THE ALGAE OF NEW JERSEY (U.S.A.) XII. THE OCCURRENCE OF *CYLINDROTHECA GRACILIS* (BREB *EX* KUTZ) GRUN IN THE HACKENSACK RIVER ESTUARY

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Abstract

A 16-month survey of a 15 km stretch of the upper Hackensack River estuary in New Jersey yielded 131 specimens of the pennate diatom *Cylindrotheca gracilis* (Breb *ex* Kutz) Grun. Correlation coefficients indicate a strong positive correlation between *C. gracilis* and elevated amounts of silica, nitrates and water temperature.

Introduction

Cylindrotheca gracilis (Breb *ex* Kutz) Grun is a weakly silicified and spindle shaped pennate diatom of the Family Nitzchiaceae. This species has been reported in Maryland, Ohio and Iowa (1) and Arizona (2) in the United States. Marine littoral samples from Texas, Georgia, North Carolina, California and Lousiana and seawater samples for Massachusetts, Long Island Sound and Sandy Hook, New Jersey have yielded specimens of *Cylindrotheca gracilis* (3). It has been reported as a salt or brackish water form (4;5). Lowe (6) considers this taxon to be alkaliphilous, eutrophic, mesohalobic to halophilous, and euplanktonic or periphytic. Czarnecki and Blinn (2) found *C. gracilis* had its best development in the psammon with a preference for moderate to high conductivity, high alkalinity and periphytic habitats. However, relatively little information is available about the ecology of this species.

The Hackensack River, lying approximately 10 km west of Manhattan Island, begins near Haverstraw, New York and extends south to Newark Bay, a linear distance of nearly 45 km. A 16-month survery of the upper Hackensack River estuary in New Jersey yielded 131 specimens of this taxon, making it one of the 30 most abundant species collected. *Cylindrotheca gracilis* achieved its greatest abundance at a sample site 5.7 km south of the reservoir dam (site #3) and was never encountered in the freshwater segment of the river (site #1). This paper provides more information concerning the ecology and distribution of *Cylindrotheca gracilis.*

Sample Sites

The section of the river investigated covered an area from the Oradell Reservoir Dam to just above Overpeck Creek. Site #1 was northernmost and site #6 is most bayward. Site #2 received run-off from a parking lot and also drainage from a duckpond. A bridge at the point where Coles Brook and French Creek enter the river was site #3 and the footbridge at Fairleigh Dickinson University, site #4. Site #5 was a bridge in the city of Hackensack, slightly upstream from an oil depot.

Materials and Methods

Grab samples of whole plankton were taken along a 15 km segment of the Hackensack River from July 1980 to October 1981. Chemical analyses of the samples were done using a Hach model DR-EL Portable Water Engineer's Laboratory Kit as outlined in the Hach Methods Manual (7). Salinity was assessed using the Mohr method of titration with silver nitrate (8). Temperature was determined *in situ* with a mercury thermometer in the field. Samples were prepared by the incineration technique (9) and cleaned material was mounted in the high refractive medium, Hyrax, as described by Foote (10). The slides were examined with a Bausch and Lomb stereoscopic microscope equipped with 100X aprochromatic oil immersion objective and 10X occulars. Counts of 250-500 individuals were done for each collection. Niche breadth values were calculated using the formula of McIntire and Overton (11) and correlation coefficient with physiochemical data were computed.

Results and Discussion

Table 1 lists the mean values for some physio-chemical parameters of the Hackensack River, the number of frustules of *Cylindrotheca gracilis* encountered at each site during the course of the study and the niche breadth value, Bi. The correlation coefficient values are given in Table 3.

A review of the sparse literature concerning this taxon indicates that there is only one specific mention of the diatom being frequent in fresh water but that most researchers have classified it as a frequent estuarine form (1). An extensive review of the diatom flora lists over the last century for the state of New Jersey indicate that *C. gracilis* has never been reported for this area. The data presented in Table 1 indicate that *C. gracilis* was found in a slightly, rather than strongly mesohaline brackish (3-10 ppt) environment.

Comparing station #3, where this species achieved its greatest abundance, with the next lower estuarine site, #4, one notices in Table I that there is little difference in temperature and alkalinity but greater differences in the values of salinity, sulfate, magnesium, total hardness, calcium and chloride. This appears to support the

conclusions of Christensen and Reimer (1) that this diatom should not be considered to be a salt water form and that conductivity and concentrations of sulfate, magnesium and calcium, or some combination of factors, may be more critical to this taxon's growth and distribution than chloride or sodium ions.

When the niche breadth values are calculated for seasons, rather than sample sites, it is found that C. gracilis grew best in the autumn and winter (5 October 1980 to 22 February 1981). The average values for physio-chemical parameters in the estuarine portion of the river (sites #2-#6) for this period are given in Table 2. The data in this table are somewhat misleading, however, because the river was frozen from sites #2-#4 throughout much of January and this prevented collecting in the upper and middle estuary. The values given in Table 2, therefore, are probably slightly elevated, based primarily on lower estuarine collections.

Correlation coefficients listed in Table 3 show a strong positive correlation between Cylindrotheca gracilis and elevated amounts of silica, nitrate and water temperature at site #3, the site where most of the specimens were collected.

It appears that C. gracilis is a species capable of withstanding mesohaline brackish water but it is not a true marine species. Cylindrotheca gracilis also appears to be able to withstand high concentrations of chloride, sulfate, alkalinity, calcium, magnesium and total hardness.

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TABLE 1. Mean chemical and physical parameter values for the Hackensack River estuary and collection data. Values are mg/l unless noted otherwise.

STATION	1	2	3	4	5	6
distance from dam, km	0.07	3.2	5.7	7.9	10.8	14.6
salinity, ppt	0.11	1.6	2.9	4.2	5.5	7.26
temperature, C	16.2	15.9	17.4	16.8	17.3	20.4
alkalinity	74	98	109	121	128	144
chloride	41	947	1152	2122	2961	4153
hardness	121	390	594	881	1133	1498
magnesium	29	238	408	547	826	1154
calcium	95	152	192	242	274	345
sulfate	28	132	175	285	354	458
number of cells	0	33	49	42	3	5
niche breadth value	--	5.2	6.6	7.6	3	1.9

TABLE 2. Mean chemical and physical values for the Hackensack River estuary from 5 October 1980 to 22 February 1981.

salinity	5.12 ppt
temperature	8.18 C
alkalinity	120 mg/l
chloride	1130 mg/l
hardness	1160 mg/l
magnesium	653 mg/l
calcium	295 mg/l
sulfate	382 mg/l

TABLE 3. Correlation coefficients for Cylindrotheca gracilis and 7 hydrographic variables.

	STATION NUMBER				
PARAMETER	2	3	4	5	6
phosphate	0.17	0.02	-0.05	0.05	-0.12
sulfate	0.001	0.02	0.03	0.005	-0.05
silica	0.14	0.64	-0.05	-0.02	-0.12
dissolved oxygen	0.001	0.02	0.03	0.004	-0.04
salinity	0.11	0.02	-0.03	0.004	-0.12
nitrate	0.14	0.72	-0.05	-0.02	-0.09
water temperature	0.13	0.52	0.26	0.005	-0.03

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