Environmental assessment from the phytoplankton community in a Marina in the Canary Islands, Spain.

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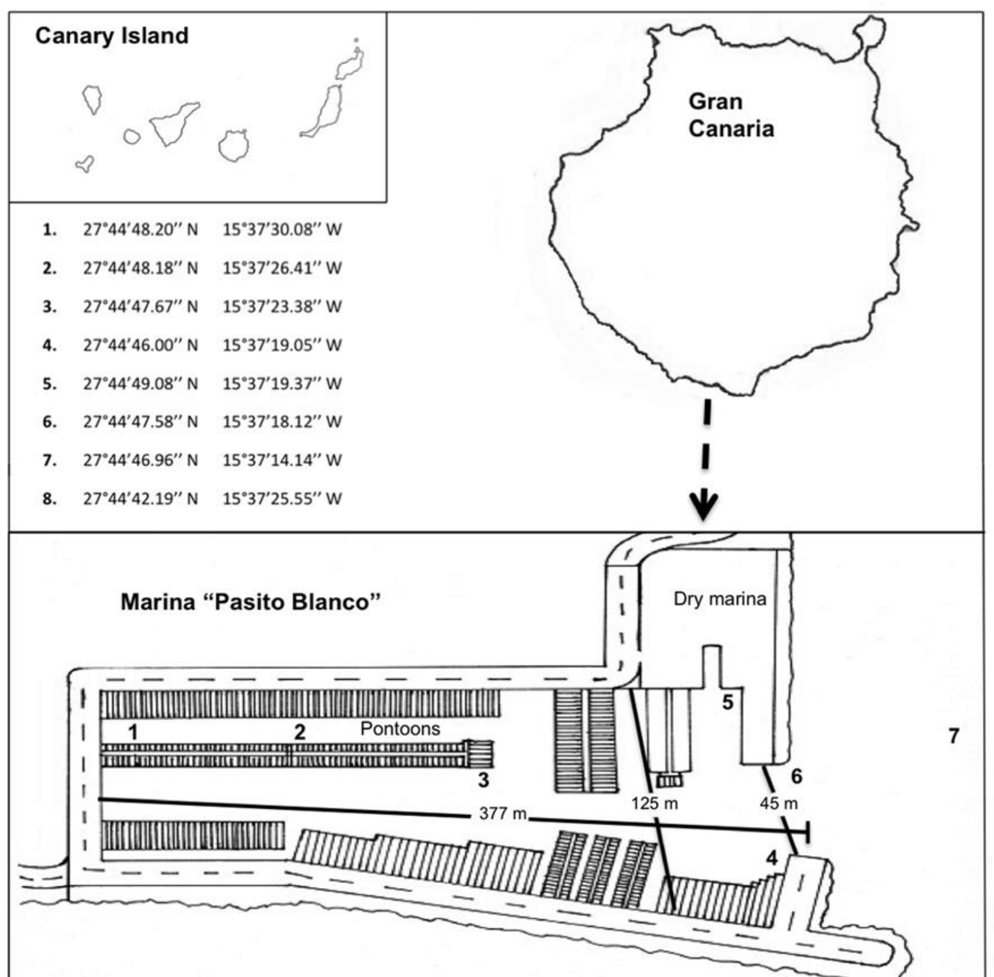
Marinas have become one of the infrastructures more frequent on the coast, which in most cases involve the construction of breakwaters to reduce the impact of the marine dynamic creating areas of semi-closed waters. All these changes, with the operational development and the increase of boats traffic, have as a consequence variations of water quality indices in these environment.

The confinement of the water increases the concentration of pollutants, the accumulation of nutrients and organic matter, inducing a process of eutrophication and the proliferation of phytoplankton, which can cause algal blooms.

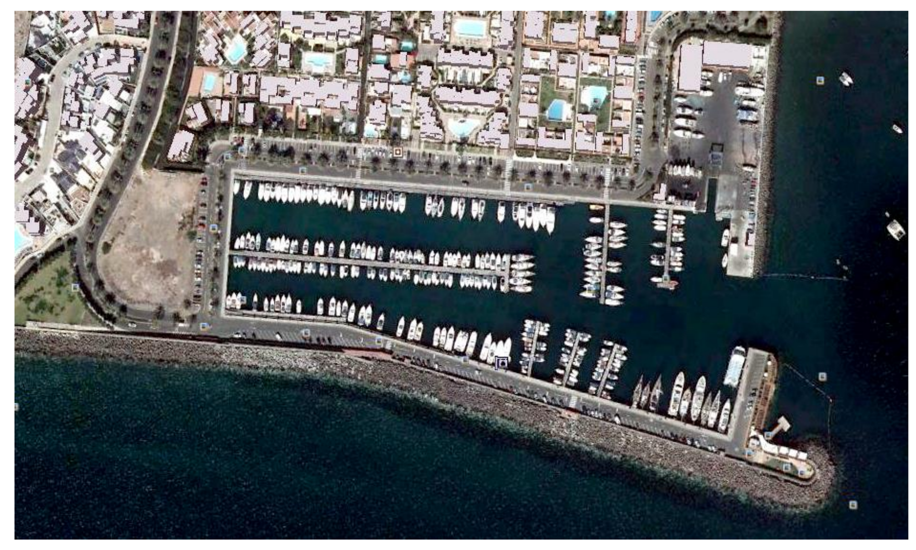
In the Canary Islands, various studies have been on the impact of marinas, focusing mainly on the effects of the construction of structures or in the presence of pollutants in the waters, however, the variability of phytoplankton as an indicator of the quality of marine water it has not been evaluated

The aim of this work was evaluated the quality of the water in a marina "Pasito Blanco" by the identification and quantification of organisms of the phytoplankton community looking for the difference between the inner and outer waters of marina along one complete year. In addition, determining the concentration of nutrients and chlorophyll-a, in order to understand the dynamics between the natural environment and the artificial structure.

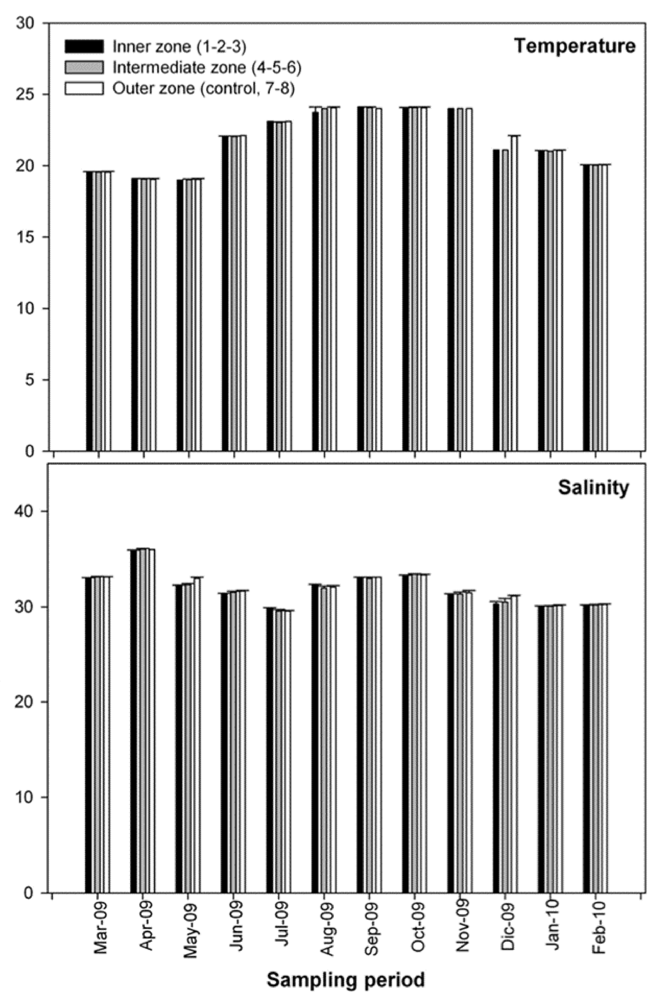


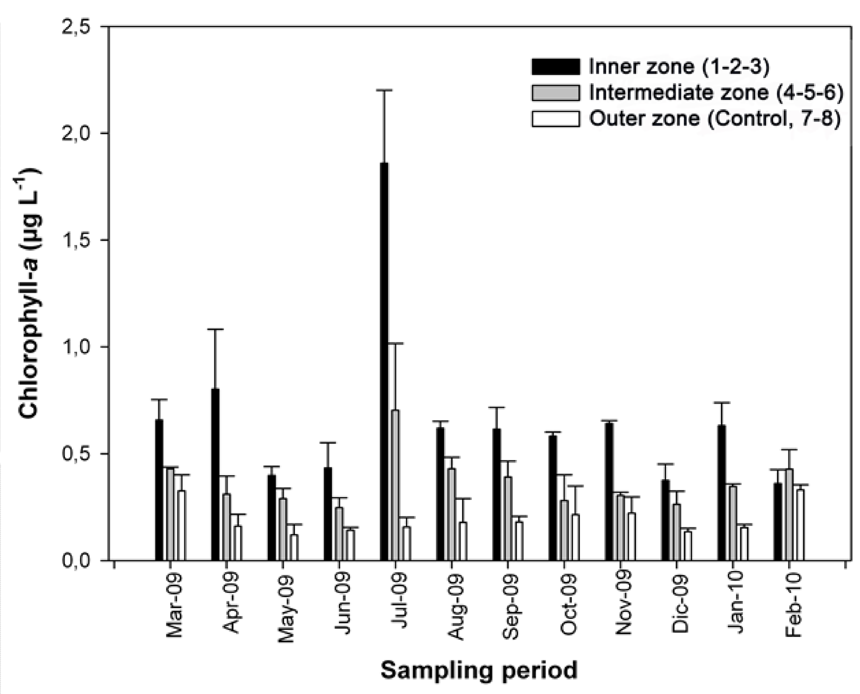
Sampling points at Marina "Pasito Blanco".

The marina "Pasito Blanco" is located in the municipality of San Bartolomé de Tirajana, South of the island of Gran Canaria, Canary Islands, Spain, and covers an area of 43.045 m2 of water warm (with a draught between three and seven meters deep) and a 45 meters long canal. Currently it has 388 points of berthing for boats from six meters and 40 meters in length.



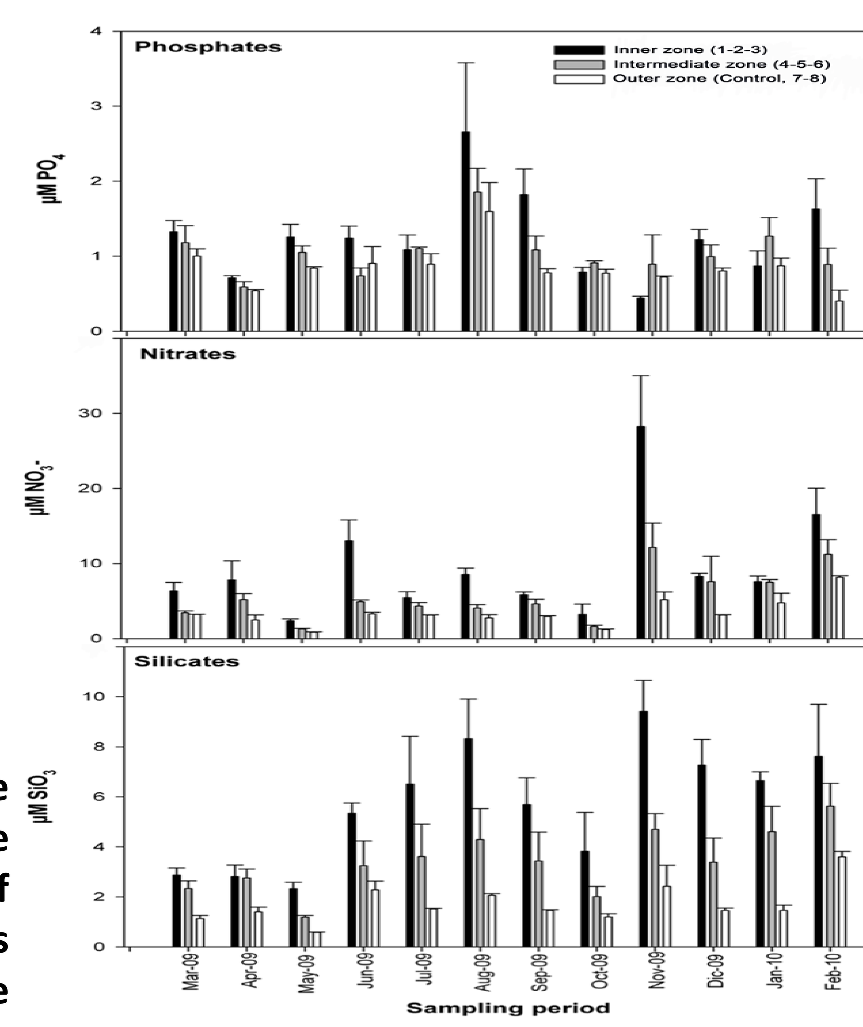
Sampling was conducted monthly from of March (2009) to February (2010) in 8 different points, located in the inner part, media and external of the marina. Points 1, 2, and 3, are areas in port and are located in inner harbor channel where turnover and movement of water is low and therefore the period of confinement of the waters is greater. Points 4, 5 and 6 represented a midpoint between areas, because they are located between the inner zone closest to the entrance of the marina and the outer zone. Points 7 and 8, correspond to the outer zone, and were considered control points .





The chlorophyll-a concentration showed significant differences both temporal and spatially ($p<0.01$). The month of July presented the largest concentration of biomass, which varied very little in the other months analyzed. The chlorophyll-a ranged from 0.05 to 2.27 mg L^{-1}, with an average of 0.44 ± 0.04 mg L^{-1}. The spatial variability introduced a pattern similar to the nutrients, with a greater concentration inner than outer sampling sites.

Among the sampling points, nutrients showed a pattern of zonation, as evidenced stations 1, 2 and 3 for the inner zone had the highest concentrations of all nutrients, while the lowest occurred in the outer zone of the harbor (stations 7 and 8).

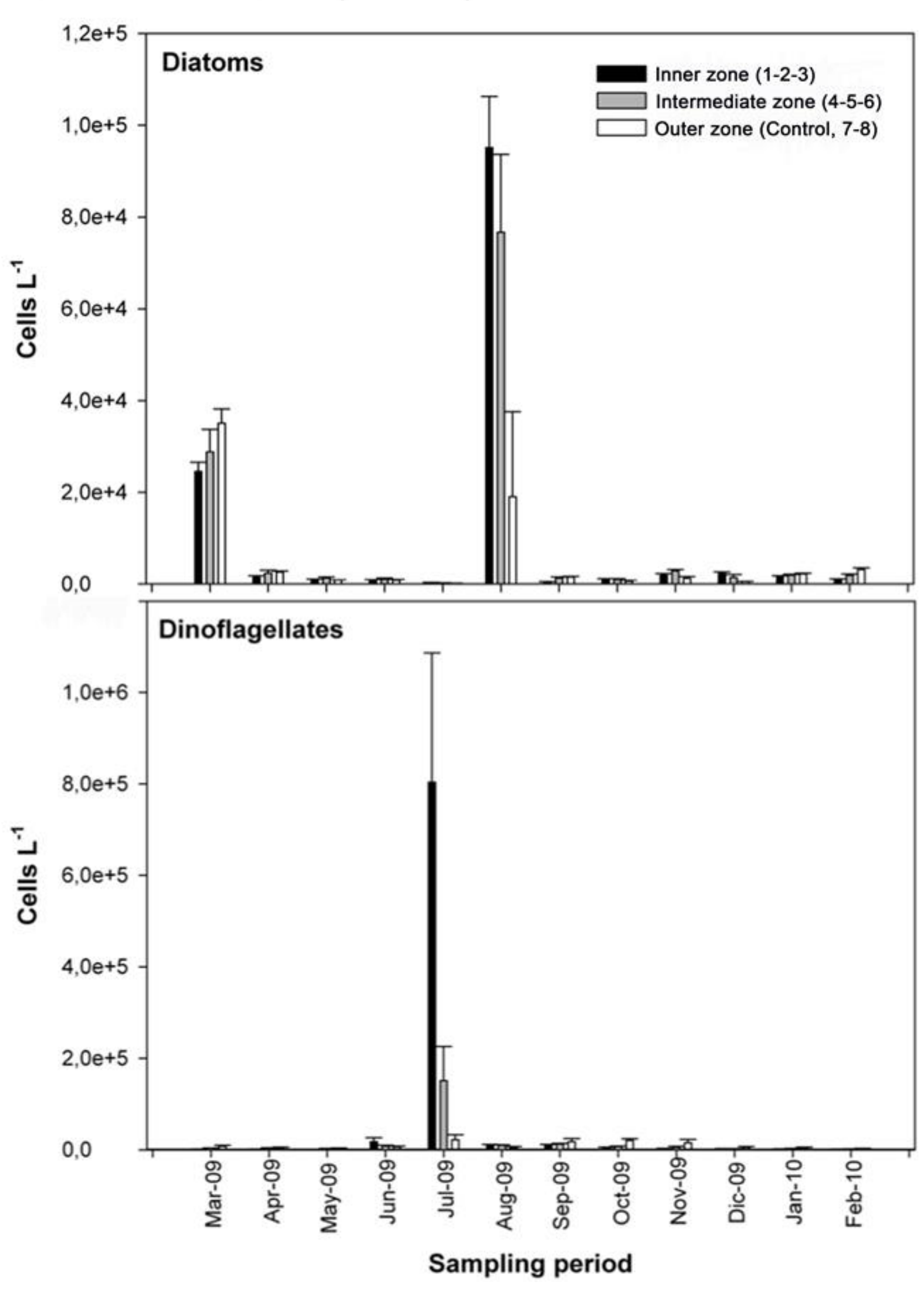


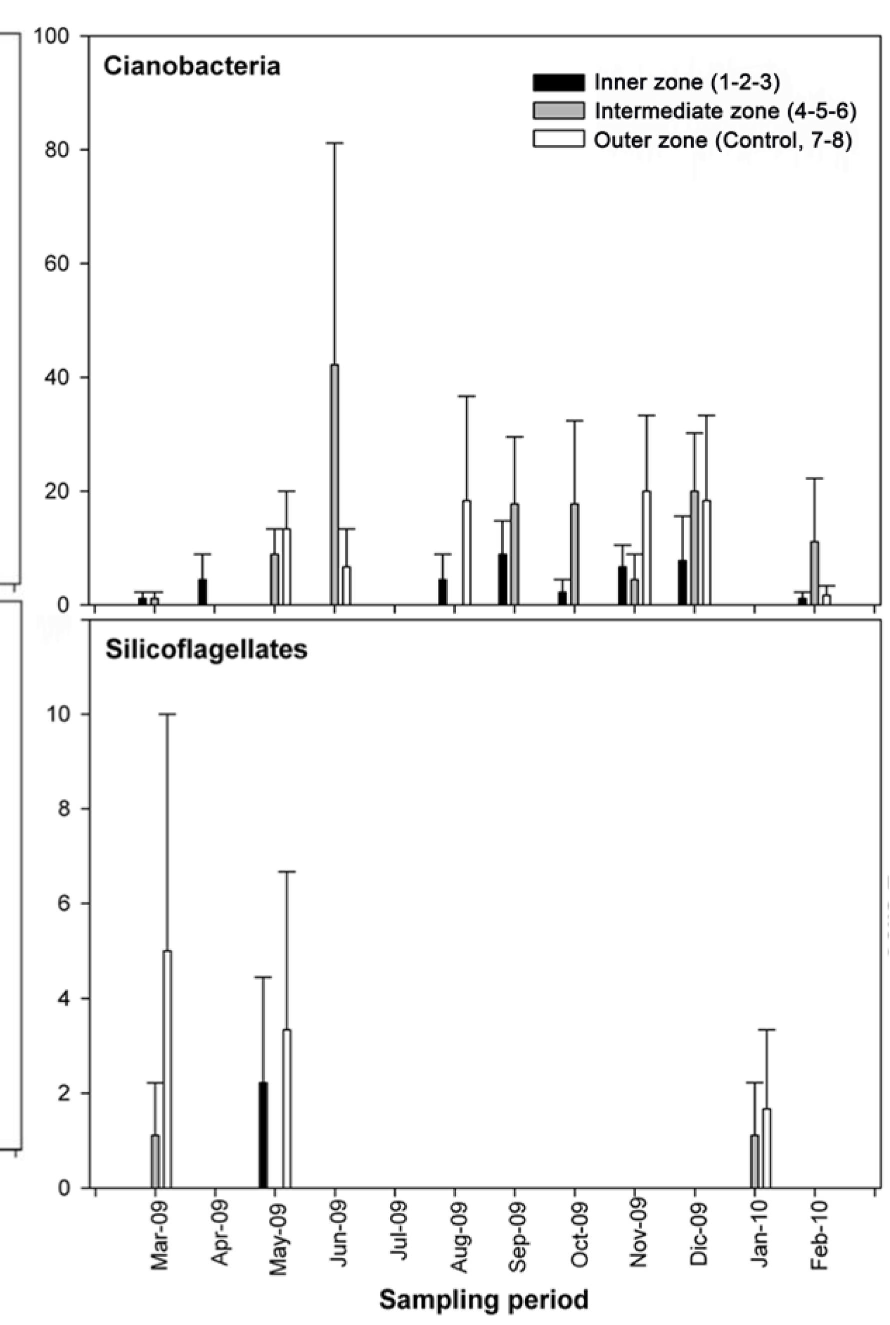
All nutrients showed significant differences between sampling months and between zones ($p<0.01$). The phosphates presented a concentration range between 0.26 and 4.48 µMol and only significant differences were observed in August. The nitrate presented a greater oscillation monthly than phosphates, showing a range of 0.810 and 39.62 µMol, with significant differences between November and February from the remaining months of the sampling period. The silicates ranged from 0.57 to 11.75 µMol, with significant variability between the months of spring, summer and autumn-winter.

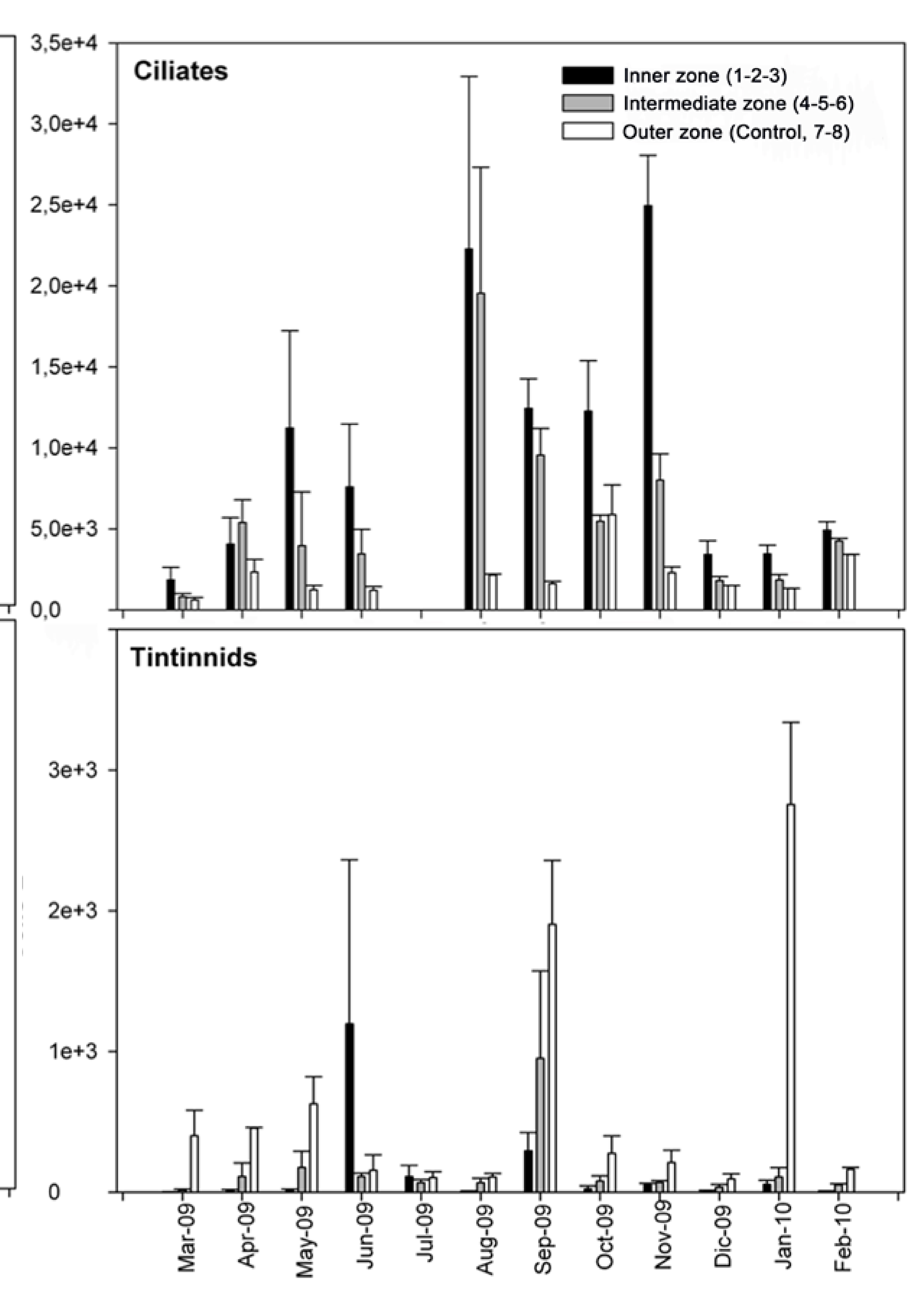
The phytoplankton community was represented by 212 species, of which the greatest diversity of species corresponded to dinoflagellates group with 100 species, followed by diatoms with 94 species, cianobacteria with 12 species, and the remaining organism distributed among groups of Prasinophyceans, Cryptophyceans, Euglenophyceans (2 species), and Silicoflagellates (2 species). In addition, we identified the Ciliates and the 28 species of Tintinnids, all the groups were present in all sampling sites. Diatom species *Cylindrotheca closterium, Leptocylindrus danicus, Navicula sp, Pleurosigma sp, Rhaphoneis amphiceros*, dinoflagellates *Gonyaulax sp, Gyrodinium glaucum,* the dinoflagellates *Prorocentrum triestinum, Protoperidinium sp1, Scrippsiella trochoidea*, the euglenophycean *Eutreptiella* sp, the tintinnid *Tintinnopsis lobiancoi*, and prasinophyceans and cryptophyceans groups were identified as species common in this work according to the pattern in every sampling site and sampling time.

The diatoms ranged from 0 to 1.1 x 10^5 cells L^{-1}, showing differences in the months of March and August, which noted a bloom of species *Guinardia striata* and *Thalassiosira* sp, respectively. The dinoflagellates were only differences in the month of July when a bloom of *Prorocentrum triestinum* was observed, causing a brown discoloration in the internal waters of the harbour. The range of variation in the concentration of dinoflagellates was $1.4x10^2$ and $1.3x10^6$ cells L^{-1}. With respect to the stations, both diatoms and dinoflagellates showed a differentiation between areas, differing significantly the inner zone where algal blooms occurred in both phytoplankton groups.

The *prasinophyceans* and *cryptophyceans*, considered as marine flagellates, were the most abundant groups during almost all the sampling, with cellular concentrations ranged between $3.5x10^3$ and $3.4x10^5$ cells L^{-1}, and between 0 and $8.2x10^4$ cells L^{-1}, respectively. Both groups showed algal blooms in the study period, the *prasinophyceans* showed an increase in cell concentration August and November, while *cryptophyceans* presented a bloom in October. Between sampling sites showed a higher abundances at inner stations (inner zone), regarding the external sites







Euglenophyceans ranged from 0 cells L^1 and 4.6x103 cells L^{-1}, and his presence was associated mainly to the inner zone.

Cianobacteria and *silicoflagellates*, showed low abundance in relation to other groups. *Cianobacteria* presented a range from 0 to 120 cells L^{-1}, while the *silicoflagellates* ranged from 0 to 10 cells L^{-1}. *Cianobacteria* tended to increase in the intermediate zone, which had the highest phytoplankton abundances of this group. *Silicoflagellates*, did not differences between sampling points, although his presence was mainly associated to external zone.

Ciliates and *tintinnids* showed a range between 0 and $4.2x10^4$ cells L^{-1}, and 0 and $3.5x10^3$ cells L^{-1}, respectively. *Ciliates* increased proliferation in August and November. *Tintinnids* increase summer and winter.