Biomass Indices of zooplankton off Southern and North-eastern coasts of Sri Lanka

W. E. K.Wijesinghe[1*], H. B.Jayasiri[2] and U.S.P.K Liyanage[2]

[1]Department of Oceanography and Marine Geology, Faculty of Fisheries and Marine Sciences and Technology, University of Ruhuna, Matara. Sri Lanka

[2] National Institute of Oceanography and Marine Sciences, National Aquatic Resource Research and Development Agency (NARA), Crow Island, Colombo 15,Sri Lanka

Abstract

The secondary production was evaluated using different biomass indices of zooplankton off the southern and north-eastern coasts of Sri Lanka. Two research cruises were conducted, one in April 2015 off the Southern coast and the other in September 2015 off the north-eastern coast for sampling of zooplankton. One-way ANOVA revealed that the zooplankton abundance, ash-free dry weight and bio-volume were significantly higher in north-eastern area than the southern area at p= 0.05. The sub area II had significantly higher biomass indices than that of other three sub areas. It is speculated that the nutrients availability into that area II might be higher than that of other three areas due to the influx from River Mahaweli which favor high secondary production. The abundance, ash-free dry weight and bio-volume of the north-eastern areas were 10 ± 6 cells/l, 24.16 ± 3.55 mg/l and 0.98 ± 0.19 mm^3/l respectively. Similarly, one-way ANOVA was performed for the southern coast study area and found that the zooplankton abundance, biovolume and ash-free dry weight varied significantly among sub areas I, II, III and IV at p= 0.05. The sub area III had significantly higher abundance, bio-volume and ash-free dry weight than that of other areas. As station III is located in off Mirissa Bay the available nutrients into that area may be higher than those of other sub areas. Therefore higher secondary production can be expected from area III. Through measurements of various estimating biomass indices of zooplankton we provide evidence that the secondary production in off north-eastern coastal area was higher than that off the southern coastal area.

Keywords: abundance, bio-volume, biomass, Sri Lanka, zooplankton

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**Corresponding author: hbjayasiri@gmail.com*

Introduction

Phytoplankton synthesize its own food, as they are primary producers and get grazed by zooplankton which are consumed by higher trophic levels. Zooplanktons play a major role in nutrient recycling and transferring the organic matters from primary producers to secondary consumers. In addition, zooplankton biomass can be taken as an index of the fertility of an area. To determine the net-plankton biomass, a number of techniques such as measurements of settled volume, displacement volume, wet weight, dry weight, ash-free dry weight, carbon content have been applied (Nagao *et al.* 2001). Dry weight, ash-free dry weight and carbon are believed to provide more accurate estimation of zooplankton biomass. Bio-volume is the amount of space a species takes up in a given area or volume and provides a link for determining biomass. It can be used to estimate biomass and can also be more useful than density, because bio-volume is an estimate of mass while density is a measure of abundance. Therefore bio-volume provides information on biomass and energetics whereas density

provides only information on abundance. If there is a change in abundance, there are a variety of abiotic and biotic factors that potentially could be responsible for it.

Materials and methods

This study was focused to assess the diversity, abundance, distribution, and biomass of marine zooplankton in two study areas. The sites were selected based on abundance of marine mammals such as whales and dolphins (de Vos, 2009). The two study sites are off north-eastern coast and off southern coast of Sri Lanka. Two research cruises were conducted; the first off the southern coast during 22 - 23 April 2015 and the second during 24-28 September 2015 off North-Eastern coast of Sri Lanka to collect zooplankton samples. The sampling was carried out with a zooplankton net of 80 µm mesh size. The sampling stations were grouped into two areas (North-Eastern coast and Southern coast). The study areas off southern and north-eastern areas were subdivided into four areas (I, II, III, and IV) (Fig. 1). Samples were analyzed for zooplankton abundance, composition and diversity. Zooplankton biomass was determined in terms of dry weight, ash-free dry weight and bio-volume. Zooplankton bio volume was calculated using geometric shapes.

Results and discussion

The present study showed that the zooplankton abundance, ash-free dry weight and bio-volume were significantly higher in North-Eastern area than that of southern area. The mean bio-volume of southern and north-eastern coasts were 0.226 ± 0.0330 mm^3/l and 0.983±0.196 mm^3/l respectively.

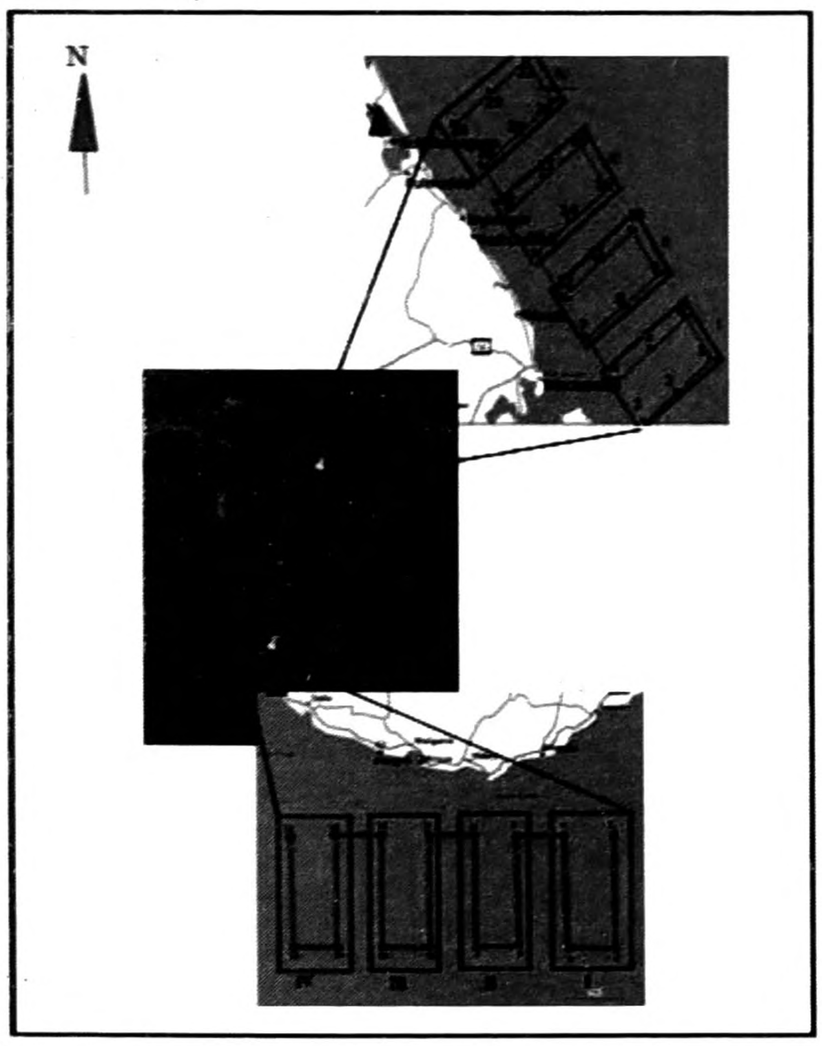

Fig. 1: Map of the study area showing sampling stations

The mean ± SE ash-free dry weights of southern and north-eastern coasts were 2.41 ± 0.50 mg/l and 24.158 ± 3.55 mg/l respectively. The north-eastern coast gets influx from the Mahaweli

Rivera and the Mirissa bay in southern coast gets influx from the Polathumodara River. The nutrient supply may be higher in Mahaweli River than Polathumodara River. The nutrient available for growth of phytoplankton may be higher in north-eastern coast than that of southern coast hence leading to higher zooplankton biomass. Zooplankton composition analysis showed that the copepods are the most abundant zooplankton in both study areas which are food source for organisms in higher trophic level.

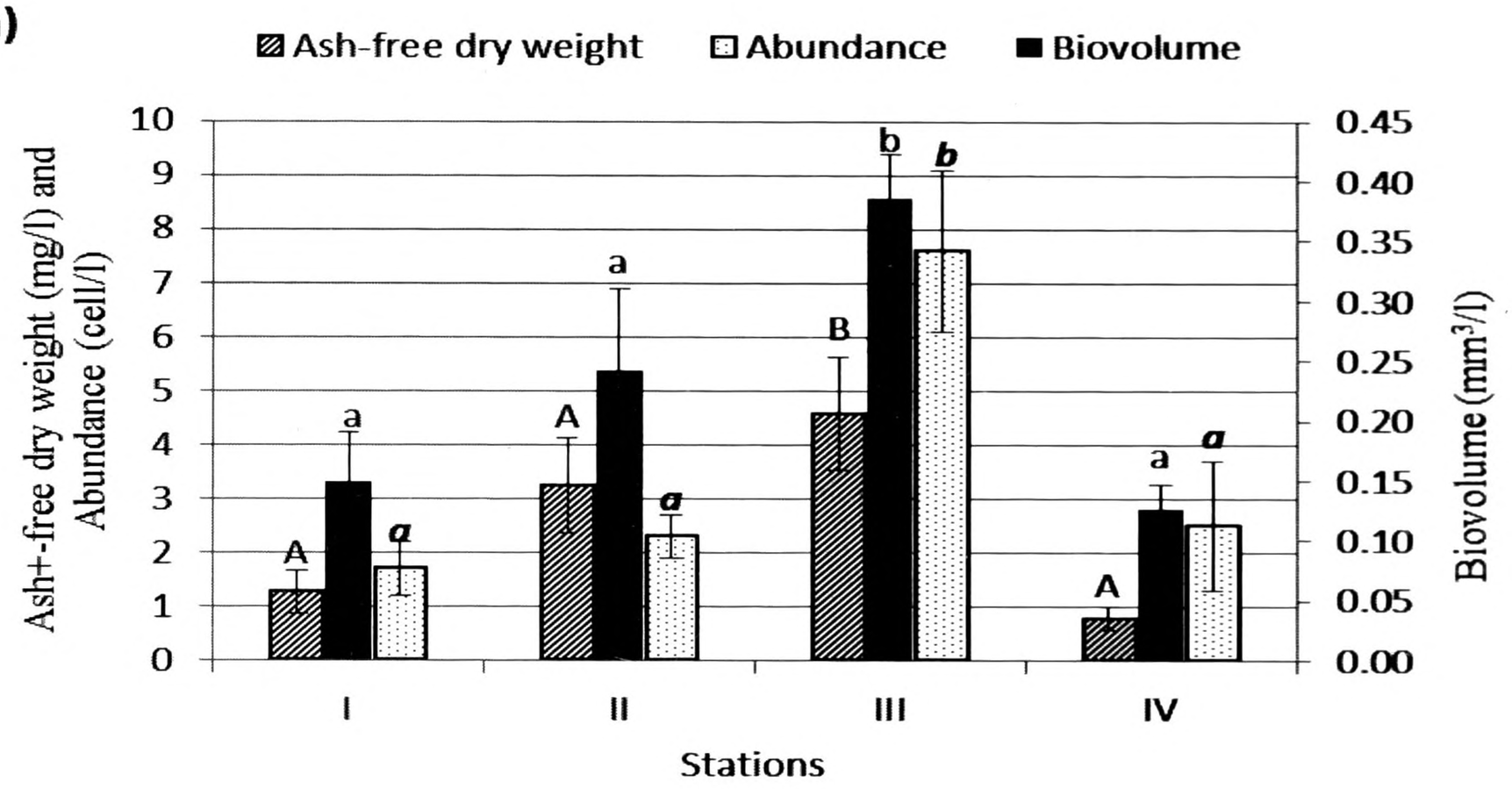

Fig.2: Mean (±SE) ash-free dry weight, bio-volume and abundance a) off southern coast (n = 4), b) North-eastern coast; Uppercase, lowercase and lowercase italic letters on bars represent the significant difference for ash-free dry weight, bio-volume and abundance at p=0.05.

One-way ANOVA was performed for the southern coast study area and found that the zooplankton abundance, biov-olume and ash-free dry weight varied significantly among sub areas I,II, III and IV at p=0.05 (Fig. 2). The sub area III had significantly higher abundance,

bio-volume and ash-free dry weight than that of areas I, II and IV. The maximum mean abundance was recorded at sub area III (7.6±1.5 cells/l) while the minimum mean abundance was in area I (1.7±0.5 cells/l). The maximum mean bio-volume of 0.386±0.037 mm3/l was recorded at sub area III while the minimum mean bio-volume was in sub area IV (0.126±0.021 mm3/l) (Fig. 2). As station III is located off Mirissa Bay, the available nutrients in this area may be higher than that of other stations. Therefore high secondary production can be expected from area III. One-way ANOVA was performed for the eastern coast and found that the zooplankton abundance, biovolume and ash-free dry weight also significantly varied among the four stations. The sub area II had significantly higher abundance, bio-volume and ash-free dry weight than that of other three sub areas. The maximum and minimum mean bio-volumes were recorded at sub area II (2.167±0.541 mm3/l) and IV (0.577±0.089 mm3/l) respectively. The maximum and minimum mean ash-free dry weight was recorded at sub area II (46.7±3.9 mg/l) and IV (11.567±3.34 mg/l) respectively (Fig. 3). The area II is situated in off Trincomalee harbor. Therefore, the available nutrients into that area might be higher than that of other three areas due to the influx from River Mahaweli As the available nutrients is high, the abundance of zooplankton may be higher in that area II than that of others.

Conclusion

Through measurement of various biomass indices of zooplankton we provide evidence that the secondary production off the north-eastern coastal area is greater than off the southern coast and this high secondary production which may favor the trophic transfer of organic matter through the food chain. The information on plankton productivity off the southern and north-eastern coasts may correlate with marine mammal sitting or abundance. Further, the North-Eastern coast is more favorable for capture fishery industry and whales watching.

References

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