Many Bombacaceae species are pollinated by a diversity of animals ranging from insects, birds, bats and arboreal mammals[10,25]. Most of the other Bombacaceae species reported from India are either pollinated by birds or bats[26]. *Cullenia* does not have a typical flower with free flowing nectar, which could by utilized by birds. It offers soft floral parts (basal part of sepal) with embedded nectaries soaked with nectar as reward, which is best suited for mammal-handling.

Non-flying mammal pollination system is considered as a relatively primitive form of pollination system[8,19]. The dual strategy of *Cullenia* is a helpful clue to understand the evolution of such systems. Sussman and Raven[8] highlight the importance of bats in the evolution of non-flying mammal pollination. They stress the fact that non-flying mammals evolved in areas where bats are few or non existent. In Kakachi, this is not entirely applicable because both primates and bats co-occur. However, differential visits to the trees based on habitat characteristics do indicate the importance of primates as well as bats in the pollination of *Cullenia*. In this site, primates are reliable visitors of *Cullenia* and bats are not. In the closed undisturbed forest, primates are the major pollinators of the species. Bats visits were few and far apart. In contrast, *Cullenia* trees in the disturbed forests and along the edges of the forests attracted bats in large numbers. This points to the fact that *Cullenia* is a non-volant, mammal-pollinated species that benefits from bat visits in disturbed environments.

1. Devy, M. S. and Davidar, P., *Am. J. Bot.*, 2003, **90**, 650–657.
2. Momose, K. *et al.*, *Am. J. Bot.*, 1998, **85**, 1477–1501.
3. Kress, W. J. and Beach, J. H., Flowering plant reproductive systems. In *La Selva: Ecology and Natural History of a Neotropical Rain Forest* (eds McDade, L. A. *et al.*), The University of Chicago Press, Chicago, USA, 1994, pp. 19–33.
4. Janson, C. H., Terborgh, J. and Emmons, L. H., *Biotropica*, 1981, **13**, 1–6.
5. Terborgh, J. and Stern, M., *Am. Nat.*, 1987, **97**, 260–269.
6. Ganesh, T. and Davidar, P., *J. Trop. Ecol.*, 1997, **13**, 459–468.
7. Procter, M., Yeo, P. and Lack, A., *The Natural History of Pollination*, Collins New Naturalist, London, UK, 1996, p. 479.
8. Sussman, R. W. and Raven, R. H., *Science*, 1978, **200**, 731–736.
9. Wiens, D., Rourke, J. P., Casper, B. B., Rickart, E. A., LaPine, T. R., Peterson, C. J. and Channing, A., *J. Biogeogr.*, 1983, **70**, 1–31.
10. Yumoto, T., *Am. J. Bot.*, 2000, **87**, 1181–1188.
11. Yumoto, T., Momose, K. and Nagamasu, H., *Tropics*, 1996, **9**, 147–151.
12. duToit, J. T., *Entomologie*, 1990, **28**, 63–68.
13. Cunningham, S. A., *Oecologia*, 1991, **87**, 86–90.
14. Goldingay, R. L., Carthew, S. M. and Whelan, R. J., *Brittonia*, 1991, **61**, 79–87.
15. Carthew, S. M., *Aust. J. Ecol.*, 1993, **18**, 257–268.
16. Whelan, R. J., The pollination of *Banksia. Conserving Nature's Ways*, 1994, **6**, 20–25.
17. Cocucci, A. A. and Sérsic, A. N., *Plant Syst. Evol.*, 1998, **211**, 113.
18. Mora, J. M., Méndez, V. V. and Gómez, L. D., *Trop. Biol. On-line Rev. Biol. Trop.*, 1999, **47**, 24–28.
19. Kress, W. J., Schatz, G. E., Andrianifahanana, M. and Morland, H. S., *Am. J. Bot.*, 1994, **81**, 542–555.
20. Green, S. and Minkowski, K., In *Primate Conservation* (eds Rainier Prince III and Bourne, G. H.), Academic Press, New York, 1977, pp. 289–337.
21. Menon, S., Ph D thesis, Ohio State University, Columbus, 1993.
22. Ganesh, T., Ganesan, R., Devy, M. S., Davidar, P. and Bawa, K. S., *Curr. Sci.*, 1996, **71**, 379–392.
23. Ganesh, T. and Devy, M. S., *Selbyana*, 2000, **21**, 60–65.
24. Consiglio, T. K. and Bourne, G. R., *J. Trop. Ecol.*, 2001, **17**, 577–592.
25. Baum, D. A., *Am. Mo. Bot. Gard.*, 1995, **82**, 322–348.
26. Subramanya, S. and Radhamani, T. R., *Curr. Sci.*, 1993, **65**, 201–209.

ACKNOWLEDGEMENTS. We thank Dr Sukhdev Thakur, Chief Wildlife Warden, Tamil Nadu Forest Department for permission to conduct the study and Prof. R. Annamalai, Field Director, KMTR for facilitating our work in the reserve. We are grateful to Tamil Nadu Electricity Board for help with necessary logistic support in KMTR. We thank Dr R. Ganesan for critically reviewing the manuscript Ramesh Kumar and Chian helped with field activities. This work was partly supported by the International Foundation of Science grant to T.G. and the Ruford Small Grant to M.S.D.

Received 5 January 2005; revised accepted 20 January 2006

Palmar dermatoglyphics of the scheduled caste Madigas in Andhra Pradesh

K. Rajasekhara Reddy*

Department of Anthropology, University of Mysore, Manasagangothri, Mysore 570 006, India

The study reports on bilateral palm prints among 400 unrelated individuals (200 males and 200 females) of Madigas in two revenue districts of Cuddapah and Chittoor in Andhra Pradesh were collected and analysed. The principal mainline formula is frequently occurring modal type in either sex. The highest incidences of Mainline D, Mainline C, Mainline B and Mainline A endings were commonly observed in types 11, 9, 7 and 3 respectively. Majority of the individuals possess axial triradius at t irrespective of sex difference. A general trend of the prevalence of the true patterns in decreasing order can be seen as IV interdigital area > III interdigital area > hypothenar area > thenar/I interdigital area > II interdigital area. The above values of the present study compared to other populations reveal the values are within the range of AP caste populations.

Keywords: Axial triradus, Madigas, mainline endings, principal mainline formula, true patterns.

HUMAN populations are known to differ in terms of a number of characteristics of anthropological significance.

*e-mail: krajasekharareddy@yahoo.co.in

It is largely believed that the genetically controlled traits retain their endowment through generations in the population. Even among the genetic traits, all those controlled by many genes are considered to be more effective and reliable in the study of population variation. The importance of dermatoglyphics in comparative human population studies hardly needs emphasis for the simple reason that dermatoglyphic traits are under genetic control. Besides, they are known to vary considerably owing to the fact that they are controlled by many additive genes. In addition, they are less adaptive and are not known to be associated with post-natal modifications or any paratypic influences. As such, dermatoglyphic patterns have been employed in the study of population variation[1]. Holt[2] has also testified the importance of dermatoglyphic traits in the study of population differences. The literature on correlations between palmar interdigital ridge counts shows clear and wide variations among different population groups[3,4].

The Madigas, chosen for the purposes of this study, belong to the endogamous subdivision of gampadhompti, the most predominant group in Andhra Pradesh, including the study area covering the Cuddapah and Chittoor districts. The Madigas, the great leather working scheduled caste of Andhra Pradesh, correspond to chakkiliyan of Tamil Nadu, Karnataka and Kerala; Madiga of Maharashtra and Orissa; Madiga of Gujarat and Rajasthan states. They are found distributed almost all over the state, including Cuddapah and Chittoor districts, where the investigation was carried out. They are called by a number of terms such as arundhatiyulu, asprughyulu, jambavulu, gosangis, matangas, muttaranivaru, harijans, ettivaru, tegavaru, masthigalu, pedda intivaru, etc. However, the terms like arundhatiya, gosangi, jambavulu, etc. are included separately in the list of other scheduled castes[5].

The Madigas are a short to medium statured people with prominent cheek bones, oval-elliptical face and hard constitution, dark brown skin colour, straight nose, black hair and brown eyes. An economically distressed community, Madigas occupy the lowest position in the Hindu caste hierarchy. Their settlement is generally situated outside the main village. They mainly earn their livelihood by working as labourers on the farm lands. Besides, they thrive on their traditional occupation of tanning of skin and making of leather articles such as shoes, buckets, belts, etc. Their family descent is patriarcheal, patrilineal and patrilocal type. The basavi system is prevalent among them.

The data for the present study were chosen from Cuddapah and Chittoor districts. Bilateral palm prints of 400 unrelated Madiga individuals (males: 200; females: 200) were collected and analysed according to the methods and techniques given by Cummins and Midlo[6]. Appropriate statistical treatment was extended.

The most frequently occurring principal mainline formulae, 11.9.7 – 9.7.5 – and other infrequently occurring formulae categorized under the 'Rest' are given in Table 1. In general, the males and females show the modal type 11.9.7. – next to which comes formulae 7.5.5. – and 9.7.5. –. The order of 11.9.7. – > 7.5.5. – > 9.7.5. – is similar in either sex of the Madiga population. But the formula 11.9.7. – is more frequent in females than males. Significant sexual dimorphism was observed.

The right hand shows relatively very higher values and also greater variation than the left hand in either sex of the Madigas. Bilateral differences are found to be statistically significant in both male and female series.

As shown in Table 2, the total symmetrical combinations are relatively lower in male series (45.50%) than in female series (54.00%). Among the modal types, the preference for symmetry is in the decreasing order of 11.9.7. –> 7.5.5. – 9.7.5. – in either sex of the population. The details of the individual mainline endings in different areas of the palm are shown in Table 3. The frequency of Mainline D ending shows the highest incidence of type 11 with least sex difference in the Madigas (M: 49.25% and F: 48.5%). The next common type is 7 followed by type 9. Mainline D is more variable in right hand than the left hand in either sex. Type 11 is more common in right hand than the left hand, while type 7 and type 9 are more frequently seen in left hand than the right hand in either sex. Further, right hand is more variable in males than females.

Though there are many ending positions of Mainline C, the highest frequencies are noticed in positions 9, 5″ and 7 in both males and females. The abortive and absent types of Mainline C are also noticed with considerable proportions in both males (X = 10.25%; *x* = 4.50% and O = 5.25%) and females (X = 5.50%; *x* = 2.75% and O = 5.50%). Most of the right hand series are more variable in position 9 as in the left hand in positions of 5″ and 7.

The highest frequencies of Mainline B are seen in ending positions of 7, 5′, 5″ in both sexes. The lowest frequencies are found in positions 3, 4, 8 and 9 in either sex and absented Mainline B is also noticed in males. Right hand is more variable than that of left in position 7, whereas left hand is more variable than that of the right as in positions 5′ and 5″.

The most frequently occurring positions of Mainline A are 3, 4 and 5′ with negligible sex difference. Right hand is more variable in position 5′ and 4 while left hand is in position 3.

On the whole the terminations of mainlines D, C, B and A generally terminate in left hands in areas with lower numbers unlike the right hand with higher inclination towards transversality.

The frequency of the position of medially placed axial triradius in the Madigas listed in Table 4 reveals its nine different combinations. Majority of the individuals possess the axial triradius at **t**, the most proximal side between thenar and hypothenar area in both males (76.00%) and females (67.25%) in the population. The next frequently occurring types are **t′**, **tt″**, **tt′**, and **t″**. The position of axial triradius at **t** is relatively higher in males than in females.

Table 1. Frequency of principal mainline formulae

Sex	Number tested	Hand	Principal mainline formulae (%) 11.9.7.–	9.7.5.–	7.5.5.–	Rest	χ^2 value (d.f. = 3) Bilaterality	Sex difference
Males	200	R	39.50	14.50	21.00	25.00	11.70**	3.75
		L	24.00	17.00	24.00	35.00		7.15
		R + L	31.75	15.75	22.50	30.00		10.49*
Females	200	R	42.50	8.50	24.00	25.00	8.38*	
		L	29.50	8.50	27.00	35.00		
		R + L	36.00	8.50	25.50	30.00		

*Significant at 5% probability level; **Significant at 1% probability level; ***Significant at 0.1% probability level.

Table 2. Incidence of symmetry and asymmetry of principal mainline formulae

Sex	Number tested	Symmetry (%) 11.9.7.–	9.7.5.–	7.5.5.–	Rest	Total	Asymmetry (%)	χ^2 value for sex difference (d.f. = 1)
Males	200	15.00	5.50	14.50	10.50	45.50	54.50	2.56
Females	200	21.50	5.00	16.00	11.50	54.00	46.00	

Table 3. Frequency of endings of the four mainlines

Endings	Males (%) Right	Left	R + L	Females (%) Right	Left	R + L
Line D						
7	23.50	27.50	25.50	33.00	37.50	35.25
8	0.00	0.00	0.00	0.50	0.00	0.25
9	18.50	30.50	24.50	13.00	17.00	15.00
10	1.00	0.50	0.75	1.00	1.00	1.00
11	57.00	41.50	49.25	52.50	44.50	48.50
8	0.00	0.00	0.00	0.50	0.00	0.25
Line C						
5′	0.50	1.00	0.75	1.50	2.00	1.75
5″	21.00	23.00	22.00	24.00	26.50	25.25
7	14.50	21.00	17.75	9.50	12.50	11.00
9	42.00	32.50	37.25	52.00	42.50	47.25
10	1.00	0.00	0.50	1.00	0.50	0.75
11	2.50	1.00	1.75	0.50	0.00	0.25
X	9.00	11.50	10.25	6.00	5.00	5.50
x	4.50	4.50	4.50	1.00	4.50	2.75
0	5.00	5.50	5.25	4.50	6.50	5.50
Line B						
3	0.00	0.00	0.00	0.00	0.50	0.25
4	0.00	0.00	0.00	0.50	1.00	0.75
5′	24.00	28.50	26.25	28.50	32.50	30.50
5″	17.00	29.00	23.00	15.00	20.00	17.50
6	0.50	0.50	0.50	0.50	0.50	0.50
7	54.50	41.00	47.75	53.00	44.50	48.75
8	1.00	0.00	0.50	1.00	0.50	0.75
9	2.50	0.50	1.50	1.50	0.50	1.00
0	0.50	0.50	0.50	0.00	0.00	0.00
4	0.00	0.00	0.00	0.50	1.00	0.75
Line A						
1	0.50	2.00	1.25	0.50	2.00	1.25
2	3.50	4.50	4.00	2.50	6.00	4.25
3	33.00	42.50	37.75	32.50	40.00	36.25
4	41.00	33.00	37.00	38.50	32.50	35.50
5′	22.00	17.00	19.50	25.00	18.50	21.75
5″	0.00	1.00	0.50	1.00	1.00	1.00

Both males and females show higher values of proximal **t** on left hands than on right hands.

As shown in Table 5, the highest proportion of true patterns is seen in the fourth interdigital area in either sex of the Madigas with higher incidence on the left than right hand. The third interdigital area comes next to the fourth one. In the hypothenar and thenar/first interdigital areas also these patterns occur with higher proportion in the former than the latter. The lowest proportion of true patterns is observed in the second interdigital area as most of it is occupied by the open fields. A general trend of the frequency of the true patterns in the decreasing order in either sex of the Madigas is as follows: IV interdigital area > III interdigital area > hypothenar area > thenar/I interdigital > II interdigital area.

Some of the palmar dermatoglyphic characters of the present study are compared with the neighbouring caste and tribal populations of Andhra Pradesh in order to appraise the extent of relationship between them (Table 6).

The principal mainline formula of 11.9.7. – is the predominant type in both caste[7–11] as well as tribal[12–17] populations. It ranges from 20.57% among Vydiki Brahmins[11] to 44.49% among pokanati Kapu[8] in male series and from 22.50% among Segidi[10] to 44.00% among Vysyas[9] in females of caste groups, whereas it varies from 20.19% among Konda Reddis[17] to 48.23% among Jatapu[16] in male series and 19.47% among Konda Reddis[17] to 42.23% among Boyas[12] in female series of tribal populations. The results closely agree with those of Tangala Mala[8] in male series and Vydiki Brahmins[11] and Niyogi Brahmins[11] in female series among caste groups, and Yerukalas[14] in male series and Jatapus[16] in female series among tribal populations. The next frequently occurring mainline formula of 7.5.5. – is observed in both caste and tribal populations, but its extent is greater in castes and lesser in tribal

Table 4. Frequency of various types of axial Triradii

Sex	Number tested	Hand	Types of axial triradii (%)								
			t	t′	t″	tt	tt′	tt″	t′t′	t′t″	tt′t″
Males	200	R	75.00	15.50	1.50	0.00	3.50	2.00	1.00	0.50	1.00
		L	77.00	13.00	1.00	0.50	5.00	2.50	0.00	0.50	0.50
		R + L	76.00	14.25	1.25	0.25	4.25	2.25	0.50	0.50	0.75
Females	200	R	67.00	18.00	3.50	1.00	4.00	5.00	0.00	0.50	1.00
		L	67.50	18.00	2.50	0.50	4.00	5.00	0.00	1.50	1.00
		R + L	67.25	18.00	3.00	0.75	4.00	5.00	0.00	1.00	1.00

χ^2 value for inter group difference (d.f. = 3); M = 2.01; F = 10.20*; M + F = 10.62*; *Significant at 5% probability level.

Table 5. Distribution of true patterns on palmar configurational areas

Sex	Number tested	Hand	True patterns (%) on palmar configurational areas				
				Inter digital areas			
			Hypothenar	Th/I	II	III	IV
Males	200	R	26.50	4.50	12.50	58.50	61.50
		L	30.00	15.50	5.50	48.00	71.50
		R + L	28.25	10.00	9.00	53.25	66.50
Females	200	R	37.00	9.00	12.50	62.00	68.50
		L	36.00	12.50	4.00	50.50	76.00
		R + L	36.50	10.75	8.25	56.25	72.25

groups. Though the least frequency is found in the formula 9, 7, 5, – in both caste[7–11] and tribal[12–17] populations, its extent is higher in tribal groups rather than caste populations. However these populations show the mainline formula values within the range of Indian populations.

The most proximally positioned axial triradius – **t** ranges between 65 to 81% among male series and 57 to 89% among female series in caste groups, while 68 to 93% among male series and 67 to 96% among female series in tribal populations. In the incidence of **t**, Madigas come closer to Yerukalas[14] and Yanadis[15].

The incidence of true patterns on hypothenar area ranges between 26–31% and 30–40% in male and female series respectively among caste populations, and between 17–37% and 15–46% among tribal populations showing higher frequency in female than male series of both castes as well as tribal populations; Madigas show relatively higher incidence of hypothenar patterns (M: 28.25% and F: 36.50%) and fall closer to all the populations in castes[7–11] and Konda Reddis[17] in tribes.

The frequency distribution of true patterns on thenar/first interdigital area of the palm reveals lower incidence of patterns, which is a common characteristic of most of the Indian populations. The patterns of this area range between 1.14 to 16.96% and 2.08 to 17.06% in males and females respectively of caste groups and 1.21 to 20.38% and 0.00 to 16.49% in male and female series respectively of tribal groups. The Madigas (M: 10.00% and F: 10.75%) come closer to Niyogi Brahmins[11] for both male and female series and Yerukalas[14] for male series only in caste and tribal groups respectively.

The second interdigital area of the palm also represents lower incidence of true patterns ranging between 6.82 to 10.00% in males and 5.20 to 11.04% in females among caste groups, and from 4.11 to 11.17% in males and 0.74 to 9.99% in females among tribal populations. Madigas (M: 9.00 and F: 8.25%) in this respect come closer to Golla[10], Vydiki Brahmins[11] and Niyogi Brahmins[11] in male series, Vydiki Brahmins[11] in female series among caste groups; while Konda Reddis[17], Jatapus[16], Yanadis[15] in male series, and Jatapus[16] only in female series among tribal populations.

The incidence of true patterns on third interdigital areas is relatively higher than the true patterns of hypothenar, Th/I, and II interdigital areas. It ranges between 38.81 to 53.25% in the males and 34.37 to 57.14% in the females among caste populations, while between 39.48 to 68.28% in the males and 38.95 to 57.65% in the females among tribes. Madigas (M: 53.25% and F: 56.25%) show relatively higher incidence of third interdigital patterns and tend to approach the Vydiki[11] and Niyogi[11] Brahmins of the female series among castes; while Nakkalas[13] in the male series and Jatapus[16] in the female series of tribes.

The highest proportion of true patterns is found in the fourth interdigital area in most of the Indian populations. The values fluctuate between 51.12% (Golla[10]) and 66.50% (Madigas, the present study) in the male series and 52.85% (Segidi[10]) and 72.25% (Madigas, the present study) among

Table 6. Frequency of some palmar dermatoglyphic traits in some Andhra population

Population	Sex	Mainline formulae (%)				True patterns (%) on palmar configurational areas						Reference
								Inter digital areas				
		11.9.7.–	9.7.5.–	7.5.5.–	'Rest'	t	Hypothenar	Th/I	II	III	IV	
Madiga	M (200)	31.75	15.75	22.50	30.00	76.00	28.25	10.00	9.00	53.25	66.50	Present study
	F (200)	36.00	8.50	25.50	30.00	67.25	36.50	10.75	8.25	56.25	72.25	Present study
Tangala Mala	M (130)	35.39	16.15	14.62	33.84	80.87	–	–	–	–	–	Chengal Reddy[8]
	F (86)	29.69	19.77	20.35	30.23	88.83	–	–	–	–	–	Chengal Reddy[8]
Pokanati Kapu	M (118)	44.49	11.44	11.44	32.63	–	–	–	–	–	–	Ramachandraiah *et al.*[9]
	F (43)	41.11	11.11	8.89	38.89	–	–	–	–	–	–	Ramachandraiah *et al.*[9]
Vysya	M (100)	43.50	9.50	14.00	33.00	–	–	–	–	–	–	Ramachandraiah *et al.*[9]
	F (100)	44.00	11.50	13.50	31.00	–	–	–	–	–	–	Ramachandraiah *et al.*[9]
Segidi	M (132)	26.13	15.90	21.97	35.99	–	26.14	1.14	6.82	40.15	51.52	Ramalakshmi[10]
	F (140)	22.50	18.93	22.14	36.43	–	31.06	3.57	6.78	35.72	52.85	Ramalakshmi[10]
Golla	M (134)	28.36	16.42	20.52	34.70	–	26.10	2.62	9.32	38.81	51.12	Ramalakshmi[10]
	F (144)	24.65	18.40	21.53	35.42	–	40.28	2.08	5.20	34.37	53.82	Ramalakshmi[10]
Vydiki Brahmin	M (115)	20.57	17.83	12.61	48.99	69.57	30.00	16.96	8.26	45.22	56.52	Sreenath[11]
	F (85)	37.65	11.76	7.65	42.94	59.41	30.00	17.06	10.00	58.24	54.71	Sreenath[11]
Niyogi Brahmin	M (123)	34.15	9.35	16.67	39.83	65.45	31.29	10.98	8.94	48.37	51.22	Sreenath[11]
	F (77)	35.71	9.74	7.79	46.76	57.14	31.17	12.99	11.04	57.14	55.84	Sreenath[11]
Kshatriya	M (130)	21.16	16.54	17.69	44.62	–	–	–	–	–	–	Anuradha[7]
	F (130)	25.78	16.92	18.46	38.84	–	–	–	–	–	–	Anuradha[7]

(Contd...)

Table 6. (*Contd...*)

Population	Sex	Mainline formulae (%)				True patterns (%) on palmar configurational areas						Reference
								Inter digital areas				
		11.9.7.–	9.7.5.–	7.5.5.–	'Rest'	t	Hypothenar	Th/I	II	III	IV	
Konda Reddi	M (290)	20.19	16.23	17.17	46.41	–	35.66	20.38	7.74	46.23	65.09	Veerraju[17]
	F (305)	19.47	14.74	18.42	47.37	–	33.16	16.49	5.96	38.95	62.98	Veerraju[17]
Jatapu	M (85)	48.23	22.93	15.28	13.55	92.93	17.15	–	11.17	42.94	54.71	Subbalakshmi[16]
	F (85)	38.75	14.80	22.66	23.78	96.47	20.59	–	9.99	57.65	61.75	Subbalakshmi[16]
Nakkala	M (85)	36.89	11.24	11.83	40.24	69.82	32.00	3.54	4.11	53.24	51.48	Narahari[13]
	F (68)	28.68	18.38	11.03	41.91	74.26	25.06	2.95	0.74	44.86	53.68	Narahari[13]
Yanadi	M (249)	43.17	15.66	9.64	31.53	67.59	–	1.21	8.03	68.28	32.13	Sreenath[15]
	F (224)	40.63	12.95	17.41	29.01	66.52	–	0.00	2.01	49.34	45.76	Sreenath[15]
Boya	M (91)	41.20	21.98	11.54	25.28	89.01	19.23	4.64	–	–	–	Gunusundaramma *et al.*[12]
	F (110)	42.23	16.82	19.09	21.86	81.81	15.46	3.18	–	–	–	Gunusundaramma *et al.*[12]
Yerukala	M (366)	29.51	21.72	23.50	25.27	75.27	37.29	8.74	6.97	39.48	63.39	Narahari[14]
	F (312)	30.93	16.02	30.13	22.92	70.51	46.16	5.93	3.85	42.31	67.31	Narahari[14]
		21.16	16.54	17.69	44.62	–	–	–	–	–	–	Anuradha[7]

*10 to 15 tribal populations. Rest are caste groups.

caste groups where they vary between 32.13% (Yanadi[15]) and 65.09% (Konda Reddi[17]) in the male series and between 45.76% (Yanadi[15]) and 67.31% (Yerukala[14]) in the female series among tribal populations. Our study shows the highest proportion of fourth interdigital true patterns (M: 66.50% and F: 72.25%) than all the castes and tribal populations of Andhra Pradesh (Table 6) and is closer to only Konda Reddis[17]. Further, the incidence of true pattern on fourth interdigital area in general is relatively more in low caste populations like Madigas and tribal populations than the upper caste populations which is substantiated by our study.

1. Rife, D. C., Fingerprints as criterion of ethnic relationship. *Am. J. Hum. Genet.*, 1953, **5**, 389–399.
2. Holt, S. B., *Dermatoglyphic Patterns in Genetical Variation in Human Populations* (ed. Harrison, G. A.), Pergamon Press, Oxford, 1966.
3. Holt, S. B., Palmas ridge counts. *The Anthropologist* (special volume), 1968, pp. 117–120.
4. Mate, M., The ridge counts of the interdigital a–b, b–c and c–d areas in a normal sample and in cerebrally damaged patterns of thurin gia, G. D. R. (East Germany). *J. Phys., Anthrop.*, 1975, **42**, 233–235.
5. Census of India, Series 2 – Andhra Pradesh Part V-A, town direction. Director of Census Operations, Andhra Pradesh, 1971.
6. Cummins, H. and Midlo, C., *Fingerprints, Palms and Soles: An Introduction to Dermatoglyphics*, Dover, New York, 1961.
7. Anuradha, K., Palmar dermatoglyphics and flexion creases in the Kshatriyas of Chittoor district. M Sc dissertation, S. V. Univ., Tirupati, India, 1982.
8. Chengal Reddy, P., Population structure and genetic variation of Malas of Chittoor District, Andhra Pradesh. Ph D thesis, S. V. Univ., Tirupati, India, 1979.
9. Ramachandraiah, T., Venkatasubbamma, N., Ranganthам, T., Narayana, Y., Basheer Ahmad, K., Pulla Reddy, A. and Narahari, S., Study of dermatoglyphics in three endogamous groups of Andhra Pradesh (India). *Int. sym. Derm.*, Patiala (India), Abstract No. ISD50, 1980, p. 27.
10. Ramalakshmi, K. V., Comparative dermatoglyphics (finger and palm) of Segidi and Golla populations of Srikakukim district, A.P., M Phil dissertation, S. V. Univ., Tirupati, India, 1980.
11. Sreenath, J., Morphogenetic studies among the Brajmins of Andhra Pradesh. M Phil dissertation, S. V. Univ., Tirupati, India, 1981.
12. Gunasundaramma, K., Rami Reddy, V. and Subhashini, A. B., Dermatoglyphics of the Boyas of Chithoor district in Andhra Pradesh. *Sci. Cult.*, 1980, **11**, 129–142.
13. Narahari , S., Finger and palmar dermatoglyphic studies among the kurivikkarans (nomadic tribe) and yerukalas (semi-nomadic tribe) of Andhra Pradesh. M Sc dissertation, S. V. Univ., Tirupati, India, 1977.
14. Narahari, S., A genetic study among the yerukalas of Andhra Pradesh. Ph D thesis, S. V. Univ., Tirupati, India, 1982.
15. Sreenath, J., A study of palmar dermatoglyphics among the Yanadis in and around Nellore (AP). M Sc dissertation, S. V. Univ., Tirupati, India, 1977.
16. Subbalakshmi, S. V., A study of ABO blood groups, finger and palmar dermatoglyphics and some morphological characters among the Jatapus of Srikakulam district, Andhra Pradesh. M Sc dissertation, S. V. Univ., Tirupati, India, 1976.
17. Veerraju, P., A genetic study of the Konda Reddis. Ph D thesis, Andhra Univ., Waltair, India, 1973.

Received 6 October 2005; accepted 28 December 2005

Can the possibility of some linkage of monsoonal precipitation with solar variability be ignored? Indications from foraminiferal proxy records

N. Khare[1,]* and R. Nigam[2]

[1]National Centre for Antarctic and Ocean Research, Headland Sada, Vasco-da-Gama, Goa 403 804, India
[2]National Institute of Oceanography, Dona Paula, Goa 403 004, India

Foraminiferal studies on a shallow water sediment core off Karwar, central west coast of India have revealed significant changes in the monsoonal precipitation during the last around 720 years. The results hint towards some possibility of linkage of monsoonal precipitation with solar variability during this period.

Keywords: Benthic and planktonic foraminifera, monsoonal variability, palaeoclimate, solar variability.

THE palaeoclimatic data play a key role in efforts to understand climate processes and potential for future climate changes by extending the long-term records with fine time resolution baseline of observations of past climatic changes. Such high resolution and long-term records of climatic variations from many different sections (marine mid-to-high latitudes) are required for climate models[1]. Beyond the instrumentation era, proxy data complement and significantly extend such records in space and back in time[2–7]. However, the extent and intensity of climate variability over the last 1000 years has received special attention[8–10]. Such studies have suggested a number of climatic aberrations/boundaries throughout the world.

This communication intends to draw the attention of palaeoclimatologists to the need of looking at the monsoonal variability in view of the changes during the last millennium in the solar variability. The possibility of the modulation of monsoonal precipitation by the sunspot minima has been explored in the past through various studies across the world[11–14]. Several important and interesting papers on the role of solar variability over climatic changes have prompted renewed interest in exploring the possibility to look for the causal link of monsoonal changes over the Indian subcontinent, with changes in solar activity. The detailed conceptual model to study palaeomonsoonal precipitation through foraminiferal variations (foraminifera are exclusive microscopic marine organisms extremely sensitive towards climatic/environmental changes) has already been published, in which we particularly considered freshwater run-off from rivers as indicative of monsoonal precipitation[15].

The utility of morpho-groups of benthic foraminifera and planktonic foraminifera as a tracer of palaeomonsoonal

*For correspondence. (e-mail: nkhare@ncaor.org)