Caspian J. Env. Sci. 2015, Vol. 13 No.3 pp. 283~288

CJES
Caspian Journal of Environmental Sciences

[Report and Opinion]

First record of *Ebria tripartita* (Schumann) Lemmermann, 1899 from south of the Caspian Sea

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(Received: Dec. 07. 2014 Accepted: May. 05. 2015)

ABSTRACT

Ebria tripartita (Schumann) Lemmermann, 1899, a non-photosynthetic flagellate algae was identified from the southern coast of the Caspian Sea in December 2012. Water temperature at the sampling time was 10 ^{o}C The average concentration of nitrate, phosphate and silicate were 0.7, 0.1 and 1.8 mg.l^{-1} respectively at the time when species was observed. Total observed phytoplankton cells was 3 × 10^{6} cells.l^{-1}, of which *E. tripartita* constitute 2×10 ^{3} cells.l^{-1} representing only 0.75% of phytoplankton community.

Key words: *Ebria tripartita*, Caspian Sea, Eutrophication, Flagellate.

INTRODUCTION

Ebria tripartita (Schumann) Lemmermann, 1899 presents in coastal planktonic communities overall the world (Vors, 1992; Throndsen, 1997; Ikavalko, 1998; Tong *et al.,* 1998; Horner, 2002; Throndsen *et al.,* 2003) but it is usually seen at low cell concentration. It belongs to Ebriid family locating in Rhizaria groups of Eukaryotes (Chantangsi *et al.,* 2010). The ebridian flagellates are a small group of marine microplankton with a long fossil record. The first fossils recognized to this group are Cretaceous in age and the biodiversity maximum for ebridian genera was recorded in the Miocene (Loeblich *et al.,* 1968; Tappan, 1980). The fossils of this species are applied as important proxies for determining geological ages of marine sediments (Onodera *et al.,* in press). Although there are reports of other species of this family, *E. tripartita* and *Hermesium adriaticum* Zacharias, 1906 especially have been recognized (Hargraves, 2002). Desired temperature is expressed different in available papers, since it has been reported in some papers in cold seasons and others in warm seasons of year (Rhodes & Gibson, 1981; Bizsel & Cirik, 2002; Suikkanen *et al.,* 2007). It is paleontogically expressed that *E. tripartita* lived in warm water at the Quaternary (Locker, 1995). It locates in heterotrophic group and on the top of the microbial food web (Uitto *et al.,* 1997; Rychert, 2013). Ebriids have two slightly subapically unequal flagella and nucleus with condensed chromosomes during interphase. They do not have external cell wall but internal silica skeleton is composed of branching or fenestrated rods (Patterson, 1999; Hargraves, 2002). *Ebria* cells are phagotrophic and range from 25 to 40 µm in length. Reproduction is unknown. The name of taxon comes from the Latin word ebrius, which means "drunken" and refers to their distinctive swimming mode. Ebriids are ecologically interest because they are herbivorous grazers (Uitto *et al.,* 1997, Chitchai *et al.,* 2010) that occasionally reach high cell concentration (Hargraves & Miller, 1974). *E. tripartita* feeds on phytoplankton, especially on diatoms and also on dinoflagellates (Taylor, 1990; Hargraves, 2002; Jin *et al.,* 2011). The details of the feeding process are still

unknown and the involvement of pseudopodia has not been definitively recognized (Taylor, 1990; Hargraves, 2002). However, the capacity to produce pseudopodia has been indicated in the literature (Patterson, 1999). In addition, a species that has the ability to swallow up diatom cells needs an ingestion mechanism and specialized cell structures. Although a distinct mouth would be one option, there is no structural data that support this theory. Hence, the hypothesis of pseudopodia in feeding is much more likely (Taylor, 1990). Despite the ecological significance of the group, research on *E. tripartita* is scarce and nearly limited to taxonomic and stratigraphic accounts. There are a few reasons for this lack of knowledge. First, it can not be cultivated *in vitro* and the second is relatively low cell concentrations in coastal water (Hoppenrath & Leander, 2006).

MATERIALS AND METHODS

The study area has located at southwestern coast of the Caspian Sea. Six stations were selected in Guilan province including Chaboksar, Sefidrood estuary, Amirbekandeh Dehkadeh saheli and Sefidkenar adjacent to Anzali and Talesh Cities at '33 ˚55, 49º 56´, '44˚49, '30˚49, '21˚49 and 48º 55´ latitudes respectively. Sampling was performed monthly in summer and autumn 2012 (from July to December). Temperature, nitrate, phosphate and silicate were measured at each station. Nitrate, phosphate and silicate concentrations were measured by using spectrophotometer (BR500 made in PERKINELMER Company Massachusetts. USA). Phytoplankton species were identified using light microscope (BX51 OLYMPUS) with 200X and 400X magnification. Phytoplankton samples were collected by bottles and were fixed in %2 formalin.

RESULTS

E. tripartita is unicellular, without pigment, and with two flagella. This species' internal siliceous skeleton is surrounded by cytoplasmic structures. It was observed at all stations except Sefidrood estuary. The cell concentration of *E. tripartita* was 2×10^3 cells.l^{-1} in the coastal waters of the Caspian Sea. The relative abundance of *E. tripartita* was 0.75%. At the same time, Diatoms were dominant group; *Chaetoceros* sp. and *Exvuiaella cordata* were the species which had the highest abundance in coastal phytoplankton community. In the present study, *E. tripartite* density showed no significant correlation with nitrate, phosphate and silicate concentrations, but was inversely correlated with temperature. Table 1 shows the water quality parameters associated with the presence and abundance of *E. tripartita*.

Table 1. Water quality parameters associated with the presence and abundance of *E. tripartita* in December 2012.

Station	Nitrate (mg.l^{-1})	Phosphate (mg.l^{-1})	Silicate (mg.l^{-1})	Temperature (°C)	Density (cell.l^{-1})
Chaboksar	0.46	0.07	0.001	10	8200
Sefidrood Estuary	1.57	0.001	5.51	10	-
Amirbekandeh	0.63	0.2	1.65	10	1900
Dehkadeh Saheli	0.79	0.15	2.61	10	1400
Sefidkenar	0.47	0.14	0.46	10	200
Talesh	0.49	0.1	0.34	10	100

DISCUSSION

Southwestern coast of the Caspian Sea is located in the temperate zone and, this area has become more and more eutrophic since the early 1980s (Salmanov, 1999; CEP., 2006; Stolberg *et al.,* 2006). *E. tripartita* was identified in this area for the first time. In the other studies, chrysophytes had not been reported from the southern part of the Caspian Sea (Nasrollahzadeh *et al.,* 2008; Ganjian *et al.,* 2010; Bagheri *et al.,* 2011, 2012a, b; Tahami *et al.,* 2012) but reported from central and northern part of the Sea (Kideys *et al.,* 2005). The salinity range is 12 - 13.5 ppt in the southern part (Bagheri *et al.,* 2012a) where *E. tripartita* was observed. It was also observed in 39 ppt in Izmir Gulf of Aegean Sea (Bizsel & Cirik, 2002) and in 14.4 - 23.2 ppt in Chesapeake Gulf of America (Rhodes & Gibson, 1981). Despite the wide temperature

range (4 - 29.5ºC) stated by Rhodes and Gibson (1981), *E. tripartita* was only observed at low temperature (10ºC) in the southwestern shore of the Caspian Sea. In a study on the variations of phytoplankton community in the northern part of the Baltic Sea, *E. tripartita* was observed when temperature and DIN concentration was low (Suikkanen *et al.,* 2007). In Izmir Gulf this species was approximately observed all year except in January 1998 (Bizsel & Cirik, 2002). In the present study *E. tripartita* cell concentration was correlated with water temperature but it was not correlated with nitrate, phosphate and silicate concentrations. At the time of presence of *E. tripartita*, concentration ranges of nitrate, phosphate and silicate were 0.46 - 1.57 $mg.l^{-1}$, 0.001 - 0.2 $mg.l^{-1}$ and 0.001 - 5.51 $mg.l^{-1}$ respectively. Concentration ranges of nitrate and phosphate were 0.023 - 0.5 $mg.l^{-1}$ and 0.05 - 6.5 $mg.l^{-1}$ respectively in Gulf Izmir when this species was observed (Bizsel & Cirik, 2002). Based on the present study, concentration of nutrients has increased in comparison with previous studies in the study area (Bagheri *et al.* 2011, 2012a, b). Following eutrophication, iatoms increased in the study area. Since they are main food source of this species, *E. tripartita* can be seen along with the increase in diatoms (Ellegaard *et al*., 2007; Korhola & Gronlund 1999). Abundance of *E. tripartita* was very low. Low abundance of this species may be due to little competition (or no competition) to the other species in eutrophication condition (Korhola & Gronlund 1999; Ellegaard *et al*., 2007). In an investigation on the sediment of northern Baltic Sea, *E. tripartita* was found on the top of sediments (0.5 - 1 cm upper level) when there has been an increase in nutrients. This increase was exactly observed in the area where the agricultural, industrial and municipal wastes flow into the Sea (Puskaric *et al.,* 1990). On the one hand, *E. tripartita* was observed in low temperature and high nutrients concentration and on the other hand, they feed on nanoplanktons (especially diatoms) which increase in eutrophic conditions, it is expected to be found in eutrophic conditions. Since this is the first report on Iranian coast of the Caspian Sea, its presence could be related to increased nutrients.

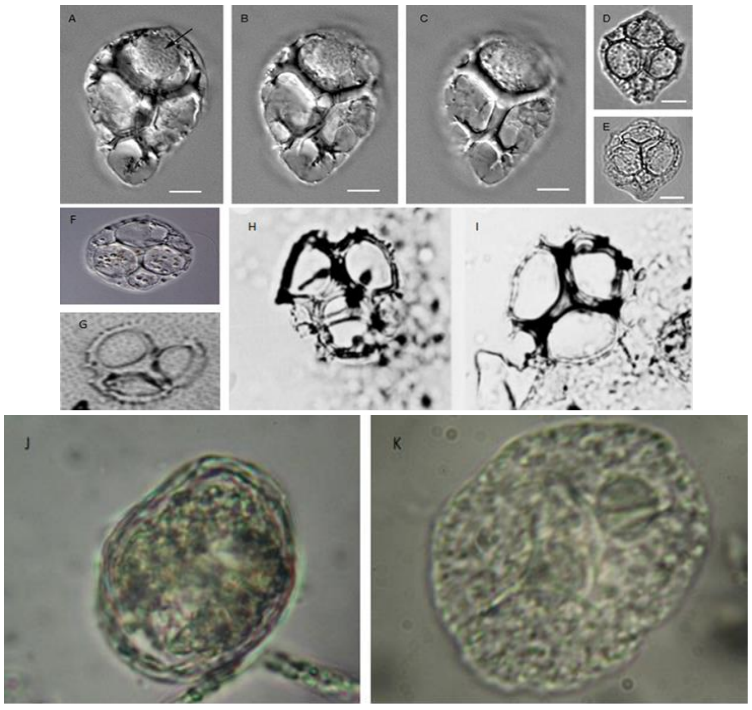

Fig. 1. A-E. Light micrographs of *E. tripartita* from plankton samples of English Bay, Vancover (from Hoppenrath & Leander, 2006). Note the nucleus (arrow) with its granular appearance. **F**. *E. tripartita* flagellum. **G**. Silicaceous skeleton of *Ebria* (Rhodes & Gibson, 1981). **H-I.** *E. tripartita* fossil (Korhola & Gronlund, 1999**)**. **J-K.** Light micrographs of *E. tripartita* isolated from the Caspian Sea plankton samples in the present study.

ACKNOWLEDGMENTS

The authors would like to thank Fisheries Department, Faculty of Natural Resource, University of Guilan for supporting this study.

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گزارش اولین مورد شناسایی تاژکدار *Ebria tripartita* (Schumann) Lemmermann, 1899 از جنوب دریای خزر

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(تاریخ دریافت: ۹۳/۹/۱۶ - تاریخ پذیرش: ۹۴/۲/۱۵)

چکیده

تاژکدار غیر فتوسنتزی*Ebria tripartita* (Schumann) Lemmermann, 1899 از سواحل جنوبی دریای خزر شناسایی شد. در بررسی جوامع فیتوپلانکتونی خط ساحلی جنوب دریای خزر، نمونه‌برداری به صورت ماهیانه در فصول تابستان و پاییز ۲۰۱۲ (از ماه جولای تا دسامبر) انجام شد. نمونه‌های فیتوپلانکتون پس از جمع‌آوری توسط فرمالین ۲٪ تثبیت شدند. نمونه *Ebria tripartita* در تمامی ایستگاههای مورد مطالعه بجز دهانه ورودی رودخانه سفید رود به دریا مشاهده شد. دمای آب در هنگام نمونه‌برداری ۱۰ درجه سانتی‌گراد و میانگین غلظت نیترات، فسفات و سیلیکات به ترتیب ۰/۷ ، ۰/۱ و ۱/۸ میلی‌گرم در لیتر بود. میانگین فراوانی کل فیتوپلانکتون‌ها ۳×۱۰^{۶} سلول در هر لیتر و *Ebria tripartita* ۲×۱۰^{۳} سلول در هر لیتر بود.

*مولف مسئول