

Original Research Article

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Diversity and Abundance of Dinoflagellates in the Inshore Waters and Kali Estuary off Karwar

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ABSTRACT

Keywords

Phytoplankton biomass, Dinoflagellates, vegetative stage, taxonomic groups

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The diversity and abundance of dinoflagellates in the inshore waters off Karwar and Kali estuary was studied for a period of thirteen months (Dec 14 to Dec 15). Thirty two species of dinoflagellates were recorded during the study of which thirty one species of dinoflagellates were recorded in the inshore waters off Karwar and twenty eight species of dinoflagellates were recorded in Kali estuary which joins the Arabian sea. *Ceratium* was dominant genera in both inshore waters and Kali estuary.

Introduction

Accounting for approximately one-fourth of all plants in the world (Jeffery and Veski, 1997), marine phytoplankton are important contributors to global carbon fluxes (Falkowski *et al.*, 1998). Phytoplankton communities in the ocean comprise many different taxonomic groups, which together determine primary production and various trophic level interactions. Quantification of phytoplankton biomass and community composition is important for understanding the structure and dynamics of marine ecosystems. Dinoflagellates are mainly

marine, unicellular biflagellate algae. They are characterized by a simple life cycle and which involves a vegetative stage and encysted stage. They are generally spherical to ellipsoidal or elongate, ranging in size from 25 microns to 250 microns. Dinoflagellates form one of the major components of the phytoplankton that form the base of the aquatic food chain (Sournia, 1986; Dodge, 1987; Balech, 1988; Hallegraeff and Lucas, 1988; Horner, 2002; Polat and Koray, 2002; Hernández-Becerril *et al.*, 2008) and are second in importance only to the diatoms (Hernández-Becerril, 1988; Polat and Özel, 2003; Licea *et al.*, 2004; Balkis, 2005). In

recent past a good amount of work on phytoplankton on estuary as well as inshore waters of Karnataka Coast were carried out but there is no studies have been made on dinoflagellates in Karnataka coast in general and Karwar waters is particular. As Karwar water is rich in its fishery resources, the study of this dinoflagellates community is very essential, which explains the status of the water quality and productivity of a given area. Hence, in the present study, a detailed work on dinoflagellates will be carried out along with environmental conditions which will certainly give a better picture of productivity and nature of the biotopes in and around Karwar region.

Materials and Methods

Dinoflagellates analysis of Kali Estuary and inshore waters of Karwar, west coast of India was carried out on monthly basis from December 2014 to December 2015 for a period of 13 months. Five study sites were selected in the inshore waters off Karwar. Three study sites were selected in the estuary of river Kali. Dinoflagellates were collected from both the different biotopes. Analysis of Dinoflagellates for abundance and distribution at different selected stations. The results of Dinoflagellates were further analysed using PRIMER software.

Qualitative analysis of Dinoflagellates was made based on the standard methods. Phytoplankton Samples were collected in 1 liter plastic can of water from surface and then it filtered with mesh size of 10 μ . Later it was preserved in 4% Lugol's solution, then filtered 50ml of plankton sample and quantified by using Sedgwick Plankton counting chamber and identified by referring standard manuals.

Results and Discussion

The study was conducted in the inshore water off Karwar and the estuarine region of Kali

estuary for a period of 13 months. The data was further studied seasonally with Monsoon (June to September), Post monsoon (October to January) and Premonsoon from (February to May). Five stations were taken in the inshore waters off Karwar and three station in the Kali estuary, During the study a period a total of 32 species of dinoflagellates were recorded both in Inshore water off Karwar and Kali estuary. Of the 32 species of dinoflagellates recorded 31 species of Dinoflagellates were recorded from the inshore water during the study period and 28 species of Dinoflagellates were recorded from the Kali estuary during the study period.

In station 1 (Majali) 29 species of dinoflagellates were recorded in station 2 (Kurumgad) also 29 species of dinoflagellates were recorded 28 species of dinoflagellates were recorded in station 3 (Devagad), in station 4 (Baithkol) 26 species of dinoflagellates were recorded and in station 5 (Binaga) 24 species of Dinoflagellates were recorded, all these stations were in the inshore water of Karwar. In Kali estuary three stations were selected in Station 6 (Kodibag) 24 species of Dinoflagellates were recorded and in Station 7 (Kadwad) 23 species of Dinoflagellates were found and in station 8 (Kanasgeri) 24 species of Dinoflagellates were recorded (Fig 2).

During Monsoon season the dinoflagellates varied from 14 nos in station 8 to a maximum number of dinoflagellates were recorded in station 1 and station 3 with 29 species, the species were more in inshore waters compared to estuarine region (Fig 3).

During Pre monsoon season the dinoflagellates varied from 19 nos in station 8 to a maximum number of dinoflagellates were recorded in station 1 with 27 species, the species were more in inshore waters compared to estuarine region (Fig 4).

Table.1 Presence absence data of Dinoflagelates in inshore waters off Karwar and Kali estuary

Sl.No	Species	Stn 1	Stn 2	Stn 3	Stn4	Stn 5	Stn 6	Stn 7	Stn 8
1	<i>Ceratium furca</i>	+	+	+	+	+	+	+	+
2	<i>Ceratium lineatum</i>	+	+	+	+	-	+	+	+
3	<i>Ceratium fuscuc</i>	+	+	+	+	+	+	-	+
4	<i>Ceratium tripose</i>	+	+	+	+	+	+	+	+
5	<i>Ceratium minutm</i>	+	+	-	-	+	+	+	+
6	<i>Ceratium macrocerous</i>	+	+	+	+	+	-	+	+
7	<i>Ceratium lunula</i>	-	-	+	+	+	+	+	+
8	<i>Ceratium hexicntum</i>	+	+	+	+	+	+	+	+
9	<i>Prorocentrum micans</i>	+	+	-	-	+	+	+	+
10	<i>Prorocentrum gracile</i>	-	+	+	+	-	-	-	-
11	<i>Prorocentrum sigmodiesntr</i>	+	+	+	+	+	+	+	-
12	<i>Prorocentrum rostratum</i>	+	+	+	+	+	+	+	+
13	<i>Prorocentrum lima</i>	+	+	+	+	+	+	+	+
14	<i>Prorocentrum balticum</i>	-	+	+	+	+	+	+	+
15	<i>Prorocentrum sp.</i>	+	+	+	+	-	-	-	+
16	<i>Protoperidinium steinii</i>	+	+	-	+	+	+	+	+
17	<i>Protoperidinium oceanicum</i>	+	+	+	+	+	+	+	-
18	<i>Protoperidinium bipes</i>	+	+	+	-	+	+	-	+
19	<i>Protoperidinium brevipes</i>	+	+	+	+	+	+	+	+
20	<i>Protoperidinium depressum</i>	+	-	+	+	-	+	+	+
21	<i>Alexandrium miuntum</i>	+	+	+	+	+	+	+	-
22	<i>Alexandrium sp,</i>	+	+	+	+	+	+	+	+
23	<i>Gonyaulux spinifera</i>	+	+	-	+	+	+	+	+
24	<i>Gonyaulax digitalies</i>	+	+	+	+	+	-	+	-
25	<i>Dinophysis tripos</i>	+	+	+	+	+	+	+	+
26	<i>Dinophysis miles</i>	+	+	+	+	+	+	+	+
27	<i>Dinophysis fortii</i>	+	-	+	-	+	+	+	+
28	<i>Dinophysis mitra</i>	+	+	+	+	+	+	-	+
29	<i>Dinophysis sp,</i>	+	+	+	-	-	-	-	-
30	<i>Ornithocercus sp</i>	+	+	+	+	-	-	-	-
31	<i>Dynophysis caudata</i>	+	+	+	-	-	-	-	+
32	<i>Pyrocystis sp.</i>	+	+	+	+	-	-	-	-

Table.2 Variation in Dinoflagellate diversity and species richness of Dinoflagellates

	Stn 1	Stn 2	Stn 3	Stn4	Stn 5	Stn 6	Stn 7	Stn 8
Individuals	29	29	28	26	24	24	23	24
Simpson_1-D	1.67	1.66	1.62	1.57	1.54	1.54	1.36	1.32
Shannon_H	2.72	2.8	2.7	2.6	2.54	2.54	2.42	2.39
Evenness_e^H/S	1	1	0.99	0.95	1	0.96	0.92	0.91
Margalef	3.46	3.46	3.47	3.47	3.48	3.49	3.5	3.21

Fig.1 Locations of the study sites in the Kali estuary and inshore waters (Arabian Sea) of Karwar

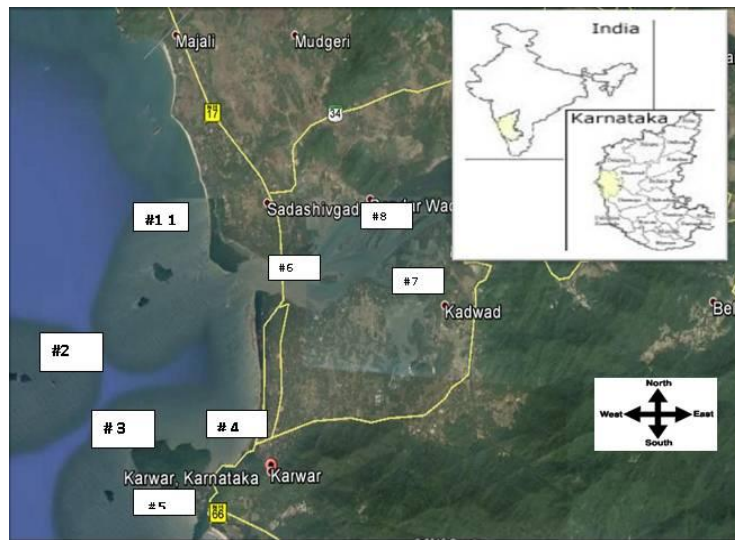


Fig.2 Total of Dinoflagellates recorded at different study stations

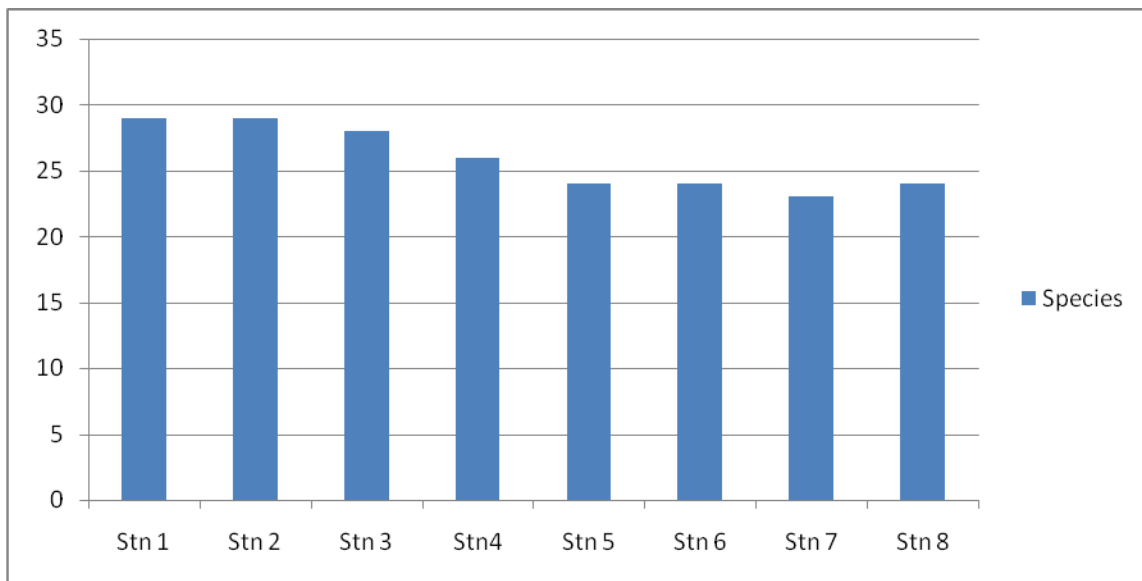


Fig.3 Total no of dinoflagellates recorded at different study station during Monsoon

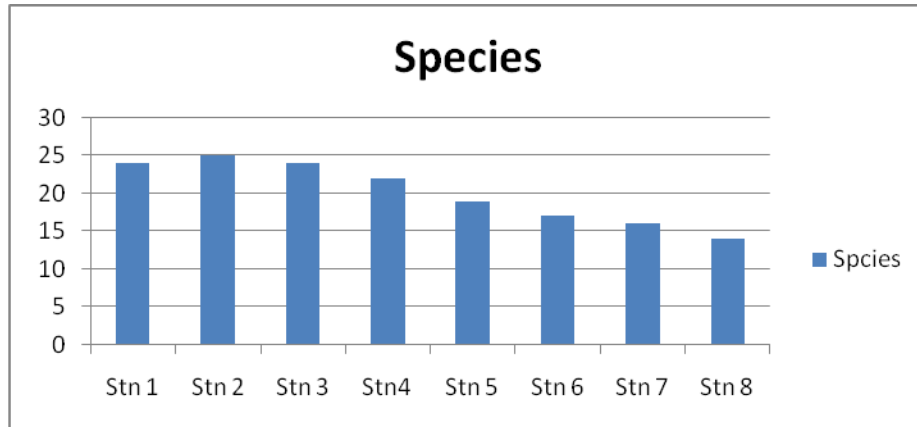


Fig.4 Total no of dinoflagellates recorded at different study stations during Pre monsoon

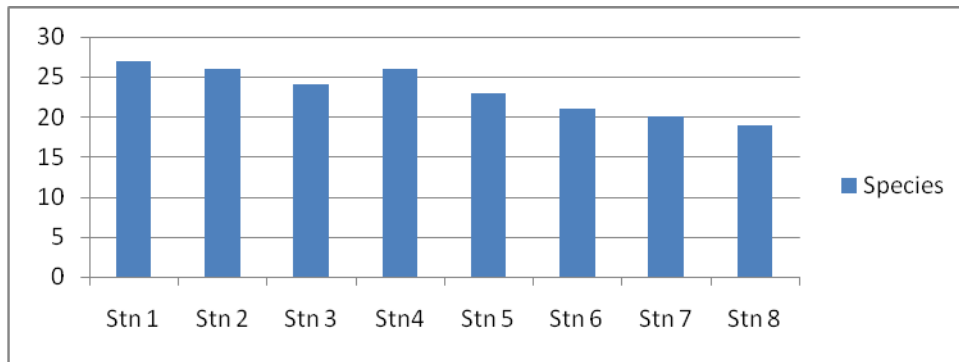


Fig.5 Total no of dinoflagellates recorded at different study stations during Post monsoon

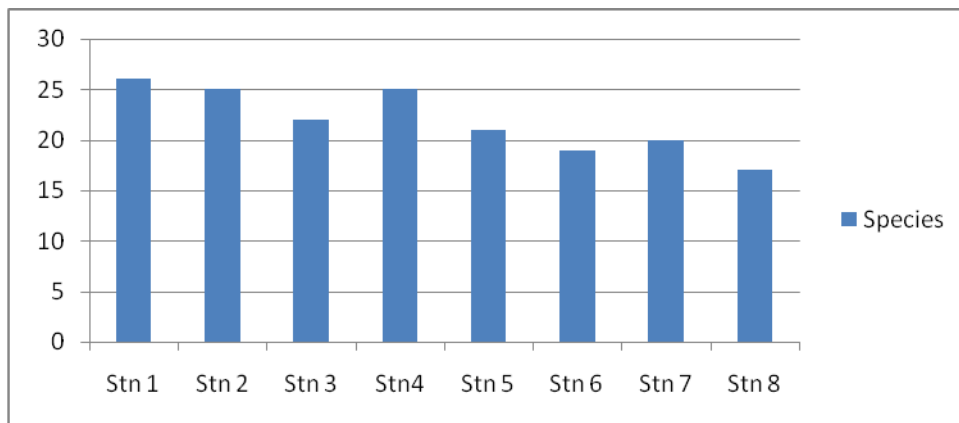
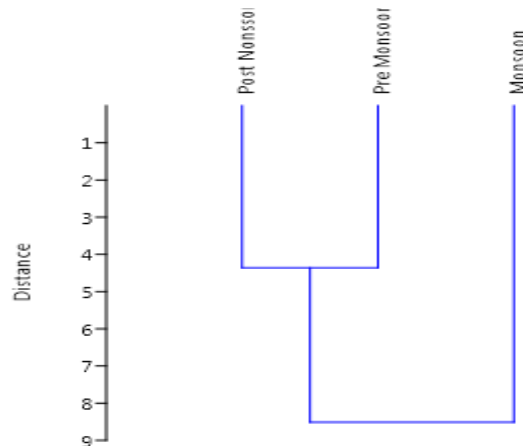


Fig.6 Dendrogram showing cluster analysis of Dinoflagellates at different seasons



During Post monsoon season the dinoflagellates varied from 19 nos in station 8 to a maximum number of dinoflagellates were recorded in station 1 with 26 species, the species were more in inshore waters compared to estuarine region (Fig 5).

The data analysis in Margalef's species richness (d'), Shannon-Weiner diversity function (H') and Pielou's evenness (J') was used to reflect the underlying changes in zooplankton species. The species richness and diversity of zooplankton at six sampling stations were determined using Pielou's evenness which was highest at the Stations 1,2 and 5 and lowest at the station 8. Margalef's diversity was highest at the stations 6 (3.49) and lowest at the station-4 (4.03). Shannon indices was highest at the stations 1 (2.72) and lowest at the station 8 (2.39) (Table 2). The dendrogram revealed that the species similarity were between the Pre monsoon and Post monsoon was linked to Monsoon (Fig 6). Same was seen and revealed in MDS plot with station 1-4 clustering together and 5 and 6 away from the rest (Fig 4).

During the present which was conducted in the inshore waters off Karwar and the Kali

estuary which joins the Arabian sea in west coast of India. Totally eight study station were recorded in the study area of which five station in the inshore waters and three stations in the Kali estuary. Generally the difference between the stations was around 3 km in the inshore waters and 2 km in the estuarine area. Phytoplankton's were collected as per the standard procedure and dinoflagellates were identified. During the study a total of 32 dinoflagellates were recorded of which 31 species of Dinoflagellates were identified in the inshore waters and 28 species of dinoflagellates in the estuarine area. Seeing this more diversity of Dinoflagellates were recorded in the inshore waters. Maximum dinoflagellates were recorded in the Station 1 and Station 2 which is around 5 km from the bar mouth of river Kali. Seasonal study of dinoflagellates were studied and it was seen that the maximum diversity of dinoflagellates was recorded during Pre monsoon both in Inshore water as well as estuary followed by Post monsoon and least diversity was observed during the monsoon in both inshore waters as well as estuary, Little work on exclusively on dinoflagellates in west coast of India is very limited. Mirudla *et al.*, (2002) studied on the diversity of dinoflagellates in

the sea off Mangalore and recorded 13 species of dinoflagellates. *Ceratium* was the dominant dinoflagellates in Karwar waters which consisted of eight species of dinoflagellates.

Several workers have recorded the occurrence of *Ceratium* as the dominant dinoflagellates that occurred regularly (Devassy and Goes, 1988, Lingdhal *et al.*, 1988) Devassy and Goes 1989 recorded appreciable number of *Ceratium* and *Peridinium* in the waters of Laccadives respectably. Reverse to all these studies poor dinoflagellates were recorded by Nair and Achuthankutty (1980) along the west coast of India, Jiyalal Ram *et al.*, (1984) also observed abundance of dinoflagellates during post monsoon season in the coastal waters of Mangalore and Thal region. During the present study, Dinoflagellates were recorded in large numbers both in inshore waters and estuarine region.

Further intensive and long term studies are required to evaluate the secondary productivity of the estuary on a seasonal, annual basis and also elucidate the plankton biodiversity in the estuary.

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