

# Observation of the Algal Flora (Phytoplankton) of the Coral Reef in Iraqi Territorial Waters

\*Nida J.M. Al-Mousawi and \*\*Jihad M. Al-Zewar

\**Department of Biology, College of Science, University of Basra, Iraq*

\*\**Department of Biological Development, Marine Science Center, University of Basra, Iraq*

(Received 27 January, 2021; Accepted 17 March, 2021)

## ABSTRACT

Coral reefs in Iraqi territorial waters are important and recent discoveries in the northwest of the Arabian Gulf. Fourteen samples were collected from five sites of these reefs from different levels of water column during the day and night. Exactly (46) taxa documented of phytoplankton suspended in the water column under (32) genus, of which (44) species belong to the Bacillariophyta, and only two species belong to the Dinoflagellate. The most common genera were *Rhizosolenia* and *Cheataceros* four species to both and *Nitzschia* three species. It was found that the species of higher frequency were *Cheatacerosdidymus*, *Coscinodiscus radiates* and *Thalassiothrixnitzschodis*, while species *Achnanthes*, *Amphora*, *Rhopalodia* and *Epithemia* were of fewer frequency.

**Key word:** *Algal Flora, Phytoplankton, Coral Reef, Iraqi Territorial Waters.*

## Introduction

A coral reef is an underwater ecosystem characterized by reef building corals. Reef is formed of colonies of coral polyps held together by calcium carbonate. They are most commonly found at shallow depth in tropical or sub-tropical water, but deep water and cold water they exist on smaller scales (Lee, 2008). Coral reefs are one of the richest environment in biodiversity (Goreau *et al.*, 1979). The productivity and biodiversity of these complex marine ecosystems can be compared to tropical rain forests in terrestrial environments (Maragos *et al.* 1996). Among these organisms, diatom was found to be rather divers. Phytoplankton are often used as food supply in the aquaculture industry for grown (Harrison *et al.*, 1990).

Coral reefs are found in the Arabian Gulf in the United Arab Emirates, Saudi Arabia, Bahrain, Qatar, Oman, Kuwait, and Iran, whose coasts are rocky

sandy nature. Soon, no reefs were registered in Iraqi territorial waters because of the muddy nature of their coastlines. But in September 2012, coral reefs were discovered in this area. It is characterized by its environmental conditions such as turbidity and its soft fragile deposits and high currents that are not related to coral reefs in most parts of the world (Pohl *et al.*, 2014).

Taxonomic studies on benthic diatoms algae from coral reef are well dominant for instant Al-Handal, *et al.*, (2016,2018). The first one detailed list of benthic diatoms investigation was made in tropical water and coral reefs of Reunion & Rodriguez Island in Indian Ocean. The list includes (141) taxa. The last work also on benthic diatoms was made in Arabian Gulf which document (96) taxa belonging to (33) genera.

Few publications were available on the phytoplankton of the coral reef, most of which were about benthic diatoms.

The phytoplankton diatoms are well dominant as they play an important role in the ecosystem. Therefore, the present paper is to describe and illustrate the different member of diatoms algae in order to provide back ground data for future research.

## Materials and Methods

### Collection of Samples

Fourteen Phytoplankton samples were collected from the coral reef area of Iraqi Marine Waters (The coral reef has an area of 28 km<sup>2</sup> and is located at 29°37'00 N and 048°48'00 E) by using net with 120µm mesh size, at depth range from 1 to 8 m, during day and night in June 2014, Table 1. At bottom, column and surface of water column. The detail information of the coral reef area, location and environmental characteristics is reported by Pohl *et al.* (2014).

### Preservation of Samples

The samples were Preserved in formalin 4%.

### Diatoms Cleaning

Diatoms samples were cleaned by boiling with 30% hydrogen peroxide for 30 minutes, described in Al-Shaheen, (2016).

The Phytoplankton taxa were identified according to Al-Handal *et al.* (2018, 2016); Bourrelly, (1981); Heurek, (1962); Al-Shaheen, (2016); Lobban and Jordan, (2010); Goreau *et al.*, (1979), and were photographed using ..... axophot imaging light microscope.

## Results and Discussion

Total, 46 taxa belonging to 32 genera were identified during the present study, Table 2; in the present investigation (30) genera of diatoms including (44) species and tow genera of Dinoflagellate, with two species have been identified, Table 2 and 3.

The classification of phytoplankton taxa Table 3 was generally based on Al-Kandari *et al.*, (2009) study, which recognized three classes under the division Bacillariophyta.

We did not notice differences in the presence of species according to the water column Table 1 Which indicates good confusion in the collection sites.

Four species of *Rhizosolenia* and *Chaetoceros* have been reported from the present investigation in water region, Table 3.

Species *Chaetocerosdidymus* and *Coscinodiscus radiates* were widely distributed 92%. Second in importance is *Thalassiothrixnitzschodis* which comprises 85%, while the species *Rhizosolenaalata* comprises 78% Plate 1.

The first station in the number of species has been dominated by (33) species, Table 2, while the third station was the lowest of species. It accounted for only eight species. It could be due to the gathering at night at the third station and day in the first station. The abundance of zooplankton has been observed in the third, fourth and eighth stations, which graze on phytoplankton, which leads to a lack of species.

The widespread occurrence of phytoplankton in coral reefs was attributed to high concentration of

**Table 1.** Different Locations and Times for Sampling of Marine Algae from coral reef in Iraqi territorial waters

| Sample No. | GPS                          | Water column | Time  |
|------------|------------------------------|--------------|-------|
| 1          | 29° 37'09.9" N 48°48'22.6" E | Bottom       | Day   |
| 2          |                              | Column       | Day   |
| 3          |                              | Bottom       | Night |
| 4          |                              | Column       | Night |
| 5          | 29°38'244" N 48°49'219" E    | Surface      | Day   |
| 6          |                              | Column       | Day   |
| 7          |                              | Bottom       | Day   |
| 8          |                              | Column       | Night |
| 9          | 29° 38'02.8" N 48°49'12.4" E | Surface      | Day   |
| 10         |                              | Bottom       | Day   |
| 11         |                              | Column       | Day   |
| 12         |                              | Bottom       | Day   |
| 13         |                              | Column       | Day   |
| 14         |                              | Bottom       | Day   |

**Table 2.** Alphabetically the distribution of identified genera and species of phytoplankton from coral reef in Iraqi territorial waters.

| Division  | Genus or Sp.  | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | Frequency |    |
|---|---|---|---|---|---|---|---|---|---|---|----|----|----|----|----|-----------|----|
| Bacillariophyta                                       | <i>Achnanthes (Eucoconeis) Barg</i>                 | + |   |   |   |   |   |   |   |   |    |    |    |    |    | 1         |    |
|   | <i>Amphiproraalata Cleve</i>                        |   |   |   |   | + |   |   |   |   |    |    | +  |    |    | 3         |    |
|   | <i>Amphora ovalis Kützing</i>                       | + |   |   |   |   |   |   |   |   |    |    |    |    |    | 1         |    |
|   | <i>Asterionellaformosa Hassall</i>                  | + |   |   |   | + |   |   |   |   |    |    |    |    |    | 3         |    |
|   | <i>Asterionellahussall Hassall</i>                  | + |   |   |   | + |   |   |   |   |    |    |    |    |    | 6         |    |
|   | <i>Bacillariaparadoxa Gmelin</i>                    | + |   |   |   |   |   |   |   |   |    |    |    |    |    |           | 4  |
|   | <i>Bacteriastrum sp. Shadbolt</i>                   |   |   |   |   |   |   |   |   |   |    |    |    |    |    |           | 10 |
|   | <i>Bacteriastrumvarians Shadbolt</i>                | + |   |   |   |   |   |   |   |   |    |    |    |    |    |           | 10 |
|   | <i>Biddulphiairaileyii Gray</i>                     |   |   |   |   |   |   |   |   |   |    |    |    |    |    |           | 5  |
|   | <i>Campylodiscus sp. Ehrenberg</i>                  |   |   |   |   |   |   |   |   |   |    |    |    |    |    |           | 1  |
|   | <i>Centronellareichetti Kützing</i>                 |   |   |   |   |   |   |   |   |   |    |    |    |    |    |           | 6  |
|   | <i>Cheatacerosparadunou Ehrenberg</i>               |   |   |   |   |   |   |   |   |   |    |    |    |    |    |           | 11 |
|   | <i>Cheatacerosarmatum Ehrenberg</i>                 |   |   |   |   |   |   |   |   |   |    |    |    |    |    |           | 13 |
|   | <i>Cheatacerosdidymus Ehrenberg</i>                 |   |   |   |   |   |   |   |   |   |    |    |    |    |    |           | 2  |
|   | <i>Cheatacerosperuvianum</i>                        |   |   |   |   |   |   |   |   |   |    |    |    |    |    |           | 8  |
|   | <i>Coccosis sp. Ehrenberg</i>                       |   |   |   |   |   |   |   |   |   |    |    |    |    |    |           | 10 |
|   | <i>Coccosinodiscus radiates Ehrenberg</i>           |   |   |   |   |   |   |   |   |   |    |    |    |    |    |           | 10 |
|   | <i>Cyclotella spp. Kützing</i>                      |   |   |   |   |   |   |   |   |   |    |    |    |    |    |           | 5  |
|   | <i>Cymatopleurasolenia W. Smith</i>                 |   |   |   |   |   |   |   |   |   |    |    |    |    |    |           | 1  |
|   | <i>Cymbella sp. Ayardh</i>                          |   |   |   |   |   |   |   |   |   |    |    |    |    |    |           | 6  |
|   | <i>Diploniesinterrupta Ehrenberg</i>                |   |   |   |   |   |   |   |   |   |    |    |    |    |    |           | 11 |
|   | <i>Epithemiaarcus Kützing</i>                       |   |   |   |   |   |   |   |   |   |    |    |    |    |    |           | 13 |
|   | <i>Epithemiasorex Kützing</i>                       |   |   |   |   |   |   |   |   |   |    |    |    |    |    |           | 2  |
|   | <i>Gyrosigma sp. Hassall</i>                        |   |   |   |   |   |   |   |   |   |    |    |    |    |    |           | 8  |
|   | <i>Melosira Herzogii</i>                            |   |   |   |   |   |   |   |   |   |    |    |    |    |    |           | 13 |
|   | <i>Nitzschia (Nitzschliella) acicularis Hassall</i> |   |   |   |   |   |   |   |   |   |    |    |    |    |    |           | 2  |
|   | <i>Nitzschialineararia Hassall</i>                  |   |   |   |   |   |   |   |   |   |    |    |    |    |    |           | 1  |
|   | <i>Nitzschiaparadoxa Hassall</i>                    |   |   |   |   |   |   |   |   |   |    |    |    |    |    |           | 4  |
|   | <i>Neiculamesolepta Kützing</i>                     |   |   |   |   |   |   |   |   |   |    |    |    |    |    |           | 3  |
|   | <i>Neiculaserians Kützing</i>                       |   |   |   |   |   |   |   |   |   |    |    |    |    |    |           | 1  |
|   | <i>Pleurosigma acuta</i>                            |   |   |   |   |   |   |   |   |   |    |    |    |    |    |           | 4  |
|   | <i>Pleurosigmanuninum Smith</i>                     |   |   |   |   |   |   |   |   |   |    |    |    |    |    |           | 1  |
|   | <i>Rhizosolenia alata Brightwell</i>                |   |   |   |   |   |   |   |   |   |    |    |    |    |    |           | 11 |
|   | <i>Rhizosolenia cochlea Brun</i>                    |   |   |   |   |   |   |   |   |   |    |    |    |    |    |           | 7  |
|   | <i>Rhizosolenia imbricate Brightwell</i>            |   |   |   |   |   |   |   |   |   |    |    |    |    |    |           | 4  |
| <i>Rhizosoleniarobusta Brightwell</i>                 |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    | 2         |    |
| <i>Rhopalodiarhopala Kützing</i>                      |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    | 1         |    |
| <i>Stephanodiscus niagame Hokanssonf &amp; Hickey</i> |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    | 1         |    |
| <i>Surirellarobusta Ehrenberg</i>                     |   |   |   |   |   |   |   |   |   |   |    |    |    |    |    | 1         |    |

Dinophyta

Table 2. Continued ...

| Division | Genus or Sp.                                   | 1  | 2  | 3 | 4  | 5  | 6  | 7  | 8  | 9 | 10 | 11 | 12 | 13 | 14 | Frequency |
|----------|--|----|----|---|----|----|----|----|----|---|----|----|----|----|----|-----------|
|          | <i>Synedra capitata</i> Kützing                |    |    |   |    |    |    |    |    |   |    |    |    |    |    | 2         |
|          | <i>Tabellariafenestrata</i> William & Round    | +  | +  |   |    |    |    |    |    |   |    |    |    |    |    | 1         |
|          | <i>Thalassionemagruntum</i> Grunow             | +  | +  |   |    |    |    |    |    |   |    |    |    |    |    | 2         |
|          | <i>Thalassiothrixnitzschodis</i> Cleven & Grun |    |    |   |    |    |    |    |    |   |    |    |    |    |    | 7         |
|          | <i>Triceratiumconsimih</i> Cleve               | +  | +  |   |    |    |    |    |    |   |    |    |    |    |    | 1         |
|          | <i>Ceratiummassilliense</i> Courrt             |    |    |   |    |    |    |    |    |   |    |    |    |    |    |           |
|          | <i>Peridiniumdepressum</i> Bergh               | 33 | 16 | 8 | 13 | 17 | 14 | 23 | 10 | 9 | 10 | 9  | 13 | 12 | 9  |           |
|          | 46   |    |    |   |    |    |    |    |    |   |    |    |    |    |    |           |

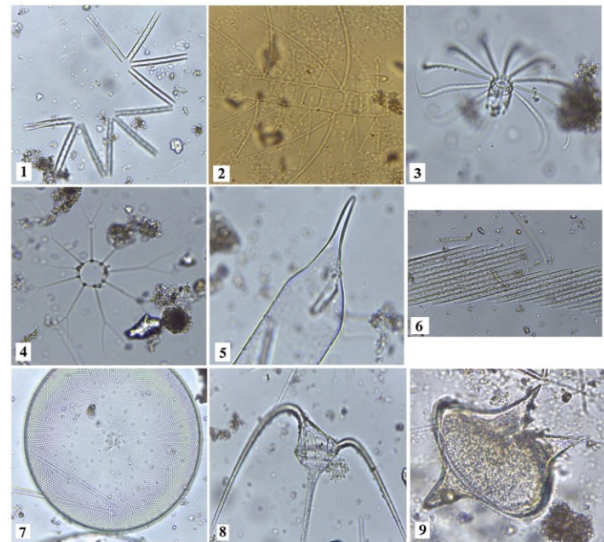


Plate 1. Some commongenera in current study station, (1) *Thalassiothrixnitzschodia* (2) *Cheatocerosdidymus* (3) *Bacteriastrumvarians* (4) *Cheatocerosarmatum* (5) *Rhizosoleniaalata* (6) *Bcillariaparadoxa* (7) *Coscinodiscus radiates* (8) *Ceratium* sp. (9) *Peridinium* sp.

silica, or may be due to the richness of organic matter and calcium and nutrients, Al-Kandari *et al.* (2009).

Referance

Abdel-Kareem, M.S.M. 2009. New algal records from the Arabian Gulf coast of Saudi Arabia. *Botany Research International*. 2(4) : 268-276.

Al-Handal, A. Y., Thomas, E. W. and Pennest, C. 2018. Marine benthic diatoms in the newly discovered coral reefs off Basrah coast, southern Iraq. doi.org “ 10.11646“ *Phytotaxa*. 372.2.1 .

Al-Handal, A.Y., Compere, P. and Riaux-Gobin, C. 2016. Marine benthic diatoms in the coral reefs of Reunion and Rodrigues Island, west Indian Oceaen. *Micronesica*. 03 : 1-78.

Al-Kandari, M., Al-Yamani, F.Y. and Al-Rifaic, K. 2009. Kuwait institute for scientific research marine phytoplankton atlas of Kuwait s water- Kuwait *Institute for Scientific Research*. (350) pp.

Al-Shaheen, M. A. 2016. Taxonomical and Ecological study on the Diatoms communities of Shatt Al- Arab River, southern Iraq. Thesis college of science , university of Basrah. (308) pp.

Bourrelly, P. 1981. Les Algues Deau Douce Initiation ala systematique. Societe Nouvelle des edition boubee. 515 pp.

Goreau, T. F., Goreau, N. I. and Goreau, T. J. 1979. Corals

**Table 3.** Taxonomic List of Marine Algae from coral reef In Iraqi territorial waters.

| Division        | Class                                   | Order   | Family   | Genus & Species  |
|-----------------|---|---|--|--|
| Bacillariophyta | Coscinodiscophyceae<br>Round & Crawford | Thalassiosirales<br>Round & Crawford<br>Cosinodisciales Round & Crawford<br>Triceratiales Round & Crawford<br>Biddulphiiales Krieger<br>Rhizosoleniales Silva<br>Chaetocerotales<br>Round & Crawford<br>Fragiliales Silva | Stephanodiscaceae  | <i>Cyclotella</i> spp. Kützing<br><i>Stephanodiscusniagarae</i> Hokanssonf & Hickey<br><i>Coscinodiscus radiates</i>   |
|                 |   |   | Nicolaeae  | <i>Triceratiumconsimilit</i> Cleve   |
|                 |   |   | Cosinodiscaceae Kützing<br>Ehrenberg <i>Melosirahierzogii</i><br>Triceratiaceae                              | <i>Biddulphiaireileyii</i> Gray<br><i>Rhizosolenialata</i> Brightwell R. <i>cochlea</i> Brun R.<br><i>imbricate</i> Brightwell R. <i>robusta</i> Brightwell<br><i>Cheateocerosarmatum</i> Ehrenberg C.<br>Ehrenberg<br><i>C. peruvianum</i> Ehrenberg<br><i>Asterionellaformosa</i> Hassall A.<br>hussal Hassall <i>Bacteriastromvarians</i> Shadbolt B. sp.<br><i>Centronellaecalis</i> Kützing <i>Synedra</i> spp. Ehrenberg<br><i>Tabellariafenestrata</i> William & Round<br><i>Thalassiothrixnitichodis</i> Cleven & Grun |
|                 |   |   | Lemmermann   | <i>Cymbella</i> sp. Agardh   |
|                 |   |   | Biddulphiaceae Kützing<br>Rhizosoleniaceae De Toni   | <i>Achnanthes (Eucocconeis)</i> Barg<br><i>Cocconeis</i> sp. Ehrenberg<br><i>Naviculamesolepta</i> Kützing <i>Navicularians</i> Kützing<br><i>Gyrosigma</i> sp. Hassall <i>Pleurosigmaacuta</i> Cleve P.<br><i>murinum</i> Cleve   |
|                 |   |   | Chaetocerotaceae Smith<br>Ehrenberg C. <i>paradunou</i><br><i>didymus</i>                                    | <i>Epithemia arcus</i> Kützing E. <i>sorex</i> Kützing<br><i>Rhopalodiarhopala</i> Kützing<br><i>Thalassionemagrund</i> Grunow<br><i>Diplonitesinterrupta</i> Ehrenberg<br><i>Amphiproradialata</i> Cleve A. <i>evalis</i> Ehrenberg<br><i>Bacillariaparadoxa</i> Gmelin <i>Nitzschia (Nitzschialia)</i><br><i>acicularis</i> Hassall N. <i>linearis</i> Hassall N. <i>paradoxa</i><br>Hassall   |
|                 |   |   | Fragilariaceae Greville  | <i>Campylodiscus</i> sp. Ehrenberg <i>Cymatopleuramosolena</i><br>W. Smith <i>Surirellarobusta</i> Kützing<br><i>Ceratiummassilliense</i> Courtt<br><i>Peridiniumdepressum</i> Bergh   |
|                 |   |   | Thalassionemataceae Round<br>Cymbellaceae Greville   | Sub-family: Pseudoraphidiae<br>Diploneidaceae Mann<br>Catenulaceae Mereschkowsky<br>Bacillariaceae Ehrenberg   |
|                 |   |   | Achnanthaceae Kützing<br>Cocconeidaceae Kützing<br>Naviculaceae Kützing<br>Plerosigmataceae Mann             | Surirellaceae Kützing<br>Ceratiaceae Lindemann<br>Peridiniaceae Ehrenberg  |
|                 |   |   | Epithemiaceae Bessey   |  |
|                 |   |   | Sub-family: Pseudoraphidiae<br>Diploneidaceae Mann<br>Catenulaceae Mereschkowsky<br>Bacillariaceae Ehrenberg |  |
|                 |   |   | Thalassiosiphysales Mann<br>Bacillariales Hendey   |  |
|                 |   |   | Surirellales Mann  |  |
|                 |   |   | Gonyaulacales FJR. Taylor<br>Peridimiales Haeckel  |  |
|                 |   |   | Pyrrophyta   | Dinophyceae West & Fritch  |
|                 |   |   |  |  |

- and coral reef. *Scientific American*. 241 : 124-136.
- Harrison, P. J., Thompson, P. A. and Calderwood, G. S. 1990. Effect of nutrient and life limitation on the biochemical composition of phytoplankton. *J. of Applied Phycology*. 2 : 45-56.
- Heurek, H.V. 1962. A treatise on the Diatomaceae. Wheldon & Wesley, LTC. and Verlag J. Cramer. (558) pp.
- Jamal, A. H. and Pavlov, 2001. Introduction to the study of plant plankton in the Arabian Gulf. Ministry of Public Works, Department of Agriculture and Fisheries Control. (101) pp. (In Arabic)
- Lee, R. E. 2008. *Phycology*. Cambridge university press. (547) pp.
- Lobban, C. S. and Jordan, R. W. 2010. Diatoms on coral Reef and intropical marine lake. Cambridge university press. (346-356) pp.
- Maragos, J.E., Crosby, M.P. and McMannus, J.W. 1996. Coral reefs and biodiversity: a critical and threatened relationship. *Oceanography*. 9 : 83-99.
- Pohl, Th. Al-Muqdadi, S.W., Ali, M.H., Fawzi, N. Al, Ehrlich, H. and Merkel, B. 2014. Discovery of a living coral reef in the coastal waters of Iraq. *Scientific Reports*. 4 : 4250/Dol:10.1038/srep04250.
-