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Insectivorous Birds and Their Significance in a Cotton-Wheat Based Agro-ecosystem of Punjab, Pakistan

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Abstract.- A total of 32 bird species including 31 passeriformes and one Coraciiformes were recorded from the croplands of Multan, of which 23 were resident while the remaining 9 were migrant. Three bird species *i.e.* Indian wren warbler, common myna and jungle babbler, were found more frequently than the others. Some species *i.e.* rosy pastor, jungle sparrow, yellow throated sparrows were observed in large flocks but on few occasions. The small green bee eater was present during the maturity stage of cotton crop and had a considerable population (0.8 birds/ha) and potential in insect predation. The Indian wren warbler, Jungle babbler, common babbler and common myna, were recorded throughout the year. Combined population of these four species was estimated to 7.1 birds/ha. Red-breasted fly-catcher, white eye and lesser white throat were scored as rare species. The total estimated bird density was 14.6 birds/ha. More than one third (37%) of the bird species (including Indian wren warbler and small green bee-eater) exclusively derived their food from insect source. In jungle babbler and common myna, the plant food was dominant during the wheat season but its proportion with insect food was almost balanced in the cotton season. Insects belonging to the orders Hymenoptera and Hemiptera formed the major proportion of arthropod based food. Common aphids and thrips dominated the food of Indian wren warbler. Outcome of this study support to implement conservational tactics to increase the birds' populations in the cotton-wheat based agro-ecosystem of southern Punjab so that they could function as biological control agent of insect pests, an essential component of IPM strategies.

Key words: Insectivorous birds, population, food habits, cotton, agro-ecosystem, Pakistan

INTRODUCTION

In Pakistan, the use of pesticides at commercial scale was introduced in 1954 (Jabbar and Mallick, 1994) and since then, these are increasingly applied to cotton, fruits, vegetables and cereal crops to obtain high yields. Approximately 54% of the total pesticide being marketed is used on cotton crop and the rest on other crops like fruits, vegetables, paddy, tobacco, sugarcane etc. (Khan *et al.,* 2002). The use of pesticides especially, in the cotton growing areas of the country has destroyed the bio-control agents and the populations of natural enemies of the insects and pests have declined up to 90% during the decade of 1990s (Hussain, 1999). It has also been recognized from the time of introduction of synthetic pesticides that they put wildlife and other non-target organisms at risk. Large number of birds, fish and other animals are reported to be killed by pesticides in agriculture environment (Biswas, 1994).

Although there is scarcity of scientific information on possible adverse effects of pesticides on wildlife bio-diversity in Pakistan yet the farmers perceive that about 50% reduction has occurred in the populations of bird species like Dove, Tilyar and Soom Chari during the pesticide use era in .southern Punjab (Khan, 2001). It is also reported that the uses of pesticides potentially contaminate the sources of soil and water in the cotton growing area of Punjab (Jabbar *et al.,* 1993).

There are about 55 passerine bird species found in agro-ecosystem of main cotton growing areas of Punjab. Reports based on general observations indicate that almost all the 55 species are either fully or partially insectivorous in their feeding habits. The proportion of insects in the diet of these birds varies with the seasons, growth stages of crops and development stages of the birds (Roberts, 1992). Majority of studies on the birds of Punjab, Pakistan describe the existence of species, their taxonomy, habitat and reproduction while the information on their food habits, if reported, is in descriptive rather than quantitative terms (Ali, 1941; Whistler, 1922; Lindsay-Smith, 1914). Food and feeding habits are investigated only in the birds

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reported from Faisalabad district (Hussain and Bhalla, 1937; Beg and Qureshi, 1980; Khan *et al.,* 1980; Quayoom *et al.,* 1982; Beg *et al.,* 1982; Hussain *et al.,* 1989).

The review of literature reveals that the use of pesticides in the agriculture environment has a potential risk to the bio-diversity of farm birds and other wildlife. It is also evident that despite a widespread and consistent use of pesticides over the last three decades in the cotton growing tracts of Pakistan, the hazards to the birds and other wildlife have not yet been systematically examined. Therefore, a study was proposed to investigate the role of small insectivorous birds in cotton-wheat based agro-ecosystem of the Punjab and the hazards of pesticides to them. This paper contains first part of this study *i.e.* species identification, their populations and food habits, to describe the role and significance of small insectivorous bird species in cotton-wheat agro-ecosystem of Multan (southern Punjab).

MATERIALS AND METHODS

Study site

The study was carried out at three representative sites *i.e.* Moaza Ghaghra, Panjkuha and 18-19 Kassi areas, situated within 50 km radius in the north and east directions of Multan city (30° 12' N 71° 28' E), Fig. 1. The area under cultivation reflects two main crops *i.e.* cotton and wheat mixed with other grain and fodder crops such as rice, maize, millet, sugarcane, barseem, lucerne, mustard etc. The mango and citrus orchard are frequently distributed and seem an essential part of this agro-ecosystem.

Experimental procedure

The observations were made on small passerine birds feeding in cultivated open fields away from the canal side tree plantations. However, fruit orchards were not avoided if falling on the transect lines for population estimation. A field binocular of 8X magnification was used where needed. Mist-netting (using nylon mist net; 50d/2ply, 1-1/4" mesh, size 7ft x 30 ft) and shooting (using air gun) was carried out to complement the field observations on identification of the bird species as well as to take stomach contents for food habit analysis. Identification and residential status of the species was decided following Ali (1979) and Roberts (1992).

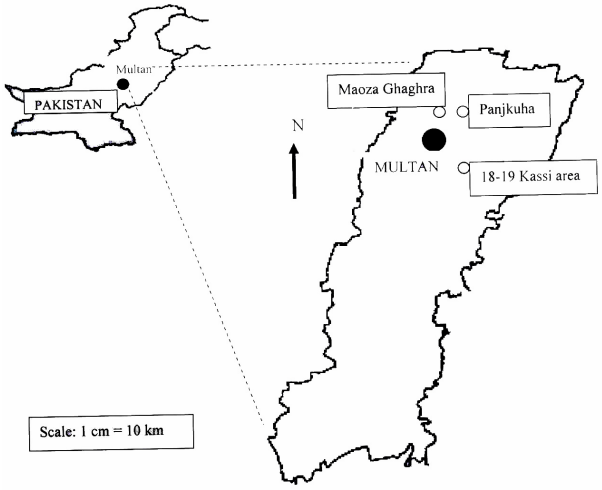

Fig. 1. Map of Multan district (30° 12' N 71° 28'E) in the Southern Punjab, Pakistan, showing three locations of study sites.

Birds' population estimation was carried from October 2002 through September 2003 at 4-5 weeks interval. During the whole period of this study 11 observations were made employing belt line-transect method (Mikol, 1980). In this 100 m wide (50 m from each side of the observer) b~ line-transect sampling, all the birds were assumed to be detected within the specified fixed distance (w) from the transect line of 100 m length (L). Birds outside the belt were not recorded. The bird density was calculated by $n/_{2LW}$, where n is the number of birds recorded. The transect lines were selected at random with assumptions; i) the sighting of one bird of particular species was independent of the sighting of any other bird of the same species, ii) each bird was counted only once.

The birds were shot by air gun or live captured (using mist nets) from the crop fields. They were autopsied at the spot and the gizzards were removed and packed in polythene bags recording all information such as date, time, habitat, sex and body weight, on the attached tag. The gizzards were frozen within 2 hours of their collection from the fields. To analyze the gizzard contents, the materials

were defrosted at room temperature. The contents of each gizzard were observed under a stereo-microscope (10X) for physical separation of plant and animal based materials. Weight of each class of material was recorded and converted into percentile of the total contents of the respective gizzard. Studying the hard body parts such as mandibles, antennae, cuticle etc identified the insect species following a Handbook on INSECTS (spiders and other terrestrial arthropods) by George C. McGavin, Dorling Kindersley, Inc., USA.

RESULTS

Field identification and population estimation

Field observation (for identification and population estimation) and capturing/shooting of birds (for food habits study) in the cotton-wheat agro-ecosystem of Multan recorded 31 bird species of the order Passeriformes. A non-Passeriformes bird, small green bee-eater (order Coraciiformes), was accounted for due to its frequent prevalence and direct feeding in the cotton crop. In both the observed and captured/killed data sets 18 species (56.3%) were common, 9 species (28.1%) were captured/killed but not observed while 5 species (15.6%) were observed only (Table I). Of the observed and captured species, 23 were resident while the remaining 8 were migrants.

The prevalence (frequency of occurrence) along with the estimated population is presented in Fig. 2. The three bird groups i.e. warblers, Indian myna and babblers were found more frequently than the other bird species. Some of the species such as rosy pastor, jungle sparrow, yellow-throated sparrows were found less in frequency but high in number i.e., large flocks observed but on few occasions (Fig. 2, Table II).

The Indian myna was usually found near human dwellings, mango and citrus orchards and livestock corrals. Activity of this bird in the open field was restricted to harvested fields, field edges in case of standing crops or on the water channels. The babblers were seen in mango and citrus orchards and under trees on the boundaries of the crop fields. They were usually seen feeding on ground under the fruit and wood trees. However, there was hardly any sugarcane field that was observed without the babblers. Indian wren warbler was the most important small birds that have normal distribution in the open croplands. In the cotton crop (at and after the stage of flowering) this bird was observed gleaning insects from the cotton plants. The movement of purple sunbird, red-vented bulbul was mostly restricted to the fruit trees. Rosy pastor and jungle sparrows were seen occasionally but in large flocks, feeding inside the cotton fields. It is important to mention that the activity of house sparrow was restricted near human dwellings such as farmhouses in the cultivated areas and this bird was scarcely observed in the open croplands. The small green bee-eater was mostly seen perching on the wires running through the open cotton fields and successively predating on air born insects.

The monthly occurrence of the bird species in the croplands of Multan is presented in Table II. It is evident that out of 23 bird species recorded during population estimation only four (Indian wren warbler, common myna, jungle babbler and common babbler) were observed in all the 11 sampling periods, with some seasonal fluctuations. Combined population of these four species was estimated to 7.1 birds/ha. Black drongo and Red-vented bulbul were recorded with a break of one or two months respectively. The small green bee-eater mainly observed from June through September had a considerable population and potential in insect predation in the cotton crop. Its average population (0.8 birds/ha) followed the three dominant bird species (Indian wren warbler, common myna, jungle babbler). Overall bird density in this agro-ecosystem was estimated to 14.6 birds per hectare (Table II).

Although the species composition has been changing but their frequency of occurrence remained almost similar from Nov. 2002 through Aug. 2003 (Table II). However, the less species number recorded in October 2002 could be attributed to the low skill of the observers because of their first observation for this population study. The maximum species (19) observed during September 2003, coinciding with the flowering and boll formation stage of cotton crop, could be due to availability of abundant insect food in the crop fields. The two peaks in the population during November and August were due to presence of larger flocks of rosy pastor.

Table I.- Passeriformes bird species observed and killed from cotton-wheat based agro-ecosystem of Multan.

Bird samples	Sr. No.	Common name	Scientific name	Family	Status*	Proportion (%)
Bird species common in observed and captured/killed samples (Order Passeriformes)	1	Ashy Crowned Finch Lark	*Ammomanes phoenicurus*	Alaudidae	Resident	56.3%
	2	Bank Myna	*Acridotheres ginginianus*	Sturnidae	Resident	
	3	Black Drongo	*Dicrurus adsmilis*	Dicruridae	Resident	
	4	Collard Bush Chat	*Saxicola torauata*	Turdidae	Migrant	
	5	Common Babbler	*Turdoides caudatus*	Timaliidae	Resident	
	6	Grey Shrike	*Lanius excubitor*	Laniidae	Resident	
	7	House Sparrow	*Passer domesticus*	Passeridae	Resident	
	8	Common Myna	*Acridotheres tristis*	Sturnidae	Resident	
	9	Indian Pipit	*Anthus novaeseelandiae*	Sylviidae	Resident	
	10	Indian Wren Warbler	*Prinia subflava*	Sylviidae	Resident	
	11	Jungle Babbler	*Turdoides striatus*	Timaliidae	Resident	
	12	Pied Bush Chat	*Saxicola caprata*	Turdidae	Resident	
	13	Purple Sunbird	*Nectarinia asiatica*	Nectariniidae	Resident	
	14	Red Vented Bulbul	*pycnonotus cafer*	Pycnonotidae	Resident	
	15	Rosy Pastor	*Sturnus roseus*	Sturnidae	Migrant	
	16	Rufous Backed Shrike	*Lanius schach*	Laniidae	Resident	
	17	Yellow Throated Sparrow	*Petronia xanthocollis*	Passeridae	Migrant	
(Order Coraciiformes)	18	Small Green Bea-eater	*Merops orientalis*	Meropidae	Local Migrant	
Bird species present in captured/killed samples only (Order Passeriformes)	19	Ashy Wren Warbler	*Pirinia socialis*	Sylviidae	Resident	28.1%
	20	Common Wood Shrike	*Tenphrodornis*	Laniidae	Resident	
	21	Grey Wagtail	*Motacilla cinerea*	Motacillidae	Migrant	
	22	Large Pied Wagtail	*M. maderaspatensis*	Motacillidae	Resident	
	23	Lesser White-throat	*Sylvia curruca*	Sylviidae	Migrant	
	24	Red Breasted Fly Catcher	*Muscicapa parva*	Muscicapidae	Migrant	
	25	Streaked Fantail Warbler	*Gisticola juncidis*	Sylviidae	Resident	
	26	Tailor Bird	*Orthotomus sutorius*	Sylviidae	Resident	
	27	White Eye	*Zosterops palpebrosa*	Zosteropidae	Resident	
Bird species present in observed samples only (Order Passeriformes)	28	Baya Weaver Bird	*Ploceus philippinus*	Ploceidae	Resident	15.6%
	29	Common Swallow	*Hirundo rustica*	Hirundinidae	Migrant	
	30	Indian Robin	*Saxicoloides fulicata*	Turdidae	Resident	
	31	Jungle Sparrow	*Passer pvrrhonotus*	Passeridae	Resident	
	32	Redstart	*Phoenicurus ochruros*	Turdidae	Migrant	

*After Roberts (1992).

Table II.- Population estimation of small bird species in cotton-wheat based agro-ecosystem of Multan.

Bird species	Month-wise population; Total birds observed (estimated population *i.e.* birds/ha)											
	Oct-02	Nov-02	Dec-02	Feb-03	Mar-03	Apr-03	May-03	June 03	July 03	Aug-03	Sep-03	Total
Indian Wren Warbler	15 (2.5)	41 (2.7)	15 (1.9)	27 (3.4)	48 (3.4)	31 (3.4)	6 (0.9)	11 (0.9)	43 (2.9)	39 (2.8)	28 (2.0)	304 (2.5)
Common Myna	1 (0.2)	34 (2.3)	5 (0.6)	6 (0.8)	16 (1.1)	16 (1.8)	32 (4.6)	80 (6.7)	35 (2.3)	19 (1.4)	39 (2.8)	283 (2.3)
Jungle sparrow				25 (3.1)					51 (3.4)	159 (11.4)*	13 (0.9)	248 (2.0)
Rosy Pastor		216 (14.4)*	2 (0.25)			5 (0.6)					17 (1.2)	240 (2.0)
Jungle Babbler	10 (1.6)	15 (1.0)	17 (2.1)	23 (4.1)	23 (1.7)	21 (2.3)	19 (2.7)	25 (2.1)	15 (1.0)	16 (1.1)	16 (1.2)	210 (1.7)
Small Green Sea-eater					4 (0.3)			23 (1.9)	23 (1.5)	11 (0.8)	37 (2.6)	98 (0.8)
Common Babbler	4 (0.7)	5 (0.3)	6 (0.8)	12 (1.5)	9 (0.6)	7 (0.8)	7 (1.0)	9 (0.7)	6 (0.4)	5 (0.4)	6 (0.4)	76 (0.6)
Red Vented Bulbul	3 (0.5)			2 (0.3)	13 (0.9)	5 (0.6)	4 (0.6)	6 (0.5)	4 (0.3)	7 (0.5)	20 (1.4)	64 (0.5)
Yellow Throated Sparrow										58 (4.1)*		58 (0.5)
Black Drongo		2 (0.1)	1 (0.1)	2 (0.3)	6 (0.4)	3 (0.3)	4 (0.6)	20 (1.7)	4 (0.3)	8 (0.6)	3 (0.2)	53 (0.4)
House Sparrow			3 (0.4)		6 (0.4)		12 (1.7)	2 (0.2)			1 (0.1)	24 (0.2)
Pied Bush Chat			2 (0.25)	1 (0.1)						7 (0.5)	12 (0.9)	22 (0.2)
Bank Myna	1 (0.2)	7 (0.5)					8 (1.1)	3 (0.25)			1 (0.1)	20 (0.2)
Common Swallows		10 (0.7)								9 (0.6)		19 (0.2)
Purple Sun-bird		1 (0.07)				6 (0.7)		3 (0.25)	2 (0.1)	4 (0.3)	1 (0.1)	17 (0.1)
Rufous Backed Shrike		1 (0.07)	2 (0.25)	2 (0.3)		2 (0.2)	3 (0.4)	1 (0.1)	2 (0.1)		2 (0.1)	15 (0.1)
Indian Pipit			8 (1)		4 (0.3)						2 (0.1)	14 (0.1)
Collard Bush Chat										2 (0.1)	4 (0.3)	6 (0.05)
Ashy Crowned Finch Lark		1 (0.07)			1 (0.07)						3 (0.2)	5 (0.04)
Indian Robin		2 (0.1)				1 (0.1)						3 (0.02)
Baya Weaver Bird					1 (0.07)						1 (0.1)	2 (0.02)
Grey Shrike					1 (0.07)						1 (0.1)	2 (0.02)
Red-start	1 (0.2)											. 1 (0.01)
Total	35 (5.9)	335 (22.3)	61 (7.7)	110 (13.9)	132 (9.3)	97 (10.8)	95 (13.6)	183 (15.3)	185 (12.3)	345 (24.6)	196 (14.8)	1784 (14.6)
No. of species observed	7	12	10	9	12	10	9	11	10	13	19	

Body weight and sex ratio

The results of the study on some body parameters of the birds inhabiting the croplands of Multan are summarized in Table III. The sample size in majority of the species was not large enough to draw any conclusion on the body weight and sex ratio. The sex ratio in the dominantly existing bird species showed its skew-ness toward the dominance of males in the three commonly found species i.e. jungle babbler, common babbler and common myna, while it was at equity in Indian wren warbler.

Food composition

Food habits of small bird species inhabiting croplands of Multan are given in Table IV. More than one third (37%) of the bird species captured had exclusively fed on insect food. Among the most dominant bird species, the warblers and small green

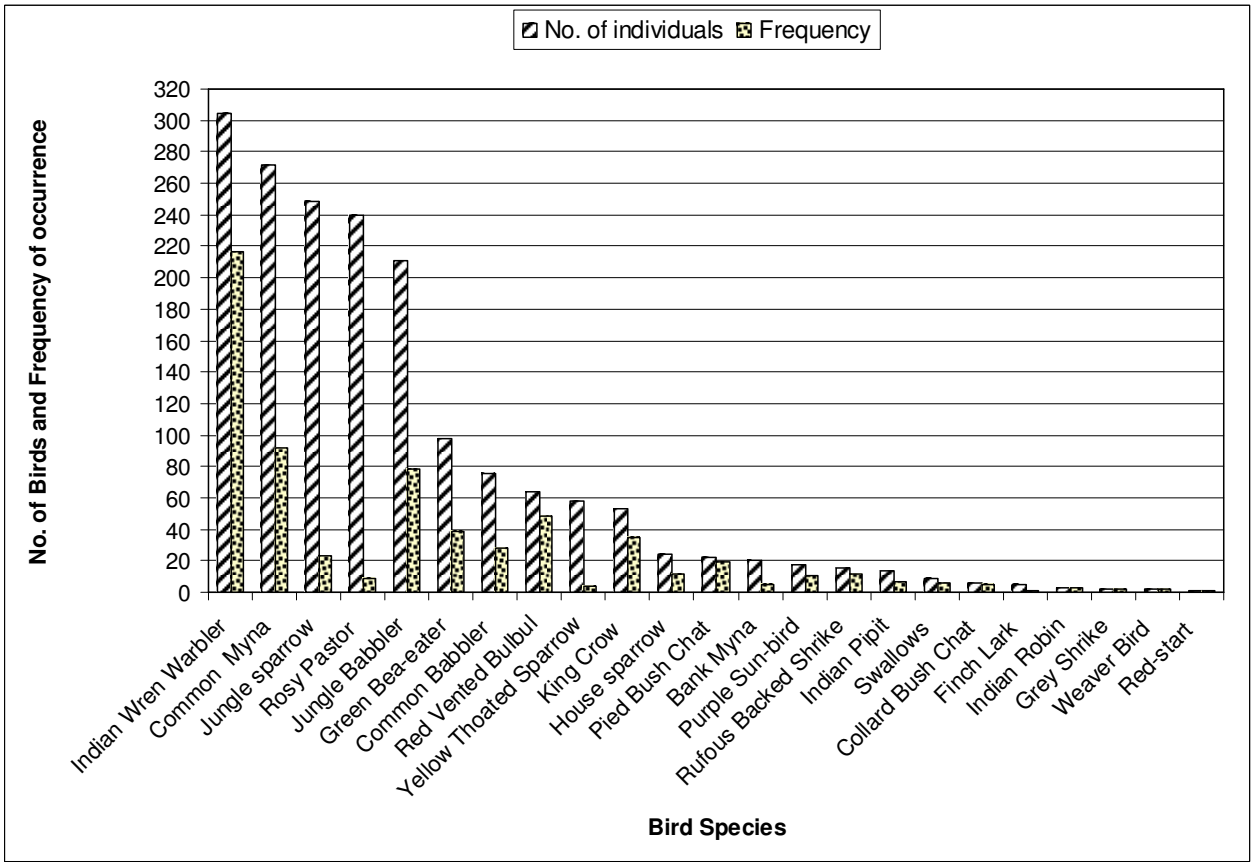

Fig. 2. Number of birds observed and frequencies of their occurrence in cotton-wheat based agro-ecosystem of Multan.

bee-eater were of significant importance as they were normally distributed and their food was exclusively derived from insect source. A further detail of food composition in the dominant species is given in Table V and Figs. 3 and 4.

In jungle babbler and Indian myna the ratio of plant-based food was dominant during the wheat season while its proportion was almost balanced with insect food during the cotton season.

Composition and frequencies of occurrence of different food items in the gizzard contents of the birds are presented in Table V. The food derived from plant sources was based on the grains and seeds. Insect based food was dominated by the orders Hymenoptera (ants and their larvae, wasps and their larvae) and Hemiptera (bugs, scale insects, aphids, lice). Common aphids and thrips dominated the food of Indian wren warbler. A detail of insects observed in the gizzard contents with their orders is given below:

Order *Hymenoptera:*	Ants and their larvae, leaf cutter ants, wasps and their larvae.
Order *Diptera:*	Pupae of fruit flies, hover flies, black flies, mosquitoes
Order *Thysanoptera:*	Thrips
Order *Hemiptera:*	Scale insects, bugs, aphids, lice
Order *Isoptera:*	Subterranean termites
Order *Lepidoptera:*	Larvae of cabbage butter fly, armyworm American bollworm, citrus butterfly, hairy caterpillar
Order *Coleoptera:*	Lady bird beetle, Pollen beetle, scavenger beetle
Order *Orthoptera:*	Locust, grasshopper

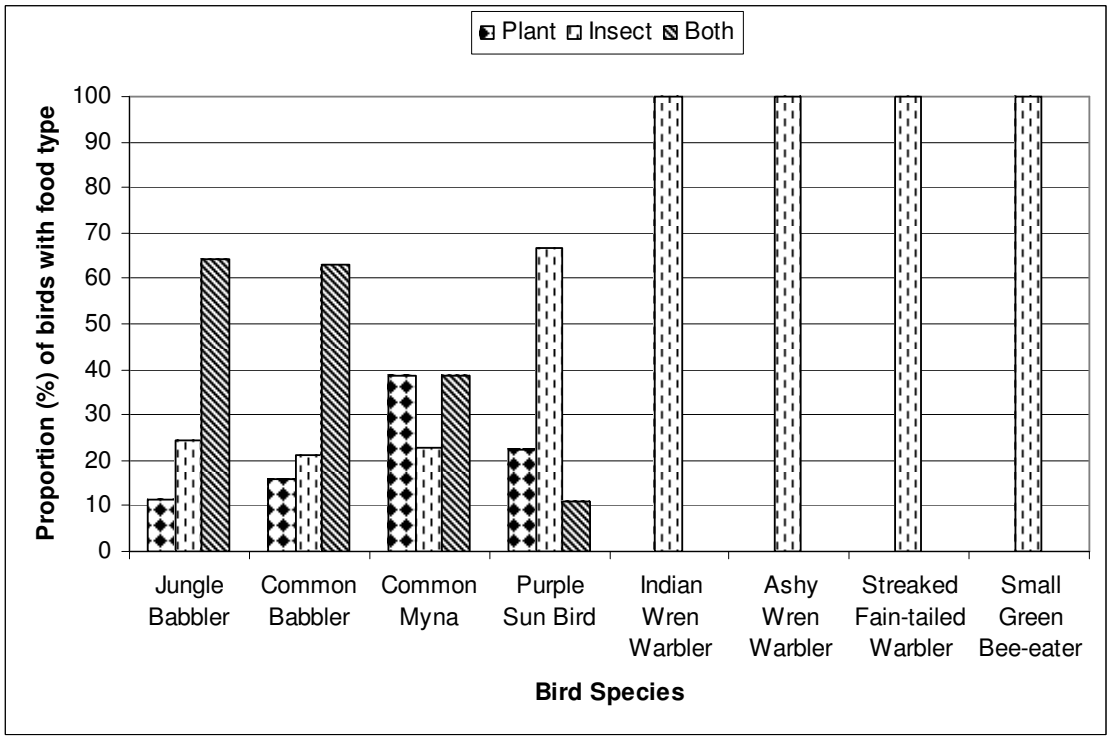

Fig. 3. Choice of some birds species for insect and plant based food in the croplands of Multan.

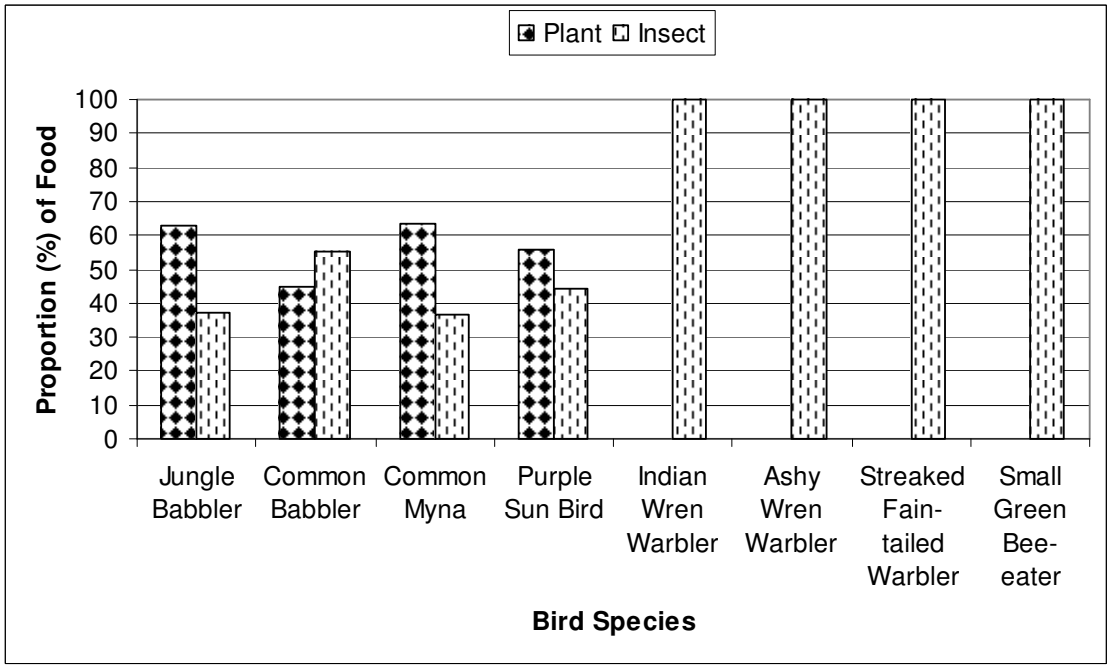

Fig. 4. Food preference of some bird species inhabiting croplands of Multan.

Table III.- Some body parameters of small birds inhabiting croplands of Multan.

Species	No. of Birds	Body Wight (Mean± SE)	Sex Ratio (Male: Female)
Ashy Wren Warbler	2	5.0±1.0	0:2
Bank Myna	5	75.2±1.3	1:4
Black Drongo	6	46.8±1.7	3:3
Collard Bush Chat	2	12.0±0.0	0:2
Common Babbler	19	48.2±Q.6	7:12
Common Myna	31	100.0±3.7	11 :20
Common Wood Shrike	2	27.5±0.5	0:2
Ashy Crowned Finch lark	2	20.5±0.5	0:2
Grey Shrike	3	24.33±3.2	2:1
Gray Wagtail	1	15	0:1
House Sparrow	1	20	1:0
Indian Pipit	1	20	0:1
Indian Wren Warbler	22	7.5±0.3	11 :11
Jungle Babbler	53	66.9±0.7	23:30
Large Pied Wagtail	1	25	0:1
Lesser White Throat	3	9.8±0.3	2:1
Pied Bush Chat	3	11.7±0.3	1:2
Purple Sun Bird	9	6.9±0.3	6:3
Red Breasted Flv Catcher	1	16	1:0
Red-Vented Bulbul	6	2.9±1.2	1:5
Rosy Pastor	4	71.8±2.5	2:2
Rufous-backed Shrike	6	33.0±0.7	3:3
Small Green Bee-eater	7	13.0±1.3	2:5
Streaked Fain-tailed Warbler	5	8.2+0.4	2:3
Tailor Bird	1	6	0:1
White Eve	1	7	0:1
Yellow Throated Sparrow	3	18.0±0.0	0:3

DISCUSSION

The 23 resident passerine bird species reported in this study are not in compliment with the previously reported 32 species (Robets, 1992) and 40 species (Beg and Qureshi, 1972) from the central and southern Punjab. The deviation could be attributed to some biases in observations of the birds *i.e.* the larger passerine such as house crow were not recorded, observation were not made on the canal sides tree plantations which are considered to provide habitat to the most of the species. According to Roberts (1992) the insectivorous birds prevalent in the cultivated crop fields of the cotton-growing belt of Punjab are the Drongo, Roller, Swallows, House Sparrow, Common Myna, Small Skylark, Indian Wren Warbler and Shrikes. Almost all of the species observed and captured in the present study are present in lists of the birds reported from Faisalabad district (Beg and Qureshi, 1980; Hussain and Bhalla, 1937; Khan *et al.* (1980; Quayoom *et al.,* 1982). Unlike an earlier report (Beg *et al.,* 1982) the house sparrow were not seen frequently in the cultivated tracts of Multan. This bird was only observed near human dwellings.

The profile of the bird populations observed under present study indicated that majority of the birds were either exclusively feeding on insect based food or deriving a significant part of their food from this source. Only the house sparrow and the tailor bird exclusively fed on the plant food, however, single sample size for each of these species prevents to draw any conclusion. The evidence is supported by earlier studies on food and feeding habits of birds in Faisalabad district and its vicinity which reported that 23-33 bird species were insectivorous and reportedly playing an important role in inhibiting insect populations (Hussain and Bhalla, 1937; Beg and Qureshi, 1980; Khan *et al.,* 1980; Quayoom *et al.,* 1982).

The present study helps to conclude that at least five bird species, jungle babbler, common babbler, common myna, Indian wren warbler and small green bee-eater have an important role in predation on insects. Among these, the Indian wren warbler and the small green bee-eater are of special significance as they were feeding directly on insects infesting the cotton crop. The bird species such as red-breasted fly-catcher, white eye, lesser white throat were observed and captured in small numbers (Fig. 2, Table II). These species, although, have less

Table IV.- Food preferences of small bird species inhabiting croplands of Multan

Species	N	Gizzard contents (g/10g B.Wt.) X±SE	Crop Season	Proportion (%) of birds exclusively fed on:		Proportion (%) of food in gizzard contents	
				Plant	Insect	Plant	Insect
Ashy Wren Warbler	2	0.12±0.02	Wheat		100		100
Bank Myna	5	0.11±0.01	All seasons	60	20	72.8	27.2
Black Drongo	6	0.08±0.01	All seasons	0	83.3	6.4	93.6
Collard Bush Chat	2	0.16±0.02	All seasons	0	100	0	100
Common Babbler	14	0.09±0.01	Wheat	143	21.4	45.9	54.1
	5	0.07±0.02	Cotton	20	20	42.0	58.0
Common Myna	18	2.25±0.02	Wheat	50	16.7	70.8	29.3
	13	1.18±0.01	Cotton	23.1	30.8	51.0	49.0
Common Wood Shrike	2	0.12±0.04	All seasons	50	50	75.4	24.6
Ashy Crowned Finch Lark	2	0.09±0.05	All seasons	50	50	5.3	94.7
Grey Shrike	3	0.1±0.02	All seasons		100		100
Grey Wagtail	1	0.06	All seasons		100		100
House Sparrow	1	0.03	All seasons	100		100	
Indian Pipit	1	0.2	All seasons		100		100
Indian Wren	15	0.10±0.01	Wheat		100		100
Warbler	7	0.10±0.02	Cotton		100		100
Jungle Babbler	27	0.12±0.01	Wheat	7.4	18.5	74.0	26.0
	26	0.10±0.01	Cotton	15.4	30.8	48.4	51.6
Large Pied Wagtail	1	0.08	All seasons		100		100
Lesser White Throat	3	0.12±0.05	All seasons		66.7	17.6	82.4
Pied Bush Chat	3	0.05±0.02	All seasons		100	0	100
Purple Sun Bird	1	0.014	Wheat		100		100
	8	0.14±0.04	Cotton	25	75	56.4	43.6
Red Breasted Fly Catcher	1	0.06	All seasons		100		100
Red-Vented Bulbul	6	0.11±0.03	All seasons	66.7	16.7	78.0	22.0
Rosy Pastor	4	0.1 ±o.01	All seasons	25	50	33.6	66.4
Rufous-backed Shrike	6	0.12±0.03	All seasons		100		100
Small Green Bee-eater	3	0.05±0.03	Wheat		100		100
	4	0.07±0.03	Cotton		100		100
Streaked Fain-tail Warbler	5	0.07±0.04	Cotton		100		100
Tailor Bird	1	0.07	All seasons	100		100	
White Eye	1	0.09	All seasons		100		100
Yellow Throated Sparrow	3	0.16±0.01	All seasons	33.3		68.2	31.8

significance as insect predators but are important in view of their low numbers and thus need special consideration for conservation. Having already in scarcity these species could have higher threat from the prevailing risks of pesticides (Jabbar *et al.,* 1993; Hussain, 1999) in this agro- ecosystem.

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Table V.- Composition of food items in the gizzard contents of birds captured and killed from the croplands of Multan.

Species	Plant materials	Occurrence frequency of insect materials (insect orders)								
		Hymenoptera	Diptera	Thysanopter	Hemiptera	Isoptera	Lepidoptera	Coleoptera	Orthoptera	Others*
Common Babbler	Grains of wheat, rice, millet, maize & seeds of weeds, mulberry, Guava	6	6	2	8				3	
Jungle Babbler	Grains of wheat, rice, millet, maize & seeds of weeds, mulberry, Guava	13	5	4	7	7	4	7	2	B(1) D(1) 0(2) S(1)
Ashy Wren Warbler	None				1	1		2		
Streaked Fantailed Warbler	None		2	2	3					
Indian Wren Warbler	None	4	1	7	10	2	1	1		
Bank Myna	Grains of wheat & maize			1		1	1			
Common Myna	Grains of wheat, millet, maize, figs, mulberry, red chillies	7	2		6		2	6	1	S(1) D(1)
Green Bee Eater	None	1		1	2	1	1		1	
Common Wood Shrike	Seeds of weeds, Akson seeds & fruit parts							1		
Grev Shrike	None	1		1	1			1		
Rufous Backed Shrike	None	3	1		1	1		1		
Collard Bush Chat	None				2	1		1		
Pied Bush Chat	None		2		1					
Purple Sun Bird	Grains of wheat, maize	1		1	5			3		
Red Vented Bulbul	Seeds of weeds, Akson seeds & fruit parts, figs, millet grains					1	1			
Black Drongo	Rice grains	3			1				2	
Yellow Throated Sparrows	Seeds of millet, mulberry and plant leaves	1						2		
Ashy Crowned Finch Lark	Weed seeds					1				T(1)
Rosv Pastor	Mulberry seeds				1		1			
Lesser White Throat	Grains of wheat and seeds of barseem & guava	1	1	1				1	1	
Grey Wagtail	None						1			
House Sparrow	Grains of wheat and seeds of barseem									
Indian Pipit	None	1								
Large Pied Wagtail	None				1					
Red Breasted Flycatcher	None				1					
Tailor Bird	Guava seeds									
White Eyes	None	1	1							
Total		43	21	20	51	16	12	26	10	

* Buthrida (B), Dermaptera (B), Odonata (0), Scolopendrida (8), Thyridoptera (T)

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