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Research Articles

ECOLOGY, BIOLOGY AND CONTROL OF BLACK RAT *RATTUS RATTUS* IN MINICOY ISLAND

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ABSTRACT

Ecological and biological studies on the predominant rodent pest of coconut in Minicoy Island, the black rat, *Rattus rattus*, revealed a high level of infestation. Rats belonging to age class 111-140 g predominated the free living populations. The male : female sex ratio was 43.3 : 56.8 with the more pronounced predominance of female sex in higher age groups (140 - 200+g). The average prevalence of pregnancy was 21.3 per cent, the maximum being in case of females over 171 g. Number of embryos per pregnant female and per female were 5.92 and 0.93 respectively.

Wooden traps and sherman metal traps were found effective in capturing adult and sub-adult rats respectively, while wire cages were comparatively less successful. With the increase in palm density/ha, a rise in rodent infestation levels and relative damages were observed. Ten times more rodents were trapped on the crowns of coconuts than at ground level, suggesting to undertake poison and trapping operations on the crowns of coconut palms rather than at ground level.

Copra followed by insects and other vegetation were the preferred food items of *R. rattus* as revealed from analysis of stomach content. Rats infesting coconut crop in residential habitat were found to feed on paddy in storage also. Results of present studies have been compared with *R. rattus* populations infesting coconut fields in Pacific Islands.

INTRODUCTION

The black rat, *Rattus rattus* (Linnaeus) is the major vertebrate pest of coconut crop as well as stored grains in Lakshadweep island including Minicoy. Ecology, biology and control of this predominant pest were studied in the Minicoy island and the results are presented in this paper.

MATERIALS AND METHODS

The experimental rodents *(R. rattus)* were trapped from the coconut plantations of Minicoy island (73°-00'E-10°-18'N) during January 1983. The rats were collected before, during and after rodent control operations carried out with nine rodenticides in crop fields. Three types of traps, *viz.*, sherman

trap (20 × 8 × 8 cm), wooden 'live' trap (30 × 11 × 10 cm) and wire cages (40 × 18 × 16 cm) were used for this field study. To find out the nocturnal movement of rodents and suitable place for poison baiting in coconut plantation, traps were placed on the crowns as well as at the base, of the infested coconut trees. Relationship between density of palms/ha and levels of rodent infestation was worked out by operating equal numbers of traps in fields having different densities of palms. To evaluate effectiveness of traps and population levels of rodents, trap indices were calculated following Barnett and Prakash (1975). All trapped rodents were identified after Ellerman (1966). To find out age structure, all animals were weighed. All specimens were examined by standard autopsy procedure (Prakash, 1971) to determine prevalency of pregnancy in various age classes, sex ratios and reproductive potential. The feeding behaviour was analysed through stomach content analysis of the rats captured, following Rana and Advani (1981). The contents were segregated to study difference in food composition of *R. rattus* inhabiting coconut palms in fields and in residential areas.

RESULTS AND DISCUSSION

A higher level of *R. rattus* infestation was recorded in the coconut plantations of Minicoy as indicated by average trap index of 18.75 rodents/100 traps/24 hours. About 55 per cent of coconuts were estimated to be damaged by rodents (Advani, 1984), compared to 24.7% damage inflicted to coconut crop in Kerala and Karnataka (Advani, 1982). Among various age classes of *R. rattus*, the rats belonging to 111–140 g group were collected in highest relative abundance (Table I).

For entire *R. rattus* populations as well as among all age classes, females predominated males in the sex ratio, enabling this species to maintain and regulate higher population levels. Watson (1950), Davis (1947) and Harrison (1951) also found excess of females over males in *R. rattus* occurring in other countries. However, Jackson (1962) found males in slight preponderance over females in *R. rattus* populations infesting coconut fields in Ponape and adjacent islands in the Pacific region. Gradual reduction of males in favour of female populations from lower to higher age groups was also observed by Ecke (1955) in *R. rattus* of South West Georgia.

The average litter size as well as the prevalence of pregnancy were much higher in case of *R. rattus* collected from Minicoy (Table II), in comparison to similar species in Pacific islands, having 3. 8 litters/female and 15. 7 per cent pregnancy incidence (Jackson, 1962). However, in Indian desert, where *R. rattus* is a house and godown pest, annual prevalence of pregnancy (25. 0%) and mean litter size (6. 60 ± 0. 10) (Rana, Advani and Soni, 1983), were higher to those of *R. rattus* in Minicoy. This may perhaps be a biological adaptation among rodent populations inhabiting desert to compensate the loss in their populations due to frequent dangers of drought, food shortages and climatic extremes (Prakash, 1971).

Table I. *Weight composition of* Rattus rattus *population from consecutive trappings at various locations of coconut fields in Minicoy island*

Sex	N	Percentages of population in different weight classes						
		50 g	51–80 g	81–110 g	111–140 g	141–170 g	171–200 g	200+g
Male	330	11.52	16.97	17.27	22.73	14.55	12.12	4.85
Female	433	9.70	15.70	15.70	19.17	18.71	14.55	6.47
Entire rat population	763	10.48	16.25	16.38	20.71	16.91	13.50	5.77

Table II. *Sex ratios and reproductive rates (female fertility) in various age classes of free living populations of* Rattus rattus

Age class (in g)	Male	Female	% Female	No. of pregnant females	Pregnancy (%)	Embryos/ pregnancy ♀	Embryos/ ♀
50	38	42	52.50	–	–	–	–
51– 80	56	68	54.84	–	–	–	–
81–110	57	68	54.40	7	11.66	5.28	0.54
111–140	75	83	52.53	10	13.33	5. 7	0.68
141–170	48	81	62.79	15	18.51	5.66	1.04
171–200	40	63	61.17	23	36.50	6.21	2.26
200 +	16	28	63.64	13	46.42	6.23	2.89
Total	330	433	56.75	68	21.31	5.92	0.93

The perforation in vagina (indicating participation in sexual activity by females) started at an early age (70 grams) than rats of Ponape island which attain sexual maturity at the body weight of 90 grams (Jackson, 1962).

For adult rats (>80 g) trap effectiveness of wooden 'live' traps (trap index (T.i) - 30.23) was much higher to that of metal sherman traps (T. i–20.35; $P < 0.05$) and wire cages (T.i–10.23; $P < 0.01$). For trapping sub adult rat population, trap success of sherman traps (T.i–15.32) was much higher ($P<0.01$) than that of wooden live traps (T.i–4.53). Higher effectiveness of wooden live traps in capturing adult rodents, is due to the ability of heavier rats to pull the bait (banana/ coconut piece) fixed in the hook of trap, which facilitates front door to close whereas, sherman 'live' trap (baited with peanut butter on its raised platform) will close even at the weight of 10 g, resulting into effective trapping of more sub adult rats.

Population levels of rodents as well as per cent rodent damage increased parallel to the increase in coconut palm population per hectare (Table III). This may be due to availability of more protected environment and continuous uninterrupted access to rodents (for frequent inter sexual interactions) in the denser plantations in comparison to sparse ones.

Table III. *Population levels of* Rattus rattus *on crowns of coconuts and at ground level (bases of palms) in relation to palm density*

Criteria	Palm density (per ha)					
	150	151–180	181–210	211–240	240 +	Mean
Trap Index						
On crowns	13.20	15.48	19.11	18.89	23.42	20.66
On base	3.04	2.84	1.22	1.57	1.92	2.11
Trap index–Total	16.24	18.32	20.33	20.46	25.34	
% Population						
On crown	81.28	85.43	93.99	92.32	92.37	90.73
On base	18.71	15.67	6.00	7.67	7.57	9.26
Rodent damage (%)	45.06	48.32	50.32	54.23	56.34	

In Pacific islands (Storer, 1962) and Fiji (Williams, 1971), besides infesting crowns of coconut palms, rodents construct and live in burrows also, the poison baiting or trapping operations are carried out on the coconut crowns as well as at the ground level. However, in case of Minicoy island, trapping of about 90 per cent rodent populations on the crowns of palms (Table III) and absence of any rodent burrow in soil of coconut fields, suggest that rodent control operations (through trapping and/or poison baiting) should be carried out only on the palm crowns to achieve better control. Absence of any rodent burrows at soil surface in Minicoy may be due to the shallow soil depth (1.2 m) which is further lined by hard bed of lime, making it difficult for rats to make their extensive and deep burrow systems.

Presence of paddy remains in the stomach of *R. rattus* captured from the coconut plantations in or around residential habitat (Table IV), indicate that in addition to coconut (80% of total food), the rats periodically visit nearby houses also, to feed upon stored grains and other food stuffs. Keeping in view this finding and occurrence of same species *(R. rattus)* in coconut fields as well as houses it is suggested to undertake simultaneous rodent control operations in crop as well as houses to achieve effective control. Presence of insects in the stomach of *R. rattus* collected from both habitats indicate their adaptation to survive upon additional food sources. Moreover, insects which contain rich protein (Phelps, Struthers and Moyo, 1975) also help rodents to maintain higher reproductive and infestation rates through supporting pregnancy and lactation among females (Richardson, Codwin and Canman, 1964).

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Table IV. *Stomach content analysis of rodents trapped from two habitats of coconut crop*

Food item	Habitat exclusive coconut crop (N = 50) (%)	Coconut crop near house (N = 50) (%)
Plant material		
Coconut kernel	85.67	79.80
Other vegetation	5.65	6.70
Paddy	–	4.52
Insects		
Coleoptera	4.32	3.44
Hymenoptera	2.31	2.32
Miscellaneous	2.05	4.52

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