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Status of Andaman Sea Ecology: Past, Present and Future

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ABSTRACT

In recent years, marine resources have become increasingly interesting, as they are rightly predicted to be a major source of food, reservoir of minerals, major suppliers of oxygen, regulator of climate and also ultimate dumping ground for the mounting burden of human waste material.

Due to unchecked human activity in recent years, physico-chemical as well biological status of these marine environments have changed significantly, which in turn resulted in the changing environmental scenario of the world.

The Andaman Sea is known to be a part of Bay of Bengal. This Bay is one of the largest Bay in the world and is known to receive large flow of sediments from several rivers and other water bodies from India, Bhutan, Bangladesh, Myanmar, Indonesia etc. Many of these rivers bring along with them, a large quantity of efluents from cities/town located on either side of these rivers, thus making the Bay nutrient rich. This Bay also plays a major role in determining the climatic conditions of India and other South East Asian countries. Thus, its ecology is of paramount interest.

Apart from the above, the Bay is also known for its oligotrophic nature as well low productivity, thus resulting in high diversity of flora and fauna. As the ecological status of the Bay has a direct bearing on lifescape of the Bay, a study was undertaken to understand the ecological status of the Bay.

In addition to the above, it is also known that there are certain member of zooplankton species, which are known to act as bioindicators, indicating the quality of water in environment. Thus, an attempt has also been made in the present studies to understand such bioindicators, which will throw light on the status of abiotic factors of the Bay.

Based on the observations, the study recommends certain appropriate measures to be taken to conserve the ecology of one of the largest Bay in the world.

Key words: Ecology, Andaman sea, zooplankton.

Introduction

Though, 71 per cent of the surface of our planet is covered with marine waters, whose average depth is 3.8 km and volume is about 1370 x 10^6 Km^3 and innumerable number of species of organism live in it since millions of year, only during recent years, it has attracted the attention of the world as a promising major source of food, reservoir of minerals, major supplier of oxygen, regulator of climate and ultimate dumping ground, for the mounting burden of human waste material, for years to come. It is also known that, 32 of 33 animal phyla exist, in sea. It is also said 173 animal classes live in sea, 35 in fresh water and 33 on land (Nicoll, 1971) for which, possible reasons are listed by May (1994). While, Grassie *et al.*, (1991) have reported that 13 out of 28 phyla found in marine environment are endemic to marine environment, and only one out of 11 phyla is endemic to terrestrial ecosystem. Thus, highlighting the importance of marine environment with regard to life scape. Thus, making it a single largest repository of organisms, where the water is the substance that surrounds all marine organisms and it composes the bulk of the bodies of the marine plant and animals, and is also the medium in which various chemical reactions takes place, both inside and outside living organism (Nybakken, 1997).

In general, sea water consist of an average of 35 g/1000 ml of dissolved compounds collectively called as salts or practival salinity units (psu) which include Cl^-(55.04%), Na^+(30.61%), SO_4^{2-} (7.68%), Mg^{2+}(3.69%), Ca^{2+}(1.16), K^+(1.10%) as major constituents and HCO_3^-(0.41%), Br (0.19%), H_3BO_3 (0.07%) and St^{2+} (0.04%) apart from 0.01 per cent of dissolved substances of several inorganic salts needed for living of the organisms in sea.

It is also known that some of the organisms like diatoms and radiolarians show their existence in a place where there is availability of silicon dioxide, which is needed for them to construct their skeleton. Thus, acting as bioindicator. Similarly in contrast to most ions, NO^{3-} (nitrates), and PO^{4-} (phosphates) do not exist in constant ratio with other elements or ions, and tend to be in short supply in surface waters. Thus, such a kind of varying in abundance will result in biological activity as many a times become a limiting factor mainly for plant production. While, the other elements such as Fe, Mn, Ca, Cu though may exist in trace amounts, but can very well act as limiting factor for sustainance of life (Martin, 1994). Among gases, O_2 and CO_2 dissolved in sea water has metabolic importance. Their solubility also varies and depends on temperature of the water, because, cold waters will have high solubility, hence O_2 is more in cold waters.

Unlike in the places like Arctic sea, temperate northern Pacific, which show summer bloom and temperate north Atlantic sea which exhibit spring bloom (Parsons *et al.*, 1984), as tropical seas show thermal stratification, their productivity and biomass in general and zooplankton in particular is some what constant.

Further, there is a new wide spread recognition that chemical monitoring is not enough and that pollution is essentially biological phenomenon because of its impact is on the living organisms (Wright *et al.*, 1994), and the need for biological methods has been accepted (Newman *et. al.*, 1992., Rosenberg and Resh, 1993). At community level too, use of biological approach is already well established and accepted (Cairns and Pratt, 1993). Further, the advantage of using these bioindicators has been listed and discussed by Rosenberg and Resh (1993).

It is known that three can be three major categories of environmental stress viz., natural, imposed and environmental manipulation (mainly by anthropogenic activities) and will be reflected in the biotic system. Pollutants effect at various levels like at cellular/molecular level, they may interfere with hormonal system and may responsible for production of more of male steroids in females.

They may also have their effect on development of reproductive system leading to induction of sterility or even death of females (consequent upon which, the population size diminishes). While, at the population level, they reduce the number of a particular species drastically and at a later stage may show the impact on community too. To look into all these aspects even software packages have been developed to predict and classify the system (Wright *et al.*, 1994).

McAllister *et al.* (1994), while analysing global distribution of coral reef fishes have reported that in Indian subcontinent, Laccadive-Maldives-Chagos and Sri Lankan region have high diversity and have also reported that sampling is weak in western Sumartra i.e., Eastern Andaman sea in particular and Andaman sea in general.

Keeping in view of the above, to fill the lacunae of knowledge ecology of Andaman Sea, an attempt has been made to contrast the past ecological status of Andaman Sea with that of present and fore see the future of the same in the light of available literature.

Material and Methods

During the Department of Ocean Development (DOD) (Government of India), and National Institute of Oceanography (NIO) organised multidisciplinary cruise SK-118, on ORV Sagar Kanya, which had a predetermined area of operation as Andaman Sea, 18 stations, covering entire Andaman groups of Islands, both near shore and off shore were selected for the present studies (Fig. 21.1)

At every station, conductivity-temperature-depth (CTD) profile system with rosette samplers was lowered to 30m depth and apart from recording the relevant data the water samples were collected from that depth by triggering the sample bottles from control panel on deck, Bethythermography, thermosalinograph were also run at all the stations to record the parameters. The water thus collected was analysed for various physico-chemical parameters such as temperature, pH, oxygen contents, salinity, chlorides, sodium, sulphates, magnesium, calcium, potassium, bicarbonates, bromide, boric acid, strontium etc., by following standard analyses methods. Results obtained for three samples each, at every station was pooled.

Simultaneously, at every station, sampling for zooplankton was also done by both vertical (30 m to surface) and horizontal hauls (on water surface) by using bongo net (dia, 0.6 m, length 2.5 m, mesh width 300 μm). A pre-caliberated flow meter (T.S. Flow meter no. 4512), was also attached to the net mouth, to calculate the actual quantity of water filtered during the operation. Thus, collected samples were brought to the deck and later isolated and separated in the laboratory on board of the vessel. Later, the samples were preserved in 4 per cent formalin and were brought to land laboratory for taxonomic identification and classification by following available literature (Kasturirangan, 1963, Mori 1964, Daniel, 1985, Zheng Zong, 1989, Santanam and Srinivasan, 1994).

Results

Figure 21.1 provides information on the stations, where the sampling was undertaken. It can be seen from the figure, that both near shore and off-shore samplings was done to have a more reliable picture about the Andaman sea.

Table 21.1 provides information on physico-chemical parameters of Andaman sea. The data obtained do not differ much with results obtained elsewhere by working at other marine environment (Nybakken, 1997).

Table 21.2 exhibits the data on number of species observed/collected in each from the present survey at the Andaman sea.

The various data obtained on biotic and abiotic factors thereby were compared with that of available earlier reports (Anonymous, 1981, Madhupratap, 1981, Vijayalaxmi, 1981) and the possibility of making the use of modern tools such as ANPP (Anal Net Primary Productivity), AVRIS (Air borne visible Infra-Red Imaging Spectrometer), BIOCLIM (Biological Climate analyses and prediction system), ERIN (Environmental Resources Information Net work, GEMS (Global Environmental Monitoring System), GRID (Global Resource Information Database), HRV/MLA (High Resolution Visible Multispectral Linear Array), MSCP (Multiple Species Conservation Plan), MSS (Multiple Spectral Scanner), RAP (Rapid Assessment Procedures) etc., to have a constant monitoring of the ecology of this sea.

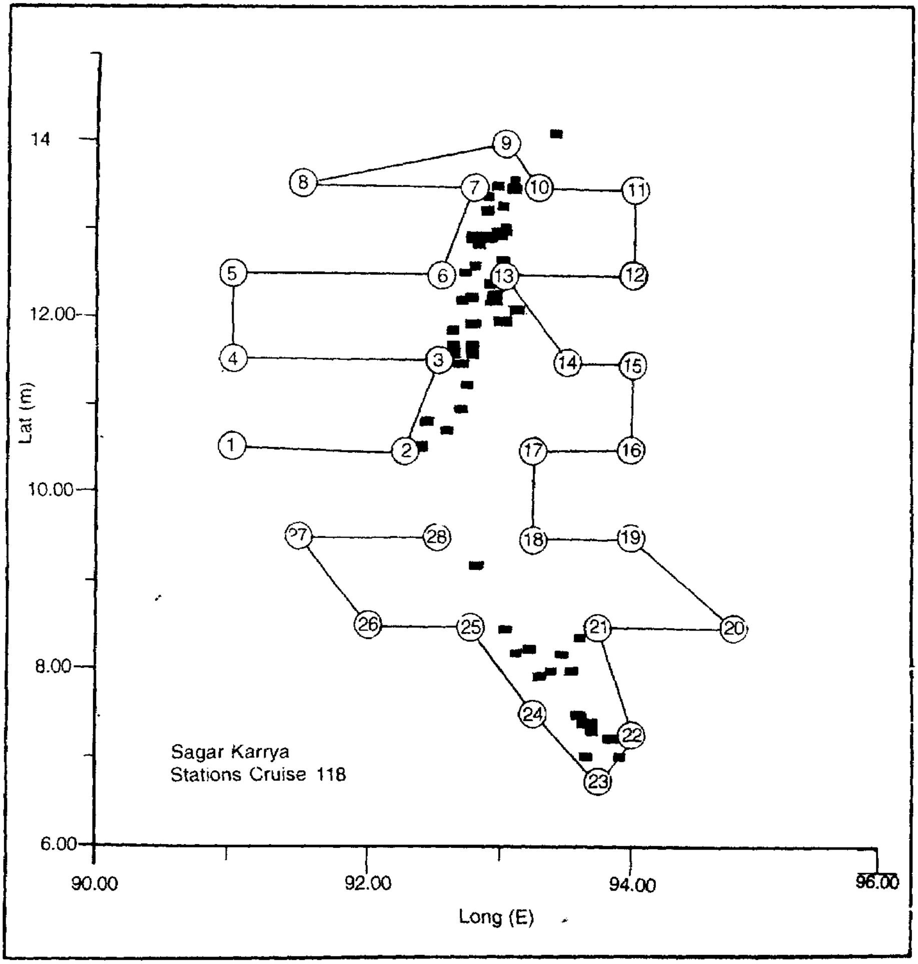

Fig. 21.1: Cruise Track for SK118 in Andaman Sea.

Table 21.1: Physico-chemical Parameters of Andaman Sea

Temperature	2.0 ± 50C	Magnecium (Mg^{2+})	3.66 ± 0.1%
pH	7.9 ± 0.4	Calcium (Ca^{2+})	1.15 ± 0.03%
Oxygen	5.1 10.6ml/lit.	Potassium (K^{+})	1.16 ± 0.02%
Salinity	34.3 ± 0.7 psu	Bicarbonate	0.46 ± 0.002%
Chlorides (Cl)	55.09 ± 1.3%	Bromide (Br)	0.21 ± 0.001%
Sodium (Na+)	30.11 ± 0.6 %	Boric acid (H_3BO_3)	0.08 ± 0.0003%
Sulphate (8042)	7.70 ± 0.2%	Strontium	0.03 ± 0.0002%

Table 21.2: Number of Zooplankton Species Observed in Andaman Sea

Taxonomic Group		*Number of species observed*
Protozoa	Foraminifera	16
	Radiolaria	06
	Tintinnida	
Coelenterata	Hydrozoa	15
	Schyphozoa	21
	Ctenophora	14
Nemertinia	Enopla	06
Annelida		26
Chaetognatha	Errentia	18
Arthropoda	Cladocera	06
	Ostracoda	19
	Calanoida	120
	Cyclopoida	27
	Herpecticoida	09
	Monstrilloida	13
	Mysidae	19
	Hyperildea	12
	Gemmaridea	19
	Euphausiacea	22
	Decapoda	17
Mollusca	Heteropoda	03
	Pteropoda	12
Chordata	Prochordata	11
	Appendicularia	13
	Thallacea	05

Discussion

It is well known that, quality of an ecosystem can be assessed by analysing its components namely abiotic and biotic ones. In a marine environment it is not only oxygen, salinity and chlorides are important yard sticks as major components, but even minor components such as calcium, strontium, pottasium, bicarbonate, bromide also would hold a key to the success of flora and fauna of the area as limiting factors (Nybakken, 1997). In the present studies, the results (Table 21.1) indicate that physico-chemical parameters analysed are all cn per with other ideal, unpolluted marine ecosystems. Further, the comparison of the present data with the earlier results obtained by earlier workers does not show significant variation. Thus, indicate the Andaman sea has not changed significantly as well not polluted so far.

Bioindicators at lower levels of organisation correlates more directly with environmental levels of known stress than those at the higher level. Many organisms have been used as bioindicators, apart from being used as sources of bioindicator molecules such as metallothioneins (Langston & Zhou, 1986) providers of cellular indices (Moore *et al.*, 1982, Moore, 1991) or at individual level (Widdows *et al.*, 1980).

Using of gastropods, branacles in general, *Mytilus edulis* in particular as bio-indicator is in vogue since 1939 (Moore and Kitching, 1939, Southward and Crisp, 1954, 1956), Dogwelks *Nucelia lapillus* and *Nassarius obselata* are helpful in analysing Tributyline indused pollution (Hawkins *et al.*, 1994), mussel egg has been identified as an indicator of mutagen (Dixon and Pascoe, 1994). *Patella vulgata, P. dispersa, Monodonta lineata, Littorina* spp. etc., are some of the well known bio-indicators of oil spill and red tides (Southward and Southward, 1978). Further, Southward (1984) indicated the role of *Sagitta setosa* and *S. elegans* as bio-indicators particularly for phosphates.

As can be seen from Table 21.2, a rich fauna of zooplankton in general and bioindicator species such as chaetognaths and other molluscs are present in abundance in Andaman sea. It can be judged that biotic factors also functioning perfectly well in this sea. It is quite understandable that, when zooplankton are present in abundance, there must be sufficient phytoplanktons to feed on and inturn there must also be sufficient secondary consumers, like fish and other higher organisms, which feeds on these zooplankton, thus completing a marine food chain systematically. This shows that at Andaman sea the ecosystem is a mature, complete, self regulating and self sustaining one.

Although the fact remains that a large number of rivers from adjoining countries bring in large run-offs along with pollutants to Bay of Bengal, the reasons for not recording noticeable pollution in this area may be due to the distance from shore to this Andaman Sea area. It may also be due to degradation of most of the pollutant before they reach this area from coasts of Myanmar, India, Bhutan, Bangladesh, Indonesia etc. It can also be suspected that due to sinking of most of the heavy pollutants to the bottom of the sea, from where they cannot disperse further due to almost stagnant conditions of water. Apart from the above, one more plausible reason is that the countries surrounding the Andaman sea have become industrialised at relatively recent period, and the quantity of effluents released is not so much so that it could pollute Andaman sea, which is quite far from the coasts of these countries.

However, as the Andaman sea environment is also prone to pollution at the rate at which the coastal areas are becoming industrialised, one has to have a close, regular and careful monitoring of the ecology of Andaman sea. It could be done by using modern techniques such as ANPP, AVIRIS, BIOCLIM, ERIN, GEMS, GRID, HRV/MLA, MSCP, MSS, RAP etc., apart from regular survey, sampling for biological organism as well for physico, chemical parameters to see that this prestine environment remains unpolluted for years to come.

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