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First record of *Protoperidinium quinquecorne* (Dinoflagellates) bloom in Dubai coastal waters at Al Mamzar Corniche

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Abstract

During our regular monitoring study of phytoplankton in Dubai coastal waters, moderate bloom of a marine dinoflagellate species, Protoperidinium quinquecorne was observed for the first time on 08th to 10th November, 2017 near Al Mamzar Corniche. The extent of the bloom in relation to the water quality of the region is reported. P. quinquecorne bloom was found in patches of about 700m in length and 50m width along the shoreline forming discoloration of water. The cell counts during the bloom period was 66.0 – 36.8 x $10^3 L^{-1}$ at different sampling locations. Nutrient concentration in the study area during the bloom period was found to be normal. During the bloom period, conversely, there were higher values of Chlorophyll-a and Carotenoids. It is observed that the density of the bloom is related to the surface water temperature (i.e.) the density increased drastically when the surface water temperature was high during day time forming patches of the bloom. However, there were no fish kill occurred in the bloom region during this period.

Keywords: Algal bloom, *Protoperidinium quinquecorne*, first record, physico-chemical, phyto pigments.

Introduction

Protoperidinium quinquecorne (Abé) Balech, is one of the most well-known species of the genus *Protoperidinium* and is a major bloom forming phytoplankton species in coastal and estuarine environments. This species sometimes occurs in very high concentration in coastal waters, as a bloom and causing water discoloration and in some occasions associated with fish kills. Some species of phytoplankton are known to produce toxins that can be accumulated by filter-feeding creatures, posing a threat to humans downstream in the food chain. Other non-toxic phytoplankton blooms can also cause substantial fish mortality due to oxygen depletion or gill blockage and damage caused by mucus secretion and asphyxiation[1].

The order Peridiniales within class dinoflagellates having a transverse flagella furrow normally located within the middle third of the length of cell. The theca is consist of several tens plates of cellulose organized in parallel to the transverse furrow in several sequences. In marine, brackish and freshwater environments, they are free-living, photosynthetic or non-photosynthetic dinoflagellates[2]. The blooms of *P. quinquecorne* along Dubai coastal water was not report previously. Therefore, this study describes for the first time the conditions in which *P. quinquecorne* proliferated to form bloom and tend to disappear when sea surface temperature drop sharply at Al Mamzar Corniche along Dubai coastal water.

Material and methods

On November 8th and 10th, 2017, phytoplankton and surface water samples were collected from two locations near Al Mamzar Corniche (25°19'0.42"N; 55°20'33.14"E and 25°18'47.53" N; 55°20'23.74"E). A Niskin water sampler was used to collected phytoplankton samples from surface water, which were then preserved in Lugol's iodine solution. One liter of the sample was poured into a measuring cylinder and allowed to settle for 24 hrs. The water was slowly decanted without disturbing the settled phytoplankton and made up to 100 ml. From this, 1ml of phytoplankton sample was taken by a pipette and then slowly transferred to a Sedgwick-Rafter slide (1ml capacity). The samples were first analysed qualitatively, and then the taxa were counted using a Leica inverted microscope with a camera attached (Leica, Eclipse 50i with 10X to 100X magnification). Three or four times, the same technique was followed. After that, the number of individuals in each taxon present in 1L of sample was computed. Following a conventional taxonomic guide[3], the phytoplankton bloom was identified. Temperature, Dissolved Oxygen, pH and Salinity were measured by a pre-calibrated YSI 6600 V2 multi-parameter water quality instrument. Water samples for nutrients and phyto-pigments estimation from surface water was collected using Niskin water sampler. During transportation, samples were kept in amber glass bottles in an ice box and tested by the Dubai Municipality Central Laboratory Department. Analyses for numerous parameters were conducted out using conventional procedures and detection thresholds as defined by the EPA, USEPA, and APHA.

Results and discussion

Field study on 8th and 10th November 2017 showed intense bloom in the form of patches of *P. quinquecorne* along the Dubai coast as shown Figures-1a and 1b.

The bloom of *P. quinquecorne* persisted for three days and then slowly disappeared. Laboratory analysis confirmed that the discoloration of coastal waters was due to the bloom of *P. quinquecorne* (Figures-1c and 1d). The bloom was observed in patches and occupied about 700m length and 50m width along the shoreline of Al Mamzar Corniche. Numerical abundance (quantitative) of phytoplankton cell density was $52.8x10^3$ L^{-1} at station 1 and $66.0x10^3$ L^{-1} at station 2 on 8th and $29.8x10^3$ L^{-1} at station 1 and $36.8x10^3$ L^{-1} at station 2 on 10th November, 2017 respectively. The quantitative enumeration of *P. quinquecorne* bloom showed higher cell density at station 2 than station 1. Physico-chemical properties of the consistency of the water quality during the bloom event of *P. quinquecorne* as shown Figures-2 and 4.

Figure-1a: Red-tide at Al Mamzar Corniche.

Figure-1b: Red-tide at Al Mamzar Corniche.

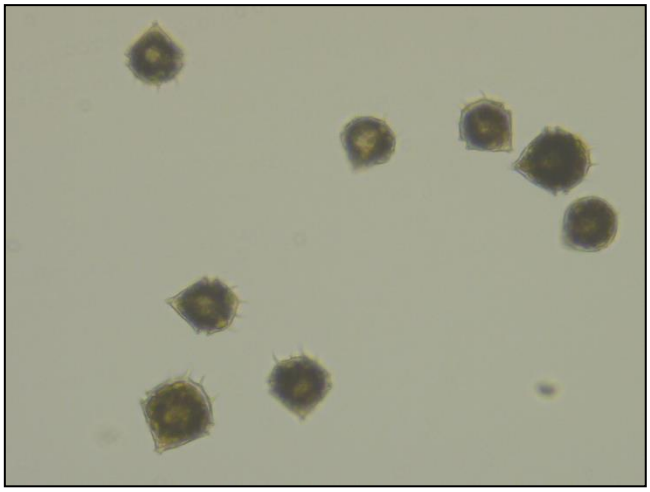

Figure-1c: Protoperidinium quinquecorne.

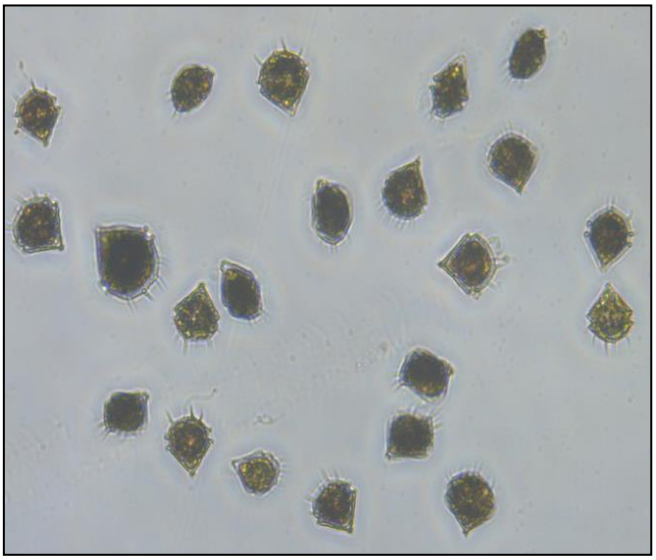

Figure-1d: *Protoperidinium quinquecorne.*

During the period of *P. quinquecorne* bloom, the water temperature ranged from 28.5˚C to 29.2˚C at stations 1 and 2 respectively. The temperature values did not show much variation at both locations and days. Surface salinity recorded a maximum of 39.99 ppt at station 2 on 8th and the minimum of 38.69 ppt at station 1 on 10th November, 2017. Variation in dissolved oxygen were observed at station 1. The maximum of 5.19mg/l was observed at station 1 on 10th, while the minimum of 3.13mg/l was at station 1 on 8th November, 2017. The low dissolved oxygen values observed during first day of bloom persisted for some time at station 1 only. The pH values varied from 8.12 to 8.22 on 10th and 8th November, 2017 respectively exhibiting insignificant variation.

The concentration of total nitrogen, nitrate-nitrogen and phosphate-phosphorus varied from 0.84 to 0.98mg/l, 0.05mg/l and 0.03 to 0.02mg/l at stations 1 and 2 on 8th November, 2017 respectively (Figure-3).

On 10th November, the concentration of total nitrogen varied from 0.76 to 0.82mg/l, nitrate value from 0.05mg/l and phosphate value from 0.02mg/l at stations 1 and 2 respectively (Figure-6). It is observed that the levels of phosphate-phosphorus, nitrate-nitrogen and total nitrogen concentrations did not show any significant higher variations during the bloom period from both the locations sampled.

The values of Chlorophyll-a (55-144mg/m^3), Carotenoids (52-155mg/m^3) and Phaeophytin (0.5-7mg/m^3) recorded on 8th November at stations 2 and 1 respectively are shown in Figure-4. Results of phyto-pigments collected on 10th November are given in Figure-7. Chlorophyll-a values were found to be from 12-21mg/m^3, Carotenoids from 13-16mg/m^3 and Phaeophytin from 0.5mg/m^3 on 10th November, 2017 at stations 1 and 2 respectively. It is observed that Chlorophyll-a and Carotenoids recorded higher values on 8th November, 2017 as compared to 10th November, 2017.

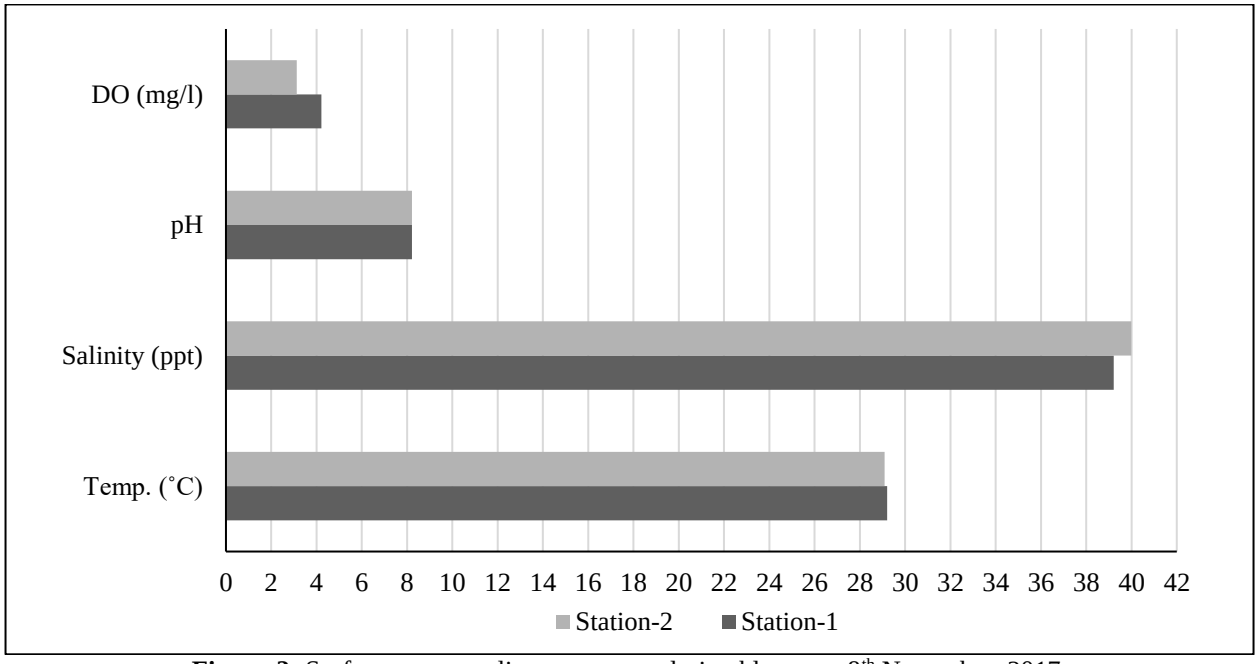

Figure-2: Surface water quality parameters during bloom on 8th November, 2017.

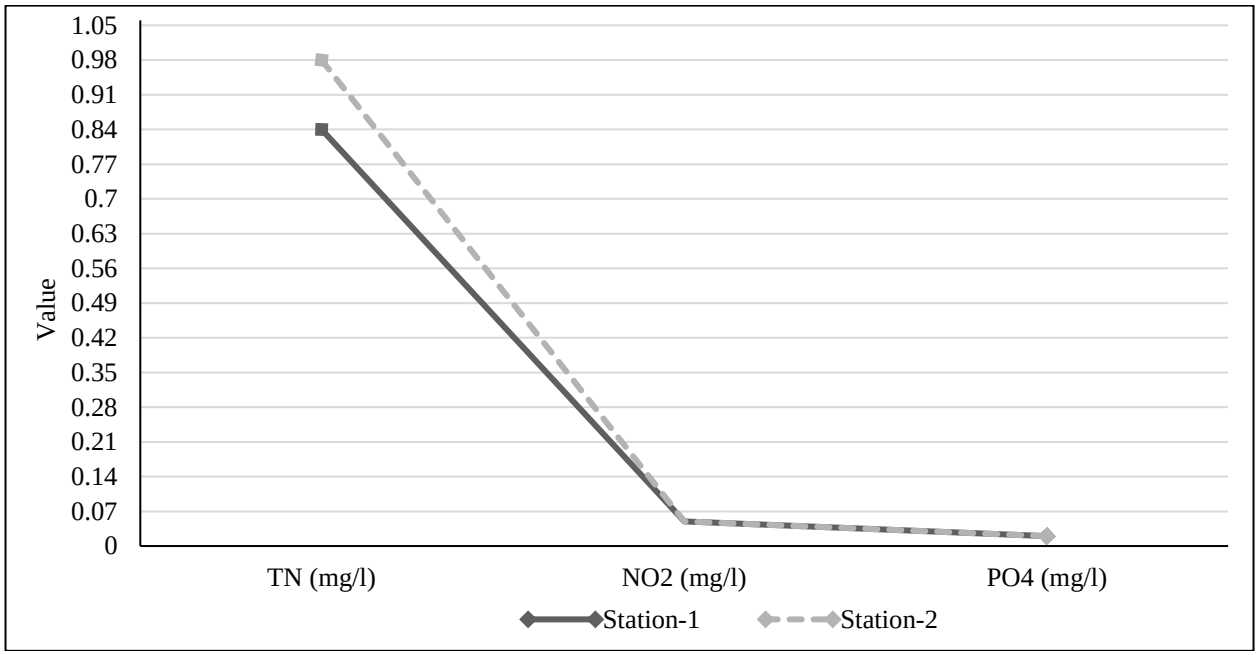

Figure-3: Concentrations of surface water nutrients during bloom on 8th November, 2017.

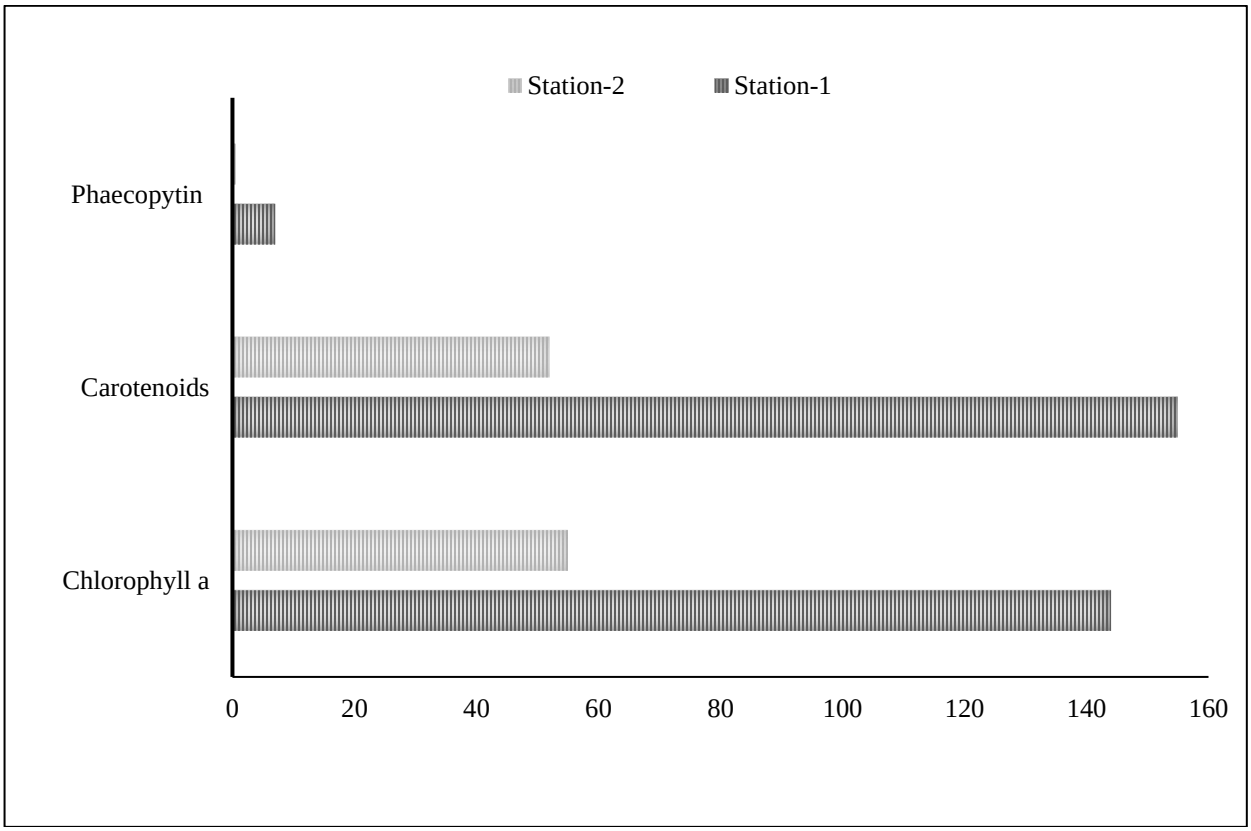

Figure-4: Concentrations of surface water phyto-pigments during bloom on 8th November, 2017.

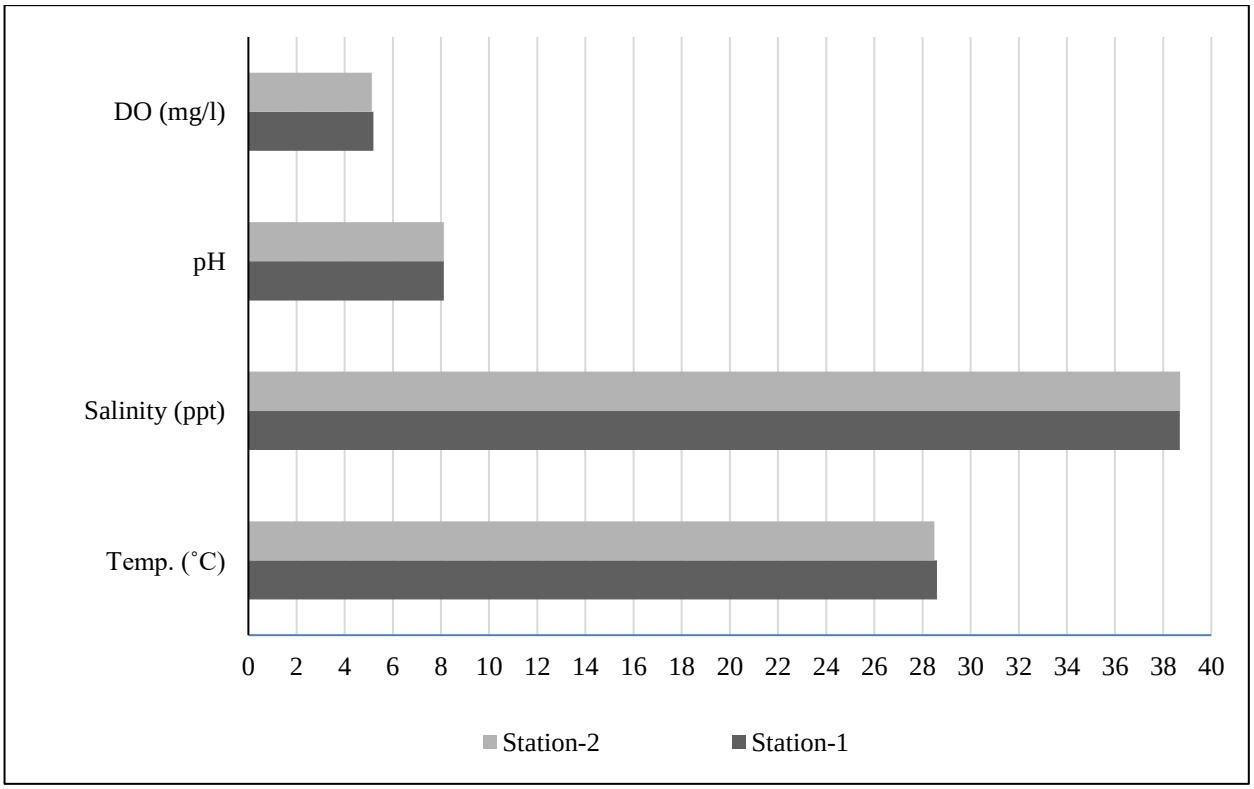

Figure-5: Surface water quality parameters during bloom on 10th November, 2017.

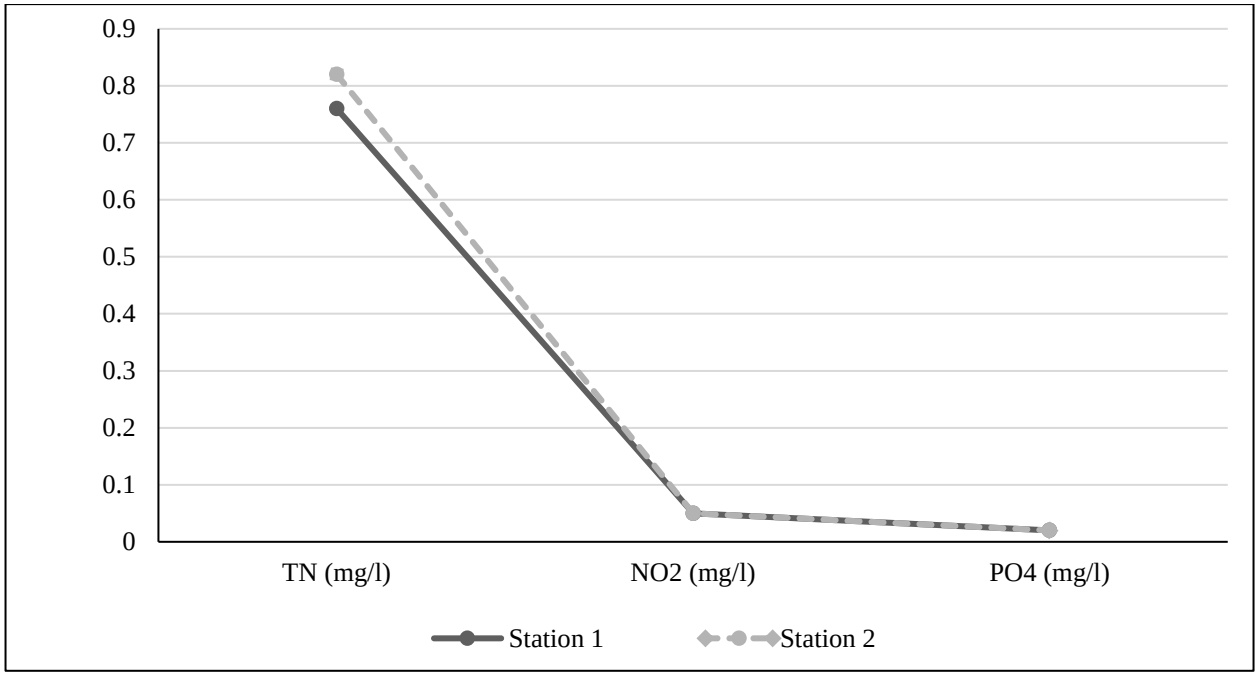

Figure-6: Concentrations of surface water nutrients during bloom on 10th November, 2017.

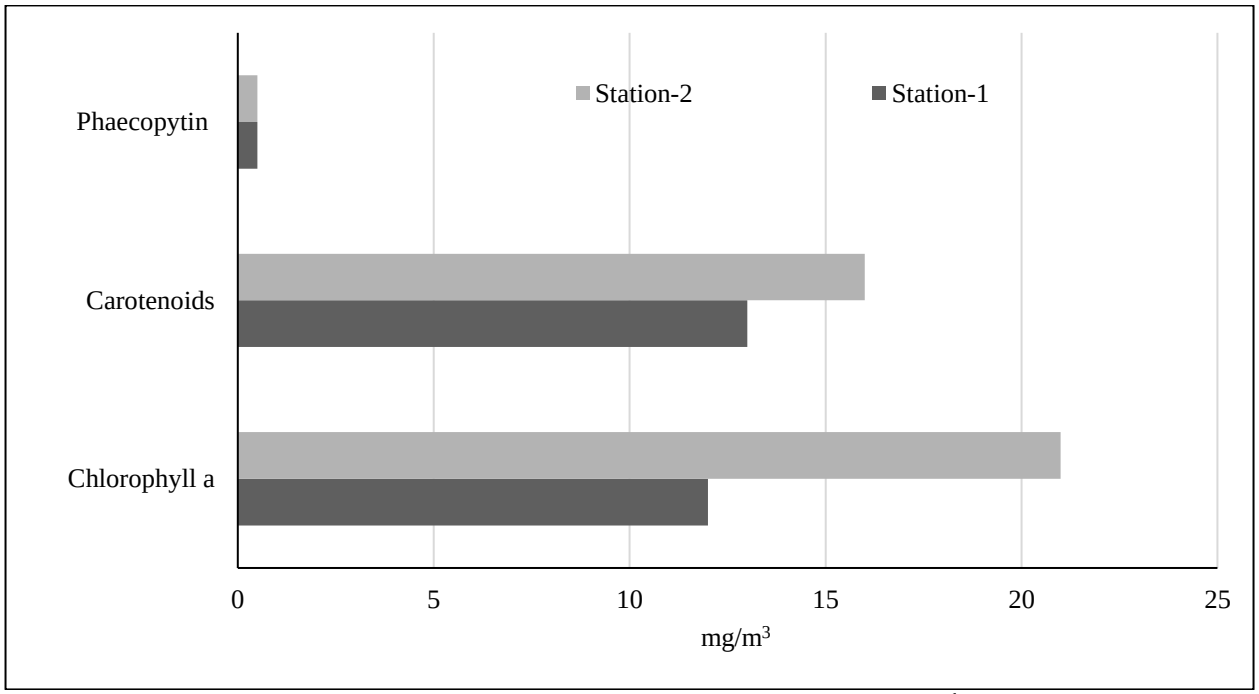

Figure-7: Concentrations of surface water phyto pigments during bloom on 10th November, 2017.

Discussion: Red-tide bloom of moderate intensity, creating reddish to brownish sea surface color with uneven patches of algae was observed during a short period of 8th-10th November, 2017 along Al Mamzar Corniche shore beaches. The red-tide bloom was dominant in the phytoplankton samples, with one dinoflagellate species identified as *P. quinquecorne*. The present red-tide bloom phenomenon reported for the first time from Dubai coastal waters. This marine dinoflagellate species of *P. quinquecorne* has been reported earlier accompanied by massive kill of small pelagic fishes in Yemani coastal waters of the Southern Red Sea[4]. However, this bloom conditions in our observation at Dubai coastal waters has not caused any fish mortality. Low levels of dissolved oxygen caused by high biomass blooms nave been blamed for fish deaths in many places of the world, rather than toxicity[5,6]. However, dissolved oxygen concentrations recorded during this present bloom

period were marginally low (3.13mg/l) on the first day and progressively increased later on. *P. quinquecorne* dominance or higher population tends to be related to its unusual ability to blossom under tropical conditions[7]. *Protoperidinium quinquecorne* can endure a wide range of salinities under high light and high temperature conditions, according to several studies, and grows best at relatively high salinities when it can generate red tide blooms[8,9]. Our findings have shown that with calm weather conditions, temperature and salinity were reported were between 28.5-29.2°C and 38.69-39.99 ppt respectively. Brownish patches of *P. quinquecorne* were found as the tidal water with temperature was rising during the daytime, suggesting that the bloom observed near the Al Mamzar Coniche area was due to very less tidal influx and current flow with stagnant closed water bodies. The present bloom condition probably occurred mainly due to the result of an accumulation processes. However, when temperatures drop dramatically, blooms begin to vanish. In several previous studies, the blooms of *P. quinquecorne* were correlated with higher levels chlorophyll-*a*[8,10], which is consistent with our findings during the bloom period of day 1, 8th November than day 2 of 10th November, 2017 of elevated chlorophyll *a*, carotenoids and phaeophytin. These levels and conditions have been described as the most conducive to the development of *P. quinquecorne* along Dubai coastal waters. The seasonal bloom conditions favored proliferation of *P. quinquecorne* in the coastal water. However, we can draw to a reasonable to the available information that *P. quinquecorne* is well suited to shallow water tropical embayment. During summer season is when phytoplankton blooms are most common, as the quantity of inorganic nutrients in the water column increases (silicate, nitrogen and phosphate compounds). Nitrogen and phosphorus compounds are the most common plant nutrients found naturally in seawater[11,12]. However, steady winds push the suspended sediments from the euphotic zone's shallow floor of the causing nutrient waters to upwelling[13]. This argument promotes the view of large phytoplankton increase and formation bloom of single species. During the period of *P. quinquecorne* bloom, the nitrate and phosphate-phosphorus concentrations in our study area was low, whereas the total nitrogen (0.76-0.98mg/l) was slightly high. Elevated total nitrogen during the bloom of *P. quinquecorne* may be associated with nutrients flow and organic matter decomposition respectively. This supremacy was linked to the species ability to thrive in a variety of physico-chemical conditions. It is not well known that certain bloom species are present in our waters. In order to understand the dynamics of these blooms along with the casual variables that trigger such blooms thorough studies are required. The prevention and management of algal bloom in Dubai coastal water will benefit from this type of information and awareness in the future.

Conclusion

The algal bloom occurred and to be related to low water circulation caused by a manmade sand bund at the Al Mamzar Corniche. Persistence for four days of brown an armored patches of the dinoflagellate *P. quinquecorne* species has related to changes in water quality conditions. This harmful algal bloom (HABs) bloom was the first of its kind observed and there were no fish kill recorded in Dubai coastal waters and its' density was found to gradually increase during the daytime. More research is needed to better understand the dynamics of these blooms and the causes that cause them. The acquisition of more knowledge on seasonal changes, periods of blooms, ecological succession of phytoplankton species, would enhance our ability to understand the potential effects on human health and on the marine environment.

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