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ON SOME pH MEASUREMENTS IN THE ARABIAN SEA ALONG THE WEST COAST OF INDIA*

By D. S. RAO AND N. MADHAVAN

Central Marine Fisheries Research Sub-station, Ernakulam-6

INTRODUCTION

pH measurements of the waters of an oceanic environment are important both for the Physical Oceanographer and the Marine Biologist. Whereas variations in the pH values in a vertical plane give an idea of the vertical mixing produced, and thus an idea of the stratification, they also provide a clue as to the extent of the photosynthetic zone (euphotic zone) where phytoplankton can thrive and conduct photosynthesis. Again close relationship exists between the pattern of distribution of pH and that of dissolved oxygen content, and the thermal discontinuity in the vertical is also related to the pH distribution in the vertical. Hence an attempt has been made to study the variation of pH with the available data collected on board R. V. *VARUNA*.

DATA AND METHODS

The data pertaining to this paper were collected during the oceanographic cruises on board R. V. *VARUNA* during January and April 1962. Four hydrographic sections have been selected as follows. (1) Off Quilon, (2) In the region near Cochin, (3) Off Calicut and (4) Off Karwar. The pH values at all stations were determined using a Radiometer, Copenhagen—pH meter—22 (conductivity type) kept on board R. V. *VARUNA*, immediately after the collection of the samples. The distribution of the pH is given in Figures 1 to 4. For the sake of clearer understanding of the character of the pH field, the thermal and the oxygen distributions are also presented along the pH charts.

DISCUSSIONS

It is worthwhile to recollect the hydrographic conditions existing in these regions when discussing the pH. January being the late winter period sinking would have almost subsided and there is clear indication of a stable stratification. The thermal discontinuity starts only at about 100 m. or so. In the convection layer off Quilon where mostly isothermal features exist, the pH shows a maximum (Fig. 1). It is again the region where maximum oxygen content is also encountered with. These high pH values are associated with the photosynthetic removal of carbon dioxide by algal plankton (Atkins, 1925). Moreover the extent of zone of maximum pH (maximum photosynthesis) is seen to decrease in a vertical plane

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when approaching the coast. The shallow depths and the turbidity associated with it can be attributed as a probable cause. Where there is a strong thermal

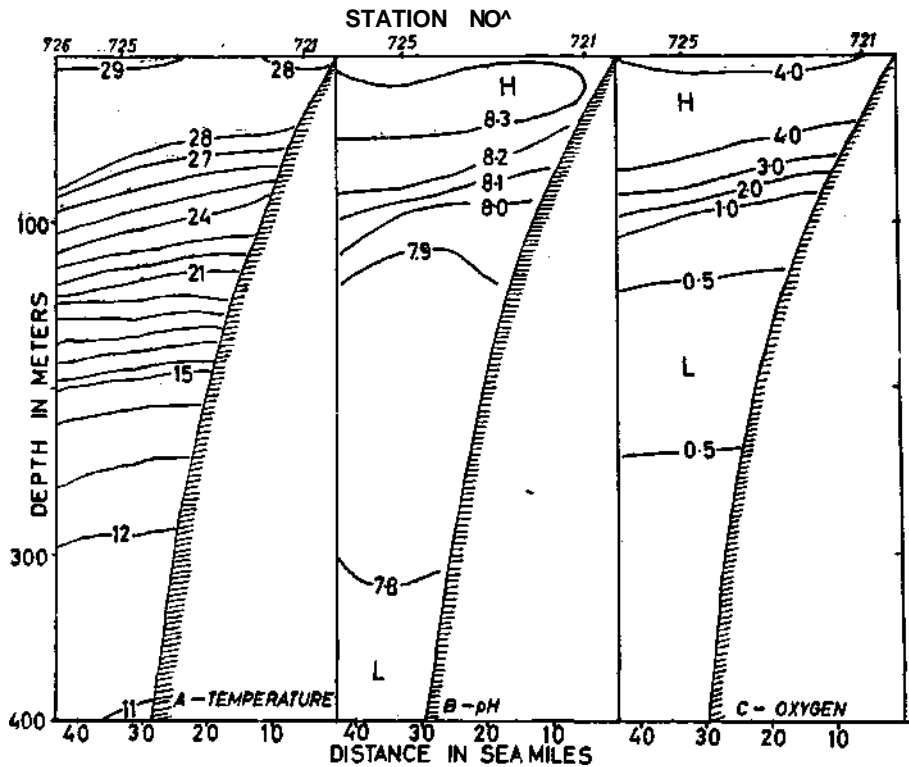


Fig. 1. Distribution of temperature, pH, and dissolved oxygen content in a vertical plane off Quilon.

and oxygen discontinuity the pH also shows a remarkable downward gradient. Although the values vary only by 0.1 or so, when the actual H^+ —ion and OH^- -ion concentrations are computed, the intensity of the markable change in alkalinity can be more clearly grasped.

More or less similar features prevail off Cochin and Calicut, (Figs. 2 & 3). In general, there does not seem to be a marked relationship between the pH content and variations in salinity. The thermocline in all cases marks a transition zone in pH. This pertains to the disphotic zone where solar radiation is not so effective. Moreover the refraction and scattering taking place within the continuously changing density field within the thermocline, decrease the light intensity very much. In most cases the minimum value of pH is noted within the Aphotic zone which mostly coincides with the intense oxygen minimum layer. The minimum value noted in regard to all the sections is 7.72. Off Karwar also during summer, similar trends in the distribution of pH is maintained.

In this connection, it would be worthwhile to consider the features that would prevail in the monsoon and immediate post-monsoon periods along this coast. It has been found by earlier workers (Ramamirtham *et al*, 1961) that during these

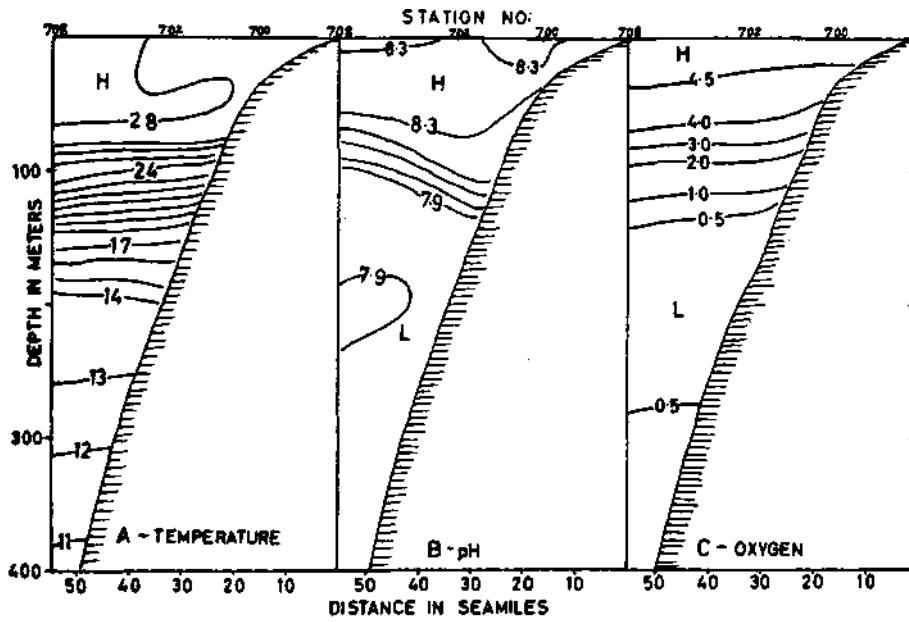


Fig. 2. Distribution of temperature, pH, and dissolved oxygen content in a vertical plane off Cochin.

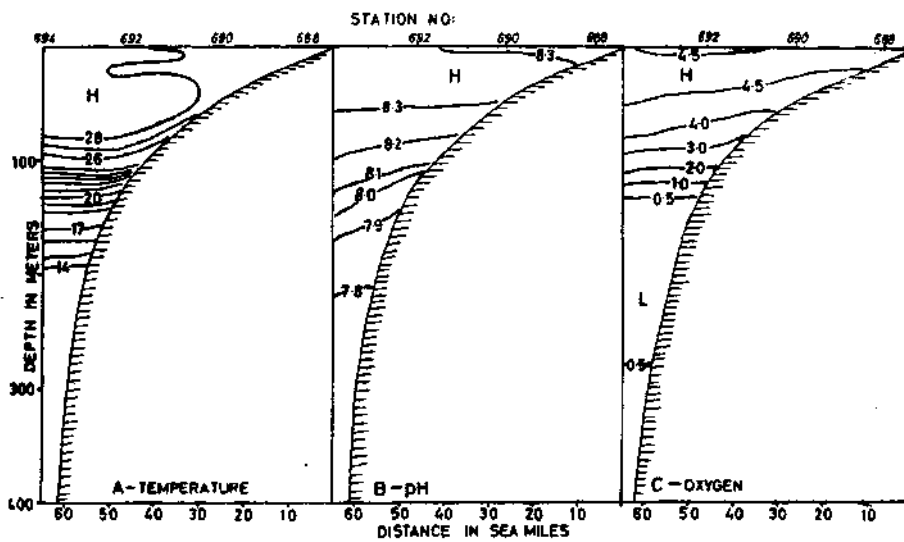


Fig. 3. Distribution of temperature, pH, and dissolved oxygen content in a vertical plane off Calicut.

seasons upwelling brings the deeper waters into the shelf and the thermocline as a whole is lifted up. This refers to more and more acidic waters intruding the shelf pod a preliminary conclusion can be that these low pH values are not at all favour-

able for the shelf fishery along this coast. Fishes in general are able to detect slight changes in pH values of the environment and the active migratory fishes like sardine and mackerel are more efficient in this respect. Workers in other countries have actually proposed an optimum pH range for particular types of fishes. Furthermore, from a physical viewpoint it can be noted that during January and

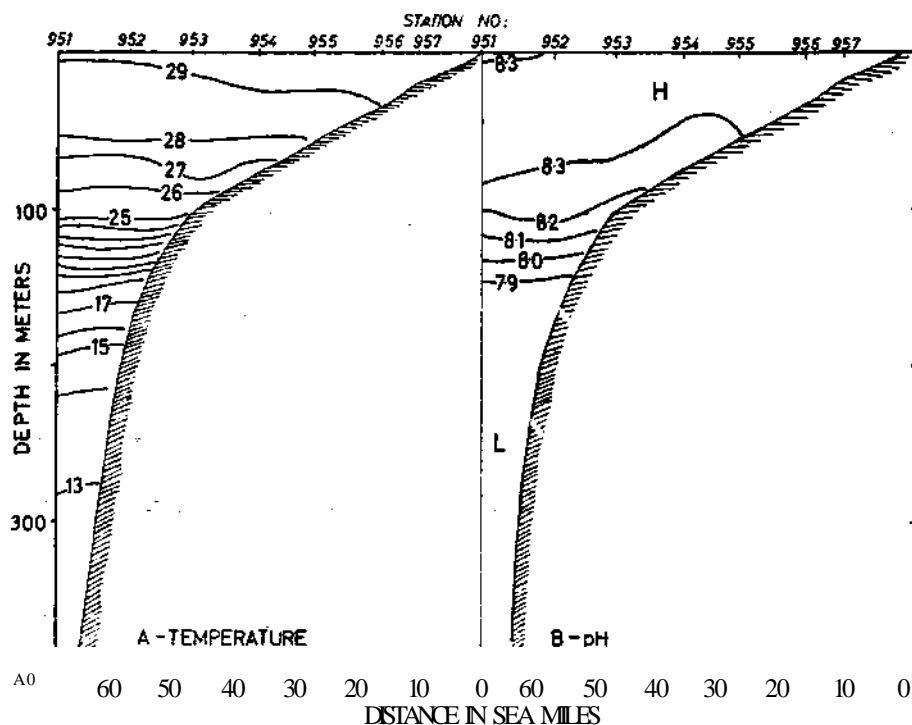


Fig. 4. Distribution of temperature and pH in a vertical plane off Karwar.

April the vertical mixing between the thermocline and the upper layers have been inhibited to a great extent, and the pH values in the upper layers are not found to decrease due to mixing with the deeper less alkaline waters. Stable stratification can be inferred. More or less uniform values are encountered within the convection layer above the thermocline.

SUMMARY

pH measurements were made in four sections along the west coast and the distribution of pH in a vertical plane in these sections is presented and discussed. It is found that higher pH values are associated with higher temperature and high oxygen content. The pH discontinuity in a vertical plane in all cases coincided with the discontinuity in temperature and dissolved oxygen content. In the mixed layer above the thermocline the distribution of pH was mostly uniform. The oxygen minimal column below the thermocline was found to be a region where pH is also very low. These peculiarities in the distribution are mostly attributed to the amount of photosynthesis by phytoplankton and the consequent assimilation of

carbon dioxide. From a physical standpoint clues as to the extent of vertical mixing inferred from temperature structure are mostly confirmed by pH distribution.

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