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BODY MASS INDEX, FAT DISTRIBUTION AND BLOOD PRESSURE AMONG POST-MENARCHEAL BENGALEE SCHOOL GIRLS

Kaushik Bose and A.B. Das Chaudhuri

ABSTRACT

A cross-sectional study of 303 post-menarcheal Bengalee school girls was undertaken to investigate differences in adiposity, central body fat distribution, systolic (SBP) and diastolic blood pressure (DBP) by body mass index (BMI) tertiles. Results revealed that individuals who are relatively heavier for their height (BMI tertile III, T3) had significantly more weight; abdomen, waist, hip, chest and mid upper arm circumferences; biceps, triceps, forearm, anterior thigh, medial calf, abdomen, suprailiac, sum of trunk (SUMTRUNK), sum of extremitly (SUMEXTREM) skinfolds; arm muscle circumference (AMC) and area (AMA), waist-hip ratio (WHR) , conicity index (CI), and systolic (SBP) and diastolic (DBP) blood pressure than those in BMI tertile I (TI). On the other hand, means for trunk-extremely (TRUEXTRM) , trunk-upper (TRUPEX) and trunk lower extremely (TRLWEX) skinfold ratios were higher in TI compared with T3. Girls in BMI tertile II (T2) had intermediate values between T3 and T1. BMI had significant effect on WHR, CI, SBP and DBP. Analysis of variance revealed that BMI tertiles had significant association with WHR, CI, SBP and DBP, even after controlling the effects of subcutaneous (trunk and extremity skinfolds) adiposity. This study has provided evidence that concomitant with weight gain, post-menarc heal Bengalee school girls have a tendency of significantly increased accumulation of adiposity in the central region of the body as well as increased blood pressure. This enhanced central body fat distribution and blood pressure could have serious health implications in later life.

Key Words : Body Mass Index, Bengalee Girls, Waist-Hip Ratio, Conicity Index, Blood Pressure

INTRODUCTION

Variation in the anatomical distribution of adipose tissue is well known (Facchini et al., 1998). The anatomical distribution of fat is a risk factor for coronary heart disease (CHD), non-insulin dependent diabetes mellitus (NIDDM), hypertension, gall bladder disease, stroke, and overall mortality (Bouchard et al., 1990) , and it appears that cnetral adiposity more fully explains this relationship than peripheral adiposity (Fujimoto et al., 1995). Abdominal body fat is highly correlated with mortality and morbidity for CHD, diabetes, and obesity (Kissebah et al., 1989; Bjorntorp, 1991; Seidell, 1992; Downing and Pi-Sunyer, 1993; Anderson at al., 1988; Freedman and Rimm, 1989; Haffner et al., 1988; Larsson et al., 1984).

It has been recognised that late childhood and youth are important periods for the development of characteristics predisposing to cardiovascular disease (Strong and McGill, 1969; Newman et al., 1986). Most of the data concerning fat patterning variation and risk factors for CHD, NIDDM and hypertension are derived from industrialised countries. No study from India has investigated, in detail, overall adiposity (BMI) and its relatilonship with central body fat distribution (WHR and CI) and blood pressure among post-menarcheal girls. The present study was undertaken to investigate whether there is any tendency of

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enhanced central body fat distribution and increased blood pressure concomitant with increasing overall adiposity (BMI) among post-menarcheal Bengalee school girls.

MATERIAL AND METHODS

The present study was undertaken at a girls' school in Calcutta. Only girls who had attained menarche were invited to participate in the study. All participants were requested to complete a two-page questionnaire which included a specific question on age at menarche. A total of 309 girls (mean age - 14.2 years, s.d. = 1.2 years) participated of whom 6 were excluded because of missing data. All anthropometric measurements were made following the standard procedure (Lohmann et al, 1988). Height, weight, five (abdomen, minimum waist, maximum hip, chest and mid-upper arm) circumferences and ten (biceps, triceps, forearm, anterior thigh, medial calf, abdomen, subscapular, suprailiac, midaxillary, chest) skinfolds were measured. Height was measured to the nearest 0.1 cm using Martin's anthropometer. The body weight of lightly clothed subjects were recorded to nearest 0.5 Kg on a weighing scale (Doctor Beliram & Sons, New Delhi, India). Both for height as well as weight, participants were requested to remove their shoes prior to taking measurement. Circumference measurements were made to the nearest 0.1 cm using a tape measure (Triced, Shanghai, China). Skinfolds were measured on the left side of the body to the nearest 0.2 mm using a Harpenden skinfold calliper.

Body mass index (BMI) was computed using the following standard equation :

BMI = Weight in Kg / (stature in metre)

Waist-hip ratio (WHR) was computed using the following equation :

WHR = Waist circumference in cm / hip circumference in cm

Conicity index (CI) was derived using the equation of Valdez et al (1993).

$CI = \text{Waist circumference (m)} / (0.109) \times \sqrt{\{(\text{Weight (kg)} / \text{Height (m)}\}}$

Arm muscle circumference (AMC, mm) and arm muscle area (AMA, mm^2) were calculated sing the following formulae of Burr and Phillips (1984) :

AMC = mid upper arm circumference - λ (triceps skinfold)

AMA = (Arm muscle circumference) ^{2} / 4 λ.

Five skinfold indices were utilised: Sum of trunk (SUMTRUNK) = abdomen + waist + hip + hest

Sum of extremity (SUMEXTREM) = biceps + triceps + forearm + medial calf + anterior thigh

Trunk - extremity ratio (TRUEXTRM) = SUMTRUNK / SUMEXTREM

Trunk - upper extremity ratio (TRUPEX Ratio) = /SUMTRUNK / (biceps triceps + forearm)

Trunk - lower extremity ratio (TRLWEX Ratio) = SUMTRUNK / (medial calf + anterior thigh)

Technical error of measurements (TEM) was calculated and the results were found to be within acceptable values given by Ulijaszek and Lourie (1994). Thus, TEM was not incorporated in statistical analysis. All statistical analyses were performed using the Statistical Package for Social Sciences (SPSS).

Left arm blood pressure was taken with a sphygmomanometer and stethoscope after the subject had been seated for five minutes. Systolic (SBP) and diastolic blood pressure (DBP) were recorded at the appearance (Phase I) and disappearance (Phase V) of sounds, respectively. The left arm was placed at the level of the heart. Two measurements were taken (in mmHg) and mean values used for all analyses. A five minute interval between the two measurements for all the subjects were maintained.

RESULTS

The results of oneway analysis of anthropometric characteristics and blood pressure by BMI tertiles are presented in Table 1. Results revealed that individuals who are relatively heavier for their height (BMI tertile III, T3) had significantly more weight; abdomen, waist, hip, chest and mid upper arm circumferences; biceps, triceps, forearm, anterior thigh, medial calf, abdomen, suprialiac, sum of trunk (SUMTRUNK), sum of extremity (SUMEXTREM) skinfolds; are muscle circumference (AMC) and area (AMA), waist-hip ratio (WHR) , conicity index (CI), and systolic and diastolic blood pressure than those in BMI tertile 1 (T1). On the other hand, means for trunk-extremity (TRUEXTRM), trunk-upper (TRUPEX) and trunk lower extremity (TRLWEX) skinfold ratios were higher in TI compared with T3. Girls in BMI tertile II (TII) had intermediate values between T3 and TI for all anthropometric characteristics. No significant differences were observed between the BMI tertiles for height, and subscapular, midaxillary and chest skinfolds.

BMI had positive correlations with both indices of central body fat distribution (WHR: $r = 0.19$, $p < 0.001$; CI: $r = 0.11$) as well as SBP ($r = 0.22$, $p < 0.001$) and DBP ($r = 0.23$, $p< 0.001$). Multiple regression studies of WHR , CI, SBP and DBP were undertaken to test for the effect of BMI on the two indices of central body fat distribution and blood pressure. Results (Table 2) revealed that BMI had significant effect on WHR ($t = 3.291$, $p = 0.0011$), CI ($t = 1.991$; $p = 0.0474$), SBP ($t = 3.875$, $p = 0.0001$) and DBP ($t = 4.024$, $p = 0.0001$). Analysis of variance demonstrated that (Table 3) BMI tertiles had significant association with WHR ($F = 10.254$, $p < 0.0001$), CI ($F = 5.517$, $p < 0.005$), SBP ($F = 7.799$, $p < 0.001$) and DBP ($F = 7.211$, $P < 0.005$) even after controlling for the effects of subcutaneous (trunk and extremely skinfolds) adiposity. This study provided evidence that concomitant with weight gain, post-menarcheal Bengalee school girls have a tendency of significantly increased accumulation of adiposity in the central region of the body as well as increased blood pressure. This enhanced central body fat distribution and blood pressure with weight increase is irrespective of the potentially confounding effect of gain in trunk and subcutaneous adiposity.

DISCUSSION

A recent study from the Netherlands (Van Lenthe et al., 1998) has investigated central pattern of body fat and its relationship with blood pressure and lipoproteins among adolescent boys and girls. However, in India, among adolescents, research on association of BMI with central body fat distribution and other risk factors for CHD, NIDDM and hypertension is lacking. The present study was undertaken to investigate whether there is any tendency of enhanced central body fat distribution and blood pressure concomitant with increasing BMI among post- menarcheal Bengalee school girls.

Results revealed that there was an increase in various body circumferences and skinfolds, central body fat distribution and blood pressure with increasing overall adiposity (BMI). However, trunk-extremity ratios, which are surrogate measures of subcutaneous adiposity on trunk relative to extremities, decreased. The results of the present investigation can be summarised into five main points. With increasing BMI, post-menarcheal girls tend to :

i) have greater body circumferences
ii) accumulate more truncal, extremity as well as total subcutaneous fat,
iii) accumulate more subcutaneous fat on the extremities relative to the trunk region
iv) possess enhanced central body fat distribution
v) have increased blood pressure.

Prospective studies (Ducimetiere et al., 1986; Donahue et al., 1987; Freedom et al., 1995) have shown that central pattern of body fat is associated with mortality from CHD, NIDDM and hypertension. It has been well established that migrant South Asians in Britain and elsewhere have markedly higher prevalence of CHD and NIDDM (Bose, 1997). Although comprehensive data on the prevalence of CHD, NIDDM and hypertension are lacking from India, a few preliminary studies have indicated that the prevalence of these conditions will reach epidemic proportions in the next 20 years (Shah, 1992). The present study elucidates that there is a tendency among post-menarcheal Bengalee girls of enhanced accumulation of central body fat and increased blood pressure with increasing BMI. Central body fat distribution and blood pressure are established risk factors for CHD and NIDDM. Since ageing involves gain in overall adiposity (BMI), this study provides evidence that post-menarcheal Bengalee girls could be susceptible to NIDDM, CHD and hypertension in later life. It can therefore be expected that the prevalence of CHD, NIDDM and hypertension among Bengalee girls will increase substantially as they approach middle age.

Future studies should investigate whether this tendency of enhanced accumulation of central body fat distribution and increased blood pressure concomitant with weight gain is present among other ethnic groups in India. Similar studies are needed on post-adolescent boys to determine if this trend is sex-specific to females or is also observed among males. More importantly, longitudinal studies should be undertaken so as to study the dynamics of the changes over time, in adiposity and body fat distribution among post-adolescent boys and girls. At present, such studies are lacking from India as well as the Indian diaspora worldwide.

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TABLE 1: Anthropometric and blood pressure characteristics of the Bengalee girls by BMI tertiles (n = 303).

Variable	First Tertile	Second Tertile	Third Tertile
	(n = 101)	(n = 101)	(n = 101)
Height (cm)	153. 3	153. 1	152. 3
	(5. 18)	(5. 59)	(5. 04)
Weight (Kg)*	41. 4	48 . 6	58 .4
	(3. 65)	(4. 15)	(7. 52)
Circumference (cm)			
Abdomen *	65. 9	73. 8	84. 4
	(4. 68)	(5. 37)	(8. 56)
Minimum waist *	57. 6	64. 1	71. 0
	(2. 92)	(3. 40)	(5. 54)
Maximum hip *	78. 5	84. 9	93. 2
	(4. 86)	(5. 43)	(6. 83)
Chest *	71. 7	78. 2	84. 2
	(4. 68)	(3. 69)	(7. 90)
Mid upper arm*	20. 1	22. 2	24. 5
	(1. 50)	(1. 12)	(1. 60)
Skinfolds (mm) Biceps*	23. 8	25. 0	25. 4
	(2. 61)	(2. 32)	(2. 25)
Triceps *	24. 4	25. 9	26. 5
	(2. 54)	(1. 49)	(1. 98)
Forearm*	6. 3	7. 0	7. 8
	(1. 19)	(1. 04)	(1. 23)
Anterior thigh*	41. 7	44. 2	47. 3
	(4. 85)	(3. 77)	(3. 77)
Medial calf*	26. 6	27. 8	29. 6
	(3. 15)	(2. 77)	(3. 84)
Abdomen*	25. 3	26. 8	28. 3
	(2. 45)	(2. 28)	(4. 29)
Subscapular	24. 9	24. 3	24. 5
	(2. 06)	(1. 75)	(2. 36)
Suprailiac*	24. 0	25. 0	26. 1
	(2. 21)	(1. 81)	(3. 80)
Midaxillary	23. 7	23. 4	24. 0
	(1. 99)	(1. 48)	(1. 81)
Chest	23. 7	23. 6	23. 8
	(1. 88)	(1. 71)	(1. 88)
Sum Trunk *	121. 61	123. 01	126. 80
	(7. 98)	(6. 29)	(10. 31)

Cont. .....

Sum Extremity*	122. 86	129. 88	136. 61
	(9. 48)	(5. 99)	(9. 11)
TRUEXTRM Ratio*	0. 996	0. 948	0. 930
	(0. 103)	(0. 053)	(0. 067)
TRUPEX Ratio*	2. 25	2. 14	2. 13
	(0. 22)	(0. 16)	(0. 19)
TRLOEX Ratio*	1. 80	1. 71	1. 66
	(0. 26)	(0. 13)	(0. 14)
Muscle Measures			
AMC (mm)*	123. 90	140. 74	162. 12
	(15. 90)	(11. 66)	(15. 78)
AMA (mm^2)*	1241. 43	1586. 86	2111. 17
	(339. 40)	(258. 51)	(414. 22)
Abdominal Adiposity			
WHR*	0. 735	0. 757	0. 763
	(0.049)	(0. 045)	(0. 039)
CI*	1. 017	1. 045	1. 056
	(0. 046)	(0. 055)	(0. 069)
Blood Pressure (mmHg)			
Systolic*	104. 8	108. 4	111. 3
	(8. 20)	(9. 51)	(11. 08)
Diastolic*	71. 6	71. 5	76. 7
	(8. 22)	(7. 70)	(9. 97)

Standard deviations are presented in parentheses.
* Significant difference between tertiles.

TABLE 2: Regression analysis of BMI with SBP , DBP , WHR , and CI.

Dependent Variable	B	s. e. B	Beta	T	Sig. T
WHR	0. 0024	0. 0001	0. 1864	3. 291	0. 0011
CI	0. 0019	0. 0001	0. 1140	1. 991	0. 0474
SBP	0. 5980	0. 1543	0. 2180	3. 875	0. 0001
DBP	0. 5573	0. 1385	0. 2260	4. 024	0. 0001

TABLE 3: ANOVA OF WHR, CI, SBP and DBP by BMI tertile with SUMTRUNK AND SUMEXTREMITY as covariates.

Source of variation	Sum of Squares	F	Sig of F
(a) Dependent Variable = WHR			
Main Effect			
BMI Tertile	0. 041	10. 254	0. 000
(b) Dependent Variable = CI			
Main Effect			
BMI Tertile	0. 036	5. 517	0. 004
(c) Dependent Variable = SBP			
Main Effect			
BMI Tertile	1449. 236	7. 799	0. 000
(d) Dependent Variable = SBP			
Main Effect			
BMI Tertile	1088. 671	7. 211	0. 001

REFERENCES

Anderson, A. L., Sobocinski, K.A., Freedman, D.S., Barboriak, J. J., Rimm, A. A. and Gruchow, H.W. (1988). Body fat distribution, plasma lipids, and lipoproteins. *Arteriosclerosis*, 8 : 88 - 94.

Bjorntorp, P. (1991). Adipose tissue distribution function. *International Journal of Obesity*, 15 : 67 - 81.

Bose, K. (1997). Coronary Heart Disease Among Migrant South Asians in Britain: An Overview. *Journal of the Indian Anthropological Society*, 32: 269-275.

Bouchard, C., Bray, G.A. and Hubbard, V.S. (1990). Basic and clinical aspects of regional fat distribution. *American Journal of Clinical Nutrition*, 52: 946 - 950.

Burr, M.L. and Phillips, K.M. (1984). Anthropometric norms in the elderly. *British Journal of Nutrition*, 51: 165 - 169.

Donahue, R.P., Abbott, R.D., Bloom, E., Reed, E.M. and Yano, K. (1987). *Central obesity and coronary heart disease in men*. Lancet, 1 : 821 - 824.

Dowling, H. J. and Pi-Sunyer, F.X. (1993) . Race-dependent health risks of upper body obesity. *Diabetes*, 42: 537 - 53.

Facchini, F., Toselli, S., Ismagulov, O., Fiori, G., Ismagulova, A. and Pettener , D. (1988). Body Composition in Central Asia Populations: Fat Patterning Variation in the Kazakhs of the Tien Shah Mountains and the Uighurs of Semericia. *American Journal of Human Biology*, 10: 241 - 247.

Freedom, D. S. and Rimm, A. A. (1989). The relation of body fat distribution as assessed by six girth measurements, to diabetes mellitus in women. *American Journal of Public Health*, 79: 715 - 720.

Freedman, D. S., Williamsom, D. F., Croft, J. B., Ballew, C. and Byers, T. (1995). Relation of body fat distribution to coronary heart disease: The National Health and Nutrition Examination Survey I (NHANES I) Epidemiologic Follow-up study. *American Journal of Epidemiology*, 142: 53 - 63.

Fujimoto, W., Bergstrom, R.W., Boyko, E.J., Leonetti, D. L., Mewell-Morris, L. L. and Wahi, P. W. (1995). Susceptibility to development of central obesity among populations. *Obesity Research 3 (Suppl.)* : 179s - 186s.

Haffner, S. M., Fong , D. , Hazuda, H. P. , Pugh, J.A. and Patterson, J. K. (1988). Hyperinsulinameia, upper body adiposity, and cardiovascular risk factors in non-diabetics. *Metabolism*, 37: 338 - 345.

Kissebah, A. H., Freedman, D. S. and Peiris, A. N. (1989). Health risks of obesity. *Medical Clinics of North America*, 73: 111 - 138.

Larsson, B., Svardsudd, K. , Welin, L. , Wilhelmsen, L. , Bjorntorp, P. and Tibblin, G. (1984). Abdominal adipose

tissue distribution, obesity, and risk of cardiovascular disease and death: 13 year follow-up of participants in the study of men born in 1913. *British Medical Journal*, 288: 1401 - 1404.

Lohman, T. G., Roche, A. F. and Martorell, R. (1988). *Anthropometric Standardization Reference Manual*. Champaign, Illinois: Human Kinetics Books.

Newman, W. P., Freedman, D. S., Voors, A. W., Gard, P. D., Srinivasan, S. P., Cresanta, J. L. , Williamson, G.D., Webber, L. S. and Berenson, G. S. (1986). Relation of serum-lipoprotein levels and systolic blood pressure to early atherosclerosis. *New England Journal of Medicine*, 314: 138 - 144.

Seidell, J. C. (1992). Regional adiposity and health. *International Journal of Obesity*, 16 : S31 - S34.

Shah, B. (1992). Progress in Cardiovascular Disease Research in India During the Last Two Decades (1971-92). Indian *Council of Medical Research Bulletin*, 22: 45 - 53.

Strong , J. P. and McGill, H. C. (1969). The pediatric aspects of atherosclerosis. *Journal of Atherosceloris Research*, 9: 251 - 256.

Ulijaszek, S. J. and Lourie, J. A. (1994). Errors of measurements. In: *Anthropometry, the Individual and Population*. pp. 30 - 35. Eds: S.J. Ulijaszek and C.G.N. Mascie-Taylor. Cambridge: Cambridge University Press.

Valdez, R., Seidell, J.C., Ahn, Y.I. and Weiss K. M. (1993). A new index of abdominal adiposity as an indicator of risk for cardiovascular disease. A cross-population study. *International Journal of Obesity*, 17: 77 - 82.

Van Lenthe, F. J., Van Mechelen, W. , Kemper, H.C.G. and Twisk, J.W.R. (1998). Association of Central Pattern of Body Fat with Blood Pressure and Lipoproteins from adolescence into Adulthood. *American Journal of Epidemiology*, 147: 686 - 693.

EFFECTS OF GASEOUS CONTENTS ON FUNGAL POPULATION OF TWO PONDS

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HARMU HOUSING COLONY
HARMU, RANCHI

ABSTRACT

Effects of gaseous contents i.e. dissolved O_2 and free Co_2 on population of fungi of University and Amgola ponds were examined. Free Co_2 content exhibited indirect correlation with fungal density, while dissolved O_2 showed more or less direct correlation with fungal population of ponds. Maximum fungal population was recorded in the month of November and minimum in the month of May in both the ponds.

Key words : Gaseous contents, Ponds, Fungal Population.

INTRODUCTION

Micro organisms possess a capacity to utilize a wide range of organic and inorganic substances by oxidation and reduction processes. The maintenance of life depends on continuous recycling of inorganic materials and decomposition of organic material to produce substance which other organisms require. The fungi play an important role in biodegradion, transformation, regeneration, utilization and cycling of elements. Gaseous contents of any water body depends upon the nature of organisms and their densities.

Alabi (1971), however, established relationship between the amount of oxygen, carbon and microbes concentration of certain fresh water ponds. High dissolved oxygen is an indication of healthy system. The importance of oxygen concentration in water is emphasized by a number of works. According to Hutchinsion (1957), the dissolved oxygen of water could provide more information about the nature of water than any other chemical constituent. Rawson (1939) gave an idea that the changes in dissolved oxygen content in a given volume of water are mainly due to consumption of oxygen during chemical oxidation and respiration of animals, plants and bacteria present in water. In this paper an attempt has been made to co- relate the gaseous contents with the concentration of decomposing fungi in two ponds under study, i.e. University pond and Amgola pond.

MATERIALS AND METHODS

For estimating the total fungal population, the soil and water sample were collected from two experimental ponds in the first week of every month in a sterilized flask separately from three different spots and mixed together to make one composite sample. The dilution was made from the mixed soil sample in ratio of ten / 1:10,000 as suggested by Johnson and Curl (1972). 1 ml of water sample was taken through a sterilized pipette and poured into a sterilized petridish containing PDA in solid condition. The petridishes were incubated at 25± P for five to six days. At the end of incubation period the percentage frequency was calculated by following formula (Prasad and Bilgrami, 1969).

$$\text{Percentage frequency} = \frac{\text{No. of observations in which a species appeared}}{\text{Total no. of observations}} \times 100$$

For estimation of dissolved oxygen Winkler's method was used to the water sample collected in 250ml ground glass stoppered bottle, one ml of manganous sulfate and 1.0 ml of alkaline potassium iodide was added to the bottom of the bottle by means of 1.0 ml pipette. After stopping the stopper, the solution was throughly mixed to develop a flucculant precipitate. After settlement of precipitate, 2.0 ml conc.H So was added to dissolve the precipitate. Fifty me of this dissolved solution was treated with 0.025 N Sodium thio-sulfate solution using starch as indicator. Dissolved oxygen content was calculated by using the following formula.

Dissolved oxygen (ppm) = no. of ml 0.025N sodium thiosulphate consumed x 4

For estimation of free Co_2 , 2 drops of phenolphthaline indicator was added to 50ml of water sample. If the solution remained colourless, it was titrated with N/44 NaOH solution until a faint but permanent pink colour appeared.

Free Co_2 (ppm) = no. of N/ 44 NaOH required x 200

RESULTS AND DISCUSSION

The dissolved oxygen was highest during winter followed by monsoon and summer. The fungal frequency also followed the same trend. Thus the oxygen content was directly proportional to fungal frequency, while Co_2 content presented inverse relationship with copopulation.

On the basis of present findings, it may be concluded that oxygen presented direct relationship with the fungal no, whereas Co_2 showed inverse relationship.

Similar findings were recorded by Bagde and Verma (1991) Free Co_2 content varied from 2.2 to 7.9 ppm in University pond and, from 3.1 to 9.2 ppm in Amgola pond Free Co_2 content was found to be highest in the month of May in both the ponds. The highest concentration of fungi was noted in the month of November in both the ponds. Dayal and Tandon (1962) also observed maximum number of fungi during the month of October- November in ponds they studied. The minimum concentration of free Co_2 was in the month of January in University pond and in the month of February in Amgola pond. Thus Co_2 content presented almost inverse relationship with the fungal frequency. Findings of present study are endorsed by other workers too (Chitranshi, 1987; Bilgrami and Duttamunshi, 1985; Hamidi, 1992; Bilgrami, 1993; Chodhary and Bilgrami, 1993;).

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Table - I

Fungal frequency in relation to gaseous contents of university and Amgola ponds during different months and seasons.

Month Season	University Pond			Amgola Pond		
	Fungal Frequency	Free Co_2 (ppm)	Dissolved Oxygen (ppm)	Fungal Frequency	Free Co_2 (ppm)	Dissolved Oxygen (ppm)
January	300	2.2	6.6	325	3.2	6.8
February	325	2.5	7.4	375	3.1	7.8
March	275	4.0	4.2	300	3.4	3.4
April	200	6.6	2.4	275	6.9	2.2
May	175	9.0	2.8	200	9.2	3.6
June	225	7.5	4.8	300	7.8	4.2
July	375	6.2	4.2	325	6.5	4.0
August	400	7.9	5.2	425	7.2	5.4
September	425	6.2	5.6	450	6.3	5.8
October	450	5.0	6.0	475	5.2	6.4
November	600	4.2	6.2	675	4.4	6.8
December	500	3.9	8.2	525	4.1	8.0
Summer	Range : 175-275	4.0-9.0	2.4-4.8	200-300	3.4-9.2	2.2-4.2
(March-June)	Average : 218.7	6.7	3.5	268.7	6.8	3.3
Monsoon	Range : 375-450	5.0-7.9	4.2-6.0	325-475	5.2-7.2	4.0-6.4
(Jul-Oct)	Average : 412.5	5.2	5.2	418.7	6.3	5.2
Winter	Range : 300-600	2.2-4.2	6.2-8.2	325-675	3.1-4.4	6.8-8.0
(Nov-Feb)	Average : 431.2	3.2	7.1	475	3.7	7.3

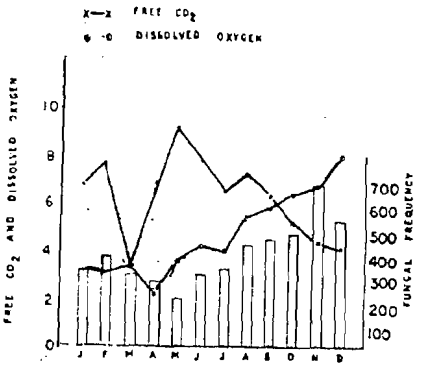

FIG. 1 : SHOWING FUNGAL FREQUENCY IN RELATION TO GASEOUS CONTENTS OF AMGOLA POND

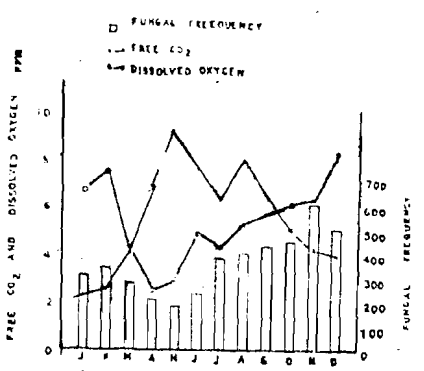

FIG. 2 : SHOWING FUNGAL FREQUENCY IN RELATION TO GASEOUS CONTENTS OF UNIVERSITY PO

REFERENCES

1) Alkali, R.O. 1971. Factors affecting seasonal occurrence of Saprolegriaceae in NIGERIA. Trans Brit. *Mycol Soc.* 56:289-299.

2) Bagde, U.S. and Verma A.K. 1991. *Current Trends in Limnology* vol. I, Nayendra Publication, Delhi.

3) Bilgrami, K.S. and Dutta Munshi J.S. 1985. *Final Technical Report*, MAB Programme.

4) Bilgrami, R.S. 1993.: *Microbes and Environment*, Narendra Publication. Delhi.

5) Chitraushi, V.R. 1987. Ph.D. Thesis, Bihar University, Muzaffarpur, India.

6) Choudhary, R.K. and Bilgarami, R.S. (1993). Effect of gaseous contents on Bacterial and fungal population of two ox-box lakes of river Burhi Gandak. *Indian Bot. Cont.* 10: 7-12.

7) Dayal, R. and Taulon, R.N. 1962. Hydrobiologia 20:121.

8) Hutchinson, H.L. 1957. *A treatise on limnology vol. I.I Geography, Physics and Chemistry*. John Willeyo & Sons Newyork ; pp. 1015.

9) Johnson, L.F & Curi; E.A. 1972. *Methods for research on the ecology of soil Borne*. Plant pathogens Burgers publ. Co.; Minnesota, pp. 247.

10) Hamidi, M.K. 1992. Ph.D thesis. Bihar University, Muzafferpur, India.

11) Prasad, S.S. and Bilgrami, R.S. 1969. Investigations on diseases of Litchi chinensis in relation to fruit rot. Indian Phytopath. 22: 507-510.

12) Rawson, D.S. 1939. In problem of lake biology publ. *A.A.A.S*; 10, 9.

POLYMORPHISM OF PALMAR C-AND D-LINE TERMINATIONS AMONG THE BANGLADESH REFUGEES OF RAIPUR DISTRICT, CHATTISGARH

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ABSTRACT

The Bengalee Namasudra settled in the Chattisgarh State have ben studied for C- and D- line terminations and compared with the other Indian caste populations caste populations bassed on C- line terminations following Sanghvi's X^2 Distance. The characteristics of the distribution of C- line termination indicate, to some extent, the resemblance to other Indian caste populations, suggesting a common population origin to have an infrequent flow of genes from other populations living in their biosocial isolation. In this population besexual differences were observed, though these were not statistically significant in every case. The results reflected by the dendrogram do not conform to the agreement of caste heierarchy or to the linguistic affinities.

Key Words : Palmer C- and D- line terminations, Bangaldesh Refugees, Other Indian caste populations, Genetic distances, India.

The Bangladesh Namasudra Refugees migrated from the East Pakistan (now Bangladesh) to Chattisgarh in two phases, in 1964 and 1971 respectively. They came in bulk, some of whom were rehabilitated in the Mana Refugee camp in the Raipur district of Chattisgarh. The Namasudras in the Hindu caste heierarchical system occupy a lower position, but they are not untouchables. As Biswas (1997) reports, they were designated as Chandals in the past. Afterwards, the social movements during the pre-Independence period in India had led West Bengal government to redesignate them as Namasudra in 1991. O'Donnel (1891) also describes them as Chandals who were active and successful enemies of the Aryans. This could be supported by the fact that there was little trace of actual conquests by early Hindu Kings beyond the Bhagirathi, except the reparian districts along its east bank. Basu (1949) , however, is of the opinion that "Namasudra caste is descended from the ancient sages and the rishis, i.e., from pure Brahmins". Originally they were agriculturists by occupation, but after their migration and subsequent rehabilitation at Mana Refuges camp, they had to take up other occupations like service, small scale business. They numbered 6528 out of which 2928 were males and 3590 females (Basu, 1983). Almost all of them could trace their consanguineal relatives in the state of West Bengal. Hence, it can be assumed that their gene pool stretches upto West Bengal.

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In the present study an attempt has been made to evaluate the variations of the terminations of the C- and D- lines among the Namasudra refugees and to assess their biological affinities with other Indian caste populations.

MATERIALS AND METHODS

Palm, sole and finger prints were taken from 112 males and 110 females of the Namasudra Bengalee Refugees from Bangladesh, who were rehabiliated in the Mana Refugee Camp within Raipur district of Chattisgarh. In this paper the incidence of C- and D- line terminations is reported. Studies in Palmar dermatoglyphics has been reported from elsewhere (Basu al., 1992). The subjects involved in the present study were normal and free from minor anomalies or chronic disease. Selection of the subjects was carried out in a manner so that only one member of each family participated. Methods proposed by Cummins and Midlo (1961) was followed in recording the palm prints and also in analysis of the prints; the terminations of the C- line, namely, radial, ulnar, proximal and absent types were recorded after Plato (1970). In this study, along with the present population, the data of four modal types of terminations of C- line of 16 other Indian caste populations (both published and unpublished) have been taken into consideration to assess interpopulational genetical distance following Sanghvi's (1953) X^2 formula. The formula is :

$$x^2 = \frac{100 \times \sum n_i = 1 \sum_{j=1} \left\{ \frac{(p\,ij - q'')^2}{q''} + \frac{(p\,ij - q'')^2}{q''} \right\}}{\text{Total number of degrees of freedom}}$$

Where pij is the proportion for jth class of jth character for one population and p' I j for other population in a pair and $q_{ij} = \frac{p'ij + pij}{2}$ Expected protection for the particular class. To the matrix of genetic distance thus obtained, a dendrogram for 17 caste populations is constructed following the unweighted pair group method (UPGM) after Sokal and Sneath (1963).

RESULTS AND DISCUSSION

Frequencies of modal types of the C- and D- line terminations :

The distribution of modal types of C- line etermination among the Namasudra Bengalee Refugees is given in **Table - 1**. They show bilateral distribution asnmetry in both the sexes (males, P.(0.001; females, X' = 6.216.

The incidence of radial type shows the heighest frequency on the right palms of the males (50.89%), while the incidence of other three modal types reveal higher frequencies on the left palm of the males. Among the females, all the modal types, barring absent modal type, show either equal or higher frequencies on the right palms as compared to those of the left palms.

Table 1. Bilateral Variation of C-Line terminations among the Bangladesh Namasudra Refugees

Sex	No. of Palms	Side	Radial (%)	Ulnar (%)	Proximal (%)	Absent (%)
Male	112	R	50.89	39.39	6.25	4.46
	112	L	27.67	47.32	19.64	5.36
	224	R + L	39.28	42.85	12.94	4.91
Female	110	R	35.45	44.54	14.54	5.45
	110	L	35.45	44.18	6.36	10.00
	220	R + L	35.45	46.36	10.45	7.72

Bilateral Distribution asymmetry : males X 2/3 = 16.572. PNS P (0.001 : females X 2/3 = 6.216 PNS. Sex difference : X 2/3 = 5.6455 P.N.S

Table 2. Bilateral Variation of D-Line terminations among the Bangladesh Namasudra Refugees

Sex	No. of Palms	Side	11 (%)	9 (%)	7 (%)
Male	112	R	50.00	30.36	19.64
	112	L	30.36	37.50	32.15
	224	R + L	40.18	33.93	25.89
Female	110	R	48.18	37.27	14.54
	110	L	39.09	41.82	28.18
	220	R + L	43.63	39.54	2136

Bilateral Distribution asymmetry : Males X 2/3 = 7.5988 P.S.P (0.002 : Females X 2/3 = 6.1162 P.S.P (0.06) Sex difference X 2/2 = 2.2334 P.N.S.

Table - 2. shows significant bilateral variation for D-line terminations in both the sexes (male $p<0.002$; famale, $p<0.05$). The incidence of D- line termination at position 11 shows higher frequency on the right palms of both the sexes while the frequencies of D- line termination at position 9 and 7 are higher on the left palms in both the sexes.

Bisexual Variation

In the present population, the incidence of modal types of C- line terminations show moderate differences in its frequencies between the sexes, but the difference is not statistically significant. Radial type termination is frequent in the females (Table:1) and the same trend is noticeable in the other proximal and absent type terminations of C- line. The frequency of D- line termination at position 11 and 9 are higher in females, but the sex difference is not statistically significant.

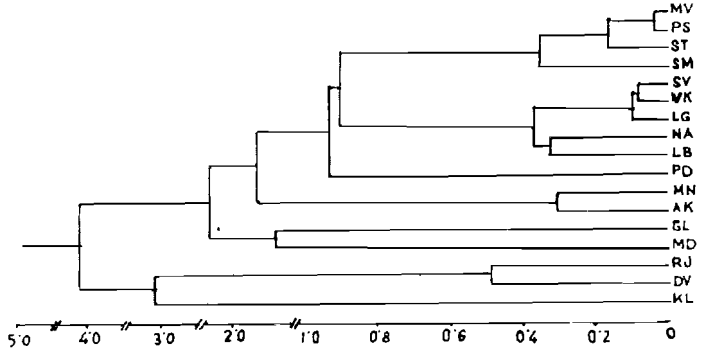
INTERPOPULATIONAL GENETIC DISTANCE :

Table - 3. provides a list of caste populations included for studying interpopulational distance.

The values of Sanghvi's X' distance between the populations and dendrogram constructed for 17 caste populations based on four modal types of C- line terminations. The results show that the smallest genetic distance of 0.031490 occurs between the Madhava Brahmin and Padma Salis, while the greatest distance (9.703450) is observed between the Kalita of Assam and Madiga of Andhra Pradesh. Among all the Indian caste populations mentioned above, two Bengali-speaking groups viz. Mana Namasudra (present study group) and the Namasudras (Sarkar, 1997) show some different characteristics, which mean that these populations have no close genetic distance between them. One of the populations, Mana Namasudras, is genetically closer to the Adikarnataka (KA) of the Karnataka, while the other population of the Namasudras (NA) is genetically closer to the Lobena of the Punjab. On the other hand, it has been observed that some of the South Indian population of viz. Madhava (MV), Padma Salis (PS), Smartha (ST), and Sengund Mudaliar (SM) make one cluster and Sri Vaishanava (SV), Vokkaliga (VK), and Lingayat (LG) form another. The populations of each exhibit close genetic relationship to each other. It indicates that there is a tendency of geographical clustering, rather geographically proximate groups tend to cluster together; the two above-mentioned Bengali-speaking groups show some mixed genetical closeness to the other groups, which are geographically and biosocially isolated. However, both belong to the brachycephlic group, which also points to their close physical link. Chanda (1981) reports in his book- 'Itihase Bangalee' (in Bengali) that their origin could be traced from 'Karnat' (Karnataka) and their genetic closeness could be attributed to the invaders who came through North-West India. So far as the social heierarchy according to 'Varnashram' is concerned, the stratified groups of Hindu Society viz. Brahman, Kshatirya, Baishya and Sudra based on their occupations do not conform to the populations genetically related as is shown in the dendrogram.

Table 3. Caste populations of India - their location social status, and sample size

Sl. No.	Population	Ad v	District/State	Language	Social Status	Sample Size			References
						M	F	M+F	
01.	Mana Namasudra	MN	Raipur/M.P.	Bengali	Namasudra	112	110	222	Present Study
02.	Namasudra	NA	Nadia/W.B.	Bengali	Schedule Caste	207	154	361	Sarkar, 1997
03.	Rajaka	RJ	Visakhapatnam/A.P.	Telegu	Sudra (Wesherman)	202	208	410	Parvatheesam and Babu, 1997
04.	Devanga	DV	Nellore/A.P.	Telegu	Artisan (Weaver)	112	92	204	Deepkumar and Ramchandraiah, 1985
05.	Sengund Mudaliar	SM	Chittoor/A.P.	Telegu	- Do -	142	56	198	Deepkumar and Ramchandraiah, 1985
06.	Smartha	ST	Mysore/Karnataka	Canarese	Brahmin	110	108	218	Basu, 1985
07.	Madhava	MV	Mysore	- Do -	Brahmin	102	101	203	Basu, 1985
08.	Sri Vaishnava	SV	Mysore	Tamil	Brahmin	103	107	210	Basu, 1985
09.	Lingayat	LG	Mysore	Canarese	Peasant	105	104	209	Basu, 1985
10.	Vokkliga	VK	Mysore	Canarese	Shepherd	117	106	223	Basu, 1985
11.	Adikar	AK	Mysore	Canarese	Scheduled Caste	101	102	203	Basu, 1985
12.	Kalita	KL	Dibrugarh/Assam	Assamese	Sudra	-	-	109	Srivastava, 1995
13.	Padma Sali	PS	Visakhapatnam/A.P.	Telegu	Weaver OBC	50	50	100	Santi Devi and Veerju, 1994
14.	Pudura Dravid	PD	Nellore & Chittor/A.P.	Telegu	Brahmin	38	33	71	Narahari, 1983
15.	Golla	GL	- Do -	Telegu	Postoral OBC	124	60	184	Narahari, 1983
16.	Madiga	MD	- Do -	Telegu	Scheduled Caste	38	22	60	Narahari, 1983
17.	Lobana	LB	Chandigarh & Jalandhar/Punjab	Punjabi	Agriculturist Group	75	71	146	Mastna, 1996



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REFERENCES

Basu. A. (1985) *Dermatoglyphices of Mysore populations.* Anthropological Survey of India, Govt. of India, Calcutta.

Basu, D. (1983) *A Study of palmar Dermatoglyphics of Bengalee Namasurdres (Mana).* M.Sc. Dissertation. Pt.Ravishankar Shukla University (Unpublished).

Basu, D.Guha, M. and Datta, U. (1992). A palmar dermatoglyphic profile of Bangladesh Namasudra Immigrants. Madhya Pradesh. *Man in India.* 72 : 105 – 113 Basu, N.K. (1949). *Hindu Samajer Caran* (in Bengali), Biswa Bharati.

Biswas. A.K. (1997). 'Letters', *Desh* (in Bengali), 8th March, pp.9 – 12.

Chanda. R.P. (1981). *Itihase Bengalee* '(in Bengali), K.P. Bagchi & Co., Calcutta.

Cummins, H. and Midlo, C. (1961). *Finger prints, palm and Soles : And Introduction to Dermatoglyphics.* Dover publications, New Yorks.

Deepkumar, V.S. and Ramchandraiah, T.(1985). Palmar C- line variation among the Telegu and Tamil weaver communities of Andhra pradesh. *Ind. J. Phys.Anthropol. & Hum. Cenet.,* 11: 71: 76

Mastana, S. (1996), polymorphism of palmar C- and D- line terminations among the Lobanas of North West India. *Man in India, 78 : 263 : 266.*

Narahari, S. (1983). Palmar C- line polymorphism in three caste groups of Andhra pradesh. Pp.321 – 328. In : *Human Biology – Recent Advances, Vol. II,* IOS Bansal (Ed.) Today & Tomorrow's printers and publishers, New Delhi.

O'Doneel, O.J. (1981). *Census of India,* Vol. I II.

Parvateesam, C. and Babu, B.V. (1997).palmar C- line polymorphism among Rajaka of Andhra pradesh, *J. Hum. Ecol.* 8 : 149 – 150.

Plato. C.C. (1970).polymorphisms of the C- line of palmar dermatoglyphics with a new classification of the C- line terminations. *Am.J.phys. Anthropol.* 33 : 413 : 420.

Sanghvi, L.D. (1953). Comparison of genetic and morphological methods for a study of biological differences. *Am.J.Phys. Anthropol.* 11 : 385 : 404.

Santi Devi.K.and Veeraju.p.(1994) C- line ter polymorphism of palms among padma Salis of Andhra pradesh *J.Hum.Ecol.* 5 : 143 – 144.

Sarkar, N.C. (1997).palmar C- line terminations among the Namasudra. *Ind.J.Phys. Anth.&Hum.Gent.* (in press)

Sokal, R.R. and Sneeth, F.H.A. (1963). *Principles of Numerical Taxonomy.* San Francisco : Freeman.

Srivastava, R.P. (1995). Biological affinities among four populations in Assam. *South Asian Anthropologis.* 16 : 41 – 45.

INVESTIGATION ON AMPLITUDE AND PHASE CHARECTERISTICS OF ELECTROCARDIOGRAPHIC POTENTIAL BY MONOPOLAR MAPPING USING POLAR CO-ORDINATE SYSTEM OF ELECTRODE PLACEMENT

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ABSTRACT

Polar co-ordinate system of electrode placement on the thorax has been used for the mapping of monopolar electrocardiogram in the present investigation. The origin of the said polar co-oridante sustem has been fixed on the chest surface from the anatomical point of view so that the electrode array becomes more or less invariant in different subjects and also in the same subject at different instants of time. In two different sets, the nonopolar electrocardiographic voltages are mapped from a number of healthy subjects(n=10).In one set electrocardiographic data have been recorded with variation of radius (r) keeping angle (θ) as a parameter (θ) and with the variation of angleθ when radius (r) is selected as parameter in the other set. Various components of electrocardiographic waves show the zones of flat amplitude response where small variation of angleθ or radius (r) will produce minimum changes in the electrocardiographic voltages and the results also show the area of sharp amplitude change which may be marked as a transition region as discussed in the text. In addition,some of the components of electrocardiographic waves represent interesting properties of phase shift in relation with the electrocardiographic pattern change in the polar co- ordiante.

Key Words : ECG mapping, Polar Co-ordinate

INTRODUCTION

Electrocardiographic mapping is an important method, other than standard twelve lead electrocardiogram, for studying the cardiac potential distribution on the body surface in nomal subjects and patients with various heart diseases. Different types of mapping procedures have been used to determine the thoracic potential distribution in normal subjects and patients.

A number of workers have studied the different components of electrocardiographic waves using various lead system of electrocardiographic mapping. The amplitude response of R-wave with different systems of electrode arrays, viz, 35 lead system,16 lead system etc. have been investigated by different research groups (Deam field et al 1983 ; Henning et al. 1978 Yusuf et al, 1979)

Fox et al (1979) noted the variation of s-wave amplitude in a 16 lead electrocardiographic map of patients with ischemia. However, the authors considered the absolute response of the said wave in mapped data. The peak amplitude response of T-waves on the body surface has been identified by Wolthuis et al (1979) using an algorithm in normal subjents. Ishikawa at al (1988) also used T-wave map in a new diagnostic methos for the identification of coronary artery disease. The significance of p-wave terminal force (negative p) in healthy middle aged man has been studied by Forfang et al (1978). In addition, inverse problem of electrocardiography has also been studied form human body surface maps (Zeselow it et

al, 1983) using a dipole model. Different mapping techniques have been employed to study the ventricular complex of the electrocardiogram. Munro et al (1973) described a new method for deriving detailed map with the display in a dynamic mode on cine film during QRS cycle. Other workers (Yamaki et al,1988;Zmyslinski et al, 1979) have pointed out the importance of QRS mapping for the diagnosis of myocardial infarction.

In usual practice of mapping , rectangular arrys are used for placement of probe electrode, i.e., the electrode is moved in vertical or horizontal direction in case of single channel recording. In multichannel recording , electrocardiographic potentials are recorded simultaneously from a row or a column of electrodes or all the electrodes placed on the array.

In the present study, the system of electrode placement for mapping has been made in a different way than the usual system. Here, the mapping of electrocardiographic potential is based on the polar co-ordinate(r-θ,were r represents radius and θ represents angle) system of electrode placement (Mitra et al, 1987) . The origin of the proposed polar co-ordinate is fixed on the front surface of the chest considering some anatomical landmarks, the procedure being discussed later in the text.

From the mapped electrocardiographic data, the effect of space co-ordiante variation(r-θ) over different electrocardiographic waves has been studied. The wave parameters show amplitude response properties in the time plane with the change of probe electrode location in the said polar co-ordinate . It is possible to locate some zones on the chest surface where various wave parameters may possess many interesting properties. A slight deviation of r or θ in the space co-ordiante may produce sharp changes in electrocardiographic wave parameter. The zones of level or relatively flat response of the wave parameters may also be identified where Δr or $\Delta\theta$ deviations in the polar co-ordinate will produce virtually no effect on the recorded waveshapes.

In addition to amplitude response properties, some electrocardiographic pattern inversion relating to phase change (inversion) charcteristics may also be observed in the time plane due to variation of electrode location in the polar co-ordinate . It may be noted that some of the parameters undergo phase change with the change of angles (i.e., $\Delta\theta$) when r is kept as parameter.

MATERIALS AND METHODS

In view of keeping the proposed polar co-ordinate relatively invarient the origin of the same is fixed on the chest surface considering some anatiomical landmarks. The said origin is fixed at a predetermined distances from Suprasternal Notch(SN) and Left Nipple(LN)as shown in Fig . 1. The distance of the Suprasternal Notch and Left Nipple from the proposed origin are approximately 15.0 cm and 2.0 cm respectively . It has been noted that the location of the origin is found to remain almost constant for a number of subjects and is very close to the standard precordial lead position V_3 as pointed out in the same Fig. 1.

The whole polar co-ordinate system on the front surface of the chest wall has been divided into four quadrants or zones, viz., first(I) , second (II) , third (III) and fourth(IV) as presented in Fig. 1 after considering some anatomical landmarks on the chest surface. The proposed quadrants are more or less invariant from subject to subject or even in the same subject at different instants of time . The straight line joining the Left Nipple(LN) and Right Nipple (RN) is approximately 15.0 cm in length and (θ=0) –line is almost parallel to this line. It may be mentioned that the classical precordial lead locations V_1 and V_2 are in the second quadrant (II), whereas the remaining precordial lead locations V_3, V_4, V_5, and V_6 are located in fourth quadrant(IV)

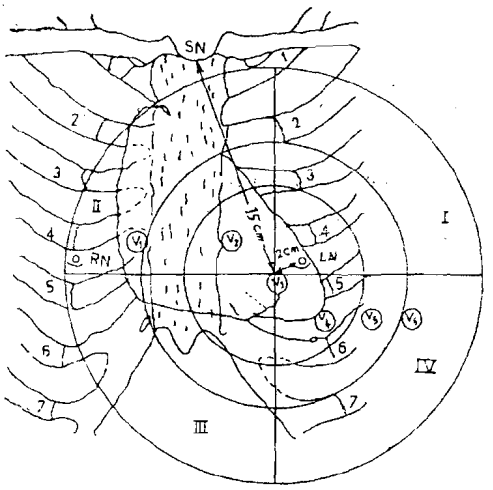


Fig. - 1

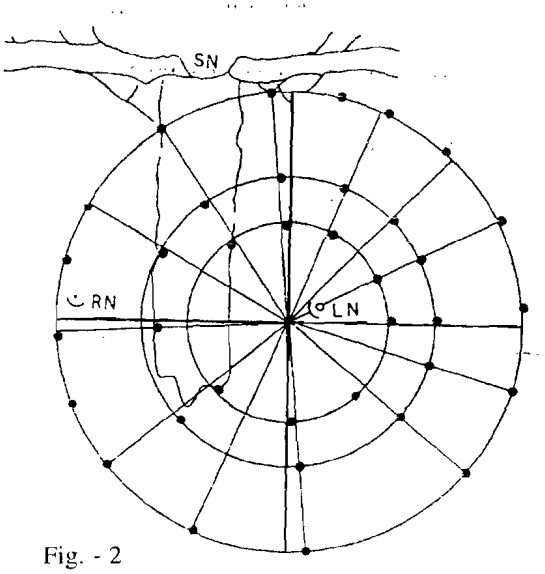


Fig. - 2

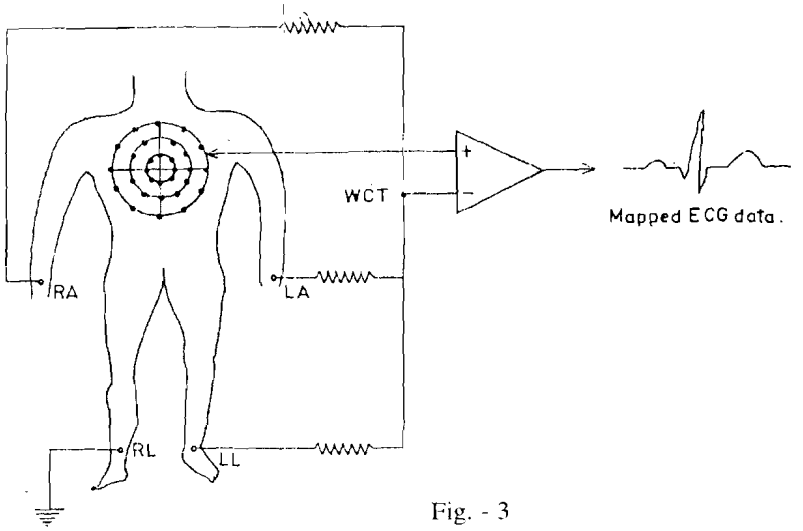


Fig. - 3

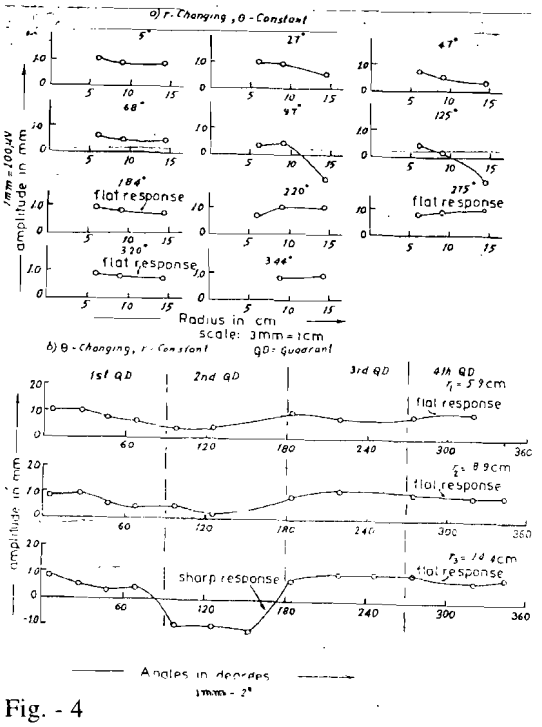
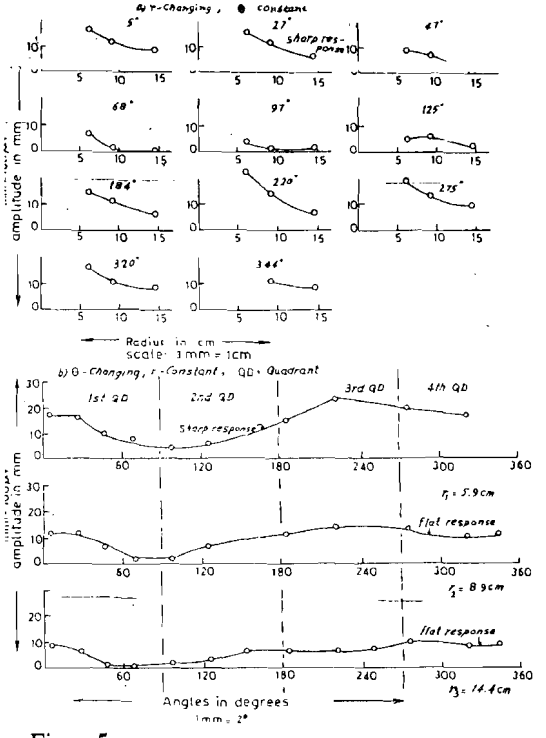

a) r - Changing, θ - Constant
flat response
flat response
flat response
Radius in cm
scale: 1mm = 1cm
b) θ - Changing, r - Constant
QD = Quadrant
1st QD
2nd QD
3rd QD
4th QD
flat response
flat response
sharp response
flat response
Angles in degrees

Fig. - 4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Angles in degrees

Fig. - 5

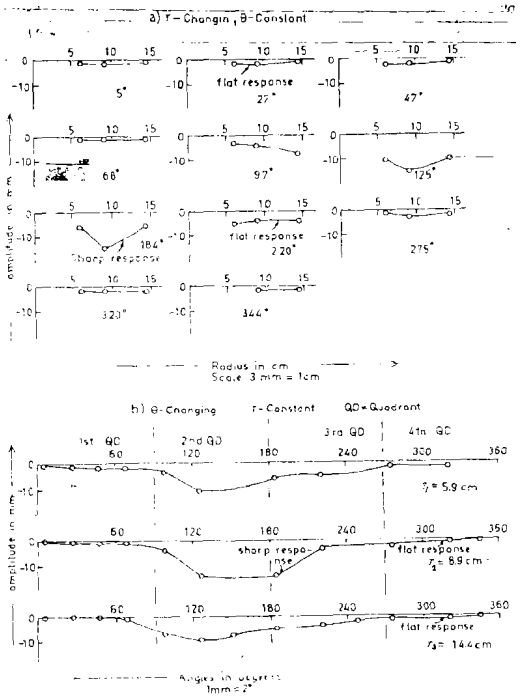
a) r - Changing, θ - Constant
flat response
sharp response
Radius in cm
Scale 3 mm = 1cm
b) θ - Changing r - Constant QD = Quadrant
1st QD
2nd QD
3rd QD
4th QD
sharp response
flat response
Angles in degrees
1mm = 2°

Fig. - 6

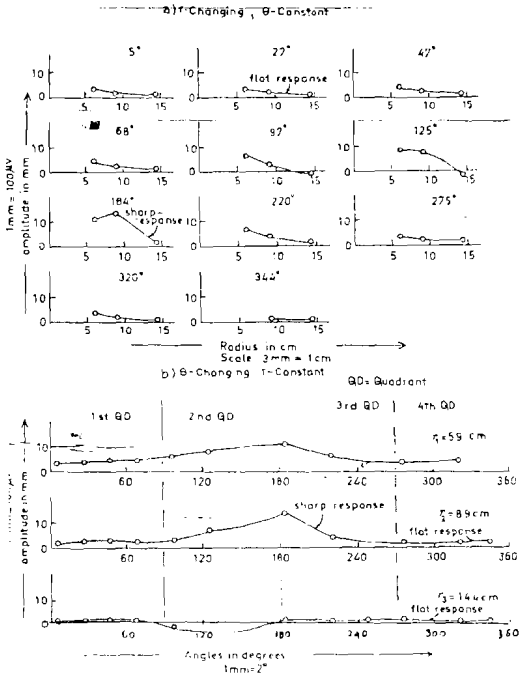
a) r - Changing, θ - Constant
flat response
sharp response
Radius in cm
Scale 3mm = 1cm
b) θ - Changing r - Constant
QD = Quadrant
1st QD
2nd QD
3rd QD
4th QD
sharp response
flat response
Angles in degrees
1mm = 2°

Fig. - 7

Three circles are drawn on the polar co-ordinate b3 by increasing the values of radius r from the specified origin. The average values of radii for different subjects are r_1 =5.0 cm , r_2 =9.9 cm. and r_3 =14.8cm. It may be mentioned that the value of the radius has been increased from the first circle to third circle in the ratio of 1:2 (approximately). The electrodes are placed on the circles with an average $\Delta\theta$=28 degrees approximately.

For the experimental study , a number of healthy human subjects (n=10) are selected within the age group 25-35 years. Electrocardiographic potentials are mapped by placing the probe electrode according to the scheme of electrode placement on the chest surface as snown in Fig. 2. The recorded voltages are unipolar, i.e., with respect to the Wilson Central Terminal(WCT). The experimental arrangement is presented in fig. 3.

During the recording of electrocardiogram, the paper speed is kept at 50mm/sec (Scher and Young, 1960). The exploring probe electrodes are placed on the body surface carefully so that the losening of the electrode may be avoided to reduce the artifacts. The usual silver-silver chloride electrodes are used for the experimental study.

The mapped unipolar electrocardiographic potentials form the cluster of electrodes refered in Fig. 2 have been grouped into two different sets,viz., i) with the change of radius (r) while angle (θ)is kept as a constant and (ii) with the variation of angle (θ)when the radius (r) is kept as parameter.

RESULTS

The peak amplitudes of p-wave , R-wave, S-wave and T-wave for all the subjects have been sampled in the time plane and the average values of p-wave and R-wave have been given in Table I and the same for S-wave and T-wave been presented in Table II. To study the level of significance for the amplitude variation in different quardants (I, II, III & IV) for all the waves one – way ANOVA for multiple groups has been done. The p values for the same has been presented in the above tables.

The variation of P-wave, S-wave , and T-wave against the change of radius (r) , when angle (θ) is constant , are graphically presented in Figs. 4a, 5a, 6a, and 7a respectively and the amplitude response against the varation of angle(θ) for different discrete values of r as parameter are also graphically shown in Figs. 4b, 5b, 6b, and 7b for the said waves. To show the phase inversion of p-and T-waves in the time plane, mapped lectrocardiographic records at different electrode positions on the polar co-ordiante are given in Fig. 8.

DISCUSSION

From the results of this study which are presented in Tables I & II and Figs. 4 to 8 , the following interesting observations have been made . It has been noted that the most stable zone of the polar co-ordinate is the fourth quadrant where a flat and steady amplitude responsc of all the waves, e.g., p-wave , s-wave and T-wave may be observed with the change of angle (θ). It may be observed form Tables I & II that in the fourth quadrant the amplitude variation with the change of angle is non – significant. In addition to that, p-wave and S-wave also represent more or less flat amplitude response in the said quadrant when radius (r) is changing (Figs. 4a & 6a) . It may not be out of place to mention that most of the classical precordial leads (i.e , V_3, V_4, V_5 and V_6 are placed in this quadrant (IV) . As the effect of change in the space co-ordinate, i.e. $\Delta\theta$ and r are minimum in these locations, a slight error in the locations of probe leectrode will produce minimum error due to change of electrocardiographic voltages, i.e. ,

$$V_{ecg} + \Delta V_{ecg} / \Delta\theta \text{ where } V \rightarrow 0$$

TABLE - 1 : Amplitude values (Mean ± SD) of P-and R-waves of the subjects (N=10) at different position on the polar co-ordinate. (P-values for each quadrant are also given.)
Qd = Quadrant. NS = Non significant

		P - Wave			R - Wave		
QD	Angle in	Amplitude in mm			Amplitude in mm		
	Degrees	r = 5.0	r = 9.9	r = 14.8	r = 5.0	r = 9.9	r = 14.8
1st	5	1.15±0.21	0.88±0.32	0.95±0.26	16.23±1.75	12.05±1.47	8.42±0.74
	27	0.72±0.28	0.66±0.21	0.45±0.10	15.67±1.06	12.3±1.08	6.22±1.05
	47	0 73±0.33	0.52±0.15	0.25±0.36	8.77±0.90	7.15±0.66	0.85±0.24
	68	0.45±0.21	0.32±0.15	0.28±0.12	5.57±0.82	1.82±0.7	0.42±0.21
	P value	P < 0.01	P < 0.01	P < 0.01	P < 0.01	P < 0.01	P < 0.01
2nd	97	0.33±0.14	0.47±0.12	-0.85±0.19	4.32±0.87	1.93±0.41	2.03±0.62
	125	0 57±0.16	0.22±0.12	0.97±0.28	5.02±0.99	6.52±0.5	3.08±0.84
	152	-	-	-1.42±0.34	-	-	5.67±1.42
	P value	P < 0.05	P < 0.01	P < 0.01	NS	P < 0.01	P < 0.01
3rd	184	0 9±0.2	0.82±0.15	0.62±0.15	14.7±1.2	11.2±0.68	6.27±0.9
	220	0.6±0.13	1.08±0.26	0.92±0.25	21.77±3.16	13.75±0.36	6.30±1.49
	247	-	-	1.08±0.26	-	-	8.0±1.04
	P value	P < 0.01	NS	P < 0.01	P < 0.01	P < 0.01	P < 0.05
4th	275	0.82±0.17	0.82±0.2	1.03±0.29	18.38±1.3	12.45±0.74	9.5±1.11
	320	0.80±0.14	0.83±0.19	0.98±0.37	17.75±1.38	11.72±1.14	9.28±2.13
	344	-	0.83±0.21	0.96±0.28	-	11.95±1.02	9.15±1.42
	P value	NS	NS	NS	NS	NS	NS

TABLE - II : Amplitude values (Mean ± SD) of S-and T-waves of the subjects (N=10) at different position on the polar co-ordinate. (P-values for each quadrant are also given.)
Qd = Quadrant. NS = Non significant

		S - Wave			T - Wave		
QD	Angle in Degrees	Amplitude in mm			Amplitude in mm		
		r = 5.0	r = 9.9	r = 14.8	r = 5.0	r = 9.9	r = 14.8
1 st	5	-1.12±0.53	-1.6±0.43	-0.7±0.24	2.98±0.41	2.38±1.30	1.8±1.03
	27	-1.6±0.30	-1.28±0.36	-0.28±0.12	3.55±0.48	2.62±1.31	1.55±0.21
	47	-2.23±0.55	-1.02±0.15	-0.78±0.5	4.42±1.4	3.20±0.83	2.40±0.59
	68	-1.72±0.26	-1.63±0.59	-1.23±0.36	4.70±0.59	2.65±0.39	1.33±0.19
	P value	P < 0.01	P < 0.05	P < 0.01	P < 0.01	NS	P < 0.05
2nd	97	-3.97±1.03	-4.45±1.57	-7.6±0.79	6.15±0.77	3.12±0.59	-0.9±0.51
	125	-10.4±0.64	-14.58±1.69	-10.73±1.63	8.18±0.37	7.03±1.94	-1.15±0.45
	152	-	-	-8.03±1.15	-	-	-1.02±0.40
	P value	P < 0.01	P < 0.01	P < 0.01	P < 0.01	P < 0.01	P < 0.01
3rd	184	-6.22±0.66	-14.22±1.52	-5.68±0.90	11.8±0.65	13.41±1.41	1.58±0.38
	220	-5.13±0.49	-4.38±0.59	-3.97±0.56	6.92±1.58	4.05±1.52	1.08±0.47
	247	-	-	-2.22±0.56	-	-	2.23±0.63
	P value	P < 0.01	P < 0.01	P < 0.01	P < 0.01	P < 0.01	P < 0.01
4th	275	-1.42±0.55	-2.96±1.04	-1.75±0.33	3.75±0.29	2.32±0.88	1.82±0.38
	320	-1.5±0.30	-1.55±0.39	-1.67±0.29	4.05±0.9	2.13±0.44	1.65±0.50
	344	-	-1.45±0.39	-1.43±0.33	-	2.02±0.22	1.70±0.45
	P valuE	NS	NS	NS	NS	NS	NS

Further , any change of wave shape at the mono-polar leads placed in this zone will mostly reveal abnormalities in the biophysical functioning of the heart. The effect of change of space co – oridnates on the changes of waveshapes due to variation of angle (θ) (in some cases radius (r) also are found to be minimum here

It also appears that the second quadrant as well as the initial part of the third quadrant of the polar co-oridnate may be indicated as the zone of transition where sharp changes in amplitudes of the waves (P,R,S,T) are noticed while both angle (θ) and radius (r) are changing . A slight deviation of probe electrode in this region may produce significant error due to change in electrocardiographic voltages. It may be mentioned that this zone corresponds to the sternum as well as the chest surface of the right side below the right clavicle.

From the Figs. 4a,5a,6a, and 7a , it may be pointed out that there is an overall tendency of decreasing of amplitudes as the values of radius is increased.

In addition to the above discussed amplitude response properties, some changes in electrocardiographic pattern involving phase response characteristivs of the same in itme plane may also be identified. This phase response characteristics can be noted with the variation of angle (θ) at the outer circle of the polar co-ordinate.

From the Fig . 8 it may be noted that P-and T-waves exihibit the said property in between first and second quadrants. An upright (or positive) P-wave is found approximately at the mid region of the first quadrant (47 degrees) and in the next portion of the same quadrant (68 degrees) the P-wave is turned into biphasic one . At the junction of the first and second quadrants(97 degrees),the P-wave is found to be inverted (negative P) and again it becomes upright (positive at the junction of second and third quadrants with an intermediate biphasic P-wave at about 152 degrees. The upright state is continued upto first quadrant. Similar types of phase inversion properties are also noted in T-wave as shown in Fig 8 .

It may be concluded that the pattern change related phase inversion of P-wave and T-wave takes place at the junction of first and second quadrants as well as at the junction of second and third quadrants.

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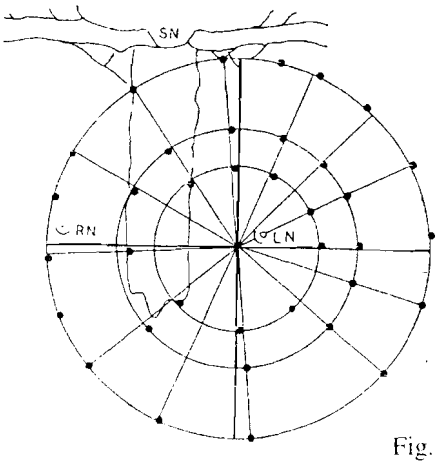

Fig. - 8

REFERENCES :

1. Deanfield, J.E., Davis, G., Mongiadi, F., Savage , C., Selwyn , A. and Fox , k. (1983) Factor influencing R wave amplitude in patients with ischemic heart disease. *Brit Heart J.*,49:8-14.
2. Forfang, K. and Erikssen, J. (1978) Significance of P-wave terminal force in presumably healthy middle aged man.
   Am Heart J.,96: 739 –742
3. Fox , k., Selwyn , A. and Shillingford, J.P.(1979) projection of electrocardiographic sign in precordial maps after exercise in patients with ischemic heart disease.
   Brit Heart J.,42:416-422.
4. Henning , H., Harderson, T., Francis, G., O'Rourke, R. A., Ryan, W. and Ross, j.(1978)Approach to the estimation of myocardial infarct size by analysis of precordial ST segment and R-wave maps. *Am J cardiol*, 41:1-6.
5. Ishikawa , T., Watabe , S., Yamada, Y. Miyachi , k...Sakai, Y..., Ito , A. and Sotobata , I. (1988) New diagnostic evidance on T- wave map involved in coronary artery patients with angina pectoris. *Circulation*,77: 301-309.
6. Mitra, T.K., Dhara, P.C. and Sikdar, B.(1987) Determination of maxima and minima of electrocardiographic potential by monopolar ECG mapping using polar co-ordiante system of electrode placement. *J. Inst Eng (India)*,IDP 67: 33-39.
7. Monro , D.M., Guarda, R.A.L., Tinker , J. , Freyer , R. and Bourdillon, P.J. (1973) New method for production of isopotential surface maps from one cardiac cycle. *Brit Heart J*,35: 560 – 567.
8. Scher, A.M. and Young , A.C(1980)Frequency analysis of the electrocardiogram. *Circ Res*, 8 : 344-451.
9. Weselowitz, D.B ., Thorsson, H.T and Jakob, G.K(1983) Inverse solution from human body surface maps. *IEEE Trans Biomed Eng*, BME –30:498-505.
10. Wolthuis , R. A. , Hopkrik, A. , Keiser, N. and Fischer ,J.R. (1979) T-wave in the exercise ECG, their location and occurance . *IEEE Trans Biomed Eng* ,BME-26:639 –645.
11. Yamaki, M. , Ikeda, k. Honma, K. , Kiriyama, N. , Tono –oka, I. , Tsuiki, k. and Yashi, S. (1988) . Diagnosis of right ventricular involvement in chronic inferior myocardial infarction by means of boby surface QRS changes. *Circulation*,77 : 1283- 1288.
12. Yusuf , S. , Lopez, R. , Maddison , A. and Sleight, P(1979) variablity of electrocardiograohic and enzyme evaluation of myocardial infarction in man. *Brit Heart J*,42: 286-291.
13. Zmyslinski , R.W. , Akiyama. T. , Briddle , T.L. and Shah, P.M.(1979) Natural course of ST segment and QRS complex in patients with acute anterior myocardial infarction. *Am J Cardiol*,43:29-34.

Fig. 1 : Polar co-ordinate on the chesst surface (Center fixed at the point 15 cm from SN and 2 cm from LN. SN-suprasternal Notch, LN – Left Nipple, RN- Right Nipple; Outer circle (r3) =14.8cm. Middle circle(r2) =9.9 cm. Inner circle(ri) =5.0 cm)

Fig. 2 : Scheme for the electrode placement in the polar co-ordinate (SN =Suprasternal Notch, RN=Right Nipple , LN=Left Nipple)

Fig. 3 : Experimental arrangement for ECG mapping using polar co-ordinate system of electrode placement. (symbols are of their usual significance,

Fig. 4 : Amplitude response of R-wave in polar co- ordinate

Fig. 5 : Amplitude response of R-wave in polar co- ordinate .

Fig. 6 : Amplitude response of S-wave in polar co-ordinate.

Fig.7 : Amplitude response of T-wave in polar co-ordinate.

Fig. 8 : Electrocardiographic records at different electrode positions of the polar co-ordinate showing pattern changes of P-and T-Waves.

PHYSIOLOGICAL STUDIES ON ALLELOPATHIC POTENTIAL OF *EUCALYPTUS* AND *PARTHENIUM*

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ABSTRACT

Allelopathic action of *Eucalyptus* and *Parthenium* was evaluated using fresh and dry leaf extracts. Pretreatment of black gram seeds with the leaf extracts of the two plant species strongly retarded percentage seed germination and such retardation was found to be drastic when the seeds underwent accelerated ageing treatments for 30 days (99.5% relative humidity). While *Eucalyptus* leaf exrtracts showed high T hours of the germinating seeds, *Parthenium* treated seed samples failed to attain 50% germination at all in non-aged seeds, and in acceleratedly-aged sceds no seed sample, either treated or untreated, could reach 50% germination. Concomitantly, speed of seed germination was significantly slowed down by the leaf extract of both the species. The effect of *Parthenium* was more injurious than that of *Eucalyptus* and effect of seed ageing was drastic in this regard. In acceleratedly-aged seeds *Parthenium* extract hindered TTC stainability but *Eucalyptus* extract enhanced it. Leaching of sugars and amino acids from *Parthenium* treated seed samples was high while *Eucalyptus* treatment arrested the leaching. Accelerated ageing treatment significantly reduced protein, DNA and RNA contents as well as activities of dehydrogenase and catalase enzymes. However, *Eucalyptus* treatment alleviated the ageing-induced reduction of the parameters while *Parthenium* the effect was found inhibitory. Protease activity was decreased by seed pretreatment with *Eucalyptus* extract but it was increased by Parthenium treatment and the effect was reverse in case of amylase. Overall seedling growth, measured in terms of root length, shoot length, leaf number, leaf area and hypocotyl circumference was inhibited by seed pretreatment with *Parthenium* extract but the effect of *Eucalyptus* leaf extract was found to be stimulatory. Differential effect of *Parthenium* and *Eucalyptus* leaf extracts on exerting their allelopathic actions on seed germination behaviour, seed metabolism and seedling growth is discussed.

Key Words: Allelopathy, *Eucalyptus, Parthenium*, Seed germination, growth, enzymes and nucleic acids.

INTRODUCTION

Allelopathy is defined as the effect of one plant upon another occurring under natural conditions and exerted by chemical means other than nutritional ones (**Evenari, 1961**). This form of interference is basically different from competition which acts through depletion of resources (**Tinnin and Muller, 1971**). Allelopathy is also an expression of the ecological phenomena, which are normal constituents of the environment of the terrestrial plants (**Datta and Sinha Roy, 1974**).

Anything , which prevents seed germination and discourages a species from thriving, must have a strong influence on the constitution of the plant community. This could perhaps indicates an allelopathic effect and led to an exhaustive survey, revealing the presence of germination and growth inhibitors.

Considerable evidences have been adduced during the last five decades demonstrating the presence of inhibitory compounds in a wide variety of plant parts (**Eberhardt, 1954; Garb, 1961; Muller *et al*; 1964; Datta and Sinha Roy, 1974; Datta and Chatterjee, 1980; Datta *et al.*, 1985; Narwal, 1994;**

Inderjit *et al.*, 1995; Basavaraju and Rao, 2000). Among the compounds mentioned are simple water souble organic acids, straight chain alcohols, aliphatic aldehydes and ketones, simple unsaturated lactones, long chain fatty acids, napthoquinones, terpenoids and steroids, simple phenols, benzoic acid and derivatives, cinnamic acid and derivaties, coumarins, flavonoids, tannins, alkaloids and cyanohydrins etc. (**Bandyopadhyay, 1983**). These compounds are not only restricted to seeds and fruits but are also found in roots, leaves and other parts of the plant.

In the present investigation an attempt is made to assess the allelopathic potential of a fast growing tree *Eucalyptus globulus* Labill. (Myrtaceae) which yields a volatile oil and that of a noxious weed *Parthenium hysterophorus* Linn. (Asteraceae). Allelopathic efficacy of the two plant species was analysed by some reliable bioassay methods using black gram (*Phaseolus mungo* L.cv. black) seeds. In fact, allelopathic action of any plant or plant part influences germination behaviour, metabolism as well as growth and development of seeds and seedlings (**Ghosh, 1979**). Further, storage potential of black gram seeds as a result of seed pretreatment with the leaf extracts of the plant species was evaluated under accelerated ageing environment. Accelerated ageing treatment, as imposed by high temperature and high relative humidity, provides a powerful tool for studying the processes of seed deterioration even within a very short period, since such treatment augments the harmful biochemical process associated with natural seed deterioration (Heydecker, 1972).

Thus the prime objective of this work is to analyse and compare the allelopathic potential and seed storability of the *Eucalyptus* and *Parthenium* leaf extracts under both normal and accelerated ageing environments.

MATERIALS AND METHODS

Mature and healthy leaves of *Eucalyptus globulus* and *Parthenium hysterophorus* growing around University campus were procured. Hundred gram fresh leaves of each species were thoroughly homogenized using 100 ml distilled water. The homogenate was then strained with the help of a fine cloth and subsequently centrifuged at 5000 g for 15 minutes. The filtrate was then made upto 500 ml and this sample was considered as seed pretreating agent (fresh leaf extract). For preparation of dry leaf extract 100g leaf samples of each species were oven-dried at 70°C for 72 hours. The dried samples were homogenized, strained, centrifuged and prepared 500 ml volume following the same procedure.

Healthy seeds (80% germination potential) of black gram in five lots of 200 g each were surface sterilized for 90 seconds with 0.1% $HgCl_2$ solution. The seeds were then separately presoaked for 8 hours in aqueous extracts of fresh and dried *Eucalyptus* and *Parthenium* leaves or distilled water and then dried back to original seed moisture level. Subsequently all the seed samples were taken in separate porous cloth bags and thus stored in a desiccator in which 99.5% relative humidity (RH) was preimposed by keeping 250 ml 1.57% H_2SO_4 .This experimental setup was kept in room temperature (32 ± 2°C) and thus the seeds were allowed to experience forced ageing treatment.

Data on seed germination behaviour, TTC stainability, metabolism of germinating seeds were analysed after 0 and 30 days of accelerated ageing treatment. Seedling growth, recorded in terms of root lenght, shoot lenght, leaf number, area and hypocotyl circumference, was analysed from 15-day-old seedlings, raised from seeds which underwant accelerated ageing for 0 and 30 days.

To analyse percentage seed germination, four groups of 50 seeds of each treatment (200 seeds for each treatment), were transferred to separate Petri dishes containing filter paper moistened with 10 ml distilled water. Germination data were recorded after 96 h of seed soaking following the International Rules for Seed Testing (**ISTA, 1976**). The time for 50% germination, of the seeds (T50) was determined following the method described by **Coolbear et al. (1984)**. Speed of germination, according to **Halder**

(1981) , was analysed at an interval of 12 hours upto 96 hours of seed soaking.

For analysing TTC stainability, four 40-seed samples of de-husked black gram seeds of each ageing period (0 and 30 days) were allowed to imbibe 0.5% TTC (2, 3, 5-triphenyl tetrazolium chloride) solution (w / v) in petri dishes for 18 hours in dark condition. Percentage TTC staining as well as differential staining pattern(viz., without colour, fully coloured, partially coloured) were recorded. The sugar (**McCready et al., 1950**) and amino acid (**Moore and Stein, 1948**) were analysed from seed leachates obtained after immersing 5 g seeds in 10 ml deionized distilled water for 16 hours. Protein level was analysed from seed kernels following the method of **Lowry et al (1951)**. DNA and RNA were extracted (**Biswas and Choudhuri, 1978**) and estimated as per the method of **Cherry (1962)** modified by **Choudhuri and Chatterjee (1970).**

Activity of total dehydrogenase was analysed by the reaction of tetrazolium chloride according to the method of **Rudrapal and Basu (1979).** The hydrogen atoms released by the dehydrogenase enzyme which are involved in the respiration process of living tissue, reduce tetrazolium to red coloured formazan (**Moore, 1973**). Extraction and estimation of the enzyme catalase was made following the method **Snell and Snell (1971)** as modified by **Biswas and Choudhuri (1978)**. For assaying this enzyme, the blank was taken as zero time control, and the activity was expressed as (A x Tv / txv), where A is the absorbance of the sample after incubation minus absorbance of the zero time control, Tv is the total volume of the filtrate, t is the time (min) of incubation with the substrate and v is the volume of the filtrate taken for incubation (**Fick and Qualset, 1975**). Extraction procedure of protease enzyme was the same as that of catalase (**Snell and Snell, 1971**). Protease activity was measured by incubation of the reaction mixture consisting of 1 ml enzyme extract, 0.1 ml $MgSO_4$, 7H O (0.1M) and 1 ml BSA (0.5 mg/ml), dissolved in distilled water for 1 hour at 37°C followed by adding 1 ml 50% trichloroacetic acid and subsequent analysis of residual protein by Folin-phenol reagent (**Lowry et al, 1951**). Activity of the enzyme amylase was estimated following the method of **Khan and Faust (1967)** with some modification (**Rai,2000**).

Root lenght, shoot lenght, leaf number, leaf area and hypocotyl circumference were recorded from 10 uniformly growing seedlings (15-day-old) of each treatment. The seedlings were grown in plastic trays containing sand and sawdust (1:1).

RESULTS

Seed germinability and T50 (Table 1): Leaf extracts of *Eucalyptus* and *Parthenium* (both dry and fresh) strongly retarded percentage seed germination in non-aged seeds. The effect of *Parthenium* was found more inhibitory than that of *Eucalyptus* and in both the cases fresh leaf extracts were more injurious than dry ones. In acceleratedly aged seeds, the inhibitory effect was found drastic. Concomitantly, in non-aged seeds time (h) required for 50% germination was noted very high in both the samples of *Eucalyptus* only. In both the leaf samples of *Parthenium*, seeds could never attain 50% germination and this was true in all the pretreated seed samples which underwent accelerated ageing for 30 days.

Speed of germination (Table 2): Germination speed was significantly slowed down at all the treatments. Here also, *Parthenium* leaf extracts exerted much more injurious effect than *Eucalyptus* extracts, and the effect of seed ageing was found drastic with respect to retardation of the speed of germination.

TTC stainability (Table 3): Treatment of the black gram seeds with leaf extracts of all types could not alter gross TTC stainability of the non-aged seeds. In acceleratedly aged seeds, however, a differential result was noted. Here, both dry and fresh extracts of *Eucalyptus* significantly enhanced percentage seed staining whereas *Parthenium* extracts decreased it. Concomitantly, fully coloured as well as partially coloured seeds were found higher in *Eucalyptus* samples.

Table 1. Effect of seed pretreatment with leaf extracts (dry and fresh) of Eucalyptus and Parthenium on germination (percentage) and T50 (hours) of black gram seeds stored under accelerated ageing condition for 0 and 30 days

Treatment	Accelerated ageing (0 days)		Accelerated ageing (30 days)	
	Germination	T 50	Germination	T 50
Control	80.5	12.5	4.9	NA
Eucalyptus (dry)	53.9	71.5	8.5	NA
Eucalyptus (fresh)	48.8	23.6	9.6	NA
Parthenium (dry)	34.1	NA	3.5	NA
Parthenium (fresh)	20.6	NA	2.5	NA
LSD (P=0.05)	3.05	2.80	0.40	–

NA : Non-attainment of 50% Germination

Table 3. Effect of seed pretreatment with leaf extracts (dry and fresh) of Eucalyptus and Parthenium on Percentage TTC Stained (PTS) seeds as well as TTC staining parttern (WC, without colour; FC, fully coloured; PC, partially coloured) of black gram seeds stored under accelerated ageing condition for 0 and 30 days

Treatment	Accelerated ageing (0 days)				Accelerated ageing (30 days)			
	TTC Stainability (percent)							
	PTS	WC	FC	PC	PTS	WC	FC	PC
Control	100.00	0.00	43.00	57.00	78.00	18.00	24.00	36.00
Eucalyptus (dry)	99.00	1.00	37.00	61.00	92.00	14.00	29.00	49.00
Eucalyptus (fresh)	100.00	0.00	23.00	77.00	95.00	12.00	34.00	49.00
Parthenium (dry)	100.00	0.00	36.00	64.00	62.00	27.00	19.00	16.00
Parthenium (fresh)	100.00	0.00	24.00	76.00	56.00	32.00	17.00	7.00
LSD (P=0.05)	NC	NC	2.56	5.05	6.55	1.50	1.66	0.95

NC : Not calculated

Leaching of sugars and amino acids (Table 4): Both sugar and amino acid levels rapidly increased in forced aged seeds. Leaf extracts of *Eucalyptus* (both fresh and dry) significantly arrested sugar leaching while that of *Parthenium* enhanced leaching from the seeds.

Protein, DNA and RNA levels (Table 5): Accelerated ageing treatment resulted in significant reduction of protein, DNA and RNA contents in the black gram seeds. Seed pretreatment with only *Eucalyptus* leaf extracts alleviated the ageing-induced reduction of the macromolecules.

Dehydrogenase and calatase activities (Table 6): Activities of both the enzymes were seriously impaired in acceleratedly aged seed samples irrespective of treatments. But in seed pretreatment with *Eucalyptus* the enzyme levels were found considerably higher than the control sample. However, the effect of *Parthenium* was found inhibitory in both aged and non aged seed samples.

Table 4. Effect of seed pretreatment with leaf extracts (dry and fresh) of Eucalyptus and Parthenium on leaching of sugar(mg//g/10 ml) and aminoacids (mg/g/10 ml) from black gram seeds stored under accelerated ageing condition for 0 and 30 days

Treatment	Accelerated ageing (0 days)		Accelerated ageing (30 days)	
	Sugar	Amino acids	Sugar	Amino acids
Control	2.05	1.05	14.50	7.57
Eucalyptus (dry)	1.88	0.90	12.05	6.60
Eucalyptus (fresh)	1.75	0.86	10.75	6.55
Parthenium (dry)	2.75	1.62	16.88	10.98
Parthenium (fresh)	2.90	1.75	18.15	10.98
LSD (P=0.05)	0.18	0.10	1.15	0.87

Table 5. Effect of seed pretreatment with leaf extracts (dry and fresh) of Eucalyptus and Parthenium on protein (ug/g wet weight) DNA (ug/g wet weight) and RNA (ug/g wet weight) levels in kernels of black gram seeds stored under accelerated ageing condition for 0 and 30 days

Treatment	Accelerated ageing (0 days)			Accelerated ageing (30 days)		
	Protein	DNA	RNA	Protein	DNA	RNA
Control	125.50	298.50	825.60	60.50	137.60	466.50
Eucalyptus (dry)	148.70	328.70	880.70	70.90	156.70	507.20
Eucalyptus (fresh)	155.70	325.50	871.50	75.60	165.00	528.80
Parthenium (dry)	98.50	260.70	623.70	49.60	112.70	315.60
Parthenium (fresh)	95.00	248.50	601.90	50.50	110.80	288.80
LSD (P=0.05)	10.75	22.70	57.70	4.98	11.55	35.70

Table 6. Effect of seed pretreatment with leaf extracts (dry and fresh) of Eucalyptus and Parthenium on dehydrogenase (ΔOD/g wet weight) and catalase [ΔOD x Tv/(txv)] activities in kernels of black gram seeds stored under accelerated ageing condition for 0 and 30 days

Treatment	Accelerated ageing (0 days)		Accelerated ageing (30 days)	
	Dehydrogenase	Catalase	Dehydrogenase	Catalase
Control	0.55	115.70	0.10	59.50
Eucalyptus (dry)	0.65	138.50	0.15	68.50
Eucalyptus (fresh)	0.65	125.50	0.15	72.20
Parthenium (dry)	0.45	92.50	0.06	42.50
Parthenium (fresh)	0.43	88.60	0.06	40.00
LSD (P=0.05)	0.02	10.05	0.10	5.06

Protease and amylase activities (Table 7): Both protease and amylase activities were found to increase in accelerated ageing treatments. Seed pretreatment with *Eucalyptus* and *Parthenium* respectively decreased and increased protease activities in both the aged and non aged samples. The effect was found reverse when the leaf extract-induced changes in the activities of the enzyme amylase was concerned.

Table 7. Effect of seed pretreatment with leaf extracts (dry and fresh) of Eucalyptus and Parthenium on protease and amylase activities in kernels of black gram seeds stored under accelerated ageing condition for 0 and 30 days

Treatment	Accelerated ageing (0 days)		Accelerated ageing (30 days)	
	Protease	Amylase	Protease	Amylase
Control	35.50	24.50	97.50	48.70
Eucalyptus (dry)	27.00	30.70	82.70	56.60
Eucalyptus (fresh)	25.00	31.00	80.80	59.90
Parthenium (dry)	48.70	18.20	125.80	38.70
Parthenium (fresh)	42.50	15.70	136.90	36.50
LSD (P=0.05)	2.75	2.00	9.88	4.65

Seedling growth (Table 8): While both *Eucalyptus* and *Parthenium* extracts stimulated root growths in non-aged seed samples, the same effect was found stimulatory in *Eucalyptus* leaf extract treatments and

Table 2. Effect of seed pretreatment with leaf extracts (dry and fresh) of *Eucalyptus* and *Parthenium* on the speed of germination of black gram seeds stored under accelerated ageing condition for 0 and 30 days

Treatment	Accelerated ageing (0 days)								Accelerated ageing (30 days)							
	12	24	36	48	60	72	84	96	12	24	36	48	60	72	84	96
Control	49.10	60.40	72.90	76.00	78.30	80.50	80.50	80.50	1.00	3.20	3.50	4.00	4.50	4.90	4.90	4.90
Eucalyptus (dry)	14.40	16.90	26.00	34.10	46.00	51.50	53.90	53.90	0.00	0.00	1.00	3.50	5.00	6.40	8.50	8.50
Eucalyptus (fresh)	12.60	16.00	21.70	25.90	39.70	43.70	47.10	48.80	0.00	1.00	2.00	3.50	4.90	6.00	8.80	9.60
Parthenium (dry)	8.90	10.80	15.80	24.00	31.10	33.30	34.10	34.10	0.00	0.00	1.00	1.50	1.90	2.60	3.00	3.50
Parthenium (fresh)	5.10	7.20	9.30	13.00	15.60	17.20	19.50	20.60	0.00	0.00	0.00	0.00	1.00	1.80	2.50	2.50
LSD (P=0.05)	1.05	1.99	2.50	2.66	3.01	3.05	2.50	3.05	NC	0.10	0.20	0.21	0.19	0.16	0.30	0.40

Table 8. Effect of seed pretreatment with leaf extracts (dry and fresh) of *Eucalyptus* and *Parthenium* on root length (mm), shoot length (mm), leaf number, leaf area (mm^2) and hypocotyl circumference (mm) of black gram seeds stored under accelerated ageing condition for 0 and 30 days

Treatment	Accelerated ageing (0 days)					Accelerated ageing (30 days)				
	Root Length	Shoot Length	Leaf Number	Leaf Area	Hypocotyl Circumference	Root Length	Shoot Length	Leaf Number	Leaf Area	Hypocotyl Circumference
Control	90.60	152.70	2.00	256.80	6.80	51.50	66.50	2.00	148.00	6.00
Eucalyptus (dry)	115.20	169.50	2.00	309.20	6.80	76.60	80.00	2.00	220.40	6.20
Eucalyptus (fresh)	106.20	229.20	2.00	384.40	6.80	85.20	83.90	2.00	236.20	6.20
Parthenium (dry)	108.40	104.20	2.00	167.80	5.50	40.60	52.50	2.00	121.70	6.00
Parthenium(fresh)	110.40	130.20	2.00	157.50	5.80	41.80	48.80	2.00	115.80	5.20
LSD (P=0.05)	9.50	12.05	NC	18.75	0.50	5.01	5.08	NC	12.25	0.50

inhibitory in *Parthenium* treatments on seed aged for 30 days. As regards changes of shoot length and leaf area *Eucalyptus*-induced effect was found promotive while *Parthenium*-induced effect was distinctly inhibitory irrespective of seed ageing. However, leaf number and hypocotyl circumference were unaffected or least affected.

DISCUSSION

The present study shows that pretreatment of black gram seeds with fresh and dry leaf extracts of *Eucalyptus* and *Parthenium* reduced seed germinability, enhanced T50 hours or inhibited to attain it at all (Table 1) and retarded the speed of seed germination (Table 2). However, the effect of the leaf extracts of the two plant species was found to be distinctly differential in subsequent analyses of parameters like TTC stainability (Table 3), leaching of sugars and amino acids (Table 4), protein, DNA and RNA contents in seed kernels (Table 5), activities of dehydrogenase and catalase enzymes (Table 6), activities of protease and amylase enzymes (Table 7) and seedling growth measured in terms of root length, shoot length, leaf number, leaf area and hypocotyl circumference (Table 8). In all the cases, seed pretreatment with *Parthenium* leaf extracts (both dry and fresh) was found to be inhibitory. Interestingly, seed pretreatment with *Eucalyptus* leaf extracts was recorded to be beneficial as would be evident by significant enhancement of TTC stainability, inhibiton of higher leaching of sugars and amino acids which is considered to be deleterious, retention capacity of vital macromolecules like protein, DNA and RNA even under stressful ageing situation, augmentation of beneficial enzymes like dehydrogenase and catalase of non-aged with concomitant arrestation of the loss of the enzyme activities in forced ageing condition, suppression of the levels of catabolic enzyme like protease along with stimulation of amylase activities and enhanced overall growth performance of the seedlings.

Reduced seed germinability and slower rate of germination by extracts of any plant or plant parts are considered to be reliable allelopathic action of the plant and such action is exerted chiefly by a number of inhibitors of diverse chemical natures (**Bandyopadhyay, 1983**). Hence seed germination behaviour is often accepted as a reliable bioassay method for assessing allelopathic potential of plants. In the present study the leaf extract-induced inhibition of overall performance of seed germination is indicative of the allelopathic action of the test material. However, although inhibitory action of *Parthenium* extracts was clearly established from all the parameters recorded in this investigation, the effect of *Eucalyptus* extracts was found to be surprisingly promotive. Such effect of *Eucalyptus* can possibly be explained by its possession of a volatile oil. Many volatile oils have been reported to have antimicrobial property (**Dey and Choudhuri, 1984; Chhetri *et al.*, 1993**) and this causes to antagonize many deleterious effects in plants. *Eucalyptus* oil-induced enhancement of seed germinability and metabolism has also recently been reported (**Maity** et al., 2000), and this result is in conformity with reported observation.

Results, therefore, pointed out that the effect of leaf extracts of two plant species are distinctly differential at least when seed metabolism and seedling performance were considered. Data further revealed that in spite of accelerated ageing treatment of the test seeds, pretreated with leaf extract of *Eucalyptus* oil performed better than control ones with respect to their metabolic status as well as seedling establishment. Thus, a conclusion is made from the overall results of this investigation that *Parthenium* leaf extract can exert a strong inhibitory effect while the effect of *Eucalyptus* leaf extract is stimulatory. However, the exact mechanism of such differential action needs to be explored.

REFERENCES

Bandyopadhyay, A. (1983). *Germination and growth inhibitors in three weeds of West Bengal.* Ph.D. Thesis. The University of Calcutta, Calcutta.

Basavaraju, T.B. and Rao, M.R.G. (2000). Tree-crop Interactions in Agroforestry System – A Brief Review. *Indian Forester,* 126, 1155-1164.

Biswas, A.K. and Choudhuri, M.A. (1978). Differential behaviours of the flag leaf of Intact rice plant during ageing. *Biochemie and Physiologie der Pflanzen,* **173**, 220-228.

Cherry, J.H. (1962). Nucleic acid determination in storage tissue of higher plants. *Plant physiology*, **37**, 670-678.

Chhetri, D.R., Rai, A.S. and Bhattacharjee, A. (1993). Chemcial manipulation of seed Longevity of four crop species in an unfavourable storage environment. *Seed Science and Technology*, **21,** 31-44.

Choudhuri, M.A. and Chatterjee, S.K. (1970). Seasonal changes in the levels of some cellular components in the abscission zone of *Coleus* leaves of different ages. *Annals of Botany*, **34,** 275-287.

Coolbear, P., Francis, A. and Grierson, D. (1984). The effect of low temperature Presowing treatment on the germination performance and membrane integrity of artificially aged tomato seeds. *Journal of Experimental Botany*, **35,** 1609-1607

Datta, S.C. and Chatterjee, A.K. (1980). Pollution by Plants. In: *Symposium on Environmental Pollution and Toxicologty* (Roy Choudhury, S.P., ed.) pp. 195-214. Today and Tommorrow, New Delhi.

Datta, S.C. Das, T. and Bhakat, R.K. (1985). Inhibitors in leaf of road-side trees during various seasons. *Sceince and Culture*, 51, 313-315.

Datta, S.C. and Sinha Roy, S.P. (1974). Allelopathy and inhibitors. *Science and Culture, **40,** 47-59.*

Dey, B.B. and Choudhuri, M.A. (1984). Esential oil of *Ocimum sanctum* L. and its antimicrobial activity. *Indian Perfumer*, **28**, 82-87.

Eberhardt, F. (1954). Ausscheidung einer organischen verbendung aus den Wurzeln des Hafers *(Avena sativa). Naturwiss*, **41**, 259-260.

Evenari, M. (1961). Chemial influence of other plants (Allelopathy). In : *Handbuchder Pflanzenphysiologie* (Ruhland, W., ed.), pp. 691-736. Springer Verlag, Berlin.

Fick, N.G. and Qualset, C.O. (1975). Genetic control of endosperm amylase activity and gibberellin responses in standard height and short statured wheat. *Proceedings of National Academy of Science*, USA, 72, 422-423.

Ghosh, K.N. (1979). *Allelopathic potential of two species of Chenopodium Linn.* Ph.D. Thesis. University of Calcutta, Calcutta.

Halder, S (1981). *Studies on viability, yeild and associated biochemical changes in leaves during seed filling in sunflower (Helianthus annuus L. cv. EC 68414).* Ph.D. Thesis, Burdwan University, Burdwan.

Heydecker, W. (1972). Vigour. In : *Viability of Seeds.* (Roberts, E.H. ed.), pp. 209-252. Chapman and Hall, London.

Inderjit, Dakshini, K.M.M. and Einhelling, F.A. (eds.) (1995). *Allelopathy : Organisms, Processes and Applications*, American Chemical Society, Washington, D.C.

International Seed Testing Association (1976). International Rules for seed Testing. Seed Science and Technology, 4, 51-177.

Khan, A.A. and Faust, M.A. (1967). Effect of growth retardants on α-amylase production in germinating barley seeds. *Physiologia Plantarum*, 20, 673-681.

Lowry, O.H., Resebrough, N.J., Farr, and A.L., Randall, R.J. (1951). Protein measurement with Folin-phenol reagent. *Journal of Biological Chemistry*, 193, 263-275.

Maity, S., Banerjee, G., Roy, M., Pal, C. Pal, B., Chakrabarti, D., and Bhattacharjee, A. (2000). Chemical induced prolongation of seed viability and stress tolerance capacity of mung been seedings. *Seed Science and Technology,* 28, 155-162.

McCready, R.M., Guggloz, J., Silvirera, V. and Owens, H.S. (1950). Determination of starch and amylase in vegetables. *Analytical Chmistry,* 22, 1156-1158.

Moore, S. and Stein, W.W. (1948). Photometric ninhydrin method for use in the chromatography of amino acids. *Journal of Biological Chemistry,* 176, 367-388.

Moore, R.P. (1973). Tetrazolium staining for assessingh seed quality. In : Seed Ecology, (Heydecker, W.ed.) Butterworths, London.

Muller, C.H., Muller, W.H. and Haines, B.L. (1964). Volatile growth inhibitors produced by aromatic shrubs. Science, 143, 471-473.

Narwal, S.C. (1994). Allelopathy in Crop Production, Scientific Publishers, Jodhpur. Rai. A. (2000). An investigation into the problems of maintenance of seed vigour and viability under adverse climatic condition of Darjeelings hills. Ph.D. Thesis, North Bengal University, India.

Rudrapal, A.B. and Basu, R.N. (1979). Physiology of hydration-dehydration treatments in the maintenance of seed viability in wheat. Indian Journal of Experimental Biology, 17, 768-771.

Snell, F.D. and Snell, C.T. (1971). Colorimetric Methods of analysis. Van Nostrand Reinhold Co., New York.

Tinnin, R.O. and Muller, C.H. (1971). The allelopathic potential of Avena fatua : Influence of herb distribution. Bulletin of Torrey Botanical club. 98, 243-250.

ANTHROPOGENIC ACTIVITIES: LOSS OF ICHTHYOFAUNAL DIVERSITY IN INDIA.

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ABSTRACT

During last four decades, fishery resources in India are under considerable and tremendous pressure because of different anthropogenic activities. Rapid industrialization, agricultural pollution, urbanization, construction of barrages and dams over exploitation, introduction of exotic species etc, destroy the physico-chemical quality of water, loss of habitat and the diversity of the ichthyofauna. These activities result in gradual extinction of the Icthyofauna including several economically important species. The present study highlights those activities in India, which affect the diversity of the fishes.

Key words : Ichthyofauna ,Diversity , Water quality, Anthropogenic activity.

INTRODUCTION

For their survival and to perform various types of activities during their life cycle, all living creatures need a platform and earth 95 crust is only a part of the universe in which every living creature can survive easily. Man's relationship with land since the origin of life and the different types of activities performed by human beings are always left in the soil of earth (Forswan *et.al.* 2001). Such type of human activities are popularly known as anthropogenic activities. Inland fishery resources of India are under considerable and sustained pressure of several anthropogenic activities associated with land and water resources development. These activities have resulted in habitat loss and degradation and consequent decline in the distribution and abundance of ichthyofauna in India . Due to various anthropogenic stresses like rapid industrialization., habitat destruction, siltation in rivers mainly due to deforestation, sewage disposal, agricultural pollution, over exploitation, illegal killing of juveniles and brood fishes and introduction of exotic species are now showing declining catch trends and some have already been threatened .

The major anthropogenic activities, which affect on population of ichthyofauna of India are:

1. Pollution due to rapid industrialization and urbanization beside the river banks.
2. Construction of barrages and dams.
3. Inter river transfer of water .
4. Channelization of the river water into irrigation canals.
5. Deforestation.
6. Introduction of exotic species
7. Over exploitation of ichthyofauna.

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8. Dynamite fishing in the river of hill streams.
9. Juvenile destruction.
10. Killing of fish .
11. Application of improved fishing technology.

1. Pollution due to rapid industrialization and overpopulation beside the river banks.

Right from human civilization , the tendency of human beings was to establish their habitat besides the river banks. In India in most of the river banks, specially the Ganga and Yamuna, the population density is very high and there has been a heavy concentration of industries in those areas. Due to these different activities of human beings are polluting the natural water body day by day . Riverine environment in India is subjected to the worst form of environmental degradation due to man-made changes which affect the fish yield in particular (Anon. 1996). Natural water resources are polluted by human activities in different ways, which are given below:

- Untreated or semi-digested sewage is discharged into rivers, lakes and estuaries, which increases the BOD and causes depletion of dissolved oxygen levels.
- Agricultural wastes like different pesticides, insecticides used in fields are washed with rain water and find their way into rivers, lakes along with different fertilizers.
- Different industrial wastes directly fall into the rivers, sea and lakes causing heavy metal pollution, oil pollution etc(Shrivastava, *et al.*, 2001).
- Different plastic materials used in daily life and thrown into the natural water bodies , which an non-biodegradable , chokes the water bodies, water surface, channels and create problems to fishes in different ways (Anon ,1982).
- Different modern fishing crafts release their fuel into sea rivers and other water bodies and finally pollute the water resources.
- In daily life human beings are using natural water bodies and releasing the diesel, mobil, petrol and detergents into these environments which pollute the water bodies and create problem to ichthyofauna.

Water pollution affects the distribution and abundance of fish fauna directly as well as indirectly . Direct effects of pollution cause mortality of fish ,decrease appetite and cause histophatological changes in different organs. It also affects physiology of respiratory , digestive,excretory circulatory and nervous systems and changes reproductive potential, spawning and survival of early life stages of fish and immunoresponse. By several anthropogenic activities,the physico-chemical parameters of the natural water bodies changes in to the lowering of dissolved oxygen, increase or decrease in P^H. Paroduction of toxic gases like ammonia (NH_3) and hydrogen sulphide (H_2S),destroy aquatic organisms which form the food of fishes and decrease the productivity of the water body . It also affects the migration of fishes, degradation of spawning and feeding grounds, foul odour to fish flesh and make them unpalatable eutrophication and causes different fish diseases. Under the environmental monitoring system of the river the CICFRI studied the bacterial count and was recorded as 572 x 10 MPN at Nurpur in West Bengal . Which causes the decline of several fish species in that area of river Hoogly (Anon. 1996)

2. Construction of barrages and dams

Several barrages, dams and weirs have been constructed in India for irrigation, generation of hydro-electricity and control of floods, which have changed the natural riverine ecology and effected their fisheries resources. These changes are fluctuations in water flow of the river. Water level in both river and reservoir, impoundment of water and conversion of running water body into a slow discharge, reduction in normal floods and occurrence of unseasonal floods, siltation etc, and ultimately change the physico chemical parameters as well as ecology of the total riverine system .

These ecological changes affect the biodiversity of fish fauna directly or indirectly. Fluctuations in water level causes either inundation or disappearance of marsh land and also affect on the growth of littoral vegetation. Thus, breeding success of certain fish species which breed among submerged vegetation in shallow water is severely impaired. Siltation also results into the failure of spawning or ineffective spawning of fishes. Impoundment affects the reservoir ecology resulting in changes in fish species composition and gradual replacement of lofic fish species by Centic species. Release of water during non-monsoon months causes unseasonal floods which again effect the ichthyofauna. Prevention of flooding often lead to an increase in the occurrence of macrophytes and as a result shifting and elimination of fish species. Breeidng of fish and development of pelagic eggs are also affected by the failure of fooding . Reduction in water flow and water level in the river below the dam alters the ecology of feeding and spawning grounds which even dry up sometimes and obstruct the fish movement.

Barrages and dams also act as a physical barrier to fish migration and prevent their access to the breeding, rearing and feeding areas . This results in permanent and irrevocable reduction in fish stocks and ultimately complete extermination. For example construction of barrages, dams and weirs on the river Hooghly , Godavari , Krishna and Cauvery obstructed the migration of Hilsa (*Tenualosa ilisha*) and thus causing sharp decline in the catches (Sinha .2000). Nevertheless, a lucrative fishery of Hilsa that existed in the middle stretch of Ganga before mid-1970's has collapsed soon after the construction of the Farakka barrage, clearly indicating that the fish caught in the river belonged to the migratory stock (Anon 1996).

Fish passes constructed without taking into consideration of the fish behaviour have proved unsuccessful. They serve as traps for fishes rather than an aid to their migration(Jhingran, 1993)

3. Interriver transfer

Inter river transfer of water changes the flow regime in the donor and the recipient river. Seasonal transfer of water for maintaining water level in the recipient river has a beneficial effect on aquatic fauna. However sudden fall in the flow of water in the donor river may lead to stranding of fishes in shallow pools and hence their ultimate fate is death due to predation. Abstraction of water level in down stream portion is inadequate to provide living conditions for commercial fish species (Jhingran. 1993).

Water transfer changes the level of nutrients, plankton density sediments pollutants and silt load in the rivers (Anon. 1996).

4. Channelization of river water into irrigation canal

These days improving reclaimed land and measures for controlling floods are generally undertaken but stream channelization causes extreme physical disturbance in the down stream area that upsets the whole ecosystem. Subsequently, erosion , water turbidity and sedimentation affect the survival of ichthyofauna and also cause degradation of spawning and nursery grounds . The fish from Bhagirathi (Hooghly) system

cannot move across due to obstruction at the Feeder canal outlet (Anon 1996), which is a good example of channelization .

5. Deforestation

Deforestation clearing of land in the catchment area or the sides of water body and overgrazing by livestock, cause soil erosion, which influence the water quality. Land reclamation has several adverse effects on fishes like reduction spawning and nursery grounds of native fishes fish covers and shelters plankton production and the growth rate of fishes. Reduction of food peaks has affected the migration of fishes to the feeding and breeding ground (Tripathi et al; 1999).

6. Introduction of exotic species

About 300 species of fishes have been introduced into Indian waters for the development of sport and culture fishery ,control of weeds and aquatic insects and also for recreation (Jhingran; 1993).

Exotic fish species have been reported to affect the native fish faunal diversity either directly through predation and competition for niche or indirectly thorugh parasitism, niche modification and hybridization.

Drastic effects of introduction of Gambusia affinis on indigenous fishes have been observed not only in India but also in other parts of the world . In Punjab it has reduced the production of many species as it has a natural tendency to feed on fish eggs and hatchlings. Das (1996) reported that Gambusia affinis has practically ousted all other indigenous species in Ooty lake in Tamil Nadu, damaging the economy of the lake area .

Oreochromis mossambicus, has had a negative impact on indigenous species. In Amaravati and Vaigai reservoirs and Powai and Jaisawand lakes, it has eliminated almost all other species including Indian major carps and the indigenous catfishes . because of its prolific breeding habits and omnivorous feeding behaviour (Das, 1996).

Many introduced fish species have affected native fishes through predation . Brown trout (Salmo trutta fario) introduced in the Beas river has affected the snowtrout (schizothorax plageostomus) by predation which was used to be major fishery of the river (Jhingran 1993).

Common carp (Cyprinus carpio) was introduced in different lakes of Kashmir and Manipur and in Krishnaraj Sagar and Gilna reservoir affected the fishery of Mrigal (Cirrhinus mrigala) due to common feeding habits (Jhingran, 1993).

Das (1996) also reported that silver carp (Hypophthalmichthys molitrix), which was introduced in 1971-72 in the multipurpose Gobindsagar reservoir in Himachal Pradesh, has resulted in a sharp decline of the dominant native species catla (catla catla) due to overlapping feeding habits and habitat.

In spite of prohibiting the import of fish seed during the past few years, the aquaculture industry in India has suffered some serious setbacks — From 1988 –1992, there was an outbreak of EUS in the north –east of India which gradually spread to the north of India (Anon, 1999). In 1993-94 , infectious haematopoietic hypodermal necrosis virus (IHHNV) and white spot syndrome (WSS) appeared in tiger shrimp Penaeus monodon symbolises the fate of introduction of seed from Thailand (Anon 1998). Finally hybridization between exotic and native species has profound effect on the genetic loss of original fish population (Jhingran, 1993).

7. Overexploitation of ichthyofauna

During the last few decades, the demand of fish is very high in Indian market. Due to this, overfishing or over exploitation leads to decline in the population of commercial fish species and has threatened some species to extinction (Jhingran 1993). Some example are: Notopterus chitala (Ham). Labeo fimbriatus (Bloch). Tor khudree (Sykes). Schzothorax richardsonii (Gray). Bagarius baragries (Ham). Ompak pabo (Ham) etc.

8. Dynamite fishing in hill streams

In cold water hill streams, the operation of any crafts and gears is problematic. Here the local people generally use dynamite for fishing . In January 23, 2000, "The chronicle", Bhopal edition reported that the people of Jhabua district in Madhya Pradesh used dynamite for fishing . It not only kills other fishes but also destroys the ecology of natural habitat.

9. Juvenile destruction

To meet the increasing demand of fish seed in India there is a heavy pressure of seed collection from natural resources. This destructive catching of seeds affects young ones of many other species . Lured by the regular income, poor people of Sundarbans resort to collect the fish and shrimp seed , but little attention has been paid on the ecological damage. While the seed collectors catch the young ones of a number of fish and prawn species, only the cultivable seed is retained and the rests are discarded (Anon,1996).

10. Killing of fish

Fish killing means killing of under aged fish, brood fish, premature fish and juvenile fish. Use of small sized mesh, specially shrimp drag net lead to high by – catch which is generally done by the fishermen everywhere in India, and a good quantity of fishes are killed as by-catch . Generally in marine sector, it is a regular practice in maritime states in India (Anon, 1997).

11. Application of improved fishing technology

Fishermen in both marine and riverine capture fishery sector in India , increase fishing effort per unit area by using modern crafts and gears which leds to a situation of declining catches. Increased number of fishing fleet also caused huge pollution and led to destruction of breeding grounds, shelters, mangroves, coral reefs and has affected natural ichthyofauna. Sometimes lost gill nets continue to kill and entangled fish leading to unwanted mortality as gillnet material is non-biodegradable (Mitra et al.,1987).

12. Action should be taken against anthropogenic activity

Although Government of India and several State Governments have taken action against those anthropogenic activities, it has to be admitted that public awareness through campaigning, humorous posters and certain rules, laws and regulation are the best way against those activities. Immediate action should be taken against anthropogenic activities in the following manner ;

- Sewage should be treated before discharge into the river systems.
- Different industrial wastes which directly fall into the rivers, lakes and sea should be treated biologically before discharge.
- Public campaigning through video cassettes, pamphlets, seminars against past pollution records should be undertaken .

- Laws should be made against the fishermen who are using the fish passes as traps.
- Deforestation should be stopped immediately and plantation should be made on an urgent basis.
- Well-equipped laboratory and farm facilities for quarantine are not yet available in India (Das, 1996) . A separate quarantine research laboratory building with equipments for diagnosis of aquatic animal disease is necessary . Equally important is a well laid-out fish farm for field studies on exotic species . The National Bureau of Fish Genetic Resources (ICAR) , in course of time, should develop this priority infrastructure.
- Some State Governments like kerala, Gujrat, Andhra Pradesh have already announced closed season, but many Governments have not yet taken such a step. Closed season should be a must for every state. It may be mentioned that even in the Constitution of king Ashoka (246 B.C.) several laws of fishery had been incorporated, according to which, fishery was totally banned during spawning season. Conservation of economically important table fish was also one of the laws in that Constitution (Bandyopadhyay and Biswas, 1999).
- Rules and regulations should be announced for specific mesh size for every fish species.
- Laws should be made against the juvenile and brood fish destruction and by-catch killing .
- Dynamite fishing should be banned in hilly streams and any kind of water bodies .

CONCLUSION

Although , Fisheries Development Commission, Government of India, Ministry of Environment and Forest, National Bureau of Fish Genetic Resources and several ICAR Institutes have taken steps against anthropogenic activities , these are not upto the mark mainly because of unequipped laboratory facilities and improper planning . In view of the usual constrains in a developing country. NACA/FAO collaboration and assistance in infrastructural development would be welcome. Considering the present situation, Government of India should show more interest in strengthening our national capabilities with the additional organized centers .But side by side it must be pointed out that though regional collaborative programmes, especially common aquatic resources in the particular region are encouraged, ultimately, the success of such programmes depends more on the attitudes and activities of the common people.

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REFERENCES

Anon, 1982. Plastic pollution and the effect on Hoogly river. *Annual Report.*CICFRI, Barrackpore.pp. 36- 38.

Anon. 1993. What is shrimp white spot Disease? *Fishing Chimes.*19(9): 21- 22

Anon, 1996. Know your fishes- 1. *Tenualosa ilisha. The Inland Fisheries News* Cent. Ind. Cap. Fish Res. Inst. (1)

Anon. 1996. Hilsa can negotiate Farakka barrage. *The Inland Fisheries News*. Cent. Ind. Cap. Fish. Res.Inst. 1(2).

Anon. 1996. Rapid survey of river system. *New Letter.* CICFRI. Barrackpore. 1(2):4

Anon. 1997. Killing of bicatch is a regular routine. *Annual Report*. CMFRI. Cochin: 86- 89.

Anon, 2000. Dynamite fishing in Jhabua District. The Chronicle. 23.01.2000. (Edn. Bhopal) Bandyopadhyay, S. and Biswas. P., 1999. *Pranibidya*. Oriental Book Company, Kolkata. 930 pp

Das. P., 1996. International and in country trade in aqutic organisms. Int. Symp. NBFGR. Lucknow: 1- 4

Ferswan, Y.S., Price, T.D. and Bisht, R.S. 2001. Utility of trace element analysis in reconstructing the intensity of occupation in ancient archaeological site. *Indian J. Environ. & Ecoplan.* 5(2): 223- 232.

Jhingran, V.G., 1993. *Fish and Fisheries of India.*Hindustan. Publ. New Delhi : 954 pp

Mitra, P.M., Ghosh, K.K., Saigal, B.N., Sarkar, N.D., Roy, A.K., Mondal,N.C. and Paul, A.R., 1997. *Fisheries of the Hoogly – Matlah Estuary System – An Appraisal.* Bull No. 67 Cent. Ind. Fish. Inst.

Mitra, P.M., Ghosh, K.K. Saigal,B.N., Sarkar, Roy, A.K., Mondal., N.C. and paul. A.R., 2000.Fisheries of the Hooghly – Matlah Estuary System – Further Appraisal. Bull No. 109. Cent. Ind.Fish Inst.

Mitra, P.M., Ghosh, K.K., Saigal, B.N., Sarkar, N.D., Roy, A.K., Mondal. N.C. and Paul A.R., 2000. *Fishing Gears of the upper and the middle Hooghly Estuary.* Bull No. 49 Cent. Ind. Fish. Inst.

Shrivastava, V.S. and Patil,P.R., 2001. Metallic pollution in river Tapti. *India.Indian. J. Environ & Ecoplan.*5(2) : 303 – 306.

Sinha, M., De, D.K. and Jha, B.C., 1998. *The Ganga environment & Fishery.* CICFRI publication. Barrackpore : 147 pp.

Sinha, M. 2001. Riverine Fisheries of India. In *Souvenir*. The fifth Indian. Fisheries Forum. Cen. Inst. of Freshwater Aqua. Bhubaneswar : 59 – 64 pp

Tiwari, T.N. and Mishra, H., 1985. A preliminary assignment of water quality index to major Indian rivers. *Indian J.Env. Port.* 12 : 246 – 250.

Tiwari, T.N. and Ali, M. 1988. In *Ecology and pollution of Indian rivers* (Edn.R.k.Trivedy)Aslish Publishing, House. New Delhi

Tripathi,Y.C. and Tripathi, G.,1999. Some important environmental problems in India and their remedies. *Indian J. Env. & Ecoplan* 2(1) : 86- 96.

STATUS OF FISHING TECHNOLOGIES FOR INLAND WATER BODIES OF SOUTH WEST BENGAL, INDIA

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ABSTRACT

The present study attempts to find out the current status of different fishing technologies for inland water bodies which are being practised by fishing communities of South-West Bengal. Usage of different crafts, gears and other fishing methods have direct bearing on the socio-economic conditions of users, environmental conditions of the fish habitats and diversity of fishes. Different types of fishing gears and crafts, which are being used in the study areas, have been described with reference to their mode of operation, target species, merits and demerits. Similarly, the design, make and mode of operation of crafts (donga, dingi, boat) from the study areas have also been taken into consideration. Besides, mode of application of other indigenous fishing technologies have been discussed. Major ecological parameters (soil and water) of different inland water bodies have been studied in order to understand the range of variations of different parameters in a year in different study sites.

KEYWORDS : Fishing technology, South West Bengal, Inland water bodies.

INTRODUCTION

Fishing technology deals with the way aquatic organisms, especially the fishes are to be captured. On account of the highly diversified aquatic habitats, the methods for fishing also range from very simplistic to very complicated ones. Besides, there exists an intricate relationships among several environmental components of the fishing sites viz. ecological parameters of the water bodies, species composition of the aquatic ecosystem and the socio economic profile of the dependant fishermen. The present paper aims at documenting the different fishing technologies which are now being used in inland water bodies of Sout-West Bengal giving emphasis on the factors which have necessiated development of such technologies.

MATERIAL AND METHODS

Three districts of South West Bengal viz. Bankura, Hooghly and Midnapore are crisscrossed by several large rivers, their rivulets, nullahas, creeks, canals, etc. which together with other adjoining wetlands, constitute the inland water bodies. In the present study, 6 major rivers viz. Subarnarekha, Darakeswar, Shilabati, Rupnarayan, Kansai, Keleghai and their adjoining water bodies have been thoroughly investigated during different months, seasons and year (Fig. 1). Three seasons are pronounced in this area viz, pre-monsoon (less precipitation), monsoon (maximum precipitation) and post monsoon. Collection and documentation of information relating to different fishing methods have been done through a set of preformulated questionnaire applied to local fishermen's community and by physical verification . Physico-chemical parameters (soil & water) of six major rivers of South West Bengal have been studied (APHA, 1995) in order to understand the range of variations of different parameters in a year in different study sites.

RESULTS

Different Fishing Technologies

In fishing technology, crafts and gears are the real means of harvesting aquatic organisms and thereby enhancing production. Gears are instrumental for fish catching and the crafts provide platform for the fishing operations, carrying of the crews and fishing gears. Besides, other indigenous fishing technologies are also in practise (Tables 1, II and IIA)

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A.7 Different types,specifications and mode of operations of fishing crafts

Fishing craft is a carrier through which fishermen can approach to fishing spots for fishing. Several types of fishing vessels have been evolved in this region depending upon the nature of fishing grounds, the type of fishes available and the habits of such fishes. Crafts, which are used only for fishing in the rivers , tributaries, jheels, large ponds and irrigation cannals, may be of following types.

a) Pansi : This is smaller and flat sized crafts. It is the most common type of craft for fishing and commonly found in shallow wetlands, bordering river tracts.

b) Donga : It is made by scooping out the central portion from a large trunk wood (palm tree, coconut tree etc.). The keel portion is made thicker than the sides. Size is around 11´x 2´x 1´. It is used chiefly for cast net operation. This type of vessel is commonly used at Moyna and Panskura of Tamluk subdivision, Dashpur and Khirai of Ghatal subdivision, Rohini and Sonakonia on Subarnarekha river, Bandar on Rupnarayan river, Midnapore and Khirai on Kansai river, and Dehati on Keleghai river.

c) Dingi : It is the most common type of craft, used for fishing mainly in rivers of this region. It is very light to handle. Size ranges from 4.5 to 7 meters in length and from 1 to 1.2 meters in width. It is used specially for hilsa fishing with the help of 'Chandi Jal" (Hish Jal) and is also used for operation of bag nets (photograph-9). This is found at Bandar and Kolaghat on Rupnarayan river, Haldia and Norghat on Haldi river, Sonakonia and Rohini on Subarnarekha river , Arambag on Dwarakeswar river, Garbeta on Shilabati river, Midnapore on Kansai river, Dehati on Keleghai river.

d) Nauka/Boat: It is constructed with good quality wood and consist of a keel and ribs. Size usually ranges from 15´to20´

in length and 3´ to 4´in width. Movement of boat is controlled by one 'hal' and two to four handles. It is totally dependent on manual service. The boat is used for the operation of cast nets, bag nets, gill nets in rivers and tributaries. It is abundantly found in Haldia and Norghat on Haldi river, Rohini and Sonakania on Subarnarekha river, Arambag and Bankura on Dwarakeshwar river, Bandar and Kolaghat on Rupnarayan river, Midnapore on Kansai river, Dehati and Khakurda on Kelaghai river.

B. Different types, specifications and mode of operations of fishing gears

A wide variety of gears are used for fishing in the different water bodies in this region of West Bengal, such as rivers, tributaries irrigation canals, large ponds(dighi), seasonal and perennial wetlands and paddy fields. The operation of gears vary in accordance with the depth of water, nature of aquatic organisms to be caught, local availability of raw materials and above all the physical conditions of the water bodies to be fished.

a) Nets : Nets made up of cotton or jute are more in practice as compared to nylon nets.

i) Cast net:

It is a cone shaped net, cast from the edges of the water body and is locally called 'Khapla Jal' or 'Pasjal' or'Matha-Ghorano Jal' (Photograph-2).

This is a circular, umbrella shaped net. The long rope is attached to the apex of the umbrella and a number of lead or iron weights are fixed all along the margin. The mesh size is usually 2.5 cm. The length

of this net is 11-14 feet. It is also variable according to length. At the periphery, circular pockets are formed by folding the net inward, each pocket containing 2-4iron sinkers. The net is made up of cotton or nylon threads. The mesh size, size of the pocket and iron weight (Kanthi) may very according to the size of fishes to be caught. The fisherman throws the net fully spread over the water, (Photograph-2) keeping the long rope in his left hand. This has to be done very skillfully so that the net falls on the surface of the water fully expanded. The net sinks to the bottom and the circumference closes due to the weights attached to it. The net is pulled out by means of the cord. The fishes enter into the net pockets and thus are caught. With the help of this net, small fishes and also fishes with body weight up to 2-3 Kg. may be caught. The cast net is extensively used in ponds, rivers, jheels and beels but cannot be used in places with full of weeds or with rocky bottom. All round the year this net is used, which shows the popularity among the fishermen of Hooghly, Bankura and Midnapore District.

ii) Bag net/purse net : This may be of different types.

a) Behundi Jal :

It is a conical net, devoid of wings, and is provided with a length of about 5-10 meters. The mesh size varies from one target species to other. This type of net looks like a bag, and that is why, it is called bag net. It is made up of cotton or nylon threads. The mouth of this net can be opened by the floats on upper rope and sinkers on lower rope (Photograph-6). These nets are being used largely by the fishermen of Rohini, Sonakonai and Gopiballavpur in Subarnarekha river, of Ghatal in Silabati river, of Tamluk, Contai and Haldia in Rupnarayan and Hooghly rivers. The net is stretched against the current with the help of stakes (bamboo poles) which is fixed on the onshore. The fishes enter in the reservoir of bag nets and are collected. Also, the net is operated from a boat, using a long handle. It is used for fishing of small fishes or fish seeds in rivers and canals.

b) Shooting net :

It is also a bag net specially used for collection of prawns as well as major carp's seeds in the rivers. The size of this net is 320 cm. in length and 310 cm in width; the perimeter of the proximal part is 60 cm and that of distal part is 25 cm. Mesh size varies from 4 to 6 mm. These nets are commonly found in Haldia and Contai of Midnapore District.

c) Ghai Jal :

It is a special type of bag net. It is conical in shape, consisting of a wide mouth and the tail end fitted with a basket (collector), made up of bamboo splits. It is placed against the current with the help of a bamboo sticks in order to enable the water to flow inside the net. Fishes enter into the basket and are collected at an interval of 4 to 6 hours. This type of gears are very common in Khakurda, Bakhrabad, Belda, Sabang and Moyna on Keleghai river, and Khirai on tributaries of Kansai river.

d) Ganti jal :

It is just like a bag net. Two poles of the bag are fitted with two long bamboo poles. The net has also a head rope with floats and foot rope with sinkers. The mesh size varies from 3 to 8 mm. (Photograph-1). This net is operated either by one or by two persons, drawing it in a pond from one side to another. It is used to catch small sized carps, weed fishes, prawns etc. This net is found in Rohini on Dulung river, Bankura and Arambag on Dwarakeshwar river, Ghatal and Garbeta on Shilabati river.

iii) Gill Net :

Gill nets are passive nets of enmeshing or entangling types. They are of mainly two types.

a) Chandi jal :

It is a very common type of gill net, usually called as 'ilish jal'. There are a number of rectangular pieces of nets which join together to form the entire net. The number of pieces vary from 500 to 1000. The width is about 10 to 12 feet and the mesh size vries from 3 to 4 inches. The nets are usually suspended by floats on the surface of water and anchor at the bottom by sinkers fixed to the foot rope. These are made up of cotton or nylon. The net is set at transverse direction like a wall against water to catch the migrating fishes. When the fishes try to swim through the net wall, the mesh form noose round their heads and the fishes are caught. It is operated in estuarine areas to catch migratory fishes i.e. Hilsa. It is used in Rupnarayan, Haldi and Subarnarekha rivers of Midnapore District.

b) Foot jal :

It is another type of a gillnet, locally called as 'foot jal'. It is of variable length, but the width remains around one feet. Mesh size varies from one target species to others. It is used in agricultural wetland. This net, after being fixed by two bamboo poles at the two ends, forms a wall against water current. When the fishes try to pass through the net wall, threads of the nets form a noose round their heads and the fishes are caught. It is used in Bankura and Arambag on Dwarakeshwar river, Haldia, Tamluk and Contai on Rupnarayan, Haldi and Hooghly rivers.

iv) Drag net :

This net is locally called a 'Tanajal' or 'Berajal'. It appears just like screen. Its width is 20 to 30 feet and the length is variable. Two to three pieces of nets are sometimes joined together to cover a long stretch of water bodies. Mesh size (6 mm-25mm) varies from one species to other . It is provided with a main rope which carries floats and a foot rope bearing sinkers. This net is made up of cotton or nylon threads. The net is drag by holding the two poles (ends) of the net from one side to the another side of the pond in a semicircular way. These nets are commonly used for fishing in jheels, beels and ponds. All around the year, this net is being used in all the corners of this region.

v) Other type of nets:

a) Feta jal/ Koli jal :

It is a triangular open net which is fixed on a 'x' shaped frame of two bamboo poles. For handling this net, a short bamboo stick is tightly fitted on the lower portion of the 'x' frame in a transverse way. It is useful for catching small fishes in canals and rivers. This jal is found in Bankura, Arambag , Garbeta, Haldia, Tamluk and Nandigram areas of South West Bengal.

b) Chakni jal :

It is a round net, fixed up on a circular frame made by bamboo or 'beth'. This net is made up of nylon or cotton and the mesh size is small (2 to 6 mm). It is useful to catch weed fishes like Amblypharyngodon mola, Puntius spp., Esomus danricus etc. and small prawns from small rivulets, ponds, irrigation canals during summer or winter months. This type of net is found all over the studied sites.

vi) Scoop net (Chabi jal) :

It is just like a Chakni jal, but is larger in size. The mesh size is also larger (10 mm) and provided with 4 bamboo sticks fitted on circular bamboo frame with equal distance. The free ends of these bamboo sticks are bound together tightly. The net is made up of cotton or nylon threads. This type of gear is useful to catch jeol fishes like Channa spp., Heteropneustes fossilis, Clarias batrachus etc. in shallow water ponds, jheels or beels. It is found frequently all over this region.

vii) Traps : They are mainly made up of bamboo or wooden materials and may be of different types as mentioned bellow.

a) Polo : It is a conical flask shaped basket for fishing. It is made up of split bamboo pieces with a small circular opening at the top and a large opening at the bottom. The basket is about one meter in length. It is used in shallow muddy water in ponds, jheels, beels and canals in agricultural fields. The trap is dropped vertically in the water with the wide opening pressed on the soft mud. After getting signals of the presence of fishes at the bottom, the fishermen enter their hands and catch the fishes like Channa spp, Clarias batrachus and Heteropneustes fossilis. This type of trap is frequently used all over this region.

b) Murgri : It is a triangular shaped cage made up of fine bamboo splits. This cage consists of a main body and two arms. There is a valve like passage in the front side of the junction of two arms. Although size is variable, the common size is with a height of 1-2½ feet depending on water depth, width 1- 1½ feet and length of (2-3 Photograph-7). It is trapped in a place where the water is flowing and the fishes and prawns easily enter into this cage through the valve with water flow ,but are not able to come out from the cage. It is used for fishing in shallow water beels, canals and inundated agricultural fields of allmost all corners of this region.

c) Ghuni : It is a rectangular cage made up of fine bamboo splits, with a height of 1-1½ feet, width of 9-12 feet, and variable length. There are 3-5 mouth openings on two sides, through which fishes enter into the cage. It is trapped on shallow flowing water in agricultural fields particularly during rainy season. It is mainly used for catching small fishes and small prawns in all study sites.

d) Botuya : It is a complex form of ghuni, extremely large in size with a height of 3 - 3½ feet, width of 2-2½´and length of 4-5´ There are 12-15 chambers, each with a mouth opening (Photograph -8). It is mainly used for deep water mass during rainy season for catching small fishes and prawns. It is commonly used by the rural people of this region.

e) Ghonga : It is a concial type of trap made up of bamboo splits. It consists of two conical traps, each with a wide circular mouth and a small opening at tail end. One smaller conical trap is usually fitted within the larger trap. After being trapped against water flow, small opening of the large conical trap is plugged with straws. The fishes enter through small conical trap openings and are collected in the large coincal trap. It is very common in all parts of South West Bengal.

f) Angle/ Pole line : This gear, locally called 'Chhip", consists of a pole, line and hooks and is commonly made with the help of bamboo sticks of variable lengh, lines are made up of monofilament nylon or cotton. The hooks are of various shapes and sizes. The hook is attached at the end point of the thread. Peak period for angling is the monsoon season, when the anglers are seen on the banks of ponds, tanks and wetlands. This may be of two types.

i) **Simple Chhip :** One end of the thread is attached at the top of a long bamboo stick, while other end tightly binds a hook.

ii) **Wheel Chhip :** This chhip contains a wheel at the base of the bamboo stick, which rolls the long thread. Sinkers are used at the base of the hook. A float known as 'fatna' is attached at the upper portion of the thread which acts as an indicator whether a fish is hooked or not. The base of the feather of peacock. (Pavo cristatus), small part of plants like Aeschynomene indica (Sola) and Schharum arundinaceum (Sar) are used as 'fatna'.After fixing suitable baits to the hook, it is dropped into the bottom of the water mass. The fishes get lured to the bait. The lines are pulled when the fishes engulf the bait which ultimately signal catching of the fishes. It is practised all round the year in ponds, rivers, jheels, wetlands etc. It is also in practice for fishing of large and predatory fishes.

iii) **Dan :** It is a special type of long line. The main line is fixed by two poles at the two ends. The several branches of lines, each with a length of about one feet, remains connected with the main line at uniform intervals. The hook is fixed at the end of each branch line. Suitable baits are used. This type of line fishing are being operated in paddy fields, shallow wetlands for catching predatory fishes such as Channa spp., Clarias batrachus and Heteropneustes fossilis. This type of gear is very common in this region.

Bait fishing : Bait fishing, also called bait casting, is a popular form of angling for some game fishes. Both natural and artifical lures are used in bait casting. The natural lures are more popular in this region. The natural baits used are earthworms, insects, molluses and minnows. The firefly, an inset (Photinous spp.), is preferred by anglers and fishermen and is being used as an indicator during the angling operations, especially under darkness. Bait fishing season commences in July and continues up to November.

Types of baits : The baits of animal or plant origin, are used in hooked form whereas baits of plant origin are broadcast.

i) **Preparation from plants :** A group of plant and plant products being utilised as baits are, rice (Oryza sativa Linn), and wheat (Triticum aestivum Linn.). Roasted rice and slices of bread are normally used as baits.

ii) **Mixture of food products :** Roasted rice and wheat mixed with each other, is cautiously thrown in the shallower areas of the water body to lure the fishes.

Preparation from animals : This includes earthworms, crickets, dragon fly, larvae of red ants, wasps, honey bees, snails, minnows and tadpoles of frogs. The undermentioned entire animal or its selected parts are used as baits.

i) **Earthworm :** Earthworms are either collected by hand sorting or by spraying extracts of plants (*Polygonum hydropiper*). As soon as this extract reaches up to the inner layer of soil, the earthworms come out on the soil surface and are collected for using as baits.

ii) **Fresh water prawn *(Macrobrachium lammeri)* :** This prawn species inhabits in most of the seasonal and perennial water bodies, from where they are collected with the help of a small piece of mosquito net.

iii) **Mole cricket (*Gryllotalpa africana*) :** It is a nocturnal agricultural pest. During day time, they remain within burrows by the side of water bodies. It is used as a bait by the anglers.

iv) **House cricket *(Gryllus spp)* :** It is a nocturnal and omnivorous insect, which is one of the most effective baits during the pre-monsoon and post-monsoon months.

v) Larvae of red ants (*Oceophylla smaragdina*) : Larvae of red ants are collected from their hives or from mango trees. It is highly in demand for fishing during monsoon.

vi) Wasps (*Vespa orientalis*) : Larvae of wasps are collected from old houses, especially during the monsoon and are used as a bait.

vii) Gastropods (*Lymnea spp. & Pila globossa*) : The buccal mass of these molluscs are used as baits. *Lymnaea spp* are available throughout the year, but *Pila globosa* is only found during monsoon season.

viii) Small fishes : *Puntias* spp., *Chanda spp., Danio* spp., are used as a baits *Channa striatus* is also utilised as a bait to catch *Wallago attu* and other large predatory fishes.

ix) Tadpoles of frogs : The tadpoles of frog (*Rana tigrina*) are collected and used as a hooked bait during monsoon.

viii) Wounding gears :

i) Chauki sar : It is a special type of hooks. It is prepared by a long bamboo pole (5´- 8´), top of this pole is fitted with a number of iron hooks (7 - 9). The end point of each hook contains a bar. It is targeted on the fishes which are seen from out side of water. It is used all over this region.

ii) Gorna : It is another type of hooks. The 5-6 hooks are attached at the top of the bamboo pole in right angle. It is operated within soft mud for catching mud eels (*Anguilla bengalensis*) and Pankal mach (*Mastacembelus* spp, *and Macrognathus spp.*). It moves horizontally in the soft mud, and fishes are trapped in between the hooks. It is a popular fishing method in the rural areas of this region.

C. Other indigenous fishing methods :

a) Bamboo screen : 'Patta' (bamboo screen) is used in shallow ponds, small rivers and irrigation canals. It is manipulated and handled like a seine. A bamboo screen and a cast net are sometimes combined for the fishing operation. Bamboo screens are used to enclose areas, piled with bushes for attracting fishes. Carps, *Channa spp*, cat fishes are the most important catch with such gears. It is commonly found in Khakurda and Dehati on Keleghai river (Photograph-5).

b) Bushes : Branches of 'Bans' (*Bambus* spp.), 'Khiris' (*Samanea saman*) and 'Kas' (*Eragrostic cynosoroides*) are directly put inside the river water column during pre-monsoon and post-monsoon months. Fishes take shelter in between the branches of these plants. About 60-85 Kg of fishes can be collected in a month. The species like *Labeo calbasu*

Mystus spp, Wallago attu, Labeo bata, Rita rita, Gagata cenia, Bagarius bagarius, Labeo boga, prawns and some other minor carps are collected (Photograph-3)

c) Piece of bamboo : A piece of hollow bamboo around 2 feet in length with two terminal openings is pushed into the mud on the bank of water bodies, just beneath surface water to attract and enable some fishes (Mastacembelus spp, Macrognathus spp.) to enter within it. At certain intervals, fishermen unearthed the same piece of bamboo and collect the fishes.

d) Poisoning : Some ichtoyotoxic plants are used by fishermen community (Table - 111) for fish hervesting in this region. It is a traditional process where plant parts are crushed and mixed in water to kill the fishes inside of rivers, pools and canals. After a few minutes of spraying, the fishes being stupefied, float on the water surface and can easily be caught with hands. Among seventeen different such plants recorded from the study sites, Polygonum hydropiper is most common piscicidal plant which is being used

by local fishermen. They complete their life cycle within a year and are found to grow on moist humus rich soils which are regularly flooded and are also found in the margin of ponds and irrigation canals. (Cook, 1996). In the present study, the application of the extracts of P. hydropiper for fishing has been noticed in Rohini, Ragra, Gopiballavpur and Sonakonia on Subarnarekha river, Midnapore on Kansai river, Khakurda and Dehati on Keleghai river.

D. Preservation of fish :

i) Drying : Drying is not very popular in South West Bengal. Freshwater fishes (Chanda spp, Danio rerio, Esomus danricus, Puntius spp.) are dried in some parts of this region, but in very small quantities.

ii) Fresh preservation: To prevent autolysis and bacterial decomposition, the fresh fishes are spread on the wet sand and leaves of Najas graminea (locally called gurigach) in successive layers of fish, wet sand and leaves of Najas. This perennial plant grows luxuriantly in standing fresh and brackish water (Cook, 1996). N. graminea is commonly used in Patagola and Kethardanga on Dwarkeswar river. Fishes preserved with this method, can be kept fresh for 12 hours.

E. Ecological Parameters :

Annaul range (July 2000-June 2001) of different ecological parameters (soil & water) of different rivers of South West Bengal is presented in the Table - IV, which show a wide range of variation of each parameter not only during different periods, but also between different study sites (Project report, DST & NES 2000-2001; Project report, West Bengal Pollution Control Board, 2001).

DISCUSSION

The world production of aquatic biological resources is nearing an almost saturation level due to their non-judicious exploitation during the last few decades. But in the vast majority of the countries of the world where protein malnutrition is widespread, fishes along with other edible aquatic organisms constitute the main source of protein. (Fresh water fishes provide easy source of proteinous food not only because of their spontaneous propagation in the natural habitats but also for their diversity. Recent pace of urbanization, coupled with population explosion, has greatly destroyed most of the natural habitats of these biotic resources.) This will bring forth not only economic loss but also will permanently cause ecological degradation. Therefore, in order to formulate proper conservation strategy of these fresh water biotic resources, a complete knowledge of different technologies relating to harvesting, preservation, transportation and marketing of those aquatic resources, is required. This will also help pinpointing the merits and demerits of existing technologies.

The modern fishing technologies (gears, crafts etc.) evolved from very simple ones in the past through different trial and error processes, utilising the achievements of science. The factors responsible for developing the present day fishing technologies may be summarised as - (i) desire to change from the catching of single organism to multiple, (ii) fishing from shallow to dipper water covering larger areas, (iii) object to reduce labour as well as time for fishing (Jhingran, 1991; Joshi, 1993; Yadav, 1997). All these factors together necessitated discovering the modern fishing appliances to be used by the fishermen's community depending on the ecological, sociological and species compostion of the areas.

Regarding the development of gears, it may be said that before invention of any fishing gear human beings used their hands only to capture aquatic organisms as hand fishing. They gradually move to spearing, angling with or without hooks, use of bows, arrows, harpoons, traps, nets, pop-guns, denamiting,

TABLE - I : INLAND FISHING CRAFTS USED IN SOUTH WEST BENGAL

Type of Crafts	Mode of Use	Subarnarekha river		Dwarekeswar river		Shilabati river		Rupnarayan river		Kangshabati river			Keleghai river	
		Rohini	Sonakonia	Bankura	Armabag	Garbeta	Ghatal	Bandar	Kolaghat	Midnapore	Gokulpur	Khirai	Dehati	Khakurda
a) Pansi	To move from one bank to other	-	-	-	-	+	++	++	-	+	-	+	+	-
b) Donga	For cast net operation	+++	+	-	-	-	++++	++++	-	+++	-	+	+++	-
c) Dingi	For 'Chandijal' (Gill net) & Bag net operation	++	++	-	+	+	+++	+++	++++	++	-	-	++	-
d) Nauka / Boat	Used for operation of Cast net, Bag net, Gill net	+	+	-	++	-	+++	+++	++++	+	-	-	++	+

++++ Most abundant, +++ Abundant, ++ Moderate, + Minimum, - Absent

TABLE - II : FISHING METHODS IN DIFFERENT AQUATIC HABITATS OF SOUTH WEST BENGAL

Fishing methods	Seasons			Subarnarekha (R)		Dwarekeswar (R)		Shilabati (R)		Rupnarayan (R)		Kangshabati (R)			Keleghai (R)		Target species
	Pr. M	M	Post M	Rohini	Sonakonia	Bankura	Armabag	Garbeta	Ghatal	Bandar	Kolaghat	Midnapore	Gokulpur	Khirai	Debati	Khakurda	
A. Nets :	++	+	+++	++++	+++	++++	+++	+++	++	+	-	+++	++	+	+++	++	All type of
i) Cast net	++																fishes
ii) Bag net / Purse net	-	++	++	-	++	-	-	+	+	++	++++	+	-	+	-	-	Small fishes, Prawns, Seeds of IMC, Weed fishes
a) Behundi jal		++															
b) Shooting jal																	
c) Ghai jal																	
d) Ganti jal																	
iii) Gill net	+	++	++	+++	+++	++	+++	++	+	+	++++	++	+	+	++	-	Hilsa, Minor carps
a) Chandi jal		+															
b) Foot jal																	
iv) Drag net	++	+	+++	-	-	-	-	-	+	-	-	+	-	+	+	+	All types
(Tana jal)	++																
v) Other types of net	+	-	++	+	++	+	+	-	-	+	+	-	-	-	+	+	Small fishes
a) Feta jal/Koli jal	+	++	+	+	+	+	+	+	+	+	+	+	+++	++	++	++	Weed fishes
b) Chakni jal																	
vi) Scoop net	++	-	++	+	+	-	-	+	-	-	-	++	+++	++	+	++	Geol fishes
(Chabi jal)	+																

++++ Most abundant, +++ Abundant, ++ Moderate, + Minimum, - Absent

TABLE - IIA : FISHING METHODS IN DIFFERENT AQUATIC HABITATS OF SOUTH WEST BENGAL

Fishing methods	Seasons			Subarnarekha river		Dwarekeswar river		Shilabati river		Rupnarayan river		Kangshabati river			Keleghai river		Target species
	Pr. M	M	Post M	Rohini	Sonakonia	Bankura	Armabag	Garbeta	Ghatal	Bandar	Kolaghat	Midnapore	Gokulpur	Khirai	Dehati	Khakurda	
vii) Traps :	+	++	+	+++	+++	++	++	+++	++	+	+	++	++	+++	+++	+++	
a) Polo, b) Mugri,		++										++	++			+	Geol fishes
c) Ghuni, d) Botuya, e) Ghonga																	Small fishes,
f) Angle/Pole	+	++	++	+++	+++	++	++	+++	++	+++	+++	+	+	++	++	+	Prawns
Line, vii) Dan			++							+	+						Large fishes & Predatory fishes
viii) Wounding Gears :													–				Any type Fishes.
a) Chauki Sar	++	++	+	+	++	-	-	-	-	-	-	+	-	+	+	++	Eels,
b) Gorna	++	++	+	+	+	+	-	-	+	+	-	+	-	++	++	++	*Macrognathus sp.*
												+					
ix) Other indigenous techniques :	++	++	+	-	-	-	-	-	-	-	-	-	++	++	+++	++	Any type fishes
a) Bamboo	++	-	++	+++	+++	++	++					++	+	++	+	++	Attracts all
Screens	-	-	+				+						+	+	++		type of fishes
b) Bushes	-	-	++	+++								+					*Mastacembalu s sp.*
c) Piece of bamboo																	All fishes
d) Poisoning				+++													

++++ Most abundant, +++ Abundant, ++ Moderate, + Minimum, - Absent

Table : III List of Piscicidal plant available in South West Bengal

Sl. No.	Scientific Name	Local Name	Family	Parts of the Plants used	Nature of plants	Distribution
1.	Morinda Pubescens	-	Rubiaceae	Crushed fruit	Tree	Midnapore, Ragra, Rohini, Gopiballavpur
2.	Meyna spinosa	-	Rubiaceae	Crushed fruit	Semi shurb	Khirai, Midnapore, Rohini, Sonakonia
3	Moringa oleifera	Sajna	Moningaceae	Root and bank paste	Tree	All over this region
4	Polygonum hydropiper	Panmarich / Man	Polygonaceae	Crushed Plant	Herb	All over this region
5	Polygonum orientale	*	Polygonaceae	Crushed plant	Herb	All over this region
6	Pongamia pinnata	Karanj	Fabaceae	Oil cake	Tree	Khakurda, Midnapore, Ragra, Garbeta
7	Strychnos nuxvomica	Kuchila	Loganiaceae	Crushed dried seed powder	Tree	Midnapore, Khirai, Rohini
8	Tephrosia purpurea	Ban nil	Fabaceae	Crushed plant	Herb	All over this region
9	Casearia elliptica	-	Flacourdiaceae	Bank	Semi shurb	Midnapore, Gopiballavpur
10	Excoecaria agallocha	-	Euphorbeaceae	latex	Semi shurb	Paniparul, Kolaghat
11	Acacia pennata	Babla	Mimosaceae	Bank	Semu tree	Dehati, Khakurda, Midnapore
12	Madhuca longifolia	Chura	Saptaceae	Oil Cake	Tree	Jhargram, Gopiballavpur, Hatibari
13	Tamarindus indica	Tetul	Caesalpiniaceae	Dried seed powder	Tree	All over this region
14	Tridax procumbens	Bisal wakaram	Asteraceae	Fresh leaf juice	Procumbent Herb	All over this region
15	Nevemphis uliginosa	-	Rubiaceae	Crushed fruit	Semi herb	Midnapore, Garbeta Arambag
16	Nicotiana tabacum	Tamak	Solanaceae	Crushed plant	Herb	Jhargram, Hati bari, Gopiballavpur
17	Sapindus mukorossi	Ritha	Sapindaceae	Powder of fruit	Tree	All over this region

poisoning, etc. Most of all of these methods are now being used by fishermen depending on the ecological and socio-economic conditions of one particular site. Similarly, the first fishing boat used by primitive hunter was just mere a large piece of wood, operated by hands. From such stage, people soon developed different types of crafts which constitute an indispensable item for successful fishing operation. In this study, we also recorded the present form of all those fishing methods, which are of different nature in

Table : IV Range of different ecological parameters of different rivers of South West Bengal

Parameters		Kansai	Keleghal	Subarnarekha	Silabati	Rupnarayan	Dwarkeswar
Temp	Air (°C)	17.5-39	16-37	16.5-38	15.5-36	14-36	16-38
	Water (°C)	18.5-36	17.5-34	8-32	7-33	15-34	17.5-33.5
	Soil (°C)	18.0-38	17-38	16-36	15-35	13-37	17-36
Water parameters							
pH		6.6-8.1	6.4-7.9	6.4-7.6	6.1-6.9	6.2-7.8	6.3-7.6
Alkalinity (mg/l as $CaCO_3$)		32-155	30-185	25-150	15-475	30-200	29-335
Total Hardness (mg/l as $CaCO_3$)		45-112	20-196	14-106	37-140	40-206	42-266
Mg-Hardness (mg/l as $CaCO_3$)		24.01-72.5	14.01-93.06	9-70.05	17.2-6.05	28-120	28.02-144.1
Conductivity (μ Mho/Cm)		98-610	70-755	84-400	120-500	267-2000	200-520
Total Dissolved soil (mg/l)		12.5-380	34-430	20-219	15-412	35-1056	70-460
Total suspended soil (mg/l)		7.5-400	20-350	5-397	5-223	75-949	15-79
Dissolved Oxygen (mg/l)		4.45-10.76	5.67-10.94	3.92-10.94	5.27-9.93	5.27-12.97	3.65-12.16
Chemical Oxygen Demand (mg/l)		18.8-196	26-196	21-175	13-190	27-175	10-139
Biological Oxygen Demand (mg/l)		0.8-5.27	2.2-5.25	0.4-4.86	0.81-6.48	1.64-6.67	0.75-4.86
Total Kjeldahl Nitrogen (mg/l)		0.3-8.75	0.44-14.26	0.44-14.87	0.875-11.81	0.262-5.25	0.28-5.68
Total Phosphate Phosphorus (mg/l)		0.001-1.86	0.0015-1.545	0.001-1.568	0.002-1.75	0.077-1.32	0.011-1.45
Chloride (mg/l)		15.62-12.78	19.88-42.6	18.46-61.06	28.4-80.94	34.79-525.4	16.12-191.7
Total coliform (MPN/100 ml)		33-=2400	170-=2400	350-1600	220-=2400	540-=2400	43-=2400
Faecal coliform (MPN/100 ml)		33-=2400	43-=1600	170-=2400	180-=2400	350-=1600	34-=2400
Soil Parameter							
pH		6.3-7.7	6-7.6	6.1-7.2	6-6.4	6.1-7.1	6.1-7.2
Organic Carbon (%)		0.93-4.02	3.28-4.76	2.18-6.13	2.98-6.29	3.62-5.31	2.19-5.74
Soil Texture	Sand (%)	88-96	25-28	88-94	24-29	20-24	96-98
	Silt (%)	12-14	32.8-35	3-4.5	34-38	40-48	2-3.5
	Clay (%)	3-4	44-52	1-3	44-47	42-47	0.5-1.5

1

2

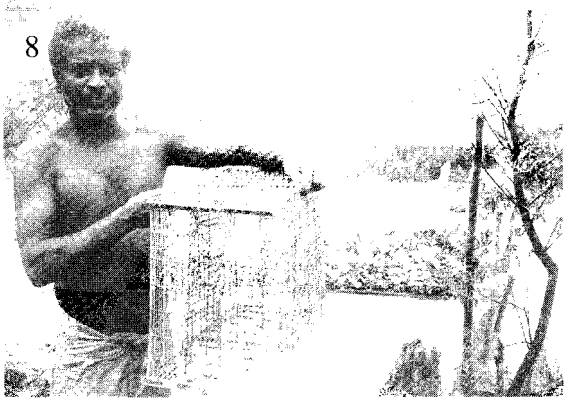
3

5

6

7

8



different study sites based on ecological, sociological and target species composition.

Due to the lack of restriction of mesh size, juveniles and many unwanted but ecologically important organisms are caught and destroyed leading to both economical and ecological loss. Nylon threads used for making different gears also pose harmful effects during fishing operation as these damage different soft parts of both target and non target aquatic organisms. Crafts and gears constructed following older technologies should be updated in order to save the energy and life of fishermen. Besides, application of the extracts of ichthyotoxic plants as a part of indigenous fishing technology, should be reviewed with a holistic approach in order to save the steady state of environmental balance.

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PHOTOGRAPH

1. 'Ganti jal' (a type of bag net) operation by two fisherman at Rohini on the confluence of Dulung river with that of Subarnarekha river.
2. 'Khapla jal' or 'Pas jal' or 'Matha ghorano jal' (cast net) operation by two fishermen standing on separate tubes at Rajagram, (Bankura) Dwarakeswar river.
3. Fishermen remove the bushes from riverine water body of Kansai river at Amtala, Midnapore.
4. A particular type of bag net, at Rohini Subarnarekha river.
5. Bamboo screen (patta) to enclose the fish habitat of Keleghai river at Dehati.
6. Fishermen demonstrate a 'Behundi jal' (bag net) at Sonakonia on Subarnarekha river.
7. 'Mugri' a traditional triangular shaped cage at Ambala on kansai river (Midnapore).
8. 'Botuya' a type of traps made up of fine bamboo splits at Khirai on tributaries of Kansai river.

REFERENCES

APHA (*American Public Health Association*) (1995): American Water Works Association and Water Environment Federation. Standard methods for the examination of water and wastewater. 19th Edition. Washington DC.

Cook, C.D.K. (1996) *Aquatic and wetland plants of India.* Oxford University press, pp 268-269, 327.

Jhingran, V.G. (1991): *Fish and Fisheries of India*, Delhi: Hindustan Publishing Corporation, 6- U.B,. Tawahar Nagar, Delhi-7: XV + 954.

Joshi, S.N., Tripathi, G. and Tewari, H.C. (1993) *Fish and Fisheries of the Gorigonga, Advances in Limnology* (Ed. H.R. Singh), Narendra Publishing House, Delhi, pp-361-366.

Yadav, B.N. (1997) *Fish and Fisheries. Daya Publishing House*, pp. 222-243.

Chakraborty, S.K. (2000-2001): Project report of DST & Nes, Inventory of threatened and endangered freshwater fishes of Midnapore District with an emphasis on bio-ecological studies of selected carp fishes for their conservation and propagation.

Chakraborty, S.K. (2000-2001): Project report of West Bengal Pollution Control Board, Water quality monitoring of five rivers of West Bengal Viz. Subarnarekha, Shilabati, Rupnarayan, Dwarakeswar and Kansai.

Short Communication

ON THE *EX-SITU* CONSERVATION OF LOCALLY THREATENED MEDICINAL PLANTS OF MIDNAPORE DISTRICT, WEST BENGAL.

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ABSTRACT

A preliminary study on medicinal plants of Midnapore district reveals 115 species of herbs, shrubs, tree and climbers of which 15 species are locally threatened. These species are raised and being rehabilitated in the botanic garden of Vidyasagar University.

Key words : Medicinal plants, Conservation, Midnapore district.

Midnapore, the largest district of West Bengal, is spread over an area of 14081 square Km. The district lies between 21°36'35"N - 22°51'10"N latitude and 86°35'50"E - 88°12'40"E longitude. Biogeographically the entire area is a mosaic of diverse landscapes. The eastern and southern parts of the district having highly fertile alluvial and coastal sandy soils are dominated by the mesophytic and halophytic vegetation characteristics of the Gangetic plains. The western and the northern portions consist of lateritic soils covered with typical sal dominated dry deciduous forests. Due to this environmental and locational uniqueness, the entire district is rich in plant species on which a large number of rural communities, both tribal and non-tribal, depend on traditional medicines among others. The pressure on these vegetations is increasing due to the growing needs of the population, leading to the local extinction of many medicinally important plant species.

Although there are scattered accounts of the flora of Midnapore district (Prain, 1903; Culshaw, 1950; Sanyal , 1991; Kamilya and Paria, 1994 and Doloi, 1999), there is virtually no attempt to document the existing medicinal plants of the area in general and to study the status of those species at risk in particular. In view of this, the department of Botany & Foresty of Vidyasagar University has recently initiated a centrally funded research programme on *ex-situ* conservation of locally threatened medicinal plants. The aims of this communication are :

1. to make an inventory of medicinal plants of Midnapore district,
2. to study the present status of species at risk and the reasons(s) thereof, and
3. to rehabilitate and conserve the threatened species in captivity.

Extensive field surveys to different corners of Midnapore district during the various seasons (pre-monsoon, monsoon and post-monsoon) in 1999- 2000 reveal 115 species of locally useful medicinal plants. These are : 40 herbs, 35 shrubs, 30 trees, and 10 climbers. Among these, the most extensively used 15 species of herb, shrub and climber are found rare in the wild and seem to be locally threatened in various ways but predominantly due to overexploitation and landuse change/ habitat destruction (Table 1). While *Aristolochia indica, Costus speciosus, Rauvolfia serpentina* and *Smilax zeylanica* are highly threatened, *Abrus precatorious, Adhatoda vasica , Andrographis paniculata, Bacopa monnieri, Gymnema sylvestre, Hemidesmus indicus* and *Semecarpus anancardium* are moderately threatened. The rest four species like *Catharanthus roseus, Centella asiatica, Enhydra fluctuans* and *Oxalis corniculata* happen to be mildly threatened. All these species which appear to be conservation dependent and therefore demand instant

attention are being rehabilitated in the newly established botanic garden of Vidyasagar University. Further studies on the multi-plication and propagation of these taxa are in progress. Similar studies are urgently needed to assess non-medicinal species also.

Acknowledgement : The authors are grateful to the Ministry of Environment and Forests, Govt. of India for financial assistance.

Table 1:List of locally threatened species

Species	Family	Category*	Nature of threat (s)
Abrus precatorius	Fabaceae	+ +	Habitat destruction and overexploitation
Adhatoda vasica	Acanthaceae	+ +	Reckless collection
Andrographis paniculata	Acanthaceae	+ +	Reckless collection
Aristolochia indica	Aristolochiaceae	+ + +	Habitat destruction
Bacopa monnieri	Scrophulariaceae	+ +	Overexploitation
Catharanthus roseus	Apocynaceae	+	Overexploitation
Centella asiatica	Apiaceae	+	Land conversion
Costus speciosus	Zingiberaceae	+ + +	Land use change
Enhydra fluctuans	Asteraceae	+	Land use change and over - collection
Gymnema sylvestre	Asclepiadaceae	+ +	Overexploitation
Hemidesmus indicus	Asclepiadaceae	+ +	Habitat destruction and over collection
Oxalis corniculata	Oxaliadaceae	+	Over-collection
Rauvolfia serpentina	Apocynaceae	+ + +	Overexploitation
Semecarpus anacardium	Anacardiaceae	+ +	Land use change
Smilax zeylanica	Liliaceae	+ + +	Land use change

*** Not following IUCN**

+ + + = highly threatened, + + = moderately threatened, + = least threatened

REFERENCES:

Culshaw, J.C. (1950) Some West Bengal Plants, *Journal of Bombay Natural History Society* **49:** 188-96.

Doloi, T.K. (1999) *Arabari: A Rapid Taxaonomic Survey*, M.Sc. dissertation, Dept of Botany and Forestry, Vidyasagar University.

Kamilya, P. and Paria, N. (1994) Chikigarh (Midnapore)- A Vegetational Pocket, *Journal of National Botanical Society*, **48:** 41-68.

Prain, D. (1903) *Bengal Plants*, Vol I & II, (Repr.ed. 1999) Bishen Singh Mahendra Pal Singh, Dehradun.

Sanyal, M.N.(1991) *A Handbook of Excursion Flora of the Gangetic Plains and Adjoining Hills*, Mittal Publications, New Delhi.

Short Communication

CHRONOLOGY, BIOLOGY AND CULTURE:PERCEPTIONS ABOUT AGEING IN A RURAL SOCIETY

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ABSTRACT

A study conducted in two regions of Midnapore District, in West Bengal revealed that there was hardly any concept of retirement from work among the rural aged persons. They may be considered as an economically productive component of the population.

INTRODUCTION

Anthropologists view ageing as a biocultural process. In every society and culture people have specific ideas and perceptions that take into account chronological, biological as well as socio-cultural dimensions to characterize the process of ageing among human beings. The demographic notion of ageing give more emphasis on the chronology of ageing. In working out the dependency ratio the demographers have fixed a particular age group as elderly persons who have to depend upon the working members of the family. The retiring age of the persons employed in government services is also based on the chronological aspect of ageing. In many departments of military services, the biological aspect of ageing is given more importance than the chronological process in determining the age at retirement.

One gathers the impression that in modern societies the chronological as well as biological parameters are used in the characterization of ageing. In traditional rural societies, however, ageing is perceived mainly on the basis of the socio-economic contribution of human beings. This, of course, does not mean that the people living in agrarian societies do not give importance to visible biological features. The rural people view ageing not only as a biological phenomenon but also a kind of socio-cultural event.

Objectives,Materials and Methods

In this study an attempt has been made to explore the perceptions about old age from the verbal statements of a group of elderly persons in two regions of Medinipur district in West Bengal. One area of the study belongs to Kolaghat police station in eastern Medinipur, while the other is located under Kharagpur police station in Western Medinipur. Thirty-one old age persons above 60 years have been interviewed and observed for this study in the month of September 2001 by using an open ended questionnaire schedule. Of these 31 persons, 10 were from the Kolaghat area while 21 belonged to the Kharagpur region. There were tribals, clean Hindu castes and Muslim old men and women in the sample population. The aged individuals were chosen on a non-random opportunity basis depending upon the exigencies of the field situation.

The collected data are mainly qualitative in nature (e.g.perceptions about old age, ideas about the necessity of elderly people in the society) although some quantitative materials (e.g. age of the persons) have also been procured through direct intensive field work.

Findings of the Study

One of the most striking observations made about the aged persons in the sample population is that these people hardly retire from their work. This is definitely a contrasting feature of the elderly people in the rural milieu in comparison with the old persons in the service sector belonging to urban middle class families. It has been found that persons above 60 years of age are still active and share the economic burden of their families. Findings of the present study are presented below in a tabular form :.

Table 1 : Age-Sex Composition of the Old Persons in the Sample

Age group	Male	Female	Total N = 31 (%)
60-64	09	01	10 (32.26)
65-69	05	03	08 (25.81)
70-74	02	05	07 (22.58)
75-79	05	00	05 (16.13)
80 +	01	00	01 (3.22)
Grand Total	22 (70.97%)	09 (29.03%)	31 (100)

Altogether, data from 31 individuals of both sexes were collected, whose ages range from 60 to 80 years. The age-sex composition of the old persons whows the nature of the sample. In the sample, most of the men were above 65 years of age and persons (men and women) between 70-80 years and above constituted 41.93 per cent of the sample. There was no women above 74 years of age in the sample. The lesser number of female in divividuals in the sample can be explained by the fact that the fieldwork was carried out by researchers with all of whom were males.

Table 2. Perception About Old Age Among the Respondents

Sl. Nos.	An old person is one	Number of respondents	Percent out of total(N=31)
1.	Who cannot walk erect	11	35.48
2.	Whose ability to work has decreased	21	67.74
3.	Whose teeth have fallen	09	29.03
4.	Whose power of vision has declined	11	35.48
5.	Whose skin shows wrinkles	09	29.03
6.	Whose memory has declined	03	09.68
7.	Whose hair has become grey	17	54.84

In this table an attempt has been made to classify the various types of responses of the informants regarding the perception about old age and its different signs and symptoms. When asked with the questions (i) ' who are old and' (ii) what are the signs of old age', the respondents came up with at least seven types of answers which are arranged in this table. In the next column of the table the numbers of persons who mentioned each of the characteristics of old age are given. The percentage value of these numbers out of the total number of persons are given in the last column. It is important to mention here that the total of third column of the table does not represent the sample size i.e.31, since all the informants have mentioned more than one 'signs' for characterizing old age. **Old age for the present group of informants is a multidimensional phenomenon.** The responses, however, show that the reduction in the ability to do work has achieved the highest response figure among all other responses (67.74%), the lowest postion being taken up by the 'loss of memory' category (9.68%). Interestingly, other than the category 'greying of hair' no other physical characteristics occupy a value of more than 35 in terms of percentgae. The figures in this table show the importance of the ability to do work by old men and women in a rural milieu.

Table 3. Tasks performed by Old Men and Women in the Sample

Sl. No.	Types of Tasks	Number of Persons			Percent out Of total (%)
		M	F	T	
1	Agriculture	3	1	3	9.08
2	Grazing cattle	3	3	6	19.35
3	Guarding and looking after the house	5	3	8	25.81
4	Selling of vegetable	2	0	2	6.45
5	Carrying food to agriculture fields	0	1	1	3.23
6	Procuring fooder for domestic animals	3	0	3	9.68
7	Preparation and repair of implements	1	0	1	3.23
8	Looking after small children	5	6	11	35.48
9	Household work	8	3	11	35.48
10	Cultivation in the homestead land	3	0	3	9.68
11	Performing religious rituals and rites	1	0	1	3.23
12	Settlement of village disputes	3	0	3	9.68

Doing work in an agriculture based rural population by the older members of the family does not only mean looking after grandchildren and staying at the house as watchmen and watchmen but also doing such outdoor works as grazing of cattle, cultivation in the agricultural field and the like. An old person in an agricultural society does not simply represent a numerical figure under the category of 'Dependent' in the standard demographic formula termed as'dependency ratio'. Such persons are an active and economically productive component of the population.

In Table 3 the tasks performed by the old persons in this sample are listed. The data show that grazing of cattle and procurement of fodder for the domestic animals cover nearly 30 per cent of the individuals in the sample, while agriculture-related activities including preparation and repair of implements and selling of vegetables constitute more than 25 per cent of the individuals.

Concluding Remarks

The quick survey, using standard anthropological methods of fieldwork and observations among some selected old men and women in families dependent on agricultural land revealed the ground realities about the livelihood pattern of the elderly population in a rural setting.

The preliminary exploration into the cognitive domain of the old persons has revealed that there is considerable scope for further research in this field. The importance of elderly people in rural society is clearly reflected in the analysis of their perceptions about the various characteristic features of the old age. Comparative studies on old age among different communities and socio-economic groups in the rural and urban areas can also be undertaken simultaneously.

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Book - Review

Fundamentals of Environmental Studies by D.K. Sinha and A.D.Mukherjee 2000,
Viswa - Bharati : Calcutta. Price Rs 200/- (Paperback)

Of late, understanding the environment with all its concomitant developments has assumed much importance. Probably as a fall out of that , environmental scientists have started feeling the increasing need of environmental education. They are the ones who have taken up the role of protagonists of educational reorientation, if not reforms. This book may be considered as an attempt in that direction, which is welcome in view of the fact that the whole question of environment has become the subject matter of a separate study, much in line with a concerted campaign to raise public awareness of environmental issues. The curricula development programme in Environmental Education (EE) undertaken by the UNESCO deals particularly with 'problem of teaching and developing modules'. The authors have claimed, and not without justification, that these are the 'precursors of the presentations made in this book'.

The book is divided into seven chapters, each dealing with an issue of vital concern relating to environmental studies. The authors have pinpointed two broad aspects of environment, namely, physical conditions determining the survival of the ecosystem, individual or a community, and social and cultural conditions shaping the behaviour of an individual or a community. Natural environment, according to the authors, should be studied an a resource producing system keeping in mind the 'matured methodology of resources utilization' , which would be able to sustain and renew natural resources. But utilization of resources without producing any negative impact on environment is not an easy job. Here, considerable stress has been given on 'integrated use of resources'. All will agree that as a first step towards enforcing such a complex utilization of natural resources, developing an all pervasive monitoring system is essential. But how far such a system will be able to reflect the intricacies and compliting of 'internal resources' dependent on innumerable variables still remains a doubtful proposition. From the methodological point of view, the need for an integrated approach was never so strongly felt as it is now. One simple example may be cited. Pollution in the form of therma pollution cannot be seen in isolation because chemical pollution takes place when in the waters of stream additional heat is generated by discharges of cooling waters from thermal power plants are put into water. Similarly, addition of living things to waters causes biological pollution. The point which emerges out of this is that water pollution of any form-chemical , physical or biological- is caused by human activities detrimental to the maintenance of quality water. The book is replete with such examples and observations. One only wonders if there could be a single approach which will be able to take a total view of the situation, where all the principal components are treated in a manner making them inseparable. Probably such an approach has to be a particularistic one, seeing the problem in its immediate context.

The contents of the chapters are well thought out and will be of much benefit to people engaged in environmental studies. These have contemporary relevance and are written with the help of latest information and research findings. Concerns with 'Environmental Degradation', 'Biodiversity', 'Utilization and Conservation' of resources, ' Wastes and Waste Management', 'Environmental Problems ' in the context of development are not only timely, but are also indicative of future trend. In view of the fact that U G C has made ' Environmental studies' compulsory at the undergraduate level, the book will be immense help to the teachers and students alike.

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Book Review

People, Parks and Wildlife : Towards Coexistence by Vasant Saberwal, Mahesh Rangaranjan and Ashish Kothari, 2001 (pp. 143 + xiv) Orient Longman Limited. New Delhi. Price : Rs 150/- (Paper back)

The lexical meanings of 'preservation' and 'conservation' are almost same, they are often used interchangeably but there is a difference and that difference is crucial. While conservation means official care and management of natural resources, preservation among others also means use of natural resources (wild animals included) in a regulated manner. But the question who is to manage the use of resources and what are the insturments of going about with it?

The three authors of the book under review who come from different disciplinary backgrounds basically dealt with the aforementioned questions in the Indian content. The implicit message which runs all through the eight closely written chapters of this small monograph could be phrased in the following manner. Since absolute non-interference ("exclusionary principle " in the words of the authors) of nature by human beings is a utopia we with an historical sensibility, visualise a preservation-conservation continuum which has preservation of nature by people through tradition ("conservation from below" in authors 'parlance) at the one end and participatory on joint management of environment by government as well as people at the other. The conservation by state from above whether in princely, colonial or Post-Independent India lies somewhere in the middle region of this continuum.

The idea of a continuum should not of course divert our attention from the potential and actual conflicts among the different conservation regimes. In fact, the authors have given many interesting examples of conflicts between peoples management systems and forest department's efforts to wards the conservation of Wildlife within the parks.

The book provides the readers with a wide range of empirical cases and incidents of the use and management of natural resources selected across the length and breadth of this vast and diverse country not simply for the sake of empirical accumulation of ecological data,. The authors have a veritable objective, of treating the business of conservation as an ideology that needs an interdisciplinary and critical examination. Suffice it to say that they have largely succeeded in performing their task.

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