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Immediate effect of bottom trawling on nutrients with special reference to nitrite and phosphate in the inshore waters off Kerala

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Abstract

Immediate effect of bottom trawling on nutrient concentration was studied by conducting experimental trawling operations along Cochin –Munambam area (Long. 75° 56'00 to 76°10' 94" and lat. 9°58' to 10°10') (southwest coast of India) at depth ranging from 0-50m during December 2000- November 2001. The highest values of nutrients were obtained during monsoon and lowest in premonsoon. Higher values were recorded at bottom than at surface. Availability of nutrients was perceptibly high immediately after trawling when compared to before it. Highest differences in phosphate concentration were noticed at 0-10m depth zone in December, where the values before and after trawling were 0.56 and 3.96 micromoles/litre respectively. Similar was the case with nitrite, the values were 0.66 and 2.88 micromoles/litre before and after trawling. Significant changes were noticed in samples collected from bottom, 5m and 10 m above bottom before and after trawling while the variations in samples collected from surface were found to be less significant.

Key words: Impact of bottom trawling, change in nutrient availability, phosphate and nitrite

Introduction

Fishing is the most widespread anthropogenic exploitative activity in the marine environment. Bottom trawling is the most destructive method as it upsets the sea benthic ecosystem. Seabed with its immense source of nutrients and minerals plays a major role in the benthic productivity. Among nutrients, which enhance the productivity in sea, nitrogen and phosphorous are the major elements (Qasim, 1977). Southwest coast of India with its rich sources of nutrients and minerals is known as the most productive area in the Arabian Sea (Banse, 1987).

There is a growing concern about the effect of bottom trawling on the marine ecosystem (ICES, 1988). All mobile bottom gears scrape the seabed and inflict heavy damage and disturbance to the bottom structure and organisms. (De Groot, 1972., Jennings and Kaiser, 1998). Studies pointed out that bottom trawling affects the basic nutrient structure (Churchill *et al.*, 1988; Watling and Norse, 1999). The southeastern Arabian Sea is well known for its rich and varied marine living resources, where the trawling, particularly bottom trawling is the most popular fishing method. Barring a preliminary report available on the effect of dredging on seabed at Cochin Harbour by

Thressiamma *et al.* (1998), no authentic information is available on the exact changes taking place on the sea bottom due to trawling. In the above context, the present study attempts to bring out the immediate effect of bottom trawling on nutrients at the sea bottom.

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Material and methods

Experimental trawling was conducted along Cochin –Munambam area (Lat. $9^{0}58'$ to $10^{0}10'$N and Long. 75° 56′00 to 76°10′ 94″E) along the southwest coast of India, at depth ranging from 0-50m during December 2000- November 2001 (Fig.1). The study area was divided into five depth zones viz., 0-10, 10-20, 20-30, 30-40 and 40-50m and two stations from each zone were selected with the help of a GPS, in a linear manner with an approximate distance of 5 km between the stations of the same depth contour. Since commercial bottom trawling is in vogue at all depth zones even in shallow waters less than 5 m in this part, no zone could be treated as control for comparison. Experimental trawling was conducted on a bimonthly basis using a statutory bottom trawl net fabricated following the specifications stipulated by the Govt.of Kerala vide Kerala Marine Fishery Regulation Act (KMFRA, 1980). The gear was further provided with 12 floats, two wooden V-form otter boards of 75kg each and a tickler chain of 60kg on the footrope. Trawling was conducted in daytime for a period of one-hour using a commercial fishing trawler of 45 ft OAL.

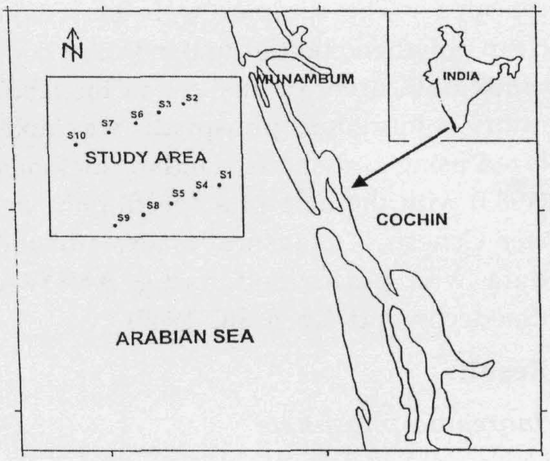

Fig.1. *Location map of the study area*

Water samples were collected both before and after trawling operations from surface, bottom, 5 and 10 m depths off bottom using a horizontal water sampler, with a capacity of 3 litres, supplied by Hydro Bios, Germany. Water samples for nutrient analyses were collected upon reaching the fixed stations. Thenceforth, the vessel was maneuvered back for about 30 minutes and carried out bottom trawling along the same track for one hour. Net was hauled up and the boat was propelled back immediately to the very exact station with the help of GPS within 10 minutes and the entire protocols were repeated. The samples were stored in clean polythene bottles under frozen condition until used for analysis in the laboratory. Inorganic phosphate was analyzed using Grasshoffs standard methods (1983) with the help of a spectrophotometer Genesis 5. Statistical analysis of the data was performed using ANOVA (Snedecor and Cochran, 1967).

Results

Inorganic phosphate

Seasonal variations in phosphate concentrations were very conspicuous registering highest values in monsoon (July). It was low in premonsoon (February and April), moderate during post monsoon (November and December). Highest values of phosphate were recorded at bottom and showed a decrease towards surface. It was very high in the samples collected after trawling when compared to the values recorded before it. Significant variations were noticed in the phosphate concentrations recorded before and after trawling at bottom, 5m and 10m above bottom ($P<0.01$). While at surface waters, significant changes could not be observed ($P>0.01$) though invariably higher concentrations were observed in the samples collected after trawling. Highest variations were noticed at bottom than the other water depths. While comparing different depth zones, highest variations were observed at 0-10m depth in December at the bottom waters where 3.96 micromoles / litre was recorded after trawling against 0.56 micromoles / litre registered in samples collected before operation (Fig.2).

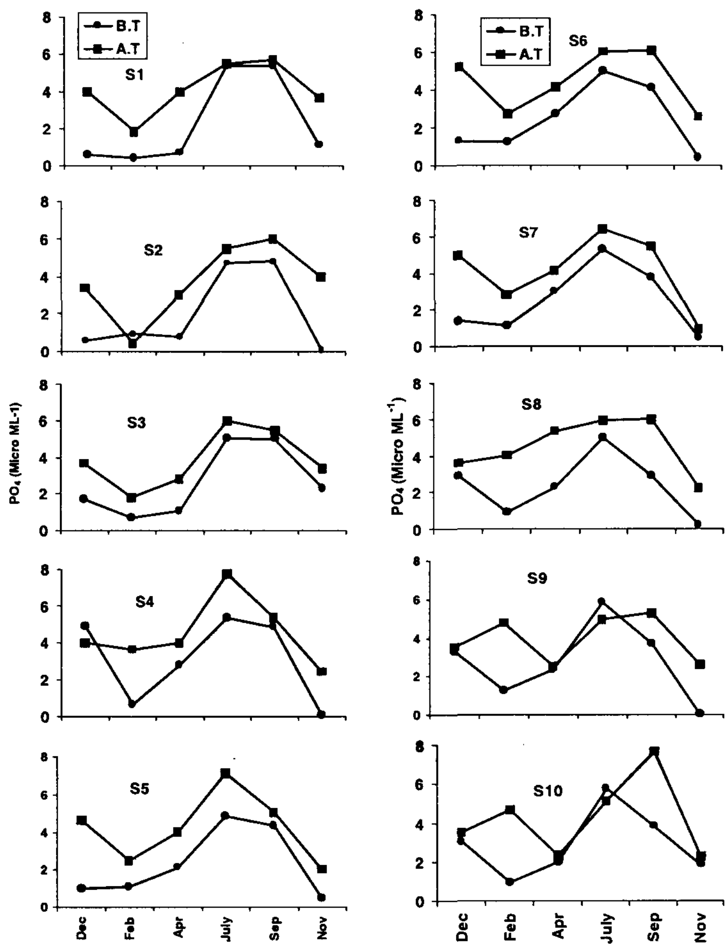

Fig.2.*Variations of inorganic phopshate at bottom waters before (B.T) and after trawling (A.T) during December 2000-November 2001*

Nitrite nitrogen

Seasonal changes in nitrite nitrogen were very prominent showing similarity to that of phosphate. Higher values were found during monsoon months and low during premonsoon in almost all stations. However, the nitrite nitrogen values were low when compared to phosphate. As in the case of phosphate, the nitrite nitrogen also showed an increasing trend towards the bottom from the surface. Wide variations were also noticed in the nitrite concentrations after trawling when compared to that of samples collected before it. Similarly highest variations were registered at bottom waters when compared to other depths where nitrite showed an average two fold increase in the samples collected after trawling, ranging between 0.8micromoles /litre in April to 4.2 micromoles/litre in July (Fig.3). While comparing different depth zones, maximum variation was noticed at Station 10 (40-50 m depth) in December with 2.3 micromoles/litre recorded after trawling against 0.59 micromoles/litre before its operation. Significant variations were also noticed at bottom, 5 and 10 meter above bottom ($P<0.01$) when compared the nitrite concentrations registered before and after trawling. The variations in samples collected from the surface waters were found to be less significant.

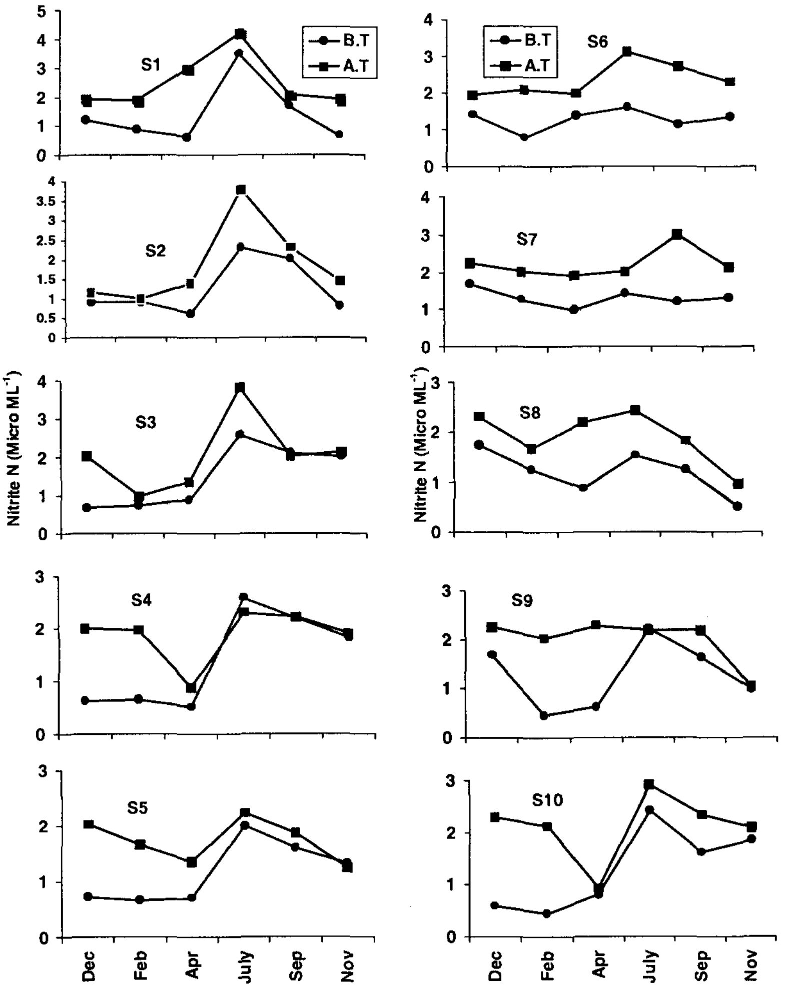

Fig.3.*Variations of Nitrite nitrogen at bottom before and after trawling during December 2000-November 2001. (B.T= Before trawling, A.T.= After trawling)*

Discussion

The pattern in the distribution of inorganic phosphate and nitrite nitrogen observed is in full agreement with the results obtained in the previous studies conducted in the Cochin waters (De Sousa *et al.*, 1996, Damodaran, 1973). High nutrients obtained in monsoon months may be due to the high influx of nutrient rich land run-off and upwelling as reported by Banse (1959). Rittenberg *et al.* (1955) who opined that in marine condition, the major source of nutrients is run-off from land area. High phosphate and nitrite concentrations observed in the near shore depths in the present study also agreed with their observations. In the present study, the high nutrients observed during monsoon months in general and at near shore depths in particular revealed that monsoon greatly influenced the distribution of nutrients in the coastal waters.

Inorganic phosphate and nitrite nitrogen recorded immediately after trawling was glaringly high and low before it. This may be due to the release of nutrients trapped in the bottom soil. During dragging, the churning action of otter boards and the heavy trawl net stirs up the bottom sediments which rise in the water column along with nutrients and minerals (De Groot, 1984; Caddy, 1973). Bottom trawling and dredging has marked impacts on the substratum. The physical disturbance due to the direct contact with the fishing gear leads to the turbulent resuspension of surface sediments (Jennings and Kaiser, 1998). Gislason (1995) stated that the bottom trawling cause physical disturbance and resuspension of sediments as well as increase the exchange of nutrients and pollutants between the sediment and the water column. The high concentration of nutrients observed in the present study, immediately after trawling can be explained due to the reasons cited above. Thressiama *et al.* (1998) observed an increasing trend in nutrients at bottom waters due to dredging at Cochin Harbour and this is in good agreement with the present findings. The high nutrients released into the water column in a way could be considered as a positive effect of trawling. The process may increase the productivity of the water. But the negative effect of trawling is more chronic as it releases lethal gases like ammonia and hydrogen sulphides, which inflict heavy damage to multitudes of living organisms in the sea bed (Riemann and Hoffman, 1991). Messiah *et al.* (1991) opined the possible effect of a sudden release of nutrients or contaminants from sediments due to trawling. The heavy turbid clouds arising during the bottom trawling may reduce the transparency of the water which hinder the penetrations of light into the water and in turn, results in the low production at the surface waters as reported by Newcombe and Mac Donald (1991). The increase in turbidity and consequent decrease in the oxygen content in the marine waters due to the bottom trawling has been proved to be lethal to the existence of the living communities. This affects the growth and development of eggs, larvae and young ones on account of the severe sudden alterations of the marine milieu (Watling and Norse, 1999). Studies along the southwest coast of India revealed that the bulk of the pelagic fish populations comprising of oil sardine, mackerel and whitebait avoided temporarily areas of intense upwelling activity because of low oxygen concentration (Pillai, 1993). So it can well be inferred from this study that the incessant operation of bottom trawlers in the coastal waters of Kerala may severely affect the marine environment leading to drastic consequences in the ecosystem.

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