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Acoustic Ambient Noise of the Cochin Backwaters

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Results of weekly field observations over 1 yr on the acoustic ambient noise levels at 3 stations in the Cochin backwaters are presented. The recorded noise are subjected to a 1/3 octave analysis using audio frequency spectrometer and oscilloscope. Monthly variations of ambient noise show 2 maxima and 2 minima which are closely related to the population variations due to the occurrence of the 2 monsoons. In the higher frequency range monthly variations of the ambient noise have been found related to the shrimp population of the backwaters. Throughout the year the pressure spectrum level shows a marked decrease with increase in frequency.

ALL applications of underwater acoustical techniques, involved in underwater communication, fathometry, fish finding and telemetry, require an understanding of the submarine ambient noise level, its spectral characteristics and spatial and temporal variations. Ambient noise in the sea has 3 major component sources, viz. water motion, man-made sources and marine life. The noise from water motion depends on the wind force and the state of the sea[1]. In the absence of sound from other sources the Knudsen curves give fairly good results in the prediction of ambient noise in the sea, particularly above 500 Hz. In coastal waters and harbours, the predominant contribution to ambient noise is from the marine life. Studies on the ambient noise due to marine life should be conducted for each region separately because different regions will have different fauna which cause regional differences in the character of ambient sound. The present investigations have been carried out to study the ambient noise spectrum contributed by marine life in the Cochin backwaters and to study its seasonal and cyclic variations with a view to forecasting ambient noise due to marine life.

Because we do not expect, under normal circumstances, to find a linear trend in ambient noise level due to marine life, it may be assumed that the macroscopic character of the noise level will have some periodicity in its occurrence. Extreme variability and confusing irregularity of ambient noise due to marine life suggest the method of spectrum analysis to find the periodic phenomena present[2,3]. This requires long series of equispaced data. Data relating to 1 yr have been analysed for seasonal variations of noise level and the results are presented in this paper.

Methods

Field recording of ambient noise was made at 3 stations located in the Cochin backwaters (Fig. 1). At station I, which is beyond the southern end of Willington Island, recording was made at 2 depths (3 and 5 m). At stations II and III the ambient noise was recorded at 3 m depth. The recordings were repeated at these stations and depths once in a week for 1 yr. Duration of recording at each point was 1 min. Recordings were made at fixed time of the day at each station and depth so that diurnal variations are not reflected in the data.

The equipments used for the field recording consisted of an ARC BC30 hydrophone, a preamplifier, a main amplifier and a Sharp RD 504 tape recorder. The hydrophone used had a sensitivity of —110 db re 1 v/μb. The preamplifier used was that described by Watkins[4] which provided the high input impedance required for proper matching with the high impedance of the hydrophone used. The main amplifier was an RC coupled amplifier whose frequency response was flat from 20 Hz to 20 kHz. It was provided with a calibrated gain control. This gain control was used as level control during recording because the gain control on the tape recorder was found to be frequency sensitive. To get stable frequency characteristics, the gain control on the tape recorder was placed at a fixed position always, both during recording and analysis. During replay

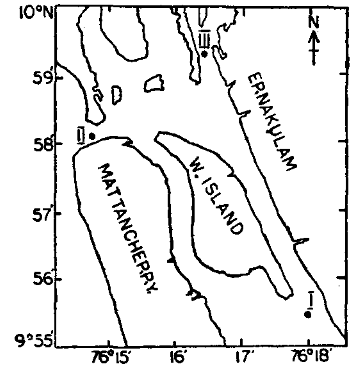

Fig. 1 — Locations of stations I-III

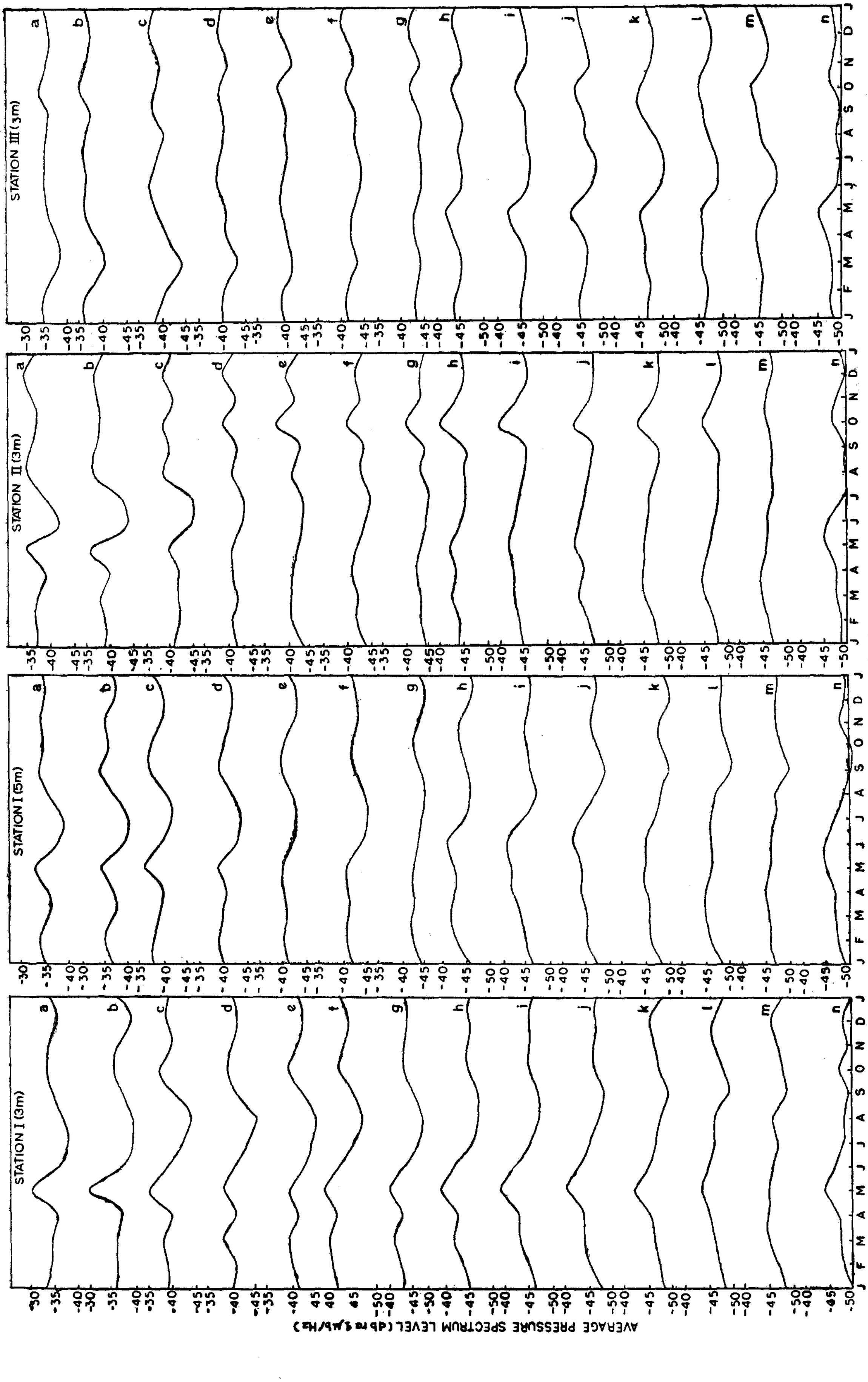

Fig. 2 — Monthly variation of average pressure spectrum level at station I (3 m), station I (5 m), station II (3 m) and station III (3 m) [Frequencies (Hz) employed: a, 125; b, 160; c, 315; d, 630; e, 800; f, 1000; g, 1250; h, 1600; i, 2000; j, 2500; k, 3150; l, 4000, m, 5000; and n, 6300]

the frequency response was found to be almost flat from 100 Hz to 8 kHz. The small differences remained were corrected with the help of a response curve for the tape recorder.

A 1/3 octave analysis of the noise was made using a B & K audio frequency spectrometer and an oscilloscope. During analysis the recorded signal was given a total amplification of 110 db. Then, if V is the r.m.s. value of the output voltage the sound pressure level (SPL) for the 1/3 octave band is

$$SPL = 20 \log V$$

SPL is expressed in db re 1 μb. From SPL the pressure spectrum level (PSL) is obtained from

$$PSL = SPL - 10 \log \Delta f$$

where Δf is the band width of the 1/3 octave band in Hertz[5]. PSL is expressed in db re 1 μb/Hz. The average of PSL for each month was calculated for different frequencies.

To obtain the overall sound pressure level the procedure described by Kinsler and Frey[5] was followed. The average pressure spectrum level for each month was plotted against frequency. The frequency scale was then divided into several bands and the mean spectrum level for each band was found. For each of the above band, the pressure band level (PBL) was found from

$$PBL = PSL + 10 \log \Delta f$$

where Δf is the width of the band in Hertz. Each PBL was then converted into an intensity using the known relation between sound pressure and intensity in water. The overall intensity was obtained by adding the separate intensities and this overall intensity was converted into overall sound pressure level.

Results and Discussion

Monthly variation of the average pressure spectrum level at different stations are given in Fig. 2. Fig. 3 gives the monthly variation of the overall sound pressure level at these stations.

Pressure spectrum level decreases with increase in frequency. For all the frequencies ranging from 125 to 6300 Hz the general trend of monthly variation of the average pressure spectrum level shows 2 maxima and 2 minima; the range of variation, on the average, being 6 db re 1 μb/Hz. This trend is seen at all the 3 stations. The maxima occur during April-May and September-October and the minima during July-August and December-January. This phenomenon shows close correlation with the occurrence of the 2 monsoons. The Cochin backwaters is characterized by low salinity during the monsoon seasons and increase in salinity during the postmonsoon seasons[6-10]. With the influx of fresh water during monsoon the animal population is changed and a reduction in noise level is effected. After monsoon, the population starts to return and the noise is again increased. This type of variation is less pronounced at station II. Here, owing to the proximity of the sea, the marine influence prevails over the effect of fresh water influx so that occurrence of monsoon does not change the condition appreciably.

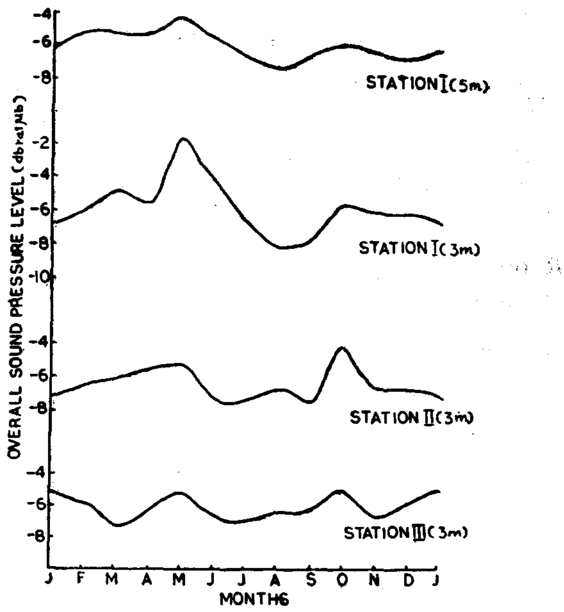

Fig. 3 — Monthly variation of overall sound pressure level at stations I-III

The maximum in the pressure spectrum level during April-May is more pronounced than that during September-October. Also the minimum during July-August is more pronounced than the minimum during December-January. This is because the influx of fresh water during south-west monsoon is considerably greater than that during north-east monsoon and also because the time lag between north-east monsoon and south-west monsoon is more than that between south-west monsoon and north-east monsoon.

In the case of higher frequencies, particularly above 2 kHz, the minimum associated with south-west monsoon extends to September whereas in the case of lower frequencies, it is more or less confined to July-August. This may partly be connected with shrimp population, because above 2 kHz the noise from marine life is predominantly from shrimp[11,12]. A shrimp bed is rather immobile and the influx of fresh water causes a reduction in the activity of the animal[13].

The annual variation of the overall sound pressure level in the entire band of frequencies ranging from 125 to 6300 Hz shows the same features as shown by the curves of pressure spectrum level. The magnitude of variation in the overall sound pressure level is, on the average, between −8 db re 1 μb and −4 db re 1 μb. A 3rd maximum and minimum in January and March respectively were observed at station III. This phenomenon as well as the less pronounced annual variations observed at station III, particularly at low frequencies, and the occurrence of high level noise at station II above 800 Hz require further study for a proper understanding.

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