

## STRUCTURAL DEFORMITY IN CENTRIC DIATOM SPECIES EVIDENCED AFTER TASMAN SPIRIT OIL SPILL

Asma Tabassum, Hina S. Baig and Aliya Rehman

Department of Botany, University of Karachi, Karachi-Pakistan (AT, AR);  
National Institute of Oceanography, Karachi-Pakistan (HSB).  
email: centricdiatomist@gmail.com

**ABSTRACT:** Present study comprised of 16 phytoplankton samples during Bioremedial Project conducted after 1.5 years of Tasman Spirit Oil Spill. Results showed that genera *Rhizosolenia* and *Guinardia* evidenced structural deformity. The present condition of cells clearly indicates the deleterious effects of crude oil on physiology of diatom species.

**KEYWORDS:** structural deformity, centric diatomic species evidence, Tasman spirit oil.

### INTRODUCTION

Diatoms are considered as the most dominant and important fraction of phytoplankton community (Naz *et al.*, 2013) and appeared as the biological indicator of water quality (Noga *et al.*, 2013). Changes in hydrographic parameters due to environmental disorders greatly affect the morphological appearances and assemblages of diatoms (Hunter, 2007). Such structural deformity took place might be due to the reduction in photosynthetic activity by the effects of petroleum oil contaminants (Singh & Gaur, 1988) resulting in the inhibition of growth of diatoms (Parab, *et al.*, 2008). Present investigation comprised of unusual shaped structures of centric diatoms reported after 1.5 years of Tasman Spirit Oil Spill i.e. during Bioremedial Project.

### MATERIALS & METHODS

Present research was conducted by studying phytoplankton samples collected from the area of Sea View Clifton Karachi. Site map, materials and methods including protocol of Light Microscopy have previously been described (Tabassum *et al.* 2010; Tabassum *et al.* 2011).

### OBSERVATIONS & RESULTS

***R. hyalina*** Ostenfeld in Ostenfeld & Schmidt (**Fig. 1a**)

Synonym: *Rhizosolenia pellucida* Cleve.

Hasle & Syvertsen, 1997, p. 151, Plate 28 (p. 152); Sunesen & Sar, 2007, p. 631-633, Fig. 16-24; Hernandez-Becerril *et al.*, 2010, p. 103 & 104, Figs. 57-62 (p. 103), Tabassum & Saifullah, 2011, p. 2191, Fig. 11 (p. 2190).

Cells usually elongated, cylindrical, solitary or in short chains, valves conical to triangular along with narrow otaria and contiguous area, processes straight or slightly curved at middle, otaria present. In the present report abnormality can be seen in valve structure.

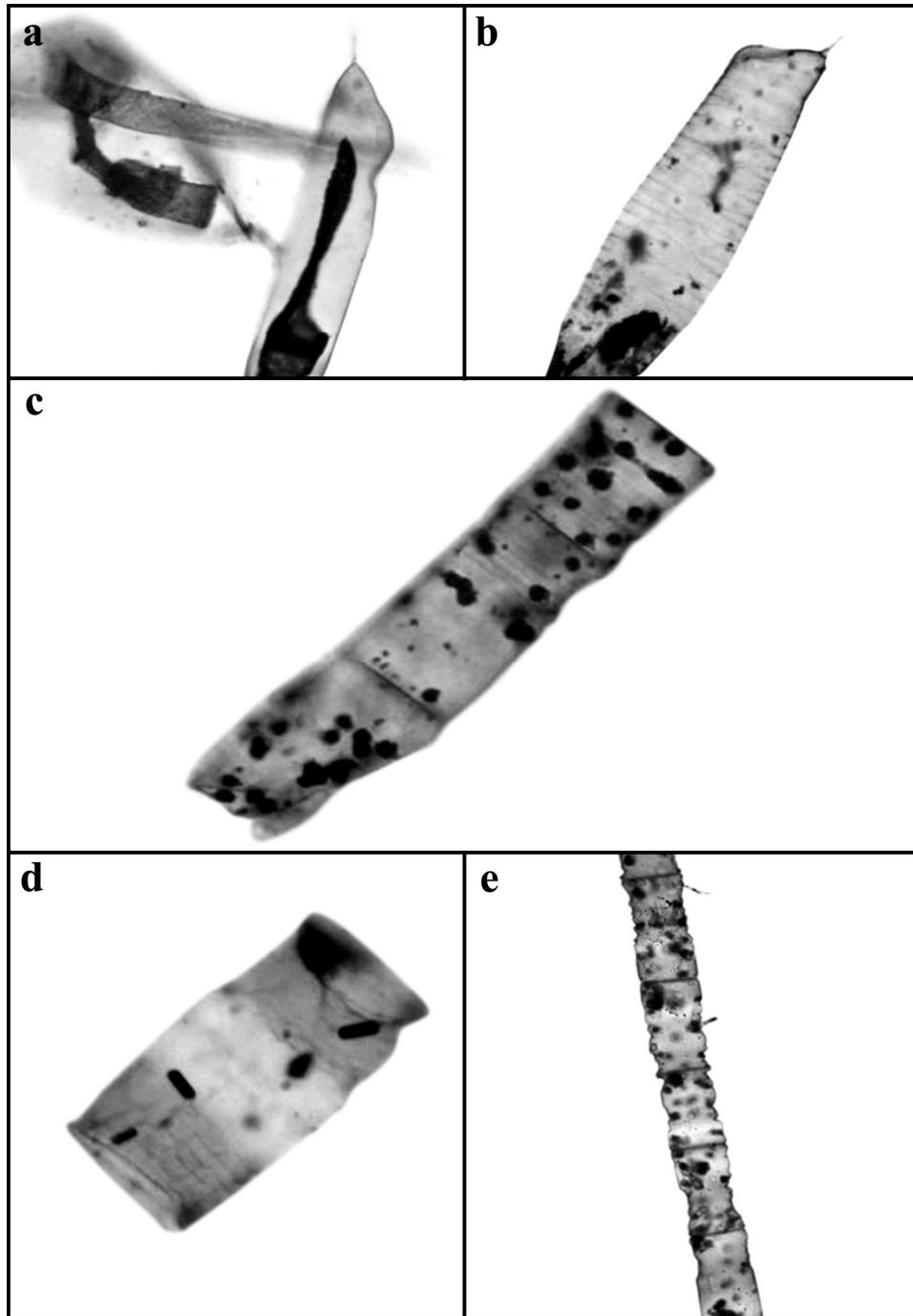


Fig. 1. a, *Rhizosolenia hyalina* Ostenfeld; b, *R. imbricata* Brightwell; c, *Guinardia delicatula* (Cleve) Hasle; d & e, *Guinardia flaccida* (Castracane) H. Peragallo.

**General Distribution:**

Wood, 1963: Indian Ocean; Sunesen & Sar, 2007: Buenos Aires coastal waters, Argentina; Hernandez-Becerril *et al.*, 2010: Mexican Pacific Ocean; Tabassum & Saifullah, 2011: North Arabian Sea.

***R. imbricata* Brightwell (Fig. 1b)**

Synonyms: *Rhizosolenia shrubsolei* Cleve; *Rhizosolenia imbricata* var. *Shrubsolei* (Cleve) Schroder.

Cupp, 1943, p. 84-86, Fig. 47 (p. 86); Subrahmanyam 1946, p.117, figs. 116 (p. 121-123); Hendeby, 1964, p. 149, Plate 3, Fig. 1; Moazzam, 1973, p.38, Plate 124, fig. a (p. 124); Hasle & Syvertsen, 1997, p. 155, Plate 29 (p. 154); Sunesen & Sar, 2007, p. 633 & 634, Fig. 534-636; D.U. Hernandez-Becerril *et al.*, 2010, p. 103 & 104, Fig. 63-68 (p. 103), Tabassum & Saifullah, 2011, p. 2191, Fig. 12 (p. 2190).

Cells usually elongated cylindrical, exist in the form of chains or sometimes solitary; valves conical to triangular, processes at terminal end, process triangular at the base, otaria present, contiguous area and claspers present, intercalary bands distinct, scale like appearance, numerous chromatophores, discoid plastids. Abnormal cell structure evidenced in this study.

**General Distribution:**

Cupp, 1943: West Coast of North America; Subrahmanyam, 1946: Madras coast, India; Wood, 1963: Indian Ocean; Hendeby, 1964: British Coastal Waters; Moazzam, 1973: Manora Channel (North Arabian Sea); Simonsen, 1974: Indian Ocean; Hallegraeff & Jaffrey, 1984: Northern Australia; Shameel & Tanaka, 1992: North Arabian Sea; Vilicic *et al.*, 2002: Adriatic Sea; Hallfors, 2004: Baltic Sea; Sunesen & Sar, 2007: Buenos Aires coastal waters, Argentina; Hernandez-Becerril *et al.*, 2010: Mexican Pacific Ocean; Mather *et al.*, 2010: Canadian Coastal Waters; Tabassum & Saifullah, 2011 (North Arabian Sea); Guilloux, 2013: Western English Channel, France.

***Guinardia delicatula* (Cleve) Hasle comb. Nov. (Fig. 1c)**

Basionym: *Rhizosolenia delicatula* Cleve.

Hasle & Syvertsen, 1997, p. 161, Plate 31 (p. 162), Yun & Lee, 2011, p. 307, Fig. 5A & B (p. 309); Tabassum & Saifullah, 2012, p. 172 Fig. 2 (p. 173).

Cells usually cylindrical, straight, bilaterally symmetrical, solitary or in chains; valve margin rounded furnished with short and thin process; intercalary bands distinct in light microscope. Nonlinear cell can clearly be seen in this report.

**General Distribution:**

Hendeby, 1964: British Coastal Waters; Shameel & Tanaka, 1992: North Arabian Sea; Caraus, 2002: Romania; Vilicic *et al.*, 2002: Adriatic Sea; Hallfors, 2004: Baltic Sea; Liu, 2008: Chinese Seas; Mather *et al.*, 2010: Canadian Coastal Waters; Anonymous, 2011: Taiwan; Yun & Lee, 2011 (Korean Coastal waters); Tabassum & Saifullah, 2012: North Arabian Sea; Guilloux, 2013: Western English Channel, France.

***Guinardia flaccida* (Castracane) H.Peragallo (Figs. 1d & 1e)**

Basionym: *Rhizosolenia flaccida* Castracane.

Cupp, 1943, p. 78, Fig. 40 (p. 78); Subrahmanyam, 1946, p. 114, Figs. 105-107 (p. 112); Hendeby, 1964, p. 141, Plate 5, Figs. 5 & 5a; Moazzam, 1973, p. 31, Figs. a&b (p. 120); Hasle & Syvertsen, 1997, p. 163, Plate 32 (p. 164), Hernandez-Becerril, 2010 *et al.*, pp. 98, Figs. 4(p. 96); Yun & Lee, 2011, p. 307 & 309, Fig. 5 (C - E) p. 309; Tabassum & Saifullah, 2012, p. 172 Fig. 3 (p. 173)

Cells usually cylindrical, large, straight, solitary or in chains; valves flat without processes, weakly silicified, intercalary bands distinctly visible in light microscope, conspicuous, numerous chromatophores, discoid plastids. Deformity in cells can show stress due to oil spill.

**Table 1. Comparison of morphometric data of *species* recorded from different location.**

S. No.	Location	Species	Apical Axis	Process	Length
1	Cupp, 1943 (Pacific Ocean)	<i>Rhizosolenia hyalina</i>	9 $\mu$ m - 60 $\mu$ m	-	-
		<i>Rhizosolenia imbricata</i>	-	-	-
		<i>Guinardia delicatula</i>	9 $\mu$ m - 16 $\mu$ m	-	-
		<i>Guinardia flaccida</i>	30 $\mu$ m - 53 $\mu$ m	-	-
2	Subrahmanyam, 1946 (Madras Coast India)	<i>Rhizosolenia hyalina</i>	-	-	-
		<i>Rhizosolenia imbricata</i>	38 $\mu$ m - 44 $\mu$ m	-	-
		<i>Guinardia delicatula</i>	-	-	-
		<i>Guinardia flaccida</i>	32 $\mu$ m - 64 $\mu$ m	-	-
3	Hendey, 1964 (British Coastal Water)	<i>Rhizosolenia hyalina</i>	-	-	-
		<i>Rhizosolenia imbricata</i>	80 $\mu$ m	-	Upto 400 $\mu$ m
		<i>Guinardia delicatula</i>	16 $\mu$ m - 22 $\mu$ m	-	Upto 60 $\mu$ m
		<i>Guinardia flaccida</i>	36 $\mu$ m - 80 $\mu$ m	-	Upto 160 $\mu$ m
4	Moazzam, 1973 (North Arabian Sea)	<i>Rhizosolenia hyalina</i>	-	-	-
		<i>Rhizosolenia imbricata</i>	15 $\mu$ m - 30 $\mu$ m	-	-
		<i>Guinardia delicatula</i>		-	-
		<i>Guinardia flaccida</i>	25 $\mu$ m - 45 $\mu$ m	-	-
5	Hasle & Syvertsen, 1997	<i>Rhizosolenia hyalina</i>	9 $\mu$ m - 60 $\mu$ m	-	-
		<i>Rhizosolenia imbricata</i>	2.5 $\mu$ m - 57 $\mu$ m	-	-
		<i>Guinardia delicatula</i>	9 $\mu$ m - 22 $\mu$ m	-	-
		<i>Guinardia flaccida</i>	25 $\mu$ m - 90 $\mu$ m	-	-

Continued ...

S. No.	Location	Species	Apical Axis	Process	Length
6	Sunesen & Sar, 2007 (Buenos Aires, Argentina)	<i>Rhizosolenia hyalina</i>	27 $\mu\text{m}$ - 46 $\mu\text{m}$	-	-
		<i>Rhizosolenia imbricata</i>	11 $\mu\text{m}$ - 26 $\mu\text{m}$	-	-
		<i>Guinardia delicatula</i>	-	-	-
		<i>Guinardia flaccida</i>	-	-	-
7	Hernandez-Becerril <i>et al.</i> , 2010 (Pacific Ocean)	<i>Rhizosolenia hyalina</i>	14 $\mu\text{m}$ - 43 $\mu\text{m}$	20 $\mu\text{m}$ - 29 $\mu\text{m}$	232 $\mu\text{m}$ - 377 $\mu\text{m}$
		<i>Rhizosolenia imbricata</i>	16 $\mu\text{m}$ - 43 $\mu\text{m}$	8 $\mu\text{m}$ - 17 $\mu\text{m}$	145 $\mu\text{m}$ - 406 $\mu\text{m}$
		<i>Guinardia delicatula</i>	-	-	-
		<i>Guinardia flaccida</i>	17 $\mu\text{m}$ - 52 $\mu\text{m}$	-	101 $\mu\text{m}$ - 159 $\mu\text{m}$
8	Yun & Lee, 2011 (Korean Coastal Waters)	<i>Rhizosolenia hyalina</i>	-	-	-
		<i>Rhizosolenia imbricata</i>	-	-	-
		<i>Guinardia delicatula</i>	7.9 $\mu\text{m}$ - 13.2 $\mu\text{m}$	-	24.9 $\mu\text{m}$ - 30 $\mu\text{m}$
		<i>Guinardia flaccida</i>	14 $\mu\text{m}$ - 42.5 $\mu\text{m}$	-	50 $\mu\text{m}$ - 125 $\mu\text{m}$
9	Tabassum & Saifullah, 2012 (North Arabian Sea)	<i>Rhizosolenia hyalina</i>	18 $\mu\text{m}$ - 35 $\mu\text{m}$	-	-
		<i>Rhizosolenia imbricata</i>	25 $\mu\text{m}$ - 36 $\mu\text{m}$	-	-
		<i>Guinardia delicatula</i>	14 $\mu\text{m}$ - 20 $\mu\text{m}$	-	-
		<i>Guinardia flaccida</i>	38 $\mu\text{m}$ - 123 $\mu\text{m}$	-	-
10	Present study (North Arabian Sea)	<i>Rhizosolenia hyalina</i>	25 $\mu\text{m}$ - 55 $\mu\text{m}$	-	11 $\mu\text{m}$ - 13 $\mu\text{m}$
		<i>Rhizosolenia imbricata</i>	28 $\mu\text{m}$ - 50 $\mu\text{m}$	-	10 $\mu\text{m}$ - 12 $\mu\text{m}$
		<i>Guinardia delicatula</i>	48 $\mu\text{m}$	-	-
		<i>Guinardia flaccida</i>	33 $\mu\text{m}$ - 60 $\mu\text{m}$	-	-

### General Distribution:

Cupp, 1943: West Coast of North America; Subrahmanyam, 1946: Madras Coast, India; Hendeby, 1964: British Coastal Waters; Shameel & Tanaka, 1992: North Arabian Sea; Vilicic *et al.*, 2002: Adriatic Sea; Hallfors, 2004: Baltic Sea; Hernandez-Becerril *et al.*, 2010: Mexican Pacific Ocean; Mather *et al.*, 2010: Canadian Coastal Waters; Anonymous, 2011: Taiwan; Yun & Lee 2011: Korean Coastal waters; Tabassum & Saifullah, 2012: North Arabian Sea; Guilloux, 2013: Western English Channel, France.

### DISCUSSION

Results showed that species of genera *Rhizosolenia* and *Guinardia* were noted with unusual structures in the samples of Bioremedial Project collected after 1.5 year of spill from the study area. Two species of genus *Rhizosolenia* including *Rhizosolenia hyalina* and *Rhizosolenia imbricata* whereas two species of genus *Guinardia* including *Guinardia delicatula* and *Guinardia flaccida* were evidenced with structural malformation. Comparison of morphometric measurements of present study with other reports also showed abnormal size than usual in most of the species that shows effect of crude oil on structure of species (Table 1). Similar deformities in the structures were also reported by other workers after an oil spill in affected area of study (Jaiswar *et al.*, 2013). Many findings showed deadly effects on growth of phytoplankton group composition due to decrease in photosynthetic activity immediately after an oil spill (Lee *et al.*, 2009). The unhealthy condition of cells in the present findings can be related to the deleterious effects of oil spill on structural organization of species of centric diatoms.

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