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USE PATTERN AND CHEMICAL CHARACTERISATION OF THE NATURAL SALT LICKS IN CHINNAR WILDLIFE SANCTUARY

K.K. Ramachandran
M. Balagopalan
P.Vijayakumaran Nair

KERALA FOREST RESEARCH INSTITUTE
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ABSTRACT

A study was conducted during 1990-92 in the Chinnar Wildlife Sanctuary (10^o 15' to 10^o 22' N latitude and 77^o 05' to 77^o 17' E longitude) of Kerala State to characterise the natural salt lick sites and gather information on their usage by wild animals.

Four sites were selected, three in natural salt lick area and one outside the salt lick which remained as control. For comparison purpose, two sites viz Anakkatty and Munnar were also selected. From each site, ten soil surface samples (0-20 cm) were taken at random. The soils were characterised and the total sodium, potassium, calcium and magnesium contents were estimated. The animal visits were recorded through regular field observations and the degree of their use by monitoring the laid out impression pad.

The soils in the natural salt lick sites had higher sodium, potassium, calcium and magnesium contents as compared to control and comparison sites. Sodium content was dominant in the natural salt lick sites. Herbivores like elephant *(Elephas maximus)*, spotted deer *(Axis axis)*, and sambar deer *(Cervus unicolor)* use the salt licks. There was very little evidence of gaur *(Bos gaurus)* using the salt licks. Animals use the salt licks irrespective of the season and age.

INTRODUCTION

Large herbivorous and omnivorous mammals have a habit of deliberate soil ingestion from selected sites. Such sites are termed as mineral licks, salt licks or natural licks. Selective excavation of soil or soft rock by animals is called 'mining' (Redmond, 1982). Soil or salt eating habit has been reported in many terrestrial vertebrate species including reptiles, birds and mammals (Kreulen, 1985). Lick use has been reported to be mainly associated with mineral defiaen-aes.

Licks are of different types, some are just scrapes in the topsoil while others vary from more or less steep sided pits or craters to deep caves. Among the most spectacular 'mines' known, are 100-150 m deep caves created by elephants and various ungulates on the Kenya slopes of Mount Elgon (Redmond, 1982). Ingestion of salt lick soil by ungulates is occurring in many different geographic areas with climates ranging from dry (DHV) Consulting Engineers, 1980) or wet tropical (Emmons and Stark, 1979) through temperate (Weeks, 1978) to arctic (Calef and Grant, 1975) and montane (Cowan and Brink, 1949).

It has been reported that animals eat soil to satisfy a craving for nutrient minerals resulting from inadequate forage. In livestock, dietary supplements of appropriate soil are in fact capable of rectifying or alleviating mineral deficien-cies. When domestic ruminants and horses are subjected to abrupt transfer from roughage to lush pasture or concentrates, they are prone to develop a disorder called 'lactic acid acidosis' (Mooreel *al.*, 1977). The sudden lack of fibre and the large increase in readily fermentable carbohydrates and soluble proteins are the key factors involved. Increased potassium intake and sodium losses associated with introduction to green forage (Kreulen and Jagger, 1984) may also play a role. Steep rise in protein and sugar levels in the rumen accelerates fermenta-tion, increases the volatile fatty acid (VFA) concentration and osmotic pressure, and cause a drop in the pH, even below the critical level of 5.5 (Slyter, 1976). However, for wild animals which frequent licks, sodium is mainly sought for. In some licks, this argument applies to most nutrient minerals (Oates, 1978).

Soil ingestion is reported to alleviate oxalate poisoning, resulting from feeding on oxalate rich plants (james, 1978). Soil ingestion has ill effects too. Tooth wear (Miller *et al.*, 1978), erosion of intestine lining (Miller *et al.*, 1977) and fungus containing antibiotics killing useful intestinal flora (Brewer *et al.*, 1971) are some of them. Silica and sodium carbonate lead to kidney stones (Wheeler *et al.*, 1980). Soil may sometimes create mineral imbalances and toxicity (Miller *et al.*, 1978). High sodium chloride increases thirst and reduces food intake (Croom *et al.*, 1982). Transmission of disease germs through lick soils cannot also be discounted.

Information on seasonal periodicity in lick use shows that this in terms of animal numbers, is limited to or reaches a peak, lasting 1 to 2months, in spring or early summer (Calef and Grant, 1975). Studies based on faecal analysis have shown that the actual consumption of soil by individuals increases 4 to 8 fold in spring (Burghardi *et al.*, 1982). A second peak is sometimes seen in autumn (Knight and Mudge, 1967). The meagre information on seasonal incidence of lick use in tropical Africa presents a similar picture, in that it appears to occur primarily at the beginning of the rainy season, corresponding with the green flush and dietary change (Henshaw and Ayeni, 1971). A second period may be observed during the transition to the dry season. On the other hand, African elephants *(Loxodonta africana)* and Indian elephants *(Elephas maximus),* visit soil licks chiefly in the dry season (Redmond, 1982). Wet-season availability of saline water, and their preference for it may explain the discrepancy (Weir, 1969). During the height of the 'lick-use season,' ungulates may spent as much as half an hour daily feeding at the licks. This suggests a substantial intake of soil which is confirmed by visual inspection of the faeces, composed largely of soil (Arthur and Alldredge, 1979). The faecal ash content (30-88% dry matter) determined for white-tailed deer *(Odocoileus virginianus)* in spring (Weeks and Krikpatrick, 1976), and of the acid-insoluble residue (30-51% dry matter) for bighorn sheep *(Ovis candensis)* (Skipworth, 1974) corroborate the above.

This investigation was undertaken in Chinnar Wildlife Sanctuary in Kerala to gather information on the animals using the salt licks and the seasons in which they use it mostly. The study also envisaged to characterise nutrient minerals associated with these natural salt licks and adjacent areas. Understanding this subject has direct relevance in wildlife management (Ayeni, 1979) and hence the significance of this study.

STUDY AREA

Chinnar Wildlife Sanctuary is located in the rain shadow region of the Western Ghats between 10° 15' to 10° 22'N latitude and 77°05' to 77° 17'E longitude. This comes under the Devikulam Taluk of Idukki District, Kerala State (Fig.1). It is bordered in the north and east by Amaravathi reserve forests of Indira Gandhi Wildlife Sanctuary. The western side merges with Eravikulam National Park. Kudakkad reserve forest and Vannanthurai sandal wood reserve forest lie adjacent to the southern boundary (Fig.1). The sanctuary is accessible by road from Munnar about 43 km passing through Marayur, a place in the south-west of the sanctuary. It can be approached from Udumalpet travelling 29 km by road to Chinnar, which is the boundary between Kerala and Tamil Nadu States. A stretch of 15km of the all weather road passes through the sanctuary between Marayur and Chinnar. The terrain of the Chinnar Wildlife Sanctuary is undulating with altitudes varying from 440m to 2372m above msl. Main river which drains the area is the east flowing Pambar river and its tributaries. Before it leaves Kerala State, Pambar joins with Chinnar river. River Pambar and its main tributaries are perennial as they originate from the evergreen sholas in the higher reaches of the ghat in the southern and western sides.

Annual rainfall ranges from 500 to 800 mm with a minimum and maximum temperature of 12°C and 36°C, respectively. The rainfall pattern of Chinnar for the period 1901-1979 shows that rains occur for 17 days during the south-west monsoon period, which brings rain from July to September (CESS, 1984). Bulk of the rainfall is received from the north-east monsoon during October to December and the rainy season lasts for about 22 days. Rains other than the ones mentioned above, account for about 11 days. Thus altogether, on an average, there are only about 50 rainy days in a year.

MATERIALS AND METHODS

Four sites were selected in Chinnar Wildlife Sanctuary, three in natural salt lick areas and one outside the salt lick area which remained as control. The natural salt lick areas were located at Mannala, Myladumpara, Athithurai. Each one is situated at least one kilometre away from the other. The control area is at Velamkad (Fig. 1). For comparison, an area each in Anakkatty in the Attappady Valley of Palghat District and Munnar in the Idukki district were taken. The former lies between 11° 8' and 11° 11' N latitude and 76° 40' and 76° 50' E longitude and the latter lies between 9° 55' and l0° 10' N latitude and 77o and 77° 12' E longitude. Anakkatty is located 550 m above msl and has a rainfall of 880 mm, and supports degraded dry deciduous forest which even reached to dry scrub. Munnar is located 1450m above msl having a rainfall of 3210 mm with southern tropical broad-leaved hill forest (Balagopalan, 1991). From each of the above areas, 10 soil surface samples (0-20 cm depth) were taken at random. The soils were analysed for particle-size separates, pH, organic carbon, exchange-able bases, exchange acidity, total nitrogen and extractable phosphorus. Total sodium, potassium, calcium and magnesium contents were also estimated (Hesse, 1965; Jackson, 1958). The mean values of soil properties and nutrients are given in Tables 1 and 2.

The salt licks were visited in different seasons to find out the evidences of animal visits and the degree of their use. In each salt lick site, a plot of 2m x 2m was made loose (impression pad) en route the salt lick. This impression pad was used for monitoring the seasonal use by different animals. Photographs of the salt licks and the excavated sites were taken (Figs. 2 to 8).

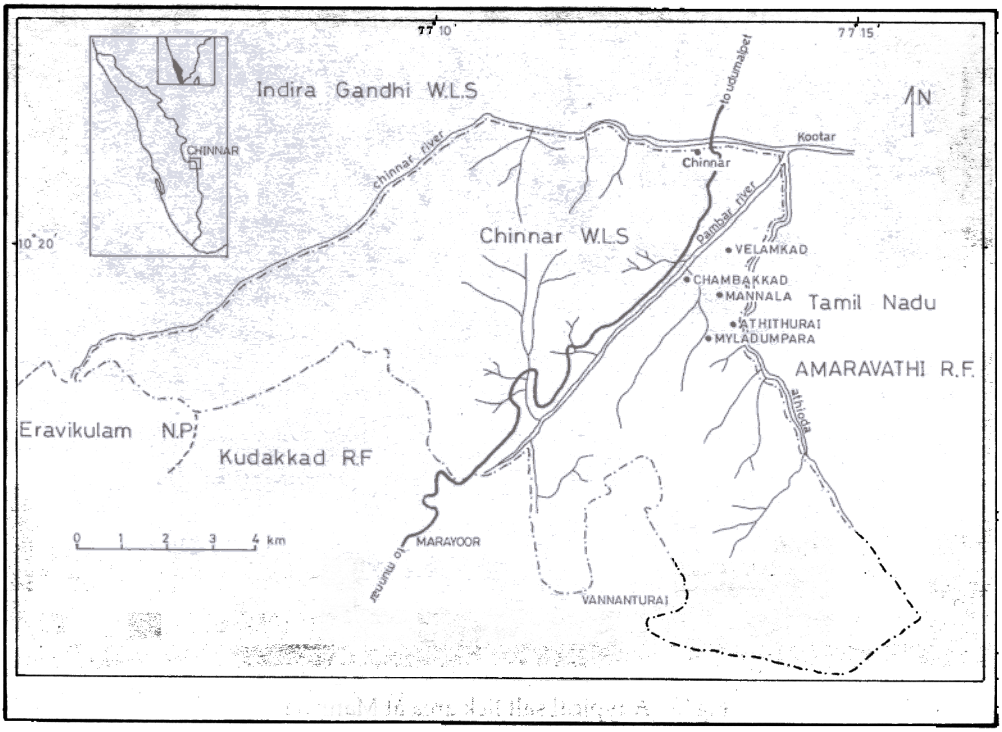

Fig. Location of study sites in Chinnar Wildlife Sanctuary.

Fig. 2. The cave like salt lick at Mannala.

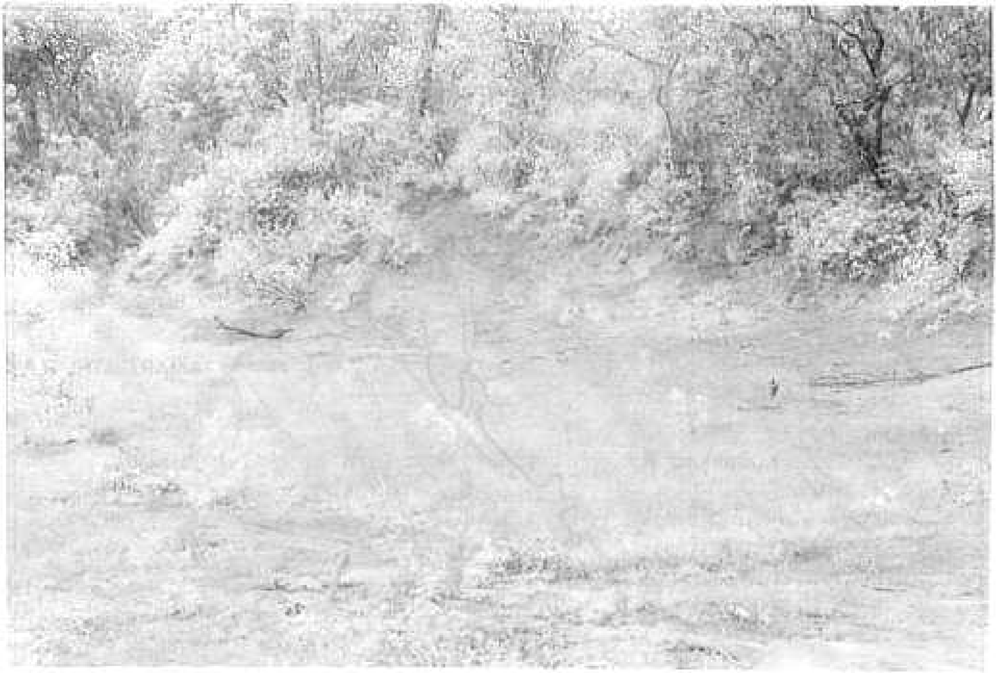

Fig. 3. A typical salt lick area at Mannala.

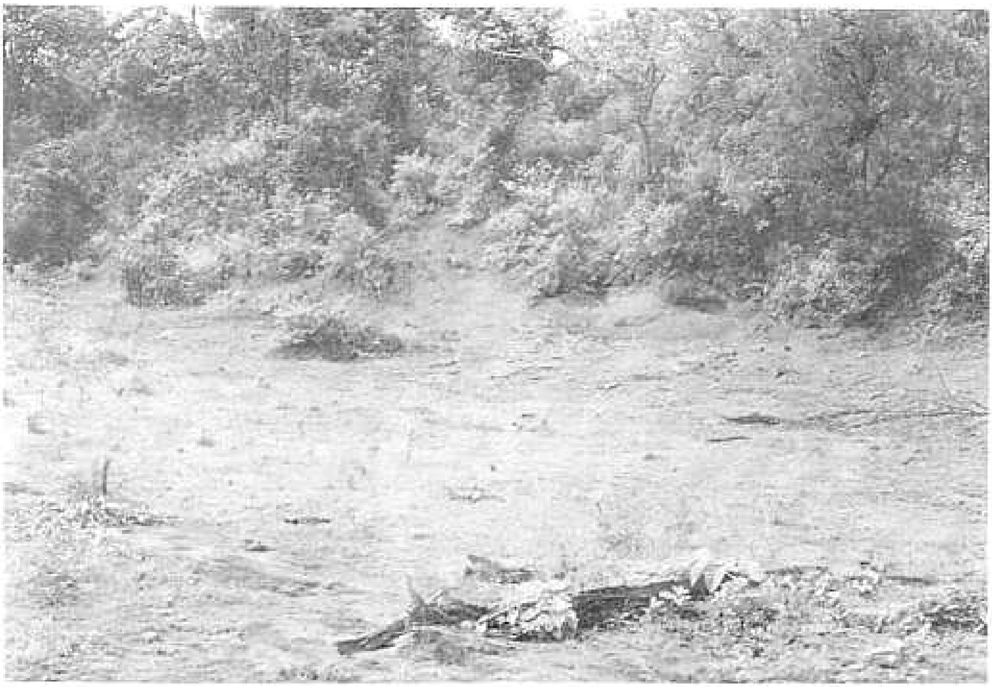

Fig. 4. The same area after one year.

Fig. 5. A close view of the salt licks used by elephants.

Fig. 6. A close view of the pit. Note the texture and colour of the soil.

Fig. 7. A location in the Athithurai where there was heavy salt lick use by elephants.

Fig. 8. The same area after a lapse of one year. Note the presence of elephant dung in the foreground.

Soil characteristics

Soils, in general, vary in physical and chemical characteristics (Table 1). They are loamy sand in the natural salt lick and control sites, and sandy loam and loam at Anakkatty and Munnar, respectively. The natural salt lick sites are neutral to slightly alkaline while Velamkad, Anakkatty and Munnar sites are neutral, slightly and strongly acidic, respectively. Lick soils have lower organic carbon and total nitrogen contents. Levels of organic carbon, exchangeable bases (EB) and exchange acidity (EA) in the natural salt lick sites were very close to one another. Exchangeable bases were less whereas EA values were more at the control site compared to the salt lick soils, indicating low salt contents in control areas. Comparison sites had relatively lower pH and high organic carbon. Exchangeable bases contents in the comparison sites were lower than those in the salt licks and vice versa for EA values. There was considerable difference in total nitrogen status of natural salt lick and control sites. Total nitrogen contents in the salt lick sites showed remarkable difference with comparison sites also.

Table 1. Soil characteristics of study sites

Locality	Properties									
	G	S	Si	Cl	pH	OC	EB	EA	Total N	Extr. P
	(...%			)		%	(me/100g soil)		(...ppm...)	
	Natural salt lick sites									
Mannala	**35**	**80**	**12**	**8**	**7.3**	**0.45**	**12**	**3**	**403**	**6**
Mayiladumpara	**37**	**84**	10	**6**	**7.6**	**0.43**	**14**	**3**	**397**	**4**
Athithurai	**40**	**89**	**7**	**4**	**7.8**	**0.37**	**13**	**4**	**343**	**3**
Mean	**37**	**84**	**10**	**6**	**7.6**	**0.42**	**13**	**3**	**381**	**4**
	Control/Comparison sites									
Velamkad	41	79	14	7	7.1	0.61	4	7	493	5
Anakatty	29	76	10	14	6.2	0.95	9	8	530	4
Munnar	9	57	24	19	5.3	3.75	10	13	2091	13

G = Gravel; S = Sand; Si = Silt; Cl = Clay; OC = Organic carbon; EB = Exchangeable bases; EA = Exchange acidity.

Table 2. Sodium, Potassium, Calcium and Magnesium status in soils of study sites

Properties				
Locality	Sodium	Potassium	Calcium	Magnesium
	(............	ppm	....	............)
Natural salt lick sites				
Mannala	1380	875	630	520
Mayiladumpara	1440	890	650	570
Athithurai	1526	924	690	540
Mean	1449	896	657	543
Control /Comparison sites				
Velamkad	427	325	165	215
Anakatty	531	417	212	173
Munnar	283	270	175	118

Sodium, potassium, calcium and magnesium contents were high in natural salt lick sites as compared to control and comparison sites (Table 2). The sodium contents were found to be very much higher than the other three bases viz. potassium, calcium and magnesium in the natural salt lick sites.

Salt licks are usually found in dry .areas where leaching is less. Several reasons are attributed to the habit of animals eating salty soil. One of them is said to be to alleviate 'lactic acid acidosis' resulting from sudden change in forage quality. Soil ingestion may counteract this. Addition of sodium chloride, carbonates or clay has been reported to be beneficial to livestock (Diven, 1975). Clay reduces the ill effects of tannins (Waterman *et al.*,1980)and detoxifies alkaloids of forbes and shrubs (Culvenor, 1973).

It was observed that the mineral nutrients were more in soils associated with natural salt licks as compared to those in control site. This may also be a reason for the animals to use this area for licking. At Chinnar, the main geological formation is of crystalline rocks (Pre-Cambrian) with Charnockites. The charnockites with narrow bands of pyroxene granulite, magnetite-quartzite and calc granulite form the most widespread group. The main geological formation at Anakkaty, where there is more or less same amount of rainfall as that of natural salt lick at Chinnar, is Archean metamorphic complex with Magnetite-quartzite minerals associated with hornblende granulites. These form a distinctive and useful stratigraphical horizon and occur as numerous massive bands. The main geological formation of Munnar is of Lower Pre-cambrian with charnockites.

Salt lick usage by herbivores

The old cave like salt lick at Mannala (Fig. 2) was frequently visited by spotted deer *(Axis axis)*, sambar deer *(Cervus unicolor)* and wild boar *(Sus scrofa)*. Elephants *(Elephas maximus)* were not found to use the cave like salt lick at Mannala. From the indirect evidences like hoof marks, it was found that spotted deer use the particular salt lick more than sambar deer.

Adjacent to the salt lick site at Mannala, there was another salt lick area which the elephants started visiting (Figs. 3 and 4). There is clear evidence to show that Mannala site is heavily used by the elephants as observed by uprooted trees at the ridge like area of the salt lick site (Fig. 4). A salt lick area is, probably, first selected by elephants, and subsequently various other herbivores like spotted deer and sambar deer use it. At Mannala site, the small trees found at the edge are uprooted by elephants (Figs. 4 and 5). The salt lick site at Athithurai was found to be expanding (Figs. 7 and 8). During summer months, elephants were found feeding in Athithurai salt lick site. As evidenced from the chemical analysis of the various soil samples from salt licks in the Mannala and Athithurai sites, the animals prefer these sites for consumption of soil. It was reported that lick use is a phenomenon following dietary change associated with leaf flush. Abrupt transition from winter or dry season, roughage to lush green grass or succulent browse can temporarily cause a large increase in urinary output of Na (Dobson, 1965), and to a lesser extent also in the faecal output of Na (Weeks and Kirkpatrick, 1976).

From the degree of salt lick usage observed, it can be said that herbivores like elephant, spotted deer and to a lesser extent sambar deer use the salt licks where their use has resulted in the formation of a cave. Some of the caves were found to be one to one and half metres deep (Fig. 2). There was very little evidence of gaur using the salt licks at Mannala. It was also observed that the animals like elephants, sambar deer and spotted deer used the salt licks irrespective of the season. Animals of all age groups frequent the sites. It was observed that all the species of animals found in the area did not use the salt licks and this finding agrees with that of Seidensticker and McNeely (1975). Species preference to salt lick areas is not universal. Evidences to support this are many. Warthog *(Phacochoerus aethiopicus)* for example, are the most avid users of licks in the Yankari Game Reserve, Nigeria (Aitken, 1976), but they seem to ignore the salt licks in the Zambezi valley (Jarman, 1972). Similarly, buffalo *(Syncerus caffer)* use licks in Nigeria (Henshaw and Ayeni, 1971) and Kenya (Redmond, 1982), but not in Wankie National Park, Zimbabwe (weir, 1969), whereas African elephants *(Loxodonta africana)* use them in all three places. Such variability may be related to variations in forage quality within and between species. In the Kalahari, licks are reported to be used by all wild ruminants and ostrich *(Struthio camelus)*, but most intensely by the large grazers: gemsbok *(Oryx gazella)*, hartebeest *(Alcelaphus buselaphus)* and wildebeest *(Connochaetes taurinus)*.

There are contradictory reports on lick use among different sex and age groups of ungulates. Weeks and Kirkpatrick (1976) report no difference in lick use either whereas Calef and Grant (1975) observed lick use mainly or exclusively in pregnant and lactating females or juveniles. Although geophagia is not exhibited everywhere, it is a phenomenon of widespread occurrence (Kreulen and Jagger, 1984), with probably manifold benefits which enhance animal performance and resource utilization, especially in areas with sharp seasonal contrasts in forage quality.

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