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Research article

Morphological characters of *Chaetoceros lorenzianus* (Bacillariophyceae) isolated from North Arabian Sea after Tasman Spirit oil spill

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Abstract: The present study investigated the morphology and taxonomy of marine centric diatom *Chaetoceros lorenzianus* from Karachi Harbor, Pakistan for the first time for the first time during the incident of Tasman Spirit Oil Spill (2003) in the area. Phytoplankton samples were collected from 5 different locations from the study area. *Chaetoceros lorenzianus* was found only at one station collected after Tasman Spirit Oil Spill. Moreover morphometric measurements of present record showed narrow range as compared to the records investigated by other workers.
Keywords: *Chaetoceros lorenzianus* - Diatom - Phytoplankton - Tasman Spirit oil spill.

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INTRODUCTION

Phytoplankton are the major primary producers of marine and fresh water environment (Baliarsingh *et al*. 2012). Among phytoplankton, the Bacillariophyta (diatoms) contributes at least 40% of the global annual primary productivity (Field *et al*. 1998). These diatoms are ubiquitous occurrence in marine environment (Sunesen *et al*. 2008). Genus *Chaetoceros* Ehrenberg is considered as most diverse and wide spread centric diatom (Cupp 1943, Rines 1999, Hasle & Syvertsen 1997). It comprises of about 400 marine species with few fresh water records (*Round et al.* 1990). Morphological and taxonomical studies of this genus contributed new records time to time from various parts of the world oceans (Hernandez-Becerril 1993, Hernandez-Becerril 1999, Rines 1999, Trigueros *et al*. 2002, Murthy *et al*. 2012, Ozgur *et al*. 2013). A number of studies have been conducted on distribution and composition of *Chaetoceros* (Hargraves 1972, Fanuko & Valic, 2009, Tabassum & Saifullah 2010). It was observed to be one of the most frequently occurring genus among centric diatoms (Nwankwo & Onyema 2003, Tabassum & Saifullah 2010). Records of *Chaetoceros* have also been well observed in sediments with special reference to their resting spores (Stockwell 1991, Witak *et al*. 2011, Ferrario *et al*. 1998, Moazzam & Baig 1994). Variation in physiological behavior and their responses to hydrological parameters have also been studied (Johansen *et al*. 1990).

Chaetoceros lorenzianus, is considered to be a harmful bloom forming species (Sunesen *et al*. 2008). This species was studied by a number of scientists (Cupp 1943, Subrahmanyan 1946, Hendey 1964, Moazzam 1973, Hasle & Syvertsen 1997, Shevchenko *et al*. 2006, Sunesen *et al*. 2008, Tabassum & Saifullah 2010). Moreover the lysis of this species by a single stranded DNA virus has also been investigated (Tomaru *et al*. 2011). The occurrence of *Chaetoceros lorenzianus* has been discussed from various parts of the world ocean (Cupp 1943, Sunesen *et al*. 2008, Shevchenko *et al*. 2006, Wood 1963, Subrahmanyan 1946, Rajasekar *et al*. 2010, Hendey 1964) It is known from North Arabian Sea bordering Pakistan (Moazzam 1973, Saifullah & Chaghtai 2005, Tabassum & Saifullah 2010). This is the first attempt to study the impact of oil spill in North Arabian Sea on morphological characters of this species.

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MATERIALS AND METHODS

Phytoplankton samples were collected by net (50 µm) hauls of 5 minute duration at speed of 2 km at 5 sampling stations which were selected in the area affected by oil spill (Fig. 1 and Table 1). Samples were fixed with 10 % buffered formalin immediately after collection. Observations on oceanographic parameters like temperature, salinity and pH were also measured at each station.

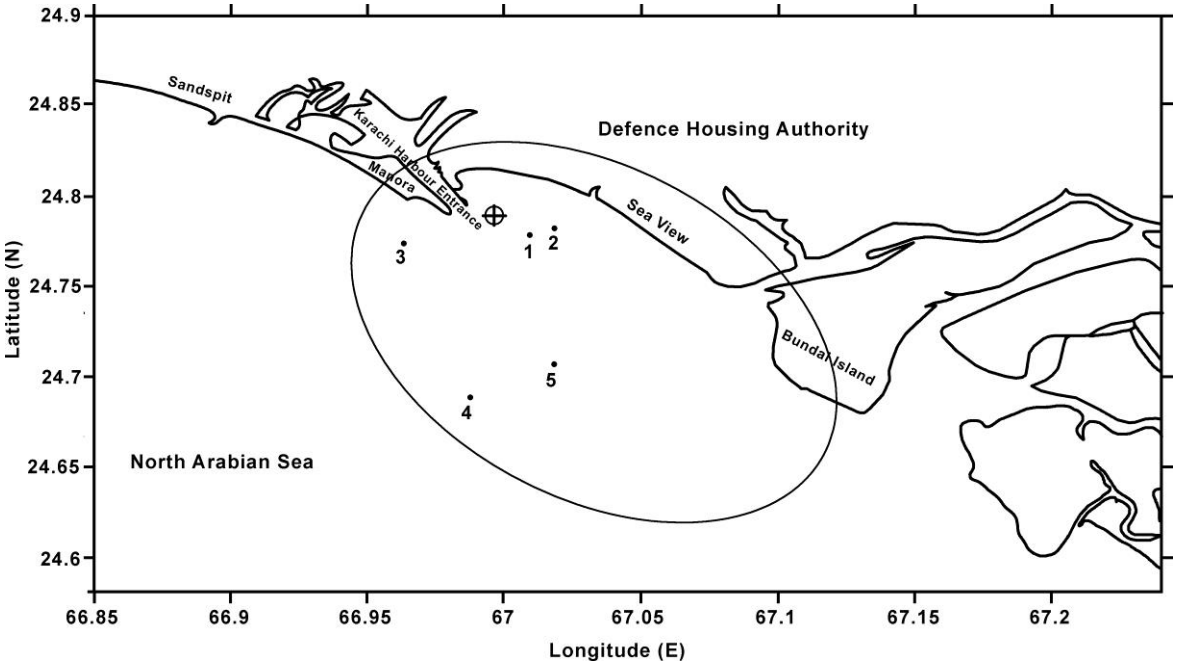

Figure 1. Map showing sampling stations of Tasman Spirit Oil Spill effected area.

Table 1. Sampling stations in off Karachi Harbour.

Station No.	Sampling date	Latitude N	Longitude E
1	19-11-03	24°80'248N	66°89'938E
2	19-11-03	24°80'816N	66°99'215E
3	19-11-03	24°80'771N	67°01'087E
4	19-11-03	24°79'753N	67°02'718E
5	20-11-03	24°77'204N	67°05'435E

Samples were observed in light microscope LABX N-400M. Prior to scanning electron microscopy (SEM) the samples were cleaned by cold H_2O_2 method (Karthick *et al*. 2010). Cleaned material were coated up to 300 °A with auto coater using JEOL # JFC 1500 having gold targets. The coated samples were then scanned with JEOL # JSM 6380A microscope. Present paper manifests the light and electron microscopic structures probably for the very first time in this study area.

RESULTS

Enumeration of species

Chaetoceros lorenzianus Grunow, 1863, 157, pl. 5: fig. 13; Cupp 1943, p. 118, Fig. 71; Subrahmanyan 1946, p. 131, Figs. 198–199, 202–204, 206–209 (p. 132); Hendey 1964, p. 124, Plate 16, Fig. 1; Hasle & Syvertsen 1997, p. 204, Plate 42; Shevchenko *et al*. 2006, p. 249, Figs. 84–89; Sunesen *et al*. 2008, p. 317 & 318, Fig. 11A–F; Tabassum & Saifullah 2010, p. 1144 & 1146, Fig. 13 (1145). **(Fig. 2)**

Chains straight, cells rectangular, apical axis 11–15 µm. Apertures wide, elliptical to lanceolate, foramina hexagonal, ranges from 10–12 µm. Setae thick, long, spiny, polygonal in cross section, fuse just near the margin, divergent with slight curve forming an angle of 35°–45° to the chain axis.

Distribution: During the present study this species was collected only from Station 2.

This species is reported by various parts of the world ocean. West Coast of North America (Cupp 1943); Madras, India (Subrahmanyan 1946); Chaleurs Bay Canada (Brunel 1962); Indian Ocean (Wood 1963); British Coastal Waters (Hendey 1964); Manora Channel Karachi (Moazzam 1973); Indian Ocean (Simonsen 1974); Peter the Great Bay, Sea of Japan (Shevchenko *et al*. 2006); Buenos Aires Argentina (Sunesen *et al*. 2008).

Observation from the study area: The valve profile of *Chaetoceros lorenzianus* is nearly close to the findings of numerous workers (Cupp 1943, Subrahmanyan 1946, Hendey 1964, Moazzam 1973, Hasle & Syvertsen 1997, Shevchenko *et al*. 2006, Sunesen *et al*. 2008, Tabassum & Saifullah, 2010) except the size of apical axis which is within a narrow range (Table 2). This may be attributed to their presence in the environment which was polluted with the crude oil because of Tasman Spirit oil spill which might have affected the cell metabolism. Parab *et al*. (2008) observed morphological changes in another centric diatom *Thalassiosira* because of oil exposure.

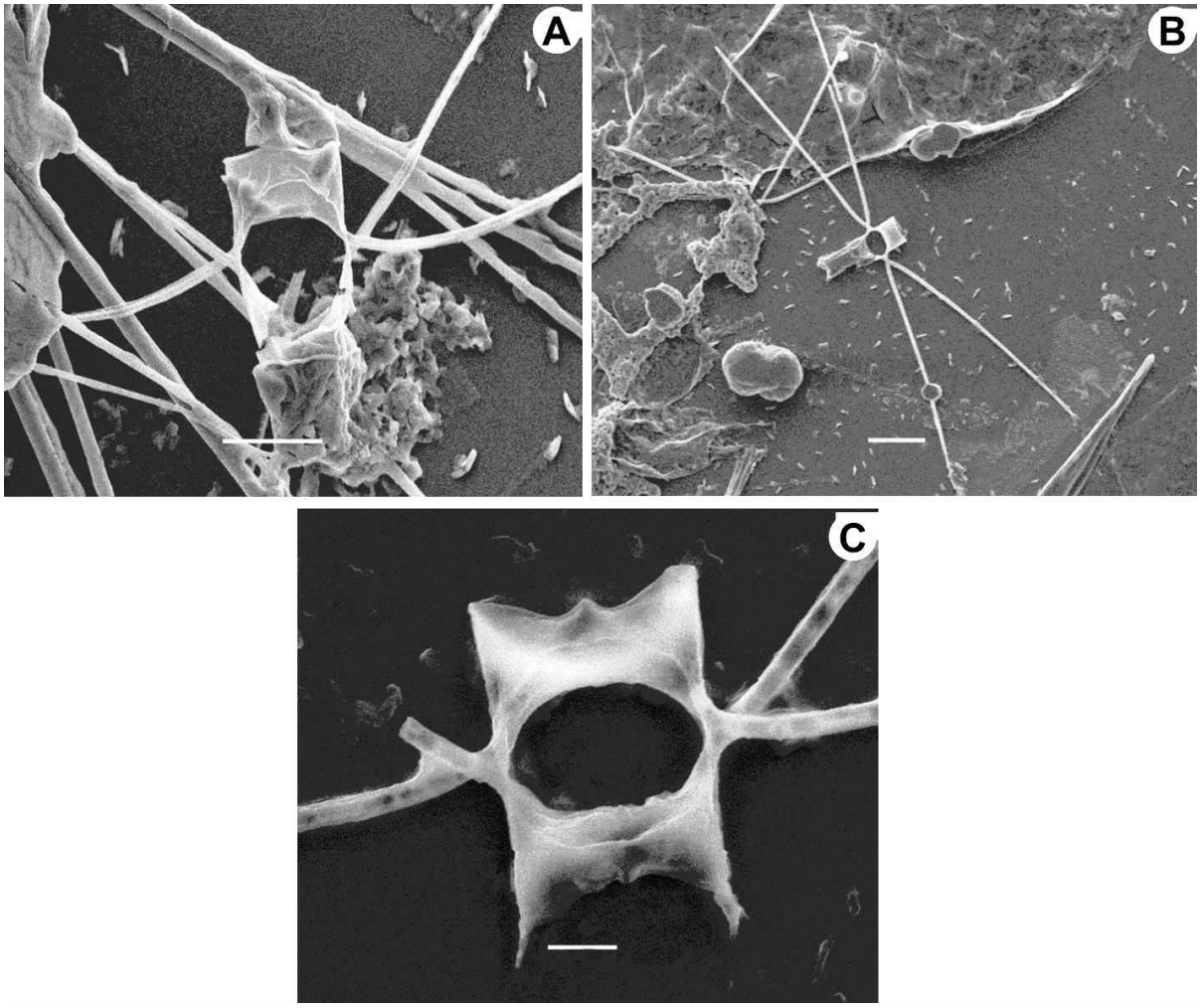

Figure 2. *Chaetoceros lorenzianus* (SEM, pair of sibling cells in girdle view): **A,** Scale bar: 10 µm; **B,** Sibling cells with long setae. Scale bar: 20 µm; **C,** Sibling valves with wide aperture. Scale bar: 5 µm.

Table 2. Comparison of morphometric data among *Chaetoceros lorenzianus* of present study with the previous records.

	Cupp, 1943 (Pacific Ocean)	Subrahmanyan, 1946 (Indian Ocean)	Hendey, 1964 (Atlantic Ocean)	Moazzam, 1973 (North Arabian Sea)	Hasle and Syvertsen, 1997	Sunesen et al., 2008 (Atlantic Ocean)	Tabassum and Saifullah, 2010 (North Arabian Sea)	Present study (North Arabian Sea)
Apical axis	7 µm – 48 µm	16 µm – 58 µm	26 µm – 60 µm	5 µm – 40 µm	7 µm – 80 µm	16 µm – 36 µm	15 µm – 35 µm	10 µm – 15 µm
Pervalvar axis	-	-	-	-	-	-	10 µm – 20 µm	7 µm – 11 µm

DISCUSSION

Any change in the ecosystem of an aquatic environment can be determined by analysis of phytoplankton composition of that area (Guilloux *et al*. 2013). An extensive amount of studies have been conducted on effects of oil pollution on ecosystem of water bodies which showed deleterious effects on growth of phytoplankton community structure (Parab *et al*. 2008, Jiang *et al.* 2010).

Genus *Chaetoceros* is termed as fast growing diatom and its domination among other members of phytoplankton was also observed during the studies conducted in the other parts of the world during stress condition of oil spill (Hallare *et al*. 2011). *Chaetoceros lorenzianus* collected from North Arabian Sea bordering Pakistan belongs to sub-genus Hyalochaete (Hasle & Syvertsen 1997). In the present study morphometric data including apical axis and pervalver axis of *Ch. lorenzianus* was found in narrow range but at the same time within the range of the results recorded earlier by other workers (Table 2). It is recorded that the traces of oil (raw or refine) are lethal to autotrophic life forms as they can cease metabolic activities by limiting their enzymatic activities (Lewis & Pryor 2013) and decrease chlorophyll 'a' concentration (Lee *et al*. 2009). As it is evident that the toxicity of crude oil is concentration dependent (Sheekh *et al*. 2000) and the species were recorded during the initial days of spill so recorded narrow range of morphometric measurements of the cells may accounted due to the effect of crude oil.

Moreover previous findings showed that Kuzmenko (1975), Tabassum & Saifullah (2010) observed 16 species of *Chaetoceros* in the month of February from Arabian Sea whereas seven species of this genus including *C. lorenzianus* were reported in the month of October from Kuwait Bay, Arabian Sea (Heil *et al*. 2001). Present study manifests sporadic occurrence of the species in the month of November immediate after Tasman Spirit Oil Spill which may have attributed to the effect of oil spill in this area.

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