

SHORT TERM VARIATIONS IN THE ENVIRONMENTAL CONDITIONS
OF THE COLA BAY, VELSAO-GOA

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ABSTRACT

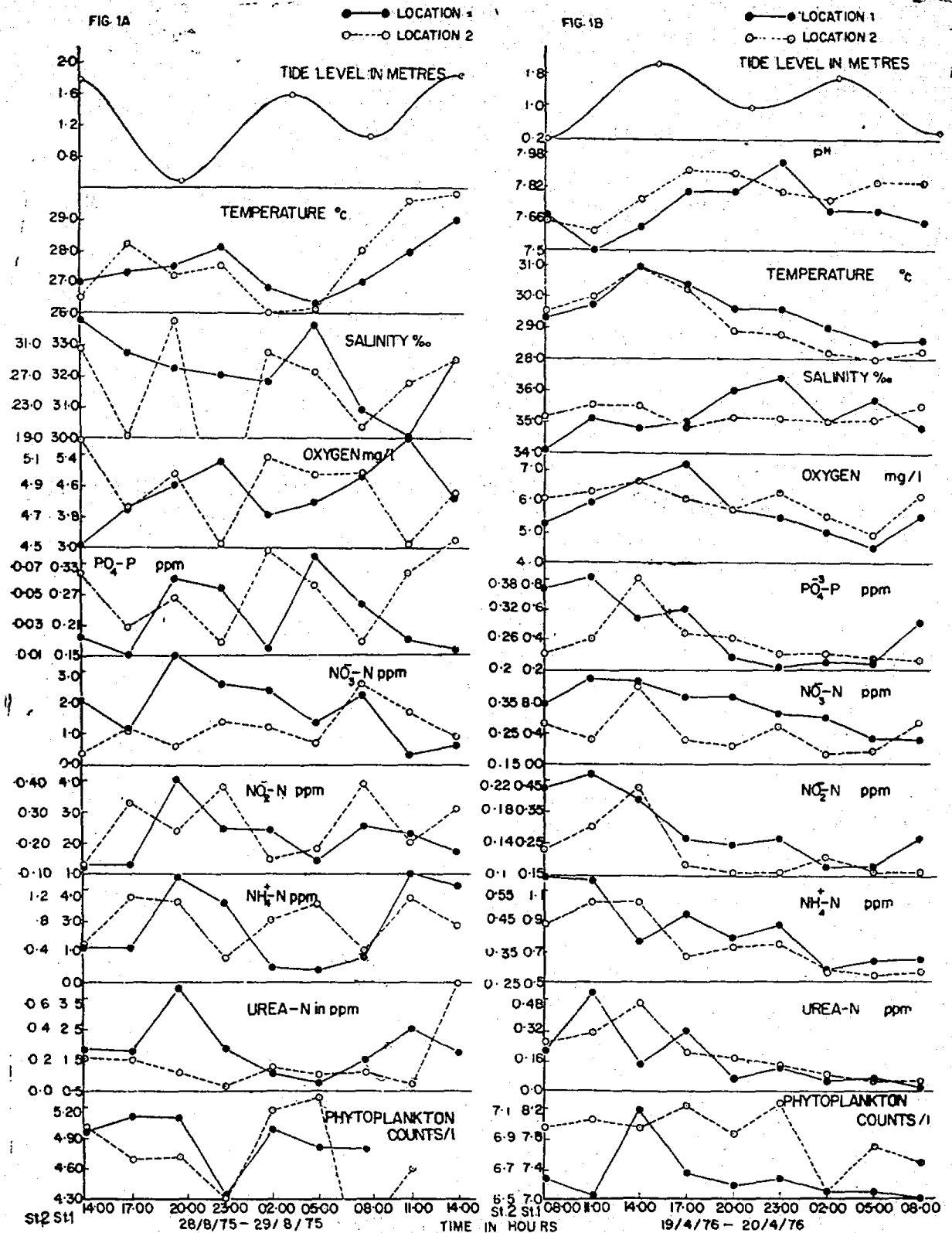
Variations in the environmental conditions during the two periods in the Cola Bay (Velsao) showed that these variations were largely due to the discharge of waste from a fertilizer factory. The concentration of nitrogen and phosphorus was found to be high and independent of tidal variation. Dispersion capacity of the effluents was good but the phytoplankton counts showed a continuous eutrophication effect.

Disposal of nutrient rich effluents from a fertilizer factory at Cola Bay has resulted in eutrophication of water in the Velsao Bay (Verlencar and D'Silva, 1977). Studies on surveillance were, therefore, conducted earlier so that the problem of eutrophication and its consequences could be determined (Singbal, Fondekar and Reddy, 1976; Verlencar and D'Silva, 1977).

In the present study, diurnal variation in the physico-chemical and biological parameters in the Cola Bay at two different periods of the year: 28-29 August 1975 and 19-20 April 1976 were undertaken to determine the rate of discharge of pollutants and their dissipation or mixing capacity in the sea.

Two locations were fixed in the Cola Bay. Location 1 (Long. 73°51', Lat 15°21') was at the discharge point of the effluents and location 2 was at a distance of about 500 m away from the former. Samples were collected at 3 hourly intervals covering the entire tidal cycle. Tide and time mentioned in Figs. 1A & 1B are according to the Indian Tide Table. Temperature, salinity, oxygen, pH, nutrients and phytoplankton counts of the water samples were determined according to the methods described elsewhere (Verlencar and D'Silva, 1977). Figs. 1A & 1B show the variation of different parameters during the two periods of observations.

Surface temperature during the 24 hour period varied from 26°C to 29.8°C and 28°C to 31°C in August 75 and April 76 (Table I). There was a gradual decrease in temperature during the night and increase during the day. However, no unusual fluctuation in temperature was noticed and hence the effects of thermal pollution were negligible. Salinity changes during the monsoon (Aug. 75) were more pronounced at location 2 and the values varied between 19.3-33.7‰ whereas at location 1 it ranged from 30.0-33.7‰. The fluctuation in salinity at location 2 during monsoon could have been mainly due to the influence of a large volume of water coming from the adjoining drain which opens on to the shore. Variation in the pH were from 7.5-8.0 during April 76. Dissolved oxygen values were found to be highly fluctuating during August, but generally remained higher than 3.0 mg/l. Nutrient concentrations showed two peaks in August—one at 20.00 hr (28. 8. 75) and the other



Figs. 1A & 1B. Diurnal variation of the physico-chemical parameters in August 75 and April 76.

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at 11.00 hr (29.8.75). The rise and fall in the nutrients at the two locations were similar. During April observations, the nutrients were high between 11.00–14.00 hr, but went on decreasing thereafter. The peaks recorded would reflect the discharge from the fertilizer factory at location 1 which got diluted during the course of the day. The levels of nutrient concentration at location 2 were much lower than at location 1 (Figs. 1A & 1B). This would indicate that mixing of effluents occurred at the location 2. Also from Figs. 1A & 1B, it can be seen that the mixing of effluents was more vigorous in the monsoon season with the turbulent sea conditions, while in the premonsoon period a steady dissipation pattern was observed. Earlier data on the currents would reveal that the surface currents in the vicinity of the effluent discharge point were weak during the premonsoon months (Feb.–May) (Kurup, Joseph and Varadachari, 1975). Moreover, it was noticed that the concentration of nitrogenous compounds during April 76 was sufficiently low compared to August 75. This change could have occurred as a result of the new offshore pipeline which has been installed for the discharge of effluents, about 1.5 km away.

Phytoplankton cell numbers showed fluctuating diurnal pattern with decrease in number during the night. Maxima of 1.86×10^5 and 1.60×10^8 cells/l were obtained during August and April observations respectively. Higher cell counts were observed in April indicating eutrophic conditions at Velsao. The diatom *Chetoceros* sp. was found to be abundant in April 76 resulting in bloom situation. Other cells included were *Nitzschia seriata*, *Bidulphia* sp., *Asterionella* sp., *Melosira miniformis*, *Cosinodiscus* sp. etc. These species were present almost throughout the year in these waters (Verlencar and D'Silva, 1977). During the August 75 *Fragilaria* sp. was predominant.

Ammonia, the toxic component of the factory effluents showed a decrease in April 76 as compared to that of August 75 (Table I). The minimum level of ammonia during the diurnal cycle was found to be 0.27 ppm-N. The continued high levels of ammonia nitrogen (Figs. 1A & 1B), sometimes exceeding the standard limits (1.2 ppm-N), can have long term effects on fish larvae which are often seen swimming in the adjacent drain and in small rock pools during the low tides. Long term toxic effects of ammonia between 0.1–0.3 ppm NH_4^+ -N may have adverse effect on breeding and growth of fishes from the area (Burrows, 1964).

Table I. Maximum and minimum concentrations of different parameters during the two periods of observations.

Parameters	28-29 August, 75		12-20 April, 76	
	Max.	Min.	Max.	Min.
Temp. °C	29.80	26.00	31.00	28.00
Salinity ‰	33.70	19.29	36.04	34.13
Oxygen mg/l	5.80	3.05	7.17	4.48
pH	—	—	8.0	7.5
Urea-N ppm	3.81	0.036	0.51	0.15
NH_4^+ -N ppm	4.51	0.296	1.18	0.27
NO_2^- -N ppm	4.07	0.126	0.47	0.10
NO_3^- -N ppm	3.54	0.306	1.1	0.18
PO_4^{2-} -P ppm	0.342	0.018	0.73	0.22
Phytoplankton cells/litre	1.86×10^5	2.0×10^4	1.46×10^8	3.58×10^6

Nitrite-nitrogen ranging between 0.10-4.07 ppm-N were also present in Cola Bay. Nitrite at higher concentrations is a potential toxicant for fish. It oxidizes haemoglobin of blood causing methaemoglobinemia and the fish may die of anoxia (Smith and Williams, 1974). High values of nitrates in Velsao (0.18-3.54 ppm-N) may be relatively less toxic than nitrite. Knepp and Ankin (1972) found that the catfishes living in channels could easily live in water containing 400 ppm nitrate concentration without any change in feeding and growth.

The higher values of nitrate and phosphate seem mainly responsible for the increase in phytoplankton counts.

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REFERENCES

- Baldwin E., 1948. *An Introduction to Comparative Biochemistry*, 3rd Edition. Cambridge University Press, Cambridge. 164 pp.
- Burrows, R. E., 1964. Effects of accumulated excretory products on hatchery reared Salmonoids. U. S. Department of the Interior Bureau of Sport Fisheries and Wildlife, *Research Report*, 66 : 12 pp.
- Knepp, G.L. and G.F. Ankin, 1972. Ammonia toxicity levels and nitrite tolerance for channel catfish (*Ictalurus punctatus*). Paper presented at *Annual Meeting of American Society of Agricultural Engineering, Hot Springs, Ark.* 6 pp. (mimeographs).
- Kurup, P. G., P. S. Joseph and V. V. R. Varadachari, 1975. Nearshore circulation in the sea off Velsao Goa. Abstract from symposium on multiuse of coastal zone. *Journal of Indian Fisheries Association* (in press).
- Singbal, S. Y. S., S. P. Fondekar and C. V. G. Reddy, 1976. Chemical characteristics in the inshore waters of Velsao Bay (Goa). *Mahasagar—Bulletin of the National Institute of Oceanography*, 9 (1 & 2): 35-40.
- Smith, C. E., and W. G. Williams, 1974. Experimental nitrite toxicity in Rainbow trout and Chinook Salmon. *Transaction of American Fisheries Society*, 103: 389-390.
- Verlencar X.N. and C. D'Silva, 1977. Comparative water quality characteristics at Velsao and Colva beaches. *Indian Journal of Marine Sciences* (in press.)