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Agricultural ornithology: an Indian perspective

MANJIT S DHINDSA and HARJEET K SAINI

All India Network Project on Agricultural Ornithology, Department of Zoology, Punjab Agricultural University, Ludhiana 141 004, India

Abstract. Agricultural ornithology aims at obtaining scientific information on birds in relation to agriculture and using this information for their management. Most of bird species play a useful role in agriculture by having a potent check on insect and rodent pests. However, some granivorous bird species, having adapted to the agricultural habitats and increased in numbers, are conflicting with our goals of agricultural production by inflicting economic losses to crops, fruits and stored grains. Bird management involves both the conservation of useful species and control of pests. Agricultural ornithology is of special importance in predominantly agricultural countries like India. Although a good deal of work has been done in this discipline in India, a lot remains to be done and, in fact, the discipline is still in its infancy. This paper reviews the progress made in agricultural ornithology in India, points out important problems and gaps in knowledge, and suggests approaches for future research.

Keywords. Applied ornithology; avian ecology; bird damage; bird management.

1. Introduction

Agricultural ornithology may be defined as the science of birds in relation to agriculture. Alternatively, it may be taken as ecology and management of birds in agroecosystems. Agricultural ornithology is a narrower term than economic (or applied) ornithology. Whereas the former is restricted only to agriculture (including the allied areas e.g., fisheries, dairy, beekeeping, etc.), the latter deals with all activities of birds that are either beneficial or harmful to mankind.

Birds constitute an important component of agroecosystems. The dual role of birds in agriculture is very well known (Ali 1949, 1971). Agriculture provides a concentrated and highly predictable source of food to birds. This food in general is of three kinds: (i) grain, seeds and fruits, (ii) green vegetation of the crop plants and grasses, and (iii) insects, other arthropods, rodents, etc., found in the soil, crops and other plants (O'Connor and Shrubb 1986). Agricultural landscapes in India, especially in the intensively cultivated areas like Punjab, have a number of fish, dairy, poultry and honeybee farms interspersed among crop fields. These farms along with a variety of native and exotic agroforestry trees provide additional food to birds in the form of fish, bees, animal feeds, tree-fruits, seeds, nectar, etc. Birds of agricultural areas, therefore, include granivores, frugivores, insectivores, carnivores, nectarivores and omnivores.

A few granivorous and omnivorous bird species have been able to harvest energy and reproduce very efficiently in agricultural habitats leading to their large population build-ups. These very abundant and widespread species come in conflict with man's interest of increasing agricultural production by inflicting economic injury to crops, fruits and stored grain. Insectivorous and carnivorous species are considered to be useful to agriculture since they keep a very potent check on populations of insect

and rodent pests of crops. These birds, however, are very less abundant than granivores and omnivores.

Agricultural ornithology aims at obtaining scientific information on birds in relation to agriculture and using that information for their management. Avian management includes both conservation of useful species and control of pest birds. The assessment of environmental impact of various control techniques is also an essential component of management. The foremost task of an agricultural ornithologist is to evaluate the impact of all useful and harmful activities of the common species and make a balance sheet to decide whether a species can be termed a useful, harmful or neutral. This indeed is a very difficult, although not impossible, task to do because the role of a species in a given ecosystem is very complex. For understanding this role, we must have a consummate knowledge on ecology of the concerned species. We need to study in detail the food and feeding behaviour, reproduction, roosting, population dynamics and damage/useful potential of all important species. Management questions can be answered only if we have a sound knowledge on these ecological aspects. The objectives of this paper are: (i) to review the progress made in agricultural ornithology in India, (ii) to point out important problems and gaps in the knowledge, and (iii) to suggest approaches for future research.

2. Present status of agricultural ornithology

Today we have a good deal of information on various aspects of agricultural ornithology. Although this information is far from sufficient, it has enabled us start looking into various questions of bird management with confidence. Here we intend to provide an overview of the present knowledge on the subject.

2.1 *Community structure and population ecology*

Bird community in agricultural lands is characterized by overdominance of only a few granivorous and omnivorous species while the rest of species are represented in very small numbers, some of which are rare. Toor *et al* (1986) described community structure of birds at a grain store in Punjab. Among 06 species recorded at the store, house sparrow *Passer domesticus* was the most abundant species having 77% dominance in the community. Dhindsa *et al* (1988) studied bird community of an intensively cultivated area at Ludhiana in March—April and recorded a species richness of 68. Ten of these species were granivorous, 10 omnivorous, 38 insectivorous and 8 others. The first four species in order of abundance (2 omnivorous and 2 granivorous) represented 47% of total birds of all 68 species. In contrast, 38 insectivorous species represented only 30% of total birds. In Britain also farmland bird community consists of a few very abundant and widespread core species and about 20 less abundant but fairly widespread species while some other species are rare (O'Connor and Shrubb 1986). Dominance by a few very common species is typical of disturbed habitats (MacArthur 1970) and agricultural areas have one of the highly disturbed habitats.

Detailed information of population dynamics is not available even on the very common species of Indian birds. Our knowledge of population structure, natality,

morality, dispersal, etc., is almost non-existent. However, some studies have been conducted on seasonal changes in population density and other indices of a few species in agricultural habitats (Toor *et al* 1986). Some estimates of density of breeding weaverbirds *Ploceus* spp. have been made in Andhra Pradesh (Mathew 1976) and Punjab (Dhindsa 1986).

2.2 *Food and feeding ecology*

Our information on food and feeding of some common bird .species in cultivated and natural habitats is quite good. Although some of this information is purely qualitative and preliminary, the rest is based on detailed analytical and quantitative studies. Food of 13 species of birds of agricultural importance has been analysed in detail. Nine of these species are granivorous, seven omnivorus and one insectivorous.

Recently, gut content analyses have been supplemented by field observations on feeding behaviour and captivity experiments on food preferences of the concerned species (Mathew 1976; Mathew *et al* 1980; Dhindsa and Toor 1990; Saini and Dhindsa 1993). When feeding ecology is studied to estimate the impact of a species on agriculture, gut content analyses alone do not serve the purpose. Field observations on feeding behaviour must also be recorded to pinpoint the sources of various foods. For instance, Dhindsa and Toor (1990) found that rice was the principal food type in the guts of three species of weaverbirds *Ploceus* spp. in Punjab. Field observations, however, revealed that most of the rice grains taken by these birds were either left in the stored straw or shed during the crop harvest and thus already wasted.

Another important aspect of feeding ecology is food preferences of captive birds. Food preference studies may be helpful in the management of pest species since a preferred crop may be used as a decoy crop to reduce damage to more important crop (Cummings *et al* 1987; Fairaizl and Pfeifer 1988). The amounts of food consumed by captive or wild birds have been employed to calculate indirectly the damage potential of a species (Avery 1979; Toor *et al* 1986; Saini and Toor 1991). Unfortunately, only a little work has been done in this direction. Mathew (1976) and Dhindsa and Toor (1990) studied preferences of captive baya weaverbirds *Ploceus philippinus* for different food types in Andhra Pradesh and Punjab, respectively. Both of these studies have provided conflicting results. Food preferences of captive rose-ringed parakeets *Psittacula krameri* have also been studied (Simwat and Sidhu 1974; Saini and Dhindsa 1993).

Some estimates of dietary overlap of coexisting species (Dhindsa and Toor 1990; Saini and Toor 1994; Saini *et al* 1994) and seasonal changes in diet diversity (Saini and Dhindsa 1991; Saini and Toor 1991, 1994; Saini *et al* 1993, 1994) have also been made. Food of three coexisting species of weaverbirds has been found to overlap to the extent of 95-99% in adults and 85-97% in nestlings in an intensively cultivated area of Punjab (Dhindsa and Toor 1990). This extensive dietary overlap between these species does not seem to threaten their coexistence in this area because of superabundance of food and fine scale interspecific differences in diet. Similarly, dietary overlap of 57-84% was found among ring dove *Streptopelia decaocto*, little brown dove *S. senegalensis* and red turtle-dove *S. tranquebarica*

(Saini and Toor 1994). In the same area, food of jungle babbler *Turdoides straitus* and common babbler *T. caudatus* overlapped by 53% (Saini *et al* 1994).

2.3 *Breeding ecology*

Breeding ecology is the area that has attracted the keenest attention of Indian ornithologists. Earlier studies on breeding of Indian birds were in the form of natural history notes. A very good work on nidification of Indian birds was that of Baker (1930-1935). Probably, the first detailed description of breeding of a species, i.e., baya weaverbird, was published by Ali (1931) followed by Crook (1960, 1963). Several aspects of breeding ecology of this and three other species of weaverbirds have been described which include nest building behaviour, nest-site selection, mortality factors, nest appropriation, clutch size, brood parasitism and reproductive success (Ambedkar 1964, 1968, 1970; Davis 1971, 1974; Dhindsa 1983a, 1983b, 1986, 1990; Dhindsa and Toor 1980, 1994; Dhindsa and Sandhu 1988; Chandola-Saklani *et al* 1990).

Basic data on breeding of house crow *Corms splendens* and its brood parasitism by koel *Eudynamys scolopacea* were recorded by Lamba (1963, 1976). Information on breeding of house sparrow is available from Gujarat (Naik and Mistry 1972, 1980; Mathew and Naik 1986), Andhra Pradesh (Kumudanathan *et al* 1983), Punjab (Simwat 1977) and Rajasthan (Rana and Idris 1989). Not much is known on breeding ecology of rose-ringed parakeet, probably because it is a hole nesting species. Other birds of agricultural importance whose breeding has been studied in some details include mynas, doves, babblers, bulbuls, etc.

Although we have a good deal of information on various breeding aspects of many common species, yet experimental studies on the impact of various factors on reproductive success are lacking. Another aspect that requires special attention is nest-site selection by common species.

2.4 *Roosting ecology*

Not much is known on roosting ecology of Indian birds. Gadgil (1970) described the function of mixed roosts and Gadgil and Ali (1975) summarized information on communal roosting in Indian birds. Studies have been conducted on roosting habits of common myna *Acridotheres tristis* (Sengupta 1973), bank myna *A. ginginianus* (Khera and Kalsi 1986), weaverbirds (Ambedkar 1968; Dhindsa and Toor 1981), pariah kite *Milvus migrans* (Mahabal and Bastawade 1984), rosy pastor *Sturnus roseus* (Mahabal and Bastawade 1980) and green bee-eater *Merops orientalis* (Bastawade 1976).

2.5. *Damage estimation.*

It is interesting to note that only 05 of about 1000 species of birds found in India (i.e., only 2.1%) have been reported to inflict damage to crops and fruits. Damage by these species to important crops and fruits has been estimated in different parts of India (table 1). Most of these are localized estimates that are not applicable

Table 1. Bird damage to crops and fruits.

Crop/Fruit	Stage	Bird species	Extent (%)	References
Crops				
Groundnut	R	Crows	24	Verghese and Chakravarthy (1978)
Maize	S	Crows, doves, babblers	20	Chahal *et al* (1973), Sandhu *et al* (1987)
	R	Parakeets, crows	12–21	Ramzan and Toor (1973), Simwat and Sidhu (1973), Singh and Kumar (1982)
Mustard	R	Parakeets	63	Simwat and Sidhu (1973)
Pearl millet	R	Sparrows, parakeets, weaverbirds	10–100	Beri *et al* (1968), Jotwani *et al* (1969), Jain and Prakash (1974), Dhindsa *et al* (1984)
Peas	R	Pigeons	54	Saini and Kaur (1986)
Pulses	S	Doves, pigeons, parakeets, sparrows	66	Mehrotra and Bhatnagar (1979), Saini *et al* (1992)
Rice	S	Weaverbirds, sparrows	41	Dhindsa and Toor (1980)
	R	Sparrows, weaverbirds, munias, parakeets, sarus cranes	26	Parasharya *et al* (1986)
Sorghum	R	Pigeons, doves	12–85	Rao and Rao (1953), Perumal *et al* (1971), Dhindsa *et al* (1984)
Sunflower	S	Crows	65	Dhindsa *et al* (1991)
	R	Crows, parakeets	22	Toor and Ramzan (1974)
Wheat	S	Crows	17–20	Chahal *et al* (1973), Toor and Sandhu (1979), Sandhu and Toor (1984)
Fruits				
Almonds	R	Parakeets	7	Sandhu and Dhindsa (1982)
Ber	R	Parakeets	NR	Lakra *et al* (1979)
Datepalm	R	Parakeets	NR	Gupta (1980)
Grapes	R	Bank mynas	12·5	Toor and Ramzan (1974)
Guava	R	Parakeets	20	Ramzan and Toor (1972), Singh and Kumar (1982)
Peach	R	Parakeets, crows	32	Toor and Sandhu (1981)

NR, Not recorded; R, ripening; S, sprouting.

over large areas. However, they do indicate damage potential of the species involved. Toor *et al* (1986) estimated bird damage at a grain store in Punjab. In their study, ring doves, sparrows and weaverbirds consumed 4074 kg of rice in five months. Besides this direct loss of grains, these birds damaged gunny bags, spoiled the site area and contaminated grains with their droppings. If we take into consideration the number of such stores in India, the damage would be enormous. Bird congregations at grain stores and rice-shelling yards in Punjab are a real problem. Saini and Toor (1991) estimated damage potential of blue-rock pigeon *Columba livia*. They reported that a flock of 1000 pigeons can consume 18 kg/day of sprouting maize, 15 kg/day of sprouting pulses, 18 kg/day of maturing lentil, 41 kg/day of maturing pea or 01 kg/day of maturing gram.

2.6 *Evaluation of beneficial role of birds*

Although it is well known that insectivorous and predatory birds play a very useful role in controlling insect and rodent pests of crops, only a few attempts have been made to evaluate this role and these too only in case of insectivorous birds. Our knowledge on the impact of predatory birds on rodent populations in India is practically nil.

Patel *et al* (1987) found that house sparrow, common myna, red-vented bulbul *Pycnonotus cafer* and three other bird species in addition to wasps play important role in reducing *Catopsilla* sp. larvae in a medicinal crop, *Cassia angustifolia.* Several species of insectivorous birds have been found to feed on insect pests of crops including *Helicoverpa armigera* (Chakravarthy 1988; Parasharya *et al* 1988; Singh *et al* 1990). In doing so, some of these species transmit nuclear polyhedrosis virus infecting *H. armigera* to healthy larvae of this pest (Vyas *et al* 1988a). Bird predators of some other insect pests have also been found to play an important role in biological control of insect pests through disease transmission (Battu 1987; Vyas *et al* 1988b), besides direct predation.

2.7 *Economic status*

Ecological information on some common species has enabled us to comment on their status in relation to agriculture. Rose-ringed parakeet is probably the only species that seems to be exclusively harmful to agriculture, having no compensatory value. House crow and blue rock pigeon have also been considered to be harmful. House sparrow, ring dove and baya weaverbird have a neutral status in relation to agriculture while a large majority of the species in the agricultural bird communities are useful. Some birds like kingfishers and bee-eaters are considered to be harmful to fish farming and bee keeping, respectively. Kingfishers undoubtedly feed on fish fry, crustaceans of commercial value, frogs, toads and tadpoles (Mason and Lefroy 1910; Mukherjee 1969-1976; Jior and Dhindsa 1988) but they do not inflict economic injury probably because of their low numbers. Bee-eaters are commonly observed feeding on flying insects including honeybees but there has been no study to substantiate the claim that bee-eaters are pest birds.

2.8 *Management*

2.8a *Conservation of useful species:* Despite ecological importance and global awareness of conservation nothing has been done to protect endangered and threatened species in intensively cultivated areas. Gaston (1984), examining the status and distribution of endemic passerine species in India and Pakistan, suggested that such species may become vulnerable to extinction in areas where habitat destruction is extensive. The populations of birds of prey have dwindled to insignificant levels because of habitat destruction and food-chain poisoning (Dhindsa 1984). Agricultural areas in India probably experience the most heavy and indiscriminate use of pesticides leading to direct and indirect mortality of predatory and frugivorous birds (Dhindsa *et al* 1986). The population of sarus crane *Grus antigone* is dwindling in some parts of India due to agricultural expansion (B M Parasharya, unpublished results). There has hardly been any information on residue analysis and other toxicological aspects on birds of agricultural habitats.

Recently, fast moving vehicles have been found to constitute a new factor of bird mortality on roads in agricultural habitats. Dhindsa *et al* (1988) found that roads in Punjab were rich food sources for birds and predicted that bird mortality on roads would occur as a result of the advent of fast vehicles and improvement in road conditions. This prediction has come true. Bird mortality on roads has also been recorded in Rajasthan (Sharma 1988).

2.8b *Control of pest birds:* Lethal and non-lethal methods of control have been tried against different birds in different parts of India. Killing is considered to be the surest way of getting rid of harmful birds but public opinion has swayed against bird killing. In certain situations, however, farmers need to kill a few birds to scare others. Shooting involves a lot of labour, and mist nets are very costly and not easily available. Certain traps, however, can be easily constructed for catching crows (Singh and Dungan 1955) and other birds. Fumigation of nest holes and nest destruction for population reduction is also very labour intensive, Some chemicals have been found to be efficient poison baits against pest birds (Bhatnagar 1976a,b). Lethal control of birds does not always solve the problems as is evident from the results of mass killing attempts on queleas *Quelea quelea* in Africa and starlings *Sturnus vulgaris* in Europe. Moreover, the killing of most of the bird species is illegal in India.

Non-lethal control measures call for special attention and research on them should be intensified. Studies have been conducted on chemical and physical bird repellents in germinating and maturing crops. Recently, a method involving camouflaging maize cobs has been discovered which protects ripening maize from rose-ringed parakeets (Dhindsa *et al* 1990). Despite the above studies, the state of our knowledge on bird control is preliminary. In fact, this area is still developing even in the developed countries and there is a lot of scope for innovative work.

2.8c *Environmental impact assessment:* We have theoretical information on the impact of human activities including agriculture on ecosystem stability. Some excellent documentations of such impacts are available from other countries. Unfortunately, nothing has been done in this direction in India although environmental impact assessment must be an essential component of all management strategies.

2.9 *Related studies*

A bulk of information has been generated in some basic areas of avian biology *e.g.*, taxonomy, anatomy, physiology, parasitology, plumage and moult, zoogeography, etc. Review of this information is out of the scope of this paper, but it must be emphasized that basic information is very important for applied research. Agricultural ornithology has benefitted from the knowledge generated by research in basic ornithology.

3. Problems and prospects

Ornithology, particularly agricultural ornithology, has been and still is a low priority research area in India. Lack of financial support is the major problem faced by

agricultural ornithologists. Almost no funding was available for research in this field until mid-1960s. Some localized projects were later supported by the ICAR and state governments in Andhra Pradesh and Punjab. Although ICAR has been running an All India Coordinated Research Project on Agricultural Ornithology since 1983, this project is at the lowest priority as far as the allocation of funds is concerned.

The second problem has been the scarcity of scientists opting for research in this area. Until 1970s, there were hardly any zoologists trained in field ornithology. Although the situation is not as grim at present as was a few years ago, the number of students preferring this field is still very low as compared to the other areas of zoology. This is probably because of scanty job opportunities in agricultural ornithology. Furthermore, applied research, according to Bucher (1991), is considered to be less attractive as well as less prestigious in academic circles. This seems to be true for agricultural ornithology in India and elsewhere.

The first problem can be solved if the funding agencies start appreciating the role of birds in agriculture and be liberal in supporting research projects in agricultural ornithology. Birds form an important component of the agroecosystem. We need to keep all existing avian species in balanced numbers in the cultivated landscapes so as to have a sustained agricultural production. Research is required to meet this objective for which funds are essential. The availability of funds would increase job opportunities and to some extent solve the second problem also. However, this problem can be solved in toto only if the ornithologists themselves realize the importance of applied research. Ornithologists doing basic and applied research must interact so that theory may be put into practice (Bucher 1991).

There are many challenges faced by agricultural ornithologists in India, and future research must be aimed at meeting these challenges. The first and foremost challenge is the management of rose-ringed parakeet, the most injurious avian pest in India. In our view, stress should be given on evolving effective strategy based on an integrated approach for the control of this species.

Although we do have sufficient data on the role of common species in agriculture from some parts of India, such information is lacking from much of the country, even from intensively cultivated states like Haryana, Uttar Pradesh, Karnataka, etc. A survey of bird problems, therefore, is wanting from different agroclimatic regions of India. Such survey can lead us to identify the regions where agricultural ornithological research needs to be undertaken. Research should be intensified on bird problems in horticulture, fish farming, dairy farming and bee keeping. These are the areas where almost no information is available. Studies are also required on ecology and conservation of birds of prey whose populations are declining in cultivated areas. Agricultural regions in India have been experiencing heavy and indiscriminate use of chemical pesticides since many years and birds must have been contaminated with their residues, especially with those of chlorinated hydrocarbons. Birds of prey being at the top of the food chain are the most likely victims of pesticidal contamination. Mortality of these and other birds due to toxic chemicals and pathogenic organisms also needs to be looked into.

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