

Behavioral Patterns and Habitat Utilization of Crow Pheasant (*Centropus sinensis*) in the South Punjab Region

Sofia Fayyaz^{1*} and Tanveer Hussain¹

1. Institute of Forest Sciences, The Islamia University of Bahawalpur, Pakistan

*Corresponding author e-mail: sofia.fayyaz7667@gmail.com

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SUMMARY

The feeding behaviour of Crow Pheasant was studied in south Punjab. During the whole study, morphology, nesting behaviour, feeding behaviour, and vegetative cover were observed. Crow pheasants are found in almost all the selected cultivated habitats. The Crow Pheasant was a Crow-like bird. The bird has a long tail, coppery brown wings, and red ruby eyes. The size of the Crow Pheasant was 40cm to 50 cm, including the tail. Weight varied from 225 to 400 g. The species made their nests on dense trees and dense vegetation. The species made their nest almost 8–12 feet above the ground. The globular, cup-like, and dome-shaped nests were observed, which are covered with dense bushes and thickets of leaves. It feeds on insects, caterpillars, snails, vertebrates, and other plant species. The remaining food items were found in the stomach and oesophagus of the species. The Lepidoptera, coleopterans, and dermoptera found their common food items. The vegetative cover near the nesting sites was also observed. The browsed species were observed. Some species of the plant are moderately palatable, others are less palatable, and others are highly or non-palatable. Some animals and birds use these plant species.

Keywords: Crow pheasant, food, nest, behavior

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INTRODUCTION

Genus *Centropus* belongs to the order Cuculiformes and the Family Cuculidae, which exist as far-reaching and non-parasitic participants to birds. The Indus basin and South Asia are residents of the crow pheasant (*Centropus sinensis*). Individually they are classified into multiple subdivisions, several of which are regarded as complete species. Ali (2002) stated that they resemble big crows with stubby tails and reddish-brown wings, ground in wide-ranging jungle surroundings. As stated by IUCN the status crow pheasant is Least Concern.

Crow pheasants are weak birds that may be found in a broad range of habitats, from the rainforest to agricultural fields near big canals and rivers, where they hunt insects and tiny vertebrates like sand vipers. Snails, bird eggs, nestlings, fruits, and seeds are all regarded as edible. Researchers reported that his bird may be surrounded by large woodland, scrubland, shrubs, grassland, vegetation, gardens, and areas close to human settlement. The top wings are light chestnut, while the underwings are black. The difference between chestnut and black in adults is clear. The heavy, solid

bill is blackish. They have deep red eyes. The colour of the feet and legs is dark grey. They have hind claws that are long and straight. These aerial-feeding birds' food sources are changeable in distribution and abundance and are primarily reliant on seasonal changes, phenotypic expression, or the vast range of ecosystems' seasonal changes, phenology, or habitat variability (Ryszkowski and Karg, 1977). Overall, these airborne insectivores are considered to be opportunistic feeders with a large ecological need based on a variety of food that is only accessible for a short time (Bryant, 1973; Waugh, 1978). The great coucal feeds on insects, frogs, lizards, small fruits, seeds etc. The great coucal also known to eat the eggs of birds and other nestlings of birds. They also eat fruits and seeds of different plants. They also try to eat vertebrate saw-scaled viper (Venugopal, 1981). Food availability is considered to be a major influence behind habitat selection for passerine birds, who also can eat practically continuously during daytime hours (Blake and Hoppes, 1986). Bottomland wood trees provide important habitat for a diverse range of birds throughout the year (Dickson, 1978; Pashley and Bar-row, 1993).

The breeding season mostly starts after the moon-soon season such as from November to May. But it may also vary according to the temperature of different ranges. Both males and females participated in the building of nests. Mostly the shape of nests is recorded as dome-shaped. All the nests are enclosed in different grasses and stems on one side. They build their nests 6m above the ground. The nests are lined with grasses, twigs, stems, ashes, leaves of different plants etc. A small opening is also present there for entrance (Taplin and Beurteaux, 1992). The shape of nests is also globular-like is recorded and cup-like also recorded. On average the clutch contains 3 to 5 eggs in a nest. The eggs are chalky white with a yellow glaze in colour. Elfis and Primia (2020) described in their research paper that the Great Coucal is used for many medicinal purposes in Indonesia. He says that the great Coucal is used in ritual treatment in Kuok village, especially in the treatment of broken bones lathes can heal or help in the process of broken bones faster because the bird has calcium content that makes bone cells more and regenerates very fast.

MATERIAL AND METHOD

A total of 25 samples of crow pheasant were dissected in the same pattern as discussed above. Five samples were dissected in December, five samples in January, five samples in February, five samples in April and the remaining five samples in June from Bahawalpur, Khanewal and Rahim Yar Khan.

STUDY AREA

South Punjab is an area in Pakistan's Punjab province that is distinguished by its distinct cultural heritage, agricultural landscapes, and historical significance. South Punjab, which includes districts such as Multan, Khanewal, Bahawalpur, and Rahim Yar Khan, is noted for its rich plains along the Indus River, which contribute greatly to the country's agricultural production. South Punjabis are known for their warm hospitality, traditional music, and vivid festivals, giving them a distinct identity within Pakistani culture (Figure 1).

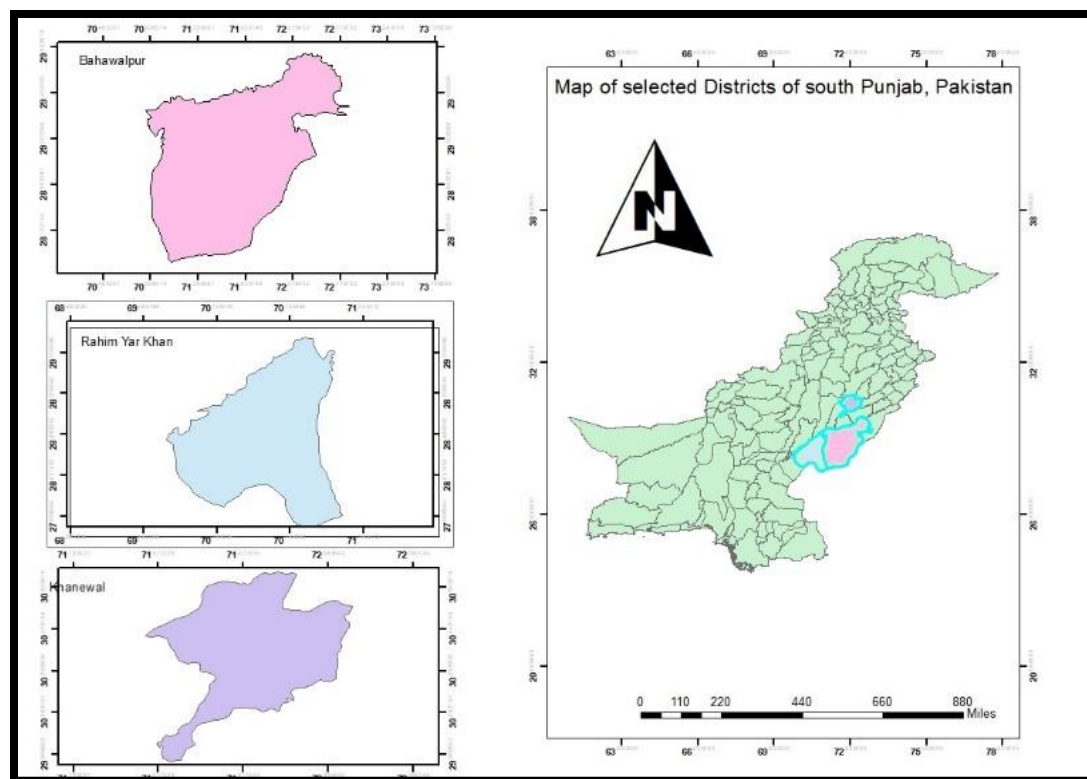


Figure 1: Map of south Punjab.

FEEDING HABITAT

The time duration for this study consists of almost six months. All our samples were trapped by mist nets by Macarthur et al. (1972). These are nets made with threads so fine that birds fail to notice them, fly in accidentally and become caught. To determine the feeding behaviour of crow pheasant, these birds were dissected. The dissection of crow pheasants was conducted in the laboratory. In the laboratory, the samples of crow pheasants were placed in the dissection tray. Firstly, we sanitised our hands then we wore the face mask and gloves. To determine the feeding ecology of crow pheasant we dissect the oesophagus and stomach of the samples because the birds also store their food in their crop which is the enlarged part of the oesophagus.

After placing the samples in different dissection tries the crow pheasant was dissected with the help of instruments from the dissection box. The stomach and proventricular contents of each bird were preserved in 95% alcohol by Reeder (1951).

VEGETATIVE COVER

The vegetative cover of the Cholistan region of Punjab is an extremely parched region. It consists of xerophytic species that have adapted to seasonal temperature and precipitation fluctuations. The eastern part (zone of 200 mm rainfall) has more vegetation than the hyper-arid southern region (100 mm rainfall zone). In the distribution of plants in the region, topography and soil chemical composition are key variables. For the study of vegetative cover in Cholistan different locations were selected. For the quantitative analysis of vegetation at each site, the quadrat method will be used. At each site, three quadrates measuring 100 x 100m were built, as well

as 15 sub-quadrates measuring 10 x 10m in each site at random Plant density, frequency, and cover were calculated in each sub-quadrant by Arshad et al. (2008).

NESTING SITES

For the study of nesting sites of these birds sampling method was used. The study sites were visited twice a month which will start in early October 2020 come after the July 2021. The random sampling method was used to observe the nesting sites of these birds. The position and condition of the nests was observed and recoded. The study took place in Rahim Yar Khan, Tehsil Khanpur, Division Bahawalpur, in a low-density urban region. The study site was much more cultivated with different trees. Different types of grasses were present. The average annual rainfall will be 174mm, where 85% will be fall in December to April. The remaining was followed by prolonged period of dry season from May to November.

Most of the nests was observed in zahir pir area which are present on at old branch of an Indian rosewood and Gum Arabic tree which is common in tehsil Khan Pur. The remaining nests are observed in Nawan Kot area, Dhareja Nagar area and in Bagho Bahar area. All the nests have almost similar structure but have a minor difference. The shapes of nests are globular, cup shape and dome shape. And these nests are covered with thickets of dense vegetation but have a small hole for entrance in it. The observation of nests is started in October of 2020. Because the breeding season of crow pheasant are started in February and followed by September.

STATISTICAL ANALYSIS

Data was partially analyzed manually. Simple calculation was made by use of scientific calculator. Diet composition was measured in regard to the number of prey species observed and the percentage of the total prey consumed. ANOVA was used to analyze seasonal changes in prey items, as well as for testing the prey size was measured in numbers.

RESULT

Genus *Centropus* belongs to the order Cuculiformes and the Family Cuculidae, exist as far reaching and non-parasitic participant in respect to birds. The Indus basin and South Asia are residence to the crow pheasant (*Centropus sinensis*), with numerous subspecies, some of which are considered complete species.

A total 25 samples of crow pheasant were dissected during the whole study period of a maximum of six months. The total percentage of the food items was taken in the table. In these percentage, the invertebrates Moths (12.65%), Caterpillars (9.2%), the class coleopteran included the Scarabaeidae larva (12.1%), Cerambycidae (6.2%), Carabidae (1.2%), Elateridae (0.3). The class Orthopterans included Stenopelmatidae (14.4%), Rhaphidophoridae (12.1%), Gryllidae (0.4%). The class Hemipterans included Cicadidae (1.3%), Cicadidae larvae (0.1), and Phasmids (2.7). The class Dictyopterans included the Mantodea (0.6%). The class Dermapterans included the Diplopodia (0.1%), Oligochaete (0.4%). The unidentified species were also found in (1.2%). Coleopterans are common prey throughout all times, however, the fall and winter months must have seen the highest consumption.

Table 1: Frequency of occurrence of prey items in 25 stomachs of crow pheasant.

Insects species	Frequency	Percentage
Invertebrates		
LEPIDOPTERA		
Moths	83	12.6
Caterpillars	60	9.2
COLEOPTERA		
Scarabaeidae	162	24.6
Scarabaeidae larvae	80	12.1
Cerambycidae	41	6.2
Carabidae	8	1.2
Elateridae	2	0.3
Unidentified	8	1.2
ORTHOPTERA		
Stenopelmatidae	95	14.4
Rhaphidophoridae	80	12.1
Gryllidae	3	0.4
HEMIPTERA		
Cicadidae	9	1.3
Cicadidae larvae	1	0.1
PHASMIDA	18	2.7
DICTYOPTERA		
Mantodea	4	0.6
DERMAPTERA		
DIPLOPODA	1	0.1
OLIGOCHAETA	3	0.4

During the winter, beetles made up the majority of the diet (45%), with Scarabaeidae beetles being the most common. A significant percentage during the winter, (40%) of Lepidoptera eaten were caterpillars as mentioned in table 3.2. In spring diet was dominated by Lepidoptera (30%), Orthopteran (40%) and Coleopteran (25%). In the spring, they comprised about 95 percent of the overall diet (Table 1). The majority of the invertebrates eaten by Crow Pheasant were big (body length 20-45 mm), while medium-sized invertebrates (9-18 mm) accounted for 30% of the overall invertebrate diet, and little (9mm) and very large (>45mm) items collectively accounted for just 3% of the entire invertebrate diet. (Table). Stick insects accounted for all items in the very large size class (> 45mm), while tiny spiders accounted for all items in the small size class (9mm). Seasonal variations (Table 2) and P value was 0.7042 (Table 3).

This species is usually seen near this vegetation Ghaz, Khagal, Rimth saltbush, Kaira, Delha, Kabra, Ruber bush, Ruber tree and Indian milkweed, Desert cotton, Bui and Burai, Fraash, Athel pine, Saksaul, Dandy, Alkali seepweed, False fleabane, Gum Arabic tree, Babul, Thorn and Mallow, Velvet leaf plant (Table 4).

Table 2: Seasonal Variation in Diet of Crow Pheasant.

Common Names	Family	Summer	Winter	Spring	Autumn
Moth	Papilionoidea	+	+	+	—
Caterpillar	Papilionoidea	+	+	+	—
Scarab Beetle	Scarabaeida	+	+	+	—
Beetle	Scarabaeidae larvae	+	+	+	—
Longhorn beetle	Cerambycidae	+	+	+	—
Ground Beetle	Carabidae	+	+	+	—
Click Beetle	Elateridae	+	—	+	+
Crickets	Stenopelmatidae	+	—	—	+
Cave Crickets	Rhaphidophoridae	+	—	—	+
True Bugs	Cicadidae	—	—	—	+
Leave insect	Phyllidae	—	—	—	+
Mantodea Insect	Mantidae	—	—	—	+
Terrestrial Worm	Lumbricoudea	+	—	—	+

Table 3: The seasonal variation and the value of p by using the ANOVA.

Source of Variation	SS	df	MS	F	P-value	F
Species	7222.479	15	481.4986	19.2034	0.009***	2.014804
Seasonal variation	17.79167	2	8.895833	0.354789	0.7042	3.31583
Error	752.2083	30	25.07361			
Total	7992.479	47				

Table 4: Vegetation cover near the nesting sites of Crow pheasant.

Sr.	Scientific Name	Common Name	Abundance
1	<i>Tamarix dioica</i> (Roxb. ex Roth.)	Ghaz, Khagal	Very Common
2	<i>Haloxylon salicornicum</i> (Bunge ex Bioss)	Rimth saltbush	Common
3	<i>Capparis decidua</i> (Edgew)	Kaira, Delha, Kabra	Common
4	<i>Calotropis procera</i> (W.T.Aiton)	Ruber bush, Ruber tree and Indian milkweed	Very Common
5	<i>Aerva pseudotomentosa</i> (Blatter and Hellbang.)	Desert cotton, Bui and Burai	Common
6	<i>Tamarix aphylla</i> (L.)	Fraash, Athel pine	Very Common
7	<i>Haloxylon recurvum</i> (moq.)	Saksaul	Common
8	<i>Salsola baryosma</i> (Roem. and amp; Schult.)	Dandy	Very Common
9	<i>Suaeda fruticose</i> (Forssk. Ex J.F.Gmel.)	Alkali seepweed	Common
10	<i>Pulicaria rajputana</i> (Blatt. And amp; Hallb.)	False fleabane	Common
11	<i>Acacia nilotica</i> (L.)	Gum Arabic tree, Babul, Thorn	Very Common
12	<i>Abutilon muticum</i> (Del. ex Dc.)	Mallow, Velvet leaf plant	Common

Key words: V.C= very common and C= common.

DISCUSSION

This study confirms the previous findings that this species eats mostly insects, with some birds and rodents thrown in for good measure. The approach utilized here has been used in most owl dietary studies: estimations of the relative significance of prey are determined by the numerical occurrence of prey species and their proportion of the diet to the total prey consumed. However, because no adjustment for biomass is done, the technique over-emphasizes the value of small objects.

Crow Pheasants were observed to feed more Coleoptera than any other insect species. The study found that the number of Lepidoptera in Crow Pheasant meals was similar to that seen in Morepork diets in New Zealand (Cunningham 1948; Clark, 1992). The adult beetles were the most common source of food, according to the authors, but caterpillars were seldom seen in the diets. In stomachs, on the other hand, we determined a large number of caterpillars. The significance of Orthopteran in the diet of Moreporks has been recognized by Lindsay and Ordish (1964), Imboden (1975); Clark (1992).

As stated by Lindsay and Ordish (1964) because orthopterans are accessible all year, they are a mainstay of the diet. We also determined that orthopteran made up 26.1 percent of the total prey taken by the Crow Pheasant in this study. We also noticed a grasshopper's leg in the Crow Pheasant's oesophagus, indicating that food digestion has already begun in the mouth. The result of seasonal variation in the diet of Crow Pheasant and the result of the present study showed that they were insect eaters, hence this study's results are largely in line with the result of some previous studies on Crow Pheasant feeding habits by Ali (2002); Venugopal (1981); Natarajan (1993, 1997). The total 658 species of food items were found in the alimentary canal and stomach of crow pheasants by Imboden (1975).

Taplin, (1992) the Pheasant Coucal, *Centropus phasianinus*, is a powerful bird of subfamily Centropodinae. Nests were created in the shape of a dome, with eucalyptus leaves and twigs covering the inside. We observed a total 7 nests of the crow pheasant in different areas of Tehsil Khan Pur. We applied a sampling method to visit the different sites in search of nests. Then we observed 7 nests of the Great Coucal.

Most of the nests were observed in the Zahir pir area which was present on an old branch of a Podocarpus tree which is common in tehsil Khan Pur. The remaining nests were observed in the Nawan Kot area, Dhareja Nagar area and Bagho Bahar area. All the nests have almost similar structures but have a minor difference which are mentioned in the table. The shapes of nests were globular, cup-shaped and dome-shaped. These nests were covered with thickets of dense vegetation but had a small hole for entrance in it. The observation of nests was started in March of 2021. The breeding season of crow pheasant is started in February and is followed by September.

Acharya and Vijayan (2009) determined that in Sikkim's Tessa valley, researchers discovered the breeding bird community and their nesting features. The nest that was observed in the Nawan Kot area of tehsil Khan Pur was in a cultivated area of the village on Kicker (gum Arabic tree). The shape of the nest was dome-like. The nest was present on the broken end of the tree. The other 3 nests were observed in the Zahir Pir area of tehsil Khan Pur. The 2 nests were present on the (Indian rosewood) Tali species of tree and the other one was present on the Kicker (gum

Arabic) tree. The two nests were globular in shape and the other one was in a dome-like shape. One nest was observed in Dhareja Nagar which was present on the Kicker (Indian gum) species of tree between two trunks. The nest was in a Dome-like shape. The other two nests were observed in the Bagho Bahar. The shape of the nests was cup-like and these were present on the Moringa tree. The percentage of the shape of nests is mentioned. Mostly dome-like shapes of the nests were observed. Wirminghaus et al. (2009) observed the same characteristics of the nests which we also determined.

Abduallah (2017) determined the forage productivity and palatability of browse species in arid land of Cholistan. We visited a total of 5 nesting sites and observed 7 nests of Crow pheasant. The vegetative cover near the nesting sites was almost same. A total 12 browse species of the plants were observed. These browse species included the *Tamarix dioica* (salt cedar), *Haloxylon salicornicum* (Hamd), *Capparis decidua* (pilu, karira), *Calotropis procera* (Aak, crown flower, giant milkweed), *Aerva pseudotomentosa* (bui, buari), *Tamarix aphylla* (khagal), *Haloxylon recurvum*, *Salsola baryosma*, *Suaeda fruticose*, *Pulicaria rajputana*, *Acacia nilotica*, *Abutilon muticum*. Some species of plants were very common near the nesting sites and others were common.

Lindsay and Ordish (1964) found grass grub moth larvae in their studies, suggesting that Moreporks eat grass. The presence of moth larvae in the stomach of the Crow Pheasant was also detected. In the current investigation, stomachs containing Scarabaeidae larvae, caterpillars, and Carabidae (Ground beetles) confirm this study. Caterpillars are mostly nocturnal and like damp environments such as clay, underbark, and pebbles. Beetle larvae live mostly below the surface. (Romoser and Stoffolano, 1994). Several writers have previously reported on spider eating (Cunningham 1948, Lindsay and Ordish 1964, Clark 1992), but only in small numbers. Stick insects, cockroaches, katydids (pettigoniidae), earwigs, cicadas, harvestmen, millipedes, earthworms, and crickets were among the invertebrates previously reported at extremely low frequencies (Gryllidae). According to Adnan Siddique (2017), the digestive system of vertebrates may be altered to fit a variety of diets. Herbivores' digestive systems are often longer and more complicated, whereas carnivores' digestive systems are smaller and less complex.

Reeder (1951) suggested that soft-bodied creatures are very instantly converted to fragments in the digestive processes of birds, many of which are unrecognizable. As a result, precise percentage composition data is very unlikely to be obtained. It's difficult to know how many invertebrate individuals make up the majority of the stomach contents. However, the species that make up a bird's primary food source are typically evident. James Stevenson (1933) suggested that the high rate of metabolism maintained in the body and the consequent quick digestion of food necessary to sustain such a pace, food is a significant element in bird life. This elevated body temperature indicates a high rate of metabolism, high heart rate and breathing rate, as well as a high level of activity.

Mtengeti and Mhelela (2006) pointed out that rangelands offer plant cover and soil protection, ensuring long-term fodder supply for cattle. Browsers (shrubs and tree foliage) and grasses, in particular, are inexpensive sources of food for animals across the world. The relevance of browsing species as animal nutrition has been observed in dry and semi-arid rangelands, particularly in severe conditions. During the dry season,

when grasses diminish in number and quality, these plants have the benefit of retaining their nutritional content and green grass. This year-round supply of fodder for cattle is made possible by the nutritional abundance and consistent performance of browses.

Taplin (1992) observed the Pheasant Coucal, *Centropus phasianinus*, is a powerful non-parasitic cuckoo in the Centropodinae subfamily. Nests were constructed in the shape of a dome, with eucalyptus leaves and twigs lining the inside. The district's flora is divided into two primary geographical zones: northern and southern. The plant life of the northern half of the irrigated tracts in central Punjab is similar to that of the remainder of the irrigated areas. Dunes dominate the southern part, which is mostly devoid of vegetation except during the wet season when a plethora of ephemeral or short-lived plants emerge and transverse the dunes. Before the arrival of summer heat, these ephemerals complete their life cycle, and the majority of the land reverts to a sandy plain, forlorn, and barren. The vegetation in this area of the desert terrain is scant in general. In this extremely dry climate, only plants with xerophytic adaptations such as deep roots, dry, hard and rod-like thick or meaty stems, leaves that are either missing or greatly reduced, although usually with a covering of wax or hair to avoid excessive transpiration, may establish themselves. The majority of the vegetation is made up of stunted, thorny, or prickly shrubs and drought-tolerant perennial plants that grow in open clumps with lots of space between them.

Abdualalh (2017) determined the same vegetative cover which we found near the nesting sites of the Crow Pheasant. A total of 12 browse species of the plants were observed and are mentioned in table 8. These browse species included the *Tamarix dioica* (salt cedar), *Haloxylon salicornicum* (Hamd), *Capparis decidua* (pilu, karira), *Calotropis procera* (Aak, crown flower, giant milkweed), *Aerva pseudotomentosa* (bui, buari), *Tamarix aphylla* (khagal), *Haloxylon recurvum*, *Salsola baryosma*, *Suaeda fruticosa*, *Pulicaria rajputana*, *Acacia nilotica*, *Abutilon muticum*. Dasti (1993) also determined these vegetative cover in Cholistan and Thal desert.

CONCLUSION

This study confirms the previous findings that this species eats mostly insects, with some birds and rodents thrown in for good measure.

REFERENCES

- Ali, S. 2002. The book of Indian birds 13th Edition. Bombay Natural History Society. Oxford University Press. Mumbai. 326pp.
- Arshad, M., A. Hassan, M. Ashraf, S. Noureen and M. Moazzam. 2008. Edaphic factors and distribution of vegetation in the Cholistan desert, Pakistan. Pak. J. Bot, 405: 1923-1931.
- Acharya, B. K. and L. Vijayan. 2009. Breeding bird community and their nesting characteristics in the Teesta Valley of Sikkim. Journal of Hill Research 221: 1-8.
- Bryant, D. 1973. The factors influencing the selection of food by the house martin. The Journal of Animal Ecology: 539-564.
- Blake, J. G. and V. Hoppes. 1986. Influence of resource abundance on use of tree-fall gaps by birds in an isolated woodlot. The Auk 1032: 328-340.
- Clark, J.M. 1992. Food of the Morepork in Taranaki. Notornis 39: 94.
- Cunningham, J.M. 1948. Food of a Morepork. N.Z. Bird Notes 3: 22-24.
- Dickson, J. G. 1978. Forest bird communities of the bottomland hardwoods. USDA Forest Service General Technical Report SE.14: 66-73.

- Dasti, A. and A.D. Agnew. 1994. The vegetation of Cholistan and Thai deserts, Pakistan. *Journal of Arid Environments* 273: 193-208.
- Elfis, E., P. Prima, T. Wahyu, S. Nunut, S. Khairani, J. Nadiatul, P. Tika and C. Indry. 2020. Ethnoornithological study in selected villages of Riau Province, Indonesia. *Biodiversitas*, 214: 1645-1652.
- Hopp, S. L., A. Kirby and C. Boone 1995. White-eyed Vireo: *Vireo Griseus*. American Ornithologists' Union.
- Imboden, C. 1975. A brief radio-telemetry study on moreporks. *Notornis*. 223: 221-230.
- Jeyathilakan, N., B. Latha, B. Sundar and S. Basith, S.A. 2012. Occurrence of *Laemobothrion maximum* in Greater Coucal. *Journal of Parasitic Diseases*, 361: 120-121.
- Lindsay, C. and Ordish, R.G. 1964. The food of the morepork. *Notornis*. 113: 154-158.
- MacArthur, R. H., J. Diamond and J. R. Karr. 1972.. Density compensation in island faunas. *Ecology*, 532: 330-342.
- Mtengeti, E. and Mhelela, A. 2006. Screening of potential indigenous browse species in semi-arid central Tanzania. A case of Gairo division. *Livestock Research for Rural Development* 188: 1.
- Natarajan, V. 1993. Food and feeding habits of the outhern crow-pheasant *Centropus sinensisparroti* Stresemann Aves: Cuculidae. at Pt. Calimere, Tamil Nadu. *Journal of the Bombay Natural History Society* 901: 11-16.
- Narayana, B., G. Surender, K. Swampy, P. Venkateshwarlu, R. Sravan Kumar and V. Vasudevarao. 2013 Greater Coucal *Centropus sinensis*. feeding on the Common Myna *Acridotherestrictis*.-A case report from Hyderabad, Andhra Pradesh. *Life Sci. Leaflets*, 10: 72-75.
- Pashley, D. N. and B. Barrow. 1993. Effects of land use practices on neotropical migratory birds in bottomland hardwood forests. Status and management of neotropical migratory birds. US Forest Service General Technical Report RM-229: 315-320.
- Reeder, W. G. 1951. Stomach analysis of a group of shorebirds. *The Condor* 531: 43-45.
- Romoser, W.S. and J.G. Stoffolano Jr.1994 *The Science of Entomology* 3rd Edition. USA: Wm. C. Brown Communications, Inc. p. 532.
- Siddique, A. 2017. A Comparison of Bird Digestive Systems by Diet Doctoral dissertation, The Ohio State University.
- Stevenson, J. 1933. Experiments on the digestion of food by birds. *The Wilson Bulletin*, 454:155-167.
- Ryszkowski, L. 1977. Variability in biomass of epidemic insects in the agricultural landscape. *Animal, vegetal and microbial ecology* 253: 501-517.
- Taplin, A. and Y. Beurteaux. 1992. Aspects of the breeding biology of the Pheasant Coucal *Centropus phasianinus*. *Emu*, 923:141-146.
- Venugopal, B. 1981. Observations on the Southern Coucal *Centropus sinensis* feeding on the Saw-scaled Viper *Echiscarinatus*. *Newsletter for Birdwatchers*. 2112:19.
- Wagh, D.R. 1978. Predation strategies in aerial feeding birds. PhD Thesis. Department of Biology, University of Stirling.

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