

## Mammalian Pests of Cocoa in South India

S. K. Bhat\*, C. P. R. Nair and D. N. Mathew†  
Central Plantation Crops Research Institute,  
Regional Station, Vittal 574 243,  
Karnataka, India

**Abstract.** The Western Ghats squirrel, *Funambulus tristriatus* Waterhouse; the South Indian palm squirrel, *F. palmarum* Linnaeus and the black rat, *Rattus rattus* Linnaeus were observed to be causing much damage to cocoa in South India; the palm civet, *Paradoxurus hermaphroditus* Pallas and the bonnet monkey, *Macaca radiata* Geoffroy were causing minor damage. Monthly surveys made for one year in Karnataka showed that the percentage of damage caused by rodents was 29.0; that by civets and monkeys 0.4 and 0.3 respectively. In Kerala and one district of Tamil Nadu rodents were estimated to be causing 15% damage and civets 3%; no monkey damage was found.

### Introduction

Cocoa, *Theobroma cacao* L., is a comparatively recently introduced commercial crop in South India. Since 1964, when production of cocoa was negligible (Wood, 1964), the area under plantation steadily increased, until by 1977 some 6500 ha had been planted (Bavappa, 1977). Most is cultivated in mixed plantations with, for example, coconut or arecanut, but in the forest areas of Kerala, Karnataka and Tamil Nadu, pure plantations exist.

In other parts of the world in which cocoa is grown, a variety of vertebrate pests including rats, squirrels, civets, monkeys, woodpeckers and parrots damage the growing crop (Urquhart and Wood, 1954; Urquhart, 1955; Everard, 1968; Stapley, 1972; Taylor, 1972; Williams, 1973; Gratz and Arata, 1975; Quesnel and Lopez, 1975). Urquhart (1955), for example, estimated that monkeys alone were responsible for the loss of 20–50% of the crop in Sierra Leone and Williams (1973) recorded rat damage to between 3000 and 9490 cocoa pods/ha/year in Fiji. Woodpeckers were estimated to damage 50% of the crop in the West Indies (Quesnel and Lopez, 1975). There is, by contrast, no published work on the damage done by vertebrate pests of cocoa in India apart from observations by Abraham and Padmanabhan (1967).

This paper reports the results of surveys that were conducted in 1976/77 (except for one observation during 1978 in the Cannanore district) in South India to identify some of the mammalian pests and evaluate their economic status.

### Methods

#### Identification of damage

To distinguish the damage done by different mammalian species, observers kept watch in plantations in Karnataka to relate animals seen feeding on cocoa pods to the forms of damage. The observations made on pods that were seen being damaged were used in subsequent surveys to assess the amounts of damage being done by the different species.

\*Present address: Central Plantation Crops Research Institute, Regional Station, Kayangulam 690 533, Kerala, India.  
†Department of Zoology, University of Calicut, Calicut University — 673 635, Kerala, India.

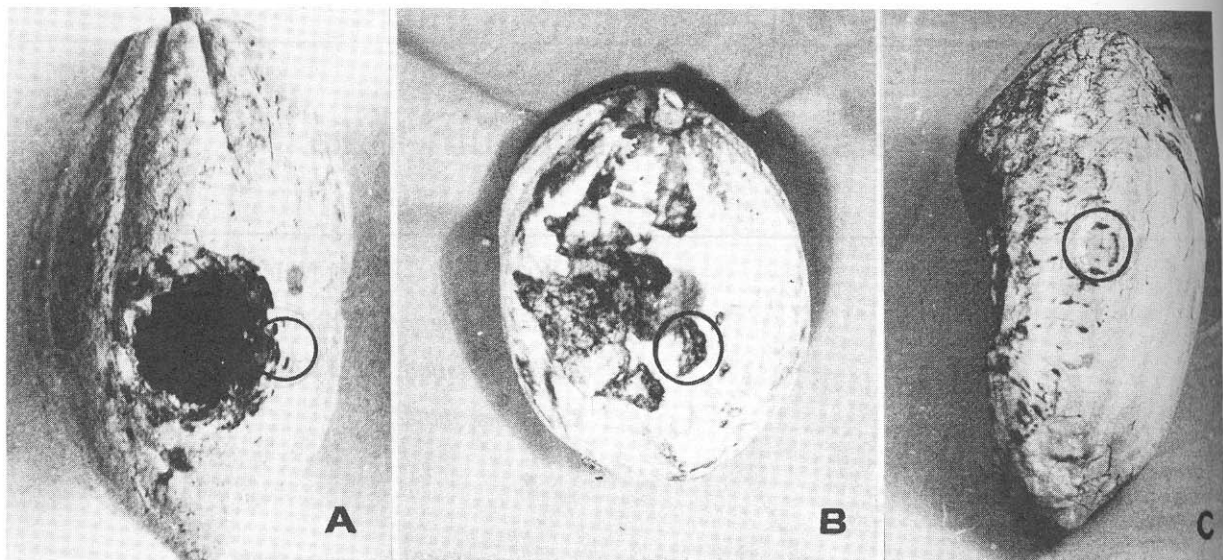


Fig. 1. Tooth marks (circled) on the cocoa pods damaged by A. rodent, B. monkey and C. civet.

#### Assessment of amounts of damage

Four cocoa gardens in the South Kanara district of Karnataka with over 250 trees each were chosen at random and in each 150 trees were randomly selected. The crop on these trees was harvested each month for a year and the numbers of mature and mammal-damaged pods counted on each occasion. The damage done by different species was attributed on the basis of the previously collected data.

Survey visits were also made to 25 randomly chosen gardens in Kerala and to two gardens in Tamil Nadu. All the gardens selected for survey in the Cannanore, Kozhikode, Palghat and Trichur districts of Kerala were surveyed twice; those in Ernakulam, Kottayam, Quilon, Trivandrum and in Tamil Nadu (Kanyakumari district) once. In each of these gardens observations were also made on 150 randomly selected trees.

TABLE 1. DAMAGE CAUSED BY MAMMALIAN PESTS TO COCOA IN SOUTH KANARA DISTRICT OF KARNATAKA (TOTAL OF FOUR GARDENS)

	Year and month												Total
	1976		1977										
	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	
Total number of pods harvested*	220	156	84	104	119	103	270	262	190	143	89	295	2035
Total number of pods damaged by:													
rodents	76	44	18	27	41	28	62	85	61	68	16	63	589
%	34.5	28.2	21.4	26.0	34.5	27.2	23.0	32.4	32.1	47.6	18.0	21.4	28.9
civet	1	1	—	4	2	—	1	—	—	—	—	—	9
%	0.5	0.6	—	3.8	1.7	—	0.4	—	—	—	—	—	0.4
monkey	—	—	—	—	—	—	—	—	3	2	—	2	7
%	—	—	—	—	—	—	—	—	1.6	1.4	—	0.7	0.3

\* Including the pods damaged by mammals.

For rodent damage:  $X^2$  df 11 = 52.78;  $P < 0.001$  due to high level of damage in Aug. 1977.

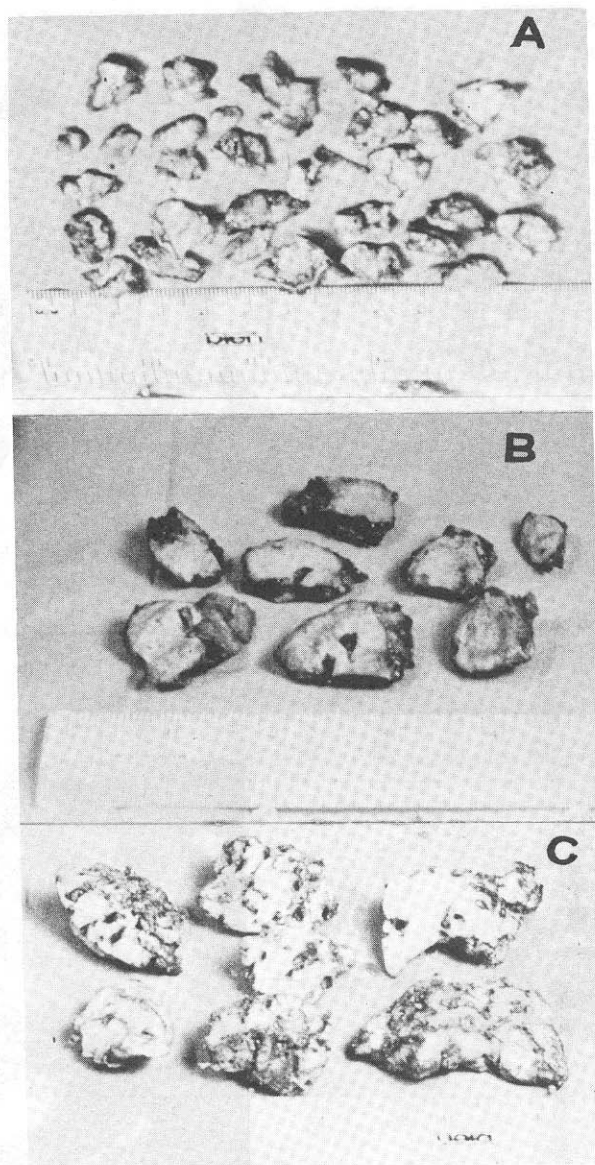


Fig. 2. Bits of husk removed by A. rodent, B. monkey and C. civet while breaching the cocoa pod.

## Results

### *Pest species observed and types of damage*

Three rodent species, the Western Ghats squirrel (*Funambulus tristriatus* Waterhouse), the South Indian palm squirrel (*F. palmarum* Linnaeus) and the black rat (*Rattus rattus* Linnaeus), the palm civet (*Paradoxurus hermaphroditus* Pallas) and the bonnet monkey (*Macaca radiata* Geoffroy) were observed feeding on cocoa pods in gardens in Karnataka. All the species observed bit through the outer husk of mature pods to reach the mucilage or beans inside and in doing so left tooth marks on the pods (Fig. 1). The tooth marks on pods that had been damaged by rats could not be distinguished from those on pods that had been damaged by squirrels, but those on pods that had been damaged by one of the rodent species were clearly distinguishable from the marks on pods that had been attacked by either monkeys or civets. When rodents were responsible, the marks of their comparatively small paired incisors (each pair being only about 3 mm wide) could be seen around the periphery of the gnawed hole; but when monkeys had bitten through the husk the marks of their 5 mm wide incisor teeth showed. Civet damage was different; the damaged area showed the distinctive scores made by canine teeth.

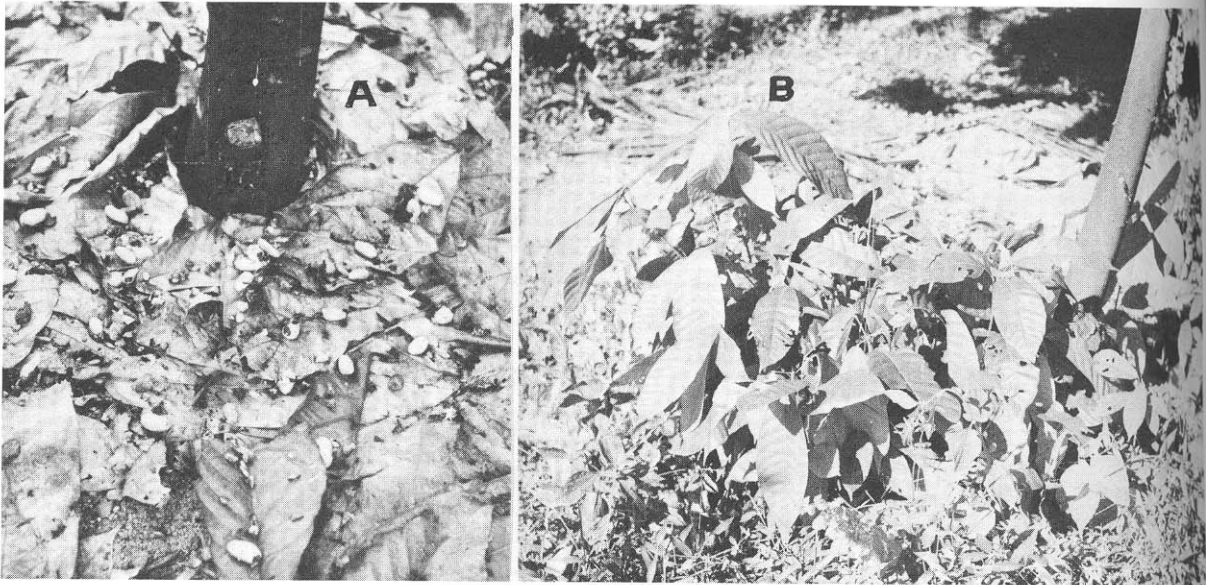


Fig. 3. A. discarded and scattered cocoa beans, after their mucilage had been consumed by rodents, near the base of a cocoa plant and B. seedlings germinated out of these beans.

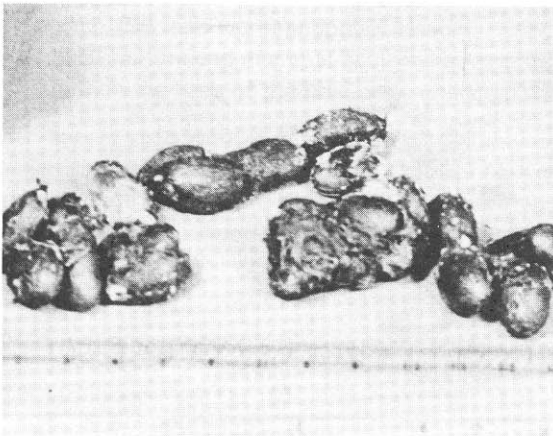


Fig. 4. Cocoa pod damaged by monkey. Note the bark of the tree removed along with the pod.

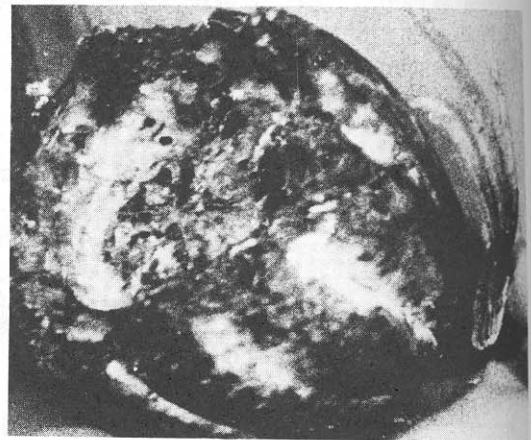


Fig. 5. Cocoa beans collected from the faeces of a palm civet.

#### Assessment of damage

About 30% of the mature cocoa pods that were harvested in 12 months in the four South Kanara gardens had been damaged by mammals, the majority (29%) by rodents and only 0.4% and 0.3% respectively by civets or monkeys (Table 1). While rodent damaged pods were found in all the monthly samples from the four gardens, civet damaged pods were found on only five occasions and monkey damaged pods on only three. Further, the civet damaged pods were found only in the first two gardens whereas the monkey damaged pods were found only in the third garden. The fourth garden was free from both civet and monkey damage. The percentages of rodent damaged pods varied significantly (Chi squared with 11df = 52.7;  $P < 0.001$ ) by months, principally because almost 50% of the crop was damaged in August compared with 18% in September.

In the samples collected in Kerala and Tamil Nadu, most of the damage found was also attributable to rodents (Table 2). Rodent damage was not recorded in all the gardens that were surveyed but was found in some gardens in every district. Those gardens which were free from rodent damage during the first visit were free from such damage during the second visit also. Further, such gardens were either recently established (3–4 year old gardens) or were

TABLE 2. DAMAGE CAUSED BY MAMMALIAN PESTS TO COCOA IN KERALA AND TAMIL NADU (BY SPOT OBSERVATIONS IN 27 GARDENS)

District	Month and year	Total gardens observed	Gardens free from rodent damage	Gardens free from civet damage	Total number of cocoa pods						
					harvested*	damaged by rodents		damaged by civets		percentage variation	
						actual numbers	average	percentage	variation		actual numbers
Kozhikode	June and Sept. 1977	6	1	5	1049	69	6.6	0-50.0	4	0.4	0-4.2
Palghat	June and Sept. 1977	4	2	2	271	44	16.2	0-25.0	20	7.4	0-10.9
Trichur	June and Dec. 1977	3	1	3	155	40	25.8	0-50.0	—	—	—
Cannanore	Dec. 1977 and Feb. 1978	3	—	1	304	92	30.3	23.9-47.1	39	12.8	0-27.6
Ernakulam	Dec. 1977	1	—	1	39	20	51.3	51.3	—	—	—
Kottayam	Dec. 1977	3	—	3	84	28	33.3	11.1-48.0	—	—	—
Quilon	Dec. 1977	2	1	2	177	26	14.7	0-23.9	—	—	—
Trivandrum	Dec. 1977	3	1	1	125	10	8.0	0-37.5	7	5.6	0-12.5
Kanyakumari	Dec. 1977	2	—	2	39	12	30.8	18.5-50.0	—	—	—
Total		27	6	20	2243	341	15.2	0-51.3	70	3.1	0-27.6

\* Including the pods damaged by mammals.

isolated from other gardens in that locality. By contrast no monkey damage at all was recorded, but the civet damage where it occurred was at a higher level than in Karnataka.

### Discussion

The results of the damage surveys indicate that rodents, probably *R. rattus*, *F. tristriatus* and *F. palmarum*, together cause a significant amount of damage in cocoa gardens in South India. Best estimates of the amount of damage suggest that between 15% and 30% of the mature cocoa pods are attacked, although some gardens may lose up to 50% of their crop at various times. Variations in the amounts of damage that occur probably reflect variations in the sizes of the rodent populations as well as changes in the availability of alternative foods. However the absence of damage in some of the gardens surveyed in Kerala and Tamil Nadu, in areas as likely to be infested as those in which damage was recorded, suggests that Everard (1968) and Williams (1973) are correct in their contention that rodents have to learn the habit of feeding on cocoa.

Civets and monkeys appear to be, by comparison with the rodents, minor pests although in some areas of Kerala the civets were responsible for serious damage in 4 of the 25 plantations that were visited.

### Acknowledgements

We are very grateful to Dr N. M. Nayar, Director, Central Plantation Crops Research Institute, Kasaragod and Mr K. Shama Bhat, Agronomist, CPCRI, Regional Station, Vittal for providing facilities to work. Thanks are also extended to all the farmers who kindly allowed the use of their fields for this study. One of us (S.K.B.) is grateful to the Council of Scientific and Industrial Research, New Delhi, for financial support.

### References

- ABRAHAM, E. V. and PADMANABHAN, M. D. (1967). Pests that damage cacao in Madras. *Indian Horticulture* 11 (3): 11–12.
- BAVAPPA, K. V. A. (1977). Plantation Crops Industry. *Journal of Plantation Crops* 5: 1–10.
- EVERARD, C. O. R. (1968). *A report on the rodent and other vertebrate pests of cacao in Western Nigeria*. pp. 123. Research Division, Ministry of Agriculture and Natural Resources, Moor Plantation, Ibadan, Nigeria.
- GRATZ, N. G. and ARATA, A. A. (1975). Problems associated with the control of rodents in tropical Africa. *Bulletin of World Health Organisation* 52: 697–706.
- QUESNEL, V. C. and LOPEZ, A. (1975). Woodpecker damage. *Annual Report on Cacao Research, 1975*. pp. 25–26. University of West Indies, Trinidad.
- STAPLEY, J. H. (1972). Principal pests of crops in the Solomon Islands. *PANS* 18: 192–196.
- TAYLOR, K. D. (1972). Rodent problems in tropical agriculture. *PANS* 18: 81–88.
- URQUHART, D. H. and WOOD, G. A. R. (1954). *Report on a visit to the cocoa zone of Bahia, Brazil*. pp. 43. Cadbury Brothers Limited, Bournville.
- URQUHART, D. H. (1955). *Report on the cocoa industry in Sierra Leone with notes on the cocoa industry in the Gold Coast*. pp. 43. Cadbury Brothers Limited, Bournville.
- WILLIAMS, J. M. (1973). Rat damage assessment and control in cocoa. *Fiji Agricultural Journal* 35: 15–25.
- WOOD, G. A. R. (1964). *Cocoa growing in India*. pp. 27. Cadbury Brothers Limited, Bournville.