Species Composition, Abundance and Distribution of Aquatic Oligochaetes in Colombo (Beira) Lake, Sri Lanka

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Abstract

Species composition, abundance and distribution of aquatic oligochaetes in Colombo (Beira) Lake were investigated from May 1993 to April 1994. Twenty two species of oligochaetes were identified representing 3 species of Aeolosomatidae, 17 species of Naididae and 2 species of Tubificidae. Seven species were recorded for the first time from Sri Lanka. These species are *Aeolosoma travancorense, Aeolosoma viridae, Allonais gwaliorensis, Dero dorsalis, Dero indica, Pristina synclites* and *Stephensiniana trivandrana*. The populations of aquatic oligochaetes fluctuated considerably in size throughout the study period. *Aulophorus michaelseni, Branchiodrilus semperi, Pristina longiseta* and *Aulodrilus pigueti* were the most abundant species. Abundance of some species of oligochaetes was positively correlated with rainfall, organic matter content in the bottom sediment, pH, dissolved oxygen content, biochemical oxygen demand, nitrate and phosphate content in the bottom water whereas negative correlations were observed with salinity and conductivity in the bottom water ($P<0.05$). The number of species and the density of worms in the saline areas of the lake were comparatively low. *Aulophorus michaelseni* and *Aulodrilus pigueti* were the most abundant species in these areas.

Introduction

Aquatic oligochaetes constitute one of the most abundant groups of benthic invertebrates in aquatic environments. These worms are very important as a food resource for a large number of predators such as benthic feeding fish and some insects, and as primary material exchangers across sediment-water interface (Darby 1962; Popchenko 1971; Bouguenec & Gaini 1989). The composition and abundance of benthic organisms are closely related to quality of waters in waterbodies (Mackenthum 1966). Aquatic Oligochaetes are dominant organisms in organically polluted aquatic environments and can be used successfully as biological indicators for the determination of water quality (Bruse et al. 1975; Lobe & Space 1993; Sarkka 1994).

Taxonomy, biology and ecology of aquatic oligochaetes in Sri Lanka are poorly known. Studies on aquatic oligochaetes have been mainly taxonomic and have been restricted to few localities in Sri Lanka (Weerakoon & Samarasinghe 1958; Mendis & Fernando 1962; Costa 1967; Costa & De Silva 1978c, Costa & De Silva 1978d). Colombo (Beira) Lake is a perennial inland waterbody, slightly saline in parts, situated close to the Colombo harbour. It has been considered as an eutrophic (Weninger 1972) and highly polluted waterbody in Sri Lanka. Although limnological and some biological aspects of the lake have been studied extensively, no detailed study has yet been carried out on aquatic oligochaetes in this lake. The present study was carried out to determine the species composition, abundance and distribution of aquatic oligochaetes in the lake. In addition, an attempt was made to correlate the abundance of oligochaetes to environmental characteristics of the lake.

Materials and methods

Sampling sites

Colombo Lake is man-made and consists of four parts namely, East Lake, West Lake, South-West Lake and Galle Face Lake. The East Lake is connected to the harbour through a canal. In the present study, five sampling stations (A, B, C, D and E) were selected covering the lake as shown in Fig. 1. West lake could not be sampled due to security reasons. Samples of bottom water and bottom sediments from the littoral zones were collected monthly from five sampling stations from May, 1993 to April, 1994 from 9:30 to 13:30 hours.

Oligochaete sampling

Aquatic oligochaete fauna were sampled at each station with a Peterson grab taking bottom sediments from an area of 0.025 m^2. Three samples were taken from different places in each sampling station. Samples were brought to the laboratory and processed separately by gentle washing with a fine jet of water through a series of graded sieve (mesh sizes: 0.50, 0.216 and 0.125 mm). Materials retained on each sieve were washed back into a beaker and 5 % alcohol was added. The oligochaetes were then qualitatively and quantitatively analyzed. Large worms were hand sorted and small worms were counted using a Sedgewick rafter and a light microscope. Worms were identified to the level of species using taxonomic keys of Naidu (1961, 1962a, 1962b, 1962c, 1963; 1965) and Brinkhurst & Jamieson (1971).

Water and benthic sediment sampling

Water samples were taken by using a Ruttner sampler. Temperature, pH, conductivity and salinity of bottom waters were measured using a Thermistor thermometer, WQC-2A model water Quality Checker (Yagamy Internationals, Japan), portable conductivity meter and a salinometer (Hach Company, USA) respectively. The dissolved oxygen concentration was determined using azide modification of Winkler method and biochemical oxygen demand for 5 days was determined using an empirical test (Taras et al. 1971). Ultraviolet Spectrophotometric method and Vando-Molybdophosphoric Acid Colorimetric method were used to measure nitrate and phosphate concentrations in the bottom waters respectively (Taras et al. 1971). Organic carbon composition in sediments was determined by the method described by Saxena (1990). Rainfall data for Colombo during the study period was obtained from the Meteorological Department, Colombo.

Data analysis

Oligochaete density and physico-chemical characteristics in the five stations in Colombo Lake were compared by One-way Analysis of Variance (ANOVA) using "MICROSTAT" computer package to determine whether there are significant differences among sampling stations. The Scheffe's test was used to compare the means (Zar 1974). Pearson's correlation coefficients between abundance of oligochates and environmental characteristics (Zar 1974) were calculated using "MICROSTAT" computer package.

Results

Aquatic oligochaetes

In the present study, twenty two species of aquatic oligochaetes were identified, three species belonging to Aeolosomatidae, seventeen species to Naididae and two species to Tubificidae (Table 1). During this study, seven species of aquatic oligochaetes were recorded for the first time from Sri Lanka representing two aeolosomatids namely *Aeolosoma travancorense, Aeolosoma viridae,* and five naidids namely *Allonais gwaliorensis, Dero dorsalis, Dero indica, Pristina synclites* and *Stephensiniana trivandrana.* Aeolosomatid species were not sampled

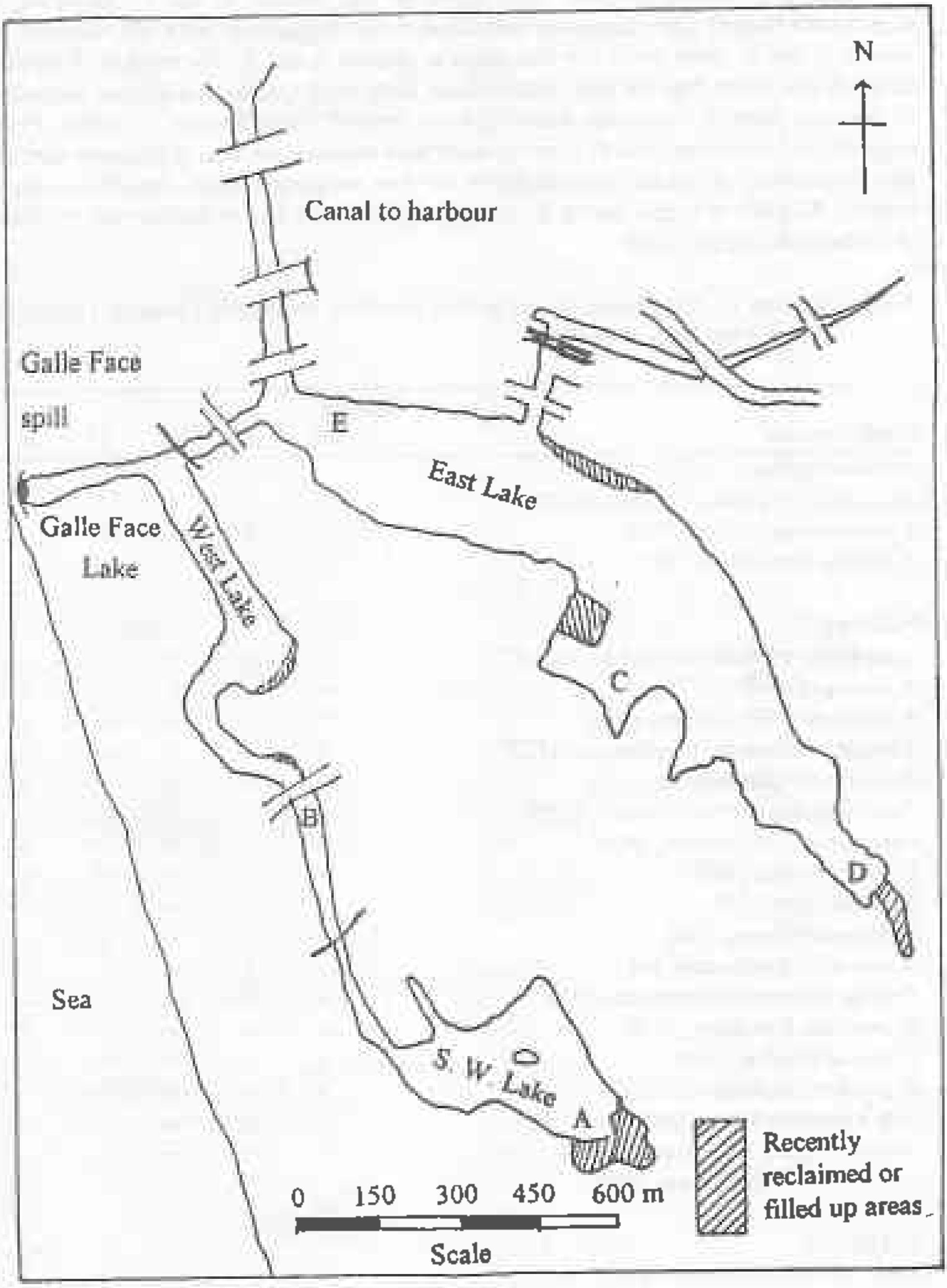

Fig. 1. The map of Colombo (Beira) Lake showing the location of sampling stations (A, B, C, D and E).

quantitatively due to nature of their highly fragile bodies. The naidid, *Dero sawayai* and the tubificid, *Limnodrilus hoffmeisteri* were very scarce and were not quantitatively sampled. All the oligochaete species recorded were found at the stations B and C. However, two oligochaetes namely *Dero zeylanica* and *Limnodrilus hoffmeisteri* were not recorded from stations D and E. *Dero nivea* was not found at stations A and E. The number of species at station E was lower than the other four stations. Only eight species (*Aulophorus michaelseni, A. furcatus, Allonais inaequalis, Branchiodrilus semperi, Dero dorsalis, D. indica, Pristina longiseta* and *Aulodrilus pigueti)* were recorded from station E, situated in the saline part of the lake. Populations of aquatic oligochaetes in the five sampling stations showed considerable monthly fluctuations in size during the study period. (Fig. 2). Heavy rainfall was experienced in Colombo during the South

Table 1. Species of oligochaetes found at five sampling stations in Colombo (Beira) Lake during May 1993 - April 1994.

Family/Species	Stations A	B	C	D	E
Aeolosomatidae					
Aeolosoma bengalense Stephenson, 1911	+	+	+	+	-
A. travancorense Aiyer, 1926*	+	+	+	+	-
A. viridae Stephenson, 1911*	+	+	+	+	-
Naididae					
Aulophorus michaelseni Stephenson, 1923	+	+	+	+	+
A. furcatus (Muller, 1773)	+	+	+	+	+
A. tonkinensis (Vejdovsky, 1894)	+	+	+	+	-
Allonais gwaliorensis (Stephenson, 1920)*	+	+	+	+	-
A. inaequalis (Stephenson, 1911)	+	+	+	+	+
Branchiodrilus semperi (Bourne, 1890)	+	+	+	+	+
Dero dorsalis Ferronniere, 1899*	+	+	+	+	+
D. indica Naidu, 1962*	+	+	+	+	+
D. nivea Aiyer, 1929	+	+	+	+	-
D. sawayai Marcus, 1943	+	+	+	+	-
D. zeylanica Stephenson, 1911	+	+	+	-	-
Pristina jenkinae (Stephenson, 1931)	+	+	+	+	-
P. longiseta Ehrenberg, 1828	+	+	+	+	+
P. minuta Sperber, 1948	+	+	+	+	-
P. synclites Stephenson, 1925*	+	+	+	+	-
Nais communis Piguet, 1906	+	+	+	+	-
Stephensoniana trivandrana Stephenson, 1925*	+	+	+	+	-
Tubificidae					
Aulodrilus pigueti Kowalewski, 1914	+	+	+	+	+
Limnodrilus hoffmeisteri Claparede, 1862	+	+	+	-	-

*Recorded for the first time from Sri Lanka.

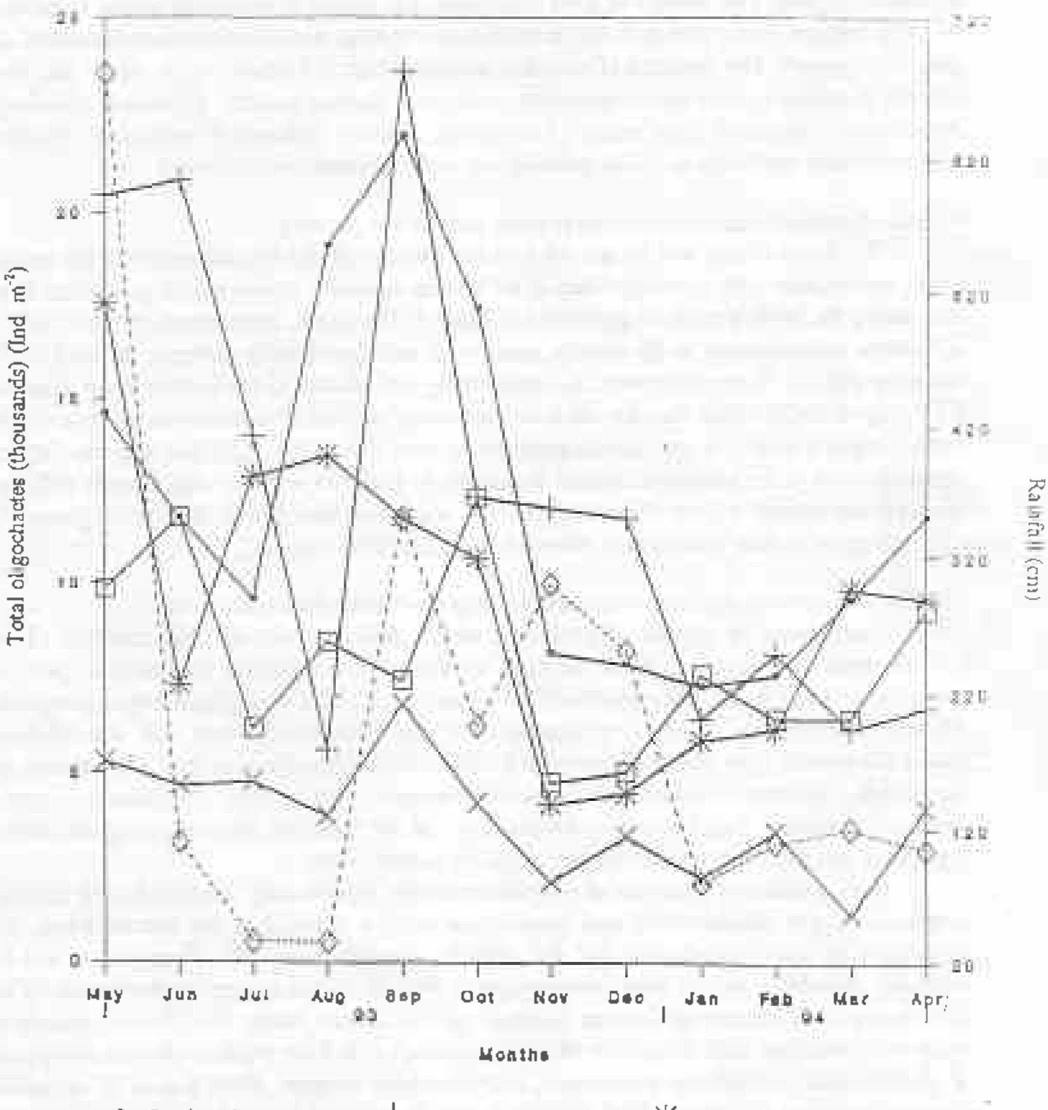

Fig. 2. Monthly variations of the density of total oligochaetes at five different sampling stations in Colombo (Beira) lake and the rainfall in Colombo during the study period.

West monsoon in May and September. High abundance of aquatic oligochaetes were recorded from May to October, 1993 which coincided with the onset of the South-West monsoon. The maximum density was recorded at station B in September, 1993 and minimum density was recorded at station E in March, 1994.

The density of total oligochaetes ranged from 1274 ind. m^{-2} and 23648 ind. m^{-2} (Table 2). The most abundant species recorded from the stations A, B, C and D were the naidids, *Aulophorus michaelseni, Branchiodrilus semperi, Pristina longiseta* and the tubificid, *Aulodrilus pigueti*. The density of total oligochaetes at station E was significantly lower than the other stations. In the station E, the most abundant species were *Aulophorus michaelseni* and *Aulodrilus pigueti*. The densities of recorded species except *Aulophorus michaelseni* and *Dero dorsalis* at station E were significantly lower than that in other stations. *Allonais gwaliorensis, Aulophorus tonkinensis, Dero nivea, D. zeylanica, Pristina jenkinae, P. minuta, P. synclites, Nais communis* and *Stephensiniana trivandrana* were not recorded at station E.

Physico-chemical characteristics and organic carbon composition

The mean values and ranges of selected physico-chemical parameters of the bottom water, and organic carbon composition in the bottom sediment at five sampling stations in the lake during the study period are presented in Table 3. The depth, temperature, pH, DO, BOD_5, and nitrate concentration in the bottom water were not significantly different for each of the sampling stations. Water transparency, conductivity and salinity of the bottom water at station E was significantly higher than the other four sampling stations. Phosphate concentration in the bottom water at station B was significantly higher than that of the other four stations. Organic carbon content in the bottom sediments at stations A, B and D were not significantly different. However the organic carbon content at station E was lower than that of the other stations. The highest organic carbon content was recorded in the sampling station C.

Correlations between oligochaete abundance and environmental characteristics

Correlations of aquatic oligochaetes with physico-chemical characteristics of the bottom water and organic carbon contents in the bottom sediment in Colombo lake are presented in Table 4. The abundance of total oligochaetes and the naidids, *Allonais inaequalis, Allonais gwaliorensis, Aulophorus michaelseni* and *Pristina jenkinae* and the tubificid, *Aulodrilus pigueti* were positively correlated with rainfall. Abundance of total oligochaetes and the naidids, *Allonais inaequalis, Branchiodrilus semperi, Dero indica, D. zeylanica, Pristina jenkinae, P. minuta, Stephensiniana trivandrana* and the tubificid, *Aulodrilus pigueti* showed significant positive correlations with the pH of the bottom water.

High population densities of oligochaetes were significantly correlated with the high dissolved oxygen concentration and biochemical oxygen demand of the bottom water. The abundance of total oligochaetes and the naidids, *Allonais inaequalis, Dero indica* and the tubificid, *Aulodrilus pigueti* positively correlated with dissolved oxygen concentration of the bottom water. Biochemical Oxygen Demand of the bottom water also showed significant positive correlations with abundance of total oligochaetes, and the naidids, *Allonais inaequalis, A. gwaliorensis, Aulophorus tonkinensis, Branchiodrilus semperi, Dero indica, D. zeylanica, Pristina jenkinae, P. minuta, Nais communis, Stephensiniana trivandrana* and the tubificid, *Aulodrilus pigueti*.

Abundance of oligochaetes were also correlated significantly with the nitrate and phosphate contents in the bottom water in the lake. The nitrate and phosphate contents showed significant positive correlations with the abundance of total oligochaetes and the naidids, *Allonais gwaliorensis, Aulophorus tonkinensis, Branchiodrilus semperi, Pristina jenkinae, P. longiseta*, and the tubificid, *Aulodrilus pigueti*. However abundance of the naidids, *Allonais inaequalis, Pristina minuta* and *Stephensiniana trivandrana* were positively correlated only

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Abundance of oligochaetes were also correlated significantly with the nitrate and phosphate contents in the bottom water in the lake. The nitrate and phosphate contents showed significant positive correlations with the abundance of total oligochaetes and the naidids, *Allonais gwaliorensis, Aulophorus tonkinensis, Branchiodrilus semperi, Pristina jenkinae, P. longiseta,* and the tubificid, *Aulodrilus pigueti.* However abundance of the naidids, *Allonais inaequalis, Pristina minuta* and *Stephensiniana trivandrana* were positively correlated only

Table 2. Mean density of aquatic oligochaets in the benthos of five sampling stations of Colombo (Beira) Lake during the study period. Ranges are given in parentheses. In a row, means not followed by the same superscript are significantly different from each other (P<0.05, ANOVA, Scheffe's Test)

Species	Sampling stations/Density (1000 x No. of individuals m^{-2})				
	A	B	C	D	E
Total oligochaetes	11933^{a} (7323-21959)	12429^{a} (5630-23648)	9468^{ab} (4223-17568)	8206^{a} (4786-12387)	3882^{b} (1274-6845)
Allonais inaequalis	701^{a} (0-1528)	895^{a} (0-3000)	746^{a} (0-2200)	475^{a} (0-1063)	96^{a} (0-302)
A. gwaliorensis	449^{a} (0-1247)	361^{a} (0-1005)	446^{a} (0-1063)	397^{a} (0-1152)	0
Aulophorus michaelseni	2563^{a} (1870-3220)	2602^{a} (1188-4941)	1954^{a} (829-3928)	2159^{a} (877-3564)	2228^{a} (852-3693)
A. furcatus	153^{a} (0-633)	168^{a} (0-603)	98^{ab} (0-304)	54^{b} (0-242)	64^{b} (0-246)
A. tonkinensis	250^{a} (0-563)	371^{a} (0-1126)	181^{a} (0-452)	97^{a} 90-477)	0
Branchiodrilus semperi	1459^{ab} (0-3379)	1944^{a} (0-3942)	947^{a} (0-2703)	822^{a} (0-2703)	144^{b} (0-246)
Dero dorsalis	825^{a} (95-1386)	845^{a} (0-1329)	675^{a} (420-901)	719^{a} (313-1815)	523^{a} (181-1088)
D. indica	574^{a} (177-1520)	468^{a} (0-1033)	374^{a} (94-839)	376^{a} (0-1264)	48^{b} (0-196)
D. nivea	0	3^{a} (0-40)	22^{a} (0-225)	27^{a} (0-318)	0
D. zeylanica	119^{a} (0-463)	261^{a} (0-1259)	33^{a} (0-281)	0	0
Pristina jenkinae	364^{a} (0-1201)	385^{a} (0-1601)	240^{a} (0-676)	152^{b} (0-353)	0
P. minuta	92^{ab} (0-387)	181^{a} (0-619)	26^{bc} (0-165)	7^{c} (0-78)	0
P. longiseta	1244^{a} (0-1936)	1326^{a} (0-3788)	1163^{a} (385-3353)	1395^{a} (0-3162)	39^{b} (0-369)
P. synclites	151^{a} (0-624)	119^{a} (0-563)	106^{a} (0-422)	74^{a} (0-563)	0
Nais communis	521^{a} (0-1506)	736^{a} (0-2326)	432^{a} (0-1888)	314^{a} (0-1266)	0
Stephensoniana trivandrana	960^{a} (0-1506)	448^{a} (0-3014)	608^{a} (0-3788)	307^{a} (0-3788)	0
Tubificids					
Aulodrilus pigueti	1517^{a} (842-2815)	1324^{a} (561-2251)	1417^{a} (562-7251)	830^{b} (562-2814)	710^{c} (191-1304)

Table 3. Physico-chemical characteristics (mean values) of the bottom water at five sampling stations of Colombo (Beira) Lake during the study period. Ranges are given in parentheses. In each row, means for one parameter not followed by the same superscript are significantly different from each other ($P<0.05$, ANOVA, Scheffe's Test).

Parameters	Sampling Stations A	B	C	D	E
Depth (cm)	65.6^{a} (45-81)	42.2^{a} (30-64)	70.3^{a} (63-77)	66.0^{a} (57-76)	69.5^{a} (64-81)
Temperature (^{0}C)	30.5^{a} (28.0-33.5)	30.0^{a} (28.0-33.5)	30.1^{a} (27.8-33.2)	30.2^{a} (26.4-33.1)	30.2^{a} (28.0-33.2)
Transparency (cm)	11.8^{a} (8-17)	12.5^{a} (9.5-18.5)	16.8^{a} (13-20)	15.4^{a} (11-20)	18.6^{b} (16-20)
Conductivity (µmhos)	260^{a} (142-430)	286^{a} (238-450)	278^{a} (230-370)	266^{a} (215-390)	381^{b} (303-490)
pH	8.1^{a} (7.2-9.5)	8.0^{a} (7.2-9.1)	7.9^{a} (7.1-9.5)	7.5^{a} (6.4-8.2)	8.1^{a} (7.4-8.9)
DO (mg l^{-1})	9.9^{a} (2.0-15.5)	8.4^{a} (2.0-14.5)	7.5^{a} (0.4-16.7)	6.7^{a} (0.8-13.9)	5.8^{a} (2.0-9.8)
BOD_5(mg l^{-1})	33.9^{a} (28.1-40.2)	37.0^{a} (28.3-53.1)	29.9^{a} (12.5-43.7)	22.4^{a} (12.5-43.8)	16.9^{a} (9.8-29.1)
Salinity (ppt)	0.81^{a} (0.10-0.28)	0.16^{a} (0.13-0.20)	0.44^{a} (0.20-0.87)	0.12^{a} (0.08-0.15)	1.89^{b} (1.18-3.13)
NO^{-1}_3 (mg l^{-1})	4.19^{a} (0.3-6.9)	4.06^{a} (0.4-6.9)	4.09^{a} (0.28-6.33)	3.78^{a} (0.7-7.06)	2.36^{a} (0.42-4.14)
PO^{-3}_4 (mg l^{-1})	0.90^{a} (0.2-1.1)	1.26^{b} (0.32-4.0)	0.63^{a} (0.16-1.37)	0.54^{a} (0.07-1.05)	0.25^{a} (0.08-0.44)
Organic carbon (%)	13.30^{a} (10.8-16.0)	12.71^{a} (10-14.8)	15.49^{b} (12-16.97)	12.38^{a} (7.7-10.9)	9.43^{c} (7.54-10.9)

with nitrate content in the bottom water. Abundance of *Dero indica and D. zeylanica* were positively correlated only with the phosphate content of the bottom water. Abundance of total oligochaetes and the naidids, *Allonais inaequalis, Aulophorus michaelseni, Pristina longiseta, P. synclites* and the tubificid, *Aulodrilus pigueti* were positively correlated with organic carbon content in the bottom sediments in the lake.

Conductivity and salinity also affected the distribution of oligochaetes in the lake. Significant negative correlations were found with conductivity of the bottom water and the abundance of total oligochaetes and the naidids, *Allonais inaequalis, Allonais gwaliorensis, Dero dorsalis, Dero indica, Pristina jenkinae, Nais communis* and *Stephensiniana trivandrana*. Abundance of total oligochaetes and the naidids, *Allonais inaequalis, A. gwaliorensis, Aulophorus tonkinensis, Branchiodrilus semperi, Dero dorsalis, D. indica, Pristina jenkinae, P. minuta, P. longiseta, P. synclites, Nais communis, Stephensiniana trivandrana* and the tubificid, *Aulodrilus pigueti* showed significant negative correlations with high salinity of the bottom water.

Discussion

In the present investigation, twenty two species of aquatic oligochaetes were recorded from the bottom sediments of Colombo lake. There were three species of Aeolosomatidae, seventeen species of Naididae and two species of Tubificidae. Of these twenty two species, seven species were recorded for the first time from Sri Lanka. These new species are *Aelosoma travancorense, A. viridae, Allonais gwaliorensis, Dero dorsalis, D. indica, Pristina synclites* and *Stephensiniana trivandrana*. Previously, Costa & De Silva (1978c) identified six oligochaete species from Colombo Lake which had been encountered on the roots of *Eichhornia* plants. They were *Aeolosoma bengalense, Aulophorus furcatus, Branchiodrilus semperi, Pristina minuta, P. evelinae* and *P. jenkinae*. In a later study of marginal fauna, Costa

& De Silva (1978d) recorded eight species including the above mentioned six species, and *Nais* sp. and *Limnodrilus hoffmeisteri*. The 22 species of oligochaetes recorded in the present study have been previously

Table 4. Correlations (Pearson's correlation coefficients) between abundance of total oligochaetes and different species of oligochaetes with selected environmental characteristics of the Colombo (Beira) Lake. Values given in bold numerals are significant at least at 5% level. Rnfl - Rainfall; Cond - Conductivity; Saln - Salinity; OrgC - Organic carbon.

Species	Rnfl	Cond	Saln	pH	DO	BOD_5	NO^{-1}_3	PO^{-2}_4	OrgC
Total Naidids & Tubuficids	**0.47**	**-0.27**	**-0.53**	**0.49**	**0.36**	**0.46**	**0.55**	**0.38**	**0.29**
Naidids									
Allonais inaequalis	**0.35**	**-0.25**	**-0.37**	**0.30**	**0.38**	**0.34**	**0.45**	0.16	**0.33**
A. gwaliorensis	**0.42**	**-0.31**	**-0.37**	0.06	0.23	**0.34**	**0.42**	**0.27**	0.23
Aulophorus michaelseni	**0.45**	-0.07	-0.21	0.14	0.16	0.07	0.15	0.17	**0.33**
A. tonkinensis	0.14	0.15	**-0.35**	0.12	0.18	**0.26**	**0.29**	**0.44**	0.10
Branchiodrilus semperi	0.14	-0.14	**-0.43**	**0.36**	0.08	**0.43**	**0.49**	**0.48**	0.18
Dero dorsalis	0.14	**-0.34**	**-0.35**	-0.06	0.16	0.21	0.11	0.17	0.14
D. indica	0.17	**-0.31**	**-0.43**	**0.27**	**0.37**	**0.27**	0.19	**0.50**	0.14
D. zeylanica	-0.05	-0.17	-0.08	**0.27**	0.05	**0.32**	0.16	**0.29**	0.10
Pristina jenkinae	**0.42**	**-0.26**	**-0.34**	**0.39**	0.18	**0.36**	**0.41**	0.27	0.23
P. minuta	-0.09	-0.21	**-0.27**	**0.50**	0.16	**0.36**	**0.26**	0.10	0.08
P. longiseta	0.07	-0.23	**-0.59**	0.05	0.21	0.23	**0.47**	**0.29**	**0.27**
P. synclites	0.16	-0.08	**-0.27**	0.20	0.18	0.21	0.16	0.17	**0.27**
Nais communis	0.09	**-0.27**	**-0.33**	0.01	0.04	**0.52**	-0.09	0.14	0.10
Stephensoniana Trivandrana	0.16	**-0.29**	**-0.25**	**0.52**	0.23	**0.36**	**0.28**	0.20	0.15
Tubificid									
Aulodrilus pigueti	**0.29**	-0.14	**-0.55**	**0.47**	**0.46**	**0.55**	**0.52**	**0.29**	**0.46**

described by Naidu (1961, 1962a, 1962b, 1962c, 1963, 1965) and Brinkhurst & Jamieson (1971) from the Indian subcontinent.

The present study showed that the density of aquatic oligochaetes in Colombo Lake ranged from 1274 to 23648 ind. m^{-2}. Mendis (1964) in a preliminary investigation on the bottom fauna of Colombo Lake found that the density of aquatic oligochaetes was low (177 ind. m^{-2}) and that chironomid larvae were the dominant organism among the invertebrate groups in the benthic sediment of the lake. However, Thiagarajah (1983) in his study on the benthos of Colombo Lake during the period 1978 to 1979, observed that there were marked changes in composition of the benthic fauna. According to Thiagarajah (1983), aquatic oligochaetes formed the predominant life form in Colombo Lake and accounted for about 93% of the benthic organisms in numbers. The average oligochaete density ranged from 52 ind.m^{-2} to 3636 ind.m^{-2}. However the record was only based on hand sorted macro-oligochaete fauna. When comparing the results of the present study and those of Mendis (1964), Costa & De Silva (1978c), Costa & De Silva (1978d) and Thiagarajah (1983), it is clear that the diversity of oligochaete species and their population densities in the lake have increased markedly during the last three decades.

The composition and abundance of benthic organisms are closely related to environmental pollution (Mackenthum 1966) and one of the dominant groups in polluted aquatic environments is generally aquatic oligochaetes (Bruse *et al.* 1975). Previous studies on physico chemical characteristics in Colombo lake showed that the lake has been gradually enriched and had become eutrophic during the last three decades (Mendis 1964; Costa & De

Silva 1978a; Thiagarajah 1983). The present study showed that pollution indicative water quality parameters (biochemical oxygen demand, nitrate and phosphate contents etc.) and other physico chemical characteristics have become considerably high in the Colombo lake. Heavy loads of waste materials including faecal matter and waste from surrounding domestic tenements, oils and contaminated waste waters from various workshops bordering the reservoir wash down into the lake. These waste materials enrich the water and the lake has become eutrophic and organically polluted. Increase in oligochaete species diversity and their high population densities could be due to the prevailing physico-chemical condition of the lake. Bacteria and algae are the main source of food for most of the oligochaetes (Brinkhurst & Jamieson 1971; Brinkhurst & Cook 1974). An increase in food sources such as high densities of bacteria (Costa & Gunatilake 1978) and phytoplankton especially blue green algae (Costa & De Silva 1978b) may be another factor that has lead to the increase in abundance of oligochaetes in the lake.

The populations of oligochaetes in the lake fluctuated considerably in size throughout the study period. The naidids, *Aulophorus michaelseni, Branchiodrilus semperi, Pristina longiseta* and the tubificid, *Aulodrilus pigueti* were the most abundant species. Most of the oligochaete species recorded in the lake tolerate the eutrophic condition of the lake. Brinkhurst (1969) stated that the presence of *Aulodrillus* species in a waterbody is a clear indication of eutrophication. Rainfall plays an important role in the biological process of a waterbody. It appears that the rain during the south-west monsoon seems to have some effect on the productivity of aquatic oligochaetes in the lake. High abundance of total oligochaetes showed significant positive correlation with the rainfall.

The physico chemical characteristics of the lake affect the abundance and distribution pattern of oligochaetes. High abundance of total oligochaetes showed significant positive correlations with pH, dissolved oxygen content, biochemical oxygen demand, nitrate and phosphate concentrations in the bottom water and organic carbon content in the bottom sediments in the lake. However analysis of correlations by species level indicated that all species of oligochaetes were not equally responding to these environmental characteristics. The high abundance of the tubificid, *Aulodrilus pigueti* showed significant positive correlations with most of these parameters. Other species showed significant relationships with only some of the parameters. Biochemical oxygen demand levels in the bottom water showed positive correlations with most of the species than other measured environmental characteristics in the lake. High biochemical oxygen demand levels in the lake could be attributed to high density of micro-organisms especially bacteria present in the lake as a result of daily input of domestic waste matter and raw sewage. Bacteria are one of the main food sources for most of the aquatic oligochaetes (Brinkhurst & Cook 1974).

The number of oligochaete species as well as their abundance were significantly lower in the West end of the East Lake where the water was saline than in the South West lake and the other parts of the East lake. In the West end of the East lake only eight oligochaete species were found whereas 20-22 species of oligochaetes were recorded in the other parts of the lake. Of the eight species recorded in the saline part of the lake, the naidid, *Aulophorus michaelseni* and the tubificid, *Aulodrilus pigueti* were the dominant species. It appears that these two species could tolerate the moderate salinity levels. Total oligochaetes and most of the oligochaete species in the lake were negatively correlated with salinity and conductivity of the bottom water. Therefore salinity acted as a critical environmental factor for the distribution of oligochaetes in Colombo Lake.

Aquatic oligochaetes can tolerate organically polluted water and can be used as biological indicators to determine the water quality (Bruse et al. 1975; Lobe & Space 1993 & Sarkka 1994). For the biological monitoring of water quality, it is very important to select aquatic organisms that are continuously present through out the year and are widely distributed (Lobe & Space 1993). Brinkhurst (1969) stated that the presence of *Aulodrilus* spp. is a clear indication of eutrophication. *Aulodrilus pigueti* was typically found in large numbers in association with organic enrichment. In the present study, the tubificid *Aulodrilus pigueti* and the naidids, *Aulophorus michaelseni, and Branchiodrilus semperi* were abundant in the lake through out the study period. Therefore, these three species may be considered as biological indicator species of eutrophication and organic pollution in the lake. However further investigations should be carried out to confirm this finding.

The present study showed that the oligochaete species diversity and their abundance in the Colombo Lake were considerably high. The number of species and their population densities were significantly lower in the saline areas of the lake. Physico chemical parameters of bottom waters and organic carbon content in bottom sediment appear to influence the distribution and abundance of oligochaetes in the lake. However most of the species did not equally respond to all the parameters. Therefore, complex interactions seem to occur among various environmental factors and the abundance and distribution of oligochaete species in the lake.

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