Phytoplankton abundance in relation to nutrient dynamics during southwest monsoon, southern coast of Sri Lanka

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Abstract

The southern coast of Sri Lanka is an important transitional passage between the Arabian sea and the Bay of Bengal. Therefore, it is important to asses the productivity of this region through the phytoplankton abundance and chlorophyll-a concentration in relation to the nutrient dynamics. The present study describes the temporal and spatial variations of phytoplankton density, nutrients and chlorophyll-a concentrations in southern coast of Sri Lanka during the southwest monsoon. The phytoplankton are the basis of the marine food webs as they are photosynthetic micro organisms and they require the enough nutrients such as nitrate, phosphate and silicate for their growth and production. Chlorophyll-a concentration is one of the good indicators of the phytoplankton biomass. Field sampling was carried out in Ranna, Matara and Galle for a three month period from August to October of 2015. The study reveals that the mean (Nitrite+Nitrate)-N, Phosphate-P and Silicate-Si concentrations were 0.099 0.083 mg l-1, 0.044 0.024 mg l-1 and7.427 6.344 mg l-1 respectively. The mean chlorophyll-a concentration was 1.889 1.751 µg l-1. The phytoplankton density of the southern coast ranged from 163.65–315640.00 cells l-1. The total of 56 planktonic flora species were reported with 34 diatoms, 20 dinoflagellates, 1 cyanobacteria and 1 silicoflagellate. Diatoms were the most abundant taxonomic group and *Chaetoceros* sp. was the most common during the study. The phytoplankton density, nutrients and chlorophyll-a concentrations showed a significant temporal variation in the southern coast of Sri Lanka during the southwest monsoon though spatial variation was not significant. The southern coastal upwelling may enhance the phytoplankton abundance through increasing the nutrient concentrations of southern coastal water.

Keywords: Chlorophyll-*a*, Southwest monsoon, phytoplankton density, nutrient, Southern coastal upwelling,

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Introduction

Phytoplankton are a group of single celled aquatic flora whose size ranges from 0.001 – 2 mm. The phytoplankton are the basis of the marine food webs as they are photosynthetic micro-organisms and they require enough nutrients such as nitrate, phosphate and silicate for their growth and production. The main patterns of phytoplankton biomass in oceanic systems are related to light, water-column stratification, nutrient availability, and the intensity of the oceanic water mixing. The Chlorophyll-a concentration is one good indicator of primary production (Verlencar and Desai, 2004). Some oceanic areas experience vastly spread phytoplankton blooms as a response to highly favorable environmental conditions. Those planktonic blooms may have a positive or negative effect on the marine environment. In an oceanographic sense the southern coast of Sri Lanka is an important a transitional oceanic passage between Arabian sea and the Bay of Bengal. Coastal upwelling in the southern coast of

Sri Lanka has been studied using ocean colour data, SST and sea surface height derived from various remote sensing methods during the south-west monsoon. However, there are few studies using field data. This study reports the phytoplankton abundance and chlorophyll-*a* concentration in relation to the nutrient variability.

Materials and Methods

Field sampling was carried out at three sites namely Ranna, Matara and Galle off the Southern coast from August to October of 2015. For each site there were three sub sampling stations towards the open ocean at one nautical mile intervals. (Fig.1). A general conical plankton net with a mesh size of 20 μm, was used to collect phytoplankton. Phytoplankton enumerations were done using Sedgwick rafter cell under SETI light Microscope. The phytoplankton were identified at either the genus or species level using plankton identification guides (Verlencar and Desai, 2004; Jayasiri, 2009). Surface water samples were collected at each station for nutrients (nitrate, phosphate and silicate) and chlorophyll-*a* analysis by the methods of Strickland and Parsons, 1965, using an Optizen 3220 UV spectrometer.

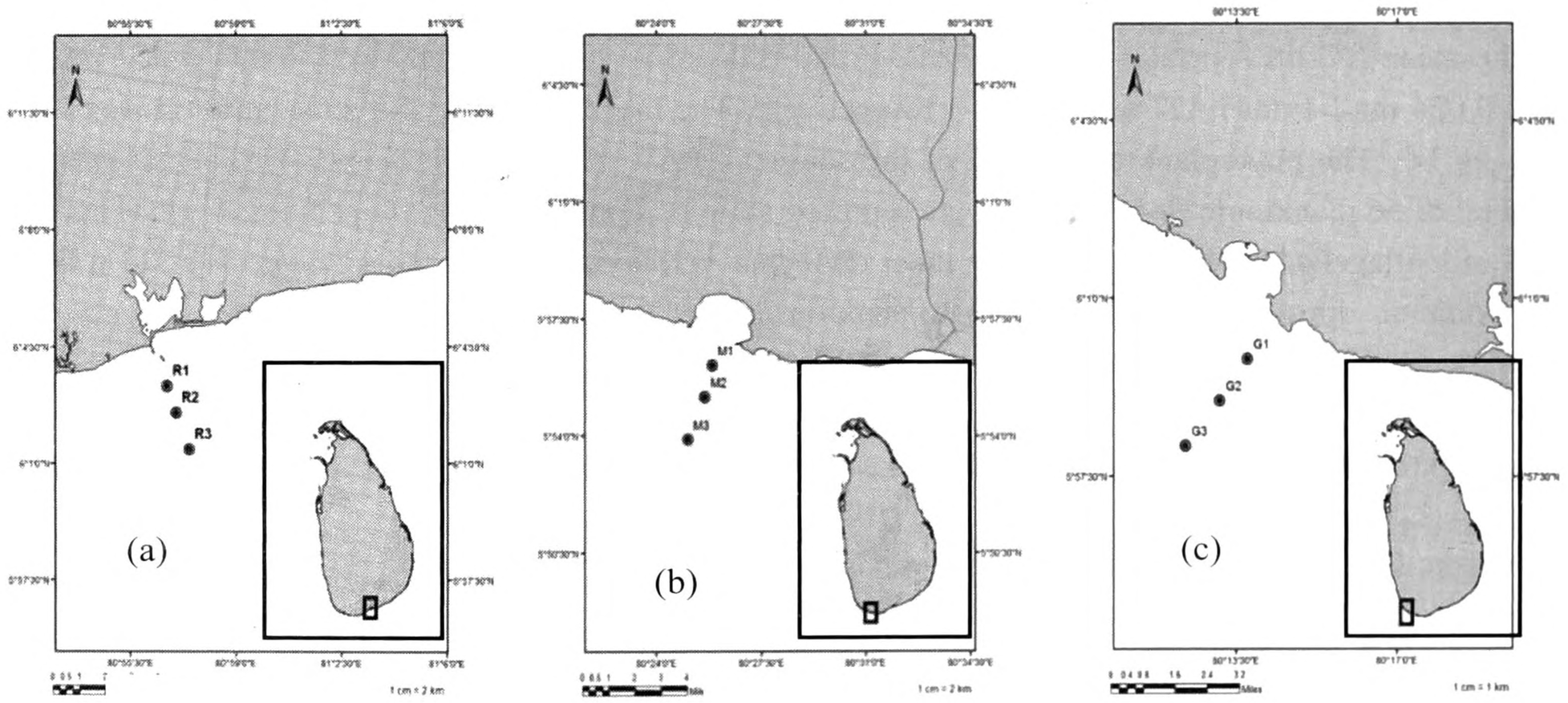
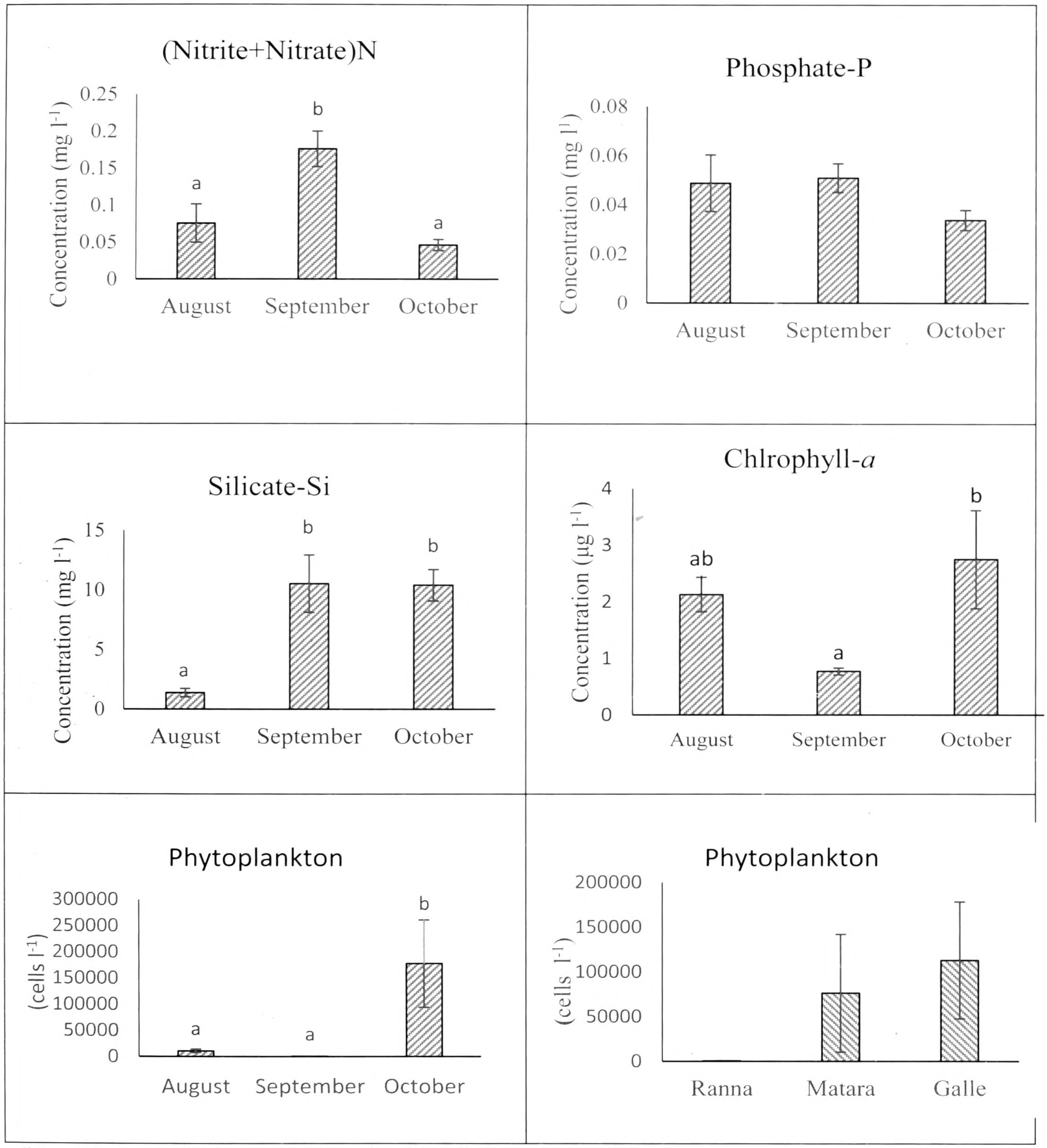


Fig. 1: Maps of the sampling locations (a) Galle, (b) Matara, (c) Ranna

Results and Discussion

The study showed that the mean±SD (Nitrite+Nitrate)-N, Phosphate-P and Silicate-Si concentrations are 0.099 0.083 mg l-1, 0.044 0.024 mgl-1; and 7.427± 6.344 mgl-1 respectively off the southern coast of Sri Lanka during August to October. The mean chlorophyll-a concentration of the southern coastal surface water was 1.889 1.751 μgl-1 and the phytoplankton density of the Southern coast ranged from 163.65–315640.00 cells l-1.Two-way ANOVA reveals that the monthly variation of the (Nitrite + Nitrate)-N, Silicate andchlorophyll-a concentrations were significant between the studied months ($P < 0.05$) but that phosphate did not show a significant difference (Fig. 2).

Fig. 2: Temporal and spatial variations of nutrients and chlorophyll-*a;* Temporal (a) and spatial



(b) variations of phytoplankton density, different lowercase letters on bars represent the significant difference at p = 0.05

The spatial variation was not significant for all the parameters (P>0.05) off the southern coast of Sri Lanka during the southwest monsoon (Fig. 2). Here, very high values of nutrients, chlorophyll-a and phytoplankton densities of this study would be represented the high influx of

nutrients through the rivers or intensive upwelling phenomenon during the southwest monsoon period. Although the lack of significant spatial variation of those observed parameters give some evidences to realize the high influence of upwelling phenomenon rather than the river input for such increments of the parameters.

Several previous studies have shown that there is a wind induced upwelling phenomenon that occurs around the southern coast of Sri Lanka related to the southwest monsoon (Vinayachandran and Yamagata, 1997; Yapa, 2009). The total of 56 planktonic flora that was recorded comprised of 34 diatoms, 20 dinoflagellates, 1 species of cyanobacteria and 1 species of silicoflagellate. Diatoms formed the most dominant group followed by dinoflagellates, cyanobacteria and Chae*toceros* and *Talassiosira* species compositions were relatively higher during the study period. In addition to that the *Melosirra* sp., *Coscinodiscus* sp., *Skeletonema* sp., *Biddhulphia* sp. and *Pseudo-nitzschia* sp. were comparatively abundant in Southern coastal waters. Dinoflagellates were not significant. There was a phytoplankton bloom condition with very higher abundance of cyanobacteria from Matara and Galle area during October. Further, there was no toxic algal blooms during the study.

Conclusion

The present study describes significant temporal variations in phytoplankton density, nutrients and chlorophyll-aconcentrations off the southern coast of Sri Lanka during the Southwest monsoon though spatial variation was not significant. The southern coastal upwelling may enhance the phytoplankton abundance through increasing the nutrient concentrations of southern coastal water. Therefore, it is important to conduct further studies on southern coastal upwelling phenomenon with frequent and continuous sampling.

Acknowledgement

This work was financially supported by University of Ruhuna and SHABASHI project. We thank Niroshani, Supuna and Kalani of NIOMS, NARA for their assistance for sample analysis.

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