

Monthly fluctuation of phytoplanktons in Vettar estuary and Nagapattinam marine water samples South east coast of Tamil Nadu India

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ABSTRACT : A study was undertaken to record the monthly fluctuation in phytoplanktons population in Vettary estuary and Nagapattinam marine water samples south east coast of Tamil Nadu, India, for a period of August 2015 to July 2016. Four groups of phytoplankton were recorded in the samples. They are i. Diatoms, ii. Dinoflagellates, iii. Blue greens and iv. Green algae. During the study, a total of 67 species, belong to 38 families and 57 genera were recorded in respective study area. Diatoms were found to be the dominant group with 52 species. Dinoflagellates formed second dominant group with 10 species. Blue greens came next in the order with 3 species followed by green algae with 2 species in Vettar estuary and Nagapattinam marine area. With respect to population density, in station-1 the density varied from 225 to 5,450 cells/L with minimum during July-18 (premonsoon) and maximum during February-18 (post monsoon), in station-2, the population density it fluctuated between 103 and 7,346 cells/L with minimum during December-15 (monsoon) and maximum during February-16 (summer), in station-3, fluctuated from 102 to 7,961 cells/L with minimum during April-15 (summer) and maximum during May-16 (summer) and in station-4, density of phytoplankton varied from 525 to 7.240 cells/L with minimum during March-16 (post monsoon) and maximum during January-16.

Index Terms: *Phytoplanktons, Diversity, Marine, Estuary, Water samples.*

1.INTRODUCTION

Phytoplankton plays a vital role in the transfer of energy from primary to secondary level; hence, it acts as an integral part of marine and estuarine ecosystem¹. Phytoplankton is a pre dominant type of plants found in aquatic system and its community and relative abundance undergoes continuous Changes at varying scales, and also used as good indicator of water Quality². Phytoplankton species are predominantly autotrophic or holophytic organisms. They are the most important producer of organic substances, and the rate of energy is stored in the tiny organisms determines the basic primary productivity of the ecosystem.

Phytoplankton is a highly diverse group of photo-autotrophic non-vascular plant and they exist either as unicellular or multi-cellular microscopic algae in freshwater, brackish and marine water environs. They

are diversified group of photosynthetic thallophytes which have a very significant role in productivity of the marine, estuarine and freshwater ecosystem that cover two-third of the earth's surface. They act as an agent for primary production and production of organic compounds from carbon dioxide in the presence of light, and a process that sustains the aquatic food web³. Phytoplankton is important in relation to global primary production in the sea which justifies a substantial study of phytoplankton production⁴. The main components of the phytoplankton in the sea are diatoms, dinoflagellates, coccolithophorids and flagellates. Blue-green algae and green algae are abundant in fresh-water but are of lesser significance in the sea⁵. Therefore, in the present study, an extensive survey was made for the period of one year, in order to assess the diversity and distribution pattern of phytoplankton variation in the respective study area by using various statistical package.

II. MATERIAL AND METHODS

Water samples were collected for season wise from the selected zones of Nagapattinam marine and Vettar estuary water samples, South east coast of Tamil Nadu, India during August 2015 to July 2016. Phytoplankton samples were collected from the surface waters by towing a plankton net (mouth diameter 0.35m) made of bolting silk (No.25 mesh size 48 μ m) for half an hour. Subsequently, samples were preserved in 5% neutralized formalin and used for qualitative analysis. Forth quantitative analysis of phytoplankton, the settling method described by Sukhanova⁶ was adopted. Numerical plankton analysis was carried out using Utermohl's sedimentation technique. Samples were allowed to settle in the counting chamber for 3–5 min prior to enumeration. Counting of plankton was done with the help of "Sedgwick-Rafter counting cell". Plankton species were identified using standard works of Smith (1950). Further, the data were subjected to various univariate and multivariate methods available in PRIMER (Ver.6).

III. RESULTS

In the present study, four groups of phytoplankton were recorded in the samples. They are i. Diatoms, ii. Dinoflagellates, iii. Blue greens and iv. Green algae. During the study, a total of 67 species, belong to 38 families and 57 genera were recorded in respective study area. Diatoms were found to be the dominant group with 52 species. Dinoflagellates formed second dominant group with 10 species. Blue greens came next in the order with 3 species followed by green algae with 2 species in Vettar estuary and Nagapattinam marine water samples.

Among the diatoms *Astrionella glaciales*, *Bellerochea malleus*, *Bacillaria paradoxa*, *Bacteriastrium comosum*, *Chaetoceros lorenzianus*, *C. curvisetus*, *C. brivis*, *C. affinis*, *C. messanensis*, *C. indicus*, *Coscinodiscus centralis*, *C. gigas*, *C. granii*, *Cyclotella* sp. *Cylindrotheca closterium*, *Gyrosigma balticum*, *Leptocylindrus danicus*, *Lithodesmium undulatum*, *Nitzschia longissimi*, *T. frauenfeldii*, *O. sinensis*, *O. mobiliensis*, *Planktoniella sol*, *Pleurosigma angulatum*, *P. normanii*, *Rhizosolenia alata*, *R. styliformis*, *R.*

cylindrus, *Skeletonema costatum*, *Stephanopyxis palmeriana*, *Thalassionema nitzschioides*, *Thalassiosira punctigera*, *Thalassiothrix frauenfeldii*, and *Triceratium favus* were found to be commonly occurring species in both the estuaries. With respect to dinoflagellates, *Ceratium furca*, *C. trichoserous*, *C. macrocerous*, *C. tripos* *Protoperidinium oceanicum*, *Dinophysis caudata* and *Phyrophacus steinii* showed consistency in their occurrence in both the regions. Coming to blue greens *Anabeana* sp., *Oscillatoria* sp., *Spirulina* sp. and *T. erythraeum* and green algae *Chlorella* sp., *Tetraselmis* sp. were found to be common in the collection. The common phytoplankton species recorded in various stations of both the regions is shown in Plate 3.

Numerical abundance of phytoplankton

With respect to population density, in station-1 the density varied from 225 to 5,450 cells/L with minimum during July-18 (premonsoon) and maximum during February-18 (post monsoon) Fig. 1.

In station-2, the population density it fluctuated between 103 and 7,346 cells/L with minimum during December-15 (monsoon) and maximum during February-16 (summer) Fig. 2.

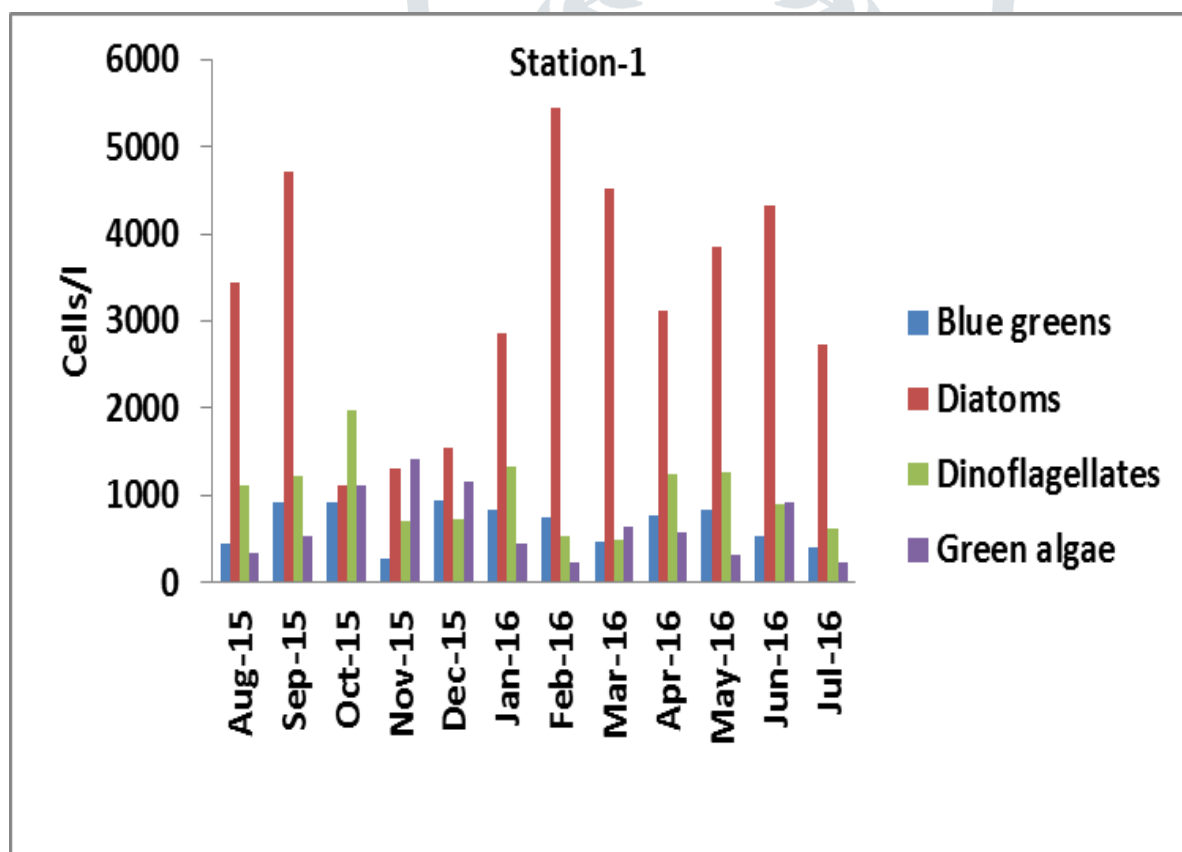


Fig. 1. Monthly variations of density of phytoplankton species recoded in station-1

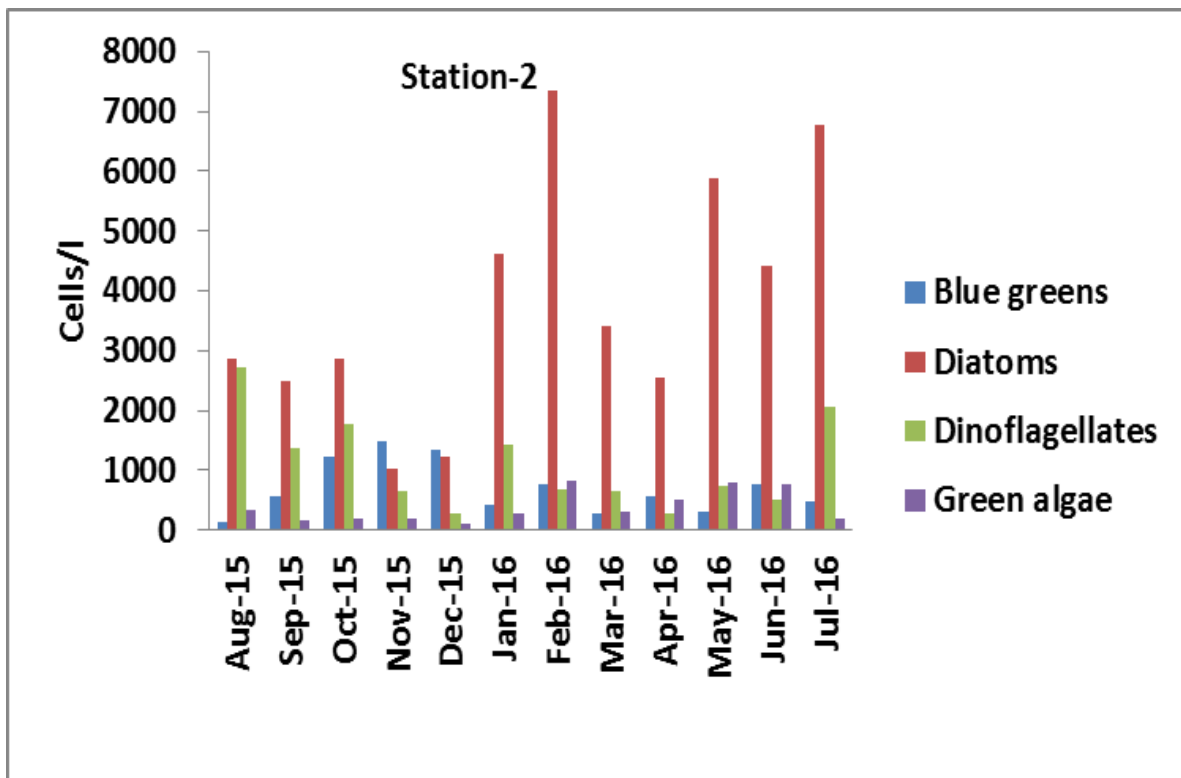


Fig. 2. Monthly variations of density of phytoplankton species recoded in station-2

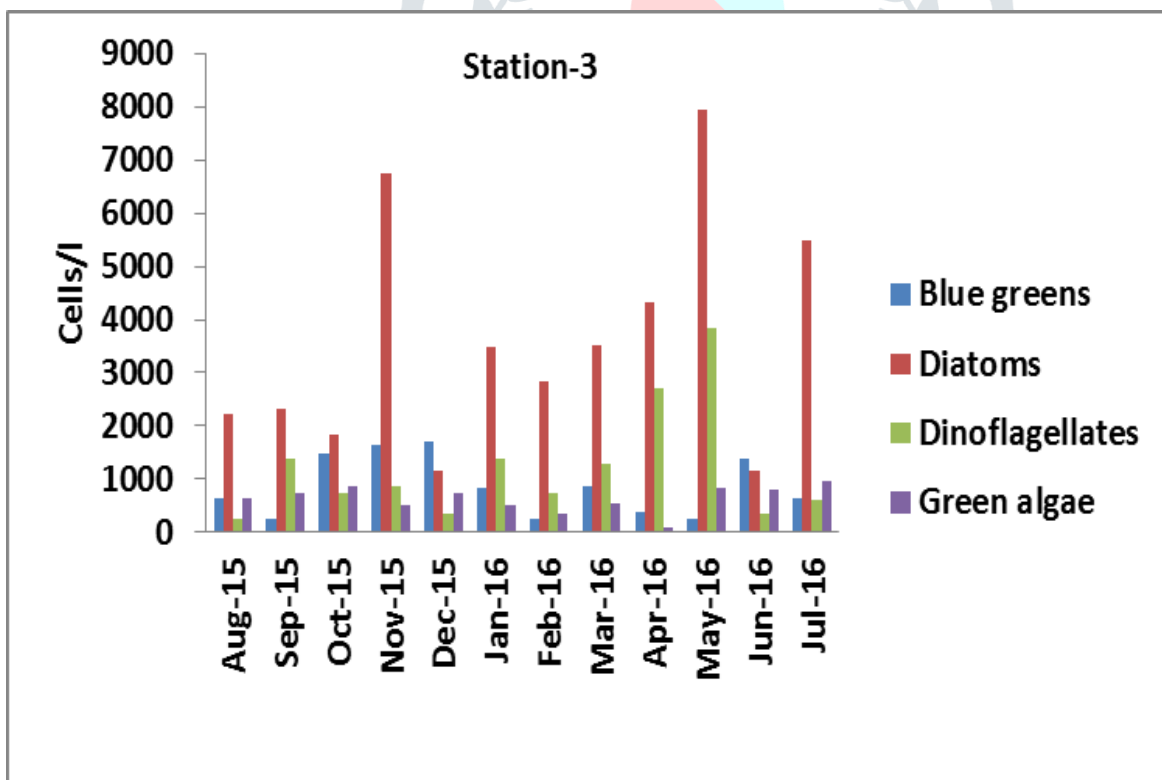


Fig. 3. Monthly variations of density of phytoplankton species recoded in station-3

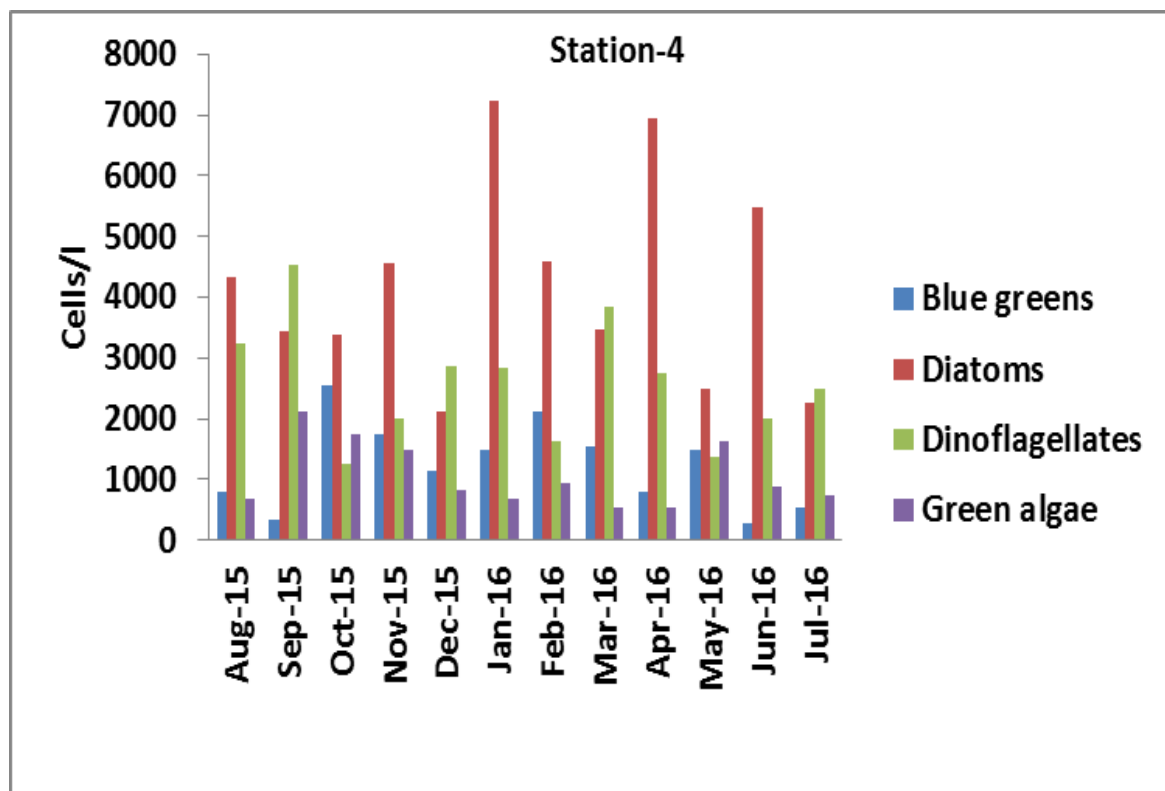


Fig. 4. Monthly variations of density of phytoplankton species recorded in station-4

In station-3, fluctuated from 102 to 7,961 cells/L with minimum during April-15 (summer) and maximum during May-16 (summer) Fig. 3. In station-4, density of phytoplankton varied from 525 to 7.240 cells/L with minimum during March-16 (post monsoon) and maximum during January-16 (post monsoon) Fig. 4.

Percentage composition of phytoplankton

In station-1, diatoms at the top with a contribution of 58% followed by dinoflagellates, blue greens and green algae with a percentage occurrence of 18%, 12% and 12% respectively to the samples collected in Nagapattinam marine water samples (Fig. 5). Likewise, in station-2, diatoms continued to be the dominant group with a percentage contribution of 63% followed by dinoflagellates with 18%, bluegreen algae with 12% and green algae in 7% (Fig. 6). In station-3, diatoms with 57% and dinoflagellates formed second dominant group with a percentage occurrence of 19%, blue greens and green algae came next in the order with a percentage occurrence of 14% and 10% respectively (Fig. 7). In station-4 diatoms at the top with a contribution of 46% followed by dinoflagellates, blue greens and green algae with a percentage occurrence of 28%, 14% and 12% respectively (Fig. 8).

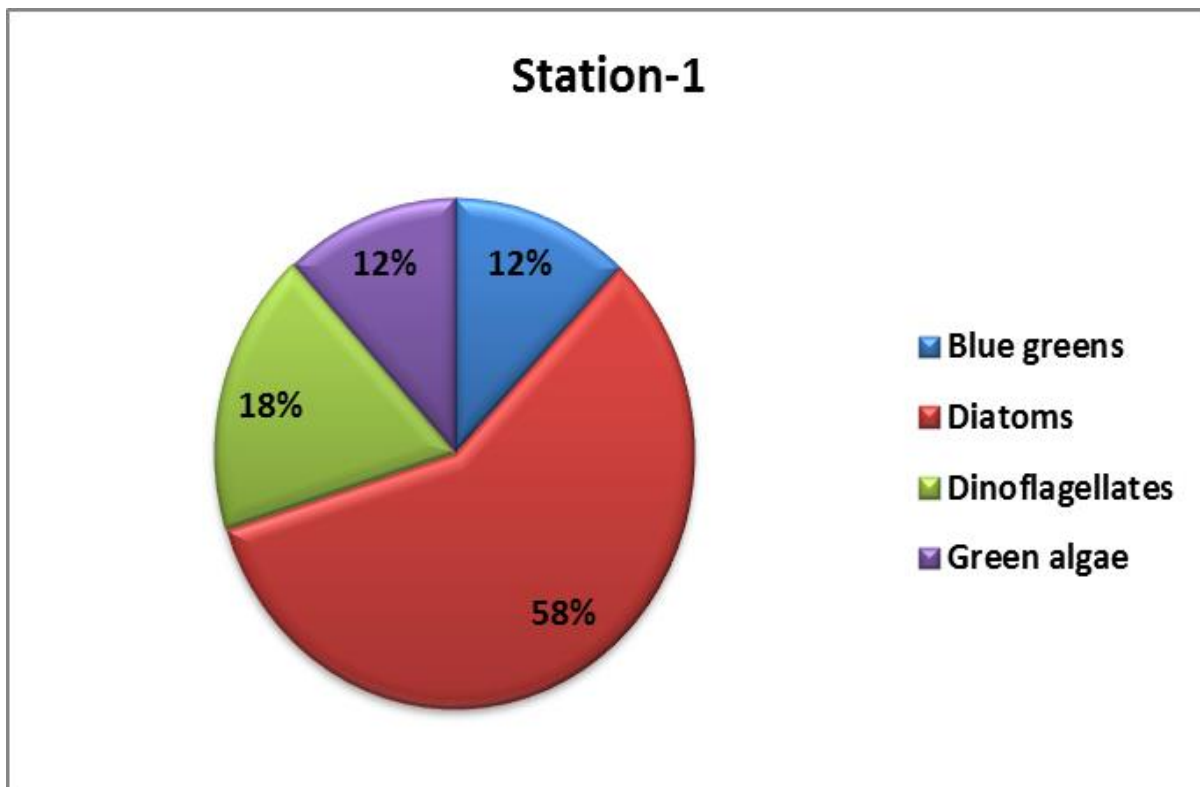


Fig. 5. Percentage composition of phytoplankton recorded in station-1

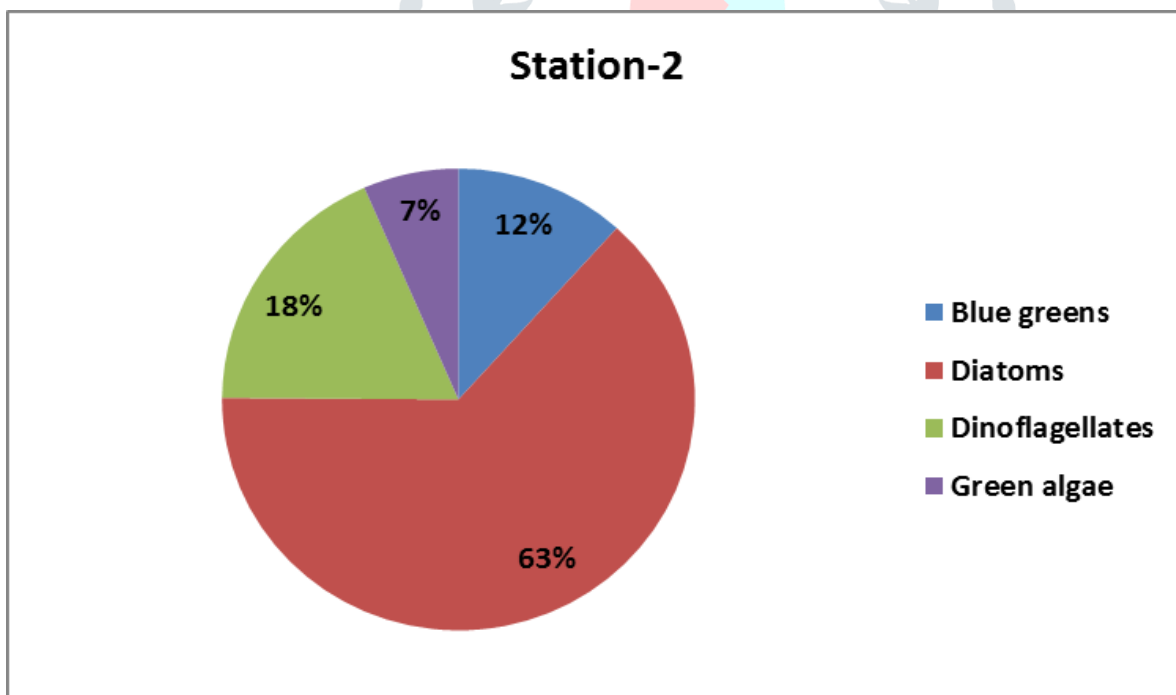


Fig. 6. Percentage composition of phytoplankton recorded in station-2

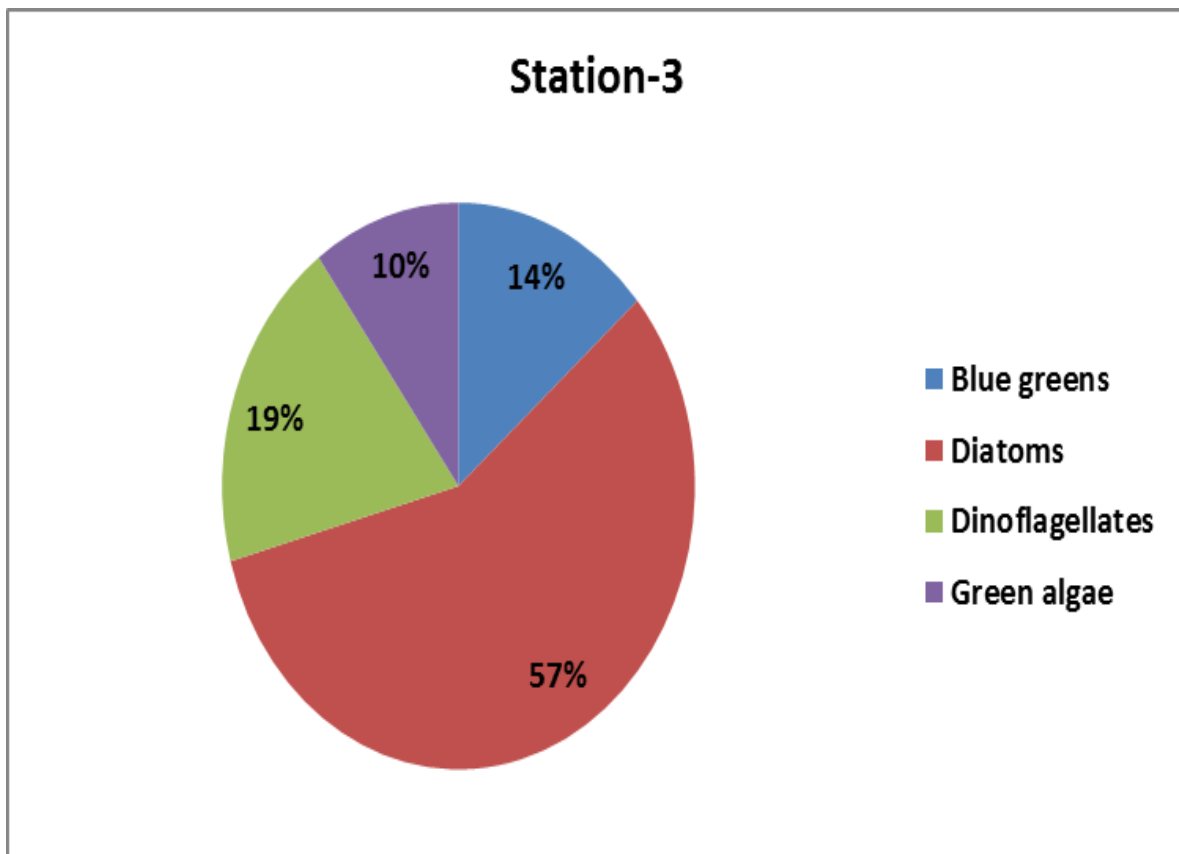


Fig. 7. Percentage composition of phytoplankton recorded in station-3

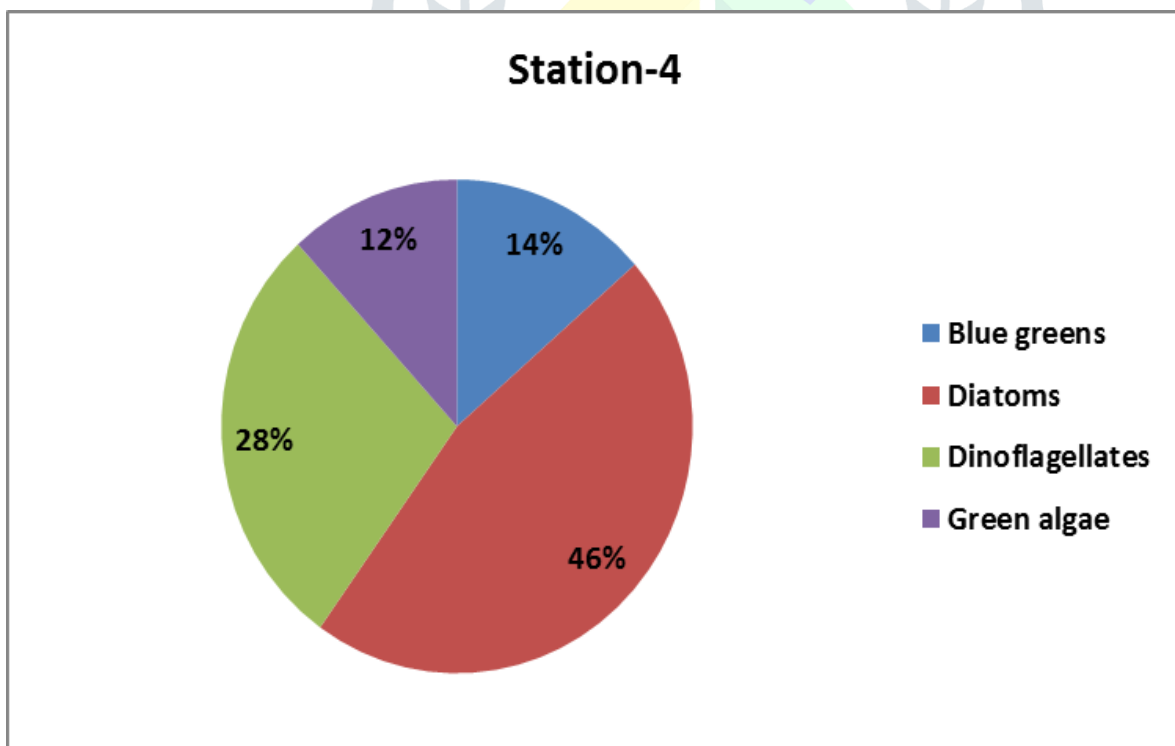


Fig. 8. Percentage composition of phytoplankton recorded in station-4

Diversity indices

Species diversity (H')

In station-1, the species diversity varied from 2.21 to 3.33 with minimum during December-15 (monsoon) and maximum in June-16 (summer). In station-2, diversity index fluctuated between 1.69 and 3.32 with minimum value during November-15 (monsoon) and maximum during April-16 (summer). In station-3, it varied from 1.89 to 3.42 with minimum value during November-15 (monsoon) and maximum during April-16 (summer). At station-4, diversity index fluctuated from 2.21 to 4.37 with maximum during April-16 (summer) and minimum during November-15 (monsoon) Figs. 9-12.

Species richness (d)

In station-1, the species diversity varied from 2.16 to 3.45 with minimum during November-15 (monsoon) and maximum in June-16 (summer). In station-2, diversity index fluctuated between 2.48 and 3.33 with minimum value during January-16 (postmonsoon) and maximum during May-16 (summer). In station-3, it varied from 2.10 to 4.77 with minimum value during September-15 (premonsoon) and maximum during May-16 (summer). At station-4, diversity index fluctuated from 3.24 to 4.79 with maximum during June-16 (summer) and minimum during November-15 (monsoon) Figs. 13-16.

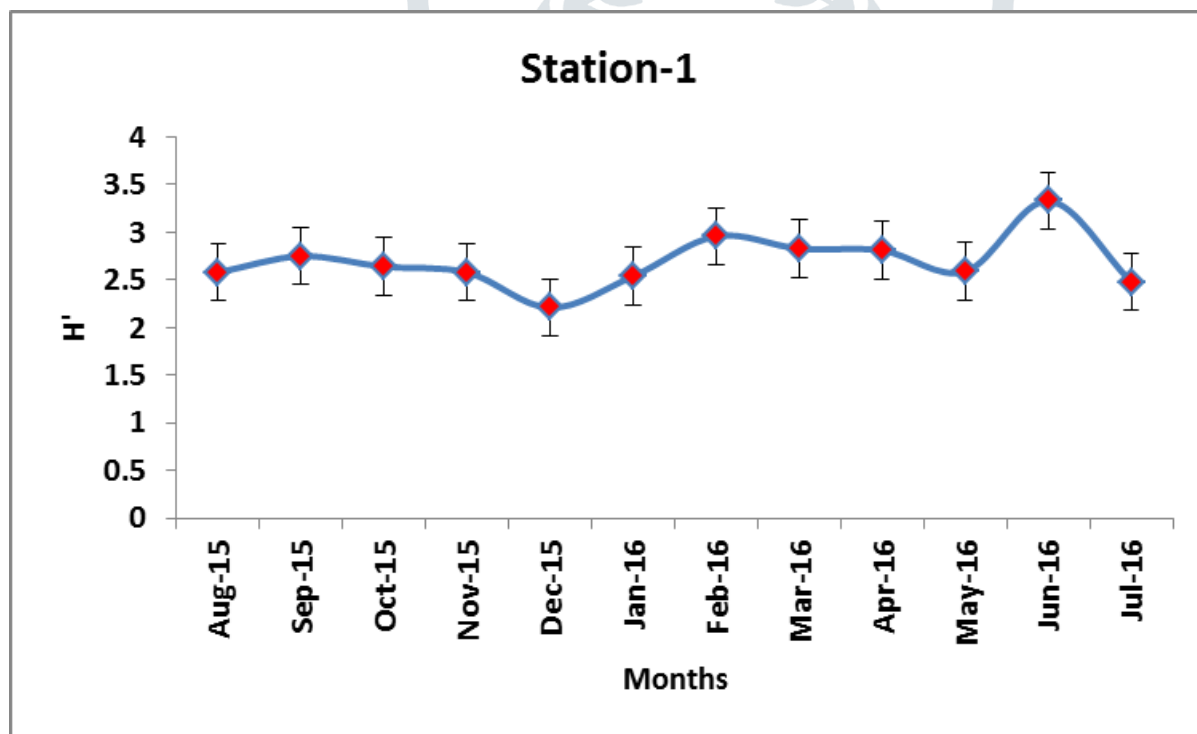


Fig. 9. Monthly variation of diversity indices in Shannon diversity (H') calculated for the phytoplankton species recorded in station-1

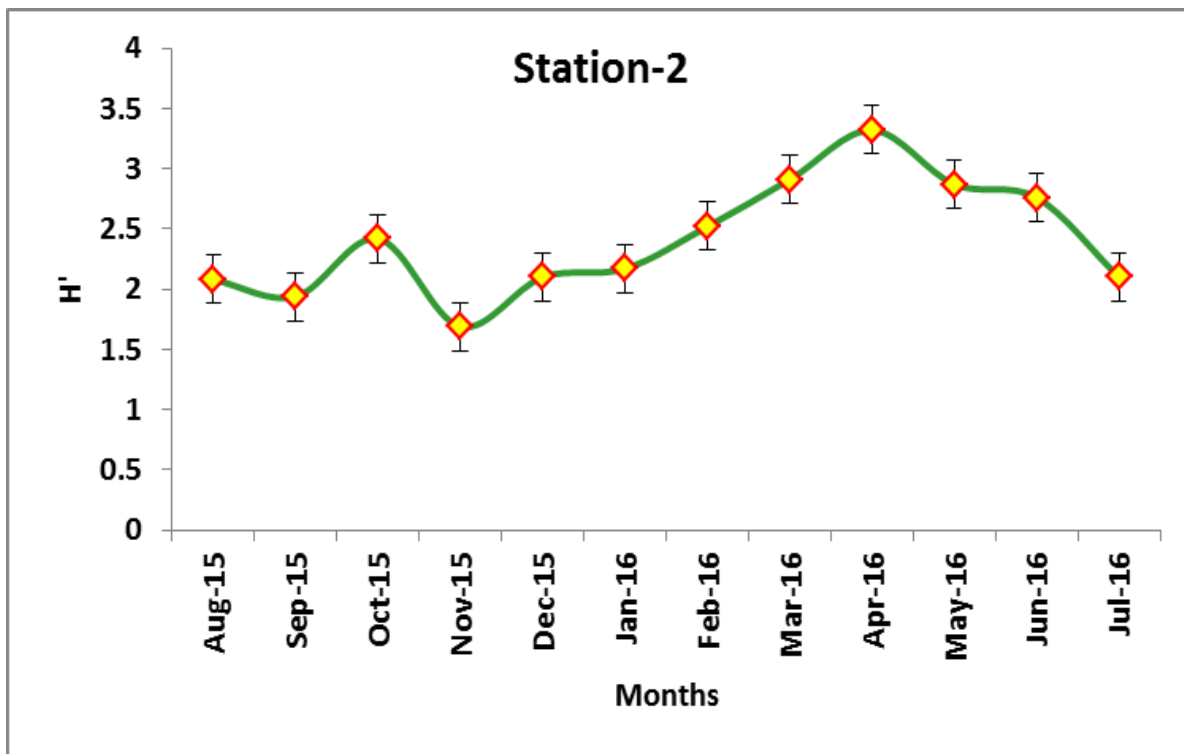


Fig. 10. Monthly variation of diversity indices in Shannon diversity (H') calculated for the phytoplankton species recorded in station-2

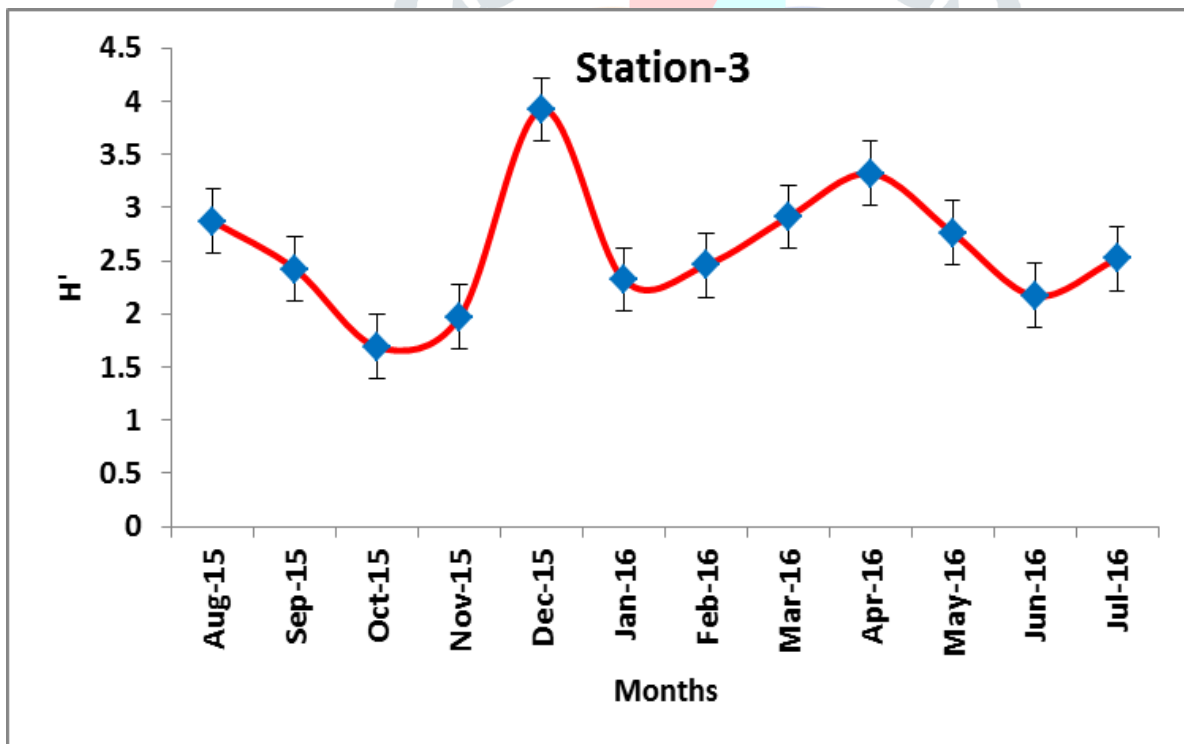


Fig. 11. Monthly variation of diversity indices in Shannon diversity (H') calculated for the phytoplankton species recorded in station-3

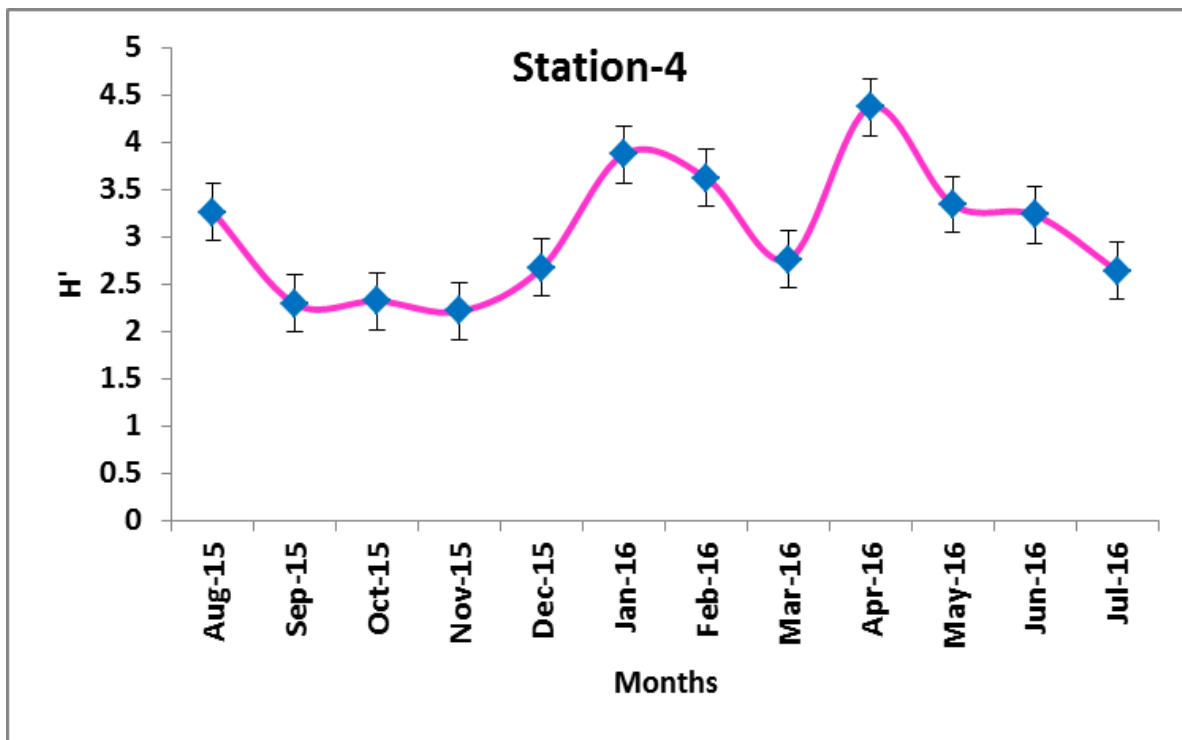


Fig. 12. Monthly variation of diversity indices in Shannon diversity (H') calculated for the phytoplankton species recorded in station-4

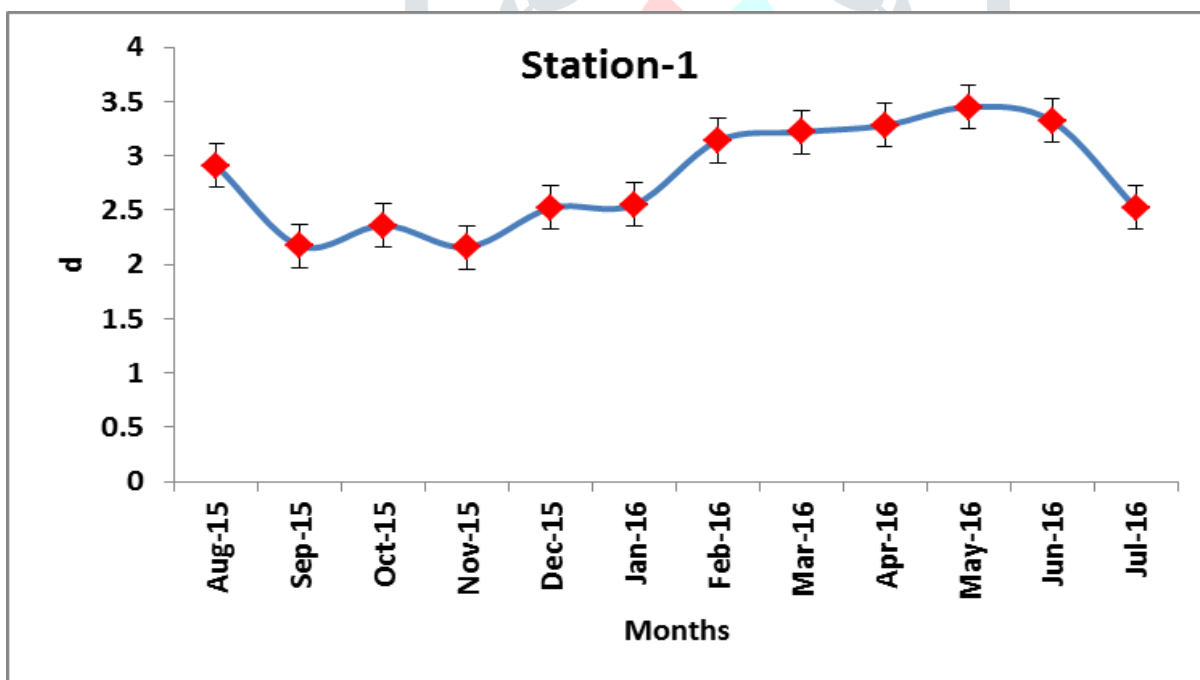


Fig. 13. Monthly variation of diversity indices in species richness (d) calculated for the phytoplankton species recorded in station-1

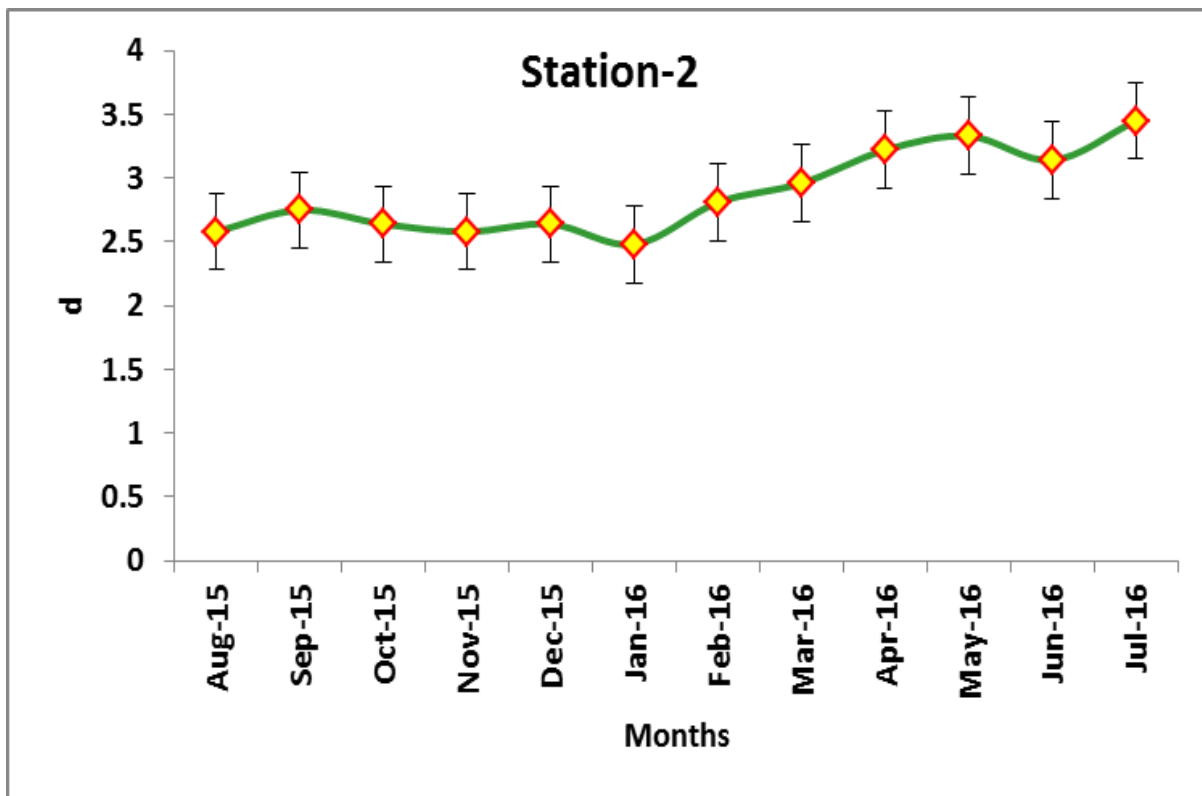


Fig. 14. Monthly variation of diversity indices in species richness (d) calculated for the phytoplankton species recorded in station-2

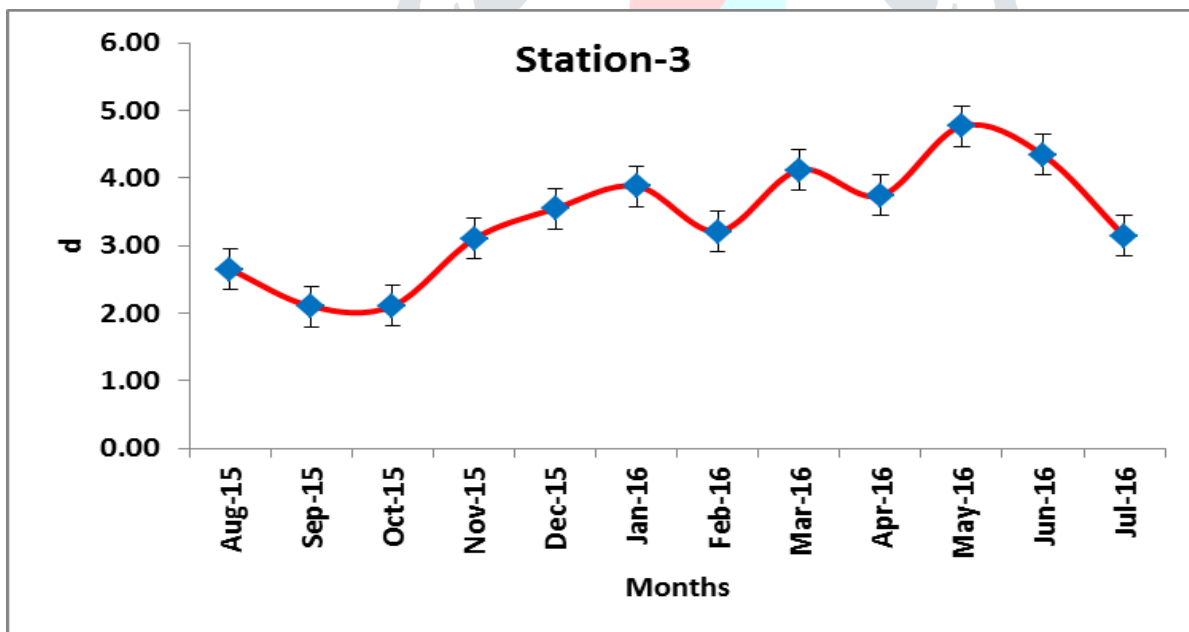


Fig. 15. Monthly variation of diversity indices in species richness (d) calculated for the phytoplankton species recorded in station-3

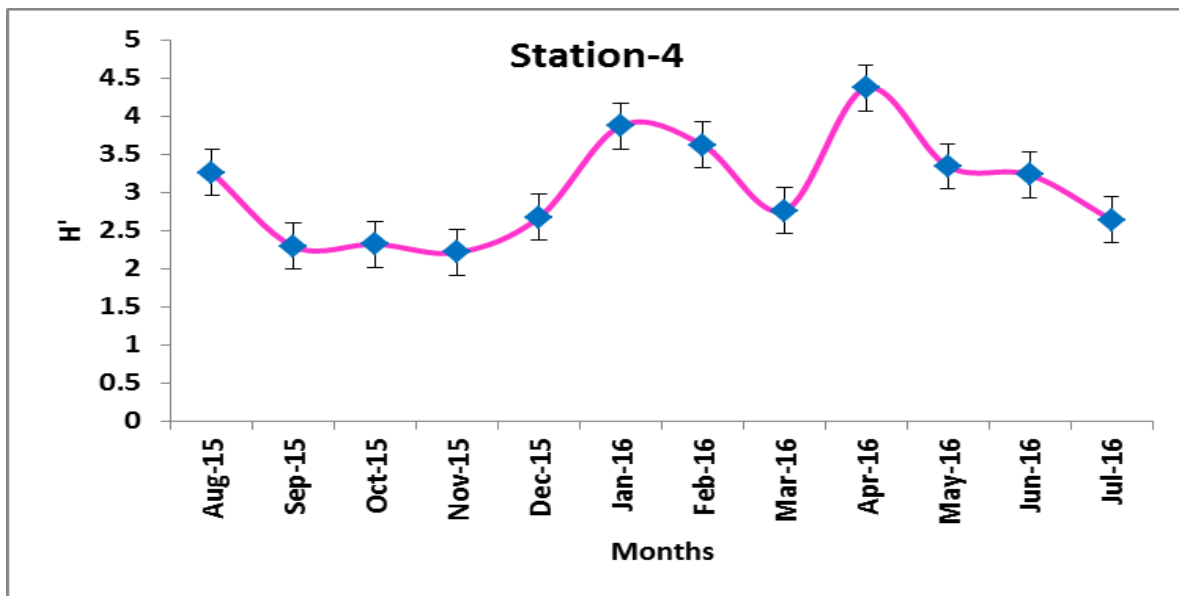


Fig. 16. Monthly variation of diversity indices in species richness (d) calculated for the phytoplankton species recorded in station-4

Species evenness (J')

In station-1, the species diversity varied from 0.83 to 0.79 with minimum during October-15 (monsoon) and maximum in July-16 (summer). In station-2, diversity index fluctuated between 0.87 and 0.91 with minimum value during June-16 (summer) and maximum during March-16 (postmonsoon). In station-3, it varied from 0.88 to 0.98 with minimum value during December-15 (monsoon) and maximum during June-16 (summer). At station-4, diversity index fluctuated from 0.93 to 0.99 with maximum during May-16 (summer) and minimum during October-15 (monsoon) Figs. 17-20.

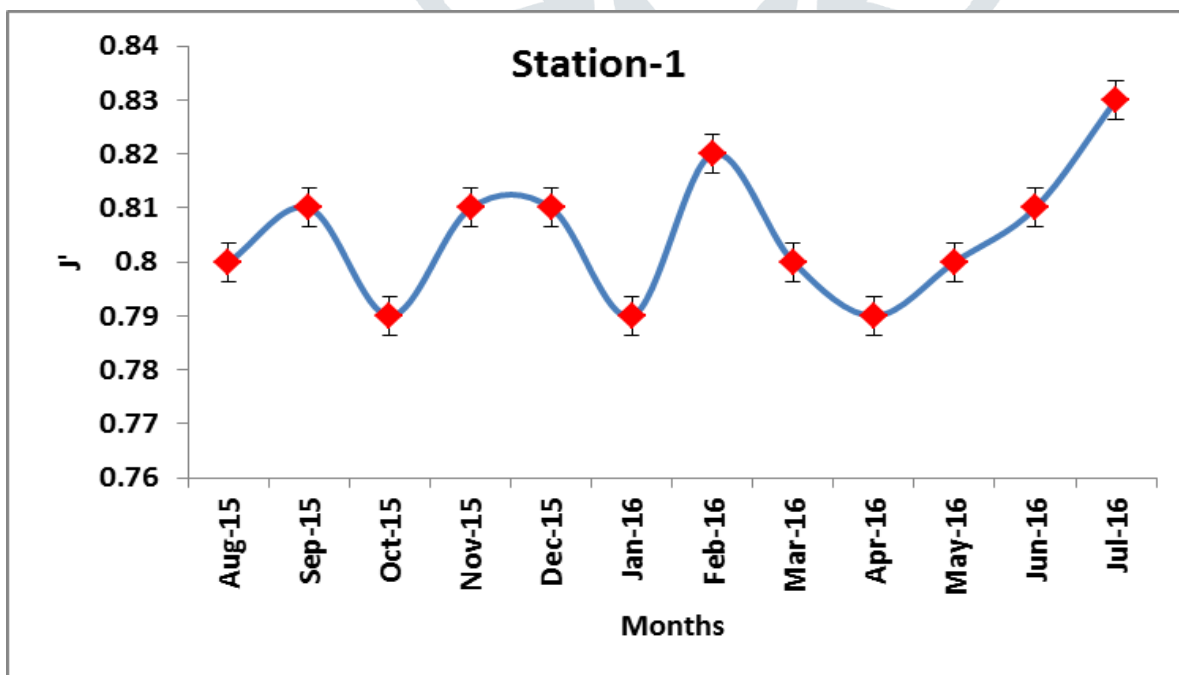


Fig. 17. Monthly variation of diversity indices in species evenness (J') calculated for the phytoplankton species recorded in station-1

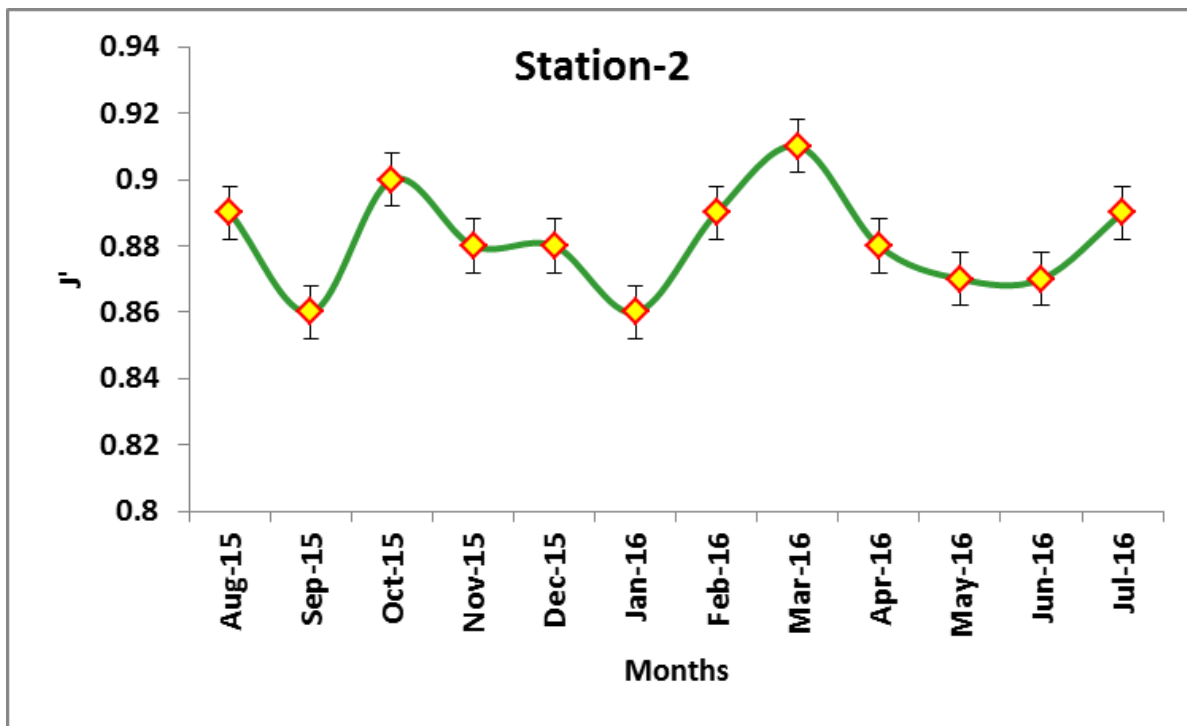


Fig. 18. Monthly variation of diversity indices in species evenness (J') calculated for the phytoplankton species recorded in station-2

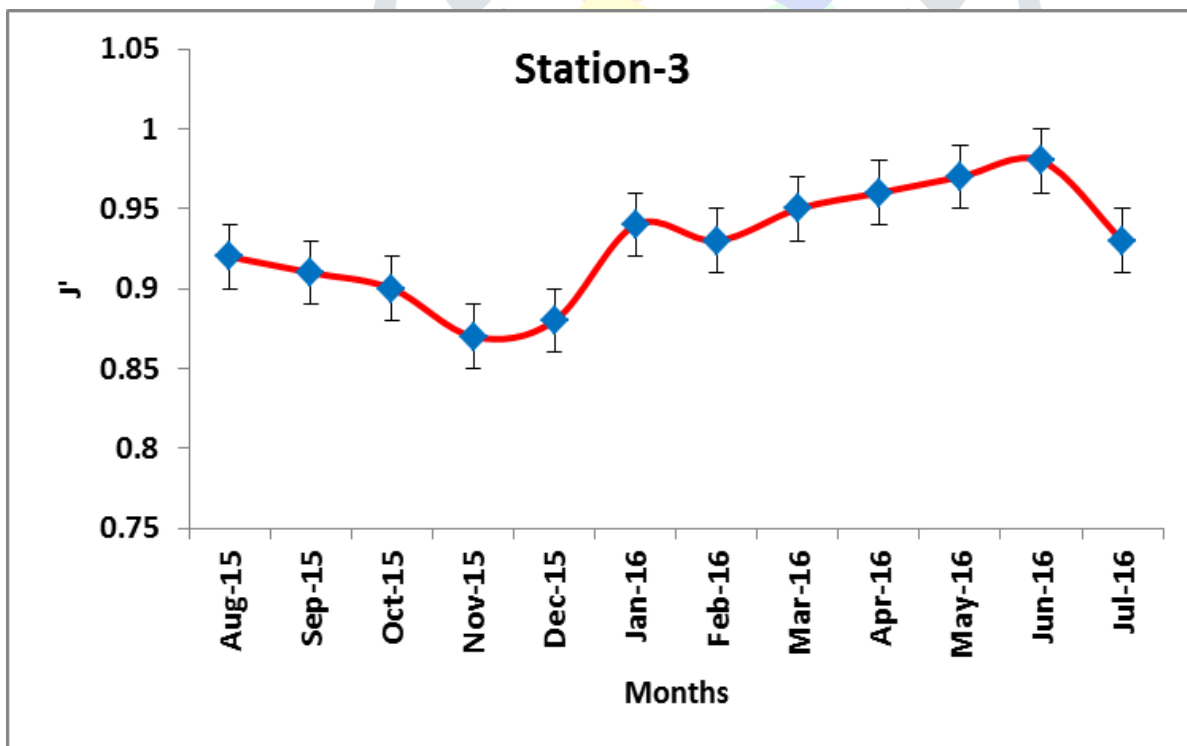


Fig. 19. Monthly variation of diversity indices in species evenness (J') calculated for the phytoplankton species recorded in station-3

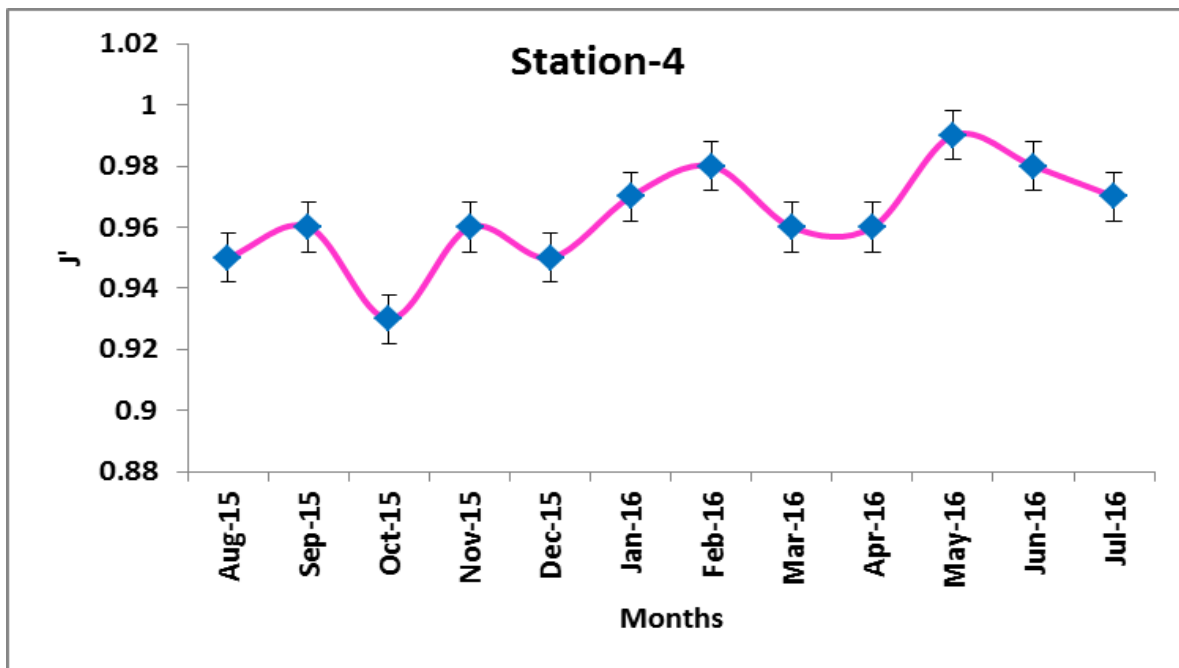


Fig. 20. Monthly variation of diversity indices in species evenness (J') calculated for the phytoplankton species recorded in station-4

VI. DISCUSSION

Over the decades, the importance of phytoplankton diversity has been realized to be one of the environmental health assessments as indicators. In coastal environments, either biotic or abiotic factors contributed substantially to the abundance and diversity of phytoplankton in the waters. In general, the distribution and abundance of phytoplankton in tropical waters, varied remarkably due to the seasonal environmental fluctuations, and these variations are well pronounced in the sheltered system of estuarine waters⁷.

Phytoplankton studies are useful for identification of the physico-chemical and other biological conditions of the water in any aquatic ecosystem. Some groups of phytoplankton can hamper recreational value of surface water, particularly by forming thick surface scum, which reduces the use of amenities for water sports or large growth, which cause deoxygenation of the water leading to fish death⁸. Over the last few decades, there has been more concern about the processes influencing the development of phytoplankton communities, primarily in relation to physico-chemical factors⁹.

In the present study, the phytoplankton community, comprised of diatoms, dinoflagellates, blue greens and green algae, was studied at Nagapattinam marine and Vettar estuarine ecosystem. Diatoms were the most dominant group in all the stations throughout the study period, which could be ascribed to the fact that diatoms could thrive well in varying environmental changes as reported earlier by several researchers¹⁰ in east coast. Gopinathan and Madhu *et al.*^{11&12} were studied in West coast. Diatoms were followed by dinoflagellates, whereas blue greens and green algae were represented by very few species during the study period. Nabout *et al.*¹³ also observed the predominance of Bacillariopyceae (diatoms) members followed by Chlorophyceae (blue greens) and Cyanophyceae (green algae) members during his study on phytoplankton community of Brazilian lakes, which lends supports to the results of the present study.

In estuarine environment, phytoplankton assemblage, structure and growth are affected by the different environmental factors that include salinity, nutrients, temperature etc.¹⁴. Phytoplankton distribution and their growth depend on several environmental factors, which are varied with seasons and regions. In both the ecosystems studied, maximum density of phytoplankton was recorded during summer followed by post-monsoon and minimum density was during monsoon. Maximum density of phytoplankton could be attributed to the neritic element domination and availability of nutrients. As the hydrological parameters were in stable condition during post monsoon season, that might have favored to record more phytoplankton production was registered higher¹⁵. Besides, more number of phytoplankton during postmonsoon could be due to increased radiation or light intensity¹⁶. Perumal *et al.*¹⁷ noticed higher density of phytoplankton during post-monsoon months and lower in monsoon on Kaduviyar estuary, India which corroborated well with the results of present investigation.

In the present study, a total of 67 species, belong to 38 families and 57 genera were recorded in all stations. The higher abundance and species diversity during summer and postmonsoon seasons might be due to the predominance of diatoms.

The higher phytoplankton abundance during summer and post monsoon season could be attributed to the increased salinity, pH, high temperature and high intensity of light penetration. Similar summer maxima and monsoonal minimal was reported earlier by Rajkumar *et al.*¹⁵. The abundance was lowest during

monsoon season, when the water column was remarkably stratified to a large extent because of heavy rainfall, high turbidity caused by run-off, reduced salinity, decreased temperature and pH, overcast sky and cool conditions. However, during this season, freshwater algal forms like *Anabaena* sp., *Oscillatoria* sp., *Chlorella* sp., *Lynbya* sp., *Spirogyra* sp. *Spirulina* major and *Microcystis* sp. were also noticed. Similar observations have been made from different locations of east and west coast of India by Gouda and Panigrahy¹⁸ reported that fresh water forms such as green algae and blue green algae.

It is worth mentioning here that, Thillai Rajasekar¹⁹ have reported 124 species of phytoplankton in Coleroon estuary and 117 species in Vellar estuary during their two years of the study. This study thus showed almost fairly comparable results with the present results with respect to the species numbers. With regard to density, the maximum density was recorded during summer and post monsoon seasons and minimum during monsoon season. The high density recorded during summer could be attributed to more stable hydrographical conditions prevailed during that period.

Diversity index is a tool, which is applied to measure the species biodiversity in an ecosystem. A stressed environment typically has a lower number of species with one or two dominant species (those adapted to the stress) having many more individuals than the other species²⁰. The conservation of biological diversity has become one of the major issues since the late twentieth century. There is worldwide recognition that reduction in the diversity of life will, sooner or later, affect us all in some manner. There are many diversity indices, some are total species-abundance ratio (e.g. Margalef index), others are derived from theoretical species abundance models and the number is based on the proportional abundance of the species (e.g. Shannon-Wiener) having different underlying principles, each index has its own strength and weakness.

Present study agrees with following studied by Edward and Ayyakkannu²¹ from Coleroon estuary and several other worker²² along the South east coast of India. The observed species richness values from both the regions are similar to those of phytoplankton abundance, and the maximum richness values were recorded during summer and postmonsoon seasons²³. Similarly, the monsoonal minimum richness values were reported earlier by Saraswathi²⁴ from the Arasalar and Kaveri estuaries.

V. CONCLUSION

Present study was undertaken to record the phytoplanktons diversity Nagapattinam marine and Vettar estuary South east coast Tamil Nadu, India. From this investigation it is observed, plankton density and diversity is higher in the summer season compared to premonsson, monsoon and post monsoon seasons.

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