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STUDY ON HABIT AND HABITAT OF RIVER LAPWING IN SUR SAROVAR BIRD SANCTUARY

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Abstract

Various ecosystems are home to river lapwings, which may be seen in open, vegetated banks, barren, unforested islands, and farmland. On the riverbanks throughout the summer, adult beetles are the most frequent surface-active prey, followed by Hymenopteron, beetle larvae, Euplecoptera, Caddis flies, adult midges, Araneus, saltatoria, arthropods, and Cladocera. Saltatoria is the most common prey collected along the river's bare bank during the rainy season. More than a hundred river lapwings were seen using Waterborne Homoeopathy (WHP) to find food. Prey consumption rates vary widely depending on habitat and season, with the most enormous variation occurring along riverbanks relatively devoid of vegetation. Foraging success was highly variable between seasons and habitat types but was consistently highest in dense vegetation near the river.

Keywords : Sur Sarovar Bird Sanctuary, Ecosystem, Water quality, Waterborne Homoeopathy (WHP)

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1. Introduction

Birds are a wide-ranging group of vertebrates that may be distinguished by their shared characteristics of being feathered, air-breathing, warm-blooded, oviparous, and bipedal fliers. They serve as detritivores, pollinators, and predators of insect pests, among other functions, in ecosystems. Of the 9,702 bird species identified globally, 1,313 have been documented in the Indian subcontinent. Medium-sized wading birds, known as waders, are distinguishable from other waterbirds due to their unique shape and ecological needs. Because of their habit of building their nests in the open, they serve as a helpful case study for researchers interested in the connections between avian species and farming. Most of the approximately 210 species of waders may be found in either a marine or a wetland habitat. Anseriformes, Charadriiformes, Ciconiiformes, Gaviiformes, Gruiformes, Pelecaniformes, Podicipediformes, and Procellariiformes are only a few of the many families of birds that live in or near water. Most waders' diets consist of tiny vertebrates and invertebrates, making them strict carnivores. They have been seen investigating the wetland's dry edge and wading into shallow water. The distribution and quantity of waders are often determined by the kind of plants that grow along rivers and streams. Variable biological and environmental gradients in riparian vegetation may cause different bird species' emergence, decline, or extinction. Waders may find suitable habitats in the channels of larger ecosystems like the Ganges and the marshes and hills surrounding the river. Nesting sites may include riverbanks and riparian vegetation. The range of this bird is mainly determined by its food supply. The lapwings, or Vanellinae, are a subfamily of the wading bird family Charadriidae. They are well-known for their wailing call and sluggish, unsure wing beat while in flight. About 22 different lapwing species exist, many of which are strictly agricultural. Seven species of lapwings are recognised as permanent residents in the region now known as Northern India. Local birdlife includes many species of lapwings, including the river lapwing (Vanellus duvaucelii), yellow-wattled lapwing (Vanellus malabaricus), red-wetted lapwing (Vanellus indicus), and sociable lapwing (Vanellus gregarius).

1.1 River lapwing-In order to learn more about the characteristics of a specific species, it is essential to place them in a systematic hierarchy. The lesson first referred to the river lapwing as Vanellus duvaucelii in 1826. The river lapwing, a member of the family Charadriidae in the order Charadriiformes, is a kind of water or plover often found in and around more significant rivers. The river lapwing may be found in the following taxonomic categories: KingdomChordata, Phylum Animalia Name Family Charadriidae Genus Vanellus Subphylum Vertebrata Class Aves Order Charadriiformes Family Charadriidae Duvaucelii, a species. Some of the names for this bird include the Asian spur-winged lapwing, the Asian spur-winged plover, the Indian spur-winged lapwing, the pied lapwing, the River plover, and the Spur-winged lapwing. The river lapwing is a medium-sized bird with distinctive black, grey, and brown plumage. During displays, it raises a black crest. As the name implies, this species is primarily found adjacent to the more significant slow-moving rivers, where it is commonly observed feeding in couples on the river banks or exposed river islands. Its harsh and powerful cry is distinctive, serving as a call of identification during exhibitions and in times of alarm. The length of a river lapwing is around 29-31 cm. River lapwing has a small beak, robust legs, and rounded wingtips (Kazmierczak, 2000).

According to Birdlife International (2014), this bird has a black crest and a grey-white throat. River lapwings have a grey-brown stripe across their chests and white bellies with a black spot. The tail is black, the back is brown, and the rear is white. Although male river lapwings are somewhat more extensive than females, their plumage is identical in the adult stage (Ali, 2002). The river lapwing is found throughout the Indochinese area and its immediate neighbouring countries (Ali & Ripley, 1987) and in northern and southern India, Nepal, Bhutan, Bangladesh, Myanmar, Thailand, Cambodia, Laos, and Vietnam. River lapwings may be found throughout most of Northern and Eastern India, from Uttar Pradesh and Western Maharashtra to Andhra Pradesh.

2. Review of literature

2.1 Bird's habitat w.r.t. area- Teneson & Ravichandran, 2015 Research on the Koothapar Periyakulam wetland revealed diverse bird species, including migratory birds, ducks, and endangered species. The study emphasises the importance of conservation measures for these vital habitats. Bhattacharjee & Shuvadip Adhikari, 2022 Research on 133 bird species in two western districts of Madhya Pradesh examined habitat preference, eating habits, migratory status, and conservation status. Despite habitat diversity, seven species are in danger of extinction due to unplanned development, urbanisation, and climate change. Kumar *et al*., 2015 Researchers at Nawabganj Bird Sanctuary studied bird species and their ecological health, revealing that 43.33 per cent of the bird population relied on wetlands, primarily insectivores. Understanding changes in bird distribution and abundance is crucial for conservation efforts. Evans-Ogden *et al*., 2008 During winter, agricultural lands in the Fraser River Delta provide crucial roosting and feeding grounds for migrating shorebirds, such as the dunlin, black-bellied plover, and killdeer. These species prefer fields with bare soil or winter cover crops, highlighting their value to wildlife. Altaf *et al.*, 2018 Research on bird diversity in Chenab, Pakistan, reveals a sharp decrease in species as they move from forests to urban areas. Connecting landscapes and using large-scale metrics for conservation are crucial. Mandal *et al*., 2021 The research investigates birds' distribution, quantity, and species richness in the Purbasthali wetland, focusing on the impact of human activities. Despite 77 bird species, human expansion threatens the wetland's ecological integrity. Community involvement in management could help maintain the wetland's ecological integrity. Mariappan *et al*., 2013 Bird diversity in cropland, marsh, plantations, and fallow land changed with cropping patterns and seasons, according to research done at Vanavarayar Institute of Agriculture in Tamil Nadu, India. Birds such as the Indian grey hornbill, yellow-footed green pigeon, common tern, paradise flycatcher, black-headed ibis, white-breasted bulbul, striated heron, and barn owl were only seen at certain times of year on fallow ground. The research lends credence to the idea that judicious use of pesticides and artificial fertilisers might help keep bird populations healthy. Harisha, 2016 This research highlights the fragility and conservation concerns of the lake by revealing 47 species of wetland birds, including members of the families Ardeidae, Scolopacidae, Podicipedidae, Anhingidae, Rostratulidae, Recurvirostridae, and Laridae. Brraich and Kaur, 2016 the research on avifaunal diversity in Nangal Wetland, Punjab, found that the wetland is home to 146 species of birds, both migratory and permanent. Despite the possible contamination, the wetland's robust condition, transparent surface, and number of trees contribute to its production. Leito *et al*., 2014 This research examines the connections between coastal and floodplain grasslands, wader species, and food availability. Epigeic earthworms were shown to significantly impact species abundance, suggesting a link between habitat flooding and the availability of this food supply. Predation on endogeic earthworms is quite unlikely. El-Hanawany *et al*., 2010 This investigation of El-Dakahlyia Province's flora and fauna reveals 197 plant species, the vast majority typical of the Mediterranean region. There were many weeds counted. Panda *et al*., 2020 Bird populations in India suffer from the effects of growing urbanisation on their habitats. Surveys in Bhubaneswar, India, identified 222 species, with agricultural regions being the most favoured habitat. The research recommends a conservation strategy to protect existing species. Aspinall & Pearson, 2000 Eco-hydrological modelling, remote sensing, landscape ecological analysis, and geographic information systems (GIS) are all used in this work to create indicators of water catchment health. The indicators stand in for essential parts of the system and are meaningful in ways other than the characteristics they track. The output from these models focuses on their function as sources of information to help decision-making, notably creating indicators of water catchment conditions as output. Long-term natural resource management is ensured by examining these indicators, which assist in dividing the terrain into functionally comparable zones. Li *et al.*, 2019 the projected Yangtze-to-Huaihe Water Diversion Project (YHWD) at Caizi Lake, a critical wintering waterbird habitat, is expected to limit habitat availability. Over half of the grassland and mudflats are expected to be destroyed throughout the winter owing to the water level increase, which is likely to have a substantial effect on waterbirds. Restoring natural water levels in Xizi Lake and Caizi Lake may be achieved by removing the dam that separates them and minimising the effects of channel excavation in the project. Manohara *et al*., 2016 The research uncovered a fragile wetland with many resident and migratory birds by recording 33 wetland bird species from Magadi Bird Sanctuary. The discovery of four species at risk worldwide highlighted conservation challenges due to human activity in changing habitats.

2.2 Biochemical Analysis of Marine and Bird Species- Jakimska *et al.*, 2011 Metal bioaccumulation in animals is affected by their size, nutrition, and environment. Metal levels in the body indicate the severity of water pollution and are strongly influenced by the diet. Gao *et al*., 2009 said that Birds from several avian taxa, including wild aquatic birds and terrestrial birds, were found to be exposed to persistent organohalogen chemicals. The most abundant pollutant was DDTs, but HCHs and PCBs were present in almost identical amounts. Possibly owing to changes in food composition and reproductive rates, pollutant levels were lower in captive birds. Lavoie *et al.*, 2014 The research compares mercury levels in summer and wintertime Double-crested Cormorants and Caspian Terns, two colonial migratory fish-eating bird species. The results reveal that Hg persists from winter to summer, with more gradual seasonal shifts in the warmer months. Beland & Russell, 1978 Large populations of dinosaurs shaped the landscapes of what is now Alberta, and their fossils may be found in the Oldman Formation of Dinosaur Provincial Park. The park's badlands are not uniform, providing a more accurate assessment of current resource demands. The paleoecology of the park relies on

generalisations made from the assemblages of big terrestrial vertebrates in the wild and on evidence from articulated vertebrate remains. Understanding the park's history is crucial due to the necessity of determining the cause of the park's diversified flora and significant herbivore biomass. He et. al., 2010 Six species of birds were tested for Tetrabromobisphenol-A (TBBPA) and three diastereomers of hexabromocyclodecane (HBCD) in a South Chinese e-waste recycling zone. It was discovered that the birds' diets are impacted by their surroundings; R-HBCD is more common in aquatic habitats, whereas -HBCD is more common on land. According to the results, dietary factors are important in setting HBCD diastereoisomer patterns. Gopal *et al.*, 2015 This research explores the water quality and pollution sources in Sur Sarovar (Keetham) Lake, Agra, Uttar Pradesh. The lake has a higher rate of primary generation of organic matter due to phytoplankton and macrophytes. This research shows that physicochemical factors, including pH, temperature, and heavy metal concentrations, are all greater than what is considered healthy for plant and animal life.

2.3 Study of River Lapwing- Arya *et al.*, 2021 The research in India revealed a diverse bird population, including the River Lapwing, a near-threatened species, and a critically endangered Red-headed vulture, highlighting the importance of preserving biological diversity in the region. Kumar *et al.*, 2021 The success of river lapwings in finding food varies widely depending on the season and their environment. Riverbanks and islands are desirable for foraging because of the easy access to food and the lack of competition from other animals. Kumbar & Ghadage, 2013 Birds of 30 different families were found in the research, with a total of 126 species found in the Krishna River Basin. The area's varied flora and pleasant climate contribute to the abundance of birdlife there. Mahalakshmi *et al.*, 2014 The research compared the avian diversity and richness in the Arumugamangalam wetland to those of other wetlands in the Tamaraparani River basin, both wet and dry. Harisha & Hosetti, 2018 The research found various migratory water birds in the Komaranahalli Kere Lake and analysed their current conservation status and threats. Despite the lake's disruption, it offers prospective homes for a few migratory and permanent birds, including vulnerable species. Monitoring and public engagement are vital for sustaining the lake's Avifauna. Sethi *et al.*, 2011 Predation was a significant problem for the Red-wattled Lapwing, Vanellus indicus, in India, causing a considerable drop in hatching success rates for both ground and roof nests despite more minor egg losses in the latter.

3. Materials and Methodology

3.1 Place of study- Keetham Lake, also known as Sur Sarovar, is an artificial reservoir that was first constructed to provide summertime water to the city of Agra but has now developed into a significant and diverse ecosystem in its own right. More than 60 kinds of fish and countless migrating birds find safety in the Site's mosaic of habitats. The more incredible spotted eagle (Clanga clanga), the sarus crane (Grus antigone), and the catfish (Wallago attu) are all endangered species. The Site is significant for Central Asian flyway migratory bird species, as over 30,000 waterbirds have been seen in the reservoir in a single year. The greylag geese (Anser anser) population here accounts for more than 1 per cent of the total in South Asia. Significant risks to the Site come from incompatible tourist practices, invasive species, and domestic and municipal wastes. The Agra area of Uttar Pradesh is home to the wetland, which can be found just off National Highway 2 between Delhi and Mathura.

3.2 Nomenclature- Local name: Titihari. The call of river lapwing is tip-tip or did-did-did.

3.3 Habitat measurements- River lapwing dwells along significant rivers and lakes. It favours broad, slow-moving rivers with sand or gravel bars and islands. They also like low wet/dry grasses and cultivated soil as their home. However, we can only find them near the sandy sides of significant rivers, which seem primarily stationary. Not only that, but we seldom see this species in the woods. Agricultural areas and water storage tanks are part of this species' artificial ecology. The riverine habitat of river lapwings was the focus of this investigation. Many bird species rely on the river for survival, and many of these species only nest on sandbars or other river channel environments. Human activity tends to cause frequent disruptions in river systems. They are subject to harsh management, aiming at flood control and preserving appropriate surface drainage. Moreover, they also acquire significant pollution from metropolitan areas and agricultural activity. Proper river management was crucial to preserving the river's high biodiversity value. Populations of riverine birds are on the decline in several previous studies conducted in Thailand, Northern Laos, Southern Laos, and North-Eastern Cambodia.

3.4 Habits -What birds eat and how they eat are two of the most critical determinants of their life histories. Knowledge of the available prey resources is crucial for the survival and reproduction of endangered species. The river lapwing relies heavily on vision for feeding. Pecking and probing are highlighted as primary foraging methods. Insects, molluscs, crabs, fish, frogs, and tadpoles are standard parts of their carnivorous diet. They usually only feed when alone or in couples.

3.5 Statistical analysis- The data were evaluated for homogeneity and normality using Kolmogorov-Smirnov and Levene tests. Parametric tests were utilised for statistical analysis after ensuring normality, whereas non-parametric tests were used for data that did not satisfy the assumptions. Mann-Whitney-Wilcoxon t-test (non-parametric) was used to examine the density of river lapwings concerning vegetation height and distance from the water. Two-way analysis of variance (ANOVA) and Bonferroni's post hoc multiple comparison test were used to examine the abundance of invertebrates concerning soil permeability. Two-way analysis of variance (ANOVA) with Bonferroni's post hoc test was also used to examine the correlation between bird abundance and factors including water level, soil penetrability, and human activities across various kinds of habitat. In addition, the interactions between potential factors (habitat characteristics and human activities) that may affect river lapwing density were evaluated using the generalised linear model (GLM, normally distributed data and identity link function Xß=). In the generalised linear model (GLM), the abundance of individuals of river lapwing was the response variable and several components (habitat variables and human activities) were fitted as predictors or explanatory variables. One-way analysis of variance (ANOVA) was followed by Tukey's post hoc multiple comparison test to compare the frequencies of different habitat categories where foraging and roosting occurred. Next, we used two-way ANOVA followed by the Bonferroni test to compare the frequencies of alarm calls, nest sightings, chick sightings,

and territorial defence among habitat types. The data was analysed and shown as mean values and standard deviation (SD) using SPSS (version 16.4) and PAST (3.12). We set the level of significance at 0.01.

4. Results and Analysis

4.1 River lapwing population density and prey abundance patterns- We took ten prey specimens from the area throughout the summer and monsoon seasons and categorised them as shown in Table 1. Most summertime prey captures occurred on the river's open, vegetation-free bank. Adult beetles account for 75% of the surface-active prey on open river banks, followed by Hymenopteron (55%), beetle larvae (42%), Euplecoptera (39%), Caddis flies (30%), adult midges (29%), Araneus (26%), saltatoria (18%), arthropods (1%), and cladocera (1%). Summer is when most of the prey is collected from the riverbank with vegetation. The most abundant prey on vegetated river bank belonged to Saltatoria (40%) followed by Hymenopteron (27%), Euplecoptera (19%), Beetle adult (18%), Araneus (16%), Midges adult (12%), Caddis Flies, Beetle larvae, Arthropod and Aclitellate Polychaeta (1%). During the monsoon season, most prey is captured along the river's exposed bare bank. Arthropods (19%), Aclitellate Polychaeta (16%), adult beetles (15%), beetle larvae (9%), adult midges (6%), Euplecoptera (5%), Araneus (4%), Caddis flies (1%), and Saltatoria (1%) were the most common prey items along the riverbank. Most prey obtained from the riverbank's vegetation occurred during the monsoons. Aclitellate Polychaeta (30%), Arthropods (29%), Hymenopteron (9%), Saltatoria (8%), Adult Midges (6%), Euplecoptera (4%), Araneus (3%), Beetle Adults (3%), and Caddis Flies and Beetle Larvae (1%) were the most common prey in the vegetated river bank.

Table 1: Prey Items in Different Habitat Types

PREY	OPEN RIVER BANK		VEGETATED RIVER BANK	
	Summer (%)	Monsoon (%)	Summer (%)	Monsoon (%)
Araneus	26	4	16	3
Beetle adult	75	15	18	1
Beetle larvae	42	9	1	1
Midges adult	29	6	12	6
Euplecoptera	39	5	19	4
Hymenopteron	55	15	27	9
Saltatoria	18	1	40	8
Caddis Flies adult	30	1	1	1
Aclitellate Polychaeta	1	16	1	30
Arthropod	1	19	1	29

In order to get food, river lapwings like to graze on bare riverbanks. The open, unvegetated river banks had the most excellent lapwing density, followed by the open, unvegetated river island, the vegetated river bank, and the agricultural field.

4.2 Hunting strategy and food acquisition in various environments and times of year

Table 2: Foraging Success of River Lapwing in Open River Bank

Foraging success	Value	Summer	Monsoon	F-value	dF	p-value
Movement rate (steps/minute)	Mean	30	25	113.204	1	p < 0.01
	SD	3.65	2.96			
Feeding rate (peck or probe/minute)	Mean	11	9	62.278	1	p < 0.01
	SD	2.32	1.02			
Foraging success rate (prey consumed/minute)	Mean	8	6	83.160	1	p < 0.01
	SD	1.5	1.6			

Table 3: Foraging Success of River Lapwing in Vegetative River Bank

Foraging success	Value	Summer	Monsoon	F-value	dF	p-value
Movement rate (steps/minute)	Mean	40	33	146.937	1	p < 0.01
	SD	4.4	3.74			
Feeding rate (peck or probe/minute)	Mean	4	3	17.897	1	p < 0.01
	SD	1.74	1.6			
Foraging success rate (prey consumed/minute)	Mean	2.5	2	6.154	1	p > 0.01
	SD	1.45	1.4			

One hundred river lapwings were seen, and all were feeding themselves (Tables 2-3). WHP was the method they utilised most often across all four environments and at all times of the year. While river lapwings spent 80% of their time hunting along vegetated riverbanks in the summer, they spent 26% in the open. Moreover, no substantial change was detected in foraging methods across various environments and seasons. Table 3 shows a statistically significant variation in the number of prey consumed per minute between habitats and seasons. The river lapwing's eating rate seems to be highest throughout the summer and most variable on open, unvegetated river banks. The estimated feeding rate varied significantly across the vegetated and unvegetated riverbanks throughout the year. However, the pace at which people walked varied greatly across different environments. Foraging success, however, varied significantly across seasons and habitat types. In the summer, foraging was most successful along the riverbank, where vegetation was dense.

5. Discussion

The river lapwing is a wading bird that employs visual pecking at or near the ground surface and tactile probing to locate food. These strategies are opportunistic foragers, catching food at the substrate edge by plucking tiny invertebrates from the surface or low plants. Pecking is used to acquire epifaunal prey at or near the surface. It requires the penetration of less than around one-fourth of its whole bill length. WHP is the most often used substance by river lapwings throughout the year and in all habitat types. In contrast, WHP, WHMP, and WH are the most common

methods along bare riverbanks in the summer. Due to the prevalence of surface-active food, including tiger beetle, earwig, caddis fly, black fly, and ants along open, unvegetated river banks in the summer, river lapwings made great use of these strategies. During the monsoon season, probes were seen in the intertidal zone of the river island and the bare, unforested river bank. During the monsoon, the river lapwing's preferred food source was water. Therefore, it hunted aquatic creatures, including tiny fish, crustaceans, and snails. The more significant possibility for prey accessibility inside the extended search depths suggests that probing may be more critical than pecking in terms of success rate on prey. Prey availability and accessibility of surface-active invertebrates were much higher in open, unvegetated river banks, leading to a significantly higher foraging success rate and feeding rate. The feeding rate was highest along uncovered riverbanks and lowest along covered ones. Norfolk's farmland has had a similar incline. Foraging rates alter depending on prey kinds and environmental parameters such as temperature, rainfall, water level, and sediment smoothness. There is a common belief that shorebirds should only graze in locations where they can maximise their food intake in the least amount of time. Birds with shorter beaks move more and forage less because they rely more on surface foraging techniques and maybe look for food visually. The optimum foraging hypothesis proposes that animals always choose the most efficient and useful patches possible when selecting a feeding area. The availability of food and the cost of foraging may significantly affect foraging site selection during times of food scarcity. During the summer, when their food was abundant, lapwing populations were highest in our research region in Gegaso along the open river banks. Many researchers have hypothesised that shorebirds prefer feeding in areas where they have the most success finding food.

6. Conclusion

Adult beetles are the most common surface-active prey along summertime riverbanks, followed by Hymenopteron (55%), beetle larvae (42%), Euplecoptera (39%), Caddis flies (30%), adult midges (29%), Araneus (26%), saltatoria (18%), arthropods (1%), and cladocera (1%). In the monsoon season, most prey is caught along the river's exposed, naked bank, with Saltatoria (40%) being the most plentiful prey. The highest concentrations of river lapwings are found on open riverbanks and without vegetation. The highest concentration of lapwings was found on the river's bare, unforested banks, followed by the river's bare, unforested island, the river's vegetated bank, and the farmland. Over a hundred river lapwings were seen foraging for food. Across all four settings and seasons, WHP was the go-to technique. Eighty per cent of a river lapwing's summer is spent hunting among the riverbank's vegetation, while twenty-six per cent is spent in the open. The rate of prey consumption varies significantly among environments and times of year. The estimated feeding rate varies considerably between vegetated and unvegetated riverbanks throughout the year, with the most significant and most varied rates seen on open, unvegetated riverbanks. The effectiveness of foraging varied greatly between seasons and habitat types, with the best results in the thick vegetation near the riverside.

References

Altaf, M., Javid, A., Khan, A. M., Khan, M. S. H., Umair, M., & Ali, Z. (2018). Anthropogenic impact on the distribution of the birds in the tropical thorn forest, Punjab, Pakistan. Journal of Asia-Pacific Biodiversity, 11(2), 229–236.

Arya, A. K., Durgapal, M., Singh, V., & Bisht, M. (2021). A survey of Avifauna in aquatic habitat and their adjoining areas of Ramnagar, Uttarakhand, India. Archives of Agriculture and Environmental Science, 6(2), 249–256.

Aspinall, R., & Pearson, D. (2000). Integrated geographical assessment of environmental condition in water catchments: Linking landscape ecology, environmental modelling and GIS. Journal of Environmental Management, 59(4), 299–319. Béland, P., & Russell, D. A. (1978). Paleoecology of Dinosaur Provincial Park (Cretaceous), Alberta, interpreted from the distribution of articulated vertebrate remains. Canadian Journal of Earth Sciences, 15(6), 1012–1024.

Bhattacharjee, K. & Shuvadip Adhikari. (2022). A checklist of Avifauna from different habitats of semi-arid landscape in western parts (Mandsaur and Ratlam districts) of Madhya Pradesh, India. Journal of Threatened Taxa, 14(5), 20988–21001.

Brraich, & Kaur, R. (n.d.). Avifaunal diversity of Nangal wetland, Punjab (India). International Journal of Advanced Life Sciences.

El-Halawany, E. F., Mashaly, I. A., Abu-Ziada, M. E., & Aal, M. A.-E. (n.d.). HABITAT AND PLANT LIFE IN EL-DAKAHLYIA GOVERNORATE, EGYPT.

Evans-Ogden, L. J., Bittman, S., & Lank, D. B. (2008). A review of agricultural land use by shorebirds with special reference to habitat conservation in the Fraser River Delta, British Columbia. Canadian Journal of Plant Science, 88(1), 71–83.

Gao, F., Luo, X.-J., Yang, Z.-F., Wang, X.-M., & Mai, B.-X. (2009). Brominated Flame Retardants, Polychlorinated Biphenyls, and Organochlorine Pesticides in Bird Eggs from the Yellow River Delta, North China. Environmental Science & Technology, 43(18), 6956–6962.

Gopal, K., Verma, H. O., & Tripathi, S. (n.d.). Water Quality Monitoring of Sur Sarovar (Keetham) Lake, Agra (Uttar Pradesh).

Harisha, M. (n.d.). Assessment of status, diversity and threats of wetland birds of Bathi Lake, Doddabathi Village, Davanagere District, Karnataka, India. Journal of Entomology and Zoology Studies.

Harisha, M. N., & Hosetti, B. B. (2018). Status and conservation issues of wetland birds in Komaranahalli Lake, Davanagere District, Karnataka, India. Journal of Threatened Taxa, 10(2), 11290.

He, M.-J., Luo, X.-J., Yu, L.-H., Liu, J., Zhang, X.-L., Chen, S.-J., Chen, D., & Mai, B.-X. (2010). Tetrabromobisphenol-A and Hexabromocyclododecane in Birds from an E-Waste Region in South China: Influence of Diet on Diastereoisomer- and Enantiomer-Specific Distribution and Trophodynamics.

Environmental Science & Technology, 44(15), 5748–5754.

Jakimska, A., Konieczka, P., Skóra, K., & Namieśnik, J. (n.d.). Bioaccumulation of Metals in Tissues of Marine Animals, Part II: Metal Concentrations in Animal Tissues.

Kumar, A., Kanaujia, A., Kushwaha, S., & Kumar, A. (n.d.). A Preliminary Assessment of Avifaunal Diversity of Nawabganj Bird Sanctuary, Unnao, Uttar Pradesh.

Kumar, V., Mishra, H., & Kumar, A. (2021). Foraging behavior in river lapwing, Vanellus duvaucelii (Lesson, 1826) (Charadriiformes: Charadriidae): Differences in technique, prey, and habitat. Journal of Asia-Pacific Biodiversity, 14(1), 33–39.

Kumbar, S. M., & Ghadage, A. B. (2014). Preliminary study on avian fauna of the Krishna River basin Sangli District, Western Maharashtra, India. Journal of Environmental Biology.

Lavoie, R. A., Baird, C. J., King, L. E., Kyser, T. K., Friesen, V. L., & Campbell, L. M. (2014). Contamination of Mercury during the Wintering Period Influences Concentrations at Breeding Sites in Two Migratory Piscivorous Birds. Environmental Science & Technology, 48(23), 13694–13702.

Leito, A., Elts, J., Mägi, E., Truu, J., Ivask, M., Kuu, A., Ööpik, M., Meriste, M., Ward, R., Kuresoo, A., Pehlak, H., Sepp, K., & Luigujõe, L. (2014). Coastal grassland wader abundance in relation to breeding habitat characteristics in Matsalu Bay, Estonia. 91.

Li, C., Li, H., Zhang, Y., Zha, D., Zhao, B., Yang, S., Zhang, B., & De Boer, W. F. (2019). Predicting hydrological impacts of the Yangtze-to-Huaihe Water Diversion Project on habitat availability for wintering waterbirds at Caizi Lake. Journal of Environmental Management, 249, 109251.

Mandal, M. H., Roy, A., Ghosh, S., Basak, A., & Siddique, G. (2021). Assemblage of wetland bird Species in Purbasthali Oxbow Lake, West Bengal, India: Implications for Management. Ornis Hungarica, 29(2), 25–45.

Manohara, G., Harisha, M., & Hosetti, B. (n.d.). Status, diversity and conservation threats of migratory wetland birds in Magadi Bird Sanctuary, Gadag district, Karnataka, India. Journal of Entomology and Zoology Studies.

Mariappan, N., Kalfan, B. K. A., & Krishnakumar, S. (2013). Assessment of Bird Population in Different Habitats of Agricultural Ecosystem. International Journal of Scientific Research in Environmental Sciences, 306–316.

Panda, B. P., Mahapatra, B., Sahoo, A. A., Ray, S. S., Parida, S. P., & Pradhan, A. (2020). Habitat Use of Urban and Periurban Birds in a densely populated City of Eastern India. 9(2).

Santhalakshmi, A. S., Thampi, P. S. J., & Arunachalam, M. (n.d.). SPECIES COMPOSITION, RELATIVE ABUNDANCE AND DISTRIBUTION OF BIRD FAUNA OF RIVERINE AND WETLAND HABITATS IN LOWER REACHES OF TAMIRAPARANI RIVER.

Sethi, V. K., Bhatt, D., Kumar, A., & Naithani, A. B. (2011). The hatching success of ground- and roof-nesting Red-wattled Lapwing Vanellus indicus in Haridwar, India.

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