrophical conditions and

can therefore produce high local cyst accumulations. In a phytoplankton monitoring survey in the Gulf of Gabes, detection and study of cysts were averred to be as essential as those of toxic species. In fact, some toxic responses related to some dinoflagellate cysts are also reported. In order to understand the dynamic of this cysts, we analyzed 20 years of harmful algae monitoring data.

MATERIAL AND METHODS

Data base of phytoplankton monitoring program (1997 to 2017) archived in 41.229.139.4:8081/INSTM_NEW/ in the Gulf of Gabes (south eastern Tunisia) concern 27 stations (Fig. 1).



S1 (1: Ellouza, 2: El Aouabed), **S2** (3: Tabia), **S3** (4:Mahres), **S4** (5: Ras Younga), **S5** (6: Jaboussa), **S6** (7: Skhira), **G1** (8: El Hicha,9: Tarf El Ma), **G2** (10: Port of Gabes), **G3** (11: Zarrat), **M1** (12:El Grine, 13 : Maghraouia), **M2** (14 : Ajim, 15 : Boughrara, 16 : Karboub, 17: HassiJerbi), **M3** (18: Cheik Yahia , 19 :BorjDjelijel, 20: HoumetEssouk), **M4** (21: cannal de Cotusal,22 : Jabiet el Haj Ali), **M5** (23 :Dar el ouest, 24 :Ilots de Bibane, 25 :El marsa), **M6** (26: Jetée Macif, 27 : Ketf).

Fig1.study area

A Van Dorn bottle was utilized to collect water at 1 m depth in maximum tide. The vegetative cells and cysts present in water were enumerated under an inverted microscope (Nikon or Olympus) using a Uthermol method. Cysts were identified to species level whenever possible based on the literature listed in the references section; images were obtained from Dino-Atlas at <https://www.pangaea.de/?q=Dino-Atlas>. Statistical relationships between parameters and cyst abundance data were tested using Pearson's correlation coefficient along with corresponding p-values using SPSS software package.

RESULTATS AND DISCUSSION

A total of 8 morphotypes cyst were identified in Gabes Gulf and the max number of cyst attempt 57810 cyst.l⁻¹. Cyst of *Protoperdinium spp* is the most abundant reaching 68,64% of total species recorded as observed in others Tunisian and mediterranean coasts (DHIB *et al*, 2016; RUBINO *et al*, 2017).Cysts were observed at all stations in the Gulf of Gabes and the higher values are detected at stations G2, G3, M2, and M3 (Fig.2)

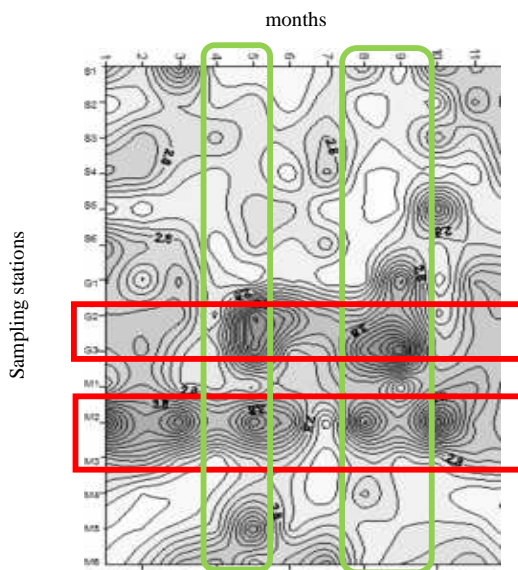


Fig 2. Spatio-temporelle distrubition of dinoflagellates cysts

Stations (G2; G3) situated near Gabes town designed polluted area (BÉJAOUI *et al.*, 2016).M2 concern Boughrara lagoon characterized with entrophic status (BEN REJEB- JENHANI,2002) present favorable

condition that can induce encystment phenomenon. The higher occurrences were recurrently recorded in 2003 (Fig.3). Since 2003 more adopted methodology of identification cyst is acquired in the laboratory and that limited the signalizations and confusion of determination.

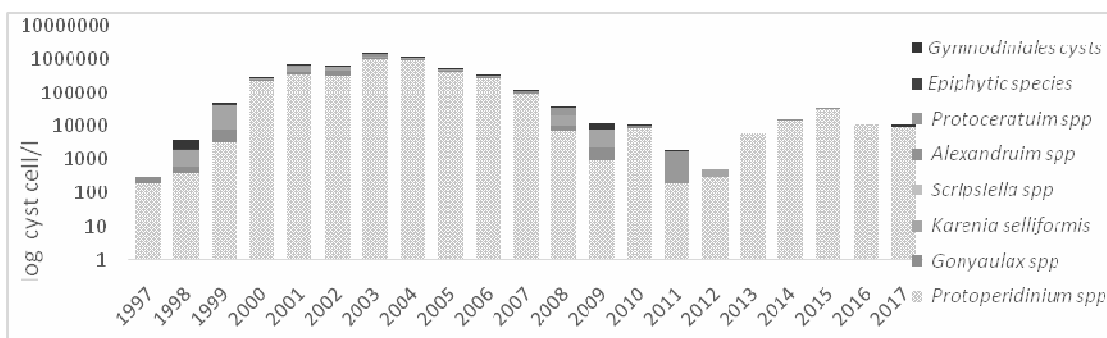


Fig 3. The abundance of Dinoflagellate cysts during 20 years in Gabes gulf

That be known encystment and dormance of phytoplankton species are governed by variations of some biotics parameters and essentially decreases or intensifies abnormally temperature and brightness (LEE ET MATSUOKA, 1996; POSPELOVA & KIM, 2010; SATTI *et al*, 2013). In our study area, this phenomenon is generally occurring in the end of the winter and maintaining until early spring. Cyst abundance mainly observed in April-May and declining

trend continued through the last summer. Since September, encystment increased and that be attributed to blooms of vegetative forms generally occurred in these periods (FEKI *et al.*, 2008, 2017) (Fig. 4). For example, we observe that blooming of dinoflagellate *Karenia selliformis* started in late summer and in the fall we can detect a high number of cysts in water column (Fig.5).

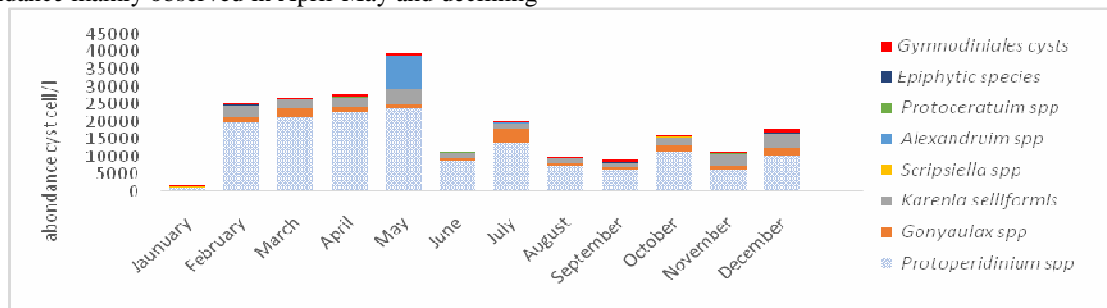


Fig 4. Mensual mean abundance of Dinoflagellate cysts in Gabes gulf

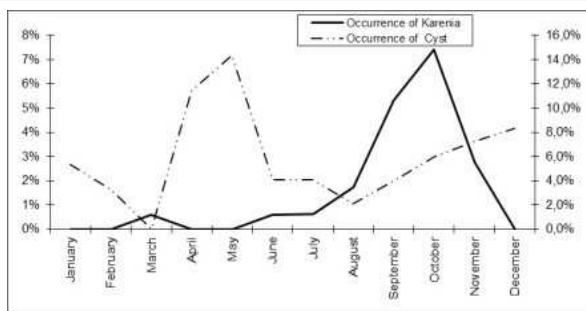


Fig 5. Mean occurrence of cyst and vegetative forms of *Karenia selliformis* in Gabes gulf

According pearson test, no significant correlation was observed between the concentrations of cysts and any of the physicochemical parameters monitored in the water column. The results indicate that our set of variables explained 81.99% of the variability with the first two axes. The first principal component (axis 1)

that explains 60.38% of total variance was positively correlated to temperature and salinity most of cysts recorded in our monitoring in S1, S2, S3, S4, M2, G1 and M3. The pH was negatively correlated with axis 1 and it is associate with area situated in center of the Gulf and cyst of *Protoceratium spp* (Fig.6).

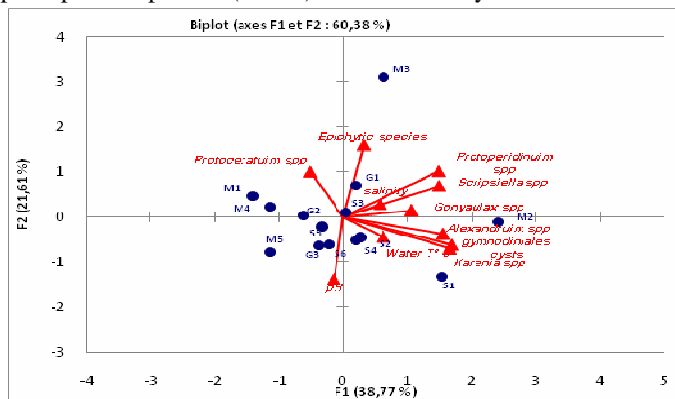


Fig 6. Biplot depicting the association between cyst dominant morphotypes, environmental factors and station of Gabes gulf

CONCLUSION

The phenomena of encystment is frequent and regular in the Gulf of Gabes, but it affects only a small variety of species. The coastal zones and especially at the level of the central zone of the Gulf of Gabes are the regions most affected to these phenomenon that be certainly relate of environmental and eutrophical conditions. The encystment can be biological response related of a consequence of bloom situations.

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