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CONTENTS

Y-LINKED TRICHOSIS AURIS IN THE GOTRAS OF RADI BRAHMANS

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Y-linked inheritance :

The presence of a few coarse hairs on ear rims (Hypertrichosis pinnae auris) was reported to be inherited by a Y-linked gene in a few isolated pedigrees from Europe (Cainer, 1898; Tomassi, 1907; Cockayne, 1933). Gates (1957) supported it with a small pedigree from India. When Penrose and Stem (1958) demolished the assumption of complete Y-linkage of 15 other traits, a vigorous search for the mode of inheritance of hairy ears began especially in India. The postulate of Y-chromosome inheritance of the trait was strengthened with the publication of nine large pedigrees (Dronamraju and Haldane. 1962; Gates et al., 1962), in which hairy ears were detected in all men, who apparently carried the same Y-chromosome and attained a certain age, but not in the aged sons of the daughters of affected men unless their fathers were affected.

Reported exceptions :

However, Gates (1960), Gates and Bhaduri (1961) and Sarkar et al. (1961) presented a few pedigrees in which hairy ears were reported in some adult men but not in others of the same mate fine. Single instances of an affected grandson of an affected maternal grandfather were claimed by both the groups of authors, without verification of father's side. Gates postulated crossing over from Y to X chromosome, and Sarkar et al. suggested sex-limited autosomal dominant inheritance of the trait to interpret these apparent exceptions. But, as noted by Haldane and Dronamraju {1962} and Gates et al. (1962), this suggestion of transmission through daughters were not confirmed by (1) direct examination of the ears, {2} evaluation of the possibility of affected fathers or affected male relatives of the father's line, or (3) illegitimacy.

Single stiff hair :

Publication of (a) a series of pedigrees in which the trait is observed in a large number of (upto 14) sons of affected fathers and in adult males of at least three successive generations, and (b) absence of unequivocal evidence of unaffected fathers of affected sons leaves little doubt about the holandric inheritance of the trait. If there were crossing over of the gene from Y to X chromosome, the gene would not be rare in women and should be common to

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their sons by unaffected fathers (Dronamraju and Haldane, 1962). The failure of penetrance after the age at onset is observed only in one series of data based on second hand (reported) information (Sarkar et al., 1961, 1962). Occasional failure of penetrance might have also been inflated because of the arbitrary criterion of atleast three stiff hairs (Gates et al., 1962; Slatis and Applebaum, 1963). At least two of the authors suggesting autosomal inheritance of the traits finally agreed that 'Undoubtedly, the accumulated evidence was suggestive of the reality of Y-linkage for hairy pinnae' (Stem et al., 1964). They as well as Malhotra (1969) recommended that a single stiff hair on one of the two ears would provide evidence of the presence of the trait. The trait should thus be appropriately called trichosis instead of hypertricosis.

Distribution and spread with age :

Initially, Gates (1960) thought that 'hairy meatus that was frequently found in older men of European descent' was quite independent of hairy ear rims found in India. But later on Gates and associates (1962) observed the presence of hair on both meatus and rim of the ear in a few male lines in India and that propositii resembled their fathers and not their maternal grand fathers in the pattern of distribution of hair an ears. Ghosh and Tyagi (1980) have concluded a common genetical background of hairiness of the ear as a whole on the evidence of the spread of hair on different parts-of the ear in a Bengalee sample. The age at onset of the trait has been reported to vary between families and between populations (Gates et al., 1962; Dronamraju, 1964). The proportion of affected males increased with age upto 70 years in Israel (Slatis and Applebaum, 1963) and in the Mongoloid tribe Bhoksa of U.P. (Garg, 1980), 50 years in Malwa region of M.P. (Goswami, 1968), 45 years in Orissa and Ceylon (Dronamraju, 1964), and 30 years in Vizagapatnam (Majumder, 1974) and West Bengal (Ghosh and Tyagi, 1980). Added to this is the problem of shedding of hair (secondary ear balding) in the old (Gates et al., 1962) which reduces the incidence of hairy ear after 50 years in some data (Basu and Ghosh, 1965).

The purpose of the present study is to verify the above findings among three exogamous patrilineal surnames, Mukherjee, Banerjee and Ganguly, who represent specific gotras of Bharadwaj, Sandilya a Sabarna and Vatsya (Ganguly represents the last two) respectively of the endogamous Radi Brahman population of West Bengal. The data serve the objective of a preliminary genetical analysis of the assumption of common paternal ancestors of the gotra members in the background of an overwhelming evidence for holandric Y-linkage of hairy ears.

Material and Method

The material for the study comprises two series of data. The first series includes records of careful examination of 50 men having stiff hairs on their ears, and the members of their extended families of at least three generations (Table 1), and 4 pedigrees in which probands were selected as unaffected old men.

Table 1 : The first series of data from pedigrees of propositii affected with hairy ears

Gotra	Affected families	No. of sibships	Individuals examined	Affected with Hair on ear
Bharadwaj	21	49	115	85
Sandilya	21	70	132	90
Sabarna	8	16	41	32
Total	50	125	288	207

The data for 288 males aged 15 to 83 years are examined for presence of at least one hair on an ear. Reports about presence or absence of hair on ear for 295 male members of the pedigrees, who were absent or dead at the time of investigation during 1980 and 1997 were also considered. The second series includes records of information on 40 men aged over 50 years and their one or two sons aged above 20 years.

Both the ears of all members of either sex who are at least 15 year old have been directly examined in broad day light through a low power handlense against the background of a white card placed behind each ear. The size and density of sternal and calf hairs of subjects were also recorded.The data were collected from metropolitan Calcutta, Dumdum, Belgaharia, Sodepur, Dhakuria, Bhadrakali, and Chandan nagar, where kindreds related through the sixth ancestral generation in the male line could be traced.

Name, age, sex, endogamous group (Obviously Radi Brahman), exogamous gotra of the father of each subject were recorded in the pedigree. The occurrence of coarse hair on meatus (m), tragus (t), helix (h) and lobe (l), and the upper region (U) side (S) and the base (B) of the helix were noted down. The distribution of hair on different parts is represented by a combination of letters. The study has been conducted among educated people so that the age records could be directly verified.

Results and Discussion

Absence of unaffected father of affected sons :

Altogether 129 living fathers whose sons were observed or reported to be affected and for whom the information could be verified from at least two independent sources give no indication of being unaffected (table 2). There is one report in a Sabarna family that a father aged 62 years of two affected sons and four affected brothers had no hair on the helix, though he had stiff hairs on the ear lobe. Reports however suggest that be had a loss of hair on the sternum. The absence of hair in particular parts of the ear need not be considered as lack of penetrance and the presence of hair on the ear as a whole is taken as the trait. Late onset of hairiness in specific areas such as the meatus and hairiness of ear lobe is relatively more irregular in appearance than that on other areas.

Table 2 : Affected living fathers of affected sons				
Gotra	Number of affected living fathers of affected sons			
	Series 1	Series 2	Reported	Total
Bharadwaj	16	1	29	46
Sandilya	12	2	45	59
Sabarna	6	3	12	21
Vatsa	0	3	0	3
Total	34	9	86	129

Absence of affected fathers of unaffected aged males is confirmed even when the mother's aged brothers are affected. Data of series 2 provide evidence that 27 fathers of 42 unaffected males aged above 20 years are free from single hairs on any part of the ear. They represent 10 Bharadwaj, 6 Sandilya, 6 Sabarna and 5 Vatsya gotra families. To verify the frequency of unaffected males members above 20 years who are supposed to carry the affected Y-chromosome, the 50 affected pedigrees (Series 1) are scrutinised and recorded for different gotras in tables 3 to 5.

Table 3 : Occurrence of coarse hair on parts of the ear after the age at onset in pedigrees of Bharadwaj gotra (surname : Mukherjee).

Pedigree	Onset age	Seen	Reported	Unaffected area	Late onset -age	Area	Hair absent in	Age	Age of Unaffected
1	32	6	2	hS	39(5)	hU	I	43	
							t	47	
2	38	2	3	hU	40(1)	lhB	hS	40	
3	27	5	4	lhU			hB	55	20
4	33	6	2		35(5)	thB	mI	35	22,26,28
5	22	7	6	27(6)	mhS	hS	58,62		
					30(5)	thB			
6	43	3	2	hBU	48(2)	t			22,25
7	35	4	4	hU		mt			24,28
8	32	6	2	hB	35(5)				26
9	45	1	4	hB					
10	36	1	2	h					20,22,24 &25
11	36	3	3						
12	28	4	10		72(1)	hU	hB	32,72	23
13	43	3	2		80(1)	hU	hB	48	
14	29	4	5	hB			hU	33	
15	26	7	2		28(1)	mhB	I	28,31,	
								34,36	
16	26	4	1				I	60	
17	56	1	2						
18	32	6	3	hU	34(1)	hB	hS	46,52	

Contd. from Table 3

					46(1)	I			
19	22	5	2						
20	26	4	3						
21	28	3	3						

Note : *Figures within brackets in column no.6 indicate number of affected individuals.*

Table 4 : Occurrence of coarse hair on parts of the ear after the age at onset in pedigrees of Sandilya gotra (Surname : Banerjee)

Pedigree	Onset age	Seen	Reported	Unaffected area	Late onset -age	Area	Hair not Seen in	Age	Age of Unaffected
1	31	7	5		62	hU	hB	60,70	23
								&73	
2	42	2	5		82	hB			
3	28	4	2	hB	46	mth	m	50	
4	45	2	3		70	l			
5	55	2	4						
6	37	2	4	hU	41	lhB	m	41	
7	35	2	4	m					
8	36	3	2		52	hS			22,24
9	45	3	2		47	hU			
10	34	2	5	Lh					
11	30	4	4	hB	34	l	l	40	21,28
					52	hU	m	52	
12	32	3	5		41	h	l	76	
13	42	3	3	h					
14	53	1	2	hUS					21
15	37	4	2	hB			t	64	25
16	26	4	7		33	hS			21,26,27
					36	hU			
					48	hB			
17	29	6	5	hU	30	l	l	34,36	24
								55,60	
							m	58	
18	32	8	15		48	hS	m	48,52	21,23,27
								58	
							l	32,56	
							hB	52	
							hU	All 6	
19	51	7	11		57	hU	m	64,64	21,23,29
20	22	15	14			m	l	36	22
							t	25	
							hBU	47	
21	42	6	4	hU			hB	42	20,21,52,
									30,30,33

Table 5 : Occurrence of coarse hair on ear after the age at onset in pedigrees of the Sabarna gotra (Surname : Ganguli)

Pedigree	Onset age	Seen	Reported	Unaffected area	Late onset age	Area	Hair absent on	Age	Age of Unaffected
1	34	7	3		38	m	m	34	32,34,36
								36,40	
							t	38	
2	43	2	3	hS			hU-one ear	46	
3	40	1	2	IhB					23
4	26	5	4		37	l	m	38	
					28	hS		35	
					60	hU		37	
5	45	4	3		47	thU	l	53	
					30(5)	thB			
6	28	4	5				all	62(R)	
							hS	67	
7	31	4	4	hU	35	hS			25,27
8	23	5	3						

Note : *Figure within brackets in column no. 9 indicates the side, for example, R = right side.*

The tables show that there is no complete absence of hair on all parts of the ear in any individual after the age at onset in any sibship. The age at onset may, of course vary in a pedigree but not within sibships. The increase of the affected parts of the ear with age indicates that the criterion of the presence of hair on the entire ear is appropriate for deciding on the mode of inheritance of the trait. The apparent failure of the highest age group to display the maximal intensity of the hairiness of the ear suggests shedding of hair in that age. Restricted distribution of hair in certain families suggests the constitutional factors limiting the expression of the gene, which runs in families suggests the constitutional factors limiting the expression of the gene, which runs in families. All these considerations leave little doubt about the Y-linked inheritance of the trait.

However, the occurrence of affected pedigrees is not universal in any one of the gotras, as seen in the second series of data, which is unbiased (Table 6).

Table 6 : Frequency of affected pedigrees in samples of a gotra of Radi Brahman

Serial no	Gotra	Total sample	Affected pedigrees	Proportion
1	BHARADWAJ	12	4	0.333
2	SANDILYA	10	4	0.400
3	SABARNA	9	3	0.333
4	VATSA	9	2	0.222
Total		**40**	**13**	**0.325**

Allowing for the limited sizes of samples, it can be concluded that there is no truth in the belief that gotra is the name of the common male ancestor who should have the same Y-linked gene. It is true that adoption, illegitimacy and mutation may change the Y-linked gene in individuals. But these factors are small in effect and the high frequencies of both affected and unaffected gotras suggest that the belief in common male ancestors of gotras is a myth.

In fact, Kane (1941, cited in Roychaudhuri and Roychaudhuri (1980) has reported that in earlier times present, gotra was not an exogamous group. In later times, amalgamation of several exogamous patrilineal lineages has given rise to the present gotras, so that descendant of one common male ancestor cannot form any one of them. The present investigation, therefore, appears to agree with Kane's observation of several Y-linked genes in a gotra.

Incidentally, the overall frequency of affected male line families appears to be closely similarly to the earlier estimate of the frequency of the Y-linked gene (Gates et al., 1962) for the bengali speaking population.

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DERMATOGLYPHIC VARIATIONS IN OCULOCUTANEOUS ALBINISM

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ABSTRACT

No. of triradii and patterns on fingers, palms, toes and soles of patients with oculocutaneous albinism (OCA) and their close relatives have been examined for significant differences. There is a general trend of increase of pattern intensity especially in toes and soles in the patients than their relatives. There is however, an opposite trend in male patients particularly for fingers and palms has been found. As a whole, the gross triradii no. tends to increase in the albinos.

Key Words : *Dermatoglyphs, Ocolocutaneous Albinism, Triradii, Pattern Intensity Index.*

Introduction

Study of associations between finger and palmer Dermatoglyphs with congenital and hereditary diseases and disorders is a burgeoning field of Biological Anthropology which has both theoretical and practical significance. While results of such studies can be useful in shedding light on the genetics of the concerned disorders and dermatoglyphics characters at the same time, they should also be useful for genetic counseling, genetical screening of disorders and their carriers and similar other practical purposes. We are reporting here preliminary results of an ongoing exploratory study on the dermatoglyphics patterns not only on fingers and palms but also on that on toes and soles on individuals affected with oculocutaneous albinism which is a single gene autosomal condition although more than one locus may be involved. A special feature of the present analysis, although based on a small number of individuals, is the use of first degree unaffected relatives of the same sex as controls for comparison. In view of the rarity of this disorder, it has not been possible to limit the study to a specific gene pool. But this lacuna is overcompensated by the intensive family investigation, only a part of which is being reported here.

Material and method

The present report is based on finger, palm, toe and sole prints collected from nine albino

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individuals, of which six are males and three females, and one same relatives of the first degree (father, son, brother or mother, daughter etc.) who are not affected. The relationships checked by studying a few genetic markers like OAB serotypes, ABH secretor status, mid-phalangeal hair etc. In eight cases, the unaffected relatives are heterozygous carriers of the concerned gene for albinism, as they are either parents or offspring of albino individuals. The relatives in the remaining case is a brother of an albino male and thus has 2/3 probability of being a heterozygous carrier of the specific albino gene in the pedigree. Thus the present study should be considered as that of a dermatoglyphic comparison between homozygotes and heterozygotes per se of the gene for oculocutaneous albinism.

The analyses are limited to the identification of patterns, namely, whorls (W), loops-ulnar (U), radial (R) on hands and fibular (F), tibial (T) on feet, distal (D) and proximal (P), on palms and soles, tented arch (TA), arch (A) and open field (O) on palms and soles (following Cummins and Midlo, 1961); and counting number of triradii (trN) on fingers, toes, palms, soles, digits (fingers and toes), hands (fingers and palms), feet (toes and soles) and gross (all area following Mukherjee, 1966, 1974, 1980). Percent frequencies of different patterns are calculated for each digit, i.e. finger or toe, and each dermatoglyphic area of palms and soles, pattern intensities are estimated (following Mukherjee et. al. 1980) and number of triradii counted after Mukherjee (1966). Sexes are studied both separately and combinedly, in view of the small size.

Results and discussion

It appears that the albinos display a reduced pattern intensity on fingers, palms and soles taken separately in the male sex (Table 1), in comparison to that in their unaffected male relatives. This is accompanied by a reduction of the number of whorls on each of those areas, and of radial loops on fingers, of distal loops on palms and soles, and of proximal loops on soles in the albino males in the present sample. Arches and ulnar loops on fingers, and open fields and radial / tibial loops on palms and soles tend to increase in the albino males. On toes on the other hand, pattern intensity increases with increased frequencies of whorls and tented arches compensated by reduced frequency of fibular loops.

In the famale sample, which has a even smaller size, the trends of pattern intensity and whorl frequency appear to be reversed on fingers, palms and soles between albinos and their relatives (Table 2). However, the increase of arch frequency in the albinos compared to that in their relatives persists on fingers in samples of either sex. The patterns on toes show a higher intensity in the albino females as in albino males compared to their relatives.

However, because of the rather small sample, especially of the females, we have pooled the samples of two sexes to find the abiding trends of difference between albinos and their carrier relatives to propose a preliminary hypothesis about the effect of albinism on dermatoglyphic patterns over all areas of ridged skin in an individual. Frequencies of whorl

and distal loops rather than differences in the occurrence of open fields in the albinos and their close relatives.

The gross total number of triradii per individual appears to increase in the pooled sample, even though it is slightly reduced in the albinos in the male sample (Table 4). The triradial number appears to exceed in the feet (considering toes and soles together). The mean numbers of triradii on hands appear to be reduced in the albinos in the pooled sample in spite of the females showing a different trend. The albinos display an excess of triradii on digits taken together although it is not so apparent in the male sample in this study.

Summary

It can be said on the basis of the preliminary results that the number increases, especially in digits and feet in the albino patients, compared to their close relatives.

Table 1 : Occurrence of patterns and their intensities in a sample of six male albinos and their first-degree male relatives, who are not affected.

Sample	Patterns%						Pattern Intensity	
	Fingers (n)	W	U	R	TA	A	Index	
Albinos	60	31.7	65.0	1.7	0.0	1.7	13.00	
Relatives	60	60.0	35.0	5.0	0.0	0.0	16.0	
	Toes (n)	W	F	T	TA	A		
Albinos	60	45.0	45.0	0.0	1.7	8.3	13.67	
Relatives	60	16.7	75.0	0.0	0.0	8.3	10.83	
	Areas of Palms (n)	W	U	R	P	D	O	
Albinos	60	0.0	0.0	3.3	0.0	23.3	73.3	2.67
Relatives	60	1.7	0.0	0.0	0.0	26.7	70.0	3.00
	Areas of Soles (n)	W	F	T	P	D	O	
Albinos	60	1.7	0.0	5.0	0.0	20.0	73.3	2.83
Relatives	60	3.3	0.0	0.0	3.3	23.3	70.0	3.33

Table 2 : Occurrence of patterns and their intensities in a sample of three female albinos and their unaffected first-degree female relatives.

Sample		Patterns %						pattern Intensity
Fingers (n)	W	U	R	TA	A			Index
Albinos	30	40.0	50.0	3.3	0.0	6.7		13.33
Relatives	30	20.0	73.3	3.3	3.3	0.0		12.00
	Toes (n)	W	F	T	TA	A		
Albinos	30	43.3	46.7	0.0	0.0	10.0		13.33
Relatives	30	6.7	70.0	3.3	0.0	20.0		10.40
	Areas of Palms (n)	W	U	R	P	D	O	
Albinos	30	0.0	13.3	0.0	0.0	26.7	60.0	4.00
Relatives	30	0.0	6.7	0.0	0.0	30.0	63.3	3.67
	Areas of Soles (n)	W	F	T	P	D	O	
Albinos	30	3.3	0.0	0.0	3.3	23.3	70.0	3.33
Relatives	30	0.0	0.0	0.0	16.7	13.3	70.0	3.00

Table 3 : Occurrence of patterns and their intensities in albino individuals of either sex and their unaffected first-degree relatives of respective sex.

Sample		Patterns %					pattern Intensity
	Fingers (n)	W	U	R	TA	A	Index
Albinos	90	34.4	60.0	2.2	0.0	3.3	13.11
Relatives	90	46.7	47.8	4.4	1.1	0.0	14.67
	Toes (n)	W	F	T	TA	A	
Albinos	90	44.4	45.5	0.0	1.1	8.9	13.55
Relatives	90	13.3	73.3	1.1	0.0	12.2	10.11
	Areas of Palms (n)	W	U	R	P	D	O
Albinos	90	0.0	4.4	2.2	0.0	24.4	68.9 3.11
Relatives	90	1.1	2.2	0.0	0.0	27.8	68.9 3.22
	Areas of Soles (n)	W	F	T	P	D	O
Albinos	90	2.2	0.0	3.3	1.1	21.1	72.2 3.00
Relatives	90	1.1	0.0	4.4	6.7	15.5	72.2 2.89

Table 4 : Gross number of triradii, triradial number on digits (fingers and toes), hands (fingers and palms), and feet (toes and soles) per individual in albinos and in their unaffected same sexed relatives of first degree.

		Average number of triradii on			
		digits	hands	feet	gross
Sex	Sample				
M	Albinos	26.67	23.67	24.60	48.27
	Relatives	26.83	27.00	22.16	49.16
F	Albinos	26.63	25.63	24.66	49.99
	Relatives	22.40	23.67	21.40	45.07
MF	Albinos	26.66	24.22	24.55	48.77
	Relatives	24.78	25.89	21.00	46.89

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SURVEY OF NUTRITIONAL STATUS OF COLLEGE-GOING ADOLESCENTS AND YOUNG ADULTS OF BIRBHUM DISTRICT OF WEST BENGAL WITH BMI-STUDY METHOD

K Roy, N. Goswami*, A. Pari**

ABSTRACT

The present study was aimed at the evaluation of nutritional status of adolescents and young adults of Birbhum district of West Bengal with the help of a simple anthropometric index, BMI. A cross sectional study was conducted on 200 college-going (17-19 years of age) students of both sexes from middle income group of Birbhum district of West Bengal. Alarmingly, a substantial amount of the subjects are reported to suffer from chronic energy deficiency (CED) of different grades as measured by BMI. The result of this study highlights the necessity to institute effective prevention and health promotion programme in rural Bengal targeting at young adults.

INTRUDUCTION

Health of a population depends on multifactorial influences. Thus, conceptually health of an individual and whole community may be considered to be the result of interaction of many important factors e.g. heredity, environment, life style, socio-economic condition, health and family welfare services etc. Other contributions to the health of a population may be derived from systems outside the normal health care system i.e. health-related programme of food and agriculture, education, industry, social welfare and rural development (12).

Several health survey reports of National Nutrition Monitoring Bureau (NNMB) on nutritional status of adolescents and youngsters of rural India indicated fifty percent of this group was malnourished and suffered from different degrees of Chronic Energy Deficiency (CED) Syndrome (1, 6, 7, 12, 14).

The present work was designed to investigate nutritional status of young adults (17 to 19 years of age) of local college-students of Birbhum district of West Bengal. For this, purpose, a cross sectional study was under taken with the help of an important anthropometric index i.e., body mass index (BMI or Quetelet's index). The said index is generally adopted for rapid survey of nutritional status and determination of CED state (7, 14, 17).

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It is assumed that the report of the survey may throw some light on the necessity for promotion of the nutritional status in young adult of rural Bengal of India.

MATERIALS AND METHODS

1. Area of study and choice of subjects

The present study was conducted on subjects randomly chosen from different localities of Birbhum district of West Bengal. 140 boy and 60 girl students (17 to 19 years of age) from middle income group of both rural and urban area were selected for study.

2. Evaluation of Nutritional status :

The over all nutritional status was monitored by a very simple and quick method employing measuring the body mass index (**BMI**) value of the subjects. Quetlet's Index or the Body mass Index (**BMI**) [defined as weight in Kg/Height in square meter] is commonly used to assess the nutritional status of adults (12, 14) Persons with BMI value less than 18.5 are considered to suffer from chronic energy deficiency (CED). This BMI value is independent of age and sex. A large number of literatures exist where BMI has been ascertained as the index of chronic energy deficiency as well as obesity (3, 7, 8, 9, 10, 11, 12, 13, 16, 17). According to WHO, (12, 16) persons with BMI values less than 18.5 are considered to suffer from Chronic Energy Deficiency (CED). CED is further classified as :

Grade I : BMI value 17-18.49
Grade II : BMI value 16-16.99
Grade III : BMI value <16.0
BMI value 18.5-24.99 is considered as Normal.
BMI value 25-29.9 is considered as Grade I obesity.
BMI value 30.0-39.9 is considered as Grade II obesity.
BMI value >40.0 is considered as Grade III obesity.

The parameters noticed for each subject were body weight in kg in light indoor clothes, and height in centimeters in standing upright posture with arms residing by the sides and without shoes. Body weight was measured by weighing machine and height was measured using anthropometric set.

RESULTS

A total of 60 girls and 140 boys were studied. Interestingly, the result shows that out of 60 girl students, only 28 students (46.5%) shows normal nutritional status as measured by **BMI**. The results in case of male students give a similar picture, i.e. out of 140 male students; only 72 students have normal nutritional status (51.4%). The results are shown in Table 1 & 2 and also in Fig 1. Only, 1.4% male students and approximately, 5% female students are found to

be Grade I over-weight. **But, alarmingly, a substantial proportion of students or precisely, half of the students of both sexes are found to suffer from CED of different grades. (FIG 1 and Table 2.)**

Table : 1. Gradation of CED with BMI values of 140 male and 60 female students.

No of Male subjects (n)	BMI value Mean +/– S.D.	CED Status
72	20.63 +/– 1.47	Normal (51.4%)
2	27.13 +/– 1.24	Overweight (obese Grade I)
36	21.41+/– 0.42	Grade I
15	16.64 +/– 0.31	Grade II
15	16.64 +/– 0.31	Grade III
No of Female subjects (n)	**BMI value Mean +/– S.D.**	**CED Status**
28	20.89 +/– 1.52	Normal (46.5%)
3	27.64 +/– 1.19	Overweight (obese Grade I)
17	17.13 +/– 0.37	Grade I
4	16.39 +/– 0.32	Grade II
8	14.69 +/– 0.64	Grade III

Table 2 : Percent of students suffering from CED

Nutritional Status	*Percentage of Females & Males*	
	Females	*Males*
CED (Grade III)	13.28	10.7
CED <Grade II>	6.64	10.7
CED <Grade>	28.22	25.7

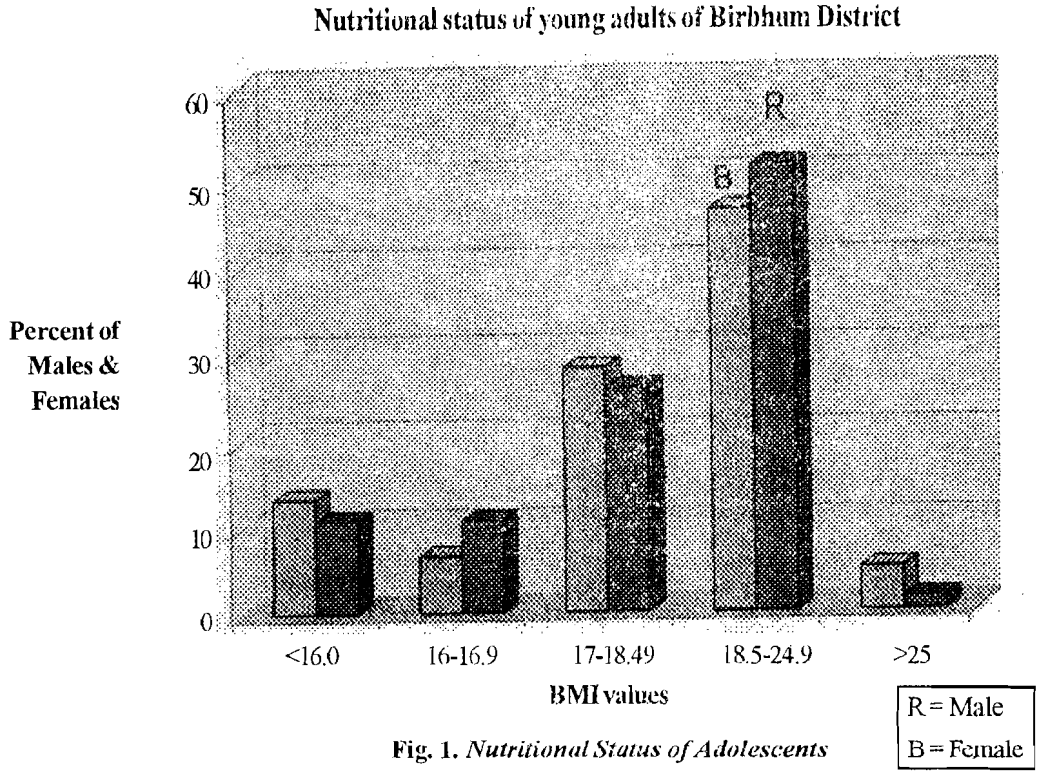

Fig. 1. *Nutritional Status of Adolescents*

DISCUSSION

According to modern concepts, school-health and post school-health services are economical and powerful means of raising community health and extremely important for the all-round development of our future generation (6, 12, 17). In 1960, Government of India constituted School health committee to assess the standard of health and nutrition of adolescent group (2). The period of transition from childhood to adulthood is called adolescence. It heralds an accelerated physical, biochemical and emotional development (5). With profound growth in adolescence, there is increased demand for energy, protein, minerals and vitamins (1,5,15) and calorie needs increase with metabolic demand of growth and energy expenditure (4), but deficiency in energy supply (17) leads to "chronic energy deficiency" (CED). The term CED was being used in Guatemala in 1987 to indicate inadequate house-hold food supply (15). Estimation of CED state can be calculated from BMI (12,16,17). Low BMI and CED indicate poor socio-economic status, less immunity function and malnourished state of health (12,15).

In the present study, college students students of both sexes and 17 to 19 years of age group in Birbhum district were selected and alarmingly, almost fifty percent of them showed CED of different grades.

It is suggested that as they hailed from middle income group and habituated to consume

junk and fast food, their health condition deteriorates and this leads to poor nutritional status (17,18).

Thus, the present study suggests the need to implement health promotion programme and to perform large-scale epidemiological studies within young adult population of rural West Bengal.

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ADULT BENGALEE TUBERCULOSIS PATIENTS AND CONTROLS : COMPARISON OF ANTHROPOMETRIC CHARACTERISTICS AND NUTRITIONAL STATUS

Sujata Jana [1,2], Kaushik Bose [1], Ashish Mukhopadhyay[1,2] and Mithu Bhadra[1]

Abstract

A comparative study of tuberculosis patients (TBP) and controls (CT) was undertaken among adult (> 20 years) Bengalees of Shyamnagar, Barrackpore, Naihati and Jagaddal of North 24 Parganas District, West Bengal, to compare their anthropometric characteristics and nutritional status. The study included 310 (154 TBP and 156 CT) men and 246 (128 TBP and 118 CT) women. The mean ages of TBP and CT were similar (men : TBP = 36.4 years; CT = 34.5; women : TBP = 26.4, CT = 25.6). Results reveled that TBP had significantly lower mean values for anthropometric characteristics in both sexes, compared with CT. Linear regression analyses with presence/absence of TB and anthropometric characteristics revealed that TB status (coded as 1 = yes, 2 = no) had significant effect on anthropometric characteristics, in both sexes, compared with CT. Linear regression analyses with presence/ absence of TB and anthropometric characteristics revealed that TB status (coded as 1 = yes, 2 = no) had significant effect on anthropometric characteristics, in both sexes. The percent variation explained by absence/presence of TB (1 = yes, 2 = no) was generally higher for subcutaneous adiposity (skinfolds) than other anthropometric characteristics in both sexes. Moreover, in general, the percent variation in subcutaneous adiposity explained by TB status was larger in women than in men. This implied that there was more loss of subcutaneous adiposity in women as compared to men, due to TB status. Furthermore, there were significant ($p < 0.00001$) differences (men : chi-square = 73.13361; women : chi-square = 59.0000) in the nutritional status between TBP and CT, in both sexes. The frequency of undernutrition was significantly higher amongst TBP, in both men (56.5%) as well as women (51.6%), compared with CT (men = 12.2%; women = 10.2%).

In conclusion, this study revealed that TBP had significantly less adiposity and higher levels of undernutrition, compared with CT. The difference in adiposity was much more pronounced for subcutaneous adiposity, in both sexes. Moreover, there were sex differentials

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in the loss of subcutaneous adiposity. Further studies are needed to fully ascertain the exact mechanism for the causation of these differences, not only among Bengalees but other ethnic groups resident in India. Based on the findings of the present study, it can also be recommended that TBP receive nutritional support during their treatment.

Introduction

Approximately, one-third of the world's population is infected with *Mycobacterium tuberculosis* (common name : tuberculosis) and the majority live in less developed countries (van Lettow et al, 2004). Anthropometric characteristics and nutritional status of tuberculosis patients have been studied in several recent investigations worldwide Macallan, 1999; Niyongabo et al., 1999; Metcalf, 2005). However, studies dealing with anthropometric measurements, nutritional status and tuberculosis from India are lacking (Macallan, 1999; Ghosh et al., 2004). The present investigation was undertaken to compare the anthropometric characteristics and nutritional status between tuberculosis patients (TBP) and controls (CT) among adult (>20 years) Bengalees of North 24 Parganas District, West Bengal.

Materials and Methods

A comparative study of TBP and CT was undertaken among adult (> 20 years) Bengalees of Shyamnagar, Barrackpore, Naihati and Jagaddal of North 24 parganas District, West Bengal. This study was conducted at the State General Hospital of Bhatpara, Dr. B.N. Bose Hospital of Barrackpore and Naihati S.D. Hospital during the period December 2003 to February 2004. Prior permission was obtained from the hospital authorities before commencement of the study. Both medically diagnosed adult (> 20 years) controls (CT) were recruited from these hospitals. The study included 310 (154 TBP and 156 CT) men and 246 (128 TBP and 118 CT) women. All participants gave their signed consent to participate in this study.

All anthropometric measurements were made by a trained investigator (SJ) following the standard techniques recommended by Lohman et al. 91988). Height, weight, circumferences and skinfolds were measured to the nearest cm.,kg., cm., and mm., respectively. A total of 6 circumferences (chest, minimum waist, maximum hip, mid-upper arm, calf and mid-thigh) and four skinfolds (biceps, triceps, subscapular and suprailiac) were studied. Total subcutaneous adiposity was measured as sum of skinfolds, i.e.,

Sum of skinfolds (mm) : biceps + triceps + subscapular + suprailiac.

Body mass index (BMI) was computed following the standard formula (World Health Organization, 1995; Lee and Nieman, 2003).

$$BMI = \text{weight (kg)} / \text{height (m}^2\text{)}$$

The following World Health Organization (WHO, 1995) recommended BMI cut-off points

were utilized to determine the nutritional status of the subjects :

Nutritional status	BMI Value
Undernutrition	< 18.5
Normal	18.5–24.9
Overweight	25.0–29.9
Obese	>= 30.0

While BMI was used as a measure of overall adiposity (Lohman et al., 1988; WHO, 1995; Lee and Nieman, 2003), circumferences were utilized as a measure of regional adiposity (Ghosh et al., 2004). Subcutaneous adiposity was measured using skinfolds (Lohman et al, 1988; Lee and Nieman, 2003).

Before taking anthropometric measurements, all subjects completed a questionnaire that included specific questions on age, ethnicity, and other sociodemographic variables. Only individuals diagnosed (by clinicians at the hospitals) as suffering from TB were classified as TBP. Technical error of measurements (TEM) was computed and they were found to be within reference values (Ulijaszek and Kerr, 1999). Thus TEM was not incorporated in statistical analyses.

The distributions of all anthropometric variables were checked for normality. It was found that the majority of the anthropometric variables and indices were not significantly skewed. Thus, transformation of data was not necessary. Students' t tests were performed to test for sex differences in anthropometric variables and indices. Percent difference was computed with the following formula :

Percent Difference (%) = Mean CT – Mean TBP/Mean CT.

Regression analyses (TB status coded as : 1 = yes; 2 = no) were undertaken to test for the impact of TB status (independent variable) on anthropometric variables and indices (dependent variable). Chi-square test (Fischer's exact test were performed (each sex separately) to test for differences in nutritional status between TBP and CT. All statistical analyses were performed with *SPSS* software package.

Results and Discussion :

There were no significant differences in mean ages between TBP (men : mean = 36.4 years, sd = 16.3; women : mean = 26.4, sd = 11.1) and CT in each sex (men : mean = 34.5 years, sd = 12.1; women : mean = 25.6, sd = 16.8). The mean (SD) and differences in anthropometric characteristics between TBP and CT among men are presented in **Table 1.** Men TBP had significantly ($p < 0.001$) lower mean for all anthropometric characteristics (except height) compared with CT of the same sex. Moreover, the differences were larger (larger percent difference) for all subcutaneous adiposity measures, i.e. skinfolds.

Table 1 : Comparison of anthropometric characteristics between male TB patients and controls.

Variable	TB patients (n = 154)	Controls (n = 156)	Percent Difference (%)	t
Height (cm)	162.6 (5.5)	162.0 (6.6)	0.37	-0.56
Weight (kg)	48.5 (4.0)	57.1 (6.8)	15.06	-13.73*
BMI (kg/m^2)	18.3 (1.5)	21.5 (2.5)	14.88	-13.75*
Circumferences (cm)				
Chest	73.8 (4.2)	80.1 (5.3)	7.87	-11.71*
Minimum Waist	64.1 (4.7)	69.4 (6.5)	7.64	-8.17*
maximum hip	79.2 (5.1)	86.4 (5.9)	8.33	-11.44*
Mid upper arm	20.0 (3.8)	23.7 (2.7)	15.61	-10.02*
Calf	24.9 (4.0)	30.4 (3.5)	18.09	-12.02*
Thigh	34.5 (5.8)	42.2 (5.4)	18.25	-12.02*
Skinfolds (mm)				
Biceps	4.0 (1.6)	7.5 (2.0)	46.67	-17.22*
Triceps	4.9 (1.7)	9.3 (2.3)	47.31	-19.17*
Subscapular	7.2 (2.4)	13.8 (4.6)	47.83	-15.88*
Suprailiac	5.6 (2.1)	13.6 (5.1)	58.82	-18.09*
Sum of skinfolds	21.7 (7.3)	44.2 (12.8)	50.90	-18.96*

Standard deviations are presented in parentheses
* $p < 0.001$.

The mean (SD) and differences in anthropometric characteristics between TBP and CT among women are presented in **Table 2.** Women TBP had significantly lower mean for all anthropometric characteristics compared with CT of the same sex As in the case with men, the differences were larger (larger t) for all subcutaneous adiposity measures, i.e. skinfolds. Moreover, the differences **(Tables 1 and 2)** were much more pronounced (larger percent difference) in women as compared with men.

Table 2 : Comparison of anthropometric characteristics between female TB patients and controls.

Variable	TB patients (n = 128)	Controls (n = 118)	Percent Difference (%)	t
Height (cm)	151.4 (5.9)	154.8 (5.1)	1.88	-4.79*
Weight (kg)	42.3 (5.1)	52.1 (7.9)	18.81	-11.45*
BMI (kg/m^2)	18.5 (2.2)	21.7 (2.9)	14.75	-9.81*
Circumferences (cm)				
Chest	74.5 (5.2)	85.7 (8.0)	13.07	-12.88*
Minimum Waist	61.4 (5.1)	68.4 (6.9)	10.23	-8.95*
maximum hip	80.0 (6.1)	92.1 (9.0)	13.14	-12.2*
Mid upper arm	19.2 (3.3)	22.9 (2.7)	16.16	-9.72*
Calf	23.5 (2.6)	30.4 (3.5)	22.70	-17.62*
Thigh	33.8 (6.0)	43.3 (4.9)	21.94	-13.61*
Skinfolds (mm)				
Biceps	4.1 (1.4)	8.4 (1.9)	51.19	-20.13*
Triceps	5.2 (1.9)	10.7 (2.3)	51.40	-20.67*
Subscapular	7.5 (2.3)	14.8 (3.8)	49.32	-18.07*
Suprailiac	5.6 (1.9)	13.9 (4.5)	59.71	-18.64*
Sum of skinfolds	22.4 (7.0)	47.8 (11.2)	53.14	-21.23*

Standard deviations are presented in parentheses

* $p < 0.001$.

These results can be summarized as :

1) There was significantly less adiposity in TBP, as compared with CT, in both sexes.

2) These differences in adiposity between TBP and CT were not uniform. The difference in subcutaneous adiposity was larger than the difference in overall adiposity (BMI) and adiposity measured by circumferences, in both sexes.

3) Moreover, the differences in subcutaneous adiposity were more pronounced in women than in men.

Results of linear regression analyses of TB status (independent variable coded as : 1 = yes, 2 = no) and anthropometric characteristics (dependent variable) in men are presented in **Table 3.** Results revealed that TB status had significant ($p < 0.0001$) impact on all anthropometric variables and indices. Moreover, the percent variation explained (adjusted R^2) by TB status in subcutaneous adiposity (skinfolds) was larger than the percent variation explained in case of other anthropometric variables and indices. The percent variation explained in subcutaneous adiposity ranged from 44.7% (subscapular) to 54.2% (triceps).

Table 3 : Regression analyses of TB status (1 = yes, 2 = no) with anthropometric characteristics among men.

Variable	B	seB	Beta	T	Adj. R^2
Weight (kg)	8.718515	0.637160	0.614877	13.683*	0.37605
BMI (kg/m^2)	3.200791	0.233424	0.615685	13.712*	0.37705
Circumferences (cm)					
Chest	6.339177	0.858714	0.554532	11.695*	0.30526
Minimum waist	5.255744	0.644583	0.421346	8.154*	0.17486
Maximum hip	7.144897	0.624687	0.545998	11.438*	0.29584
Mid upper arm	3.734482	0.371742	0.496786	10.046*	0.24435
Calf	5.471545	0.424130	0.592279	12.901*	0.34869
Thigh	7.671220	0.638420	0.564943	12.016*	0.31695
Skinfolds (mm)					
Biceps	3.469172	0.201718	0.699913	17.198*	0.48822
Triceps	4.360057	0.227866	0.736959	19.134*	0.54163
Subscapular	6.559416	0.414526	0.669641	15.824*	0.44663
Suprailiac	8.013170	0.444894	0.716222	18.011*	0.51139
Sum of skinfolds	22.401815	1.185678	.732681	18.894	0.53532

* $p < 0.0001$.

TB status used as an independent variable.

Results of linear regression analyses of TB status (independent variable coded as : 1 = yes, 2 = no) with anthropometric characteristics (dependent variable) in women are presented

in **Table 4.** Results revealed that TB status had significant ($P < 0.0001$) impact on all anthropometric variables and indices. As in the case with men, the percent variation explained (adjusted R^2) by TB status in subcutaneous adiposity (skinfolds) was larger than the percent variation explained in case of other anthropometric variables and indices. The percent variation explained in subcutaneous adiposity ranged from 58.0% (subscapular) to 63.5% (triceps). Moreover, in general, the percent variation in subcutaneous adiposity explained by TB status was larger in women than in men. This implied that there was more loss of subcutaneous adiposity in women as compared to men, due to TB status. This could be due to the fact that normal healthy women have greater levels of subcutaneous adiposity compared to men.

Table 4 : Regression analyses of TB status (1 = yes, 2 = no) with anthropometric characteristics among women.

Variable	B	seB	Beta	T	Adj. R^2
Weight (kg)	9.781939	0.840730	0.597357	11.635*	0.35420
BMI (kg/m^2)	3.224128	0.325369	0.535675	9.909*	0.28403
Circumferences (cm)					
Chest	11.155720	0.851998	0.642397	13.094*	0.41027
Minimum waist	6.983011	0.770369	0.501909	9.065*	0.24885
Maximum hip	12.095114	0.973063	0.622663	12.430*	0.38520
Mid upper arm	3.710646	0.385377	0.524729	9.629*	0.27237
Calf	6.869783	0.385187	0.752265	17.835*	0.56412
Thigh	9.465440	0.701214	0.653848	13.499*	0.42517
Skinfolds (mm)					
Biceps	4.309799	0.211573	0.793544	20370*	0.62819
Triceps	5.531634	0.417870	0.797862	20.674*	0.63509
Subscapular	7.357985	0.399318	0.762795	18.426*	0.58014
Suprailiac	8.314288	0.433608	0.775300	19.175*	0.59946
Sum of skinfolds	22.401815	1.185678	0.732681	18.894*	0.53532

* $p < 0.0001$.

TB status used as an independent variable.

The results of regression analyses can be summarized as :

1) TB status had significant effect on adiposity in both sexes

2) This impact was greater on subcutaneous adiposity

3) In general, this impact was greater in women.

Contingency chi-square tests were performed for each sex separately to test for the association of TB status with nutritional status. Results for men and women are presented in **Table 5** and **Table 6**, respectively. There were significant ($p < 0.0001$) differences in the frequency of undernutrition between TBP and CT in men (Chi-square = 73.13361) as well as women (chi-square = 59.0000). The frequencies of undernutrition were significantly more common in both men (56.5%) as well as women (51.6%).

Table 5 : Nutritional status (based on BMI) of Bengalee TBP and CT males.

	Undernutrition	Normal	Overweight
TBP	87 (56.5)	67 (43.5)	—
CT	19 (12.2)	125 (80.1)	12 (7.7)

Percentages are presented in parentheses.
Chi-square$_{(2)}$ = 73.13361; $p < 0.00001$.

Table 6: Nutritional status (based on BMI) of Bengalee TBP and CT females.

	Undernutrition	Normal	Overweight
TBP	66(51.6)	61 (47.7)	1 (0.8)
CT	12 (10.2)	91 (77.1)	15 (12.7)

Percentages are presented in parentheses.
Chi-square$_{(2)}$ = 59.0000; $p < 0.00001$.

The results of contingency chi-square revealed that :

1) Undernutrition was significantly more common among TBP in both sexes

2) The rates of undernutrition among TBP were similar in both sexes.

In conclusion, this study revealed that TBP had significantly less adiposity and higher levels of undernutrition, compared with CT. This difference in adiposity was much more pronounced for subcutaneous adiposity, in both sexes. Moreover, there were sex differentials

in the loss of subcutaneous adiposity. Further studies are needed to fully ascertain the exact mechanism for the causation of these differences, not only among Bengalees but also among other ethnic groups resident in India. Based on the findings of the present study, it can be recommended that TBP receive nutritional support during their treatment.

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CONSANGUINITY EFFECT ON FERTILITY AND RELATED PHENOMENA AMONG TELUGU SPEAKING POPULATION OF KHARAGPUR, WEST BENGAL

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Abstract

Consanguineous marriages refer to marriage between spouses whose biological relationship could be traced through one or more common ancestors. The direct genetical significance of consanguineous marriages is that they lead to inbreeding in the offspring. Inbreeding is a process by which alleles are identical by descent, are transmitted to an individual through both parents. The present study is an attempt to verify any effect of consanguinity in different levels on fertility among Telugu speaking populations of Kharagpur, West Bengal. The study reveals that there is an increased rate of live births in women in consanguineous marriages over that in the non-consanguineous marriages. There is also an overall trend of greater number of age specific birth rates in consanguineous marriages than in the non-consanguineous marriages in women of younger age groups. But there is no consistent evidence of increased sterility or increase of twinning rate in consanguineous marriages in the study populations.

Key words : Consanguinity effect, fertility, sterility, twinning

Introduction

In terms of fertility, various studies showed that there is an elevation of birth rates among consanguineous couples as compared with non consanguineous couples of their own populations e.g. Japan (1); Samaritans of Israel (2); Egypt (3); Punjabis of Pakistan (4). Similar observations of elevated birth rates have also been reported among Muslims of North India (5); tribal populations of Madhya Pradesh (6); population of Karnataka (7,8) and populations of Andhra Pradesh (9,10,11,12,13). A comparative survey on data collected in North & South India and in Pakistan observed that, in 17 out of the 20 populations examined, a positive association between consanguinity and fertility was confirmed (8).

Fertility is higher in UN marriages than in more distantly related parents e.g. in a small population of Tirupati (14). However, this has not been confirmed in studies on other populations (15, 16, 5) including that in a large sample from Tamilnadu, which of course are heterogeneous in respect of gene pools (17).

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There are widespread suggestions regarding positive associations between fertility and consanguinity like greater materno-fetal compatibility in blood groups, overcompensation for increased foetal mortality in consanguineous mating (18,19), conservative preference for families due to low birth order of consanguineous spouses (20); inter-spouse relationship (11), younger maternal age at marriage (14); psycho physiological processes like shorter post partal-amenorrhea (20) in the consanguineous women.

The proportion of sterile couples has been found to exceed in consanguineous marriages in several urban populations : France (21), Sweden (22), Israel (23) and Andhra Pradesh in India (24). But it does not hold good in the large heterogeneous populations (1, 25, 26, 17, 27). The phenomenon is, however, found correlated with closeness of marital consanguinity as measured by Kinship Coefficient (28). It is suggestive to be due to deliberate birth control by Schull (29).

Some earlier reports suggest an increased rate of twin births to consanguineous parents among Sheikh Muslims of West Bengal (30,31). There are also reports of higher rate of twin births in Muslims than in others in Srinagar, Lucknow, and Kanpur cities (32), hospitals of Calcutta and Midnapore (33). A somewhat reverse trend was also observed in other studies (34, 17, 35).

In this background, the present analysis aims at verifying the validity of 'consanguinity effects' on fertility by considering different maternal ages in different major types and degrees of closeness of consanguinity in different endogamous populations.

The study also verifies the 'consanguinity effects' on the proportion of sterile woman as well as twinning rates in different degrees of marital consanguinity in different populations under study.

◆ Materials and Methods

The present Telugu-speaking population of Kharagpur consists of at least 27 strictly endogamous populations, whose ancestors had immigrated to Kharagpur from three coastal districts of North-eastern Andhra Pradesh and the adjoining Ganjam district of Orissa. Those ancestors had initially come here as workers who laid the rail tracks of Bengal Nagpur Railways (now called South-Eastern Railways), in which most of the Telugu-speaking people of Kharagpur are yet employed. With the increase of job opportunities in the Railways, the earlier Telugu-speaking employees brought their relatives who have now settled in Kharagpur. Here only three most numerous endogamous populations considered for analysis.

Over 70 percent of the Telugu-speaking families in Kharagpur trace their origin from the drought-prone areas of Srikakulum district, and only a few families from the East Godabari district of Andhra Pradesh. Most of the members of two of the three largest local endogamous

populations-the Telaga (T) and Sristikarnam (SK) had come from Srikakulum district, Andhra Pradesh and the border areas of Ganjam district, Orissa, while about equal proportions of the third population, the Segidi (S), trace their origin from Srikakulum and Vishakhapatnam districts of Andhra Pradesh, There is narrow range of variation in respect of socio economic and educational status among the people. Over 90 percent of the male members and widows are employed as low–grade skilled workers in the workshop or open lines of the South Eastern Railway, the rest being engaged in shop keeping. Most adult males have received technical training after middle level schooling in shop keeping. Most adult males have received technical training after middle level schooling and adult female have generally attended upper primary schools.

Types of consanguineous marriages (traced from the husband side following the convention) are classified according to kinship relationship between spouses in the categories of maternal uncle-niece (UN), first Cousin (IC), first Cousin once removed (ICI), second Cousin (2C) marriages, It has been possible to collect reliable data for consanguineous relationship up to 2C only but not beyond that, because precise information of marriages beyond four generations have not been possible to obtain from the subjects who lack knowledge about their distant ancestors partly because of their immigrant nature. Parental consanguinity of non-consanguineous couples has not been considered for the classification of such marriages. It may be assumed that some of the apparently non-consanguineous marriages in the data might, in fact, represent marriages between very remote consanguineous individuals.

Inbreeding coefficients (F) are calculated for autosomal genes by applying Wright's path coefficient method and considering F-values of common ancestors of both parents. However, for utilising samples of reasonable sizes, the offspring of (i) unrelated parents (F=0), (ii) relatives more remote than first cousins ($0<F<0.0625$), (iii) first cousins ($F\geq0.0625$), (iv) maternal uncle : niece pairs ($F\geq0.125$) are grouped into successive classes ignoring variation within each level.

Differential fertility of parents with different types/degrees of consanguineous and non-consanguineous marriages are analyzed by considering age-specific birth rates (ASBR), considering five yearly age groups. The number of live births of women (including those who had no pregnancies) of five yearly age groups up to the age of 49 years representing each type of marriages was counted separately. The average number of births recorded in the next higher age group of women to estimate age group specific birth rates (ASBR) of the women of the latter age group.

The total fertility per woman for each type of marriage was estimated by applying the by summing up the birth rate of married women of each five yearly age group up to 49 years. However, in a few cases, a small sample of women in each type of marriage has shown negative i.e. minus rates or zero value of birth rate in isolated age groups due to sampling

fluctuation. In such cases, women of two subsequent age groups were pooled together for each type of marriage for comparison.

There is obviously a considerable amount of limitation in the analysis of differential fertility in respect of degree of consanguineous relationship between spouses in the present data. If fertility is measured by number of live births, it is related to maternal age, adoption of birth control measures by some women, lack of adequate data for comparison of fertility between different degrees of consanguinity between spouses in the small size of the population samples under study.

The available data in the collected pedigrees have yet been analyzed here to detect any consistent trend of change in fertility with the degree of consanguineous relationship between spouses, especially in the relatively larger population samples.

The women aged 20 years and above .who had no recognised pregnancy after three years of their marriage has been considered as relatively infertile for verifying of the effect of consanguineous marriages on infertility. The phenomenon has been loosely referred to as 'sterility' of married couples and the married woman displaying this condition as sterile following the convention in earlier studies. However, in a strict sense, such a definition does not appear to be precise enough for a critical biological study. Younger women had not been considered for this study in congnizance of the phenomenon of adolescent infertility.

Percent frequency of twin pregnancies has been calculated in different populations in different degrees of consanguineous marriage to observe the effect of inbreeding, if any, on twinning rates.

Results and discussion

Number of births per woman in reproductive age (≤49 years of age) :

The data suggest that the average of live births to consanguineous couples during the reproductive age of the female spouse exceed the number of live births to non-consanguineous couples of corresponding age groups of females in these populations (Table 1). This does not contraindicate the hypothesis of increased fertility of consanguineous couples. The number of live births is generally greater in atleast some types of consanguineous marriages than in non-consanguineous marriages. There is an indication of steady increase of fertility with closeness of consanguinity in marriage in any of these populations. This observation cannot be considered as evidence against the hypothesis of increased fertility with closeness of consanguinity, in view of the expected non-linearity of consanguinity effect on fertility and mortality.

Table 1 : Total number of birth (t) per woman in reproductive age (≤49 years), who are married to consanguineous relatives of different degrees.

Relationships between spouses	UN		1C		1C1+2C		Consangu-ineous		Non consangu ineous	
Samples	**n**	**t**	**n**	**t**	**n**	**t**	**n**	**t**	**n**	**t**
Telaga	128		100		65		293		399	
		3.5		3.5		3.4		3.5		2.9
Sristikarnam	19		20		5		44		65	
		3.5		3.1		1.8		3.1		2.7
Segidi	15		14		3		32		85	
		3.1		3.1		4.0		3.2		3.1

• n : number of pregnancies

Age specific birth rates in women married to different types of consanguineous and non-consanguineous relatives : There is no consistent trend of the effect of consanguineous marriages on the age specific birth rate in women of different age groups in any of the three population samples under study. However, despite sample fluctuations, there is an overall trend of increased age specific birth rates in consanguineous marriages in woman of younger age groups for occasional sampling error (Table 2-4). It can, therefore, be suggested that the present data do not reflect any serious obstacle to the earlier hypothesis of increased number of births in consanguineous marriages.

Table 2 : Age-group specific birth rate of Telaga women (with number of infertile women in brackets) in each degree of consanguineous relationship with husbands.

Age Group (in years)	UN		1C		1C1+2C		NC	
	Ever married women	Age specific birth rate	Ever married women	Age specific birth rate	Ever married women	Age specific birth rate	Ever married women	Age specific birth rate
<5	1	0.00	2	1.50	-	-	2	0.00
15–19	13	1.77	5	0.90	3	1.33	36	0.91
20–24	29 (1)	0.95	26	0.37	20 (1)	1.52	65 (1)	1.06
25–29	34	0.93	26	1.00	18	0.48	91 (3)	0.60
30–34	20 (1)	0.95	20	0.48	17	0.55	67 (2)	0.22
35–39	12	0.40	15	0.02	3	1.12	51	0.84
40–49	19	0.36	6	0.06	4	0.00	88	1.17
40–44	15	0.60	4	-0.27	2 (1)	0.50	42	1.11
45–49	4	-1.10	2	1.00	2	-1.00	46	0.04
45+	9 (2)	-1.93	8	1.37	4	1.00	148	0.72
All women	133 (4)		106		67 (2)		501 (6)	
Infertile %	119	3.39	99	<1.01	62	3.12	463	1.30

* Age groups have been pooled when needed to obtain positive values

Table 3 : Age specific birth rate of Sristikarnam women (with numbers of infertile women in brackets) in each degree of consanguineous relationships with husbands

Age Group (in years)	UN		1C		1C1+2C		NC	
	Ever married women	Age specific birth rate	Ever married women	Age specific birth rate	Ever married women	Age specific birth rate	Ever married women	Age specific birth rate
<15	0	-	0	-	0	-	2	-
15–19	1	2.0	1	2.0	4	1.5	3	2.0
20–24	1	-1.0	5	0.0	0	-	10	0.10
25–29	3	1.33	6	1.0	0	-	20 (2)	0.15
30–34	5	2.27	1	0.0	1	1.5	10	0.55

35–39	3	-1.93	3	1.33	0	-	8 (1)	0.20
40–44	3	2.33	3	1.34	0	-	3	1.00
40–49	3	0.33	1	-4.67	0	-	9	0.44
45–49	3	0.33	1	-4.67	0	-	9	0.44
45+	5	0.20	3	-0.33	0	-	30	1.67
35-44	6	0.77	6	2.0	0	-	11	0.47
40-49	6	2.63	4	-0.17	0	-	12	1.33
All women	21	-	22	-	15	-	86.(3)	-
Infertile %	119	3.39	99	<1.01	62	3.12	463	1.30

* Age groups have been pooled when needed to obtain positive values

Table 4 : Age specific birth rate of Segidi women (with numbers of infertile women in brackets) in each degree of consanguineous relationships with husbands

Age Group (in years)	UN		1C		1C1+2C		NC	
	Ever married women	Age specific birth rate	Ever married women	Age specific birth rate	Ever married women	Age specific birth rate	Ever married women	Age specific birth rate
<15	0	-	0	-	1	-	0	-
15–19	4	1.00	1	3.00	1	2.00	5	1.00
20–24	2	1.50	4	0.50	0	-	15 (1)	0.86
25–29	2	1.00	3	-0.50	1	2.00	22	1.00
30–34	1	0.50	3	-0.67	0	-	15	1.07
35–39	5	0.80	2	0.17	1	2.00	13	-0.39
40–44	0	-	1	4.50	0	-	8	0.96
45–49	1	-0.80	0	-	0	-	7	0.21
45+	6	0.70	4	0.25	0	-	27	1.76
20-34	5	2.20	10	0.00	1	2.0	52	1.88
30-39	6	1.17	5	-0.60	1	2.0	28	0.89
35–49	6	0.67	3	0.84	1	2.0	28	0.18
All women	20	-	18	-	4	-	105 (1)	-
Infertile %	-	-	-	-	-	-	100	1.00

* age groups have been pooled when needed to obtain positive values

Consanguinity effect on Sterility : The greater frequency of sterile couples in consanguineous than in non consanguineous marriages can be traced only in the most numerous Telega (T) population of sterile couples with closeness of consanguineous relationship between spouses in interrupted by the absence of sterile couple in sample of IC marriages, suggesting a frequency of less than one percent. The samples of other Telugu speaking populations do not indicate any increased of sterility with closeness of consanguinity between spouses. If sterility, as defined in this study, occurs in other population samples, they are confined to apparently non consanguineous marriages only.

These findings do not substantially contribute to the resolution of the controversial suggestion on the consanguinity on increased sterility. However, the positive finding, allowing for non-linear effect and / or sampling error in the T population cannot be altogether ignored. Due to a tendency of familial aggregation of consanguineous marriages in the study populations, it could be suspected that the sterility, as defined here should be attributed to inbreeding (resulting from parental consanguinity) in one or bothe of the spouses, rather than to their own consanguineous marriages.

However, there is no definite indication of an increase of inbreeding in the married men or woman who are classified as sterile as sterile in the present data. In the sample of T population, only of the four sterile woman married to their maternal uncles in the product of a 1C marriage between FSZ and MBD), and in only one of the six sterile non consanguineous couples, the husband is the product of 1C 1 marriage (his mother is the FSDD of his father). The rest or their husband in the T and other populations have not displayed any recognizable in breeding in them.

Consanguinity effects on twin birth pregnancies : The analysis of the pregnancy outcome reveals no consistent increase or decrease of twining rate increase of the degree of consanguinity between couples in all studied populations (Table-5). However, in Segidi population samples, there is a marked increase in twinning rate among the most closely related parents (i.e. who are related as maternal uncle and niece). But in that case, the twins are same sexed suggesting the possibility of many of them being monozygotic. In the case of T population, the birth of unlike sexed (dizygotic) tends to occur about equally in uncle : niece and non-consanguineous marriages. There is no trend of increase in twining rate in lower degree of consanguinity in parents in the present data.

These would suggest a positive effect of inbreeding on twining rate due to consanguineous marriages that are usually preferred among the Muslims. In the present study, at least two population samples may support the positive effects of high inbreeding ($F<0.0625$) rather than low inbreeding on twining rates. Two reasons can be suspected for the absence of twining rate with closeness of consanguinity between spouses in other population samples in the present study. Firstly, as twining is a rare phenomenon and depends upon factors like age

at mother hood, the sample available may not be adequate.

Table 5 : Percent frequency of Twin births in pregnancies of different types of Consanguineous marriages

Population	F represents Range to	Pregnancies	Twins %	DZ/MZ	DZ
				Like Sex %	Unlike Sex %
Telaga	0.000	1768	0.7	0.5	0.2
	0.000<F<0.0625	247	-	-	-
	0.0625≤F<0.1250	398	-	-	-
	0.1250≤	499	0.2	-	0.2
Sristikarnam	0.000	306	0.3	0.3	-
	0.000<F<0.0625	9	-	-	-
	0.0625≤F<0.1250	82	-	-	-
	0.1250≤	85	-	-	-
Segidi	0.000	405	0.3	0.3	-
	0.000<F<0.0625	12	-	-	-
	0.0625≤F<0.1250	75	-	-	-
	0.1250≤	75	4.0	4.0	-

to examine the inbreeding on twining rate in each samples. Secondly, it has been reported that the frequency of surviving twins are smaller than that observed in the neonates in the hospitals (36). It is possible that the high risk of early death in the cotwins may result in incomplete reports on twin births in the pedigrees. Thus, the present data do not contraindicate the earlier suggestion of consanguinity effect on twinning though not providing strong support for the same.

I may be concluded that the present data do not provide any definite evidence against the hypothesis of a greater average fertility in consanguineous marriages when the data are relatively more adequate in spite of many limitations of such a study in terms of adoption of birth control practices. But there is no consistent evidence of increased sterility or increases or increase of twinning rate in consanguineous marriages in the study populations.

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A COMPARATIVE ACCOUNT ON AQUATIC WEEDS INFESTATION IN TWO ADJACENT DISTRICTS OF ORISSA

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Abstract

Balasore and Mayurbhanj are two adjacent districts of Orissa, India and are also governed under similar climatic condition. Both the districts have natural water bodies. A survey has. been carried out to assess the aquatic weeds infestation of those water bodies. Total nine tanks have been surveyed and assessed during post monsoon period in respect of aquatic weeds infesation pertaining to soil and water quality and morphometry of habitats, where aquatic weeds grow. Total sixteen plants have been observed to have weedy behaviour and their percentage of occupying areea have been assessed by visual findings. The present survey highlights how the suitable morphomerty and chemical constituents of havitats influence the aquatic plants being weeds, in spite of similar climatic consition.

Key Words :- Aquatic weeds infestation, water bodies of Balasore and of Mayurbhanj.

Introduction

Moderate amount of plants growing in water bodies are inherently useful, directly as food for fishes, or indirectly to give shelter to wild life. But when the density of such plants becomes high then their effect can range from being a nuisance to becoming a danger. These aquatic plants are labeled with the term 'weed' in the specific situation when their excessive growth cause the loss of water resources and let their habitats remain waste, thus bringing the long term threat to the particular areas.The causes which influence the aquatic plants being nuisance indicate tropicla and subtropical climates such as rinfall, temperature, humidity, and soil and water characters. Once one area falls under aquatic weeds infestation it means that it will bring the increasingly evidents in the form of (i) prolific growth of aquatic plants, (ii) deterioration of water quality, (iii) sedimentation and shrinkage in extent of aquaculture and (iv) diseases in diverse biological entities, 0particulary in endemic and endangered species.

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According to Chakravarti (1961), of viable water bodies in W.B., Assam, Bihar Orissa, and M.P. are infested with infested with aquatic weeds. Similar study on aquatic weeds infestation in water bodies of different states in India later carried out by philipose (1968) and Sharma (1971) has supported the above estimation. Apart from that, the water bodies infested with weeds also suffer from the loss of nutrient loads, which get depostied into the bottom and are also valuable for the growth & development of other aquatic lives. For instance, Boyd (1970) and jagadesh & Lakshminarayan (1971) have estimated that 1980 kg of nitrogen, 322 kg of phosphorus, 248 kg of sulphur, 750 kg of calcium, 3188 kg of potassium 255 kg of sodium, 19 kg of iron, 296 kg of managanese, 4 kg of zinc and 1 kg of copper are removed in a year by continuous growth of warer hyacinth per hactre. This is not a isolated incident, but a common phenomenon prevalent in every unutilized water body, whenever it happens to be affected by water hyacinth. However, the purpose of this study is to ascertain how the different chemical constituents as well as morphometry of habitas influence aquatic weeds groth, which have been assessed during the present survey conducted in two districts of Orissa.

Material and Methods

Location and physiography of the areas

Total nine perennial tanks; five tanks under Mayurbhanj district and other four tanks under Balasore district have been surveyed 'Tank' is mentioned here to refer to the water body covering more than one hactre area. Both the districts fall under Orissa state, India in two distinctly geographical locations. Mayurbhanj is situated in the geographical range; latitude 21°17′N – 22°34′N, longitude 85°40°E – and altitude minimum 20 m. high – maximum 1165 m. high from MSL, comes under North Orissa Jurisdiction and is dominated by dense forest in relatively uneven terain. On the other hand, Balasore is situated in the geographicla range; latitude 21°3′N – 21°58′N, longitude 86°18′ E – 87°29′ E and altitude minimum 0m. – maximum 545 m. high from MSL, comes under East coastal zone of Orissa facing the Bay of Bengal and has been reported to be suitable for agricultural practice.

Climate

Mayurbhanj enjoys dry-wet climate with moderate humidity 40% – 70%. Temperature recorded shows maximum 38°C and rainfall recorded shows almost uniform figure about 165 cm per anum.

Balasore enjoys wet climate with high humidity 60% – 90%. Rainfall ranges from 150 cm. to 175 cm. and temperature recorded ranges from 14°C to 35°C. (Anonymous -1994)

Methods followed

Floristic survey was carried out during post - monsoon (july to October). Identification and nomenclature of the pants behaving as weed mentioned in the table -1. have been made

after subrahamanyam (1962) nad willis (1957). Life and growth form of aquatic weeds have been mentioned in table -1. following the classification made by Tansley (1949), spence (1964) and Sculthrope (1966). Biomass (live weight) and density of aquatic weeds per m^2 mentioned in Table -1. have been measured in field with weighing instrument and visual counting respectively. Percentage and degree of aquatic weeds infestation have been assessed by anecdotal findings.

Soil and water samples were collected and analyzed following the standard methods mentioned in APHA. All chemical data recorded and the morphometry measured of respective habitats are mentioned in table -2.

Result & Discussion

During the present survey carried out in post - monsoon period, sixteen aquatic plant species mentioned in table -1. have been observed to have weedy behaviour pertaining to their respective havitats. Out of which four species, viz, *Eichhornia crassipes, Pistia stratiotes, Nymphaea stellata and Nymphaea nouchalli* have been noticed being nuisance in terms of invading the water bodies of both the districts, wherever those water bodies found remained unutilized. Floating leaved weeds and submerged weeds have been found to have luxuriant growth, particularly in Balasore and have caused the respective habitats to get affected severely. At least sixteen plant species, which have weedy behaviour mentioned in table -1, occupy across the water bodies and also form heterogeneous association among themselves. That is why the babitats in Balasore region are fully weed choked from bottom to top and the degree of weeds infestation assessed by anecdotal findings has been higher as compared to havitats surveyed in Mayurbhanj. In addition, the havitats studied in Balasore are comparatively more shallow as well as nutrients rich than those studied in Mayurbhanj, where only free floating leaved weeds viz, E. *crassipes* and P *Strationtes* have been found ocuppying the same. Other aquatic plants in those areas are found insignificant to be treaed as weed.

Table -2 show that nutruent status in havitats studied in Balasore are higher than those studied in Mayurbhanj. Consequently, the biomass per m^2 of all individuals of weeds growing in Balasore are measured to have been higher than those measured in Mayurbhanj. However, population density per m2 of the weeds in both the regions have been recorded almost alike which signifies that chemical constituents in those habitats facilitate probably vegetative growth rather than reporductive one, In this connection, it is relevant to state that nutrient rich condition alosng with micro and micro nutrients influence hydrophytes to achieve luxuriant growth (Sculthroope -1966). This view havd also been mentioned earlier by Pearsall (1921), who advocated that the ions of major metabolic significance in fresh water are potassium, calcium, magnesium, iron, nitrite, suplhate, chloride, phosphate and bicarbonate. These ionic contents of standing water usually reflect the degree of fertility of catchments area (Rodhe

-1949). Similarly, the depth of habitats is one of the important factors to play major role in the distribution of aquatic palnts of different life forms viz, free floating, submerged and floating leaved pants. Shallow water depth 0.5 - 1.5 m, uniform across the water bodies has been found favourable for harbouring the same. Therefore, the habitats in Balasore, ranging 0.5 - 1.5 m. depth, have been found ideal for inhabiting aquatic plants of different life forms mentioned in table -1. However, habitats in Mayurbhanj, ranging more than 2 m. depth, are found unsuitable for floating leaved, and submerged pants to some extent. while free floating which is found suitable to survive to those depth is very much common. Because, the principle influence of the substrate upon the distribution of vegetation is due to its physical texture rather than its chemical composition (Sculthrope - 1966, Mortimer - 1942, Ruttner - 1963). Most of the habitats surveyed in Balasore, where depth is ideal for the growth of aquatic plants, are adversely affected by aquatic weeds infestation, while situation is not so worse in the same of Mayurbhanj.

Conclusion

It may be suggested from the present study that aquatic plants turning weed are triggered by the influence of both the factors as high nutrient load depositd in habitats and morphonentry of the same, besides the influential climate prevalent in tropical and sub-tropical region. This present survey highlights that thought two districts are governed under almost similar evironmental condition, yet habitats in Balasore are badly affected by all types of aquatic weeds because of their suitable physical structure along with enriched chemical composition deposited within them. Probably, it may be concluded that morphometry of habitat plays more influential role to aquatic plants for their uniform distribution across the water body than chemical constituents do in case of habitats having similar nutrients status.

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Table – 1. Scientific names, life forms, forms, degree of infestation, biomass and density of aquatic weeds in Mayurbhanj and in Balasore.

Sl. No.	Species	Life forms	Mayurbhanj			Balasore		
			Degree of infestation	Bio-mass (kg.)/m²	Density/m²	Degree of infestation	Bio-mass (kg.)/m²	Density/m²
1.	*Eichhornia crassipes* (Mart.) Solms	Free-floating hydrophyts	+++	12 - 13	40 - 50	+++	18 - 20	40 - 50
2.	*Pistia stratiotes* L.	Free-floating hydrophyts	+++	4 - 5	80 - 100	++	5 - 6	70 - 90
3.	*Spirodella polyrrhiza* L.	Free-floating hydrophyts	+	NM	NM		–	–
4.	*Lemna minor* L.	Free-floating hydrophyts	+	NM	NM	–	–	–
5.	*Salvinia cucullata* Roxb.	Free-floating hydrophyts	+	NM	NM	–	8 - 10	1 - 2
6.	*Nymphea nouchalli* Burm	Floating leaved hydrophytes	+	6 - 7	1 - 2	+++	8 - 10	1 - 2
7.	*N. stellata* Willd	Floating leaved hydrophytes	+	6 - 7	1 - 2	+++	2 - 3	1 - 2
8.	*Nymphoides indicum* (L.) o. Kuntze.	Floating leaved hydrophytes	+	–	–	++	1 - 2	NM
9.	*N. cristatum* (Roxb.) O. Kuntze	Floating leaved hydrophytes	+	–	–	++	5 - 6	NM
10.	*Hydrilla verticillata* (L.f.) Royle	Submerged gydrophytes	+	–	–	++	5 - 6	NM
11.	*Vallisneria spiralis* L.	Submerged hydrophytes	+	–	–	++	5 - 6	NM
12.	*Najas minor* (Pres.) L.	Submerged hydrophytes	+	–	–	++	5 - 6	NM
13.	*Potamogeton indicus* roxb.	Submerged hydrophytes	+	–	–	++	4 - 5	9 - 12
14.	*Panicum paludosum* L.	Submerged hydrophytes	+	–	–	++	2 - 3	NM
15.	*Ottelia alismoides* (L.) Pres.	Submerged hydrophytes	+	_	_	++	6 - 7	1 - 2
16.	*Ceratophyllym demersum* L.	Submerged hydrophytes	+	_	_	++	1 - 2.5	NM

NM indicates insignificant for measuring. no. of '+' indicates degree of infestation more. '–' indicates scatter presence

Table – 2. Range of chemical constituents and morphometry of different habitats in Mayurbhanj and in Balasore

Sl.		Mayurbhanj					Balasore			
No.	Parameters	Zone - I	Zone - II	Zone - III	Zone - IV	zone - V	Zone - I	Zone - II	Zone - III	Zone - IV
1.	Area (Approx.) (ha)	2.0	1.5	1.0	1.0	2.5	1.0	1.5	1.5	1.5
2.	Depth (Approx.) (m.)	4 - 5	3 - 4	2 - 4	2 - 5	2 - 5	1.0 - 1.5	1.0 - 1.25	0.75 - 1.0	0.5 - 1.0
3.	PH									
	a. Water	8.8 - 9.0	8.0 - 9.0	8.0 - 9.0	8.2 - 8.8	8.2 - 8.8	7.0 - 8.0	7.5 - 8.0	7.2 - 8.2	7.2 - 8.2
	b. Soil	7.4 - 7.8	7.4 - 7.8	7.4 - 7.8	7.0 - 7.5	7.5 - 7.8	6.8 - 7.2	6.7 - 7.2	6.8 - 7.2	6.4 - 7.0
4.	Total Alkalinity									
	a. Water	190 - 280	200 - 300	190 - 210	180 - 200	195 - 290	200 - 380	210 - 350	210 - 370	200 - 340
	b. Soil	5.0 - 28.2	3.4 - 18.2	4.2 - 20.0	4.2 - 21.5	3.8 - 20.0	6.0 - 30.0	5.5 - 28.5	5.5 - 28.5	5.8 -29.0
5.	Phosphates									
	a. Water	0.16 - 0.20	0.20 - 0.30	0.18 - 0.30	0.18 - 0.30	0.20 - 0.32	0.30 - 0.60	0.40 -0.80	0.45 - 0.85	0.42 -0.85
	b. Soil	1.5 -12.0	2.5 - 23.0	2.5 - 22.0	2.5 - 22.0	2.0 -15.0	3.5 -40.0	4.0 - 55.0	3.5 -52.0	3.9 - 48.0
6.	Nitrate									
	a. Water	0.05 - 0.5	0.06 - 0.8	0.06 - 0.9	0.07 - 0.85	0.08 - 0.90	0.1 -1.5	0.09 - 1.95	0.09 - 1.98	0.1 - 2.2
	b. Soil	26.0 - 40.0	25 - 35	24 - 38	26 - 40	24 - 38	26 - 62	27 - 65	26 - 62	27 - 65
7.	Weeds Infestation (%)	50	50	60	70	60	90	80	75	90

STUDIES ON GASTROPOD DISTRIBUTION IN INDIAN SUNDERBAN WITH SPECIAL REFERENCE TO THE INFLUENCE OF HABITAT FACTORS

*Sougata Roy and S.C. Santra**

Abstract

The aim of the study was to survey on the ecology, distribution, abundance and behaviour (tidal influenced movements, feeding reproductive season, predators) of mangrove gastropods from different sites of Indian Sunderban Managrove habitat, namely Jharkhali (Basanti), Gangasagar (Sagar Island), and Dhanchi Reserve Forest (Patharpratima). Abundance and types of gastropod species have been measured along with selected environmental parameters such as temperature, salinity, pH of surface water and some sediment characteristics.

This study showed that there are twenty different species of gastropods. Depending on their ecological niche they can be categorized into three types : (1) Species attached to stems, pneumatophores and leaves of plants (arboreal), (2) Species on the muddy substratum. either moving freely on it (epifauna) or burrowing into it (infauna). and (3) Species attached to crevices of dykes, bricks, wooden pillars and jetties Among all the three biotopes viz. mangrove substratum, creek and mudflat, most of the gastropod species were fund in the mudflat babitat. The species like *Littoraria melanostoma, Assiminea brevicula. Assiminea beddomeana* and *Cerithidea obtusa* were strictly associated with the mangrove habitat.

The quadrate study proved that the most dominant gastropod species in the sunderban Mangrove was *Assiminea brevicula.* The co-dominant species was *Cerithidea cingulata.* Breeding periods of most of the gastropods were in the month of Noverber and December. However species like Nerita sp., Natica sp. and Cymia lacera showed breeding in the month of April ot June. Among the studied habitat parameters salinity was the principal factor influencing the distribution of gastropods in mangrove region.

The gastropods in mangrove region also showed characteristic tide inlfuenced movement viz some prefers submersion while some aviod it and the arboreal forms were observed moving down from the mangrove trunk at low tide and grazed in the intertidal area in

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accordance with the periodic wetting of the substrate. Thus on the basis of their distribution pattern the gastropod of mangrove enviroment of Sunderban can distinctly categorized into five zones, (1) Littoraria zone, (2) Nerita zone, (3) Bivalve zone, (4) Mucreeper and crevice dweller zone and (5) Burrower zone.

Key Words : Gastropod distribution, Habitat factors, Indian Sunderban.

Introduction

Mangrove ecosystem is very specialized environment in the natural transition zone between the land and the sea and thus plays important role in protecting and extending coastiline by trapping sediments. suportign fishery and also controlling the regional climatic condition. West Bengal has a small stretch of coastine and a vast exposure of estuary covering sunderbans. As the diversity of the mangrove environment in reflected in the diversity of the molluse fauna, an ecological study of gastropod fauna of three different part of Sunderban – Jharkhali (Basanti Island). Gangasagar (sagar Island), and Dhanchi (patharpratima) was done. Molluscs are the generally primary consumers of mangrove ecosystem as sea grass and phytopplankton are the foods of them and some of these molluss are foods of several fishes, birds and even man.

There are many descriptive studies on the ecology of mangrove swamps. Several authors worked on the ecology of mangrove molluscs in different region of the world. The works of Berry (1963.) on mangroves of Malaysia, Brown (1971) on South African mangroves and plaziat (1984) on Atlantic and Caribbean realm are very much significant. In India mangrove malacofauna have been recorded from Godavari and Krisna estuary (Radhakrishna and Janakiram, 1975), Machilipatnam, Andhra Pradesh (Murty and Balaparameswara Rao, 1977), Pichavaram mangroves, (Kashinathan and Shanmugam, 1985). The malacofauna of Sunderban of West Bengal however was reported by Preston (1915), Annandale and Prashad (1919), Subba Rao, Dey and Barua (1983) and Chowdhuri, Bhunia nad Nandi (1984) and Subba rao surya Rao and Mitra (1987).

This paper records the ecology, distribution and abundance of gastropods of three areas of Sunderban. This study was conceived with a view to understand the important effects of various environmental paramenters on the gastropod distribution and their behaviour.

Materials and Methods

Three sampling stations were selected in the three parts of mangrove area. In each location, water and sediments were collected periodically for selected parameters. Gangasagar was selected on the southwesern sunderban close to the mouth of rivers Hooghly where mangrove swamps are degraded. Another sampling station, Jharkhali was selected on the mideastern Sunderban by the side of rivers Matla and Bidya. The third station dhanchi reserve

Forest was selected on the central Sunderban by the side of rivers saptamukhi and Thakuran. (Fig. 1 Map of sampling locations)

Physico – Chemical Analysis of Water And sediment samples

The surface water and sediment temperature was recorded on site by using mercury thermometers. pH of water and sediment was determined by using pH meter in the laboratory. Salinity of water and sediment samples was determined by using a refractometer and conductivity. Total organic carbon of the sediment was estimated using a refractometer and coductivity meter respectively. Total organic carbon of the sediment was estimated using chromic acid digestion and titrating Ferrous ammoniun sulphate using diphenylamine as indicator.

Biological samples

Monitoring of gastropod population was carried out at the three different sites Observation was done to see their tide influenced movement feeding biology and reproductive season. In each Sampling station, at least five sam;ing locations covering three biotopes were undertaken for collection of the gastropod population of the area. There was a minimum distance of aboutfifly-meter between the two sampling locations. The population density of the gastropods was studied using quadrate (one square ıneter) method analysis. As most of the gastropods were conspicuously bigger in size, they were picked up by hands from the different mangrove zones during low tide. The specimens were then kept in formalin for narcotization and finally cellular body was removed from the shell by froceps. The identification of the different species was made by comparing with the type specimens. manuals and other literatures in Zoological Survey of India, Kokata.

Results

A knowledge of the environmental parameters of estuary is an essential prerequisite to understand the composition of inhabitants, their distribution, dispersal and relative zonal abundance within the vast and interior of the estuary.

Hydrochemistry

The hydro-chemical parameters like temp, salinity and pH of surface water and sediment showed in Table - 1. The temperature varied from 23–31°C. High temperature was recorded in summer and low values during in winter. Salinity of surface water varied from 20–29. Comparatively low salinity prevailed in site-II and high salinity in site III. The pH ranges between 7.8 to 8.3. Identically the sediment showed the pH values between 7.26 to 8.5. Soil salinity varied from 2.4 to 5.8. Organic carbon of sediment showed value ranges from 0.624 to 0.829.

Gastropod poputation

A total of twenty species of gastropods were collected from three distinct sites during the entire study period. (Table II)

Depending upon the ecological niche, the macrobenthic gastropods of the esturary can be broadly grouped under three categories.

1. Species are attached to stems, pneumatophores, and leaves of living plants (arboreal) namely *Cerithidea obtusa, Littoraria melanostoma, Littoraria scabra and Nerita articulata Littoraria undulata and Neritina smithi.*

2. Species on the muddy substratum, either moving freely on it (epifauna) or burrowing into it namely *Assiminea brevicula, A. beddomeana, Cerithidea cingulata, Stenothyra deltae. Nassarius stolatus, Pythia plicata, Natica tigrina, and Pugilinum cochlidium, ellobium gangeticum and Cassidula nucleus.*

3. Species living in the crevices of dykes, bricks, wooden pillars, jetties etc namely *Nerita articulata, Littoraria scabra, Cymia lacera and Collumbella duclostana.*

A few of the gastropod species may have overlapping habitats. But in general, it has been observed that the species, which were arboreal don't usually occur on the ground except for a short duration. Those living in the crevices of dykes, jetties don't usually forsake the crevice dwelling habit. The majority of gastropods in the mangrove were epifauna. There are three different biotopes present in the mangrove estuary – mangrove substratum, creek and mudflat. The fauna which were more common in one biotope appear very poor in other closely associated biotopes. Thus the reason for this uneven distribution was due to the nature of substratum, tidal flux, period of desiccation and availability of food. (Chowdhuri, Bhunia and Nandi, 1984).

The distribution and relative abundance of gastropods was not uniform throughout the estuary. Among gastropods, *A. brevicula* was the dominant species occupying for about 81% of the total gastropod population. The co-dominant species was *C. cingulata.* Other common gastropod species of Sunderban mangrove were *Littoraria* sp., *Telescopium,* and *Nerita* sp. It is interesting to note that two sympatric species of *Assiminea* viz. *A. brevicula* and *A. beddomeana* occupy different ecological niches. *A. brevicula prefer* crawling on the mud whereas *A. beddomeana* live in the holes and crevices of muddy substratum (rao, Dey and Barua, 1983). *Cerithidea cingulata* are common on beach, they wear very much abundant near the mouth of the creek and on the exposed mudflat. The monthly collection of gastropods revealed that in September to November *Assiminea* sp. were dominant while *Littoraria* population was high during August – September.

Environmental parameters and gastropod distribution

Light play a major factor inducing algal growth and obviously it has secondary role for the herbivorous gastropods distribution. However shade is especially important for the intertidal air – breathing gastropods-mellampids, littorinids, potamids and onchidiids, as a humidity-preserving factor. The observation showed that *Cerithidea obtusa* and *Cassidula nucleus* prefers shady areas of mangrove forest, other gastropods like *Nerita articulata, Littoraria scabra, Thais lacera* were abundant in the crevices of dykes, wooden pillars and lower shaded part of the jetty, *Assiminea* sp. was found in the holes and crevices of the muddy substratum. In contrary the population density of *Cerithidea cingulata* was higher in the unshaded bare mudflats. However majority of gastropods lay their eggs in the shaded part and juveniles were also found in the shady area.

Hard substrate is rare on the intertidal flats of delta and lagoons because of high sedimentation rates, therefore mangrove trunks and roots provide the substrate for the larvgal settling. The species like *Nerita articulata, Cerithidea obtusa* were obseved from the tree trunks of mangrove plants even up to the height of two metres. However species like *Littoraria scabra, Thais lacera were very common in jetties, rocks, bricks* and *Collumbella duclosiana attached to bricks.*

A good number of gastropod species like *Telescopium telescopium, Cerithidea cingulata, Assiminea sp., Natica tigrina, Pugilina sp., Nassarius stolatus* are mudcreeper gastropods as they prefer soft substratum.

Sediment texture in another important factor of gastropod distribution. *Cerithidea cingulata* prefers sand mixed clayey substratum. *Telescopium telescopium* prefers muddy substrata. Whereas *Natica tigrina* prefers sandy mud mixture.

Salinity in a mojority of estuarine gastropods is stenohaline. Among them *C. obtusa, C. cingulata, T. telescopium, Natica sp., Collumbella* sp., *Pythia* are truly estuarine gastropods. *Pythia* sp. and *C. obtusa* preferred generally low salinity thus *Pythia* sp. was only found at site II and the population density of *C. obtusa* was higher at site II than other two sites. While the population density of *L. scabra* was higher in high saline areas i.e. site III. The gastropod population size in general increased from November to April with the increasing gradient of salinity (Bhunia and Chowdhury, 1981 ; Chowdhury et al, 1980).

The distribution of gastropods is also influenced by the substrate **organic carbon**. The region with fine sediments with higher organic carbon provides a habital for mud dweller species viz. *Cassidula* sp. and *Assiminea* sp.

Gastropod movement

The Sundarban estuary is a tide-dominated delta. Tides facilitate transportation of sediment,

replenishment of nutrients, flushing out of wastes and mixing of fresh and salt waters. Tides also help in transporting some of euryhaline marine organisms from the sea into the estuary. The tidal influenced movement of some gastropods of mangrove habitat were observed during low tide in the course of our field visit. They are discussed here.

Littoraria melanostoma and Littoraria scabra were common at the supratidal zone attached to the mangroves and shrubs. These intertidal gastropods are adapted to air breathing. *Littoraria melanostoma feed on the microflora of the mangrove bark moves down at low tide between the tidal levels.*

Natica tigrina occurs in sandy mud. When substrate was wet, it remains active but once it gets dried up the snail burrows inside the sand and remains there till the next tide washed them. *Certhidea cingulata* and *Telescopium telescopium telescopium* prefered both submersion and periodical exposure but *Cerithidea obtusa* preferred mainly exposure and avoided submersion. Thus it was found towards the land far from the water edge. *Certhidea obtusa* descended towards the ground during low tides for feeding and ascended during high tide. *t. telescopium* was found mainly between HTL and MTL always on the ground & never climbs the trees. Thus the gastropods took submersion and exposure with eases indicating that the respiration was both by aerial and aquatic mode.

Getting close to the water in necessary for intertidal life not only for food but reproduction also. Young forms generally inhabit the channels, pools and mangrove edge areas from where they migrate as adults to the higher intertidal levels. The juvenile stages of *Littoraria scabra* were found on the pillars of jetty at Jharkhali. They were observed closely associated with barnacles. But the adult species was frequently found on the leaves of mangrove trees. Snails like *Cassidula & Elliobium* are arboreal species, as soon as teh tide recedes they move downs to the moisture parts of the trees in search of food.

Nutrition of gastropods

Majority of gastropods found in the three sites of Sunderban were prosobranchs. Majority of prosobranchs were benthic microphagy. **Algal** cells, sand grains, foraminiferans and detritus were found in the alimentary tract of many. The mud creeping snails, melampids, onchiidids, potamids, and some of the melaniids were detritus and microalgae feeders (diatoms and filamentous algae). The gastropods belonging to the family Naticidae and Muricidae were reported attach bivalves and other snails by boring a hole through their shells, inserting the proboscis through the hole and rasping out the soft parts with their radula. *Natica* sp. Prefers to eat *Nassarius* sp. Some feed also on barnacles. *Pugilina also reported preying on* ***andara earlier.***

Cerithidea cingulata feeds on the detrital matter in the substratum. It was a common inhabitant in the mats of the green alga *Enteromorpha.* It subsists mainly on detritus present

in the substatum where the gastropod lives. There were mainly fine detrital matter, grains and unicellular diatoms like *Navicula, Nitzschia, Coscinodiscus, Fragillaria, Pleurosigma* and minute scraps of algal filament found in the alimentary canal of the gastropods. *Certhidea obtusa descend* towards the ground during the low tides for feeding. They were frequently found feeding on encrusting algae, which lies over the trunk region of some mangrove trees (*especially Avicenia* sp.). Gastropod species like *cassidula, Ellobium and Onchidium feed on the algae and other organic debris of the trees. Telescopium telescopium* fed the detritus matter matter and diatoms settled on the substratum. They were mainly herbivore but at times detrivores. It prefered mainly filamentous green algae. Mainly detritus matter and diatoms were found in the alimentary canal of this gastropod. The neritids are microphage herbivores feeding on the filamentous algae and other fine algal growths from rocks, bricks and other hard surface.

Distribution and zonation patterns of gastropods

There are different patterns of zonation of the mangrove mollusks. For Malayan mangroves, Berry (1965) includes in his scheme bothe vertical and horizontal distribution. Identically Plaziat (1984) made similar kind of zonation studies on Atlantic and Caribbean mollusc. However in the present study a modified version of gastropod distribution pattern in the Sunderban was suggested.

The mangrove leaves above extreme high water spring tide (EHWS) are characterized by the presence of *Littoraria* spp., (*Littoraria melanostoma Iand I Littoraria scabra)* and it is termed as the Littoraria zone. Among them *Littoraria melanostoma* were found in the upper portion of the trees. At about mean high water spring tide (MHWS) the main gastropods are *Nerita articulata,* and *Certhidea obtusa.* This is the second zone or Nerita zone.

A marginal zone or third zone close to the sea edge is characterized by the presence of bivalves (Bivalve Zone). Mud creeper and crevice dweller zone can be considered as the forth zone which is referred as Uca zone by Berry (1963) due to richness of crabs mainly *Uca* sp. The main gastropods in this zone are *Cassidula nucleus, Natica* sp., *Pugilina* sp. and *Nassarius* sp. The fifth is the Burrower zone comprises the coastal bank. The main gastropods in this zone are *Teredo* and the species of *Onchidium.* Later was found crawling on the mud in the night because of their nocturnal habit. 3–5 cms above the ground level.

Discussion

The distribution and relative abundance of gastropods was not uniform throughout the estuary. Most dominant gastropod sp. was *Assiminea brevicula* (81% of the total gastropod population). The works of Subba rao et al (1983, 1987) on Muriganga estuary and Gangasagar of Sunderban showed identical features. the other common gastropods of Sunderban mangrove ecosystems are *Telescopium telescopium, Littoraria melanostoma, Littoraria scabra,*

Cerithidea cingulata and *Cerithidea obtusa*. The studies of Murty and Balaparameswara Rao (1977) on Machlipatnam mangrove zones, Berry (1964) on Malayan mangrove and kashinathan and Shanmugam (1985) on Pitchavaram mangrove shown the similar assemblages of the gastropod species. But Brown (1971) reported the presence of *Neritina natalensis, Assiminea bifasciata* and *Cerithidea decollata* from South African mangroves. These species were absent in the Sunderban mangrove. The presence of *Littoraria undulata* was reported only from the mangroves of Godavari estuary. In our present study this sp. was also found in the Sunderban estuary.

The monthly collection of gastropods revealed that from September to November species of *Assiminea* was dominant. While Littoraria population was higher during August to September. This observation coinside with the report made by Subba rao, et al (1983). *Littoraria* sp. was always found near the seaward edges of swamps on the *Avicennia* and rhizophora leaves, because the undersides of the leaves bear hairs which were grazed by it. *Pythia plicata* was found only at station II where low salinity was reported. Subba rao, et al (1983) also observed the presence of this species from the same area. *T. telescopium* was common on banks of small ditches or canals with a little flow of water. The population density varied from 1–15/sq.m. This observation was also similar with the report made by Subba rao, et al (1983). *Terebralia palustruis* which was common in most of the mangroves of Indo-Pacific (Flaziat, 1984) was absent in the Snderban estuary.

The faunal abundance and distribution were affected by the environmental factors like salinity, temperature, and sediment quality and also associated floral species assemblages. In Malayan mangroves most gastropods occur in areas with over 90% exposure time, with only a few exceptions like *Collumbella duclosiana, Stenothyra polita* and *Nassarius Ispp. (Sasekumar, 1994). In Sunderban estuary the dominant gastropods were also able to withstand exposure to air.* The pulmonate gastropod sp. - mellampids, littorinids, potamids prefer a shady area rather than exposed areas and low saline water areas (such as *pythia plicata, Stenothyra deltae).* This trend was supported by the description given by Kashinathan and Shanmugam (1985) in the Pitchavaram mangrove and Plaziat (1984) on Atlantic and Caribbean realm. *Cerithidea obtusa population was higher at site II where salinity was relatively lower from the other two stations.* Kashinathan and Shanmugam (1985) also reported the similar pattern. Sediment grain size is important for the settlement of detritus and microorganisms, which are the food of detritus feeding molluscs, like *c. cingulata* and other potamidids (Balaparameswara Roa and Sukumar, 1981 ; Sreenivasan, 1985). Thus the assiminids and potamidids were didely distributed in the estuary. As *Natica tigrina* prefer sandy mud mixture, this species was found near the beach.

The most interesting feature of the gastropods of maugrove region was their tide-influenced movements, Arboreal species move downs from teh upper part of the mangrove trees at low tide and grazed in the intertidal area. *Cerithidea cingulata* and *Telescopium telescopium*

prefer both submersion. This observation was also similar to the report made by Sreenivasan (1985) and Subba Rao, et al (1987). *Cerithidea cingulata* was reported to climb trees in the Vellarestuary (Sreenivasan, 1985). However neither in our study nor in the study of Subba Rao et al (1983) similar behaviour never observed.

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Table I : Hydro-chemical characteristics of sunderban estuary

	Parameters	Station I		Station II		Station III	
		Sum	Wint	Sum	Wint	Sum	Wint
Water	Temp. (°C)	28 ± 2	23 ± 2	29 ± 2	22 ± 2	29 ± 3	23 ± 3
	pH	8.19 ± 0.05	8.25 ± 0.05	8.0 ± 0.05	8.20 ± 0.05	8.0 ± 0.05	8.19 ± 0.05
	Salinity	22 ± 2	25 ± 2	20 ± 2	22 ± 2	24 ± 2	29 ± 2
Sediment	pH	8.30 ± 0.05	8.10 ± 0.05	8.05 ± 0.05	7.45 ± 0.05	8.0 ± 0.05	7.95 ± 0.05
	Salinity (micro-moh)	4.01 ± 0.05	3.62 ± 0.5	3.35 ± 0.5	401 ± 0.5	4.45 ± 0.5	3.66 ± 0.5
	Organic Carbon (mg/gm)	0.632 ± 0.05	0.810 ± 0.05	0.627 ± 0.05	0.817 ± 0.05	0.430 ± 0.05	0.624 ± 0.05

Sum = Summer, Wint = Winter

Table II : Species found in the three sites of sunderban

Name of family	Name of Species	Station I	Station II	Station III
NERITIDATE	*Nerita articulata*	+	+	–
	Neritina smithi	+	–	–
LITTORINIDAE	*Littoraria scabra*	+	–	–
	Littoraria melanostoma	+	+	+
	Littoraria undulata	+	–	+
ASSIMINIDAE	*Assiminea brevicula*	+	–	+
	Assiminea beddomeana	+	–	+
POTAMIDIDAE	*Cerithidea cingulata*	+	+	+
	Cerithidea obtusa	+	+	+
	Telescopium telescopium	+	+	+
NATICIDAE	*Natica tigrina*	+	–	–
MURICIDAE	*Cymia lacera*	+	–	–
MELONGINIDAE	*Pugilina cochlidium*	+	–	–
NASSARIIDAE	*Nassarius stolatus*	+	–	–
ELLONIIDAE	*Ellobium gangeticum*	+	–	–
	Cassidula nucleus	+	–	+
	Pythia plicata	–	+	–
PLANORBIDAE	*Indoplanorbis exustus*	+	–	–
THIARIDAE	*Thiara tuberculata*	–	+	–
VIVIPARIDAE	*Bellamya bengalensis*	+	–	–

CONSERVATION OF THE GREAT INDIAN ONE HORNED RHINO (*RHINOCEROS UNICORNIS L*) IN JALDAPARA WILDLIFE SANCTUARY, WEST BENGAL, INDIA

*P.K. Pandit**

Introduction :

Jaldapara Wildlife Sanctuary (JWLS), renounced in the wildlife map of India and abroad as home of the great one horned Rhinoceros (*Rhinoceros unicornis*), is located in the foothills of Eastern Himalaya in the district of Jalpaiguri, West Bengal, India that is situated between the latitude 25°58" and 27°45" north and longitude 89°08" and 89°55" east. It lies in the flood plain of river Torsa and its tributaries like Sanjoy, Bhaluka, Sissamara, Chirakhawa, Gorumara, Hollong etc which support large tracts of grassland sustaining a small population of one horned rhinos. During rainy season, a number of seasonal water sources developed like TiTi, Howri, Purnekhola, Sanjoykhola, Kalikhola, Dayamara etc. All the river and rivulets are flowing from north to south direction of the sanctuary.

Configuration of the sanctuary is more or less flat and the elevation varies between 60-130 metre except Titi block which is hilly having elevation ranging from 152- 610 metre above mean sea level.

It was declared as a Game Sanctuary in 1941 comprising an area 99.5 sq.km. With two subsequent extensions in 1976 and 1990 the area was increased to 216.5 sq.km covering 12 forest blocks and 46 compartments (pandit, 1996). The sanctuary is trouser like in its southern part and width of the two legs varies from less than a km to 4.5 km (Pandit, 1996). There are 32 revenue villages, 4 forest villages and 9 tea gardens situated in and around the sanctuary having approximately 90,000 human and 1,00,000 cattle population.

The sanctuary is located near Madarihat town, 140 km away from Siliguri, which reached by air from Kolkata, Delhi and Guwahati. From Siliguri, Madarihat can be approached by rail (Meter Gauge) or by road. Alternatively the sanctuary can be approached by road (about 80 km) from Cooch-Behar town which is linked by train (in broad gauge) with Delhi, Kolkata and Guwahati. Nearest broad gauge railway station is Falakata which is 22 km away from JWLS.

JWLS harbours the one horned Rhinoceros – a threatened species included in Schedule - I of the Wildlife (Protection) Act, 1972 of India. Besides rhino, it harbours 15 wild animals which belong to same Schedule. These animals are tiger, gaur, elephant, sloth bear, leopard, hog badger, hispid hare, swamp deer, pangolin, Bengal florican, peacock, large

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falcon, Indian pied hornbill, python, and Indian Soft-shelled Turtles.

The sanctuary contains 33 species of mammals, 230 species of birds, 24 species of reptiles (including 8 species of turtles), 30 species of fishes and huge number of micro fauna (Pandit 1996, Pandit & Yadav, 1996). Rhinoceros, hispid hare and hog deer are endemic to Jaldapara. Swamp deer (*Cervus duvaucelli*) once existed in the sanctuary but become extinct sometimes in late sixties. Total Rhino population of the sanctuary constitutes 2% of total rhino population in the world.

The vegetation structure in this sanctuary is variable and within a stretch of few km. several types of vegetations are available. The entire forests of JWLS falls under North Indian Moist Tropical Forest according to Champion and Seth's recent classification (1968) However, from recent observation following type of vegetations are found in the sanctuary (Banerjee, 1993; Pandit, 1996; Anon, 1997; WII, 1997; Das *et al*, 2003; Pandit *et al*, 2004).

(i) Riverine Forests (ii) Sal Forests (iii) Wet mixed Forests (iv) Semi evergreen Forests (v) Evergreen Forests (vi) Savannah Grasslands (Moist sal savannah; Low Alluvium Savannah woodland; Eastern Alluvial Grassland; Primary Grassland) (vii) Hydrophytic Vegetations.

Savannah grassland covers a considerable part (18.24%) of the sanctuary (Pandit, 1996; Das *et al*, 2003; Pandit *et al*, 2004) mainly on flood plains, elevated riverbeds in pure forms or in association with khair - sissoo, simul – siris.

Savannah grassland dominated by few species of grasses like *Arundinella bengalensis, Saccharum narenga, S. longosetosum, S. arundinaceum, S. spontaneum, S. bengalense* and *Themeda* species This tract of grassland support rhino (key species of JWLS) and other herbivores. The sanctuary contain 585 species of flowering plants (Banerjee, 1993), which belonging to 429 genera and 111 families out of which 71 are grass species, 19 orchid species and 47 endangered plant species (29 genera) that needs conservation. Recently Das *et al* (2003) have provided an additional list of 224 species (141 dicotyledonous, 51 monocotyledonous and 32 pteridophytes) to the flora of the sanctuary.

It is very rich in flora of Non Timber Forest Produces (NTFPs). Recently Pandit *et al* recorded that 116 species of dicotyledons (15 families and 93 genera), 14 species of monocotyledons (8 families and 13 genera) 2 pteridophytes (2 families and 2 genera) are collected and marketed by local fringe people as their livelihood. These are used for medicines, decorations, fodder, edible materials, thatching, religious purposes, detergent, snake repellent, bath sponge, spices, masticators, and construction purposes. It is needless to mention that these plants are collected most unscientifically and unsustainably.

JWLS provides an opportunity to study ecology, behaviour requirement, habitat analysis, food habit, demographics, genetic threat and reproduction biology of rhino. It offers excellent possibility for studying bio-diversity, as it is very rich in flora and fauna.

It belongs to the Bio-Geographical zone &B (Lower Gangetic Plain) according to Rodgers and Panwar (1988).

Totopara village, the home of the endangered Toto tribe situated in the north of the

sanctuary. The socio-economic practices, religion, culture and language of them is a matter of great anthropological interest. Currently this remote village has small population slightly greater than 1000 and till this day Totos have managed to keep and have preferred to be swamped by the inroads of the mainstream culture.

JWLS has tremendous potential of Eco-tourism and every year 12-15000 visitors come to the sanctuary through which local people get direct and indirect benefit (Pandit.1996).

Key areas of the JWLS

As rhino is the key species so, the area where it concentrated more is considered as key areas. The three main rhino concentrating areas are Jaldapara and Malangi beat, Sissamara beat and Moiradanga beat area where food, cover and water sources are good. The areas of these consisting of approximately 24 sq.km. 8 sq .km and 19 sq. km respectively (Pandit, 1996). Maximum managerial intervention to be required to these key areas to conserve Rhino and other wild lives without much damaging natural habitat and eco-system.

Rhino Population in India :

The five species of Rhinoceros, which still exist on the earth, have been subjected to serious threat as a result of poaching, illegal trade and destruction of habitat. The world population of Rhinoceros, which was about 70,000 twenty years ago, has drastically dropped down to 11,000. The Asian population of the great Indian one horned Rhinoceros was 1900 in 1992 (Dey, 1994).

In India Rhino population is distributed in two major states viz., Assam and West Bengal (not considering the small number of Rhino introduced in Dudwa National Park in Uttar Pradesh) containing 1500 Rhinos (Dey, 1994) broadly over 7 areas (5 in Assam and 2 in West Bengal).

The killing of Rhino and trade with Rhino is a major problem throughout the world, as it is believed that Rhino horn has an aphrodisiac property. Fortunately it was banned in India for nearly 60 years and in other countries of Asia for a considerable period. For that reason Rhino population has got some momentum in Asian continent. Nepal and India showing a remarkable rise of Rhino population, the figure increasing in Nepal from about 60 to about 400 in 1992 during last 60 years. In India the figure has increased to from about 50 in 60 years ago to about 1600 in 1991 (Dey, 1994).

Asian Rhinos are more prone to poaching than their African counterpart because horns are much more valued and nearest to the consumer centre (Dey, 1994).

Rhino Conservation Strategies in National Level :

The conservation of Rhino has a two-way approach – one for conservation of habitat through different managerial intervention and other for conservation of species by controlling poaching and illegal trade through legislation. The first Act was first start in Assam and subsequent acts that were formulated and enacted are given chronologically :

1887 - Act for preservation of Wild birds and animals.
1891 - Assam Forest Regulation.
1912 - Wild Birds and Animals Protection Act.

1927 - Indian Forest Act.
1932 - The Bengal Rhino Preservation Act.
1954 - The Assam Rhino Conservation Act.
1972 - The Wild Life (Protection) Act followed by its main amendments in 1986 & 1991.

India is a member of CITES since 1996 and also signatory to various conventions and protocols on environment and wildlife conservation.

Indian Action Plan for conservation of Rhino include :

a) Habitat protection and restoration.
b) Creation of corridors for migration.
c) Proper communication network.
d) Anti-poaching squad and strike force.
e) Training of Wildlife personnel.
f) Arms training to protective staff.
g) Research and Monitoring.
h) Eco-development activities.
i) Education and public awareness programme.
j) Relocation of enclaved villages through persuasion.
k) Veterinary care.
l) Translocation of animal for rehabilitation and captive breeding.
m) Development of intelligence network.
n) Reward for good work and case detection.

Past Distribution of Rhino in West Bengal :

Rhinos in India were distributed in Brahmaputra valley and Indo-Gangetic Plains centuries ago. It was stated to have extended from Burma in the east to Peswar in the west all along the foothills and alluvial plains. In West Bengal it was existed in the Sunderban (Gupta, 1966) and the district of Malda (Banerjee, 1966), till the second half of the last century. Another one species of Rhino, viz., *Rhinoceros sondaicus*, used to exist in North Bengal, which became extinct and last sighting was recorded in Chilapata Forests in 1900 (Bist, 1994). The Great Indian one horned Rhino has managed to survive in West Bengal, especially North Bengal despite of all threats.

Besides Jaldapara and Gorumara. Rhinos were previously reported from Bholka (Buxa Forest Division), Patlakhawa (Cooch Behar Forest Division) and Chapramari (Jalpaiguri Forest Division). As many as 10 Rhinos were reported each in Bholka and Patlakhawa in 1958 -59 (Bist, 1994).

Factors influencing the Rhino conservation strategies in JWLS :

Due to small area, large interface and typical shape the sanctuary has been subjected to tremendous pressure in different point of view, which directly or indirectly affect the rhino population. Following factors affect the Rhino conservation strategies from time to time.

1. Poaching : Poaching of Rhinos takes place primarily for tremendous demand of its

horn in the clandestine market, which believed to act as an aphrodisiac property through not based on facts. A well-connected international network of poachers operates from their base camp to the population site by utilizing middleman and exploiting poverty fringe people. Prior to 1968, records of Rhino pouching in JWLS were not maintained properly. A total of 34 Rhinos was shot dead by poachers during the period 1969 to 1972-73 but after 1973 to 1977 no rhino was poached. In the year 1978 one Rhino was killed and again 11 Rhinos were shot dead in between the period 1980-85. Some hopeful situation appeared between 1986 – 90 when no Rhino was killed. Since the year 1991 pouching was continuing but in lesser extent and in between 1991 to 2003 total 11 rhinos were kill by poachers. As a result of which population of rhino has been more or less in upward directions. Maximum Rhinos were poached in JWLS from 1968 – 1973 and as a result of which Rhino population was drastically reduced from 80 (1968-69) to 23 in 1975 (Bist, 1994; pandit, 1996). Besides Rhino, other animals like tiger, elephant, deer, wild boar, Jungle fowl etc. are also killed time to time by the poachers and local villagers.

In Jaldapara poaching is being done by long range Rifle but recently incidences of poaching by poisoning has also been recorded Pandit,1996). Due to lack of adequate infrastructures, national and inter national co-ordination, inter departmental co-ordination, public awareness and presence of unauthorized firearms in fringe villages, poaching has not totally stopped.

2. Hunting : Hunting was a factor to reduce the rhino population in earlier days prior to Bengal Rhino preservation Act, 1932 because at that time Maharaja of Cooch Behar had exclusive right to hunt rhino in his jurisdiction. According to Bist, 1994, a total of 132 rhinoceros shot dead by the hunters in between the period 1877 to 1904 in Jaldapara and Buxa region.

3. Destruction of Habitat : Degradation of habitat lead to inadequate grazing and foraging area of rhino and other herbivores. Following are the factor of causing degradation of habitat

(a) Illicit felling of timber and collection of firewood, Non Timber Forest Produces (NTFPs) from the sanctuary

It was done because presence of large number of wood based industries, large gap between demand and supply, unemployment and poverty of the fringe population.

(b) Grazing of livestock of fringe villages

There are 32 revenue villages, 4 forest villages and 9 tea gardens are situated in and around the sanctuary having approximate one lakh livestock population and a fair percentage of it regularly grazed inside the sanctuary which causing depletion of fodder grasses of wild herbivores in one way and in other way transmitting diseases of Foot and Mouth Disease, Rinder Pest and Anthrax. Domestic livestock received least veterinary care and general appearance is dwarf size with poor health. An attempt was made by present author (1996) to ascertain the grazing intensity in JWLS by laying out 121 sample plot (100 X 100 m) in all forest block

and result proved that everyday nearly 11000 cattle grazed within the sanctuary. Intensity of grazing in block wise was Barodabri followed by Hasimara, Jaigaon, Dalsingpara, Jaldapara, Torsa, Chilapata, Salkumar, Titi and Malangi.

4. Infestation with weeds and climbers: Among weeds, *Leea* species, Lemon grass, *Eupatorium* sp., *Clerodendron* sp., *Cassia tora* and *Solanum nigrum* are predominant. *Mikania* sp. is serious weeds in JWLS which damaged many fodder grass plantation. All these weeds and climbers cause reduction of fodder grasses of wild animals.

5. Advancement of Woodland in grassland: As JWLS situated in the flood plains of river Torsa so as a natural process of succession species like khair-sissoo, simul-siris, simul-sidha which made conversion of grassland in to woodland i.e., reduced the suitable habitat of rhino. An attempt was made by present author (1996) by laying out sample (100 sq.m.) plot in some natural grassland areas of different compartment and it has been found that total 2992 plants per hectare counted. Out of which 1579 were in height (ht) class of 0.5m and less, 617 were 0.5 - 20 m ht. class, 517 in 2.0 m and above ht class and 282 were in tree class. The study revealed that 58.72% plants were belonged to age group 0 – 2 years (yrs), 16.81%, 3.64%, 20.22%, 0.60% belonged to 2 – 4 yrs, 4 – 6 yrs, 6 – 8 yrs and 8 – 10 yrs age group respectively. If it is roughly assumed that 40% of the total plants will reach tree category then approximately number will be nearly 1100 which is very high density.

6. Fire: Fire in grasslands of JWLS is quite common every year although not in great extent. Uncontrolled fire is mainly caused by poachers, illicit collectors of simul floss, thatch grass and other NTFPs. Judicious fire has important role to maintain grassland but unregulated man made fire cause damage to the vegetation, wildlife and changes composition of natural vegetation.

7. Past forestry practices: In the past, some of the natural forests of JWLS in Bania and Mendabari block were converted to monoculture for better production of timber that is unsuitable for wildlives. Due to change of policy on forest management and conservation of biodiversity in PA's monoculture in natural forests has been discouraged. Forest conservation Act, 1980 also have imposed severe restrictions on such conversion.

8. Natural Calamities: The only known natural calamity that affects the habitat of JWLS is flood of rivers which are very common in North Bengal. Flood in one hand washed out the habitat but in other hand its positive effect to conversion of tree land to grassland. Fortunately, no such severe death of wild life was done except few cases due to flood. Floods of severe nature occur during the year 1952, 1954, 1964, 1968 & 1993 (Bist,1994; Pandit,1996). Of these, 1968 flood is considered to be a physiographic landmark since this resulted in a total change in the course of river from western to eastern leg of the sanctuary.. This has caused heavy damaged to the forests of Bania, Chilapata and Barodabri blocks along the course of Siltorsa. Due to flood of 1954 three rhinos were died (Bist, 1994). Damage of crop and forests was done in second week of September 1984 due to flood of river Torsa. Heavy rain occurred on 19th July 1993 (992 mm) and as a result of which flood of Hollong, Siltorsa, Malangi, Titi and Howri river eroded forests of Titi, Jaldapara, Barodabri and Hasimara

block (Pandit, 1996).

9. **Disease:** Wild animals of JWLS are very prone to cattle borne diseases like Anthrax, FMD, Rinderpest etc. but fortunately incidence of out break of diseases is very rare in past. One rhino was died due to Septicaemia in 1967-68. In 1986, one abandoned female Rhino calf was caught and reported to be suffered from pneumonia and corneal disease in the right eye. One calf was died due to unknown reason in the year 1987 (Bist,1994). There was an outbreak of Rinder pest in the year 1968 which reduced the population of Gaur (Indian Bison) 31 number. During January-February, 1994, 3 wild tuskers were died (Pandit, 1994) due to out-break of anthrax in Torsa 2 and 3 compartment. All departmental elephants and 24 wild Rhinos were vaccinated with live anthrax spore vaccine (Pandit, 1994) to save them against anthrax in February 1994. After that there was no record of disease incidence in the sanctuary.

10. **Intra & Inter specific struggle**

(a) **Intra specific struggle**: Fighting of Male Rhino among others of their own species is very common probably due to mating and rivalry which sometime causing death and injury of Rhino. A total of 14 rhinos are killed by this factor since 1948-49 to 2003 [Bist, 1994; Office record of Assistant Wildlife Warden (AWLW), Madarihat] in the year 1948-49,1950-51, 1983,1986,1992,1993,1994, 1999,2001,2002and 2003.

(b) **Predation:** There was a report in JWLS that Tiger killed the Rhino Calf as their prey although incidences are rare. Till date there two cases has been recorded in the year 1981 and 1994 (Bist, 1994).

11. **Accidents :** Rhino sometime died due to accident like trapped in swamp and mud, neck injury etc in JWLS. Although no past record was not available but from recent records (Bist,1994; Office record of AWLW) it is found that total 6 rhinos have been died due to accident in between the period 1984 to 1995.

12. **Trans boundary Problems :** Titi and Jaigaon block i.e. extreme northern boundary of the sanctuary forms the international boundary with Bhutan. People of Bhutan side are creating constant pressure on biotic resource. Smugglers and poachers generally take advantage of International borders and as there is no proper co-ordination between two countries so it becomes very difficult to stop international smuggling racket of Rhino born, elephant tusks etc.

Other factors, which directly or indirectly affect the Rhino population, are insufficient infrastructure, man-animal-conflict, irregular shape of the sanctuary etc.

Past Management of Jaldapara Sanctuary :

The area of the sanctuary has remained under control of Forest Department since 1865, no records are available of its management till 1875 when for the first time a scheme for systematic management was prepared by Dr. William Schlich, the then Conservator of Forests. In the working Plan of Buxa Reserves (1905-06 to 1919-20) Mr. C.C. Halt prescribed selection felling to be followed by natural regeneration. But the area remained untouched as

it was poorly stocked.

Mr. C.K. Homfray first emphasized the need for maintenance and improvement of the 'Savannah' areas to provide habitat for the rich grassland fauna of this tract like Rhinoceros, swamp deer, hog deer etc. in Working Plan of Buxa Forest Division (1929-30 to 1948-49).

Titi block (northern part of the sanctuary) came to Hill working circle under Shebbere's Plan (1919-20 to 1924-25) and prescription were of clear felling and artificial regeneration on a rotation of 80 years and trees over the exploitable girth might be removed from anywhere.

Ultimately the Bengal Rhinoceros Preservation Act came into force in 1932 to ensure the protection of the one horned Rhinoceros. The area, however, declared as a game sanctuary in the year 1941 only consisting of 99.5 sq. km. area.

A separate game sanctuary-working circle was created in the 5th working plan of the Buxa Division virtually covering the present area of the sanctuary with the exception of Salkumar block (Southern most isolated block) which continued to be worked under sal conservation working circle. The main objective of constituting a separate game sanctuary working circle was to preserve and improved the existing stock of indigenous fauna. All types of extractions including thatch were prohibited except limited felling of timber trees by departmental agency. Control burning in alternate years and removal of evergreen crop invading the grassland were carried out in 'Savannah' areas.

In the year 1951, the entire area of the sanctuary came under the control of newly created Couch-Behar Division for better management. The first working plan was prepared in the year 1962-63 for 10 years. An area of 99.5 sq.km. was kept under sanctuary working circle. The same area was managed under same working circle in second working plan for the period 1972-73 to 1981-82. Special emphasis ware given in this plan to create and maintain glades, saltlicks and periodic removal of trees invading the grasslands.

The game sanctuary was re-notified as Jaldapara Wildlife Sanctuary in the 1976 vide Govt. notification no. 5404 – For, dated 24.06.1976 and the area has been increased to 115.53 sq. km. The sanctuary area came under control of newly created Wild Life Division – 11 on 10.02.1982 for effective management and another 100.98 sq.km. area has been added to with the inclusion of valuable forests of Titi, Bania, Mendabari, Jaigaon and Dalsingpara blocks to the sanctuary from Cooch Behar Division vide Govt notification no. 7245 – For, dated 31.08.1990. Total area of the sanctuary stands at present is 216.51 sq. km. However, management of the extended area was lying with Cooch-Behar Forest Division. Again in the year 1995, whole area (216.51 sq. km.) of the sanctuary transferred to administrative control of Cooch-Behar Division vide Govt. notification no. 4983 – For dated 25.09.1995 and till date it is managed by this Division.

Present Management of the Sanctuary:

To manage each sanctuary it needs a approved realistic management plan for its efficient management with specific goals, objectives and strategies considering biodiversity conservation, socio- economic and socio-cultural condition, resource dependency of local people, man –animal conflicts, nature based tourism and other factors. Management plan is

a document, prepared by Management Plan Officer, which sets out of the values and objectives of management of Protected areas (Sawarkar, 1995). It guides and controls the management of protected areas recourses, the uses of the area and development facilities needed to support that management and use.

First Management plan of the sanctuary was prepared for the period 1981-82 to 1985-86. The management plan prescribed for raising fodder plantation including fruit species to supplement food resources of herbivores, providing saltlicks and wallow pools, eradicating Mikania and cutting back of trees to arrest the successional development of the grassland areas, maintenance of fire line and patrolling track and creation of boundary trenches. Commercial felling was prohibited during the plan period. During the period infrastructure of the sanctuary had improved a lot with the induction of large number of Casual Daily Labour and with the supply of more firearms, R.T. net works and vehicles.

However, two important targets of the plan viz., translocation of Rhinoceros, reintroducing of swamp deer (*Cervus duvauceli*) and wild buffalos (*Bubalus bubalis*) and relocation of habitations (11 villages) between the two legs of the sanctuary could not be met. Chectal (*Anis axis*) was successfully released in the sanctuary during the year 1982 – 83 and their population showing upward trend. The first Management plan expired in March 1986 but its prescription have been followed more or less during the following years.

One impartment development after first management plan period was the launching of " Fringe" area development scheme in 1991 in the fringe villages of Jaldapara to reduce their dependency on the forest based resources by providing some alternatives. Work was undertaken under this scheme in the fringe villages to raised fuel wood plantations, distribution of seedlings for farm forestry, improvement of village road, construction of culverts and bridges, provision of drinking water and irrigation facilities, community pond, duckery and piggery unit etc.

In the mean time a project "Strengthening Management Planning and Eco -development Planning Capabilities" was sponsored under United Nations Development Project (UNDP) and Wildlife Institute of India (WII). The main theme of the project was to train some selected Forest officers in the country and abroad to write Management Plan of some Protected Areas (PA) and to provide funds for better management of the PAs. Accordingly the present author was selected from West Bengal for training and writing Management Plan of JWLS.

Second management Plan of JWLS

In this plan sanctuary has been delineated in four zones for efficient management viz., (i) Wilderness zone consisting of 37.69 sq. km. area where limited management intervention should only be allowed and habitat should be protected as it was. (ii) Intensive development zone comprising of 71.53 sq.km.area where maximum managerial input should give. (iii) Tourism zone having overlapping jurisdiction over 46.29 sq. km areas and in this zone both wild life management as well as tourist-oriented work to be undertaken. (iv) Conflict management zone comprising of an area 61.03 sq km This area should be used to reduce conflicts between Sanctuary and people.

The main strategies (Pandit, 1996; Anon, 1997) of second Management Plan were as follows.

i) Conservation of Biodiversity.

ii) Control of Poaching of rhino and other species as well as illicit felling of timber by – (a) extensive patrolling, (b) induction of Lady force, (c) strengthening forest protection force, (d) reorganization of Ranges, Beats and Camps, (e) strengthening communication network, (f) providing more arms and ammunition including sophisticated firearms and small arms for undercover operation, (g) strengthening wireless network, (h) establishment of legal cell, (i) improvement of intelligence network, (j) co-ordination amongst various law enforcement agencies, (k) providing incentive and rewards to staff, (l) publicity, nature education and awareness regeneration.

iii) Sustainable growth of rhino and other wildlife population by –
   (a) Improvement of habitat without much affecting the eco-system.
   (b) Over wood removal followed by indigenous fodder plantation including fruit species and bamboo.
   (c) Eradication of weeds and climbers like *Leea* sp., *Cymbopogon* sp., *Eupatorium* sp, *Mikania* sp. etc. in some strategic locations.
   (d) Control burning of older unpalatable grassland as well as planted area in a staggered manner to supplement new palatable and nutritious fodder grasses.
   (e) Control of wild fire.
   (f) Maintenance of special habitat by protecting riparian areas, caves, burrows, breeding sites of animals, retaining older trees, hollow, top drying, partially dead or fully dead (snag) standing trees, fallen trees etc.

iv) Control of grazing of domestic livestock of fringe villages and departmental elephants by (a) extensive patrolling (b) imposing fine (c) raising fodder plantation in vested or Panchayat land (d) Castration of bulls (e) providing hybrid cow (f) Raising fodder plantation inside the sanctuary only for departmental elephant.

v) Reforestation of degraded forestland along the boundaries of the sanctuary by raising indigenous timber species.

vi) Heavy 'D' grade thinning of older monoculture plantation and converting them in to mixed culture by raising wild animals user-friendly species.

vii) Conservation of soil and moisture by embankment protection work, constructing water-harvesting structure in strategic location.

viii) Control of illegal wood based industries and furniture shop by strict vigilance and enforcement of laws.

ix) Control of illicit removal of timber, fuel wood, medicinal plants, non-timber forest produces and other wildlife by enforcing appropriate law and constant strict vigilance.

x) Reduction of Man – animal conflicts by raising awareness generation, public support, strengthening wildlife squad, speedy distribution of compensation.
xi) Veterinary care of wild animals, departmental elephants.
xii) Management of departmental elephants
xiii) Veterinary care of rescued animals.
xiv) To reduce trans bound any problem with Royal Government of Bhutan regular co-ordination meeting, strengthening intelligence networks, joint patrolling work etc. to be done.
xv) Creating nature awareness, erection of power fencing, need based priority basic Eco-development activity is needed to get local support to save JWLS.
xvi) To depress in breeding among rhino introduction of rhinos from other areas a wild born zoo reared mail sub adult Rhino from Assam was introduced in a fenced area but it was not successful as that rhino could not survived due to repeated attack of other male w ild Rhino.
xvii) Re introduction of Barasingha, Gharial and Sambar.

Presently sanctuary is being managed as per above cited prescription and getting UNDP fund. In the mean time midterm review is necessary to ascertain strategies to be remained same or some to be changed, any improvement has been made or not.
Other than these management strategies, some activities has been proscribed – in plan which will be helpful directly or indirectly to manage the sanctuary. These are as follows :

(1) Site specific need based, resource oriented, priority basis eco-development activities such as (i) production of fuel wood and fodder grasses in panchayat, private and vested land (ii) Provision of collection of certain NTFP, s such as simul flows of thatch grass etc. (iii) provision of drinking water by digging ring well and tube well, (iv) provision of irrigation in agriculture field by digging irrigation channel, pond, dug well etc., (v) provision of agricultural extension service, (vi) cattle improvement programme, (vii) health care services, (viii) development of employment regeneration to the fringe people by raising farm forestry, vocational training on apiary, piggery, duckery, knitting, weaving, tailoring etc; fruit species plantation (ix) Educational and allied services, (viii) raising of interdepartmental co-ordination.

(2) Research, Monitoring and Training :

JWLS act as a storehouse of research information but till date no such work was done form any agencies. So present plan prescribed to establish a field laboratory and research oriented basic infrastructure at Madarihat to regenerate scientific information. Research work should be done in collaboration with Wildlife Institute of India, Zoological survey of India, Botanical survey of India, Universities and Research Institutes. Current plan prescribed establishment of data storage and retrieval system, study on floral and faunal survey, fire regime, visitors impact, resource dependency, straying of wild animal, attitudinal changes of people etc. As monitoring is an important component so monitoring on animal sighting, elephant movement,

diseases, fire regime, socio-economic changes etc to be done.

Training should be given on protection and extension, monitoring, resource management, tranquillization, rescue, veterinary care and cattle improvement, application of law and regulation, health care of wildlife, post mortems etc. Training should be imparted within the sanctuary or at other recognised institutes.

(3) Tourism, Interpretation of conversation education :

Tourism, Interpretation facilities should be improved by (i) Developing Madarihat Nature interposition centre. (ii) Interpretative talk, (iii) audiovisual programme, (iv) signages (v) establishment of nature camp and Nature trail (vi) proper utilization of existing staying arrangements, (vii) development of interagency co-ordination (viii) guided tour etc.

Population dynamics of rhino in JWLS :

Rhino were reported to be reasonable in the West Bengal towards the end of 19th century and approximately 240 Rhinos were existed (Bist, 1994). The Fawcus committee (Fawcus, 1943) has estimated that Rhinos population of Jaldapara and Patlakhawa was about 200 in 1920 s.

Due to killing, poaching and hunting Rhino population of Jaldapara show very unstable trend up to nineties of last century and after that due to undertaken of appropriate management strategies, constant increasing trend of population was reported. Variation of population of Rhino is given in the following table.

Table – 1 : Population dynamic of rhinos in Jaldapara

Year	Population	Year	Population	Year	Population	Year	Population
1920	200 approx. including Patlakhawa	1953-54	30-56	1975	23	1992	33
1932	40-50	1957	50 approx.	1978	19	1994	35
1936-37	56 Including Panbari of Buxa Tiger Reserve	1964	72	1980	22	1996	42
1940-41	Increased in number	1965-66	75	1986	14	1998	56
1948	60 approx.	1968-69	75	1988	24	2002	76
1949-50	Increasing	1973-74	21	1989	27		

Source : Bist, 1994 and Office record of AWLW, Madaarihat

Age & Sex wise population structure of rhino: Records of age and sex wise classification of rhino in Jaldapara were not maintained properly in earlier days. However, Bist, 1994 had taken an attempt to recorded it on the basis of available information from the year 1968-1992 only. Present author updated it up to 2002 on the basis of available record in the office of the AWLW at Madarihat which is given in the following table.

Table -2: Age and sex wise Population structure of rhino

Year	Adult			Calves	Total
	Male	Female	Unsexed		
1968	-	-	70	5	75
1975	7	7	4	5	23
1978	5	7	4	3	19
1980	9	11	-	4	24
1989	9	13	-	5	27
1992	8	12	-	13	33
1996	9	18	2	8	42 (including one sub adult female & sub adult unknown sex 4 no.)
1998	16	25	-	14	55
2002	33	28	-	17	84

Source: Bist, 1994 and Office record of AWLW, Madarihat

Reproduction Trend of rhino: Earlier no record was maintained to ascertain the reproduction trend of Rhino in JWLS. However, Bits, 1994 has taken an initiation and recorded the information in between the year 1988-1992. Present author then had been updated it from the available records of the office of AWLW, Madarihat upto 2002 which is given in the following table.

Table – 3: Birth and Death of Rhino in JWLS

Year	Birth	Death	Year	Birth	Death	Year	Birth	Death
1988	3	-	1993	3	1	1999	5	-
1989	2	-	1994	3	2	2000	2	-
1990	2	-	1995	5	3	2001	4	-
1991	3	-	1997	1	-	2002	5	-
1992	2	1	1998	3	-	2003	4	-

Source: Bist, 1994 and Office record of AWLW, Madarihat

Mortality of rhino in JWLS:

Causes of death of Rhino in JWLS are may be old age, injuries, poaching, hunting, accident, predation, natural calamities etc. Bist, 1994 first recorded it from the available information from the year 1930 to 1992 and and then present author updated the information up to 2002 which is given the following table.

Table – 4 : Mortality of rhino in Jaldapara

Year	Population Status	Year	Population Status	Year	Population Status	Year	Population Status
1930-31	50 approx	1957-58	2	1984-87	10	1998	2
1932	40-50	1967-68	1	1991	1	1999	2
1936-37	1	1968-72	30	1992	2	2000	3
1940-41	2	1972-73	6	1993	1	2001	4
1948-49	2	1973-80	9 (2 in Patlakhawa)	1994	1	2002	5
1949-51	5	1981	2	1995	3	2003	2
1954	3	1982	3	1996	1		
1955-56	4	1983	4	1997	3		

Source: Bist, 1994 and Office record of AWLW, Madarihat

Conclusion :

In JWLS, history of rhino conservation is very old. Throughout the world rhino population subjected to several natural as well as human pressure. But fortunately the great one horned Rhinoceros till survived despite several yhreats in the world as well as JWLS. One species *Rhinoceros sondaicus* reported to exist earlier in the North Bengal but it became extinct by 1900. The population of one horned Rhino in JWLS has been fluctuated due to poaching, hunting, biotic interferences, habitat degradation, natural calamity, mortality, depletion of forest resources and other factors. But due to timely taken of proper steps by Forest Department of Government of West Bengal, conservationist rhinos still exist in the 21st century in a small pocket like Jaldapara. Number of rhinos is steadily increasing since 1990 as a result of taking appropriate management strategies however, till the population is not up to the mark and there is no scope of satisfaction. Different Laws and action plan according to situation has been prepared by state and national level to boost the population. Appropriate effects should be taken by Forest Department and other agencies to enter the Rhino population in the 22nd century despite of all odds.

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ROLE OF PROBIOTICS IN AQUACULTURE

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Abstract

To control devastating outbreaks of diseases, use of antibiotics lead to drug - resistant strains and reduces the natural defense mechanism to the aquacultural animals. The alternative situation is the production of beneficial bacteria to fight against pathogenic bacteria as probiotics in aquaculture. Probiotics are cultures of special microorganisms, which have been used as feed additives in food specimen and in pharmaceuticals. The use of well designed probiotics like gram positive bacteria,gram negative bacteria, yeast, microalgae, bacteriophages to upgrade aquaculture and with conventional biological water treatment processes, to guarantee the overall water quality and fish production.

Key words :Aquaculture, Probiotics

Introduction

Recent disease outbreak in shrimp farming caused mainly by bacteria, virus, fungi or a combination of these etiologic agents is attributed to disturbance in the environment of pond. To combat this, different antibiotics and chemicals are being used which are reported to be not environment friendly. Of late, all the shrimp farmers worldwide are using a new and unique biotechnological product called "probiotics", which is found to be more effective and environmentally safe also. This is believed to be due to the different effects of antibiotics, which tends to remove indigenous gut flora along with disease causing agents. This situation is avoided by an alternative situation in the production system through the use of beneficial bacteria to fight against pathogenicbacteria i.e., probiotics that is an acceptable proctice in aquaculture. The health of the animal thus improved by the elimination of elimination of pathogens or at least minimizing the effects which benefits aquaculture.

Elie Metchnikoff's work at the beginning of this century is regarded as the first reaearch conducted on probiotics. He described them as "microbes ingested with the aim of promoting good health" This same definition was modified to "organisms and substances which contribute to intestinal microbial balance" Fuller (1989), to "a live microbial feed supplement which

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beneficially affects the host animal by improving its intestinal microbial balace". Gibson and Roberfroid (1995) introduce the concept of 'prebiotics'. It is defined as non-digestible food ingredients that beneficially affect the host by selectively stimulating the growth and the activity of one or a limited number of bacteria in the colon, nad thus improves host health. A beneficial microorganism, which can protect organisms against pathogens or enhance their growth.

Probiotics are now also being used in aquaculture and therefore, the definition may have to be modified. In aquatic animals, not only the digestive tract is important but also the durrounding water. Probiotics from aquaculture point of viwe as culture (single or mixed) of selected strains of bacteria that are used in culture and production systems (tanks, ponds and others) to modify or manipulate the mocrobial communities in water and sediment reuce or eliminate selected pathogenic species of microorganisms and generally improve growth and survival of the target species. Gatesoupe (1999) defines probiotics as "microbial cells that are administered in such a way as to enter the gastrointestinal tract and to be kept alive, with the aim of improving health". Although probiotics be classified as growth promoters, since their action is not confined to improved growth but is associated with a general improvement in health.

Aquacultural Probiotics

The range of probiotics examined for use in aquaculture has encompassed gram - negative and gram - positive bacteria, bacteriophages, yeasts and unicellular algae. In particular probiotics have been reported to be successful with a wide range of invertebrates (Riquelme et al., 2000) and vertebrates Gatesoupe (1999). To date, Probiotics have been used in artificial feeds, live feed, i.e. artemia and rotifers and in water.

Gram - positive bacteria

Aerobic gram - positive endospore - forming bacteria i.e. Bacillus sp. have been evaluated as probiotics, with uses including the improvement of water quality by influencing the composition of water born microbial populations and by reducing the number of pathogens in the vicinity of the farmed species. Thus, the bacilli are thought to antagonize potential pathogens in the aquatic environemts. This is curious because it is generally accepted that loboratory cultures do not survive well when re-introduced into the natural environments; the cells being often outcompeted / antagonized by the natural microflora (Austin, 1998). Nevertheless, a direct benefit to the use of the bacilli was the reduction in the use of chemicals in the aquatic environment and in enhanced growth of farmed species (Patra and Bandyopadhyay, 2003).

Gram - negative bacteria

Pseudomonas fluorescens has been reported to inhibit *Suprolenia* sp. and *Aeromonas*

salmonicida in finfish culture (Smith and Davey, 1993) and Pseudomonas 1–2 antagonized shrimp pathogenic *Photobacterium danselae, Vibrio fluvialisi, Vibro harveyi, Vibrio parahaemolyticus and Vibrio vulnificus* by means of low molecular weight inhibitors (Chythanya et al., 2002). Moreover, bathing rainbow trout for 6 days in Pseudomonas fluorescens AH 2, which was isolated from *Lates niloticus* (L), reduced mortality from 47 – 32% following challenge with *Vibrio anguillarum*. In a large -scale investigation, Spanggaard et al. (2001) recover 1018 bacterial isolated from the skin, gills and intestine of rainbow trout. of these, 45 isolates were inhibitory to *Vibrio anguilarum* in a disc diffusion assay.

Bacteriophages

It is debatable whether or not bacteriophages constitute bona fide probiotics. Nevertheless, informantion will be included here for completeness. Park et al. (2000) worked with two culturs of bacteriophages, which were derived from diseased Ayu, *Plecoglossus altivelis* and presented the families Myoviridae and Podoviridae. By oral administration (in feed), the bacteriophages protected against infection by P. *Plecoglossicida*, which is a phathogen of cultured Ayu. The workers monitored the effects of bacteriophages on *P. plecoglossicida* populations and concluded that there was rapid decline in the number of bacterial cells in the kidney and water.

Yeasts

Catla, Catla catla (Ham.) has been used to evaluate the potential of both bacteria and yeasts as probiotics with data indicating the successful candidates led to increased the survival and body weight (Mohanty et al., 1996). Naik et al. (1999) used a commercial premix, G-probiotic in tilapia, Oreochromis mossambicus (Peters), feed, and determined that food conversion and protein efficiency was best at a dose of 7.5 g of G - probiotic kg $^{-1}$of idet. It is noteworthy that cells and β-glucan of Saccharomyces *cerevisiae*, an isolate of Saccharomyces exiguous containing xeaxanthin (HPR1) and phaffia rhodozyma improved resistance of juvenile penaeid to vibroosis. Here, the data revealed that the diets containing *phaffia rhodozyma* led to great imporvement to larval survival. Also, Debaryomyces hansenii, a polyamine producing yeast recovered from the digestive tract of fish improved the survival but led to reduced growth of larval seabass, Dicentrarchus labrax (L), following incorporation into the diet. The presence of the yeast, which was capable of adherence to the gut, led to enhanced amylase secretion of brush border membrane enzymes in 27 – day – old larvae.

Microalgae

A heterotrophically grown, spray – dried unicellular alga, Tetraselmis suecica, has been used as a feed for penaeid and as a feed – additive for salmonids with data revealing a reduction in the level of bacterial diseases (Austin et al., It was suggested that the mode of

action might have reflected the presence of unspecified antimicrobial compounds in the algal cells.

Conclusion

Although further research should be made for the upliftment of the application of probiotic bacteria in aquaculture but several beneficial effects has already proved. Besides protecting animals against enteric infectious, feeding probiotic bacteria result in increased feed conversion ratio and live weight gain. there is evidence that mocrobial degradation of dietary nutrients occur in the stomach, especially by fermentation of simple sugars and complex carbohydrates. Due to devastation outbreaks of diseases in aquaculture industry in the last 20 years, use of antibiotics lead to drug - resistant strains and reduces the natural devense mechanism to the aquacultural animals but the probiotics had already give the better immunoresponse, survival and promotes the growth and nutrient utilization. It can assure the nutritional security in the next millennium.

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