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Evaluate impact of environmental contaminants of agricultural and industrial origin on wetlands with high avian biodiversity, using fish-eating birds as indicators.

Principal Investigator

Dr. S. Muralidharan

Co-Investigator

Dr. S. Jayakumar

Sálim Ali Centre for Ornithology and Natural History,
(South India Centre of Wildlife Institute of India),
Ministry of Environment, Forest and Climate Change,
Government of India
Anaikatty, Coimbatore 641 108, Tamil Nadu.

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Email: salimalicentre@gmail.com & salimali@sacon.in, Website: www.sacon.in
Correspondence: Dr S. Muralidharan - ecot_mur@yahoo.com

Name & postal address of principal investigators:

Dr. S. Muralidharan, (Retd.)
Senior Principal Scientist Gr I
Division of Ecotoxicology,
Sálim Ali Centre for Ornithology and Natural History Anaikatti,
Coimbatore, Tamil Nadu 641 108

Name & postal address of principal investigators:

Dr S Jayakumar
Assistant Professor
A.V.C. College (Autonomous), Mannampandal-609305,
Mayiladuthurai, Tamil Nadu.

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Final Technical Report

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Ministry of Environment, Forest and Climate Change, Govt. of India.

Principal Investigator

Dr S Muralidharan (Retd.)

Senior Principal Scientist Gr I, Division of Ecotoxicology

Sálim Ali Centre for Ornithology and Natural History

Coimbatore 641 108, Tamil Nadu.

Co-Investigator

Dr S Jayakumar

Assistant Professor

A.V.C. College (Autonomous), Mannampandal-609305,

Mayiladuthurai, Tamil Nadu.

Researchers:

Dr. K Nambirajan, Project Scientist,

Mr. K Sharma, JRB,

Mr. Gourav Sonawane, JRB,

Ms. E Jeevitha, JRB,

Mr. L Kalaiarasu, Technical Assistant.

Sálim Ali Centre for Ornithology and Natural History
South India Centre of Wildlife Institute of India
(Ministry of Environment, Forest and Climate Change, Government of India)
Anaikatty, Coimbatore, 641 108.

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Terms and Abbreviations used in the Report

BBS	Bhadalwadi Bird Sanctuary
BDL	Below Detection Limit
CB	Carbamate
CIBRC	Central Insecticide Board and Registration Committee
DDT	Dichlorodiphenyltrichloroethane
DPPQS	Directorate of Plant Protection, Quarantine & Storage
EC	European Commission
F	Fungicide
FAO	Food and Agriculture Organization of the United Nations
g	Gram
GC-MS/MS	Gas Chromatography –Mass Spectrometry/Mass Spectrometry
H	Herbicide
ha.	Hectare
HCH	Hexachlorocyclohexane
I	Insecticide
IBA	Important Bird Area
IUCN	International Union for Conservation of Nature
Kg/ha	Kilo gram per hectare
Km	Kilometre
Lat	Latitude
LC50	Lethal Concentration
LC-MS/MS	Liquid Chromatography-Mass Spectrometry/Mass Spectrometry
LD50	Lethal dose
Long	Longitude
mg	Milligram
mg/kg	Milligram per kilogram
MRM	Multiple Reaction Monitoring
MT	Metric Ton
NBS	Nelapattu Bird Sanctuary
ng/g	Nanogram per gram
NMBS	Nandur madhmeshwar Bird Sanctuary
OC	Organochlorine
OCP	Organochlorine Pesticide

OP	Organophosphate
POPs	Persistent Organic pollutants
Ppb	Parts per billion
Ppm	Parts per million
RPM	Rotation per minute
SACON	Sálim Ali Centre for Ornithology and Natural History
Sq.km	Square kilometre
TBS	Telineelapuram Bird Sanctuary
UBS	Uppalapadu Bird Sanctuary
USEPA	United States Environmental Protection Agency
WHO	World Health Organisation
µg/g	Microgram per gram
µg/kg	Microgram per kilogram

Contents

Executive Summary

In recent times, colonial waterbirds are facing diverse anthropogenic and environmental pressures including climate change. Generally, birds are good indicators of the environmental changes and toxic chemicals introduced into their habitats. Ill effects of contaminants would include unnatural mortality of birds, breeding failure and physiological stress. Among birds, fish-eating birds are worst sufferers as they feed mostly on fishes, which are known to mediate the toxic contaminants to the higher vertebrates. In India, although there are breeding colonies of fish-eating birds within many protected areas, their major feeding habitats are ponds and lakes located in agricultural landscape. While it may be a general assumption that the population of birds, especially fish-eating birds is on the decline, information available is inadequate on the population status and breeding success of these birds in India. Further, it is possible that environmental contaminants, mainly from agricultural and industrial activities have been insidiously playing a role in the overall population decline of these birds. Although a few studies have examined residues of contaminants in eggs and tissues of birds, ecotoxicological data including eggshell thinning in birds are limited in India.

In this context, this comprehensive study was proposed to assess the impact of environmental contaminants, particularly pesticides on wetlands with high avian biodiversity, using fish-eating birds as indicators. Although, it is necessary to conduct extensive studies to conserve birds in the entire country, considering the vast area of the country, it has been planned to conduct the study in a staggered manner. Thus, under Phase-I states, namely Andhra Pradesh and Maharashtra have been considered, and proposed for four years with the following main objectives, 1) Identify active heronries in Andhra Pradesh and Maharashtra, 2) Assess population status, nesting and breeding ecology of fish-eating birds along with ecological covariates in select heronries in Andhra Pradesh and Maharashtra, 3) Assess the impact of pesticides and other chemical contaminants on the breeding ecology of fish-eating birds from select sites in Andhra Pradesh and Maharashtra using biological and non-biological samples.

The first objective was to document the heronries in select states by performing systematic field surveys keeping information available in the literature as baseline. Second objective was to address ecological aspects such as distribution of heronries, species distribution, nest-site selection, and breeding ecology of fish-eating birds. The third objective was to assess the various environment contaminants, namely organochlorine, organophosphorus and carbamate pesticides, and heavy metals in biological samples such as eggs, tissues of dead birds and food materials (molluscs, frogs and fishes) and non-biological samples, namely sediments. During the first phase of the project, we conducted surveys to locate active heronries. Local people were also enquired to get details on the nesting locations and breeding history of colonial nesting birds. In order to collect ecological data, direct

count method was followed to estimate the number of individuals. Breeding ecology of select species of colonial nesting birds are to be studied using focal animal sampling technique. Samples of sediments, fishes, tissues of dead birds and eggs will be collected and analysed for environmental contaminants during the second phase of the project. Data gathered between February 2022 and January 2023 are compiled and reported here.

Status of heronries and bird species in Andhra Pradesh

Totally, 33 sites in 11 districts of Andhra Pradesh, mostly wetlands and associated areas were surveyed between February 2022 and January 2023 to find out active heronries. The distribution of active nesting areas showed that not all the districts in Andhra Pradesh have ideal breeding locations for the fish-eating birds. Among the districts surveyed, Anantapur district had the highest number of heronries (07) followed by Srikakulam (04) while the remaining districts had between one and three sites. With respect to species distribution, Little Egret had the maximum distribution with 15 sites followed by Painted Stork in 13 sites. Survey identified 18 active heronries and 30 species of birds belonging to seven orders, namely Pelecaniformes, Anseriformes, Charadriiformes, Suliformes, Ciconiiformes, Gruiformes, Podicipediformes. Among the 30 species, Painted Stork had the maximum abundance (n=3284) followed by Spot-billed Pelican (n=1993) and Asian Openbill (n=1802), while Lesser-whistling Duck, Garganey, Little Grebe, Gray-headed Swamphen, Intermediate Egret, Little Tern and Bronze-winged Jacana had the minimum.

In order to assess the diversity of birds, a few diversity indices were employed. It revealed that Brahmayya Lingam Cheruvu from Vijayawada district had the highest species diversity (Shannon: 1.87; Simpson: 0.84), while the lowest species diversity was in Kolleru Wildlife Sanctuary (Shannon: 0.06; Simpson; 0.02). Among the sites surveyed, Nelapattu Bird Sanctuary, Guntur had the highest species richness (n=14), while the lowest richness was recorded in Ethirapattu Bird Area, Srikakulam (n=1). Other sites which recorded relatively high richness are Singanamala Cheruvu, Anantapur (n=13), Uppalapadu Bird Sanctuary (n=13) and Telineelapuram Bird Sanctuary (n=9). Three, heronries, namely Nelapattu Bird Sanctuary (NBS) in Nellore district, Uppalapadu Bird Sanctuary (UBS) in Guntur district and Telineelapuram Bird Sanctuary (TBS) in Srikakulam district were selected as intensive study sites for further investigations, based on active nesting, presence of similar species for comparison, geographical heterogeneity and also agricultural activities. All the intensive study sites selected are Important Bird Areas in Andhra Pradesh.

Totally, 26 species of waterbirds belonging to eight orders and eleven families were observed at NBS during the surveys. Similarly, 19 species of waterbirds belonging to six orders and ten families were observed at UBS. In TBS, 20 species of waterbirds belonging to eight orders and 12 families were observed during sur-

veys. Details of breeding birds, number of nests and nesting tree species were also compiled across all the three sites. During the survey, 120 nests of breeding birds, namely Asian Openbill, Spot-billed Pelican and Indian Cormorant in Nelapattu Bird Sanctuary, 63 nests of four breeding birds, namely Painted Stork, Spot-billed Pelican, Oriental Darter and Black-headed Ibis in Uppalapadu Bird Sanctuary, and 80 nests of breeding birds, namely Painted Stork, Spot-billed Pelican in Telineelapuram Bird Sanctuary were recorded. In Nelapattu Bird Sanctuary, most of the nests were found on Prosopis juliflora, Acacia nilotica and Barringtonia acutangula. Two species, namely Acacia nilotica and Prosopis juliflora supported the maximum number of nests in Uppalapadu Bird Sanctuary. In Telineelapuram Bird Sanctuary, most of the nests were on Ficus religiosa and Tamarindus indica, the most abundant trees.

While all the three study sites have active heronries in Andhra Pradesh, water level and availability of nesting trees or substrates appear to be deciding factors in terms of number of breeding species and number of nests. Further, nesting success will also depend on the quality of food available. Since, all these study sites are quite nearer to agricultural fields and they receive agricultural runoff, monitoring the impact on the fish-eating birds is recommended for better understanding of the impact of agrochemicals on the ecosystem.

Status of heronries and bird species in Maharashtra

Field surveys were conducted in 28 sites from six districts in Maharashtra. Among the districts surveyed, highest number of heronries were recorded in Nagpur (n=10) followed by Osmanabad (n=5). The remaining districts had between one and three sites. Among the heronry bird species, Little Egret was found in 12 sites followed by Indian Pond Heron and Eurasian Spoonbill in 11 sites. A total of 62 species of birds belonging to 10 orders, namely Charadriiformes, Coraciiformes, Gruiformes, Anseriformes, Pelecaniformes, Podicipediformes, Suliformes, Phoenicopteriformes, Ciconiiformes and Galliformes were recorded. Great Painted-Snipe and Pallas' Gull had the highest abundance (n=637) followed by Little Egret (n=431), while Common Sandpiper, Purple Heron, Northern Pintail, Whiskered Tern had the least abundance. Among the sites surveyed, Masla Khurd Lake, Osmanabad recorded the highest species diversity (Shannon index: 3.31; Simpson index: 0.96) and Pingali Lake in Satara recorded the lowest diversity (Shannon index: 0.50; Simpson index: 0.32). Highest species richness was recorded in Bhadalwadi Bird Sanctuary, Pune (n=50) followed by Nandur Madhmeshwar Bird Sanctuary (n=40) and lowest in Kanhan, Nagpur and Indapur, Pune (n=1). Therefore, Nandur Madhmeshwar Bird Sanctuary in Nashik district and Bhadalwadi Bird Sanctuary in Pune district have been select for further studies.

Nandur Madhmeshwar Bird Sanctuary had 739 individuals consisting of 40 bird species (Simpson: 3.06) belonging to eight orders. Bhadalwadi Bird Sanctuary recorded 2537 individuals comprising 50 bird species (Simpson: 2.88) belonging to

eight orders. There are five major breeding bird species, namely Painted Stork, Grey Heron, Little Cormorant, Little Egret and Black-crowned Night Heron found in both the study sites. Totally, 61 nests in Bhadalwadi Bird Sanctuary and 52 nests in Nandur Madhmeshwar Bird Sanctuary were recorded. Acacia nilotica was found to be the most common nesting tree species in both the sites.

Water bodies and associated vegetation in both the sanctuaries provide critical breeding, nesting, and feeding grounds for resident waterbirds which are breeding in these sanctuaries over several decades. Furthermore, these sanctuaries act as vital stopover sites for many migratory waterbirds. Hence, it will be prudent to assess and monitor the population and breeding biology of fish-eating birds, the indicators, in these important heronries. Equally important is to also keep track of the impact of contaminants on the birds.

Ecotoxicological Assessment: Pesticide residues in sediments in the vicinity of study sites

As per the project plan, one of the components of the study is to assess the impact of pesticides on the breeding outcome of fish-eating birds in select heronries in Andhra Pradesh and Maharashtra. Thus, the plan was to estimate pesticide residues in samples of dead birds, eggs, fishes, and sediments from select intensive study sites during the second year of the project, and relate it to the breeding outcome of fish-eating birds. Although, due to lack of funding the project could not be continued, we managed to collect limited number of sediment samples from the vicinity of the intensive study sites (foraging ground) in Andhra Pradesh and Maharashtra, and analysed for a set of 67 pesticides, which are being used in India.

In total 48 sediment samples were collected from the vicinity of the three study sites of Andhra Pradesh. Around 10% of sediment samples analysed had pesticide residues. Among the 67 pesticides analysed, residues of six pesticides, namely quinalphos, metribuzin, chlorpyrifos, ethion, parathion methyl and phorate were detected. While sediments from Telineelapuram Bird Sanctuary had residues of seven pesticides, sediments from Uppalapadu Bird Sanctuary had residues of two pesticides. However, no residues of any of the pesticides analysed were detected in the sediments collected from Nelapattu Bird Sanctuary.

In Maharashtra, totally 12 sediment samples were collected; Four from from Bhadalwadi Bird Sanctuary and eight from Nandur Madhmeshwar Bird Sanctuary, for contaminant analysis. Two out of 16 sediment samples detected residues of five pesticide compounds, namely monocrotophos, metribuzin, atrazine, transfluthrin and chlorpyrifos. None of the pesticides analysed was detected from sediments collected from Nandur Madhmeshwar Bird Sanctuary. Although, varying levels of pesticides were detected in the sediment samples, the levels were below the levels reported to be toxic to birds. Among the pesticides detected, presence of highly toxic monocrotophos is a cause for concern. Regular monitoring of the impact of pesticides on all the wetlands, particularly IBAs and heronries is recommended to

conserve the dynamic wetland ecosystems including fish eating birds.

Although, the study was proposed for four years, due to lack of continued funding commitment, it had to be aborted at the end of first year. Hence, this is more of a closer report. However, we would endeavour to secure necessary funding, and resume the work.