

**ECOLOGY OF DUNG BEETLES (SCARABAEIDAE:  
COPRINAE) IN TWO VILLAGES OF  
WEST BENGAL**

*By*

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(With 3 Tables)

INTRODUCTION

Beetles of the subfamily Coprinae are primarily adapted to eating and burying the solid waste products of mammals, particularly the excrement of man and bovids. Because of the high concentration of bovids and man on or near the grasslands of the northern hemisphere, the population of dung beetles is highest there and the activities of the beetles are of extreme importance (Halffter and Matthews, 1966).

The sudden introduction of new species, such as cattle and sheep, into an area disrupts the flow of energy in the local ecosystem. This is particularly evident in Australia, where the indigenous species of dung beetles are not adapted to the dung of exotic mammals. The result, in part, is that 80% of the nitrogen contained in the fecal matter is lost into the air, rather than returned to the soil to replenish supplies needed for further plant growth. In addition, if fecal matter remains on the soil surface, the nutrients contained in it reenter the soil at a slow rate. Burial of the excrement by dung beetles not only speeds up and increases the efficiency of nutrient recycling, but also increases the porosity and water holding ability of the soil (Bornemissza, 1960; Gillard, 1967). These combined activities of dung beetles result in greatly increased plant growth and yield (Bornemissza and Williams, 1970).

The aim of this study, presented in part here, is to determine the role of dung beetles in a rural area of West Bengal, which is densely populated by man and his domestic animals.

#### METHODS

The study was done in two villages (Singur and Nasibpur) located 4km NNW of Calcutta in an agricultural area. From January 1971 to February 1972 pit-fall traps were set out twice weekly in each of four different habitats: (1) a tree-shrub habitat with closed canopy and thick undergrowth, (2) a bamboo habitat with closed canopy and a thin layer of leaf litter on the surface of the ground, (3) a banana grove with open canopy and a bare ground surface, and (4) a grazed grass habitat with no canopy cover. Initially six traps were placed in each habitat, each baited with 25 gm of one type of dung: human, monkey (*Presbytis entellus*), dog, goat, cow and buffalo. Starting in mid-August two more traps were added to each trap site: one with elephant dung and one without dung to serve as a control. Position of the bait was rotated randomly among the traps to eliminate position effects. The traps were set between 1400 and 1500 in the afternoon and were picked up the following day between 0830 and 0930. The beetles were removed from the traps, labeled, sorted and identified to species and sex where possible.

#### RESULTS

The primary peak in abundance of dung beetles in the traps occurred in June, just prior to the heavy monsoon rains of July and August. A secondary peak in abundance occurred in October after the rains had subsided and the watertable dropped below the soil surface. The beetles were most active during the hot wet months and least active during the cold dry months (Table I). Almost half of the beetles were trapped

TABLE I.— Per Cent of total Scarab beetles caught in year occurring in each season and in each habitat\*

Seasons	Tree Shrub	Bamboo Grove	Banana Grove	Grassy Plot	Total Per Cent
March—					
May	5.2	19.2	4.1	1.8	30.3
June—					
August	10.0	22.3	9.8	2.7	44.8
September—					
November	4.1	6.5	7.5	2.9	21.0
December—					
February	1.0	0.6	1.5	0.8	3.9
Total					
Per Cent	20.2	48.5	23.0	8.3	100.0

\* Based on 35 Scarab species and 10,553 individuals.

in the bamboo groves and most of these were caught during May, June and July. The tree-shrub habitat and the banana grove habitat each had about 20% of the beetles, whereas the grassy plots had only 8%.

During the period of March 1971 to February 1972 over 10,500 beetles were captured. Many of these beetles (44%) were attracted to the traps baited with human feces and 21% were attracted to dog feces. Monkey dung attracted 16%, goat dung 10%, cow dung 6% and buffalo 3%. During the period of August 1971 to January 1972, when the two additional traps were used, over 55% of the beetles were attracted to human dung and less than 1% were caught in the control trap.

Thirty-five species of scab dung beetles were captured and identified (Table II). Of these, 14 were most abundant in the bamboo grove, 10 in the banana grove, and 8 on the grassy plot. No species had its greatest density in the tree-shrub site. The species which were most abundant in the bamboo grove tended to have large populations, whereas those that were most abundant on the grassy plot had small populations or were rare.

More species were attracted to cow dung (29) than to any other dung; however, only 7 of these chose cow dung as their first choice and these species tended to be rare or low in abundance. Human dung attracted 27 species, 14 of which were most abundant of human dung, and all these species tended to have high populations. Monkey and dog dung attracted 24 and 23 species respectively, but none chose monkey dung as their first choice, and only one chose dog dung as its first choice. Eight of the 26 species collected on goat dung chose it as their first choice. Buffalo dung attracted 24 species, but all of these, except one, occurred primarily on the dung of another mammal.

In terms of wet weight 8 of the 35 species accounted for almost 100% of the total beetle biomass and will be discussed below in greater detail. None of the 35 species appeared to be in direct competition and this is exemplified by 8 species shown in Table III. Two of these species were most abundant in the premonsoon months, but one, *Gymnopleurus aethiops*, occurred only in bamboo groves and was attracted to cow dung. The other *Catharsius pithecius*, occurred primarily in banana groves and was attracted to human dung. Five species had their peak abundance during the months of June and July, but only three of these chose the same dung (human) as their first choice: *Onthophagus unifasciatus*, *O. orientalis*, and *Caccobius unicornis*. The first species was most abundant in the banana habitat, whereas the latter two were most abundant in the bamboo habitat. *O. orientalis* is more than twenty times larger (in terms of wet weight) than *C. unicornis* and thus competition

TABLE II.— Per Cent of Scarab dung beetles collected from each dung type and in each habitat between March 1971 and February 1972.

Genus and Species	Dung Types							Habitats				Notes
	Human	Monkey	Dog	Goat	Cow	Buffalo	Total	Tree-Shrub	Bamboo Grove	Banana Grove	Grassy Plot	
<i>Caccobius</i>												
<i>aterrimus</i>	—	—	—	—	—	100	1	—	—	—	100	
<i>diminutivus</i>	—	—	—	—	—	—	1	—	—	—	100	(1)
<i>tortus</i>	4	16	—	36	24	20	25	—	—	4	96	* (2)
<i>unicornis</i>	48	25	22	3	2	1	3022	20	55	22	4	*
<i>vulcanus</i>	48	7	7	14	15	10	59	3	36	61	—	* (2)
<i>Catharsius</i>												
<i>molossus</i>	61	18	8	5	5	2	905	20	57	15	8	*
<i>pithecius</i>	36	27	11	11	11	4	55	—	51	4	46	*
<i>sagax</i>	36	9	—	27	18	9	11	—	46	36	18	
<i>Copris</i>												
<i>sinicus</i>	4	13	6	52	16	9	403	23	46	21	9	*
<i>Drepanocerus</i>												
<i>setosus</i>	—	—	—	—	100	—	1	—	—	—	100	
<i>Gymnopleurus</i>												
<i>aethiops</i>	10	7	7	21	42	13	150	—	100	—	—	*
<i>miliaris</i>	43	14	29	14	—	—	7	—	86	—	14	
<i>Oniticellus</i>												
<i>spinipes</i>	33	33	—	—	33	—	3	33	33	33	—	
<i>Onitis</i>												
<i>philemon</i>	—	—	—	—	100	—	1	—	—	—	100	
<i>Onthophagus</i>												
<i>bonasus</i>	—	—	—	75	25	—	4	25	—	50	25	
<i>gazella</i>	9	22	2	36	25	7	59	—	3	39	58	*

Genus and Species	Human	Monkey	Dog	Goat	Cow	Buffalo	Total	Tree-Shrub	Bamboo Grove	Banana Grove	Grassy Plot	Notes
<i>Caccobius</i>												
<i>rectecornutus</i>	9	—	9	—	46	36	11	9	82	9	—	
<i>bifasciatus</i>	44	6	48	1	1	1	2134	34	23	40	5	*
<i>tragus</i>	48	13	6	16	12	6	69	15	28	19	39	*
<i>vigilans</i>	69	7	10	7	7	—	29	28	69	3	—	*
<i>crassicollis</i>	46	27	4	22	1	—	74	7	31	62	—	*
<i>centricornis</i>	40	29	5	17	4	6	324	16	37	39	9	*
<i>cervus</i>	24	13	24	25	9	5	113	12	21	35	32	*
<i>dama</i>	8	—	—	25	42	25	12	8	42	42	8	
<i>duporti</i>	12	11	4	37	21	17	346	30	54	15	1	*
<i>luridipennis</i>	—	9	1	62	17	10	87	12	78	5	6	*
<i>malabarensis</i>	100	—	—	—	—	—	1	—	100	—	—	
<i>mopsus</i>	—	—	—	42	42	17	12	17	25	50	8	
<i>orientalis</i>	53	24	7	12	2	2	1332	24	54	20	2	*
<i>ramosellus</i>	34	16	16	19	9	6	232	4	3	45	48	*
<i>spinifex</i>	67	22	11	—	—	—	9	22	11	67	—	
<i>triceratops</i>	7	—	—	57	24	13	46	17	20	35	28	*
<i>turbatus</i>	1	3	2	28	50	18	119	3	88	7	2	*
<i>unifasciatus</i>	65	1	33	—	1	1	713	2	29	47	23	*
<i>bengali sp.</i>	27	6	4	12	37	15	186	8	90	2	1	*(3)

\* Significant difference in dung preference when tested with Chi Square at P=.001

(1) Collected on elephant dung

(2) Only distribution of males is shown.

(3) New species (Gordon and Oppenheimer, in prep.)

TABLE III .—Comparison of the eight most important dung beetles

Species	Total Number	Average Weight (gm)	Per Cent Total Biomass	Seasonal Abundance (%)				Per Cent at Human dung	Dung of choice	Habitat first choice
				Mar.— May	June- Aug.	Sept.- Nov.	Dec.- Feb.			
<i>Catharsius molossus</i>	905	2.9200	83	15.3	23.7	55.9	5.2	61.3	—	Bamboo
<i>Copris sinicus</i>	401	0.3895	5	24.1	48.9	22.6	4.5	3.7	Goat 52.0	Bamboo
<i>Onthophagus orientalis</i>	1332	0.0873	4	26.0	58.5	14.3	1.3	52.6	—	Bamboo
<i>Gymnopleurus aethiops</i>	150	0.6250	3	70.3	29.7	0.0	0.0	10.0	Cow 42.0	Bamboo
<i>Onthophagus bifasciatus</i>	2134	0.0269	2	25.9	38.9	27.2	8.0	44.0	Dog 48.0	Bamboo
<i>Catharsius pithecius</i>	55	0.6240	1	52.7	41.8	0.0	5.5	36.0	—	Banana
<i>Onthophagus unifasciatus</i>	713	0.0419	1	30.9	56.3	11.4	1.4	65.9	—	Banana
<i>Caccobius unicornis</i>	3022	0.0038	1	38.2	44.0	15.9	1.8	48.0	—	Bamboo

between these two species would be minimal. The last species, *Catharsius molossus*, was the largest species captured in the pit-fall traps and was the only one with a peak abundance in October. A single individual of this species was capable of burying over 100 gm of human feces in a matter of minutes and could ingest more than one gram in a twelve hour period.

#### DISCUSSION

The differences in the abundance of dung beetles present in the four habitats probably can be attributed to differences in microclimate and to the availability of suitable dung. The closed canopies of the tree-shrub and bamboo habitats eliminated the high day-time soil surface temperatures that occurred in the banana and grass habitats. The thick understory in the tree-shrub habitat probably prevented deposition of excrement there, whereas bamboo habitats were open underneath and were one of the main defecation areas for the human inhabitants. Cattle and goats were also frequently tethered in the bamboo groves. Eight of the 14 species that were most abundant in the bamboo habitat were attracted primarily by human dung, and these species tended to have the largest populations. On the other hand, the eight species which had their highest abundance in the grass habitat were species with low populations and were attracted primarily to the dung of cows or goats.

Although this study was done in an agricultural area with an abundance of live stock, the size of the human population was four times greater than of cattle which was the most abundant domestic animal in the area (Odend'hal, 1972). Most of the people defecated outside, mostly in the fields and bamboo groves (G. Schad, pers. com.). Cattle dung though abundant was rarely available to dung beetles as it was collected by the villagers to use as fuel after being dried. Thus although more species were attracted to cow dung than to human dung, the greater availability of human dung appears to have selected for larger populations of beetles that fed on it. Most of the species captured in this study were euryphagous in that they were attracted to more than one species, but none-the-less they showed definite preferences. Laboratory studies done with *Catharsius molossus* collected in the field in Uttar Pradesh obtained similar results (Upadhyaya and Tripathi 1973). It has previously been reported that the preferences exhibited by a species in a particular locality may reflect the availability of different types of excrement in the area (Halffter and Matthews, 1966). This suggests three possible strategies: (1) a species may be genetically polymorphic for dung preference, (2) adult beetles tend to feed on the same type of dung that was provided for them by their parents during larval development, or (3) that adult beetles learn which

dung types are most available and thereafter seek them out. All three might be used.

The high attractiveness of monkey and dog dung to the beetles probably is related to the similarity of the feeding habits of these two animals to those of man, as the actual availability of monkey (Oppenheimer, 1973) and dog dung in the area was very low. Dogs are omnivores and dung is similar to that of man (Halffter and Matthews, 1966). The monkeys are primarily leaf and fruit eaters, but are phylogenetically closely related to man. It is possible that many of the dung beetle species that now are primarily attracted to human excrement, were at one time primarily attracted to monkey excrement. In this study the excrement of these three mammals was attractive to some of the same scarab species.

Goats made up 8% of the mammal population and attracted 9.7% of the beetles. Buffalo dung attracted more beetles than might be expected, but most of these beetles were from species that were primarily attracted to cow dung.

The seasonality in the activity of the dung beetle population has some very important implications. The beetles are most active in burying excrement at the time of the year when flies are laying their eggs and maggots are feeding on excrement. The same species of flies that were laying eggs on human feces during this study were captured in the market place feeding and walking on food to be ingested by the villagers. Human viruses were isolated from some of these flies (Graves and Oppenheimer, 1975). Flies are implicated in many ways in the transmission of agents pathogenic to man and his domestic animals (Graham-Smith, 1913; Gregorio *et al.*, 1972). The removal of excrement from the soil surface by dung beetles has been shown to be a very effective means for controlling fly populations (Boremissza, 1970; Lingquist, 1935). The burying activity of these beetles can also directly reduce the number of parasitic larvae infective to domestic animals (Fincher, 1973; Reinecke, 1970). Helminth eggs and protozoan cysts, contained in fecal matter, are reported to be destroyed when ingested by the medium to small dung beetles (Miller, 1961; Miller *et al.*, 1961).

On the other hand, certain species of dung beetles are known to be intermediate hosts for parasites of domestic animals (Balthasar, 1963; Fincher *et al.*, 1969; Halffter and Matthews, 1966). But it would appear that the benefits to be derived from the activities of dung beetles may vastly outweigh any detriment.

The introduction of insecticides into rural areas for control of crop pests may result in decreased soil fertility and crop yield, and increased public health problems due to the elimination or reduction of dung

beetle populations. Hopefully further research on the behaviour and ecology of dung beetles will lead to a greater awareness of the importance of these animals and their value to man.

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#### SUMMARY

Thirty-five species of scarab dung beetles were caught in pitfall traps baited with the feces of man, monkey (*Presbytis entellus*), dog, goat, cattle and buffalo between March 1971 and February 1972 in four kinds of habitats in two West Bengal villages, 40 km NN W of Calcutta. The beetles were most abundant in June, occurred most frequently in bamboo groves, and were attracted most (44%) to traps baited with human feces. Cattle dung attracted the most number of species (29), but only 6% of the beetles. None of the species appeared to be in direct competition.

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