CHAPTER – 2

Selection of key bird species to assess the impact of organochlorine pesticides

1. Introduction

Birds are exposed to pesticides when they eat granules or residues on plants, in prey items or come in contact with pesticides For instance, some birds feed on dead and dying insects, following application of insecticides or when wildlife enter the fields during or soon after an insecticide has been sprayed they may be exposed to the pesticides and these pesticides enter their body through different routes like skin contact, eyes or when they inhale the vapor Exposure to highly toxic insecticides can result in death of the animal. Sub-lethal exposure may cause sickness Birds made sick by pesticides are more prone to predation and disease and also bird's activity decrease or avoid social and breeding activity like neglecting their young ones.

Among the pesticides, the chlorinated hydrocarbons are known to have the great impact on birds (Risebrough, 1986). The principal products include DDT, dicofol, dieldrin, aldrin, endrin, hexachlorocyclohexanes (HCH or BHC), mirex, chlordane, toxaphene, heptachlor and endosulfan The toxicity of organochlorine will be governed by many factors including age, sex, repellency, type of exposure, formulation, interaction with other contaminants and type of stress, including food shortage, extreme weather, migration, reproductive activity, hibernation, molting and disturbance etc. (Hayes, 1991).

The agricultural landscape of Kheda district provides habitat for wide variety of bird species. These species are utilizing the crop and surrounding environment in different ways and means. How much of the pesticides used for protecting the crop affects the avifauna depending on agricultural fields for their food is to be evaluated. It is not possible to assess the organochlorine pesticides residues in all the bird species existing in the study area and some of the bird species may utilize their environment in such a way so that they are rarely at risk, such species might not be affected by the contaminant present in the environment. Hence, the proper selection of key species in assessing pesticide residues in the environment and its impact on the biota can result in assessment based on the species most sensitive to the substance (pesticides) and ecologically most susceptible to the exposure. Thus, an assessment based on selected key species will give us the idea on effect of organochlorine for a much broader array of species. However, this concept will be effective only when appropriate consideration is given to the selection of the key species. Considering the above facts of pesticide behavior in environment and difference in exposure of the bird species to this pesticides; attempt were made to identify key species for assessing the impact of organochlorine pesticides.

2. Method

For the selection of key species from existing bird species in Kheda district, the biological characteristic of each species was reviewed by surveying the literature available on and further supported by observations whenever required. They were screened on the basis of set of criteria proposed by Environment Protection Agency (EPA) as follow

1 The species are commonly nesting and foraging in or around (within the drift zone) the agro-ecological scenario

2. Their foraging techniques render the species subject to exposure
3. The species obtain substantial portion of their diet from contaminated field or surrounding habitat within the drift zone.
4. The species is sensitive to the organochlorine pesticides.

3. Result and Discussion

The study area was monitored for documenting the occurrence of various species. After a long period of monitoring, 293 species of birds were observed, belonging to 53 different families (Table 2.1). The highest birds species recorded were from the family Musicicapadidae (38) followed by Charadridae (31). Second highest was Anatidae (18) followed by Ardidae (13). The taxonomic diversity was 3.45, it was as high as one observed in the protected area and other similar habitats. When birds were grouped on the basis of their residential status in the area, 53 % of the total recorded birds were resident as well as breeding in this area. While 36 % of the total birds were migratory during winter (Table 2.2). the values indicate that both groups of birds utilize the habitat potentially for foraging. The large numbers of species (20) of top predators were also observed in the area. Looking to this fact (number of birds and its taxonomic diversity), it suggests that the study area exclusively supports rich avifaunal diversity. Thus it is very important to note their role in crop production and protection of agricultural fields from pests. On the other hand we required knowing the impact of agricultural activity on the avifauna. However, it is very difficult to assess the impact of agricultural activity especially pesticide use on such a huge volume. But it can be possible through selecting the key species on the basis of their taxonomic group. For that above given information serves as one of the useful clue for selecting the key species.

Table 2.1: Number of birds recorded in different family of avifauna of Study area

Sr. No.	Family	No. of species	Sr. No.	Family	No. of species
1	Accipitridae	20	28	Laridae	13
2	Alaudidae	8	29	Meropidae	5
3	Alcedinidae	5	30	Motacillidae	11
4	Anatidae	18	31	Muscicapidae	38
5	Apodidae	2	32	Nectariniidae	2
6	Ardeidae	13	33	Oroioldae	2
7	Burhinidae	2	34	Pelecaniidae	2
8	Campephagidae	3	35	Phalacrocoracidae	4
9	Capitonidae	1	36	Phasianidae	8
10	Caprimulgidae	1	37	Phoenicopteridae	2
11	Charadridae	31	38	Picdae	3
12	Ciconiidae	5	39	Pittidae	1
13	Columbidae	6	40	Ploceidae	9
14	Corvidae	3	41	Podicipedidae	3
15	Cuculidae	6	42	Psitticidae	3
16	Dicaeidae	2	43	Pteroclididae	1
17	Dicruridae	2	44	Pycnonotidae	3
18	Emberizidae	3	45	Rallidae	6
19	Falconidae	2	46	Recurvirostridae	2
20	Fimgillidae	1	47	Rostratulidae	1
21	Glareolidae	3	48	Strigidae	4
22	Gruidae	3	49	Sturnidae	6
23	Haematopodidae	1	50	Threskniornidae	4
24	Hirundinidae	6	51	Turnicidae	1
25	Irenidae	2	52	Upupidae	1
26	Jacanidae	2	53	Zosteropidae	1
27	Laniidae	6			

Table 2.2: Status and frequency of birds observed in the study area.

Sr. No.	Status	Frequency	Percentage
1	Breeding only	2	0 68
2	Migratory	105	35 80
3	Residentıal and breeding (summer)	2	0 68
4	Residential & breeding (also migrate)	15	5.12
5	Residentiàl and breeding	156	53.20
6	Residential	9	3.07
7	Residential (summer)	2	0.68
8	Residentıal (also mıgrate)	2	0 68

There are several variables, to which the birds species shows varied response, because they are mobile, moving among and within various habitats, exposure can vary depending on habitat use, and the extent of its contamination. As a consequence, for the estimation of damage to wildlife one requires the consideration of those numbers of variables including environmental residues, routes of entry, habitat requirements and spatial movements for the species associated with the pesticide contaminated area For terrestrial wildlife there are three major routes of entry i.e. oral, dermal and inhalation. Oral exposure occurs through the consumption of contaminated food, water or soil and direct ingestion of granular products mistaken as grit or food source. Dermal exposure occurs when pesticides are absorbed directly through the skin when the animal contacts spray particles directly or contacts contaminated biotic and abiotic components of the habitat. Exposure from inhalation occurs when volatile pesticides or fine dust particles or droplets are respired into the lungs However, of the three routes, the major portions of the pesticides enter through oral routes i e with the dietary components, in the form of invertebrate prey, seeds and fruits For this reason the food habit and food guild ascertained the due weitage in selection of the key species Considering all these factors two species were selected namely Cattle Egret (*Bubulcus ibis*) and Black-throated Weaver Bird (*Ploceus benghalensis*). Among the selected birds, the Cattle Egret belongs to insectivore groups, which feed on variety of insects while Black-throated Weaver Bird is a granivore, feeds on seeds, grains and other vegetations The biological characteristics of selected key species are given below and a brief account on Black-throated Weaver Bird along with required EPA specification is presented in Table 2 3.

Table 2.3: Compassion of EPA recommended* criteria for granivorous passerine with Black-throated Weaver Birds.

Criteria	EPA recommendation	BTWB Specification
Weight	20g	18-26g
Foraging technique	Ground gleaning	Ground gleaning
Food preference	100% seeds	Almost 100 % seed
Proportion of diet from contaminated field	100 %	Assumed to be 100 %
Proportion of time spent in contaminated field	100 %	100%
Sensitivity to pesticides	Use oral acute and dietary lab toxicity test for birds or representative species	311 to 1869 for DDT 579 to 1869 for DDD 825 to 3572 for DDE 118 to > 1400 for HCH 75 to > 2000 for lindane

*Source: Avian Effects dialogue group 1994

1. Cattle Egret

Species *Babulcus ibis* is about 53 cm in length, with a mean wingspan of 94 cm and weigh between 0.3 –0.5 kg. The bill, lore yellow, upper mandible slightly down-curved; base of lower mandible slightly gives heavy jawed look and the legs greenish brown. In breeding season, there are conspicuous orange-yellow plumes on whole head, fore neck and back (Plate Ia). For part of the season, lore, bill, and legs become vermilion-red. In the non-breeding season; the plumage of the body are all white though some have yellow tinge on crown (Sonobe and Usvi, 1993). Status of the bird in the agricultural landscape of Kheda district is, that this species can be found in attending most of the agricultural operations. They are also seen attending grazing cattle.

These birds can be found along agricultural fields, inland freshwater reservoirs and rivers. Nesting occurs either in single or mixed colonies. It is gregarious and usually associated with cattle and other grazing animals. Cattle Egrets are native to Africa and Asia. The nature and success of their distribution is almost worldwide, dynamic and complex, but well documented. In Kheda district, Cattle Egrets, nest generally near human habitation, surrounded by agricultural land. They are primarily associated with Median Egret, Little Egret, Pond Heron and White Ibis in the heronry. In 1995, they occupied 42 heronries with 3300 nests in Kheda district (Patel, 1996b). While during 1999, they had occupied 69 heronries having a total 4252 nests. Several large and small colonies are found nesting all over Gujarat. In study area, nesting activity starts in the months of June-July depending on the onset of the monsoon, their breeding season lasts for seven to nine weeks. Their nest consists of twigs and is bowl-shaped The average clutch size recorded was 4 3, egg-laying interval was about one day The incubation period is about twenty-four days. Cattle Egrets

Plate Ia. Cattle Egrets in breeding plumage

Plate Ib. Black-throated Weaver Bird

lose about 12 % of their eggs, but hatching failure of remaining eggs is low i.e.3.44 %. Chick mortality is about 29 %.

Annual mortality rate among different age groups recorded in Texas was juveniles 56 %, fledglings 30% and adults 28 %. Few birds (about 4 %) live longer than 7-8 years. Maximum lifespan is not known, but may reach up to 20 years (Telfair, 1982). Mortality is due to natural causes, such as predation, diseases, injuries, accidents and rarely hunting. Agricultural pesticide residues have been found in egg and bird tissues in Texas and Mexico; however, there is no documentation of adverse effects to its population.

Cattle Egrets obtain about 95 % of their food from agricultural landscape. Major prey is grasshoppers and coleopteran and lepidopteron insects (Ikeda, 1956; Heubeck, 1967; Martin *et al.,* 1967; Singh *et al.,* 1988). Rarely prey items include ticks, earthworms, fish and small birds. Consumption of grasshoppers and other pest insects from agricultural crop may be of great economic benefit to farmer. Cattle Egrets reduce the number of tabanid fly and thereby the incidence of bovine anaplasmosis. Heronaries near human habitation cause noise, odor and fears of diseases such as ornithosis and histoplasmosis. But there is no evidence of such diseases in the Kheda district.

2. Black-throated Weaver Bird

The Black-throated Weaver Bird *Ploceus benghalesis* is a member of Ploceidae family of genus Ploceus that is the largest avian genus (Plate Ib). It is important species associated with agricultural landscape, particularly paddy crop agroecosystem. Adults are about 14 cm in length, have a wing length about 64–75 mm in male and 63 –72 mm in female, and weigh range between 18 –26 g (Patel, 1996a).

Breeding season is from June–September. Nest is similar to that of Baya Weaver but, instead of hanging by thin neck, the top dome of the nest is interwoven into a number of standing reed stems and there is a shorter vertical entrance tube, the nests are always built close to or above water in tall dense *Saccarum* spp. grass or reeds and in small scattered cluster (Grimmett *et al.*, 1998). However, in present study area, Babul were frequently used as a substrate for nest building, which is located on the edge of field crop.

Black-throated Weaver Birds solely depend for their food from agricultural fields. It is a granivore, feeds exclusively on the seeds and occasionally preys on the insects. Major food items are paddy, bajra, sorghum and wheat grains. Consumption of these grains varies seasonally depending on their availability in the environment; maximum consumption of rice reported was 99.6 % in November, and bajra 89.6 % in October (Patel, 1996a). The incidences of grit in gut occurred at 45.69 %. The study on daily food consumption reveals that they require 3.08 g grains daily.

In addition to EPA criteria for the selection of key species Cattle Egret and Black-throated Weaver bird also fulfill the criteria given by Moore (1966) for selecting the indicator species for determining the impact of organochlorine residues on wildlife. Both selected species are widely distributed and relatively abundant and easy to capture. They are also residential and sedentary in nature. Thus it adds benefit for assessing the local problems due to organochlorine pesticides. On the other hand, the Cattle Egret being a predatory species provides better indication of bioaccumulation (Douben, 1998) in addition to its role as one of the bio-control agent.