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by
M. L. NARANG
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Issued by the Director
Zoological Survey of India, Calcutta

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Introduction

It is a well-known fact that birds play an important role in relation to agriculture. There is a general tendency to dwell on the harm they do, presumably because most land birds feed on grains, vegetable matter and fruits. The fact that most of them also feed on insects larvae, imagoes and adult insects, pests of agriculture and horticulture often goes unnoticed. Moreover their role as pollinating and seed dispersal agents is not fully realised or recognised. It will, therefore, seem unjust to brand them as 'harmful' without evaluating the amount of good done by them compared to the harm they do. Mynas (Family: Sturnidae), the subject of this study, are typical land birds with all the foregoing attributes.

Historical background

Economic ornithology caught the fancy of ornithlogists as early as latter half of the nineteenth century. Credit goes to the American ornithologists for initiating these studies. Prof. Jenks (in Kalmback 1934) is supposed to have set the ball rolling in 1858 with his studies on the stomach contents of Robins. Samuel Augheys (1878) wrote about the food of the birds of Nebraska. Kalmback (1934) reviewed the early history of food habits of birds and he has credited Prof. S. A. Forbes (1880) with being the founder of modern food habits studies, because of his publication on the food of Illinois birds. Other workers of the United States Department of Agriculture like Fisher (1893), Barrows and Schwarz (1895), Beal (1897) and Judd (1900) also contributed substantially towards the food habits studies of American birds.

In India, Jerdon (1862) was perhaps the first ornithologists to write about the food of birds. His (Jerdon, 1862) 'Birds of India' contained delightful field notes, including their food and feeding habits. Our present-day knowledge of the food of birds in India is largely based on the findings of Mason and Lefroy (1912). They (Mason and Lefroy, 1912) analysed the food of 110 species of birds based on 1325 stomach contents, collected at Pusa, Bihar. Their findings added valuable information on the food of birds in India and established their economic importance. D'Abreu (1918) studied the food of birds in the Central Provinces. The next work of importance which has a bearing on the

history of economic ornithology in India is that of Baker (1922-29), who complied the information then available on the food of most of the Indian birds. Whistler (1928) and Fletcher and Inglis (1936) also provided some information on the food habits of birds. Salim Ali (1936) pointed out the need for studying the biology of Indian birds in relation to agriculture and forestry. Hussain and Bhalla (1937, 39) of the Panjab Agricultural University, Lyallpur, studied the food of 93 species of birds of Lyallpur, based on stomach analysis. Theirs (Hussain and Bhalla, 1937) was presumably the last significant contribution to the field of economic ornithology in this country, although a number of notes on the food habits of birds have appeared from time to time. Bates (1943), Beresford (1944) and Wright (1959) added to our knowledge of the subject. Samuel (1949) described the Indian House Sparrow as a serious pest of orchard and wheat in Baluchistan. Faruqui et al (1960) studied the seasonal food of three species of game birds of India and Pakistan. Ridley (1954) and Abdulali (1964) made observations on the diet of Flamingoes. Some recent contributions to the food habits of Indian birds are by Kirkpatrick (1953) Mukherjee (1963), Sengupta and Brahmachary (1968), Pillai (1968), Ramzan & Toor (1972, 73), Toor & Ramzan (1974), Simwat & Sidhu (1974, 75), Gupta (1975), Mukherjee and Saha (1975), Moeed (1976) and Mathew et al (1980).

All these workers, however, have made a qualitative assessment of food of birds and have completely ignored the quantitative assessment of the food of birds, an aspect which is very important to determine the economic status of birds. Mukherjee (1969-76) was perhaps the first in India to make a quantitative assessment of the food of birds. He made a gravimetric assessment of the 24 species of water birds of the Sunderbans (West Bengal).

Previous work

As already stated, Jerdon (1862) gave brief accounts of food of various species of Mynas. He dealt with all the five species covered in this study, viz., *Sturnus pagodarum* (Gmelin), *Sturnus contra contra* Linnaeus, *Acridotheres tristis tristis* (Linnaeus), *Acridotheres ginginianus* (Latham) and *Acridotheres fuscus fuscus* (Wagler). He based his results purely on field observations and did not carry out any analysis of the stomach contents. His account of Mynas gave information on the feeding time, feeding areas, habits and habitat of Mynas. His observations

on food items were restricted to general groups of plants and animals like grains, fruits and insects. Whereas groups of insects like grasshoppers and bugs etc. were mentioned, identification of species involved was not attempted. Oats (1889) in his 'Fauna of British India' made a passing reference to the feeding places of these species of Mynas. Mason and Lefroy (1912) carried out the stomach analysis of three species of Mynas dealt with in this study namely, *Acridotheres tristis tristis* (Linnaeus), *Acridotheres ginginianus* (Latham) and *Sturnus contra contra* Linnaeus. They identified and counted the insects and caterpillars found in the stomachs of these birds. But excepting *Acridotheres tristis tristis* (Linnaeus) the number of stomachs they analysed was not large enough for ornithologists to come to any conclusion. Moreover sampling of *Sturnus contra contra* Linnaeus and *Acridotheres ginginianus* (Latham) were limited to one half of the year only. The samples of *Acridotheres ginginianus* (Latham) were collected just for two months i.e., August 1908 and June 1909, and in all less than ten birds were examined.

Most of the later workers fared no better. Baker (1926) just summerised the information then available for all the five species of Mynas dealt with here, without any attempt at stomach analysis. Whistler (1928) and Fletcher and Inglis (1936) also provided some information on the food and feeding habits of Mynas. They employed field observations for the study of food habits or quoted references from other workers. Whereas Whistler (1928) dealt with all the five species covered here, Fletcher and Inglis (1936) studied only two, viz., *Acridotheres tristis tristis* (Linnaeus) and *Sturnus contra contra* Linnaeus. Hussain and Bhalla (1937) employed stomach analysis as the source of their information. They identified a few of the insects and caterpillars recovered from the guts of *Acridotheres tristis tristis* (Linnaeus). Percentages of various food items were also given but without indicating whether it was by weight or by volume.

Then after a lapse of nearly thirty years, food habits of Mynas again arrested the attention of economic ornithologists. Sengupta (1968) proved that nestlings of *Arcidotheres tristis tristis* (Linnaeus) feeds upon animal as well as vegetable diet. Toor and Ramzan's (1974) analysis of 51 gut contents revealed *Acridotheres tristis tristis* (Linnaeus) to be an omnivore. Simwat and Sidhu (1975) described *Acridotheres ginginianus* (Latham) as a serious pest of grapes. They analysed the guts of 159 birds collected thoughout the year. But they (Toor and Ramzan, 1974; and Simwat

and Sidhu, 1975) made qualitative assessment only and no quantitative data was given. Moeed (1976) analysed the guts of 43 examples of *Acridotheres tristis tristis* (Linnaeus) during a period of five days at Bhopal, Central India. He (Moeed, 1976) counted the number of insects but their identification was not attempted. Percentages of different groups of insects, seeds and fruits were mentioned but without an indication whether it was by weight or volume. Mathew et al (1980) studied the food of 32 examples of *Acridotheres tristis tristis* (Linnaeus) and gave frequencies (Numerical method) of birds taking particular item of diet.

Purpose of study

Simply because a bird is often seen feeding in cultivated fields does not automatically make it a pest. Whether a bird is beneficial or injurious to agriculture depends upon what it eats. Mynas, more often than not, are seen feeding in cultivated fields. Therefore a special effort is required to be made to determine their beneficial or otherwise status. These birds are generally considered to be the friends of farmers. They are known to feed on agricultural pests like grasshoppers, crickets, beetles, ants, cutworms and caterpillars etc. Like other species of birds they too feed on cereal grains and fruits. The question arises, 'Do they eat more of insects harmful to agriculture'? or 'Do they eat more of cereal grains and thus become a pest to agriculture'? The literature available on the food habits of Mynas shows that large lacunae remain in our knowledge of this aspect. Almost all the previous workers have made a qualitative assessment of food of Mynas and no quantitative data are available. Hence the quantum of insects or grains destroyed cannot be assessed. The best way to determine this is obviously to collect a good number of examples of each species and examine their daily meals, over a prolonged period of time.

The present studies were therefore initiated to analyse and assess the food intake of Mynas quantitatively as well as to determine the exact quantum of loss caused or benefit brought by these birds.

Material and Methods

Material for study was collected from nature within the study area. Birds were collected by shooting them with a 12 bore DBBL gun using Nos. 6-9 shots. As Mynas generally feed early in the morning, the specimens were collected within 2-3 hours after sunrise i.e., between

07.30 hrs. and 10.30 hrs. during summer and between 08.30 hrs. and 11.30 hrs. during winter. The birds shot down were labelled and packed individually in polythene bags and brought to the laboratory. In the laboratory the birds were opened and their guts (crops and gizzards) were examined.

The material which could not be examined within six hours of collection was preserved in commercial formaldehyde (5%) diluted with water to be studied later. These samples were deformalised for 3-5 minutes before processing.

The crops and gizzards were then opened and their contents were collected in screen sieves by washing the opened crop under a tap. The contents were spread over a piece of blotting paper for five minutes to remove the excess of water from them. The weight and volume of the contents were taken. An electronic Single Pan Balance, accurate to .001 gms. was used to weigh the samples. A graduated measuring cylinder, true to .1 ml. was used for measuring the volume.

After the weight and volume were taken, the contents were transferred to a pettry dish. The animal and vegetable matter was broadly separated into phylla and classes. Whenever seeds were found in the study material, these were separated with the help of foreceps. The principal component of the sample was judged by ocular comparison and drawn to the edge of the dish with the help of a brush or a needle and a scalpel. The item thus sorted out was then removed, weighed and measured. The process was repeated with all the components of the sample till the whole sample was analysed.

Examples of animal diet were identified in the laboratories of Zoological Survey of India. Plant material were determined by the Botanical Survey of India. Some insect larvae were identified at the Forest Research Institute & Colleges, Dehra Dun. Identification of a few insects were confirmed by British Museum, London.

The identification of caterpillars proved a difficult proposition on account of their excessive mutilation. Caterpillars are soft and are normally torn or mutilated by the birds in the process of eating. The setae, on which the identification of caterpillars depends are usually damaged. In the identification of caterpillars therefore, indirect methods like field observation and actual collection of whole caterpillars from the feeding grounds (Plants, trees and ground) and a later comparison with the bits of caterpillars found in the guts was resorted to.

The photographs of the gut contents and of Mynas in nature were taken with a 35 mm Asahi Pentax camera with a normal 50 mm/F 1.8 lense and 200 mm/F 4 tele lense.

The study area was mapped and general notes were kept on the ecological conditions. The data on weather conditions was secured from the Forest Influences Branch of the Forest Research Institute & Colleges, Dehra Dun.

In the past, three different methods have been used by various workers to analyse the stomach contents of birds quantitatively viz.,

1. Numerical method.
2. Gravimetric method.
3. Volumetric method.

As the objective of this study was to establish the status of Mynas as a 'friend' or 'foe' of the farmers, a combination of these known methods was used.

For analysing the animal diet, a combination of numerical and volumetric methods was used. The advantage of this method was that if we were to determine the economic status of any item of animal diet, especially insects, we must know its size to determine the extent of its involvement.

Similarly another combination, that of numerical and gravimetric methods, was followed for analysing the vegetable diet. It seemed more appropriate to express the vegetable matter by weight rather than by volume. For example the statement that 'a bird crop contained 20 cc of wheat' does not convey the meaning as forcefully as the statement that 'the bird consumed 20 gms of wheat during a single feed in a day', as it gives a clear idea of the damage done by the bird.

The merits and demerits of these methods have been discussed in detail by Narang and Lamba (1980).

Abbreviations used:

N: Number of birds which had taken the item of diet.

W: Maximum weight (in gms) of item of diet found in any single specimen.

V: Maximum volume (in ml) of item of diet found in any single specimen.

%Wt.: Maximum percentage of food item by weight found in any single specimen.

%Vol.: Maximum percentage of food item by volume found in any single specimen.

List of species (of Mynas) studied:

1. *Sturnus pagodarum* (Gmelin), Blackheaded or Brahminy Myna
2. *Sturnus contra contra* Linnaeus, Indian Pied Myna
3. *Acridotheres tristis tristis* (Linnaeus), Indian Myna
4. *Acridotheres ginginianus* (Latham), Bank Myna
5. *Acridotheres fuscus fuscus* (Wagler), Northern Jungle Myna

Study Area

Physiography

The study area comprised the city of Dehra Dun and surrounding villages in a radius of about 50 kms.

The city of Dehra Dun, the gateway of Himalayas, as it is popularly called, is situated at an altitude of 650 mts. It is located in the Doon Valley in the northern part of Uttar Pradesh at 78°2′ N and 30°20′ E. The Doon is a broad valley lying between the Himalayas on the north-east and by Siwalik hills on south-west. It is bounded by the rivers Jamuna and Ganga on the north-west and south-east respectively (Text-figure 1). Central part of the valley is a watershed. It slopes down gradually in both the directions i.e. to the Jamuna in the west and Ganges in the east. There is a total fall of about 280 mts. on either side. Outer ranges of the Himalayas and the Siwaliks have an altitude of about 1000 mts. The slopes of the two ranges meet midway at an altitude of about 640 mts. The area is well watered by large perennial streams rising from the Himalayan foothills, the 'Asan' flowing through the western doon into the Jamuna and the 'Song' and the 'Suswa' through the eastern doon into the Ganga. Besides, the whole valley is traversed by seasonal streams locally known as raos.

The valley is covered by decidous forests and scrub in the sub-Himalayas and Siwalik foothills. A major part of the valley is cultivated.

Vegetation

The flora around the city of Dehra Dun furnishes a long list of

plants, shrubs, herbs and climbers. The study area was originally a sal (*Shorea robusta*) forested area, now converted into orchards, pine plantations, tea gardens and cultivated fields. Chief crops grown are rice, sugarcane, chick-pea, beans, maize and wheat.

The prominent trees found in the study area are: *Shorea robusta, Adina cordifolia, Butea monosperma, Litsea monopetella, Ficus religiosa, Ficus benghalensis, Lannea coromandelica, Cassia fistula, Grevillea robusta, Erythrina suberosa, Syzygium cumini, Mangifera indica, Mallotus phillippensis, Ehretia laevis, Cordia dichotoma, Xyloma longifolia, Flacourtia indica* etc.

Amongs the shrubs, the exotic species *Lantana camara* forms an impenetrable thicket at some places. Other shrubs are *Calotropis procera, Adhatoda vasica, Murraya koenigii, Lepidagathis cuspidata, Carissa spinarum, Ziziphus mauritiana, Pyrus pasha* and *Clerodendrum viscosum.*

The herbs includes *Mimosa pudica, Bidens biternata, Tridax procumbens, Cassia tora, Indigofera hirsuta, Alysicarpus vaginalis, Lindernia crustacea, Desmodium microphyllum* and others.

Some of the climbers that reach the top of sal trees are *Acasia sinuta, Ampelocissus latifolia, Cissus adnata, Phanera vahlii* and *Smilax* sp. etc.

All the five species of Mynas make use of this vegetation in one form or other.

Climatic factors

The climate of Dehradun differs from that of the plains of northern India. The temperature is slightly lower than in the plains because of its elevation and the forested ranges of Siwaliks partly block off and cool the scorching winds that blow during the hot weather in the north Indian plains. Being located in the valley, it is protected by Mussoorie hills from cold Himalayan winds during winter. The average of mean minimum annual temperature of this area ranges between 4.3°C (December) to 22.6°C (July) and the mean maximum between 19°C in January to 35°C in May.

Seasons

Generally speaking, the year at Dehra Dun may be divided climatica into three main seasons.

The cold season begins from November when the average minimum temperature drops to about 8.4°C and extends to February when the average minimum temperature is 5.6°C, December being the coldest month with the mercury dropping as low as 2.7°C at times.

The hot season may be said to begin from the middle of March when the average maximum temperature shoots upto 25.7°C. The rise in temperature continues till it reaches its maximum in May when the average maximum temperature rises to 35°C. Thus May and June are the hottest months in Dehra Dun. With the onset of the monsoon by June end/early July, the temperature starts falling again.

The rainy season or monsoon season begins by the end of June. The south-west monsoon winds are responsible for rains for about four months. During rains there is a slight fall in the temperature and the humidity increases to more than 90%. July and August are the months of heaviest rainfall.

Rainfall

As already stated, south-west monsoon is the chief source of rains in Dehra Dun, though some rainfall usually occurs almost throughout the year. The monsoon breaks over Dehra Dun by the latter half of June and is at its heaviest during July and August and gradually tapers off in September. August has the maximum rainfall sometimes having as much as 1094.6 mm of rain. The highest number of rainy days are met in July and August. November is a month of 'No rains' In winter also (December to February) on an average 41.6 mm of rainfall occurs in Dehra Dun. The average annual rainfall for the last twenty years as recorded by the Forest Influences Branch of the Forest Research Institute & Colleges, Dehra Dun is 2545.3 mm.

TABLE 1

Monthly mean rainfall (in mm) for the years 1975-79

Years	Months											
	Jan.	Feb.	Mar.	Apr.	May	June	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
1975	71.1	67.1	119.2	0.0	21.4	380.1	430.8	487.7	428.2	48.8	0.0	0.0
1976	26.5	72.2	21.5	10.1	39.0	129.2	669.7	556.2	106.1	4.3	0.0	1.6
1977	49.4	1.2	6.2	39.4	65.9	285.9	627.2	767.1	513.6	16.2	0.0	58.2
1978	4.4	67.6	171.4	65.8	4.0	390.0	656.6	1094.6	433.1	4.6	69.2	7.6
1979	48.6	121.3	11.9	7.3	65.1	253.8	622.3	408.7	15.0	0.0	0.6	25.7

Monthly mean rainfall for the years 1975-79 is given in Table 1 and in text figure 2.

Humidity

The city of Dehra Dun, as already stated, is enclosed by Himalayas in the north and Siwaliks in the south. Vegetation being thick, the area attracts sufficient amount of rains. The rivers Jamuna and Ganga flowing in the north-west and south-east, helps to increase the relative humidity which is considerable throughout the year reaching its maximum during summer and winter rains. During winter rains it reaches a maximum of 98%. April and May are the driest months.

The monthly mean relative humidity for the years 1975-79 is tabulated in table 2 and in text-figure 3.

TABLE 2

Monthly mean relative humidity for the years 1975-79 (in %) at 07.00 hrs.

Years	Months											
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
1975	93	93	88	73	62	74	90	93	93	91	95	96
1976	96	94	90	79	68	74	90	95	94	92	95	97
1977	97	94	81	77	68	73	94	95	94	95	96	96
1978	96	94	88	83	65	81	93	95	92	91	95	98
1979	96	93	89	81	69	73	98	93	91	92	93	96

Temperature

The monthly mean of daily minimum temperature ranges from 4.3°C in December to 22.6°C in July, while the mean of daily maximum temperature ranges from 19°C in January to 35°C in May. The monthly mean temperature is the lowest in December. It rises steadily thereafter until the maximum is reached in May. With the onset of monsoons in second half of June, there is slight fall in temperature. The daily range of temperature is least during the months of July and August (near about 7°C) while in the winter season it is generally large (about 13-19°C).

The monthly mean minimum and maximum temperatures for the years 1975-79 are tabulated in table 3 and 4 and in text-figure 4.

TABLE 3

Monthly mean minimum temperature (in °C) for the years 1975-79

Years	Months											
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
1975	4.6	6.0	9.3	13.3	17.0	20.8	21.7	22.0	20.2	15.2	5.4	2.7
1976	4.2	6.2	8.8	12.5	16.5	20.8	23.3	22.1	20.2	13.1	8.5	3.0
1977	4.5	4.4	9.4	14.4	17.0	20.5	23.4	22.6	20.4	15.7	10.3	5.4
1978	3.4	5.7	8.3	13.2	18.4	23.2	22.7	22.7	20.1	13.7	8.9	4.8
1979	5.1	6.0	8.5	14.2	15.8	20.6	22.0	22.0	17.1	13.1	9.0	5.5

TABLE 4

Monthly mean maximum temperature (in °C) for the years 1975-79

Years	Months											
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
1975	17.7	20.6	25.7	33.3	36.9	33.9	30.0	29.8	28.6	28.7	24.1	21.1
1976	19.7	20.1	25.0	31.4	34.5	33.6	30.7	28.9	29.8	29.0	25.8	21.8
1977	19.3	23.2	30.9	31.9	32.7	34.5	29.6	29.8	29.1	27.5	25.1	20.3
1978	18.7	20.0	22.7	30.6	36.6	33.3	30.0	29.2	29.0	28.4	24.1	21.0
1979	19.9	19.6	24.1	32.6	34.5	35.3	30.6	30.9	31.0	30.0	27.0	21.7

Observations

As already stated observations were made on five species of Mynas, viz. :

1. *Sturnus pagodarum* (Gmelin); Blackheaded or Brahminy Myna
2. *Sturnus contra contra* Linnaeus; Indian Pied Myna
3. *Acridotheres tristis tristis* (Linnaeus); Indian Myna
4. *Acridotheres ginginianus* (Latham); Bank Myna
5. *Acridotheres fuscus fuscus* (Wagler); Northern Jungle Myna

from 1975 to 1979 in and around Dehra Dun. Individual species are dealt with in the following text separately.

1. Sturnus pagodarum (Gmelin); Blackheaded or Brahminy Myna

Habits and habitat

Sturnus pagodarum (Gmelin), as reported by Jerdon (1862), Oats (1889), Baker (1926), Whistler (1928), Ali (1968), Ali and Ripley (1972), and Ganguly (1975) is a residential bird with seasonal movements. Found singly, in pairs or flocks in association with other Mynas, the bird generally feeds on the ground and also in the trees. These birds are usually seen moving along and among grazing cattle, picking up insects disturbed by their movements. Though partial to moist grass land, the bird is also found in cultivated fields and scrub. Occasionally, these birds may be seen following a farmer ploughing his field where they capture insects and grubs unearthed by the plough.

The above description tallies with the behaviour of *Sturnus pagodarum* (Gmelin) observed during the present study, around Dehra Dun.

Gravimetric and volumetric analysis of the food

During the period of study (1975-79) gravimetric and volumetric analysis of stomach contents of 67 adult specimen was done. The results are tabulated here below (Tables 5 and 6)

Table 5

Vegetable diet

Item of diet	N	W	%Wt	Remarks
Family: Malvaceae				
Hibiscus esculentes L	4	49 mgms	79	Seeds

Item of diet	N	W	%Wt.	Remarks
Family: Rhamnaceae				
Ziziphus sp.	3	56 mgms	47	Ripe fruits
Family: Papilionaceae				
Pisum sativum L.	2	26 mgms	72	Partially digested green peas
Butea monosperma (Lamk.)	4	1.43 gms	100	Flower parts
Family: Mimosaceae				
Albizia lucida	5	56 mgms	75	Introduced plant around Dehra Dun
Family: Myrtaceae				
Syzygium cumini (L.)	4	45 mgms	72	Ripe fruits
Family: Verbanaceae				
Lantana camara L.	22	1.10 gms	100	Berries as well as flower parts
Family: Lauraceae				
Litsea monopetella (Roxb.)	5	2.30 gms	100	Fruits
Family: Proteaceae				
Grevillea robusta Cam.	5	56 mgms	75	Flower parts
Miscellaneous				
Gramminea seeds				Not identifiable
Weeds				—do—
Wild grasses				—do—
Vegetable matter				—do—

TABLE 6

Animal diet

Item of diet	N	V	%Vol.	Remarks
Phylum: Mollusca				
Class: Gastropoda				
Order: Megagastropoda				
Family: Aninicolidae				
Digonoistoma pulchella (Bensen)	1	.3 ml	56	Complete shell
Digoniostoma sp.	1	.2 ml	33	Partially broken shell
Misc. Mollusca fragments				Not identified
Phylum: Arthropoda				
Class: Insecta				
Order: Orthoptera				

Item of diet	N	V	%Vol.	Remarks
Family: Tetrigidae				
Hedotettix sp.	7	.4 ml	61	Partially digested
Euparatettix sp.	6	.3 ml	49	—do—
Family: Gryllidae				
Gryllus sp.	3	.3 ml	34	Destroys paper clothes, fruits etc.
Turanogryllus sp.	2	.4 ml	41	
Family: Gryllotalpidae				
Gryllotalpa sp.	9	.6 ml	78	Partially digested. Damages roots of crops
Family: Acridae				
Spathosternum prasiniferum (Walk.)	5	.7 ml	69	Pest of rice, maize grasses etc.
Acrida sp.	6	..8 ml	81	Feeds on the leaves of maize, rice millets
Aelopus sp.	8	.6 ml	73	Pest of rice and cereals
Oxya sp.	4	.7 ml	67	Pest of Kharif crops such as maize, sorghum, rice.
Acrida exaltata Walk.	10	.8 ml	78	Pest of paddy, maize, sugar-cane millets etc.
Grasshoppers (Fragments)				Not identifiable
Order: Dermaptera				
Family: Carcinophoridae				
Subfamily: Carcinophorinae				
Euborellia sp.	3	.4 ml	31	Partially digested. Minor pest of ground-nut
Nala lividipes (Dufour)	1			Identified from forceps only
Misc. Earwigs fragments				Not identifiable
Order: Dictyoptera				
Family: Blattidae				
Cockroaches (Fragments)				Not identifiable
Order: Isoptera				
Family: Termitidae				
Subfamily: Termitinae				
Odontotermes sp.	5	.2 ml	19	Partially digested. Pest of wood and damages sugar-cane, wheat etc.

Item of diet	N	V	%Vol.	Remarks
Order: Hemiptera				
Family: Pentatomidae				
Eysarcocoris ventralis Westw.	6	.3 ml	41	Suck juices of plants
Cydnus sp.	4	.2 ml	36	—do—
Coptosoma cribrarium F.	2	.2 ml	31	—do—
Family: Lygaeidae				
Nysius sp.	2			Minor pest of sunflower
Naudurensia sp.	2	.1 ml	12	Suck juices of plants
Order: Lepidoptera				
Family: Noctuidae				
Mythimna separata (Haworth)	4	.5 ml	45	Larvae serious pest of wheat, sugarcane, maize etc.
Agrotis sp.	7	.4 ml	68	Larvae feeds on the seedlings of potato, cucurbits, peas, wheat, maize, etc.
Misc. Caterpillars				Not identifiable
Order: Diptera				
Family: Muscidae				
Musca domestica Linn.	2	.1 ml	11	Partially digested. Carries germs of various diseases
Family: Stratiomyidae	1			Badly damaged. Identified upto family level
Misc. Flies (Fragments)				Not identifiable
Order: Hymenoptera				
Family: Formicidae				
Subfamily: Myrmecinae				
Pheidole sp.	12	.5 ml	63	Pest of wheat paddy etc.
Aphaenogastor sp.	4	.1 ml	14	
Lophomyrmex quadrispinosus (Jard.)	3	.1 ml	12	
Myrmecinae ants				Not identifiable due to lack of workers
Subfamily: Dorylinae				
Dorylus labiatus Schuck	4			Eats plants below and at the level of soil
Dorylus orientalis Westwood	5			—do—

Item of diet	N	V	%Vol.	Remarks
Family: Apidae				
Nomia sp.	1			Partially digested
Apis dorsata Fabricius	2	.2 ml	25	Helps in cross pollination of flowers as well as produces honey
Misc. Ants and bees				Not identifiable
Order: Coleoptera				
Family: Rhysodidae				
Rhysodes boysi Arrow	4	.1 ml	33	
Family: Scarabaeidae				
Onthophagus sp.	3	.3 ml	47	Feeds in dung and dead insects
Allisonotum simile Arrow	7	.6 ml	82	—do—
Aphodius sp.	4	.2 ml	29	Feeds in dung
Family: Tenebrionidae				
Scleron sp.	3	.1 ml	17	Pest of tobacco
Gonocephalum sp.	5	.4 ml	51	Injurious to seeds of *Shorea robusta* and feeds on roots of sugarcane, tobacco etc.
Family: Chrysomelidae				
Diapromorpha turcica Fabr.	2	.2 ml	27	Larvae and adults both are injurious to plants
Family: Elateridae				
Drasterius sp.	4	.1 ml	29	Pest of potato
Family: Coccinelidae				
Coccinella sp.	3	.1 ml	26	Useful insect. Predaceous upon wheat aphid, mustard aphid, maize aphid, brinjal aphid
Coccinella septempunctata Linn.	4	.2 ml	34	—do—
Family: Curculionidae				
Tanymecus sp.	5	.1 ml	23	Serious pest of rabi crops like wheat, gram
Miscellaneous				
Maggots larvae	7	.5 ml	62	
Pupa	3	.3 ml	24	Not identifiable
Insect fragments				—do—

Item of diet	N	V	%Vol.	Remarks
Class: Arachnida				
Order: Araneida				
Family: Lycosidae				
Lycosa sp.	1			Carnivorous, feeds on insects
Pardosa sp.	1			—do—
Family: Theridiidae				
Theridion sp.	1			—do—

Seasonal food preference

The diet of this species kept on changing with the change of seasons, crop rotation, fruiting seasons, emergence of various groups of insects etc. during the year. The vegetable and animal matter that was available freely during the time was made use of. Out of the available material, definite food preferences were indicated in the food consumed as can be seen from the following tabulated year round monthly data (Table 7).

TABLE 7

Year-round record of the food materials consumed

Month	Food
January	Lantana berries; wild grasses—unidentified; caterpillars—*Mythimna separata* (Hawarth), *Agrotis* sp.; maggots larvae—unidentified; beetles—*Rhysodes boysi* Arrow, *Allisonotum simile* Arrow; mole crickets —*Gryllotalpa* sp.; termites—*Odontotermes* sp.
February	Caterpillars—*Mythimna separata* (Hawarth), *Agrotis* sp.; beetles—*Gonocephalum* sp., *Tanymacus* sp., *Rhysodes boysi* Arrow; earwig forceps—*Nala lividipes* (Dufour); termites—*Odontotermes* sp.; spider—*Lycosa* sp.; bugs—*Cydnus* sp.; ants—*Pheidole* sp.
March	Beetles—*Tanymacus* sp., *Scleron* sp., *Onthophagus* sp.; mole crickets —*Gryllotalpa* sp.; crickets—*Gryllus* sp.; earwig forceps—*Euborellia* sp.; bugs—*Eysarcocoris ventralis* Westw.; maggots larvae—Unidentified; ants—*Pheidole* sp., *Dorylus labiatus* Schuck, *Lophomyrmex guadrispinosus* (Jard.).

Month	Food
April	Molluscs—*Digoniostoma pulchella* (Bensen), *Digoniostoma* sp.; lantana berries; caterpillars—Unidentified; green peas—*Pisum sativum* L.; flower parts of *Butea monosperma* (Lamk.); flower parts of *Grevillea robusta* Cam.; beetles—*Coccinella* sp., *Coccinella septempunctata* Linnaeus, *Diapromorpha turcica* Fabr., *Aphodius* sp.; bugs—*Coptosoma cribrarium* F.; ants—*Aphaenogaster* sp., *Dorylus orientalis* Westw.
May	Flower parts of *Grevillea robusta* Cam.; flower parts of *Butea monosperma* (Lamk.); lady-finger seeds—*Hibiscus esculentes* L.; seeds of *Albizia lucida*; lantana berries; termites—*Odontotermes* sp.; ants—*Pheidole* sp., *Aphaenogaster* sp.; beetles—*Drasterius* sp.
June	Termites—*Odontotermes*, sp.; ants—*Pheidole* sp.; bees—*Nomia* sp.; bugs—*Nysius* sp.; *Naudarensia* sp.; beetles—*Drasterius* sp.; *Tanymacus* sp., *Allisonotum simile* Arrow, *Gonocephalum* sp.; grasshoppers—*Acrida exaltata* Walk.; mole crickets—*Gryllotalpa* sp.; *Ziziphus* sp.; jamun—*Syzygium cumini* (L.); Weed—unidentified; Seeds of *Albizia lucida.*
July	Jamun—*Syzygium cumini* (L.); fruits of *Litsea monopetella* (Roxb.); lantana berries; beetles—*Rhysodes boysi* Arrow, *Allisonotum simile* Arrow, *Onthophagus* sp.; spider—*Pardosa* sp.; ants—*Pheidole* sp. *Dorylus orientalis* Westw., *Aphaenogaster* sp., *Dorylus labiatus* Schuck; grasshoppers—*Acrida exaltata* Walk., *Acrida* sp., *Aelopus* sp.
August	Lantana berries; maggots larve—Unidentified; flies—unidentified; bees—*Apis dorsata* Fabr.; ants—*Pheidole* sp., *Dorylus orientalis* Westw.; grasshoppers—*Oxya* sp.,*Aelopus* sp., *Acrida exaltata* Walk.; crickets—*Hedotettix* sp., *Turanogryllus* sp.; mole crickets—*Gryllotalpa* sp.; beetles—*Coccinella septempunctata* Linnaeus; earwigs—*Euborellia* sp.; spider—*Theridion* sp.
September	Lantana berries; cutworms—*Agrotis sp.*; grasshoppers—*Spathosternum prasiniferum* (Walk.), *Acrida* sp., *Aelopus* sp.; crickets—*Hedotettix* sp., *Euparatettix* sp.; mole crickets—*Gryllotalpa* sp.; cockroach parts—Unidentified.
October	Crickets—*Gryllus* sp., *Hedotettix* sp.; grasshoppers— *Acrida exaltata* Walk., *Oxya* sp., *Aelopus* sp.; mole crickets—*Gryllotalpa* sp.; beetles—*Coccinella* sp., *Scleron* sp., *Gonocephalum* sp.; ants—*Pheidole* sp.; bugs—*Eysarcocoris ventralis* Westw., *Cydnus* sp.
November	Pupa—Unidentified; ants—*Pheidole* sp., *Dorylus orientalis* Westw.; beetles—*Aphodius* sp., *Allisonotum simile* Arrow; grasshoppers—*Acrida exaltata* Walk., *Oxya* sp., *Spathosternum prasiniferum* (Walk.), *Aelopus* sp.; mole crickets—*Gryllotalpa* sp.; crickets—*Euparatettix* sp., *Gryllus* sp.; lantana berries.

Month	Food
December	Ants—*Pheidole* sp., *Lophomyrmex quadrispinosus* (Jard.); house fly—*Musca domestica* Linn.; mole crickets—*Gryllotalpa* sp.; cutworms—*Agrotis* sp.; maggots larvae—Unidentified; beetles—*Allisonotum simile* Arrow.

Discussion

The food of *Sturnus pagodarum* (Gmelin) as stated by Jerdon (1862), Baker (1926), Ali (1968), Ali and Ripley (1972) and Ganguly (1975) is based on field observations only. No systematic stomach analysis was done by them. According to these workers, the food consists of berries like *Lantana*, *Ziziphus*, and fruits like *Ficus*, *Capparis decidua*, *Salvadora persica*, jesmine and nectar of flowers like *Erythrina*, *Salmalia* and *Butea*. The insect diet included grasshoppers, moths and caterpillars etc.

As already stated, no stomach analysis was done by the previous workers. This is the first time that the food of this species has been studied by analysing the stomach contents. Seven species of vegetable matter have been added to the known item of vegetable food of this species. These were: bhindi (*Hibiscus esculentes*), green peas (*Pisum sativum*), seeds of *Albizia lucida*, jamun (*Syzygium cumini*), lantana berries [*Lantana camara* (Fig. 1)] fruits of *Litsea monopetella* (Fig. 2) and flower parts of *Grevillea robusta*.

Among the articles of animal diet, one species of mollusc viz., *Digoniostoma* sp. and thirty eight species of insects were identified. These included crickets (*Hedotettix* sp., *Euparatettix* sp., *Gryllus* sp., *Turanogryllus* sp.), mole crickets (*Gryllotalpa* sp.), grasshoppers (*Spathosternum prasiniferum*, *Acrida* sp., *Aelopus* sp., *Oxya* sp.), earwigs [*Euborellia* sp. (Fig. 3), *Nala lividipes* (Fig. 4)], *termites* (*Odontotermes* sp.), bugs (*Eysarcocoris ventralis*, *Cydnus* sp., *Coptosoma cribrarium*, *Nysius* sp., *Naudarensia* sp.), caterpillars (*Agrotis* sp.), flies (*Musca domestica*), ants [*Pheidole* sp. (Fig. 5), *Aphaenogaster* sp., *Lophomyrmex quadrispinosus* (Fig. 6), *Dorylus* sp.] bees (*Nomia* sp., *Apis dorsata*), beetles [*Rhysodes boysi*, *Onthophagus* sp. (Fig. 7), *Allisonotum simile* (Fig. 8), *Aphodius* sp., *Scleron* sp., *Gonocephalum* sp., *Diapromorpha tursica*, *Drasterius* sp., *Coccinella* sp., *Tanymacus* sp.], spiders (*Lycosa* sp., *Pardosa* sp. and *Theridion* sp.) and pupa.

As the analysis of gut contents proved, *Sturnus pagodarum* (Gmelin) fed chiefly on grasshoppers, crickets, caterpillars, ants, beetles and lantana berries. Twenty three percent of the samples studied were found to contain four species of grasshoppers. These species were *Acrida* sp., *Aelopus* sp., *Spathoternum prasiniferum* (Walk.) and *Oxya* sp. These species of grasshoppers were consumed to the extent of 81%, 73%, 69% and 67% of the total diet respectively. All these species are serious pests of crops, such as paddy, maize and sorghum. The mole crickets, *Gryllotalpa* sp., which damage roots of crops accounted for 78% of the total food intake. But the occurrence of this species was found in 13% of the samples studied. The crickets, *Hedotettix* sp. and *Euparatettix* sp. were found in 11% of the samples studied. These species of crickets constituted 61% and 49% of the diet respectively. Caterpillars were recovered from 15% of the samples studied. The surface caterpillar, *Agrotis* sp., which accounted for 68% of the birds' diet is a serious pest of wheat and vegetables like potato, peas, cucurbits etc. It was consumed by 9% of the birds studied. Ants, especially *Pheidole* sp. and *Dorylus* sp. were found in 18% and 13% respectively of the samples studied. Both these species are minor pests of plants. While the *Pheidole* sp. formed 63% of the diet in few cases, *Dorylus* sp. was found to be of negligible quantity. Three species of injurious beetles were eaten by these birds. Two of these were *Tanymacus* sp., a serious pest of rabi crops like wheat and gram and *Gonocephalum* sp., a pest of roots of crops like sugarcane and tobacco. These beetles were found in 7.5% of the samples studied and they accounted for 23% and 51% of the diet respectively. The third species, *Scleron* sp. which is a pest of tobacco, accounted for 17% of the diet and its occurrence was reported in barely 4.5% of the samples studied. Harmless beetles like *Allisonotum simile* Arrow, *Aphodius* sp., *Rhysodes boysi* Arrow and *Onthophagus* sp. were recovered from 7%, 6%, 6% and 4.5% of the samples studied. These beetles formed 82%, 29%, 33% and 47% of the food intake respectively.

The only useful insects eaten by these birds were beetles of *Coccinella* sp., which occurred in 9% of the samples studied. These beetles formed 34% of the diet. These beetles are reported to be predaceous upon aphids like wheat aphids, maize aphids, mustard aphids and brinjal aphids.

Among the plant material, lantana berries were most preferred by these birds. The occurrence of this shrub was recorded in 33% of

the samples studied. Lantana, which was imported into India just as a decorative plant has spread at such an alarming rate that it has become a problem for the Indian agriculturists. *Sturnus pagodarum* (Gmelin) has taken to the berries of this shrub as the chief source of its food, which at times may constitute 100% of its diet. This species has presumably played an important role in the dispersal of this nuisance shrub. A few birds consumed lady-finger seeds (*Hibiscus esculentes* L., berries of *Ziziphus* sp., jamun, *Syzygium cumini* (L.) and green peas, *Pisum sativum* L. but the percentage of such birds was very low (19%). This is the only species of Mynas under study which did not take wheat or any other grain.

Conclusion

From the foregoing discussion, one can easily conclude that *Sturnus pagodarum* (Gmelin) is a beneficial bird. An increase in its population is likely to help the farmer.

2. **Sturnus contra contra** Linnaeus ; Indian Pied Myna

Habits and habitat

The habits and habitat of Sturnus contra contra Linnaeus has been described by various workers in the past. Workers like Jerdon (1862), Oats (1889), Baker (1926), Whistler (1928), Fletcher and Inglis (1936), Ali (1968) and Ali and Ripley (1972) have written about the habits and habitat of this species. According to them, *Sturnus contra contra* Linnaeus is a resident bird, with local seasonal movements. This species is a social, predominantly insectivorous and ground feeding. Generally found in open cultivation, this species is also seen near the villages and in the vicinity of human habitations. It is found in small parties and noisy squabbling flocks, when not paired off for breeding, commonly in association with other Mynas. It is often seen attending on grazing cattles, picking up insects disturbed by their movements. The bird also follows a farmer ploughing a field for the same reason. Its other favourite feeding grounds are damp grazing grounds, scrub, banks of ponds and thanks, sewage farms and municipal refuse damps etc.

The foregoing description very aptly applies to the *Sturnus contra contra* Linnaeus populations around Dehra Dun on which the present study is based.

Gravimetric and volumetric analysis of the food

During the years of study (1975-79), gravimetric and volumetric analysis of the stomach contents of 147 adult specimens was done. The results are tabulated here below (Table 8 and 9).

TABLE 8

Vegetable diet

Item of diet	N	W	%Wt.	Remarks
Family: Malvaceae				
Hibiscus esculentes L.	3	1.50 gms	37	
Family: Rhamnaceae				
Zizyphus sp.	7	.86 mgms	26	
Family: Myrtaceae				
Syzygium cumini (L.)	8	1.10 gms	34	Endocarp only
Family: Solanaceae				
Solanum tuberosum L.	3	91 mgms	50	Appears to be kitchen waste
Family: Verbanaceae				
Lantana camara L.	31	2.40 gms	100	Berries alongwith flower parts
Family: Lauraceae				
Litsea monopetella (Roxb.)	5	1.80 gms	71	Fruits
Family: Proteaceae				
Grevillea robusta Cam.	6	21 mgms	10	Flower parts
Family: Moraceae				
Ficus benghalensis L.	13	17 mgms	8	Ripe fruits
Ficus religiosa L.	12	23 mgms	13	—do—
Family: Poaceae				
Triticum aestivum L.	6	83 mgms	28	Germinating seeds and stored grain
Miscellaneous				
Grammineae seeds	3			Not identifiable
Wild seeds	2	1.60 gms	100	—do—
Weeds	3			—do—
Misc. vegetable matter				—do—

TABLE 9

Animal diet

Item of diet	N	V	%Vol.	Remarks
Phylum: Chordata				
Class: Amphibia				
Order: Salientia				
Family: Microhylidae				
Microhyla ornata (Dumeril & Bibron)	1	.6 ml	30	Adult slightly digested
Family: Bufonidae				
Bufo melanostictus Schneider	1	.7 ml	28	—do—
Phylum: Annelida				
Class: Oligochaeta				
Order: Terricolae				
Family: Megascolecidae				
Eutyphoeus waltoni (Michaelson)	6	1.9 ml	86	Mostly in parts
Eutyphoeus orientalis (Beddard)	11	.8 ml	73	—do—
Phylum: Mollusca				
Class: Gastropoda				
Order: Stylommatophora				
Family: Ariophantidae				
Macrochlamys sp.	6	.2 ml	12	Complete and broken shells
Kaliella sp.	5	.1 ml	8	Complete shells
Family: Subulinidae				
Opeas gracilis Hutton	3			Complete and broken shells
Order: Megagastropoda				
Family: Aninicolidae				
Digoniostoma sp.	4			Complete and partially broken shells
Digoniostoma pulchella (Bensen)	9	.4 ml	57	—do—
Order: Basommatophora				
Family: Lymnaeidae				
Indoplanorbis exustus (Deshayes)	5	.2 ml	25	Complete and broken shells

Item of diet	N	V	%Vol.	Remarks
Misc. Mollusca (Fragments of shells)				
Phylum: Arthropoda				
Class: Insecta				
Order: Orthoptera				
Family: Tetrigidae				
Acrydium sp.	3	.2 ml	8	Partially digested
Hedotettix sp.	7	.5 ml	31	—do—
Euparatettix sp.	4	.6 ml	35	—do—
Family: Gryllidae				
Gryllus sp.	6	.4 ml	27	Destroys clothes paper, fruits etc.
Family: Gryllotalpidae				
Gryllotalpa sp.	5	1.2 ml	59	Partially digested damages roots of crops
Family: Acrididae				
Chrotogonus sp.	8	.9 ml	39	Partially digested pest of wheat, cotton, sugarcane, barley etc.
Acrida exaltata Walk.	10	1.1 ml	57	Feeds on the leaves of rice, maize, millets, sugarcane, grasses etc.
Oxya sp.	7	.9 ml	33	Pest of kharif crops, such as maize, sorghum, rice etc.
Atractomorpha sp.	11	1.2 ml	55	Pest of cereal crops
Misc. Grasshoppers (Fragments)				
Order: Dermaptera				
Family: Carcinophoridae				
Subfamily: Carcinophorinae				
Euborellia annulipes (Lucas)	7	.4 ml	17	Partially digested. Minor pest of ground-nut
Family: Labiduridae				
Labidura sp.	2	.5 ml	21	Identified with foreceps only
Misc. Earwigs fragments				Not identifiable
Order: Dictyoptera				
Family: Blattidae				

Item of diet	N	V	%Vol.	Remarks
Periplanata sp.	6	.7 ml	60	Parts of cockroach. Pest of paper, cloth etc.
Order: Isoptera				
Family: Termitidae				
Odontotermes sp.	8	.1 ml	15	Partially digested. Pest of wood and damages sugarcane wheat etc.
Order: Hemiptera				
Family: Pentatomidae				
Aeschrocoris sp.	3	.2 ml	5	Extract juices from succulent parts of plants
Eysarcocoris ventralis Westw.	8	.9 ml	30	—do—
Cydnus indicus Westw.	4	.2 ml	16	—do—
Family: Membracidae				
Oxyrhachis taranda (Fabr.)	2	.1 ml	9	Pest of citrus and mango trees
Misc. Fragments of bugs				Not identifiable
Order: Lepidoptera				
Family: Noctuidae				
Mythimna separata (Haworth)	5	1.2 ml	80	Larvae are serious pests of wheat, sugarcane and maize etc.
Agrotis sp.	13	.9 ml	64	Larvae feeds on the seedlings of potato, peas, cucurbits, wheat, maize, sugarcane etc.
Family: Crambidae				
Chilo auricilia Dudgeon	4	.8 ml	53	Caterpillars are destructive pests of sugarcane. Also feeds on wheat
Misc. Caterpillars, cutworms and parts of butterflies and moths				Not identifiable
Order: Diptera				
Family: Muscidae				
Musca domestica Linnaeus	3	.2 ml	7	Partially digested. Carriers of germs of various diseases
Family: Drosophilidae				

Item of diet	N	V	%Vol.	Remarks
Drosophilia sp.	2	.1 ml	6	
Family: Ephydridae	1			Partially digested. Identified upto family level
Misc. Flies (Fragments)				Not identifiable
Order: Hymenoptera				
Family: Apidae				
Apis dorsata Fabricius	2	.2 ml	23	Helps in pollination while collecting honey from flowers
Family: Vespidae				
Vespa basalis Smith	2	.3 ml	24	Minor pests of citrus plants
Family: Formicidae				
Subfamily: Myrmecinae				
Pheidole sp.	11	.3 ml	100	Pest of wheat and paddy
Aphaenogastor beccari Emeray	5			
Lophomyrmex quadrispinosus (Jard.)	4	.1 ml	11	
Subfamily: Camponotinae				
Camponotus campressus Fabr.	7	.3 ml	26	Stored grain pests
Subfamily: Dorylinae				
Dorylus orientalis (Westwood)	13			Eats plants below and at the level of soil
Dorylus labiatus Schuck	11			—do—
Family: Chalcidae				Partially digested. Identified upto family level
Misc. Fragments of bees and wasps				Not identifiable
Myrmecinae and Camponotinae ants				Not identifiable due to lack of workers
Order: Coleoptera				
Family: Languriidae				
Anadastus bifasciatus (Mots.)	7	.3 ml	23	
Family: Rhysodidae				
Rhysodes boysi Arrow	11	.6 ml	21	
Family: Limnichidae				

Item of diet	N	V	%Vol.	Remarks
Platypelochares latimargo Champ	3	.3 ml	11	
Family: Byrrhidae				
Syncalypta curimoides Champ	6	.4 ml	17	
Family: Coccinelidae				
Coccinela sp.	6	.2 ml	23	Useful insect. Predaceous upon aphids like wheat aphid, maize aphid, brinjal aphid
Family: Curculionidae				
Tanymacus indicus Faust	12	.8 ml	57	Adults injurious to leaves of rabi crops particularly wheat, gram, mustard etc.
Tanymacus sp.	5	.5 ml	17	—do—
Myllocerus blandus Fst	9	.4 ml	22	Pest of maize, sorghum, groundnut etc.
Family: Carabidae				
Bembidion sp.	3	.4 ml	18	Pest of corn and strawberries
Family: Tenebrionidae				
Anthracophora crucifera Oliv.	2	.4 ml	29	
Scleron sp.	2	.1 ml	14	Pest of tobacco
Gonocephalum sp.	4	.3 ml	23	Injurious to seeds of *Shorea robusta* and damages roots of sugarcane, tobacco etc.
Lyprops sp.	5	.4 ml	19	
Family: Staphylinidae				
Oxytelus (*Anotylus*) *andrewesi* Cameron	7	.3 ml	25	Carnivorous, reported eating ants
Philonthus sp.	2	.2 ml	18	
Family: Scarabeidae				
Alissonotum simile Arrow	14	1.3 ml	100	Feeds in dung and on dead insects
Aphodius sp.	6	.2 ml	45	Feeds in dung

Item of diet	N	V	%Vol.	Remarks
Onthophagus sp.	5	.4 ml	67	Feeds in dung and on dead insects
Family: Elateridae				
Drasterius sp.	9	.1 ml	21	Pest of potato
Family: Chrysomelidae				
Chaetocnema sp.	3	.2 ml	22	Larvae and adults both are injurious to plants
Crioceris sp.	9	.2 ml	17	Larvae feeds on aquatic as well as low plants
Miscellaneous				
Maggots larvae	21	.9 ml	69	Not identifiable
Insects fragments				Not identifiable
Class Arachnida				
Order: Acrina				
Family: Ixodidae				
Boophilus microplus (Canestrini)	3			Ectoparasite on cattles and cause the disease Anplasmosis
Hyalomma anatolicum Koch.	2			—do—
Order: Araneida				
Family: Lycosidae				
Lycosa sp.	2			Feeds on insects
Pardosa sp.	3			—do—
Misc. spiders (Fragments)				Not identifiable

Seasonal food preference

The diet of this species kept on changing with the change of seasons, crop rotation, fruiting season, emergence of various groups of insects etc. during the year. The vegetable and animal matter that was available freely during the time was made use of. Out of the available material, definite food preferences were indicated in the food consumed as can be seen from the following tabulated year-round monthly data (Table 10)

TABLE 10

Year-round record of the food materials consumed

Month	Food
January	Caterpillars—*Mythimna separata* (Haworth), *Pieris brassicae* (Linn.), *Agrotis* sp.; maggots larvae— unidentified; ants—*Pheidole* sp.; beetles—*Oxytelus andrewesi* Cameron, *Rhysodes boysi* Arrow, *Allisonotum simile* Arrow, *Onthophagus* sp., *Platypelochares latimargo* Champ, *Tanymacus indicus* Faust; termites—*Odontotermes* sp.; molluscs—*Kaliella* sp., *Digoniostoma* sp., wheat seeds—*Triticum aestivum* L.
February	Bugs—*Eysarcocoris ventralis* Westw.; grasshopper fragments; caterpillars—*Mythimna separata* (Haworth), *Agrotis* sp.; termites—*Odontotermes* sp.; ants—*Pheidole* sp., *Dorylus orientalis* Westw.; beetles—*Tanymacus indicus* Faust, *Drasterius* sp., *Rhysodes boysi* Arrow, *Chaetocnema* sp., *Allisonotum simile* Arrow, *Syncalypta curimoides* Champ, *Myllocerus blandus* Fst.; earwigs—*Euborellia annulipes* (Lucas); ticks—*Boophilus microplus* (Canestrini); molluscs—*Kaliella* sp., *Indoplanorbis exustus* (Deshayes), *Digoniostoma pulchella* (Bensen); spiders— *Pardosa* sp.
March	Caterpillars—*Chilo auricilia* Dudgeon, *Agrotis* sp.; beetles—*Oxytelus andrewesi* Cameron, *Rhysodes boysi* Arrow, *Tanymacus* sp.; crickets—*Gryllus* sp.; molluscs—*Indoplanorbis exustus* (Deshayes), *Macrochalamys* sp.; potato—*Solanum tuberosum.*
April	Beetles—*Rhysodes boysi* Arrow, *Oxytelus andrewesi* Cameron, *Coccinella* sp., *Anadastus bifasciatus* (Mots.); bugs— *Cydnus indicus* Westw., *Oxyrhachis taranda* (Fabr.); ants—*Pheidole* sp.; maggots larvae—Unidentified; molluscs—*Macrochalamys* sp.; weeds—Unidentified.
May	Termites—*Odontotermes* sp.; caterpillars—*Chilo auricilia* Dudgeon; maggots larvae—Unidentified; beetles—*Coccinella* sp., *Lyprops* sp., *Gonocephalum* sp., *Rhysodes boysi* Arrow; mole crickets—*Gryllotalpa* sp.; mollusc—*Opeas gracilis* Hutton; berries of peepal and Banyan—*Ficus religiosa* L. and *Ficus benghalensis* L.
June	Ants—*Aphaenogaster beccari* Emeray, *Pheidole* sp.; grasshoppers—*Chrotogonus* sp.; crickets—*Gryllus* sp.,*Acrydium* sp.; maggots larvae—Unidentified; cockroaches—*Periplanata* sp.; bugs—*Aeschrocoris* sp.; beetles—*Opatroides* sp., *Scleron* sp., *Gonocephalum* sp.; flower parts of *Grevillea robusta* Cam.; ber—*Ziziphus* sp.; jamun—*Syzygium cumini* (L.).

Month	Food
July	Berries of peepal and banyan—*Ficus religiosa* L. and *Ficus benghalensis* L.; seeds of *Litsea monopetella* (Roxb.); jamun—*Syzygium cumini* (L.); flower parts of *Grevillea robusta* Cam.; ants—*Pheidole* sp.,*Lophomyrmex quadrispinosus* (Jard.), *Dorylus orientalis* Westw., *Dorylus labiatus* Schuck; cockroaches—*Periplanata* sp.; mole crickets—*Gryllotalpa* sp.;grasshoppers—*Acrida exaltata* Walk., *Atractomorpha* sp.; beetles—*Bembidion* sp., *Allisonotum simile* Arrow; spiders—*Lycosa* sp.; earthworms—*Eutyphoeus waltoni* (Michaelson) and *Eutyphoeus orientalis* (Beddard).
August	Earthworms—*Eutyphoeus orientalis* (Beddard) and *Eutyphoeus waltoni* (Michaelson); frogs—*Bufo melanostictus* Schneider and *Microhyla ornata* (Dumeril & Bibron); beetles—*Coccinella* sp., *Onthophagus* sp.,*Lyprops* sp. *Crioceris* sp.; earwig forecep—*Labidura* sp.; grasshoppers—*Atractomorpha* sp., *Chrotogonus* sp.,*Oxya* sp.; spiders—*Lycosa* sp.; maggots larvae—Unidentified; ants—*Pheidole* sp.
September	Earthworms—*Eutyphoeus orientalis* (Beddard); beetles—*Anadastus bifasciatus* (Mots.), *Aphodius* sp., *Anthracophora crucifera* Oliv., *Syncalypta curimoides* Champ, *Crioceris* sp.; maggots larvae—Unidentified; crickets—*Euparatettix* sp.,*Hedotettix* sp.; grasshoppers—*Atractomorpha* sp., *Acrida exaltata* Walk., *Chrotogonus* sp.; molluscs *Macrochalamys* sp.
October	Lantana berries including flower parts—*Lantana camara* L.; bees and wasps—*Apis dorsata* Fabr. and *Vespa basalis* Smith; ants—*Pheidole* sp., *Lophomyrmex quadrispinosus* (Jard.), *Camponotus campressus* Fabr.; earwigs—*Euborellia annulipes* (Lucas); termites —*Odontotermes* sp.; flies—*Musca domestica* Linn., *Drosophilia* sp.; grasshoppers—*Acrida exaltata* Walk., *Atractomorpha* sp.; crickets—*Hedotettix* sp., *Euparatettix* sp.; bugs—*Eysarcocoris ventralis* Westw.; beetles—*Crioceris* sp., *Drasterius* sp.
November	Wheat seeds—*Triticum aestivum* L.; lantana berries; termites—*Odontotermes* sp.; ants—*Pheidole* sp., *Dorylus orientalis* Westw., *Dorylus labiatus* Schuck, *Camponotus campressus* Fabr.; beetles—*Aphodius* sp., *Drasterius* sp., *Mylloceras blandus* Fst., *Onthophagus* sp., *Philonthus* sp.; grasshoppers—*Acrida exaltata* walk., *Atractomorpha* sp.; ticks—*Hyalomma anatolicum* Koch.
December	Maggots larvae—Unidentified; flies—*Musca domestica* Linn.; ants —*Camponotus campressus* Fabr., *Lophomyrmex quadrispinosus* (Jard.); beetles—*Aphodius* sp., *Allisonotum simile* Arrow, *Tanymacus indicus* Faust, *Mylloceras blandus* Fst.; caterpillars—*Agrotis* sp., *Pieris brassicae* (Linn.); spiders—*Pardosa* sp.; earwigs—*Euborellia annulipes* (Lucas); ticks—*Boophilus microplus* (Canestrini).

Discussion

A number of workers have made a mention from time to time of the dietry habits of this species. The list is too long to be mentioned in detail. The prominent ones are: Jerdon (1862), Mason and Lefroy (1912), D'Abreu (1918), Baker (1926), Whistler (1928) and Fletcher and Inglis (1936). Out of these Mason and Lefroy (1912) are perhaps the only ones who examined the gut contents in a systematic manner to arrive at their conclusion. However, no attempt was made by them to do detailed gravimetric or volumetric analysis of the data, presumably, because this type of studies was not in vogue during their time.

The present study has added a list of plants and animal matter to the known food of *Sturnus contra contra* Linnaeus. The vegetable matter recorded for the first time were lady-finger seeds (*Hibiscus esculentes*), jamun (*Syzygium cumini*), lantana berries (*Lantana camara*), ber (*Ziziphus* sp.), potato (*Solanum tuberosum*), fruits of *Litsea monopetella*, flower parts of silver oak (*Grevillea robusta*), and wheat seeds (*Triticum aestivum*).

The animal diet identified for the first time from the guts of these birds are listed below.

Frogs (*Microhyla ornata*, *Bufo melanostictus*), earthworms (*Eutyphoeus waltoni*, *Eutyphoeus orientalis*), molluscs (*Macrochlamys* sp., *Kaliella* sp., *Opeas gracilis*, *Digoniostoma* sp. and *Indoplanorbis exustus*), crickets (*Acrydium* sp., *Hedotettix* sp., *Euparatettix* sp., *Gryllus* sp.), mole crickets (*Gryllotalpa* sp.), grasshoppers (*Acrida exaltata*, *Oxya* sp., *Atractomorpha* sp.), earwigs (*Euborellia annulipes*, *Labidura* sp.), cockrooach (*Periplanata* sp.), termites (*Odontotermes* sp.), bugs [*Aeschrocoris* sp. (Fig. 9), *Eysarcocoris ventralis* (Fig. 10), *Cydnus indicus*, *Oxyrhachis taranda*], caterpillars (*Mythimna separata*, *Agrotis* sp., *Chilo auricilia*), flies (*Musca domestica*, *Drosophilia* sp.), bees and wasps (*Apis dorsata*, *Vespa basalis*), ants (*Pheidole* sp., *Lophomyrmex quadrispinosus*, *Dorylus* sp.), beetles [*Rhysodes boysi* (Fig. 11), *Platypelochares latimargo*, *Syncalypta curimoides*, *Coccinella* sp., *Tanymacus* sp. (Fig. 12), *Myllocerus blandus*, *Bembidion* sp., *Anthracophora crucifera*, *Scleron* sp., *Gonocephalum* sp. (Fig. 13), *Lyprops* sp., *Oxytelus andrewasi*, *Philonthus* sp. (Fig. 14), *Allisonotum simile*, *Aphodius* sp., *Drasterius* sp. (Fig. 15), *Chaetocnema* sp., *Croceris* sp., *Anadustus bifasciatus* (Fig. 16)], ticks (*Boophilus microplus*, *Hyalomma anatolicum*), and spiders (*Lycosa* sp., *Pardosa* sp.).

Mason in his conclusive remarks about this species has written that this species is "decidedly more vegetarian than Common Myna" This is probably due to the fact that he collected all the samples of this species during the winter season and early summer when insects are not so abundant. The present studies have proved beyond doubt that *Sturnus contra contra* Linnaeus is more insectivorous than *Acridotheres tristis tristis* (Linnaeus).

The analysis of the food consumed revealed that *Sturnus contra contra* Linnaeus fed mostly on insects (chiefly grasshoppers, caterpillars and beetles), earthworms, molluscs and lantana berries. Four species of grasshoppers viz., *Acrida exaltata* Walk., *Atractomorpha* sp., *Chrotogonus* sp., and *Oxya* sp. were recovered from 21% of the samples studied. These species formed 57%, 55%, 39% and 33% of the total diet respectively. All these species of grasshoppers are serious pests of crops like paddy, sugarcane, cotton, wheat, maize and sorghum. Caterpillars consumption was recorded in 23% of the birds studied. In some cases, the caterpillars formed 80% of the total diet. The surface caterpillar, *Agrotis* sp., a serious pest of crops and vegetables was consumed by 9% of the birds studied. Beetles seems to be the (most) favourite diet of these birds. Beetles were recovered from 73% of the samples studied. The injurious beetles *Tanymacus* sp. and *Myllocerus blandus* Fst. were recorded from 12% and 6% respectively of the samples studied. These beetles accounted for 57% and 22% respectively of the total food intake. Both these species are serious pests of crops like maize, gram, wheat, mustard and groundnut. The less injurious beetles (*Gonocephalum* sp. and *Drasterius* sp. constituted 23% and 21% respectively of the total diet. These species were recovered from 3% and 6% respectively of the samples studied. The former is a pest of seeds of *Shorea robusta* and damages roots of crops like sugarcane and tobacco, whereas the latter is a minor pest of pototo. Thirty five percent of samples were found to contain harmless beetles. These included beetles like *Allisonotum simile* Arrow, *Onthophagus* sp., *Aphodius* sp., *Oxytelus andrewesi* Cameron, *Anadastus bifasciatus* (Mots.) and *Rhysodes boysi* Arrow. These beetles constituted 100%, 67%, 45%, 25%, 23% and 21% respectively of the total diet. The ants, *Pheidole* sp. which were consumed 100% in one case and *Dorylus* sp. were found in 22% of the samples studied. Both these species are minor pest of plants. The bugs do not appear to be liked much by these birds. Eleven percent of the samples studied were found to contain

four species of bugs *viz.*, *Eysarcocoris ventralis* Westw., *Cydnus indicus* Westw., *Oxyrhachis taranda* (Fabr.) and *Aeschrocoris* sp. which accounted for 30%, 16%, 9% and 5% respectively of the diet. These bugs are considered injurious as they extract juices from succulent parts of plants.

Only two groups of beneficial insects *viz.*, Coccinelid beetles (*Coccinella* sp.) and honey bees (*Apis dorsata* Fabr.) were met with in the gut contents of 6% of samples studied. The Coccinelid bettles are known to prey upon different types of aphids pests of plants. The role of honey bees in plant pollination and honey industry is well known. Both these groups jointly accounted for 23% of the food recovered from the guts.

Two species of ticks were consumed by 4% of the birds studied. These were *Boophilus microplus* (Canestrini) and *Hyalomma anatolicum* Koch. Both these species are ectoparasite on mammals and cause diseases like anplasmosis and tick fever etc.

Eleven percent of the samples studied were found to contain two species of earthworms. The species were *Eutyphoeus waltoni* (Michaelson) and *Eutyphoeus orientalis* (Beddard) These earthworms accounted for as much as 86% and 73% respectively of the food intake.

All the five species of molluscs consumed by 18% of the birds studied, are hardly of any economic importance.

A few birds collected during the sowing season were found to contain seeds of wheat. But the percentage of such birds was as low as 4%. The occurrence of wheat seeds never exceeded 28% of the food intake. During the harvesting season neither wheat seeds nor any other grain were recovered from the guts of these birds. In fact these birds were never observed to feed in a freshly sown wheat field (Narang and Lamba, 1976). Twenty two percent of the birds studied contained lantana berries and in 9% of the samples, the food consisted entirely of lantana berries.

Sturnus contra contra Linnaeus is doing a wonderful job for the Indian agriculturists by feeding on grasshoppers, caterpillars and beetles which are injurious to crops. During the rainy season these birds may be said to cause a bit of harm to farmers by feeding on earthworms which bring organic matter above the surface of earth and make the soil more fertile.

The above discussion leaves none in doubt that *Sturnus contra contra* Linnaeus is much more beneficial to agriculture than it is harmful.

3. **Acridotheres tristis tristis** (Linnaeus), Indian Myna

Habits and habitat

According to Jerdon (1862), Baker (1926), Whistler (1928), Ali (1968), Ali and Ripley (1972), Dharamkumarsinhji and Lavkumar (1972) and Ganguly (1975), *Acridotheres tristis tristis* (Linnaeus) is one of the most (universally) common birds in India. It is essentially a bird of civilisation. It is found wherever man is found. It is a frequent visitor to human habitations and freely enters kitchen and gardens. It usually live in small parties or large flocks when not paired off for breeding. Flocks of *Acridotheres tristis tristis* (Linnaeus) follow the plough catching insects, caterpillars and grubs turned up with the soil. For the same reason they are seen in the fields when crops are being irrigated. They moves along with cattle to pick up insects disturbed by their movements and sit on their backs to pick off the ticks.

The above description is in comformity with our observations on the behaviour of *Acridotheres tristis tristis* (Linnaeus) around Dehra Dun.

Gravimetric and volumetric analysis of the food

During the period under study (1975-79), gravimetric and volumetric analysis of 104 adult specimen was done. The results are tabulated here below (Tables 11 and 12).

TABLE 11

Vegetable diet

Item of diet	N	W	%Wt.	Remarks
Family: Papilionaceae				
Pisum sativum L.	7	2.01 gms	88	Green peas
Phaseolus mungo L.	3	.31 mgms	20	Kitchen waste
Arachis hypogea L.	9	.70 mgms	46	Pieces of ground-nut
Cicer arietinum L.	3	.19 mgms	8	Kitchen waste
Lens culinaris Medic.	4	.80 mgms	64	Kitchen waste and cereals in legume

Item of diet	N	W	%Wt.	Remarks
Phaseolus sp.	1	.42 mgms	24	Kitchen waste
Family: Myrtaceae				
Eucalyptus sp.				Observed feeding on the nectar
Family: Apiaceae				
Coriandrum sativum L.	3			Kitchen waste
Family: Solanaceae				
Solanum frutescens L.	14			Kitchen waste as well as green chillies
Solanum tuberosum L.	5	1.05 gms	91	Kitchen waste
Solanum melongena L.	2	.82 mgms	75	—do—
Solanum nigrum L.	2	2.37 gms	91	Ripe fruits
Family: Verbanaceae				
Lantana camara L.	27	4.14 gms	100	Berries and flower parts
Family: Proteaceae				
Grevillea robusta Cam.	4	.63 mgms	34	Flower parts
Family: Moraceae				
Ficus benghalensis L.	3	2.43 gms	78	Berries
Ficus religiosa L.	5	3.40 gms	90	—do—
Family: Poaceae				
Triticum aestivum L.	37	4.10 gms	100	Stored grains as well as germinating seedlings
Zea mays L.	6	3.42 gms	70	—do—
Oryza sativa L.	25	3.21 gms	100	Kitchen waste as well as stored grain
Family: Lauraceae				
Litsea monopetella (Roxb.)	2	2.00 gms	67	Fruits
Family: Mimosaceae				
Albizia lucida	1	.33 mgms	15	A plant introduced around Dehradun
Family: Rosaceae				
Pyrus communis L.				Observed feeding on the nectar
Miscellaneous				
Grammineae seeds	6	.97 mgms	48	Not identifiable
Weed seeds	5	.07 mgms	2	—do—

TABLE 12

Animal diet

Item of diet	N	V	%Vol.	Remarks
Phylum: Chordata				
Class: Reptilia				
Order: Squamata				
Family: Geckonidae				
Hemidoctylus sp.				Observed feeding on a lizard of 7-8 cm size
Class: Amphibia				
Order: Silentia				
Family: Microhylidae				
Microhyla ornata (Dumeril & Bibron)	1	.4 ml	23	Adult. Partially digested
Phylum: Annelida				
Class: Oligochaeta				
Order: Terricolae				
Family: Megascolecidae				
Eutyphoeus waltoni (Michaelson)	2	.3 ml	61	In pieces
Eutyphoeus orientalis (Beddard)	4	3.4 ml	87	—do—
Phylum: Mollusca				
Class: Gastropoda				
Order: Stylommatophora				
Family: Subulinidae				
Opeas gracilis Hutton	2			Complete and broken shells
Order: Basommatophora				
Family: Lymnaeidae				
Indoplanorbis exustus (Deshayes)	1			Complete shell
Misc. Mollusca (Fragments of shells)				Not identifiable
Phylum: Arthropoda				
Class: Insecta				
Order: Orthoptera				
Family: Tetrigidae				

Item of diet	N	V	%Vol.	Remarks
Hedotettix sp.	6	.3 ml	21	Partially digested
Paratettix sp.	4	.2 ml	17	—do—
Family: Gryllidae				
Gryllus sp.	4	.3 ml	26	Pest of paper, clothes, fruits
Liogryllus bimaculatus	2	.3 ml	32	Cuts through the stems of potato at ground level
Family: Gryllotalpidae				
Gryllotalpa sp.	9	.5 ml	28	Partially digested. Damages roots of crops
Family: Acrididae				
Chrotogonus sp.	7	.6 ml	37	Pest of wheat, sugarcane, cotton
Oxya sp.	4	.5 ml	29	Pest of kharif crops like maize, sorghum, rice
Spathosternum prasiniferum (Walk.)	11	.8 ml	59	Pest of crops like paddy, maize, wheat, sorghum, vegetables like brinjal and weeds
Acrida exaltata Walk.	8	.7 ml	67	Feeds on the leaves of paddy maize, sugarcane and millets
Aelopus sp.	5	.6 ml	46	Polyphagous and feeds on the leaves of paddy maize, sugarcane and millets
Misc. Grasshoppers (Fragments)				Not identifiable
Order: Dermaptera				
Family: Labiduridae				
Subfamily: Labidurinae				
Labidura sp.	2			Identified with only forceps
Family: Carcinophoridae				
Subfamily: Carcinophorinae				
Euborellia sp.	3			Identified with forceps only. Minor pest of ground-nut
Order: Dictyoptera				
Family: Blattidae				
Periplanata sp.	5	.6 ml	43	Partially digested. Pest of paper, clothes
Misc. Cockroaches (Fragments)				Partially digested. Pest of paper, clothes

Item of diet	N	V	%Vol.	Remarks
Order: Isoptera				
Family: Termitidae				
Odontotermes sp.	6	.5 ml	37	Partially digested. Pest of wood and damages wheat, sugarcane etc.
Order: Hemiptera				
Family: Pentatomidae				
Cydnus indicus Westw.	2	.1 ml	7	Extract juices from the succulent parts of plants
Eysarcocoris ventralis Westw.	5	.1 ml	5	—do—
Nezara viridula L.	2			Pest of vegetables like brinjal and potato
Family: Membracidae				
Oxyrhachis taranda (Fabr.)	1			Pest of citrus, mango, tamarinda, etc.
Family: Cicadellidae				
Idioscophus clypealis (Lethierry)	2			Pest of mango
Family: Lygaeidae				
Geocoris sp.	1			Known to be of predaceous nature
Blissus sp.	1			Found on the sugarcane and grasses but harmless
Order: Lepidoptera				
Family: Noctuidae				
Agrotis sp.	8	.7 ml	49	Larvae feeds on the seedlings of wheat, maize, potato, cucurbits
Heliothis armigera (Hubner)	4	.3 ml	30	Serious pest of gram, sorghum, maize
Misc. Caterpillars	9			Not identifiable
Order: Diptera				
Family: Muscidae				
Musca domestica Linn.	4	.1 ml	7	Carriers of germs of various diseases
Misc. Flies (Fragments)				Not identifiable
Order: Hymenoptera				
Family: Formicidae				

Item of diet	N	V	%Vol.	Remarks
Monomorium indicum Forel	6			Household pest
Dorylus orientalis Westw.	2			Eats plants below and at the level of soil
Dorylus labiatus Schuck	1			—do—
Subfamily: Myrmecinae				
Aphaenogaster sp.	2			
Pheidole sp.	16	.7 ml	57	Pest of wheat, paddy
Subfamily: Camponotinae				
Camponotus campressus Fabr.	4			Stored grain pest
Misc. Myrmecinae and Camponotinae ants				Not identifiable due to lack of workers
Order: Odonata				
Odonata larva	1	.3 ml	19	Not identifiable
Order: Plecoptera				
Stonefly larva	1	.1 ml	12	Not identifiable
Order: Coleptera				
Family: Chrysomelidae				
Oocassida pudibunda (Boh.)	2			
Rhapidopalpa foveicollis (Lucas)	1			Pest of vegetables like pumpkin, tinda, ghiatori
Family: Curculionidae				
Myllocerus blandus Fst.	2	.1 ml	8	Pest of crops like maize, wheat, arhar, ground-nut
Tanymacus sp.	3	.1 ml	11	Pest of rabi crops particularly wheat, gram, mustard
Pachytychius sp.	1			Pest of crops
Family: Tenebrionidae				
Gonocephalum sp.	3	.2 ml	18	Injurious to seeds of *Shorea robusta* and damages roots of tobacco and sugarcane
Family: Coccinellidae				
Coccinella sp.	1			Useful insect. Predaceous upon wheat aphids and mustard aphids
Family: Scarabaeidae				
Onthophagus sp.	3	.3 ml	27	Feeds in dung and on dead insects

Item of diet	N	V	%Vol.	Remarks
Allisonotum simile Arrow	2	.3 ml	12	
Aphodius sp.	3	.1 ml	5	Feed in dung
Miscellaneous				
Maggots larvae	8	1.2 ml	58	Unidentifiable
Insects (Fragments)				Not identifiable
Class: Arachnida				
Order: Acrina				
Family: Ixodidae				
Hyalomma marjinatume issaci Sharif	3	.1 ml	6	Ectoparasite on mammals and cause the disease anplasmosis, tick fever etc.
Boophilus microplus (Canestrini)	4	.1 ml	8	—do—
Order: Araneida				
Family: Lycosidae				
Lycosa nigrotibialis Simon	1			Feeds on insects
Lycosa sp.	2			—do—
Pardosa sp.	1			—do—
Salticus sp.	1			—do—
Misc. Spiders (Fragments)				Not identifiable
Class: Myriapoda				
Order: Chilopoda				
Family: Scolopendridae				
Otostigma sp.	1	.1 ml	12	Partially digested
Centipedes (Full and fragments)				Not identifiable. Observed feeding on a centipede of nearly 15 cms.
Order: Diplopoda				
Millipedes	2	.2 ml	9	Not identifiable

Seasonal food preference

The diet of this species kept on changing with the change of seasons, crop rotation, fruiting season, emergence of various groups of insects etc. during the year. The vegetable and animal matter that was available freely during the period was made use of. Out of the

available material, definite food preferences were indicated as can be seen from the following tabulated year-round monthly data (Table 13).

TABLE 13

Year-round record of the food materials consumed

Month	Food
January	Cooked rice—*Oryza sativa* L.; wheat seeds and seedlings—*Triticum aestivum* L.; lantana berries; maize—*Zea mays* L.; weeds—Unidentified; chillies—*Solanum frutescens* L.; urd—*Phaseolus mungo* L.; grammineae seeds—Unidentified; pieces of groundnut—*Arachis hypogea* L.; spider—*Lycosa* sp.; parts of grasshopper—Unidentified; flies—Unidentified; beetles—*Gonocephalum* sp., *Tanymacus* sp.; ticks—*Hyalomma marjinatume issaci* Sharif; ants—*Pheidole* sp.; caterpillars—Unidentified, *Heliothis armigera* (Hubner).
February	Weeds—Unidentified; chillies—*Solanum frutescens* L.; wheat seeds—*Triticum aestivum* L.; dal masur—*Lens culinaris* Medic.; green peas—*Pisum sativum* L.; paddy seeds—*Oryza sativa* L.; pieces of groundnut—*Arachis hypogea* L.; grammineae seeds—Unidentified; maize—*Zea mays* L.; dhania—*Coriandum sativum* L.; cooked potato—*Solanum tubersosum* L.; lobia—*Phaseolus* sp.; nectar of *Eucalyptus* sp. and *Pyrus communis* L.; houseflies—*Musca domestica* Linn.; beetles—*Onthophagus* sp.; ants—*Dorylus orientalis* Westw.; caterpillars—Unidentified.
March	Pieces of ground-nut—*Arachis hypogea* L.; wheat seeds and seedlings—*Triticum aestivum* L.; potato—*Solanum tuberosum* L.; dal channa—*Cicer arietinum* L.; maize—*Zae mays* L.; chillies—*Solanum frutescens* L.; dal malka masur (seeds and cereal in legume)—*Lens culinaris* Medic.; paddy—*Oryza sativa* L.; green peas—*Pisum sativum* L.; nectar of *Eucalyptus* sp. and *Pyrus communis* L.; beetles—*Allisonotum simile* Arrow, beetles—Unidentified; cockroach—*Periplanata* sp.; mollusc—*Indoplanorbis exustus* (Deshayes), odonata larva—Unidentified.
April	Wheat seeds—*Triticum aestivum* L.; potato—*Solanum tuberosum* L.; chillies—*Solanum frutescens* L.; rice (kitchen waste and stored paddy)—*Oryza sativa* L.; green peas—*Pisum sativum* L.; dhania (kitchen waste)—*Coriandum sativum* L.; lantana berries; seeds of *Litsea monopetella* (Roxb.); brinjal (kitchen waste)—*Solanum melongena* L.; weed seeds—Unidentified; flower parts of *Grevillia robusta* Cam.; cockroach parts—Unidentified; bugs—*Cydnus indicus* Westw., *Eysarcocoris ventralis* Westw., *Idioscophus clypealis* (Lethierry); maggots larvae—Unidentified; mollusc—*Opeas gracilis* Hutton; ants—*Pheidole* sp.; beetles—Unidentified.

Month	Food
May	Flower parts of *Grevillea robusta* Cam.; berries of peepal and banyan—*Ficus religiosa* L. and *Ficus benghalensis* L.; mole crickets —*Gryllotalpa* sp.; caterpillars—Unidentified, *Agrotis* sp.; beetles— *Rhapidopalpa foveicollis* (Lucas); earwig forceps—*Labidura* sp.; centipedes—Unidentified.
June	Flower parts of *Grevillea robusta* Cam.; berries of peepal and banyan—*Ficus religiosa* L. and *Ficus benghalensis* L.; ripe fruits of makoh—*Solanum nigrum* L.; wheat—*Triticum aestivum* L.; crickets —*Hedotettix* sp., *Gryllus* sp.; grasshoppers—*Acrida exaltata* Walk.; mole crickets—*Gryllotalpa* sp.; caterpillars—Unidentified, *Agrotis* sp.; spider—*Lycosa nigrotibialis* Simon; millipedes—Unidentified; mollusc —*Opeas gracilis* Hutton; beetles—*Aphodius* sp.; ticks—*Boophilus microplus* (Canestrini); bug—*Geocoris* sp.
July	Cookroach—*Periplanta* sp.; ants—*Pheidole* sp., *Aphaenogaster* sp., *Camponotinae* ants; earthworms—*Eutyphoeus orientalis* (Beddard) and *Eutyphoeus waltoni* (Michaelson); termites—*Odontotermes* sp.; caterpillars—Unidentified; beetles—*Aphodius* sp., *Onthophagus* sp., *Coccinella* sp.; crickets—*Paratettix* sp.; grasshoppers—*Chrotogonus* sp., *Spathosternum prasiniferum* (Walk.); maggots larvae—Unidentified; bugs—*Blissus* sp.; flower parts of *Grevillea robusta* Cam.; chillies—*Solanum frutescens* L.; dal channa—*Cicer arietinum* L.; maize—*Zea mays* L.; pieces of groundnut—*Arachis hypogea* L.; fruits of *Litsea monopetella* (Roxb.); lantana berries.
August	Ants—*Pheidole* sp., *Camponotus campressus* Fab.; maggots larvae— Unidentified; caterpillar—Unidentified; beetles—Unidentified; spiders —*Pardosa* sp.; cockroach—*Periplanata* sp.; grasshoppers—*Acrida exaltata* Walk., *Oxya* sp., *Spathosternum prasiniferum* (Walk.), *Aelopus* sp.; crickets—*Gryllus* sp., *Hedotettix* sp.; frog—*Microhyla ornata* (Dumeril and Bibron).
September	Termites—*Odontotermes* sp.; beetles—*Pachytychius* sp., *Onthophagus* sp.; *Allisonotum simile* Arrow; maggots larvae—Unidentified; cockroach—Unidentified; crickets—*Paratettix* sp.; ants—*Pheidole* sp., *Dorylus orientalis* Westw., *Monomorium indicum* Forel; mole crickets —*Gryllotalpa* sp.; grasshoppers—*Chrotogonus* sp., *Acrida exaltata* Walk., *Spathosternum prasiniferum* (Walk.), *Aelopus* sp.; wheat seeds—*Triticum aestivum* L.; pieces of groundnut—*Arachis hypogea* L.; dhania (kitchen waste)—*Coriandum sativum* L.; dal mung (kitchen waste)—*Phaseolus mungo* L.; chillies—*Solanum frutescens* L.; *Lantana* berries.

Month	Food
October	Earthworms—*Eutyphoeus orientalis* (Beddard) and *Eutyphoeus waltoni* (Michaelson); ants—*Pheidole* sp., *Monomorium indicum* Forel; cockroach—Unidentified; stonefly larva—Unidentified; bugs—*Eysarcocoris ventralis* Westw., *Nezara viridula* L.; caterpillars—Unidentified, *Agrotis* sp.; maggots larvae—Unidentified; grasshoppers—*Acrida exaltata* Walk., *Chrotogonus* sp., *Oxya* sp.; crickets—*Hedotettix* sp., *Liogryllus bimaculatus*; beetles—*Oocassida pudibunda* (Boh.); seeds of *Albizia lucida*; chillies—*Solanum frutescens* L.; lantana berries; dal masur (kitchen waste)—*Lens culinaris* Medic.
November	Wheat seeds—*Triticum aestivum* L.; maize—*Zea mays* L.; lantana berries; paddy seeds—*Oryza sativa* L.; grammineae seeds—Unidentified; dal channa (kitchen waste)—*Cicer arietinum* L.; ants—*Pheidole* sp., *Aphaenogaster* sp.; termites—*Odontotermes* sp.; beetles—*Myllocerus blandus* Fst.; ticks—*Hyalomma marjinatume issaci* Sharif; spiders—*Salticus* sp.; earwig forceps—*Euborellia* sp.; aphid—*Oxyrhachis taranda* (Fabr.); houseflies—*Musca domestica* Linn.; centipedes—*Otostigma* sp.; grasshoppers—*Spathosternum prasiniferum* (Walk.), *Aelopus* sp., *Acrida exaltata* Walk.
December	Rice (kitchen waste as well as stored paddy)—*Oryza sativa* L.; lantana berries; green peas—*Pisum sativum* L.; wheat seeds—*Triticum aestivum* L.; pieces of groundnut—*Arachis hypogea* L.; mole crickets—*Gryllotalpa* sp.; ants—*Pheidole* sp., *Dorylus labiatus* Schuck; ticks—*Boophilus microplus* (Canestrini); spider—*Lycosa* sp.; beetle—*Tanymacus* sp.; earwig forceps—*Euborellia* sp.; caterpillars—*Agrotis* sp.; *Heliothis armigera* (Hubner).

Discussion

The food of *Acridotheres tristis tristis* (Linnaeus) has been recorded by workers like Jerdon (1862), Mason and Lefroy (1912), Baker (1926), Whistler (1928), Fletcher and Inglis (1936), Hussain and Bhalla (1937), Bates and Lowther (1952), Dharamkumarsinhji and Lavkumar (1972), Yadava *et al* (1973), Toor and Ramzan (1974), Moeed (1976) and Atwal (1976) Out of these Mason and Lefroy (1912), Hussain and Bhalla (1937), Toor and Ramzan (1974) and Moeed (1976) are perhaps the only one who based their results on the stomach analysis of these birds. However, no attempt was made by any of these workers to do detailed gravimetric or volumetric analysis of the food of this species.

The following vegetable and animal food materials which were

recovered during the present studies were also recovered by previous workers.

Vegetable materials: Paddy grains [*Oryza sativa* (Fig. 17)], *Ficus* fruits, maize grains [*Zea mays* (Fig. 18)], wheat (*Triticum aestivum*), groundnut (*Arachis hypogea*) and moong (*Phaseolus* sp.).
Animal materials: *Gryllotalpa* sp., *Oxya* sp., *Liogryllus bimaculatus*, *Camponotus campressus*, *Pheidole* sp., *Dorylus* sp., *Tanymacus* sp., *Myllocerus* sp. and caterpillars (Fig. 19)

A number of vegetable and animal matter have been recorded for the first time during the present studies. The vegetable matter not recorded previously were: green peas (*Pisum sativum*), channa (*Cicer arietinum*), masur (*Lens culinaris*), dhania (*Coriandum sativum*), chillies (*Solanum frutescens*), potato (*Solanum tuberosum*), brinjal (*Solanum melongena*), makoh (*Solanum nigrum*), lantana berries (*Lantana camara*), flower parts of silver oak (*Grevillea robusta*), fruits of *Litsea monopetella*, seeds of *Albizia lucida* and nectar of *Eucalyptus* sp. and *Pyrus communis*.

The animal matter recorded for the first time were molluscs (*Opeas gracilis*, *Indoplanorbis exustus*), crickets (*Hedotettix* sp., *Paratettix* sp.), grasshoppers [*Spathosternum prasiniferum* (Fig. 20), *Aelopus* sp.], earwigs (*Labidura* sp., *Euborellia* sp.), cockroaches (*Periplanata* sp.), bugs (*Cydnus indicus*, *Eysarcocoris ventralis*, *Nezara viridula*, *Oxyrhachis taranda*, *Idioscophus clypealis*, *Geocoris* sp., *Blissus* sp.), ants (*Moncmorium indicum*, *Aphaenogaster* sp.), beetles [*Oocassida pudibunda*, *Rhapidopalpa foveicollis*, *Gonocephalum* sp., *Onthophagus* sp., *Allisonotum simile* (Fig. 21), *Aphodius* sp. (Fig. 22), *Pachytychius* sp.], ticks [*Hyalomma marjinatume issaci* (Fig. 23), *Boophilus microplus*], spiders (*Lycosa* sp., *Pardosa* sp., *Salticus* sp.), centipedes (*Otostigma* sp.) and millipedes (Fig. 24)

Toor and Ramzan (1974) have contradicted the findings of Mason and Lefroy (1912) about consumption of beetles by these birds. They (Toor and Ramzan, 1974) recorded beetles throughout the year in the guts of these birds, whereas, Mason and Lefroy (1912) has said that these birds seldom eat beetles. In the present studies it was discovered that beetles were not a favourite item of food of these birds. Only 20% of the samples studied were found to contain beetles.

It is clear from the data (Tables 11 and 12) that *Acridotheres*

tristis tristis (Linnaeus) took more vegetable diet than animal diet. Out of the 104 samples of birds studied, 38 samples were found to contain 100% vegetable diet, 60 samples contained mixed diet and only 6 samples contained 100% animal diet. The animal diet consisted of grasshopers, crickets, mole crickets, termites, caterpillars, beetles, ants bugs and ticks. True to its generic name *Acridotheres* which means a grasshopper catcher, this species was found to be very much fond of grasshoppers. Dewar (1913) in his 'Glimpse of Indian birds' says that "grasshoppers are to the Common Myna what bread and meat are to the Englishmen, the *piece de resistance* of the menu" His observations have been confirmed in the present studies. 34% of the samples studied were found to contain five species of grasshoppers *viz.*, *Acrida exaltata* Walk., *Spathosternum prasiniferum* (Walk.), *Aelopus* sp., *Chrotogonus* sp., and *Oxya* sp. These grasshoppers were consumed to the extent of 67%, 59%, 46%, 37% and 29% respectively of the food intake. All these five species, as already said, are serious pests of crops. Crickets were recorded from 11% of the samples studied. *Gryllus* sp. and *Hedotettix* sp. formed 26% and 31% respectively of the total diet. The mole crickets *Gryllotalpa* sp. which occurred in 9% of the samples studied, constituted 28% of the diet. This species damages roots of crops because of its digging habits. Termites, *Odontotermes* sp. were found in 6% of the birds that were examined. This species damages crops like wheat and sugarcane and formed as much as 37% of the diet. Caterpillars which are a serious pest of crops and plants occurred in 18% of the samples studied. The consumption of caterpillars was found to the maximum of 49% of the food intake. As already said, *Acridoteres tristis tristis* (Linnaeus) seems to have a second preference for beetles. A few injurious beetles like *Myllocerus blandus* Fst., *Tanymacus* sp. and *Gonocephalum* sp. were found in 6% of the samples examined. But the percentage of injurious beetles in the total diet was never more than 18. Six species of ants were identified from 23% of the guts that were examined. But except for *Pheidole* sp. which formed 57% of the diet and which is a minor pest of crops, the rest of the ants constituted a negligible percentage of the food intake. Like *Sturnus contra contra* Linnaeus, this species also does not prefer bugs. Though seven species of bugs were recovered from 10% of the birds examined, only two species *viz.*, *Cydnus indicus* Westw. and *Eysarcocoris ventralis* Westw. constituted a moderate percentage *i.e.*, 7% and 5% respectively of the diet. All the bugs recovered were of harmful nature. The housefly, *Musca domestica* Linnaeus and ticks,

Boophilus microplus (Canestrini) and *Hyalomma marjinatume issaci* Sharif were recovered from 5% of the guts examined. These species constituted, 7%, 8% and 6% respectively of the food intake. The housefly is a well known carrier of germs of various diseases. Both the species of ticks are known vectors of diseases like anplasmosis and tick fever etc.

The only useful animal diet taken by these birds were earthworms, *Eutyphoeus waltoni* (Michaelson) and *Eutyphoeus orientalis* (Beddard) which formed 61% and 87% respectively of the diet during the rainy season. But the earthworms occurred in only 5% of the guts examined. Earthworms, as already said, make the soil more fertile by bringing organic matter above the surface of earth.

The vegetable diet of this species consisted of wheat, lantana berries, rice, groundnut, *Ficus* berries, maize and kitchen waste. Wheat and rice were consumed by 36% and 24% respectively of the birds studied and at least in 40% of the cases, the diet consisted entirely of these two items. Lantana berries were recovered in 25% of the samples studied and the berries formed 100% of the diet in few cases.

Conclusion

These birds are definitely injurious to cereal crops like wheat, gram, paddy etc. during the sowing as well as the harvesting time. During the rabi season scores of birds haunt the freshly sown wheat fields and destroy wheat seeds and small seedlings. A few birds have consumed as much as 4.10 gms of wheat in a single meal. Assuming that these birds have two major meals a day, a bird eats 8.20 gms of wheat daily during the sowing season and again during the harvesting season. Not only this, these birds are always present around and on roof tops of rice-shelters and feeds on paddy, maize or any other grain being processed or stored there.

During the intervening period, when the crops are growing, these birds seems to play a reverse role. During this period these birds are busy destroying and eating the crop pests like cutworms, caterpillars and larvae, thereby saving the crops to some extent.

From the foregoing account it can be concluded that *Acridotheres tristis tristis* (Linnaeus) does a great amount of harm during the sowing and harvesting seasons and compensates for it by feeding on grass-

hoppers, cutworms and caterpillars during the rest of the year. Hence it is a neutral bird.

4. **Acridotheres ginginianus** (Latham), Bank Myna

Habits and habitat

Bank Mynas are so called because they build their nests in earthern banks, in the sides of a well and in holes which the bird excavates for itself, always near the vicinity of water. According to workers like Jerdon (1862), Oats (1889), Dewar (1913), Baker (1926), Whistler (1928), Ali (1968) and Ali and Ripley (1972), *Acridotheres ginginianus* (Latham) is a social bird and keeps in flocks even during the breeding season. Although seen in crowded markets and railway platforms picking up titbits from the feet of passengers, it is more a bird of cultivation areas and open country side. It prefers localities near water. Flocks of *Acridotheres ginginianus* (Latham) follow the plough and pick up insects and grubs turned up with the soil. These birds are usually in attendance on grazing cattle and frequently visits dairy farms picking up insects from the ground and in dung. These birds ride on the back of cattle to pick out ticks from various body parts. Their other favourite resorts are irrigated fields, municipal refuse dumps and the neighbourhood of canals and jheels.

Not much could be added to this account on the basis of observations made during the study.

Gravimetric and volumetric analysis of the food

During the years of study (1975-79), gravimetric and volumetric analysis of 107 adult specimens was done. The results are tabulated here below (Tables 14 and 15).

TABLE 14

Vegetable diet

Item of diet	N	W	%Wt.	Remarks
Family: Rhamnaceae				
Ziziphus sp.	1	41 mgms	42	
Family: Papilionaceae				
Cicer arietinum	1	22 mgms	20	Legumes

Item of diet	N	W	%Wt.	Remarks
Pisum sativum L.	4	2.13 gms	100	Green peas
Butea monosperma (Lamk.)	1	1.16 gms	100	Flower parts
Arachis hypogea L.	7	1.13 gms		Pieces of groundnut
Family: Solanaceae				
Solanum frutescens L.	5	52 mgms	43	Green chillies
Family: Verbanaceae				
Lantana camara L.	17	2.45 gms	100	Berries as well as flower parts
Family: Proteaceae				
Grevillea robusta Cam.	2	27 mgms	17	Flower parts
Family: Moraceae				
Ficus benghalensis L.	6	1.63 gms	73	Ripe fruits
Ficus religiosa L.	4	2.71 gms	92	—do—
Family: Poaceae				
Triticum aestivum L.	14	3.50 gms	95	Seeds and germinating seedlings
Misc. Vegetable matter				Not identifiable

TABLE 15

Animal diet

Item of diet	N	V	%Vol.	Remarks
Phylum: Annelida				
Class: Oligochaeta				
Order: Terricolae				
Family: Megascolecidae				
Eutyphoeus orientalis (Beddard)	1	.6 ml	22	Pieces of earthworms
Phylum: Mollusca				
Class: Gastropoda				
Order: Stylommatophora				
Family: Ariophantidae				
Macrochalamys sp.	2			Complete shells
Phylum: Arthropoda				
Class: Insecta				

Item of diet	N	V	%Vol.	Remarks
Order: Orthoptera				
Family: Tetrigidae				
Paratettix sp.	4	.2 ml	21	Partially digested
Euparatettix sp.	6	.2 ml	19	—do
Family: Gryllidae				
Gryllus sp.	4	.5 ml	24	Destroys paper, clothes, fruits etc.
Turanogryllus sp.	2	.2 ml	8	
Family: Gryllotalpidae				
Gryllotalpa fossor Scudder	5	.5 ml	20	Damages roots of crops owing to its digging habits
Gryllotalpa sp.	11	.7 ml	37	—do—
Family: Acrididae				
Acrida exaltata Walk.	9	.1 ml	56	Feeds on the leaves of rice, maize, millets, sugarcane and grasses
Spathosternum prasiniferum (Walk.)	6	.5 ml	31	Pest of crops like paddy, maize, wheat, sorghum
Oxya sp.	3	.2 ml	19	Pest of kharif crops such as maize, sorghum, rice etc.
Aelopus sp.	5	.4 ml	27	Polyphagus and feeds on the leaves of rice, maize, sugarcane etc.
Family: Pyrgomorphidae				
Atractomorpha crenulata (Fabr.)	7	.4 ml	21	Pest of cereal crops
Misc. Grasshoppers (Fragments)				Not identifiable
Order: Dermaptera				
Family: Carcinophoridae				
Subfamily: Carcinophorinae				
Euborellia annulipes (Lucas)	4	.2 ml	11	Partially digested. Minor pest of groundnut
Euborellia sp.	3	.1 ml	20	Not fully developed
Family: Labiduridae				
Subfamily: Labidurinae				
Labidura sp.	2			Identified from forceps only
Nala lividipes (Dufour)	3			—do—

Item of diet	N	V	%Vol.	Remarks
Submafily: Spongiphorinae				
Spongovostox sp.	1			—do—
Family: Diplatyidae				
Subfamily: Diplatyinae				
Diplatys sp.	1			Identified from forceps only
Misc. Earwigs (Fragments)				Not identifiable
Order: Dictyoptera				
Cockroach parts	8	.7 ml	48	Not identifiable
Order: Isoptera				
Family: Termitidae				
Odontotermes sp.	4	.2 ml	12	Partially digested. Pest of wood and damages sugar-cane, wheat etc.
Order: Hemiptera				
Family: Pentatomidae				
Eysarcocoris ventralis (Westw.)	5	.1 ml	14	Extract juices of plants
Cydnus indicus Westw.	3			—do—
Cydnus nigritus F.	2			—do—
Cydnus sp.	3			—do—
Coptosoma cribrarium F.	2	.1 ml	17	—do—
Nezara viridula L.	3	.1 ml	13	Pest of vegetables like potato, brinjal
Order: Lepidoptera				
Family: Noctuidae				
Agrotis sp.	5	.4 ml	23	Larvae feeds on seedlings of potato, wheat, peas, sugar-cane, maize
Misc. Caterpillars	13	1.5 ml	100	Not identifiable
Head of a butterfly	1			—do—
Order: Diptera				
Family: Muscidae				
Musca domestica Linn.	2	.1 ml	10	Partially digested, carries germs of various diseases
Family: Ephydridae	1			Identified up to family level
Order: Hymenoptera				
Family: Formicidae				

Item of diet	N	V	%Vol.	Remarks
Subfamily: Myrmecinae				
Pheidole sp.	10			Pest of wheat, paddy
Lophomyrmex quadrispinosus (Jard.)				
Crematogaster sp.	4			
Subfamily: Dorylinae				
Dorylus labiatus Schuck	8	.1 ml	4	Eats plants below and at the level of the soil
Dorylus orientalis Westw.	9	.1 ml	20	
Subfamily: Camponotinae				
Camponotus campressus (Fabr.)	5			Household pest
Misc. Myrmecine and Camponotinae ants				Not identifiable due to lack of workers
Fragments of wasps				Not identifiable
Order: Coleoptera				
Family: Rhysodidae				
Rhysodes boysi Arrow	5			
Family: Coccinellidae				
Coccinella sp.	4	.4 ml	19	Useful insect, feeds upon wheat and mustard aphids
Family: Curculionidae				
Myllocerus blandus Fst.	5			Pest of maize, sorghum, groundnut
Tanymacus indicus Faust	4			Injurious to leaves of rabi crops like wheat, gram, mustard
Tanymacus sp.	4			—do—
Pachytychius sp.	2	.1 ml	8	
Family: Carabidae				
Acupalus sp.	3	.1 ml	6	
Dioryche sp.	2			
Macrochilus sp.	4	.2 ml	7	
Brachynus sp.	3	.1 ml	6	
Tachys sp.	1	.1 ml	6	
Clivina striata Putz	1			
Family: Tenebrionidae				

Anthracophora crucifera (Oliv)	2	.3 ml	16	
Gonocephalum depressum F.	2	.6 ml	100	Injurious to seeds of *Shorea robusta* and damages roots of sugarcane, tobacco
Gonocephalum sp.	7	.2 ml	8	—do—
Alphitobius sp.	1			
Family: Staphylinidae				
Cryptobium sp.	2			
Philonthus sp.	4	.1 ml	11	
Family: Scarabaeidae				
Onthophagus dama Fabr.	10	.6 ml	37	Feeds in dung and on dead insects
Onthophagus centricornis F.	7	.4 ml	28	—do—
Aphodius sp.	4	.2 ml	23	—do—
Allisonotum simile Arrow	21	2.1 ml	100	—do—
Family: Elateridae				
Drasterius sp.	3			Pest of potato
Family: Erotylidae				
Episcapha quadrimaculata (Wied)	1			Found chiefly in mushrooms and plant stems
Family: Heteroceridae				
Heterocercus sp.	4	.1 ml	5	Predaceous, feeds on the insect life of its habitat
Family: Chrysomelidae				
Diapromorpha turcica Fabr.	2			Larvae feeds on the leaves of plants, uncultivated shrubs and herbs
Haltica cyanea Web.	1			
Family: Langruidae				
Anadastus bifasciatus (Motsch)	2	.1 ml	6	
Family: Histeridae				
Hister sp.	2			Predaceous. A sp. of *Hister* is reported to feed on the *Agrotis* larvae
Family: Hydrophilidae	1			Identified upto family level only

Misc. Beetles (Fragments)				Not identifiable
Miscellaneous				
Maggots larvae	6	.3 ml	16	
Pupa	3	.3 ml	14	Not identifiable
Insect fragments				—do—
Class: Arachnida				
Order: Acrina				
Family: Ixodidae				
Hyalomma marjinatume issaci Sharif	4	.1 ml	33	Ectoparasite on cattle and cause the disease anplasmosis
Boophilus microplus (Canestrini)	9	.2 ml	11	—do—
Order: Araneida				
Family: Lycosidae				
Lycosa sp.	5	.1 ml	33	Predaceous. Feeds on insects
Pardosa oakleyi Gravely	1	.1 ml	3	—do—
Family: Araneidae				
Neoscona theis (Walckenaer)	1			Predaceous. Feeds on insects
Family: Clubionidae				
Chiracanthium sp.	1			Predaceous. Feeds on insects
Family: Theridiidae				
Theridion sp.	2			Predaceous. Feeds on insects
Class: Myriapoda				
Order: Chilopoda				
Family: Scolopendriidae				
Otostigma sp.	2	.1 ml	10	
Misc. Centipedes (Full and pieces)	7			Not identifiable

Seasonal food preference

The diet of this species kept on changing with the change of seasons, crop rotation, fruiting season, emergence of various groups of insects etc. during the year. The vegetable and animal matter that was freely available during the time was made use of. Out of the available material, definite food preferences were indicated as can be seen from the following tabulated year round monthly data (Table 16).

TABLE 16

Year-round record of the food materials consumed

Month	Food
January	Mole crickets—*Gryllotalpa* sp.; termites—*Odontotermes* sp.; beetles—*Gonocephalum depressum* F., *Allisonotum simile* Arrow, *Rhysodes boysi* Arrow, *Hister* sp.; *Pachytychius* sp.; mollusc—*Macrochalamys* sp.; ants—*Pheidole* sp.; pupa; spiders—*Pardosa* sp.; earwigs—*Euborellia annulipes* (Lucas); centipedes; wheat—*Triticum aestivum* L.; chillies—*Solanum frutescens* L.; channa legume—*Cicer arietinum* L.
February	Green chilles—*Solanum frutescens* L.; green peas—*Pisum sativum* L.; beetles—*Rhysodes boysi* Arrow, *Pachytychius* sp., *Allisonotum simile* Arrow, *Dioryche* sp., *Acupalus* sp., *Cryptobium* sp., *Anadastus bifasciatus* (Motsch), *Dipromorpha turcica* Fabr., *Onthophagus dama* Fabr.; ants—*Pheidole* sp., *Dorylus labiatus* Schuck, *Dorylus orientalis* Westw., *Crematogaster* sp.; termites—*Odontotermes* sp.; cockroach parts—Unidentified; earwigs forceps—*Euborellia* sp., *Nala lividipes* (Dufour); mole crickets—*Gryllotalpa* sp.; caterpillars—Unidentified; centipedes—Unidentified; spiders—*Lycosa* sp., *Pardosa* sp., *Chiracanthium* sp., *Theridion* sp.; mollusc—*Macrochalamys* sp.
March	Beetles—*Allisonotum simile* Arrow, *Rhysodes boysi* Arrow, *Tanymacus indicus* Faust, *Onthophagus centricornis* F., *Gonocephalum* sp.; spiders—*Pardosa* sp., *Lycosa* sp.; crickets—*Gryllus* sp.; mole crickets—*Gryllotalpa* sp.; centipedes—unidentified; ants—*Pheidole* sp., *Dorylus orientalis* Westw.; caterpillars—*Agrotis* sp.; earwigs—*Euborellia annulipes* (Lucas).
April	Flowers of *Butea monosperma* (Lamk.); silver oak—*Grevillea robusta* Cam.; lantana seeds and flower parts; caterpillars—unidentified; ants—*Pheidole* sp., *Lophomyrmex quadrispinosus* (Jard.) *Camponotus campressus* Fabr., Myrmecinae ants; bugs—*Eysarcocoris ventralis* Westw., *Cydnus indicus* Westw.; beetles—*Allisonotum simile* Arrow, *Onthophagus dama* Fabr., *Clivina striata* Putz., *Aphodius* sp.
May	Lantana seeds and flower parts; silver oak—*Grevillea robusta* Cam.; berries of peepal and banyan—*Ficus religiosa* L., *Ficus benghalensis* L.; termites—*Odontotermes* sp.; mole crickets—*Gryllotalpa fossor* Scudder; caterpillars—unidentified; maggots larvae—unidentified; cockroach parts; bugs—*Cydnus nigritus* F., *Cydnus* sp.; spiders—*Pardosa* sp.; ants—*Pheidole* sp.; centipedes—unidentified.

Month	Food
June.	Beetles—*Allisonotum simile* Arrow, *Onthophagus dama* Fabr., *Phllonthus* sp., *Heterocercus* sp., *Macrochilus* sp.; maggots larvae—unidentified; cockroach parts; crickets—*Hedotettix* sp., *Euparatettix*; mole crickets—*Gryllotalpa* sp.; grasshoppers—*Acrida exaltata* Walk., grasshoppers fragments; berries of peepal and banyan—*Ficus religiosa* L., *Ficus benghalensis* L.
July	Beetles—*Onthophagus dama* Fabr., *Allisonotum simile* Arrow, *Rhysodes boysi* Arrow, *Drasterius* sp.; spiders—*Pardosa* sp., *Pardosa oaklevi* Gravely, *Theridion* sp.; bugs—*Eysarcocoris ventralis* (Westw.), *Nezara viridula* L.; grasshoppers—*Spathosternum prasiniferum* (Walk.), *Atractomorpha crenulata* (Fabr.); crickets—*Paratettix* sp.; centipedes—unidentified; berries of *Ficus religiosa* L. and *Ficus benghalensis* L.; *Ziziphus* sp.
August	Lantana berries, beetles—*Coccinella* sp., *Brachynus* sp., *Myllocerus blandus* Fst., *Episcapha quadrimaculata* (Wield), *Onthophagus centricornis* F., *Heterocercus* sp.; grasshoppers—*Oxya* sp., *Aelopus* sp., *Acrida exaltata* Walk.; crickets—*Euparatettix* sp.; mole crickets—*Gryllotalpa* sp.; spiders—*Pardosa* sp.; earwigs—*Euborellia* sp., *Labidura* sp.; ants—*Pheidole* sp., *Crematogaster* sp., *Dorylus orientalis* Westw.; ticks—*Hyalomma marjinatume issaci* Sharif.
September	Caterpillars—unidentified; lantana berries; crickets—*Gryllus* sp., *Paratettix* sp., *Euparatettix* sp., *Turanogryllus* sp:; mole crickets—*Gryllotalpa fossor* Scudder; grasshoppers—*Spathosternum prasiniferum* (Walk.), *Acrida* sp., *Atractomorpha crenulata* (Fabr.), *Acrida exaltata* Walk.; beetles—*Gonocephalum* sp., *Tanymacus indicus* Faust, *Macrochilus* sp., *Haltica cyanea* Web.; ants—*Pheidole* sp., *Lophomyrmex quadrispinosus* (Jard.); pieces of groundnut—*Arachis hypogea* L.; ticks—*Boophilus microplus* (Canestrini).
October	Grasshopper—*Acrida exaltata* Walk. *Spathosternum prasiniferum* (Walk.), *Atractomorpha crenulata* (Fabr.), *Aelopus* sp.; crickets—*Euparatettix* sp., *Turaneogryllus* sp.; bugs—*Eysarcocoris ventralis* Westw., *Cydnus* sp., *Coptosoma cribrarium* F.; ticks—*Boophilus microplus* (Canestrini); ants—*Pheidole* sp., *Dorylus labiatus* Schuck, *Camponotus campressus* Fabr.; beetles—*Drasterius* sp., *Allisonotum simile* Arrow, *Tanymacus* sp., *Aphodius* sp., *Alphitobius* sp.; ticks—*Hyalomma marjinatume issaci* Sharif; centipedes—*Otostigma* sp.

Month	Food
November	Lantana berries; wheat seeds and seedlings—*Triticum aestivum* L.; beetles—*Tanymacus* sp., *Myllocerus blandus* Fst., *Allisonotum simile* Arrow, *Anthracophora crucifera* Oliv., *Brachynus* sp., *Tachys* sp., *Philonthus* sp., *Heterocercus* sp., *Aphodius* sp., bugs—*Cydnus indicus* Westw., *Eysarcocoris ventralis* (Westw.); caterpillars— unidentified; *Agrotis* sp.; spiders—*Pardosa* sp., *Lycosa* sp., *Neoscona theis* (Walckenaer); head of a butterfly; pupa—unidentified; cockroach parts; grasshoppers—*Spathosternum prasiniferum* (Walk.), *Aelopus* sp., *Atractomorpha crenulata* (Fabr.); mole crickets—*Gryllotalpa* sp.; housefly—*Musca domestica* Linn.; ticks—*Boophilus microplus* (Canestrini); flies—unidentified.
December	Wheat seeds—*Triticum aestivum* L.; green chillies—*Solanum frutescens* L.; pieces of groundnut—*Arachis hypogea* L.; beetles—*Allisonotum simile* Arrow, *Onthophagus dama* Fabr.., *Myllocerus blandus* Fst., *Tanymacus indicus* Faust, *Coccinella* sp., aquatic beetle, *Philonthus* sp., *Gonocephalum* sp., caterpillars—*Agrotis* sp., caterpillars—unidentified; mole crickets—*Gryloltalpa* sp.; earwigs—*Euborellia* sp., *Nala lividipes* (Dufour), *Spongovostox* sp., *Diplatys* sp.; spiders—*Lycosa* sp., *Pardosa* sp.; ants—*Pheidole* sp., *Dorylus orientalis* Westw., *Dorylus labiatus* Schuck, *Lophomyrmex quadrispinosus* (Pard.), Myrmecinae ants; termites—*Odontotermes* sp.; ticks—*Boophilus microplus* (Canestrini); crickets—*Gryllus* sp., *Euparatettix* sp.; bugs—*Cydnus* sp.

Discussion

A number of notes have appeared from time to time on the food of *Acridotheres ginginianus* (Latham) To mention a few of them Jerdon (1862), Mason and Lefroy (1912), Dewar (1913), Ali (1968) and Simwat and Sidhu (1975) Out of these, Mason and Lefroy (1912) and Simwat and Sidu (1975) are the only one's who cared to examine the gut contents to arrive at their conclusion.

These workers however did not make any attempt to do detailed gravimetric or volumetric analysis of the food of this species.

The following vegetable and animal food materials which were recovered during the present studies were also recorded by previous workers.

Vegetable materials: Wheat (*Triticum aestivum*), berries of Banyan (*Ficus benghalensis*) and peepal (*Ficus religiosa*)

Animal materials: *Gryllotalpa* sp. (Fig. 25), *Oxya* sp., *Nezara viridula*, *Musca domestica*, *Camponotus campressus* and *Myllocerus* sp.

A large number of vegetable and animal matter have been recorded for the first time during the present studies. The vegetable matter recorded for the first time were: ber (*Ziziphus* sp.), channa (*Cicer arietinum*), flower parts of *Butea monosperma*, green peas (*Pisum sativum*), chillies (*Solanum frutescens*), lantana berries (*Lantana camara*) and silver oak (*Grevillea robusta*).

The animal matter not recorded by earlier workers were earthworms (*Eutyphoeus* sp.) and molluscs (*Macrochalamys* sp.). The following insects were recorded for the first time during the present studies. Crickets (*Paratettix* sp., *Euparatettix* sp., *Hedotettix* sp., *Gryllus* sp. and *Turanogryllus* sp.), grasshoppers [*Acrida exaltata* (Fig. 26), *Spathosternum prasiniferum*, *Aelopus* sp., *Atractomorpha* sp.], earwigs [*Euborellia* sp. (Fig. 27), *Labidura* sp., *Nala lividipes*, *Spongovostox* sp. Fig. 28) *Diplatys* sp.], termites (*Odontotermes* sp.), bugs *Eysarcocoris ventralis*, *Cydnus* sp., *Coptosoma cribrarium*), caterpillars (*Agrotis* sp.), ants [*Pheidole* sp., *Lophomyrmex quadrispinosus*, *Crematogaster* sp. (Fig. 29), *Dorylus labiatus* (Fig. 30)], beetles (*Rhysodes boysi*, *Coccinella* sp., *Tanymacus* sp., *Pachytychius* sp., *Acupalpus* sp., *Dioryche* sp., *Macrochilus* sp., *Brachynus* sp., *Tachys* sp., *Clivina striata*, *Anthroacophora crucifera*, *Gonocephalum* sp., *Alphitobius* sp., *Cryptobium* sp., *Philonthus* sp., *Onthophagus* sp., *Aphodius* sp., *Allisonotum simile*, *Drasterius* sp., *Episcapha quadrimaculata*, *Hetrocercus* sp., *Diapromorpha turcica*, *Haltica cyanea*, *Anadustus bifasciatus*, *Hister* sp.), ticks [*Hyalomma marjinatume issaci*, *Boophilus microplus* (Fig. 31), spiders (*Lycosa* sp., *Pardosa* sp., *Neoscona theis*, *Chiracanthium* sp., *Theridion* sp.), centipedes (*Otostigma* sp.) and pupa (Fig. 32)].

It is clear from the data (Table 14 & 15) that *Acridotheres ginginianus* (Latham) fed mostly on grasshoppers, crickets, caterpillars, ants, bugs, beetles, ticks, spiders, lantana and *Ficus* berries and wheat seeds. Twenty-three percent of the sample studies were found to contain five species of grasshoppers *viz.*, *Acrida exaltata* Walk, *Spathosternum prasiniferum* (Walk.), *Aelopus* sp., *Atractomorpha crenulata* (Fabr.) and *Oxya* sp. These species of grasshoppers were consumed to the extent of 56%, 31%, 27%, 21% and 19% respectively of the food intake. All these species are, as already said, serious pests of agricultural crops. The mole cricket *Gryllotalpa* sp., which damages

roots of crops was consumed by 15% of the birds studied. This cricket formed 37% of the diet. Fourteen percent of the samples contained five species of crickets. These were *Gryllus* sp., *Paratettix* sp., *Euparatettix* sp., *Hedotettix* sp. and *Turanogryllus* sp. These constituted 24%, 21%, 19%, 11% and 8% respectively of the diet. In a few cases caterpillars formed 100% of the diet which were found in 16% of the samples studied. Ants, though consumed by 30% of the birds studied, were not found in significant quantity in the birds diet. Six species of ants recovered from the guts are either household pests or minor pests of crops. Bugs were consumed by 14% of the samples studied but their percentage in the total diet was negligible. All the five species of bugs found in the guts are injurious as they extract juices from the succulent parts of plants. Beetles, unlike *Acridotheres tristis tristis* (Linnaeus) were consumed by nearly 50% of the samples studied. Beetles formed the major portion of this bird's diet also. Twenty six species of beetles were identified from the guts of these birds. The three species of curculionids beetles *viz.*, *Myllocerus blandus* Fst., *Tanymacus* sp. and *Pachytychius* sp., though found in 13% of the samples studied, were consumed in very small quantities. All these species are, as already said, serious pests of agricultural crops. Eight percent of the birds studied had taken the tenebrionid, *Gonocephalum* sp. This beetle damages roots of crops like sugarcane and tobacco and at times formed 100% diet of these birds. The harmless dung beetles were consumed by 35% of the samples studied. The four species of dung beetles recovered from the guts were: *Allisonotum simile* Arrow, *Onthophagus dama* Fabr., *Onthophagus centricornis* F and *Aphodius* sp. These beetles constituted as much as 100%, 37%, 28% and 23% respectively of the total food intake. The beetle *Allisonotum simile* Arrow was found in 20% of the birds studied and at least in 50% of the cases, the diet consisted entirely of these beetles.

Eleven percent of the samples contained two species of ticks. These were *Hyalomma marjinatume issaci* Sharif and *Boophilus microplus* (Canestrini) These species formed 33% and 11% respectively of the diet. These ticks cause diseases like anplasmosis and tick fever.

Six species of spiders were found in 14% of the samples studied. The two most prefered species were *Lycosa* sp. and *Pardosa* sp. which constituted 33% and 12% respectively of the total food intake.

The beneficial animal diet of this species consisted of earthworms

and two species of beetles. The earthworm, *Eutyphoeus orientalis* (Beddard), which brings organic matter above the surface of earth and makes the soil more fertile formed 22% of the diet. But it was consumed by just one bird out of 107 that were studied. Five percent of the samples contained two species of beetles *viz.*, *Coccinella* sp. and *Hister* sp. *Coccinella* sp. constituted 19% of the diet. These beetles are reported to prey upon different types of aphids and *Agrotis* larvae respectively.

The vegetable diet of these birds consisted chiefly of lantana and *Ficus* berries, groundnut and wheat seeds. Lantana and *Ficus* berries were consumed by 16% and 9% respectively of the birds studied. In a few cases the occurrence of these items was as high as 100% and 92% respectively of the food intake. Wheat seeds and seedlings were found in 13% of the samples studied and at times formed 95% of the diet.

Conclusion

From the foregoing account it can be judged that these birds are doing a lot of good by feeding on injurious species of grasshoppers, caterpillars and beetles, thereby saving crops to a large extent. During drought, these birds were found to feed on ticks which are responsible for diseases like anplasmosis and tick fever in cattles.

Hence one can easily conclude that *Acridotheres ginginianus* (Latham) is the best friend of farmers and steps should be taken to conserve and augment its population.

5. **Acridotheres fuscus fuscus** (Wagler), Northern Jungle Myna

Habits and habitat

As the name indicates, this Myna is a bird of the forest, though it usually frequents the neighbourhood of houses. According to Jerdon (1862), Oats (1889), Baker (1926), Whistler (1928) and Ali and Ripley (1972), *Acridotheres fuscus fuscus* (Wagler) is a resident bird with seasonal local movements. Unlike *Acridotheres tristis tristis* (Linnaeus), this bird is less dependent upon man. Except for the breeding season, this species is generally found in parties and sometimes in large flocks. Like the other mynas, these birds also follow the plough and accompany cattle to pick up insects disturbed by their movements.

Acridotheres fuscus fuscus (Wagler) often rides on the back of cattle and picks up ticks from their body parts.

The previous workers have reported this species to be less dependent upon man. During the present studies, these birds were seen feeding on kitchen waste. A bird, once, was seen feeding on a ball of dough.

Gravimetric and volumetric analysis of the food

During the period under study (1975-79), gravimetric and volumetric analysis of gut contents of 45 adult specimens was done. The results are tabulated here below (Tables 17 and 18)

TABLE 17

Vegetable diet

Item of diet	N	W	%Wt.	Remarks
Family: Malvaceae				
Hibiscus esculentes	2	1.56 gms	88	Seeds
Family: Rhamnaceae				
Ziziphus sp.	2	1.20 gms	39	Berries
Family: Papilionaceae				
Arachis hypogea L.	1	.40 mgms	16	Pieces of groundnut
Family: Mimosaceae				
Albizia lucida	3	.21 mgms	12	A plant introduced around Dehra Dun
Family: Myrtaceae				
Syzygium cumini (L.)	5	1.70 gms	92	Ripe fruits
Family: Apiaceae				
Coriandum sativum L.	1			Appears to be kitchen waste
Family: Solanaceae				
Solanum frutescens L.	1	.57 mgms	42	
Family: Verbanaceae				
Lantana camara L.	8	3.40 gms	100	Berries
Family: Proteaceae				
Grevillea robusta Cam.	1	.22 mgms	61	Flower parts
Family: Moraceae				
Ficus religiosa L.	2	1.11 gms	82	Berries
Ficus benghalensis L.	3	.78 mgms	74	—do—

Item of diet	N	W	%Wt.	Remarks
Family: Lauraceae				
Litsea monopetella (Roxb.)	1	1.04 gms	59	Fruits
Family: Poaceae				
Triticum aestivum L.	3	1.43 gms	83	Seeds and seedlings

TABLE 18

Animal diet

Item of diet	N	V	%Vol.	Remarks
Phylum: Arthropoda				
Class: Insecta				
Order: Orthoptera				
Family: Tetrigidae				
Acrydium sp.	1	.1 ml	9	Partially digested
Euparatettix sp.	3	.2 ml	15	—do—
Family: Gryllidae				
Gryllus sp.	3	.2 ml	21	Partially digested. Destroys clothes, paper, fruits
Family: Gryllotalpidae				
Gryllotalpa sp.	2	.1 ml	14	Badly damaged. Damages roots of crops
Family: Acrididae				
Acrida exaltata Walk.	4	.2 ml	21	Feeds on the leaves of paddy, maize, millets, sugarcane and grasses
Oxya sp. (Nymph)	1	.1 ml	10	Pest of crops such as maize, sorghum, paddy
Aelopus sp.	2	.2 ml	17	Polyphagous and feeds on the leaves of paddy, maize, millets, sugarcane and grasses
Family: Pyrgomorphidae				
Atractomorpha crenulata (Fabr.)	5	.3 ml	37	Pest of crops
Misc. Grasshoppers (Fragments)				Not indentifiable
Order: Dermaptera				

Item of diet	N	V	%Vol.	Remarks
Family: Labiduridae				
Subfamily: Labidurinae				
Labidura sp.	1			Identified from forceps only
Nala lividipes (Dufour)	1			—do—
Family: Carcinophoridae				
Subfamily: Carcinophorinae				
Euborellia sp.	2			Identified from forceps. Minor pest of groundnut
Order: Isoptera				
Family: Termitidae				
Subfamily: Termitinae				
Odontotermes sp.	4	.1 ml	9	Partially damaged. Pest of wood and damages wheat and sugarcane crops
Order: Hemiptera				
Family: Pentatomidae				
Cydnus sp.	1			Extract juices from succulent parts of plants
Eysarcocoris ventralis Westw.	3	.1 ml	8	—do—
Family: Lygaeidea				
Blissus sp.	1	.1 ml	14	Found on the sugarcane and grasses but harmless
Order: Lepidoptera				
Family: Noctuidae				
Agrotis sp.	4	.3 ml	31	Larvae feeds on the seedlings of wheat, maize, potato, cucurbits etc.
Misc. Caterpillars	6	1.4 ml	100	Not identifiable. Pest of various crops and plants
Order: Diptera				
Family: Barboridae				
Leptocera sp.	1			Partially digested
Misc. Flies (Fragments)				Not identifiable
Order: Hymenoptera				
Family: Formicidae				
Monomorium indicum Forel	3			Household pest

Item of diet	N	V	%Vol.	Remarks
Subfamily: Myrmecinae				
Lophomyrmex quadrispinosus (Jard.)	5			
Pheidole sp.	6	.1 ml	10	Pest of wheat, paddy
Aphaenogaster sp.	3			
Myrmecinae ants	3	2.1 ml	100	Not identifiable due to lack of workers
Subfamily: Dorylinae				
Dorylus orientalis Westw.	2			Eats plants below and at the level of soil
Misc. Camponotinae ants				Not identifiable due to lack of workers
Family: Apidae	1			Partially digested. Identified upto family level
Order: Coleoptera				
Family: Coccinellidae				
Coccinella septempunctata Linn.	2	.1 ml	8	Useful insects. Predaceous on aphids like wheat aphid, maize aphid, mustard aphid, cabbage aphid, brinjal aphid
Menochilus sexmaculata Fabr.	1			—do—
Coccinella sp.	1			—do—
Family: Curculionidae				
Myllocerus blandus Fst.	4	.1 ml	13	Serious pest of maize, sorghum, groundnut etc.
Tanymacus sp.	2			Pest of rabi crops like wheat, gram, mustard etc.
Pachytychius sp.	1			Pest of crops
Family: Histeridae				
Hister sp.	2			Useful insect. A sp. of *Hister* is reported to feed on the *Agrotis* larvae
Family: Scarabaeidae				
Allisonotum sp. nr. *simile* Arrow	6	.7 ml	28	Feeds in dung
Aphodius sp.	2			—do—

Item of diet				Remarks
Onthophagus sp.	3	.1 ml	17	Feeds in dung and dead insects
Family: Rhysodidae				
Rhysodes boysi Arrow	2			
Family: Elateridae				
Drasterius sp.	2	.1 ml	6	Pest of potato
Miscellaneous				
Maggots larvae	6	1.2 ml	100	Not identifiable
Pupa	2	.2 ml	12	—do—
Insect fragments				Not identifiable
Class: Arachnida				
Order: Acrina				
Family: Ixodidae				
Ticks				Observed feeding on ticks on cattle in dairy farm
Order: Araneida				
Family: Lycosidae				
Pardosa sp.	1			Carnivorous feeds on insects
Family: Linyphiidae				
Erigonidium sp.	2			Feeds on insects
Family: Myriapoda				
Order: Chilopoda				
Family: Scolopendridae				
Otostigma sp.	1	.1 ml	33	Partially digested
Centipedes	2			Not identifiable

Seasonal food preferences

The diet of this species too, like other Mynas, kept changing with the change of seasons, crop rotation, fruiting season, emergence of various groups of insects etc. during the year. The vegetable and animal matter that was available freely during the time was made use of. Out of the available material, definite food preferences were indicated as can be seen from the following tabulated year-round monthly data (Table 19)

TABLE 19

Year-round record of the food materials consumed

Month	Food
January	Pieces of groundnut—*Arachis hypogea* L.; maggots larvae—unidentified; cutworms—*Agrotis* sp.; flies—*Leptocera* sp.; beetle—*Aphodius* sp., *Allisonotum simile* Arrow; spider—*Erigonidium* sp.; pupa—unidentified.
February	Beetles—*Coccinella septempunctata* Linaeus, *Coccinella* sp., *Menochilus sexmaculata* Fabr., *Allisonotum simile* Arrow; caterpillars—unidentified; maggots larvae—unidentified; bees—family: Apidae (identified upto family level); bugs—*Eysarcocoris ventralis* Westw.; earwig forceps—*Labidura* sp.; ants—*Pheidole* sp., *Monomorium indicum* Forel; chillies—*Solanum frutescens* L.
March	Maggots larvae—unidentified;ants—*Pheidole* sp., *Dorylus orientalis* Westw., myrmecinae ants—identified upto subfamily level; spider—*Pardosa* sp.; beetles—*Onthophagus* sp., *Rhysodes boysi* Arrow; pieces of dhania (kitchen waste)—*Coriandum sativum* L.
April	Termites—*Odontotermes* sp.; caterpillars—unidentified; spider—*Theridion* sp.; vegetable matter—unidentified; lantana berries (seeds and flower parts).
May	Bhindi seeds—*Hibiscus esculentes* L.; lantana berries (seeds and flower parts); flower parts of *Grevillea robusta* Cam. seeds of *Alibizia lucida*; berries of peepal and banyan—*Ficus religiosa* L. and *Ficus benghalensis* L.
June	Lantana berries (seeds and flower parts); berries of *Ziziphus* sp.; jamun—*Syzygium cumini* (L.); seeds of *Alibizia lucida*; beetles—*Tanymacus* sp., *Rhysodes boysi* Arrow; ants—*Pheidole* sp., *Aphaenogaster* sp.
July	Jamun—*Syzygium cumini* (L.); lantana berries (seeds and flower parts); berries of *Ziziphus* sp.; fruits of *Litsea monopetella* (Roxb.); centipedes—*Otostigma* sp.; ants—*Lophomyrmex quadrispinosus* (Jard.), *Pheidole* sp., myrmecinae ants (identified up to subfamily level); beetles—*Onthophagus* sp., *Pachytychius* sp., *Myllocerus blandus* Fst., *Aphodius* sp.; termites—*Odontotermes* sp.; caterpillars—unidentified; mole crickets—*Gryllotalpa* sp.; bugs—*Blissus* sp.; maggots larvae—unidentified.

Month	Food
August	Lantana berries (seeds and flower parts); berries of peepal and banyan—*Ficus religiosa* L. and *Ficus benghalensis* L.; maggots larvae—unidentified; termites—*Odontotermes* sp.; centipedes—unidentified; ants—*Pheidole* sp., *Lophomyrmex quadrispinosus* (Jard.); beetles—*Hister* sp., *Allisonotum simile* Arrow; spider—*Erigonidium* sp.; flies—unidentified; grasshopper—*Atractonorpha crenulata* (Fabr.), *Acrida exaltata* Walk., *Oxya* sp. (Nymph).
September	Grasshoppers—*Acrida exaltata* Walk., *Aelopus* sp.; crickets—*Euparatettix* sp.; mole crickets—*Gryllotalpa* sp.; caterpillars—unidentified; cutworms—*Agrotis* sp.; earwig forceps—*Euborellia* sp.
October	Lantana berries; centipedes—unidentified; ants—*Pheidole* sp., *Monomorium indicum* Forel; beetles—*Myllocerus blandus* Fst.; crickets—*Acrydium* sp.; grasshoppers—*Atractomorpha crenulata* (Fabr.).
November	Beetles—*Myllocerus blandus* Fst., *Tanymacus* sp.; ants—*Pheidole* sp., *Aphaenogaster* sp., camponotinae ants (identified upto subfamily level); grasshoppers—*Aelopus* sp., *Atractomorpha crenulata* (Fabr.); crickets—*Gryllus* sp., *Euparatettix* sp.; earwig forceps—*Euborellia* sp.; lantana berries.
December	Wheat seeds and seedlings—*Triticum aestivum* L.; weeds—unidentified; bugs—*Cydnus* sp., *Eysarcocoris ventralis* Westw.; beetles—*Drasterius* sp., *Allisonotum simile* Arrow, *Onthophagus* sp.; earwig forceps—*Nala lividipes* (Dufour); cutworms—*Agrotis* sp.

Discussion

The diet of *Acridotheres fuscus fuscus* (Wagler) as reported by Jerdon (1862), Ali (1949), Ali and Ripley (1972) and Johnsingh (1979) is based upon field observations only. No stomach analysis was done by them. According to these workers, the food consists of fruits, berries and wild figs, grains, insects chierly grasshoppers and bugs and nector of *Erythrina* and *Bombax* etc.

As already mentioned, no stomach analysis was done by the previous workers. This is the first time that the food of this species has been studied by analysing the stomach contents. Twelve species of vegetable matter *viz.*, bhindi (*Hibiscus esculentes*), ber (*Ziziphus* sp.), groundnut (*Arachis hypogea*), seeds of *Albizia lucida*, jamun (*Syzygium cumini*), dhania (*Coriandum sativum*), chillies (*Solanum frutescens*), berries of

Lantana and *Ficus*, fruits of *Litsea monopetella*, flower parts of silver oak (*Grevillea robusta*) and wheat seeds (*Triticum aestivum*) were recorded. Amongs the animal diet thirty seven species of insects were identified. These included crickets (*Acrydium* sp., *Euparatettix* sp., *Gryllus* sp.), mole crickets (*Gryllotalpa* sp.), grasshoppers [*Acrida exaltata*, *Oxya* sp. (Fig. 33), *Aelopus* sp., *Atractomorpha crenulata*], earwigs (*Labidura* sp., *Nala lividipes*, *Eubcrellia* sp.), termites [*Odontotermes* sp. (Fig. 34)], bugs [*Cydnus* sp. (Fig. 35), *Eysarcocoris ventralis* (Fig. 36), *Blissus* sp.], caterpillars (*Agrotis* sp.), flies (*Leptocera* sp.), ants [*Monomorium indicum*, *Lophomyrmex quadrispinosus*, *Pheidole* sp. (Fig. 37), *Aphaenogaster* sp., *Dorylus orientalis* (Fig. 38)], beetles [*Coccinella septempuncatata*, *Menochilus sexmaculata*, *Mylloccrus blandus*, *Tanymacus* sp., *Pachytychius* sp. (Fig. 39), *Hister* sp., *Allisonotum simile*, *Aphodius* sp., *Onthophagus* sp., *Rhysodes boysi* (Fig. 40), *Drasterius* sp.], spiders (*Pardosa* sp., *Erigonidium* sp., *Theridion* sp.) and centipedes (*Otostigma* sp.).

The analysis of gut contents proved that *Acridotheres fuscus fuscus* (Wagler) fed on crickets, grasshoppers, termites, caterpillars, ants, beetles, maggots larvae, jamun, lantana and *Ficus* berries. Twenty seven percent of the samples studied were found to contain three species of grasshoppers. These were *Atractomorpha crenulata* (Fabr.), *Acrida exaltata* Walk. and *Aelopus* sp. These species constituted 37%, 21% and 17% respectively of the diet. All these species of grasshoppers, as already mentioned, are serious pest of agricultural crops. The mole crickets, *Gryllotalpa* sp. was consumed by barely 4% of the birds studied. In one sample its occurrence was as high as 78% of the diet. It damages roots of crops because of its subterrarean life. Two species of crickets were consumed by 16% of the birds studied. These were *Gryllus* sp.,, *Euparatettix* sp. and accounted for 21% and 15% respectively of the diet. Termites, *Odontotermes* sp. taken by 9% of the birds studied formed 9% of the food intake. Termites are known to damage wood and also crops like wheat and sugarcane. Caterpillars intake was found to be as high as 100%. These were found in 23% of the samples studied. Caterpillars are known pests of various crops. Ants were recovered from 29% of the samples studied. But except for *Pheidole* sp. and myrmecinae ants (unidentified) which accounted for 10% and 100% respectively of the food, the percentage of rest of the species of ants in the total diet was negligible. All the species of ants recovered are either household pests or pests of plants and

crops. Beetles were recovered from 36% of the samples studied. Thirteen percent of the samples studied were found to contain four species of injurious beetles. These were *Myllocerus blandus* Fst., *Tanymacus* sp., *Pachytychius* sp. and *Drasterius* sp. *Myllocerus blandus* Fst. and *Drasterius* sp. formed 13% and 6% of the food intake, while occurrence of rest of the two species was negligible. The dung beetles were consumed by maximum number of birds. The beetles *Allisonotum simile* Arrow was consumed by 13% of the birds studied and formed 28% of the diet. *Onthophagus* sp. consumed by 6% of the birds constituted 17% of the diet. *Aphodius* sp. taken by 4.5% of the birds studied was found to be of negligible quantity. All these species are harmless. Nine percent of the samples contained three species of bugs *viz.*, *Cydnus* sp., *Eysarcocoris ventralis* Westw. and *Blissus* sp. Last two of the species mentioned formed 8% and 14% respectively of the diet. These species of bugs extract juices from succulent parts of plants and are therefore injurious. Spiders were recovered from 7% of the samples studied. But their percentage in the diet was almost nil.

Three species of useful beetles were also consumed by these birds. These were *Coccinella septempunctata* Linnaeus *Menochilus sexmaculata* Fabr. and *Hister* sp. The *Coccinella* sp. were found in 7% of the samples studied and constituted 8% of the diet. *Menochilus* sp. was found in just one sample and its percentage in the total diet was negligible. These coccinelids are known to prey upon various aphids injurious to crops and vegetables like wheat, maize, mustard and brinjal etc. The *Hister* sp. was found in 4.5% of the samples studied but its percentage was almost zero. This beetle is reported to prey upon injurious *Agrotis* larvae.

The vegetable diet consisted chiefly of jamun *Syzygium cumini* (L.), lantana and *Ficus* berries. During the months of June and July, these birds were found to be seriously damaging and eating the fruits of Jamun. Ripe fruits were recovered from the guts of 11% of the samples studied and in cases its percentage was as high as 92% of the diet. *Ficus* berries were also recovered from 11% of the birds studied and it constituted 82% of the diet. Lantana berries were found in 18% of the birds studied and formed 100% of the diet.

Conclusion

Judging from the foregoing account it can be said that these birds

feed mostly on grasshoppers, caterpillars, ants and beetles which are either injurious to crops or are harmless. Like other species of Mynas, these are also feeding on lantana berries and helping in the dispersal of this nuisance shrub.

On the whole it appears that these birds do more good than harm and therefore should be protected by law.

Summary

The studies on the food habits of Mynas were initiated to analyse and asses the food intake of Mynas quantitatively as well as qualitatively in order to determine the exact quantum of loss or benefit done by these birds, *vis-a-vis* agriculture/horticulture etc.

The study was conducted in nature around the city of Dehra Dun. Birds were collected by shooting them with a 12 bore gun during and just after the feeding hours. The crops and gizzards of these birds were opened and gut contents were analysed and studied.

A combination of known methods *viz.* numerical method, gravimetric method and volumetric method was used to obtain the best results. For analysing the animal diet, a combination of numerical and volumetric methods was used. For analysing the vegetable diet, a combination of numerical and gravimetric methods was made use of.

The following species of Mynas were covered during the study:

1. *Sturnus pagodarum* (Gmelin), Brahminy Myna
2. *Sturnus contra contra* Linnaeus, Indian Pied Myna
3. *Acridotheres tristis tristis* (Linnaeus), Indian Myna
4. *Acridotheres ginginianus* (Latham), Bank Myna
5. *Acridotheres fuscus fuscus* (Wagler), Northern Jungle Myna

Sixty seven adult specimens of *Sturnus pagodarum* (Gmelin) were collected. The analysis of gut contents of these birds revealed that *Sturnus pagodarum* (Gmelin) is omnivorous in dietry habits but has a marked preference for insects some of which are injurious to agriculture. The gravimetric and volumetric analysis of gut contents revealed that *Sturnus Pagodarum* (Gmelin) is a beneficial bird.

In case of *Sturnus contra contra* Linnaeus, 141 adult specimens were

collected. The analysis of gut contents proved that *Sturnus contra contra* Linnaeus is chiefly insectivorous, though it feeds on fruits and berries also. After weighing all the pros and cons, it was found that *Sturnus contra contra* Linnaeus is much more beneficial to agriculture than it is harmful.

Acridotheres tristis tristis (Linnaeus) was found to be omnivorous in its dietry habits, although it took more vegetable diet than animal diet. After analysing the gut contents of 104 adult specimens it was discovered that these birds does a great amount of harm during the sowing and harvesting seasons but compensates for the damage by feeding on grasshoppers, cutworms, and caterpillars during the rest of the year. Hence it is a neutral bird.

Acridotheres ginginianus (Latham), like the previous species, was also found to be an omnivorous bird. But it took more insects than vegetable diet. Gravimetric and volumetric analysis of 107 adult specimens of this species was done and it was found that these birds fed mostly on harmful inspects like grasshoppers, caterpillars, ants and beetles etc. So these birds are much more beneficial to agriculture than any other species of Mynas.

Acridotheres fuscus fuscus (Wagler) was also found to feed upon vegetable as well as animal diet. Gravimetric and volumetric analysis of 45 adult specimen was done and it was proved that these birds does more good than harm to agriculture.

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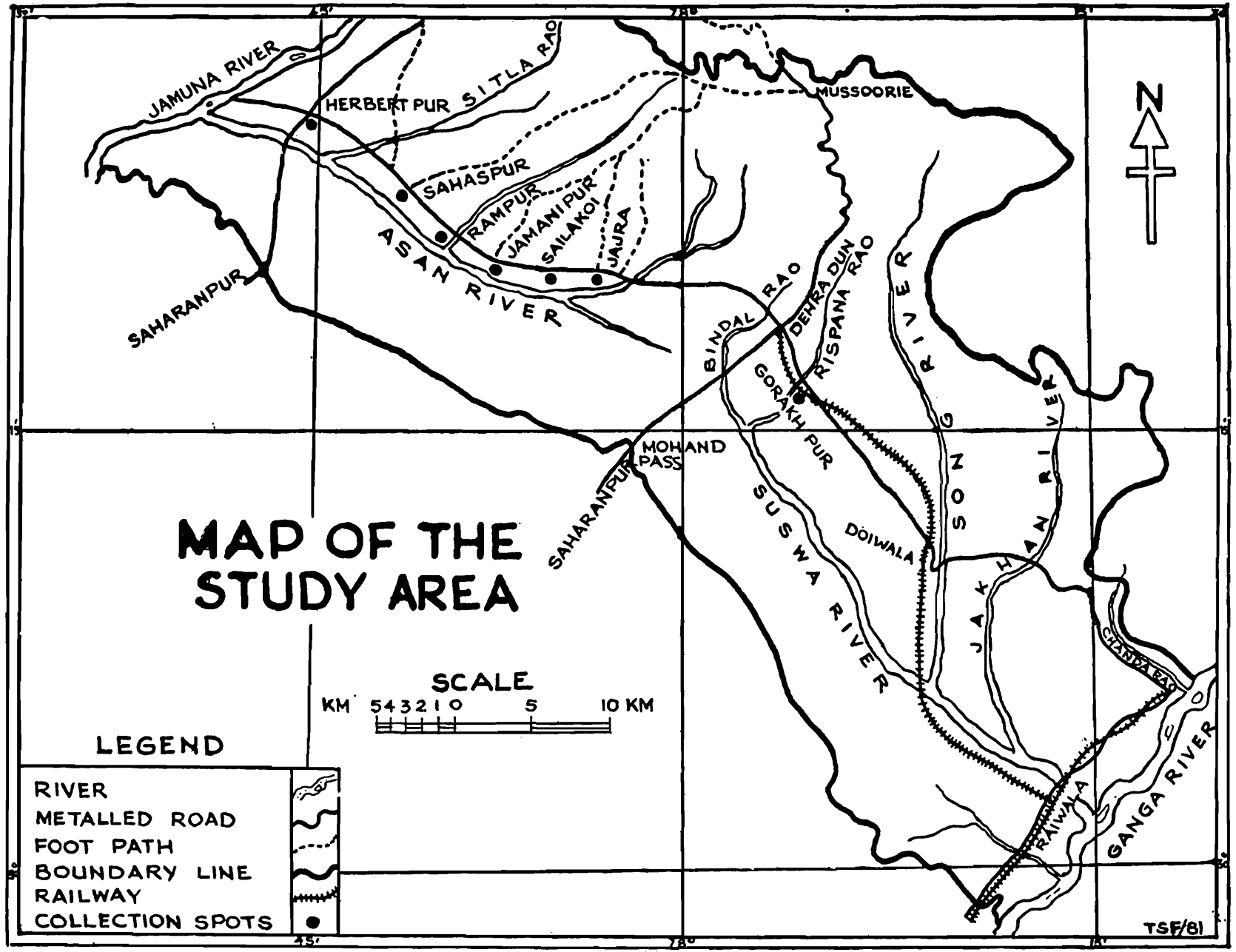
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MUSSOORIE
SAHASPUR
RAMPUR
JAMANIPUR
SAILAKOI
JAJRA
ASAN RIVER
SAHARANPUR
BINDAL RAO
DEHRA DUN
RISPANA RAO
SONG RIVER
GORAKH PUR
MOHAND PASS
SAHARANPUR
SUSWA RIVER
DOIWALA
JAKHAN RIVER
CHANDI PASS
RAIWALA
GANGA RIVER
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COLLECTION SPOTS
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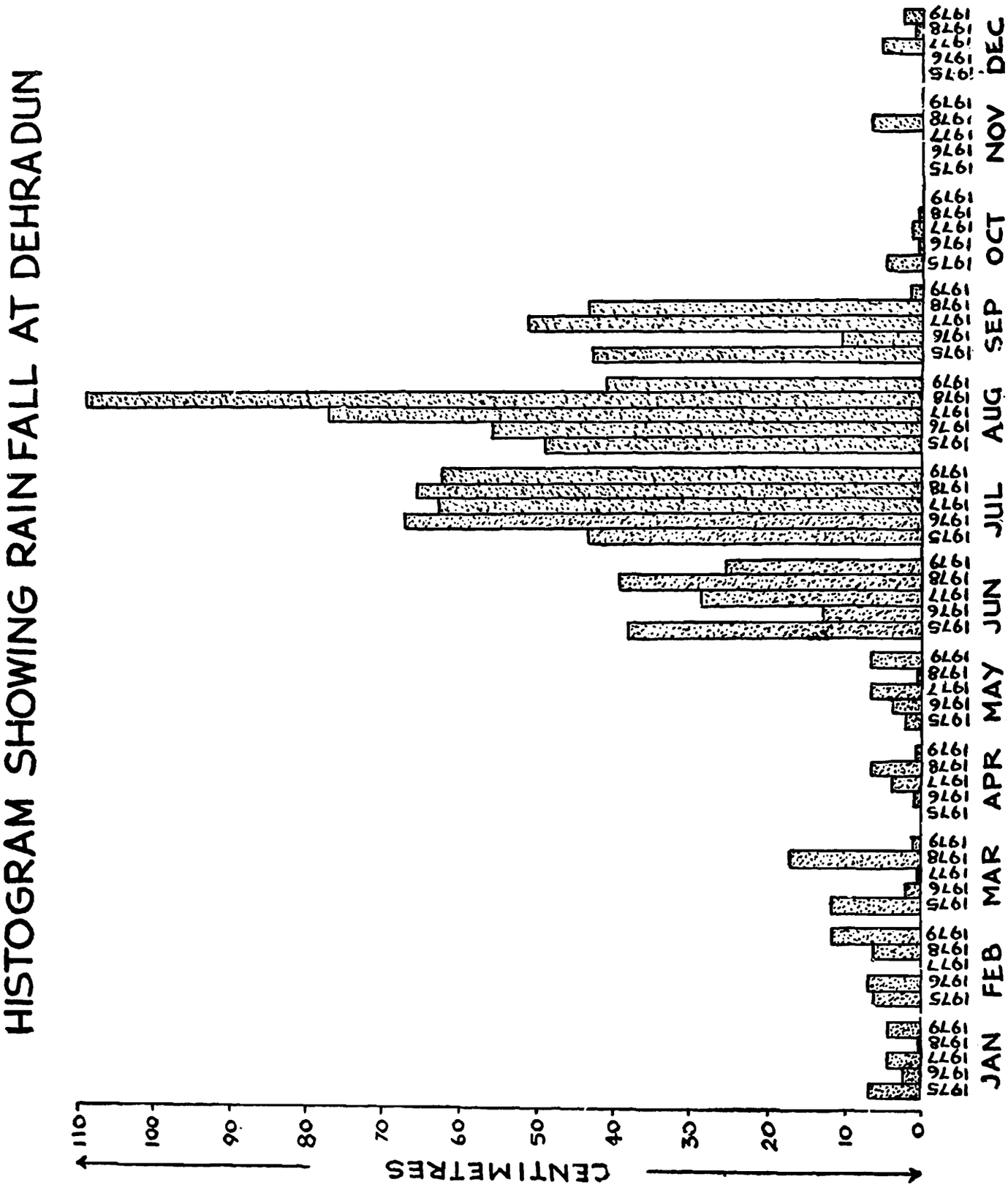
HISTOGRAM SHOWING RAIN FALL AT DEHRADUN
CENTIMETRES
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110
JAN
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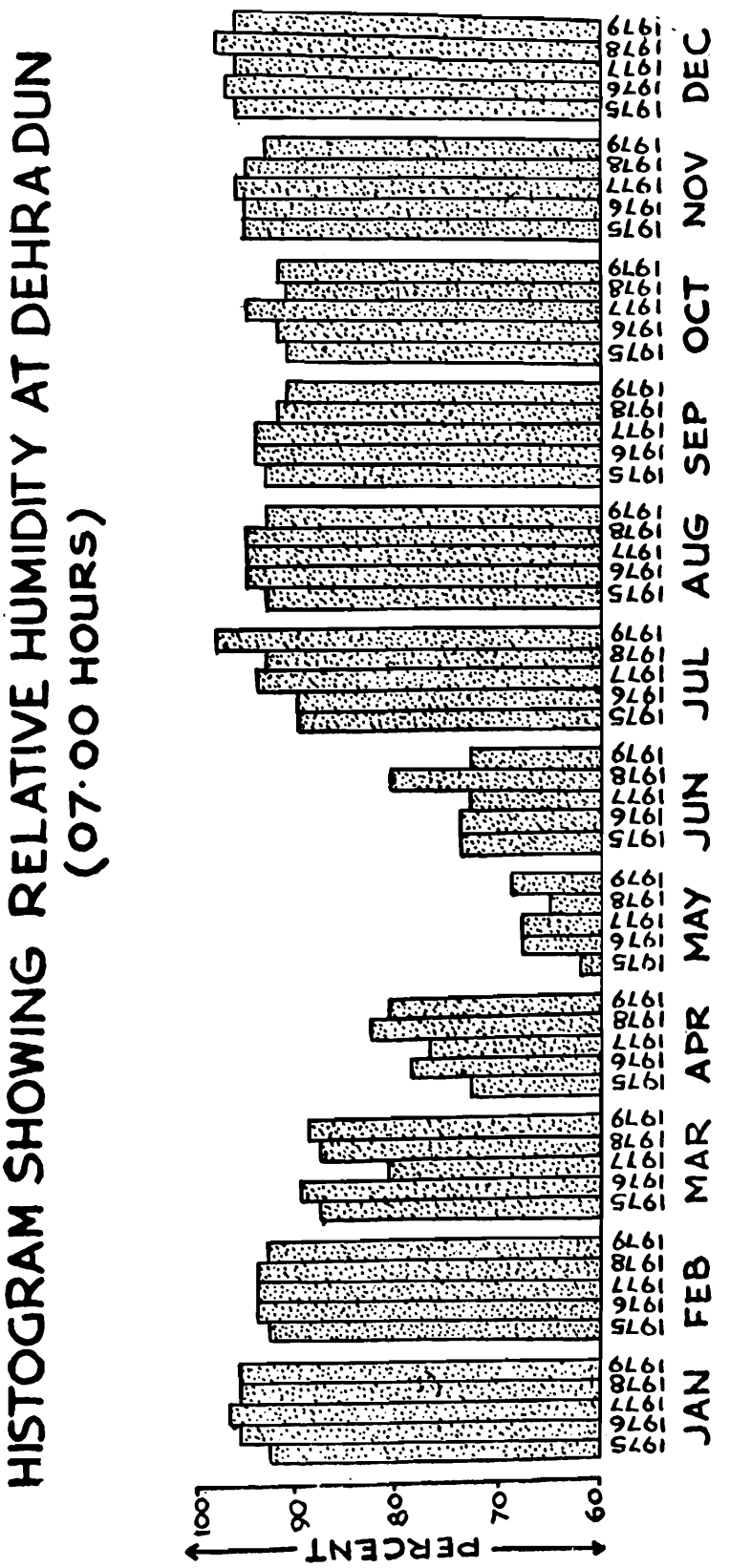
HISTOGRAM SHOWING RELATIVE HUMIDITY AT DEHRADUN
(07·00 HOURS)
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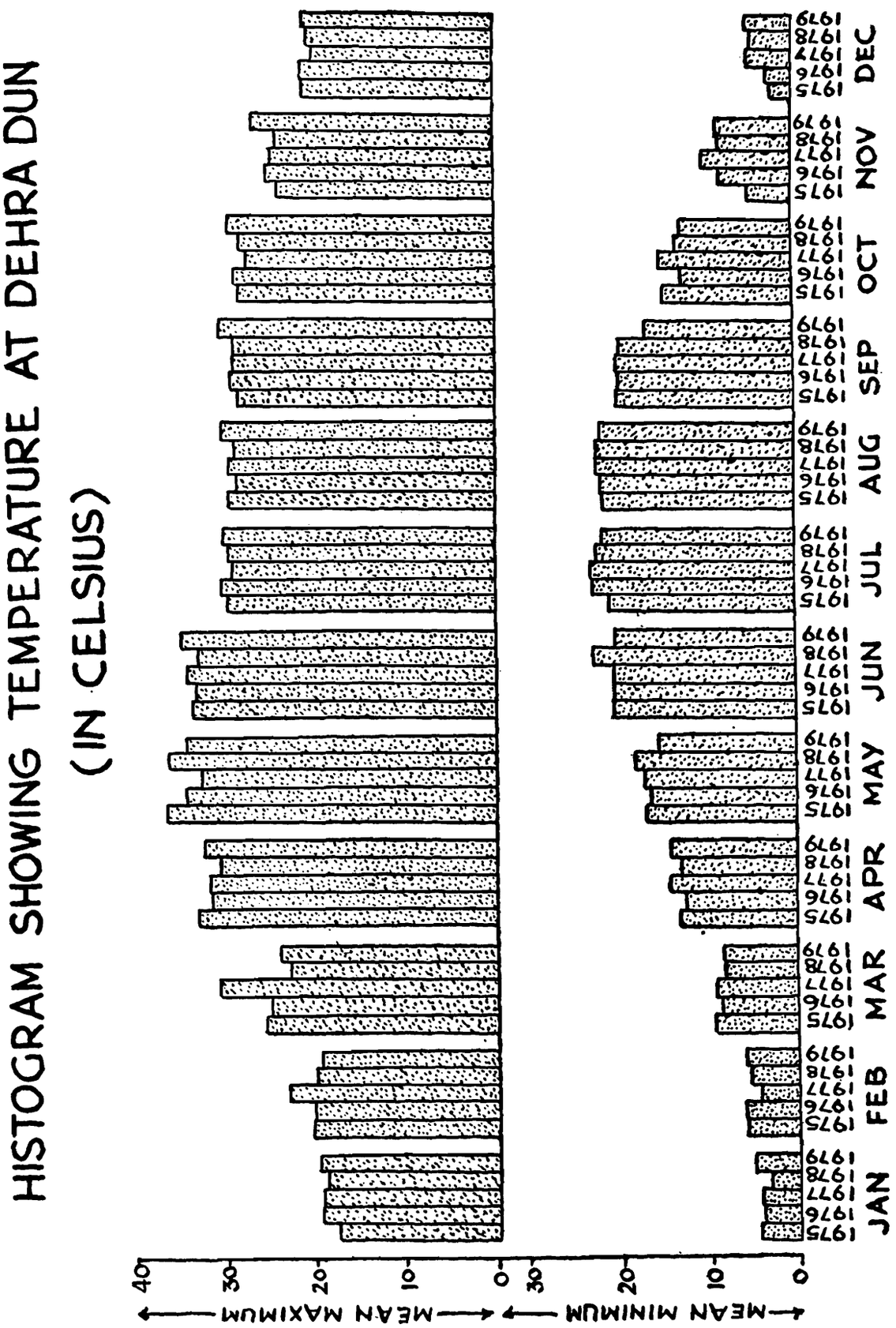
HISTOGRAM SHOWING TEMPERATURE AT DEHRA DUN
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MEAN MINIMUM
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Text-Fig. 4

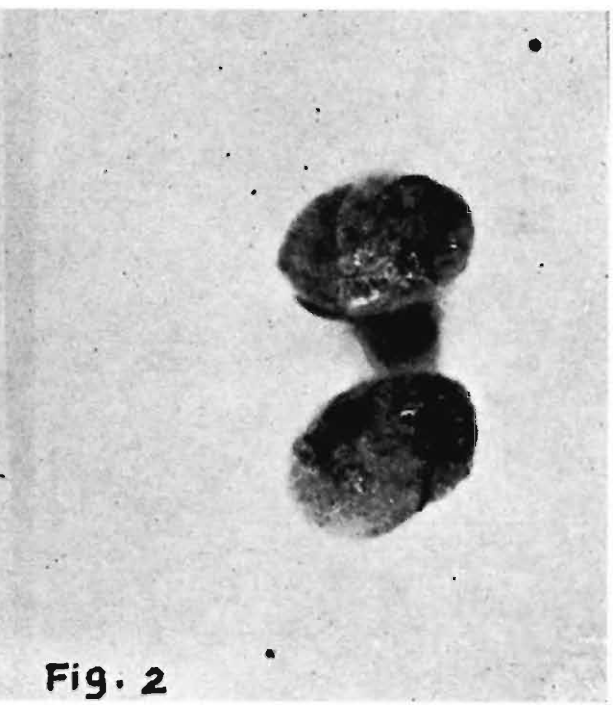

Fig. 1. Seeds of *Lantana camara* L.

Fig. 2. Seeds of *Litsea monopetella* (Roxb.)

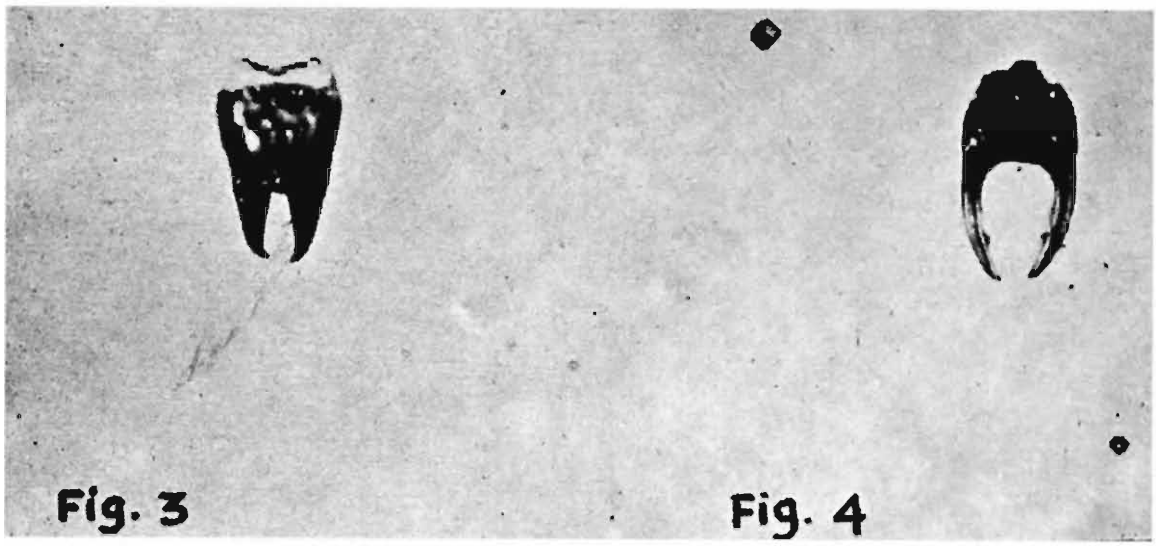

Fig. 3. Forcep of *Euborellia* sp.

Fig. 4. Forcep of *Nala lividipes* (Dufour)

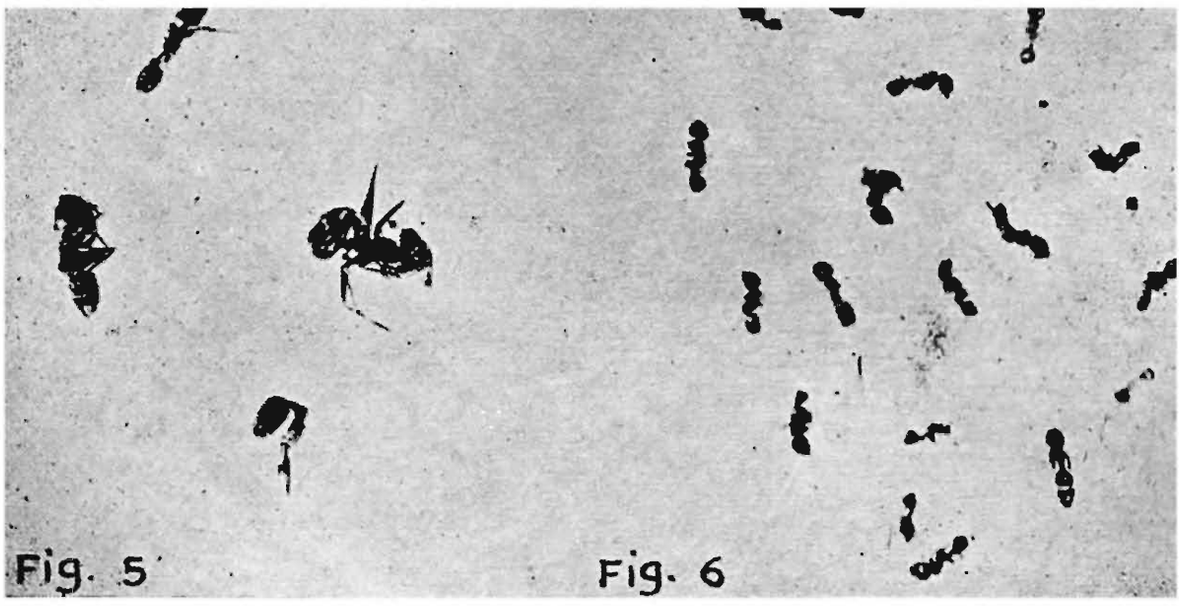

Fig. 5. *Pheidole* sp.

Fig. 6. *Lophomyrmex quadrispinosus* (Jard.)

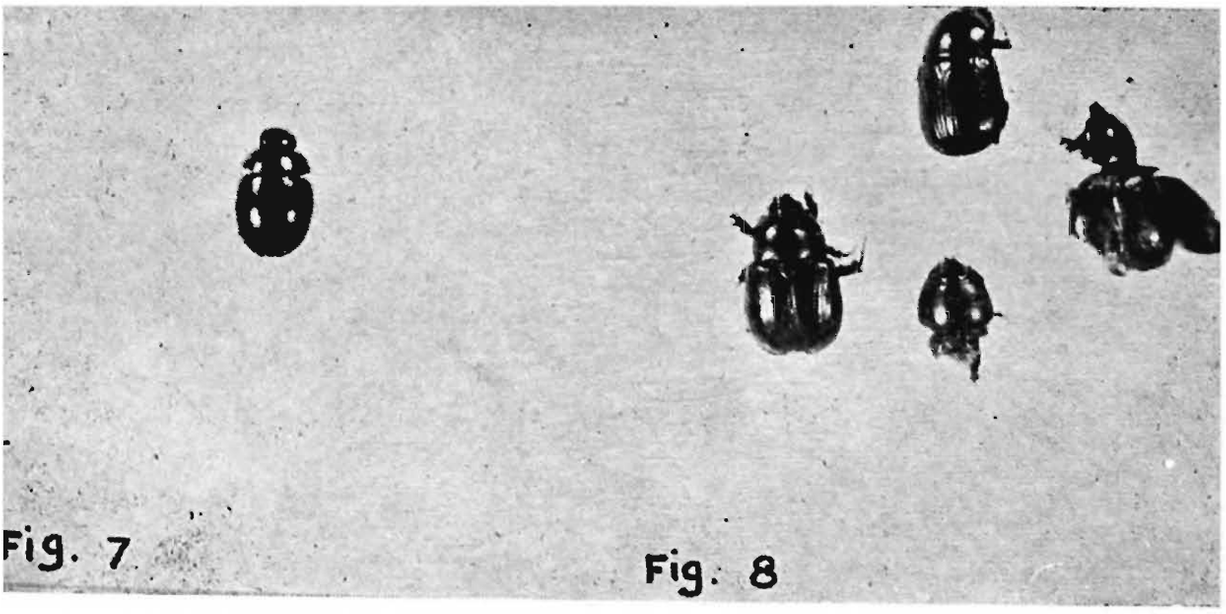

Fig. 7. *Onthophagus* sp.

Fig. 8. *Allisonotum simile* Arrow

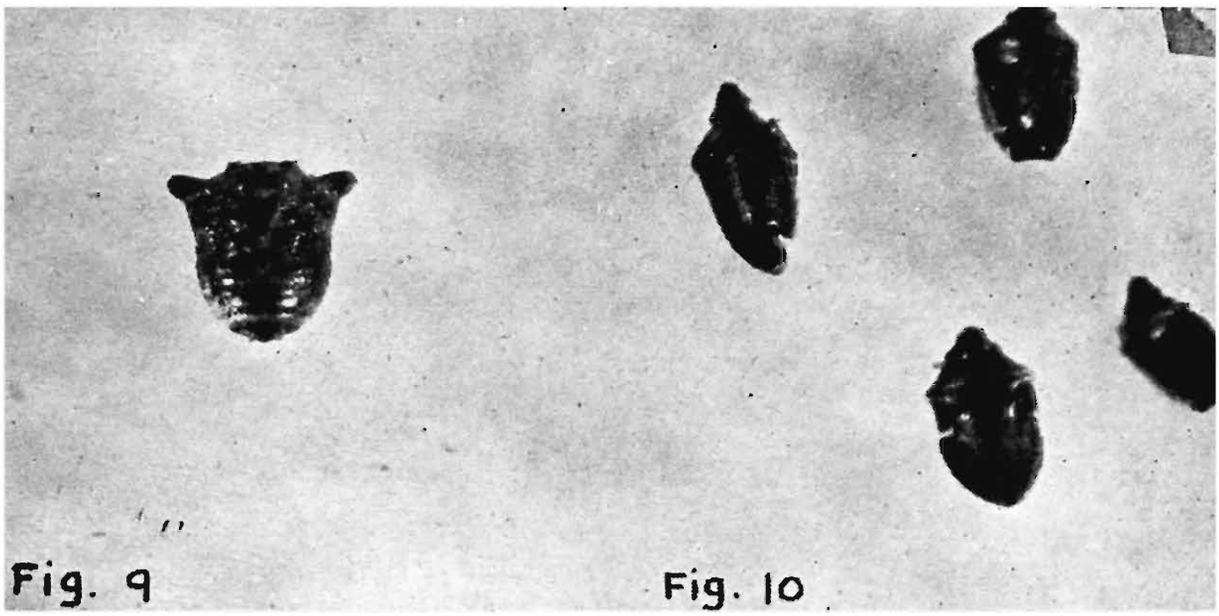

Fig. 9. *Aeschrocoris* sp.

Fig. 10. *Eysarcocoris ventralis* (Westw.)

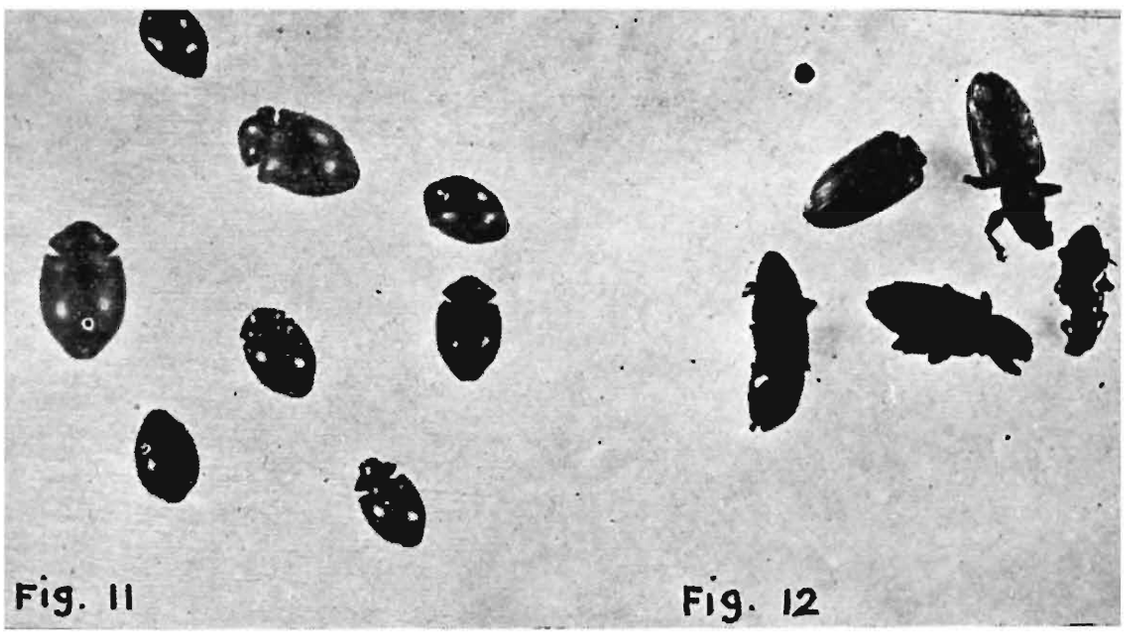

Fig. 11. *Rhysodes boysi* Arrow

Fig. 12. *Tanymacus* sp.

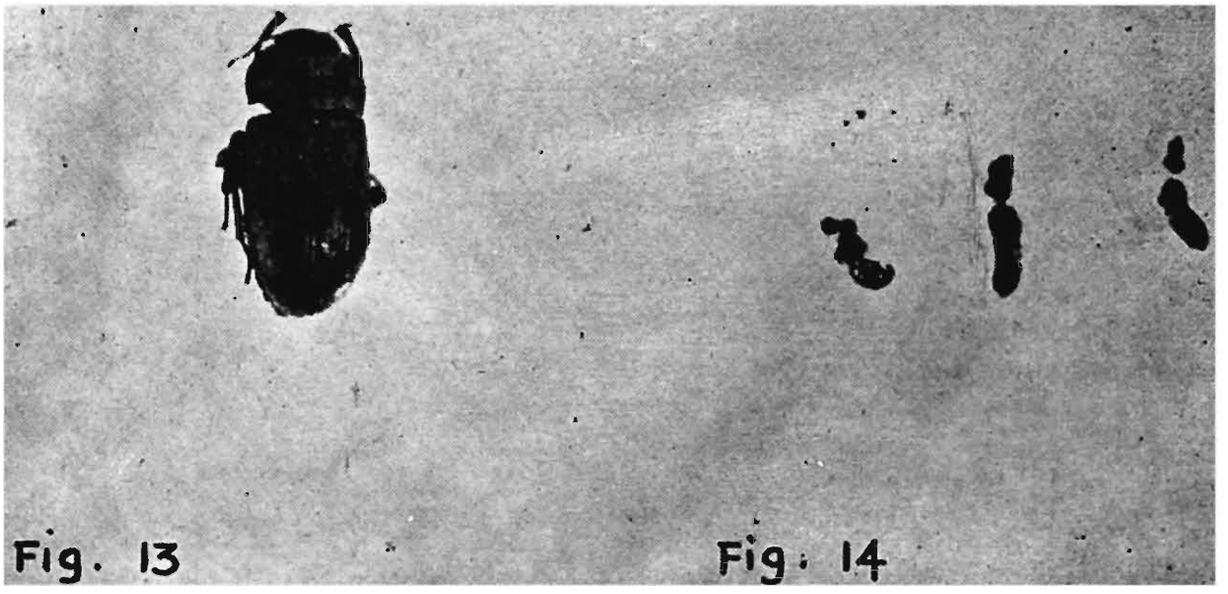

Fig. 13. *Gonocephalum* sp.

Fig. 14. *Philonthus* sp.

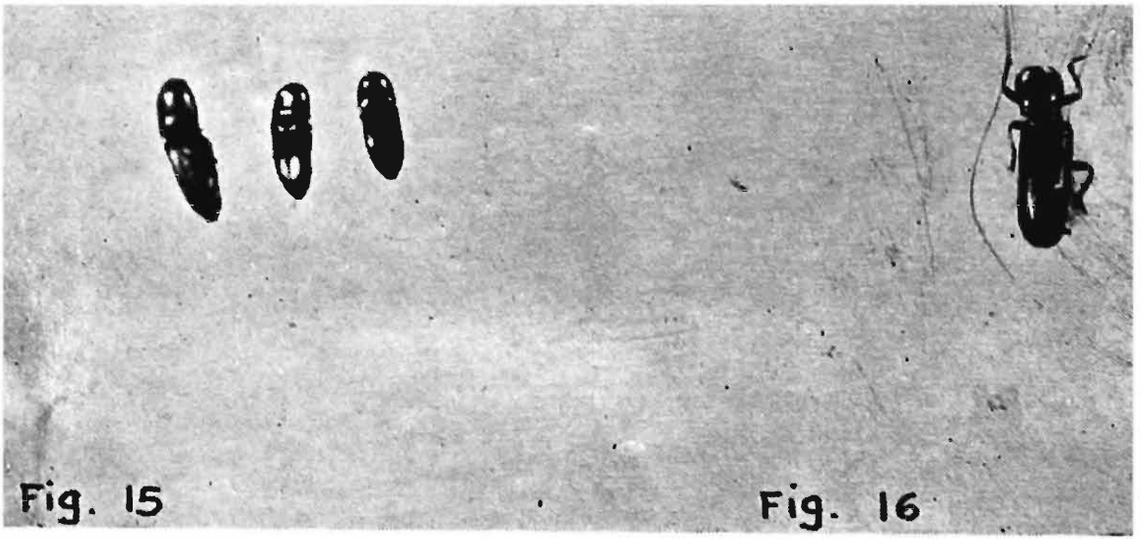

Fig. 15. *Drasterius* sp.

Fig. 16. *Anadustus bifasciatus* (Motsch)

Fig. 17. Grains of *Oryza sativa* L.
Fig. 18. Grains of *Zea mays* L.

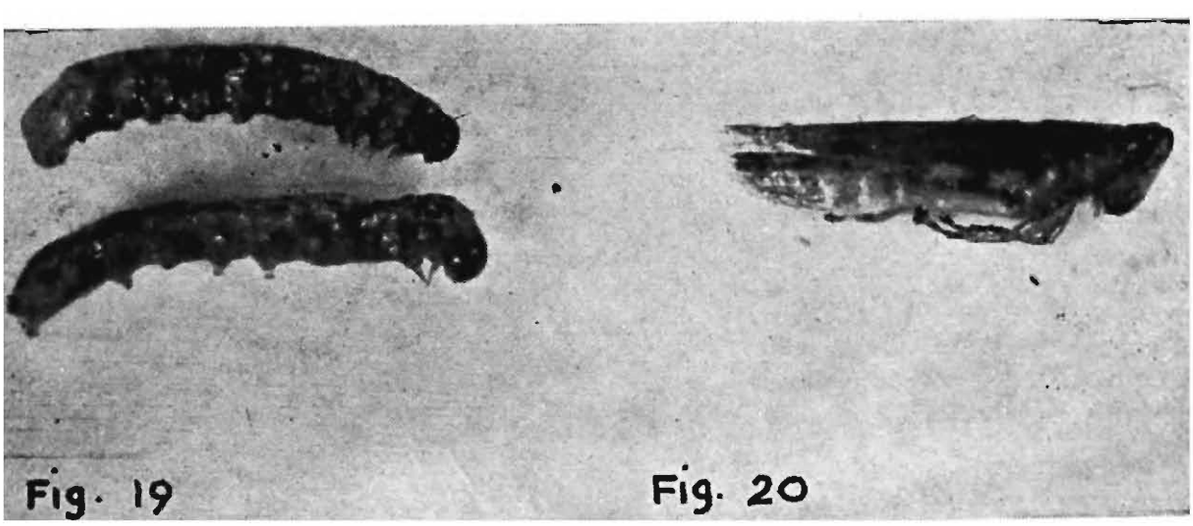

Fig. 19. Caterpillars
Fig. 20. *Spathosternum prasiniferum* (Walk.)

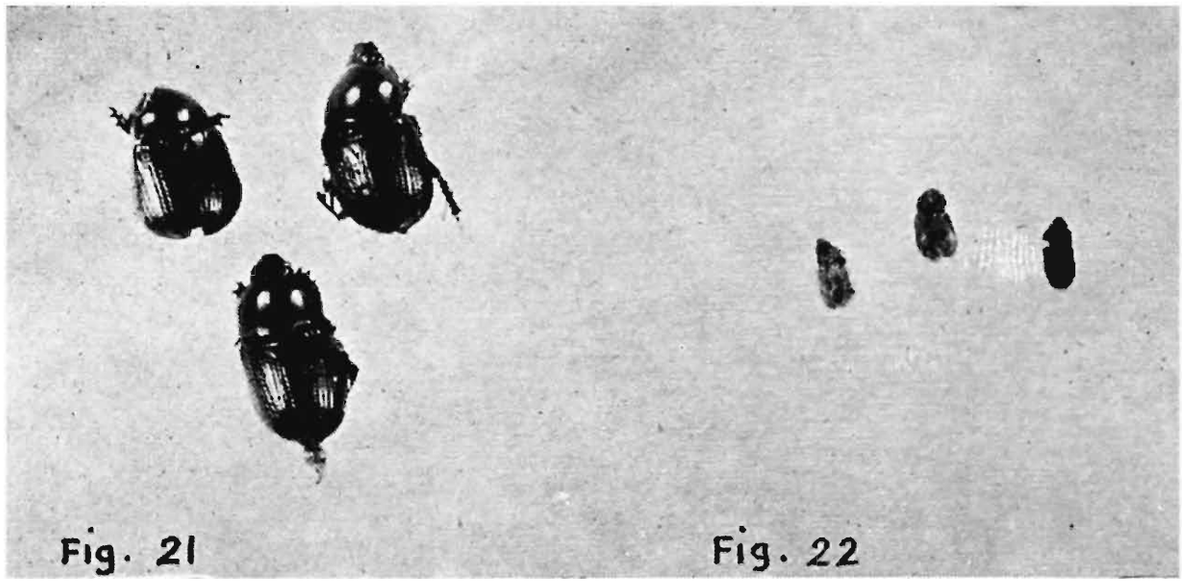

Fig. 21. *Allisonotum simile* Arrow
Fig. 22. *Aphodius* sp.

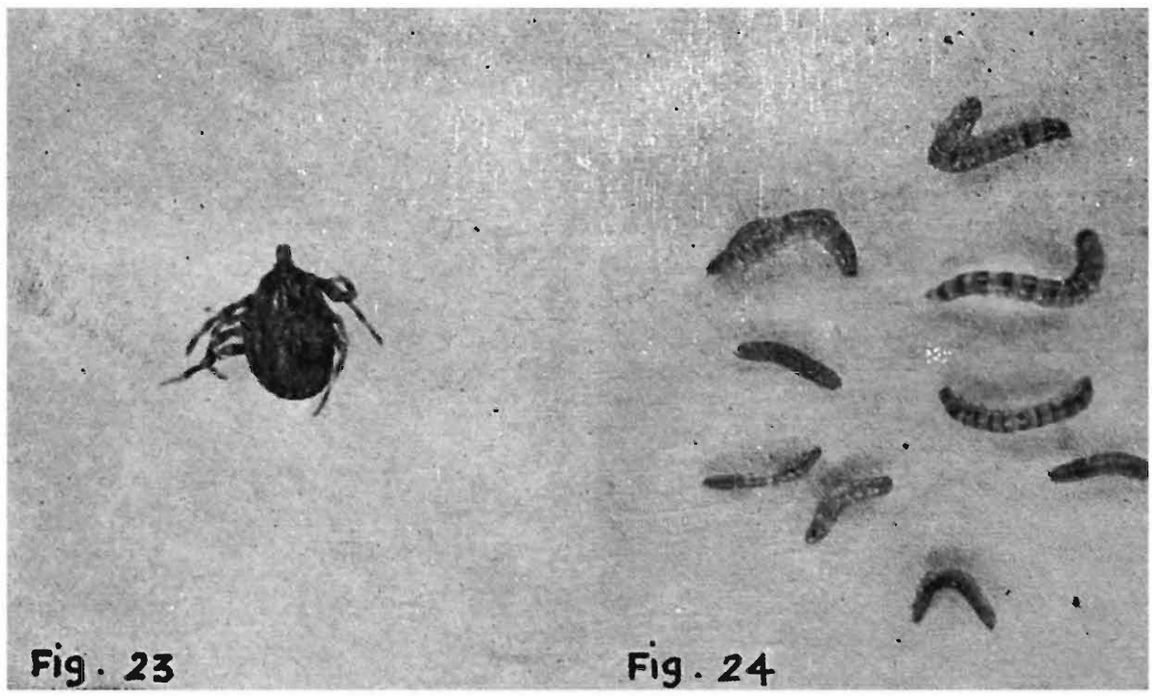

Fig. 23. *Hyalomma marjinatume issaci* Sharif
Fig. 24. Millipedes

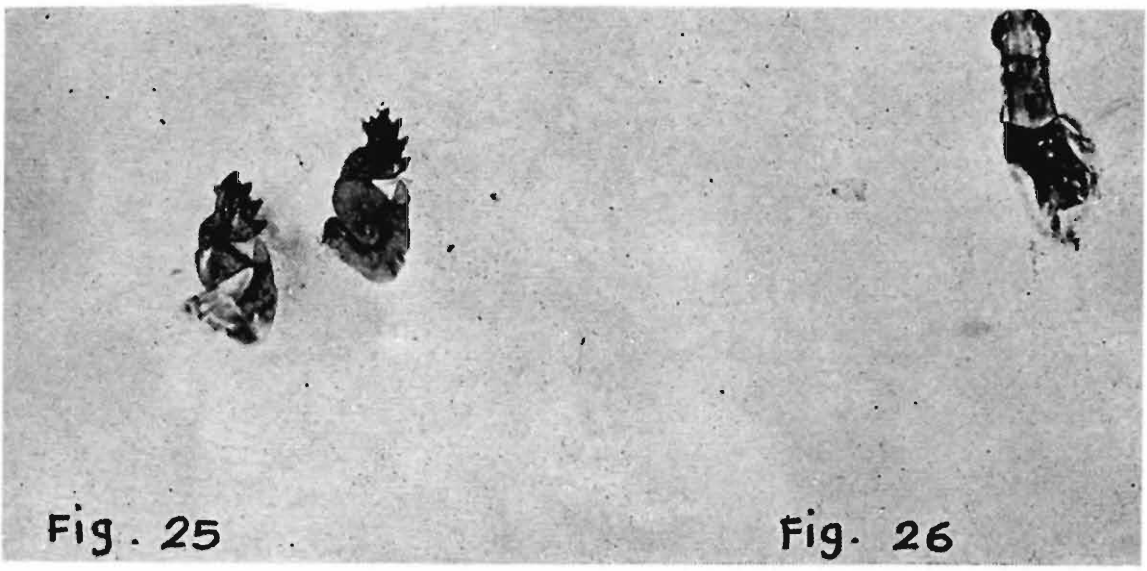

Fig. 25. Forearm of *Gryllotalpa* sp.
Fig. 26. *Acrida exaltata* Walk.

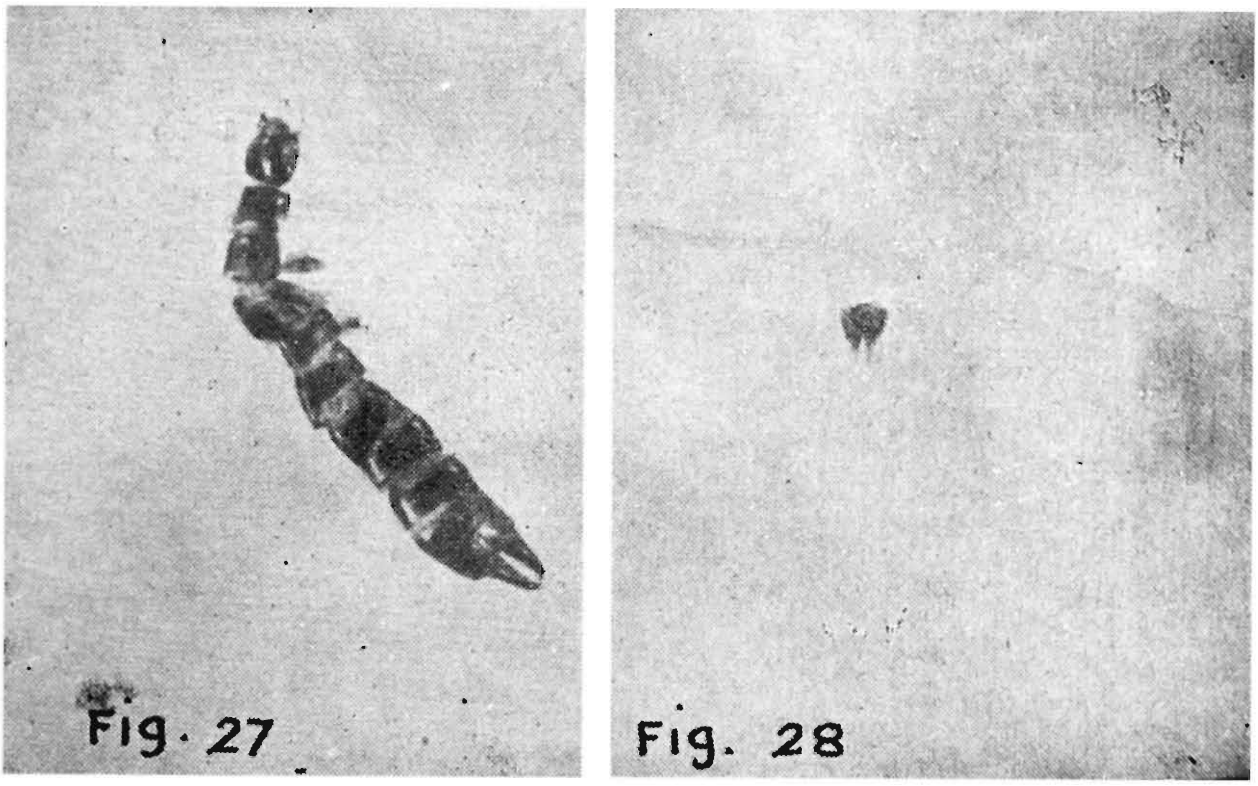

Fig. 27. *Euborellia* sp.
Fig. 28. Forcep of *Spongovostox* sp.

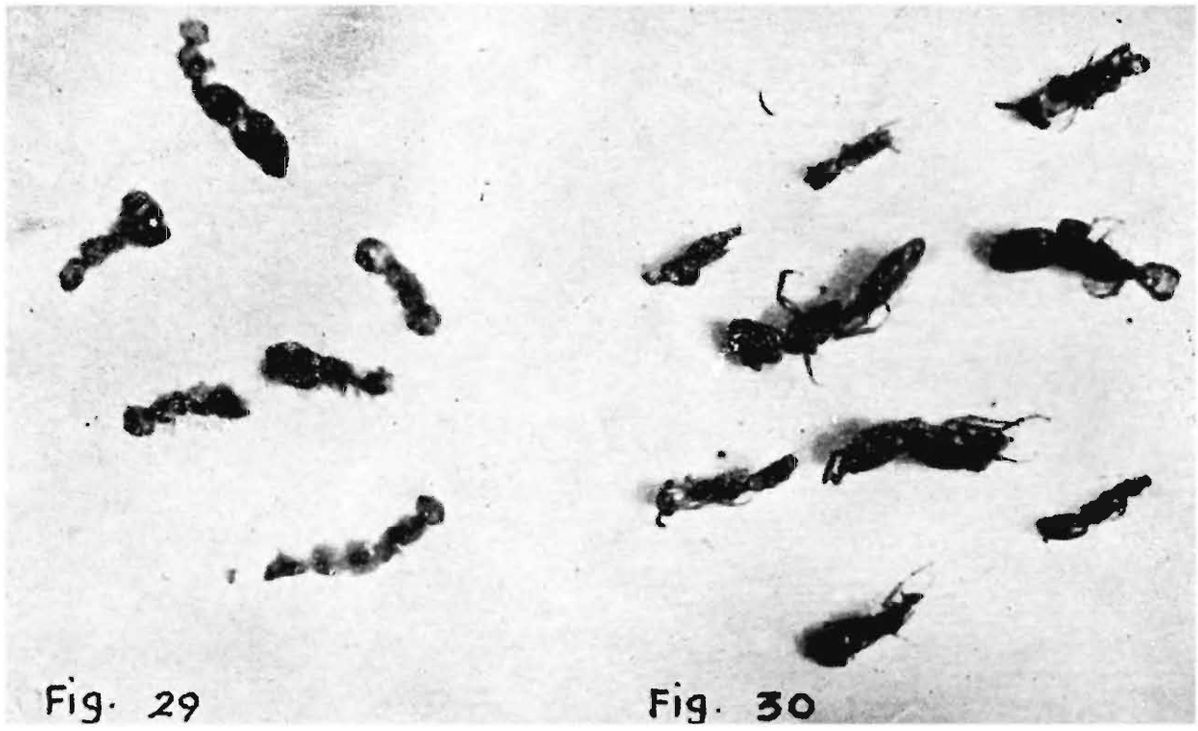

Fig. 29. *Crematogaster* sp.
Fig. 30. *Dorylus labiatus* Schuck

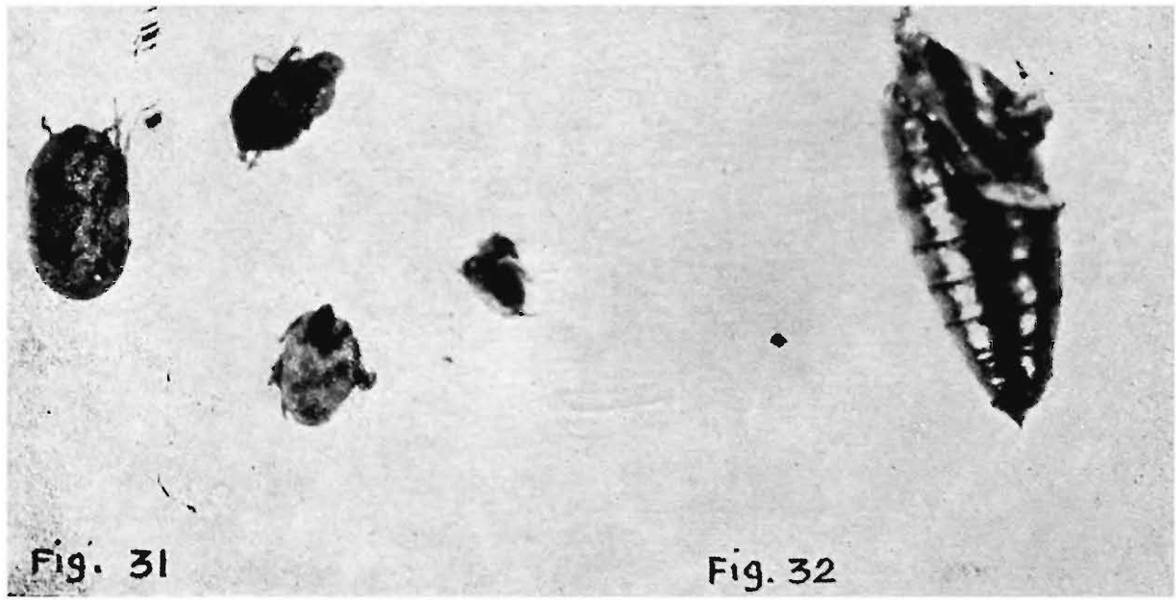

Fig. 31. *Boophilus microplus* (Canestrini)
Fig. 32. Pupa

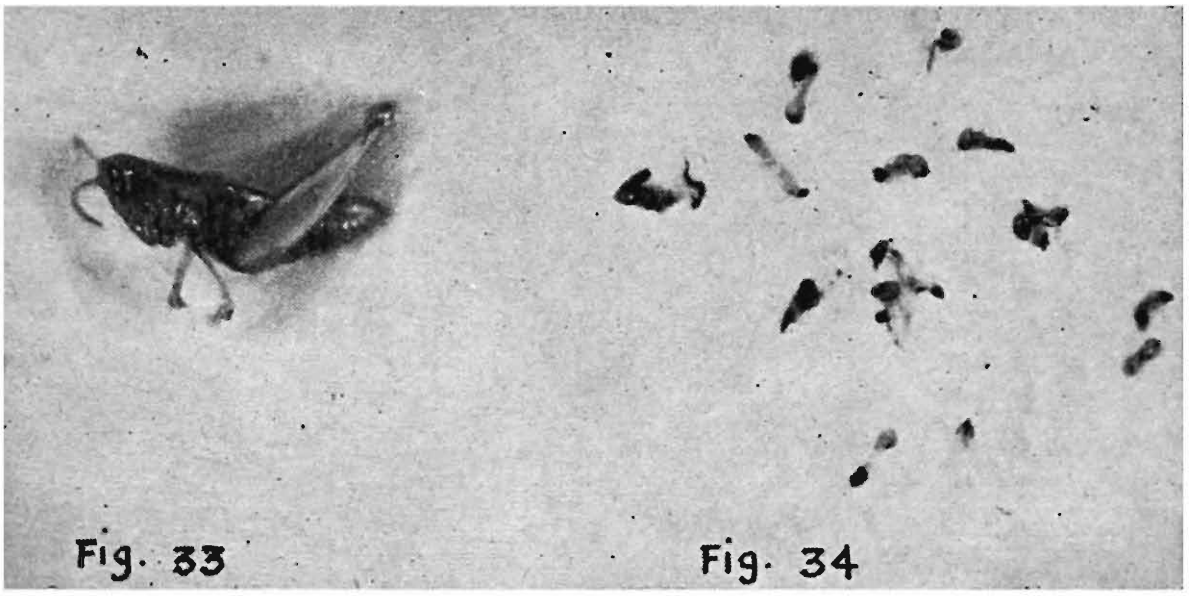

Fig. 33. Nymph of *Oxya* sp.
Fig. 34. *Odontotermes* sp.

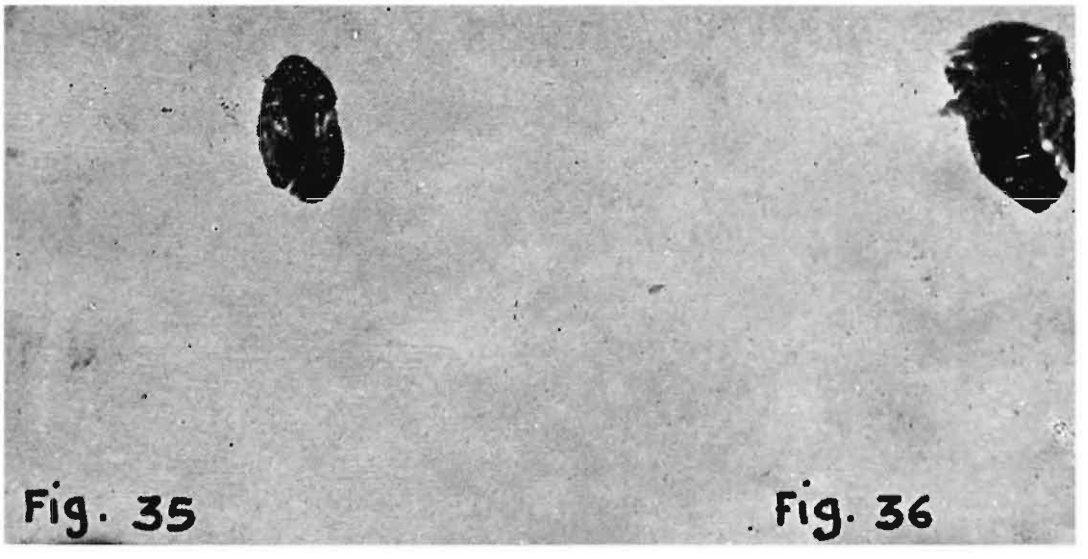

Fig. 35. *Cydnus* sp.
Fig. 36. *Eysarcocoris ventralis* (Westw.)

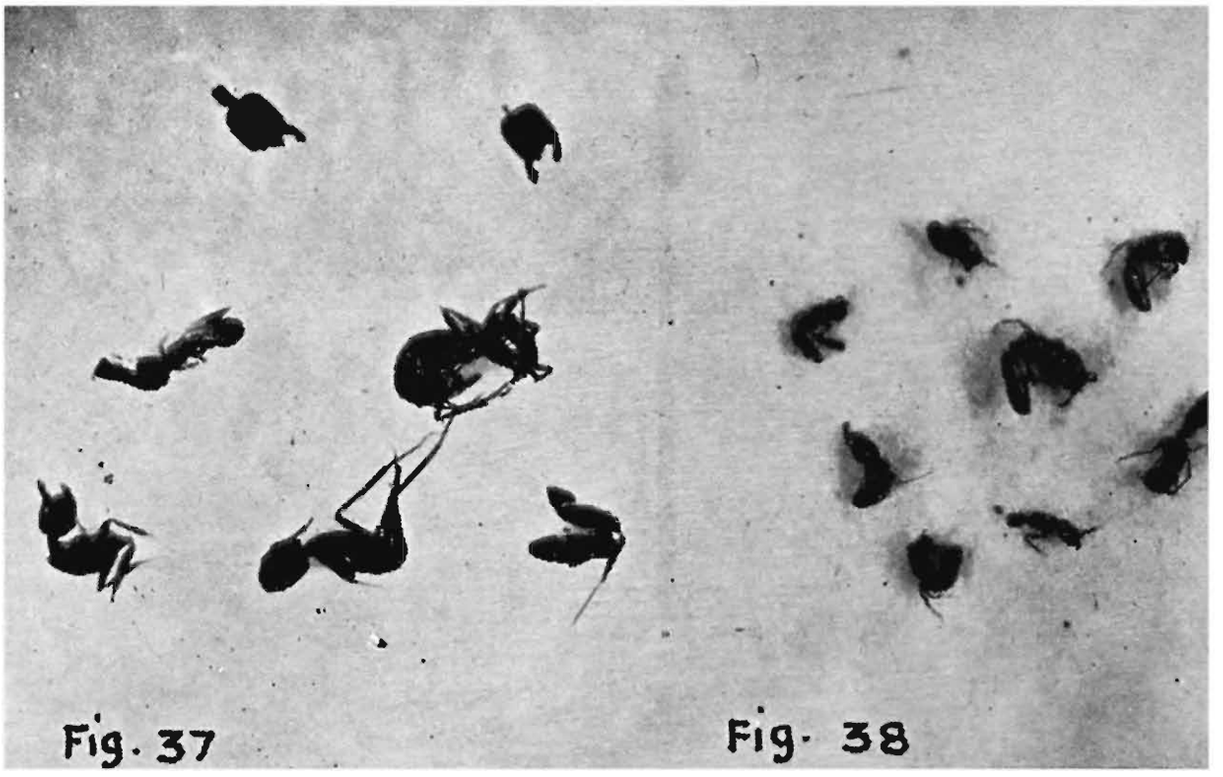

Fig. 37. *Pheidole* sp.

Fig. 38. *Dorylus orientalis* Westw.

Fig. 39. *Pachytychius* sp.

Fig. 40. *Rhysodes boysi* Arrow