

Biodiversity Balance in Conservation of Great Indian Bustard in Relation to Avian Fauna in Rollapadu Wildlife Sanctuary of Nandyal District, Andhra Pradesh, India

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ABSTRACT

Variety of the living organisms, biological systems and biological processes found on Earth constitute the Biodiversity. India accommodates good amount of world's biodiversity making it one of the 17 mega diversity countries in the world. Conservation of biodiversity is of utmost priority now-a-days. Rollapadu Wildlife Sanctuary, Nandyal district (formerly in Kurnool district), Andhra Pradesh is one of the recognised conservation area for Great Indian Bustard. Though

research activities and surveys were made in this area regarding the conservation of the Great Indian Bustard, very little is unveiled so far on the associated avian species. Various avian fauna having adapted to different habitats inhabit the sanctuary for certain period in a year. Balance of biodiversity is very well observed especially in relation to avian fauna, which draws more attention on the conservation efforts of Great Indian Bustard, by the Ministry of MoEFCC, Government of India at State and Central levels.

Keywords Biodiversity, Aves, Rollapadu, Great indian bustard, Nandyal.

INTRODUCTION

India has a rich and varied heritage of biodiversity, encompassing a wide spectrum of habitats from tropical rainforests to alpine vegetation and from temperate forests to coastal wetlands. India contains about 7-8% of the World's biodiversity on 2.4% of the Earth's land area, making it one of the 17 mega diversity Countries in the World. This is based on the species richness and levels of endemism recorded in a wide range of taxa of both plants and animals. The Rollapadu Wildlife Sanctuary, famous for the conservation of Great Indian Bustard (here after termed GIB), is located in the Nandyal district (formerly in Kurnool District) of Andhra Pradesh, India with core coordinates around 15.7548°N, 78.3779°E.

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This sanctuary is one of very rare sanctuaries in the world having grassland ecosystem and is the only pure grassland sanctuary in the country where many different grassland fauna can be seen in large numbers (Manakadan and Rahmani 1989). Though several research activities and surveys were made in this area regarding the conservation of the GIB, very little is revealed on the associated avian species. This research work is carried out to characterize the balance of biodiversity, especially in relation to avian species where in the conservation of GIB is the only objective in the establishment of Rollapadu Wildlife Sanctuary (1988). Balance of biodiversity is very well observed especially in relation to avian fauna, which draws more attention on the conservation efforts of Great Indian Bustard by the Ministry of Environment, Forest and Climate Change (MoEFCC), Government of India at State and Central levels.

There is a need to include valuation of environmental services and biodiversity in development planning because of the economic opportunities indicated by increasing number of development projects in the country. Obtaining knowledge of flora and fauna is of immense scientific and commercial importance. Ecosystem services have emerged as an integrated framework for managing ecosystems in an increasingly human dominated world (Harris *et al.* 2006 ; Lele *et al.* 2013). To ensure minimization and mitigation of environmental and social impacts, it is essential to review and modify relevant environmental policies in addition to implementation of strict regulatory frameworks (Webb *et al.* 2012). Concomitantly, the results of the protected area gap analysis should be integrated with national land use plans to limit conflicting land uses and maximize connectivity across conservation corridors.

Though aimed for conservation of GIB, many other avian fauna also inhabit the sanctuary for certain period in a year due to the favorable conditions existing there. From the ecological point of view, representation of more number of other birds in addition to only GIB is encouraging and it elucidate the favorable climatic, geographical, environmental, ecological aspects of avian fauna and helps in the various studies. This has drawn authors' attention in preferring this study.

MATERIALS AND METHODS

Direct method involving sampling area i.e. as mentioned above (Rollapadu Wildlife Sanctuary, Nandyal district, Andhra Pradesh) and also based on secondary data. Authors visited the sanctuary at least once in a month for a period of one year. The first three months of the year are pleasant with moderate winds from the Southeast. The summer heat starts at the end of March and April and May are the hottest months with temperatures soaring to 42°C. Towards the end of April, sanctuary experiences dust storms accompanied by a few showers, giving respite from the heat. Rainfall is received from the SW and NE monsoons, with an average annual rainfall of 667.8 mm which varies from year to year. Cyclonic storms that hit the Andhra coast almost every year, especially during the NE monsoon period, result in continuous downpours. Winter is mild and the Coldest month is December (18°C).

The vegetation is of the Tropical Thorn Forest type (Champion & Seth 1968). However, human and human-related pressures have converted the landscape to one of crop fields, grazing lands and very light scrub and is generally termed grassland with a few scattered shrubs and trees. The common grass species are *Aristida funiculata*, *Chrysopogon fulvus*, *Eremopogon foveolatus*, *Heteropogon contortus* and *Iseilema antheophoroides*. Most of the plants being termed as 'monsoon ephemerals'. Life for these plants begins with the onset of the monsoon in June, changing the bare brown/yellow landscape to lush greenery.

RESULTS AND DISCUSSION

A balance of diversity is observed especially with reference to several other avian fauna in addition to only species GIB which was supposed to be protected, conserved in Rollapadu Wildlife Sanctuary. Authors describe the birds as observed (45 nos.) at the site of conservation along with the mentioning of their natural habitats. General name, local name (in parentheses) and scientific/zoological names are provided for better understanding (Table 1).

Even this expanse of 614 ha is not in one block, but divided into three portions of varying sizes sep-

Table 1. Avian fauna in the Study Area.

Sl. No.	Name of the Avian Species (Local Name)	Scientific/Zoological Name	Description/Habits
1	Pied bush chat (Kampa vallanchi)	<i>Saxicola caprata</i>	Male black with white rump and wing-patch ; rufous fringes to body in non-breeding and first winter plumages. Female has dark brown upper parts and rufous-brown under parts with rufous-orange rumps. Habitat: Mainly cultivation and open country with scattered bushes or tall grass.
2	Indian Robin (Vallanchi)	<i>Saxicoloides fulicatus</i> (formerly) <i>Copsychus fulicatus</i>	Reddish vent and black tail in all plumages. Male has white shoulders and black under parts. Female has greyish under parts. Habitat: Dry stone areas with scrub and cultivation edges.
3	Grey heron (Narayana pakshi)	<i>Ardea cinerea</i>	In flight, black flight feathers contrast with grey upper wing and under wing coverts. Adult has yellow bill, whitish head and neck with black head plumes and black patches on belly. Immature has dark cap with variable crest, greyer neck, and lacks or has reduced black on belly. Habitat: Wetlands
4	Common Tailorbird (Likku jitta)	<i>Orthotomus sutorius</i>	Rufous forehead, greenish upper parts and whitish under parts including under tail-coverts. Habitat: Bushes in gardens, cultivation edges and forest edges.
5	Common Stonechat (Banda vallanchi)	<i>Saxicola torquatus</i>	Male has black head, white patches on neck, orange breast and whitish rump (features obscured in fresh plumage). Female has streaked upper parts and orange on breast and rump. Habitat: Winters in scrub, reedbeds and cultivation.
6	Indian Nightjar (Bharatha reyipitta)	<i>Caprimulgus asiaticus</i>	Adult, like a small version of large tailed. Has boldly streaked crown, rufous buff nuchal color, bold black centers and broad buff edges to scapulars and relatively unmarked central tail feathers. Habitat: Open scrub and cultivation.
7	Coppersmith Barbet (Kamsali pitta)	<i>Megalaima haemacephala</i>	Small barbet with crimson forehead and breast-patch, yellow patches above and below eye, yellow throat and streaked under parts. Juvenile lacks red on head and breast. Habitat: Open wooded country, groves and trees in cultivation and gardens.
8	Eurasian Golden Oriole (Vangapandu)	<i>Oriolus oriolus</i>	Male golden-yellow with black mask and mainly black wings. Female and immature variable, usually with streaking on under parts and yellowish-green under parts. Habitat: Open woodland and trees in cultivation.
9	Southern Grey Shrike (Pedda bilinchi)	<i>Lanius meridionalis</i>	Narrow black forehead and broad black mask, grey mantle with white scapulars, broad white tips to secondaries, white sides and tip to tail and white under parts. Habitat: Open dry scrub country.
10	Red-vented bulbul (Pigilipitta)	<i>Pycnonotus cafer</i>	Adult, blackish head with slight crest, scaled appearance to upper parts and breast, red vent and white rump. Habitat: Open deciduous forest, secondary growth and trees around habitation.
11	Rosy starling (Gulabi parikipitta)	<i>Pastor roseus</i>	Adult has blackish head with shaggy crest, pinkish mantle and under parts and blue-green gloss to wings. In non-breeding and first winter plumage, much duller than shown ; pink of plumage partly obscured by buff fringes, black obscured by greyish fringes. Habitat: Cultivation and damp grassland.

Table 1. Continued.

Sl. No.	Name of the Avian Species (Local Name)	Scientific/Zoological Name	Description/Habits
12	Cattle Egret (Santikonga)	<i>Bubulcus ibis</i>	Small stocky egret, with short yellow bill and short legs. In breeding, plumage has orange-buff on head, neck and mantle. Habitat: Wetland and grassland, often associated with livestock.
13	Rufous-tailed lark (Ambali jorigadu)	<i>Ammomanes phoenicurus</i>	Adult dusky grey-brown upper parts, rufous-orange under parts, prominent dark streaking on throat and breast and rufous orange upper tail-coverts and tail, with dark terminal bar. Habitat: Open dry scrub, cultivation.
14	White-browed wagtail (Tellakampa jitta)	<i>Motacilla maderaspatensis</i>	Large black and white wagtail. Head black with white supercilium and black mantle. Juvenile has brownish-grey head, mantle and breast, with white supercilium. Habitat: Banks of rivers, pools and lakes.
15	White-throated kingfisher (Tellagontu buchigadu)	<i>Halcyon smyrnensis</i>	Adult white throat and center of breast, brown head and most of under parts and turquoise upper parts. Show prominent white wing-patch in flight. Habitat: Cultivation, forest edges and wetlands.
16	Red-rumped Swallow (Yerranadumu vanakoela)	<i>Cecropis rufula</i>	Rufous-orange neck sides and rump, finely streaked buffish-white under parts and black under tail-coverts. Habitat: Cultivation and upland pastures.
17	River tern (Ramadasu)	<i>Sterna aurantia</i>	Adult breeding has orange-yellow bill, black cap, greyish-white upper parts and long tail. Large size, stocky appearance and stout yellow bill (with dark tip) help separate adult non-breeding and immature from black-bellied. Habitat: Marshes, streams and rivers.
18	Red-necked falcon (Yerratopi jaaledega)	<i>Falco chicquera</i>	Powerful falcon with pointed wings and longish tail. Flight usually fast and dashing. Has rufous crown and nape, pale blue-grey upper parts, white under parts finely barred with black and grey tail with broad black sub terminal band. Habitat: Open country.
19	Common kestrel (Tondalamoochi dega)	<i>Falco tinnunculus</i>	Long, rather broad tail; wing-tips more rounded than on most falcons. Frequently hovers. Male has grey head and tail and rufous under parts heavily marked with black. Female and juvenile have rufous crown and nape streaked with black, diffuse and narrow dark moustachial stripe, rufous under parts heavily marked with black and dark barring on rufous tail. Habitat: Open country.
20	Eurasian marsh Harrier (Tellathala pilligadda)	<i>Circus aeruginosus</i>	Broad-winged and stocky. As with other harriers, glides and soars with wings in noticeable V, quartering the ground a few metres about it, occasionally dropping to catch prey. Male has head, brown mantle and upper wing-coverts contrasting with grey secondaries/inner primaries. Habitat: Marshes, lakes and grasslands.
21	Black-shouldered kite (Adavi ramadasu)	<i>Elanus axillaris</i>	Small size, grey and white with black shoulders. Flight buoyant with much hovering. Juvenile has brownish-grey upper parts with pale fringes and less distinct shoulder-patch. Habitat: Grasslands with cultivation and open scrub.

Table 1. Continued.

Sl. No.	Name of the Avian Species (Local Name)	Scientific/Zoological Name	Description/Habits
22	Montagu's harrier (Montagu pilligadda)	<i>Circus pygargus</i>	Folded wings reach tail-tip and legs shorter than on pallid. Male has black band across secondaries, extensive black on underside of primaries and rufous streaking on belly and underwing-coverts. Habitat: Open country.
23	Short-toed snake eagle (Pamula gadda)	<i>Circaetus gallicus</i>	Long and broad wings, pinched in at base and rather long tail. Head broad and rounded. Soars with wings flat or slightly raised ; barred under body, dark tailing edge to under wing and broad sub-terminal tail-band ; can be very pale on under body and under wing. Habitat: Open dry country.
24	Indian roller (Paalapitta)	<i>Coracias benghalensis</i>	Has rufous-brown on nape and under parts streaking on ear coverts and throat and greenish mantle. In flight, shows turquoise band across primaries and dark blue terminal band to tail. Habitat: Cultivation, open woodland, groves and gardens.
25	Little Cormorant (Chinna neetikaki)	<i>Microcarbo niger</i>	Small size with short bill. Adult breeding all black with a few white plumes on forecrown and sides of head. Non-breeding browner (and lacks white head plumes) with whitish chin. Immature has whitish chin and throat, fore neck and breast a shade paler than upper parts with some pale fringes. Habitat: Lakes, pools and rivers.
26	Paddy-field pipit (Bharatha jittangi)	<i>Anthus rufulus</i>	Adult smaller than richards with well streaked breast ; lores usually look pale when flushed. Comparatively weak, rather fluttering flight. Habitat: Short grassland and cultivation.
27	Brown-headed Gull (Godumathala gourukaki)	<i>Chroicocephalus brun-nicephalus</i>	Larger than black headed, with more rounded wing-tips and broad bill. Adult has broad black wing-tips (broken by white mirrors) and white patch on outer wing ; under side to primaries largely black ; iris pale yellow (rather than brown as in adult black-headed). In breeding plumage, hood paler brown than that of black headed. First winter has broad black wing-tips. Habitat: Lakes and rivers.
28	Asian koel (Kokila)	<i>Eudynamys scolopaceus</i>	Male is greenish black with green bill. Female is spotted and barred with white. Habitat: Open woodland, gardens and cultivation.
29	Yellow-billed babbler (Pasupumukku chitkaruvi)	<i>Turdoides affinis</i>	Adult creamy-white crown, dark mottling on throat and breast and pale rump and tail base (although juvenile more similar to jungle). Habitat: Scrub areas.
30	Black drongo (Nalla etrinta)	<i>Dicrurus macrocercus</i>	Adult has glossy blue-black under parts and white rictal spot. Tail fork may be lost during moult. Immature has black under parts with bold whitish fingers. Habitat: Around habitation and cultivation.
31	Brahminy Starling (Nallatopi parikipitta)	<i>Sturnia pagodarum</i>	Adult has black crest and rufous-orange sides of head and under parts. Juvenile lacks crest ; grey-brown cap and paler orange-buff under part. Habitat: Dry, well-wooded areas and thorn scrub.

Table 1. Continued.

Sl. No.	Name of the Avian Species (Local Name)	Scientific/Zoological Name	Description/Habits
32	Black-rumped flameback (Nallanadumu bangaruveepu vadrangipitta)	<i>Dinopium benghalense</i>	Black eye-stripe and throat (lacking dark and moustachial stripe), sporting on wing-coverts and black rump. Habitat: Light forest and groves and trees in open country.
33	Indian Silverbill (Januvayi)	<i>Euodice malabarica</i>	Adult has white rump and upper tail-coverts, black tail with elongated central feathers and rufous-buff barring and flanks. Habitat: Dry cultivation, grassland and thorn scrub.
34	Ashy-crowned sparrow-lark (Potti pichika)	<i>Eremopterix griseus</i>	Male has grey crown and nape and brownish-black under parts. Female has stout greyish bill, rather uniform head and under parts and dark grey under wing-coverts. Habitat: Open dry scrub, dry cultivation.
35	Eurasian collared Dove (Peddabella guvva)	<i>Streptopelia decaocto</i>	Sandy-brown with black half-collar. Larger and longer-tailed than red collared. Plumage similar to female red collared but with paler upper parts and under parts and white under wing-coverts. Habitat: Open dry country with cultivation and groves.
36	Green bee-eater (Chinnapassiriki)	<i>Merops orientalis</i>	Adult small bee-eater with blue cheeks, black gorget and golden colouration to crown. Green tail with elongated central feathers, juvenile has green crown and nape, lacks black gorget and has square-ended tail. Habitat: Open country with scattered trees.
37	Common Hoopoe (Kukudupitta)	<i>Upupa epops</i>	Orange-buff with black and white wings and tail and black-tipped fan like crest. Habitat: Open country, cultivation and villages.
38	Red-wattled lapwing (Yanappachitava)	<i>Vanellus indicus</i>	Adult, black cap and breast, red bill with black tip and yellow legs. Wing and tail pattern much as yellow-mantled. Habitat: Open flat ground near water.
39	Indian courser (Yerrachitava)	<i>Cursorius coromandelicus</i>	Grey-brown upper parts and orange under parts with dark belly. Has chestnut crown, prominent white super cilium and dark eye stripe. In flight, shows white band across upper tail coverts ; under wing very dark and wings broad with rounded wingtips. Juvenile has brown barring on chestnut-brown under parts. Habitat: Open dry country and dry river beds.
40	Bar-headed goose (Tella peddabathu)	<i>Anser indicus</i>	Adult has white head with black banding grey and white line down grey neck, with a blacktipped yellowish bill and yellowish legs. Juvenile has white face and dark grey crown and hind neck. Plumage paler steel-grey with paler grey forewing compared with greylag. Habitat: Large rivers and lakes.
41	Shikra (Jaaledega)	<i>Accipiter badius</i>	Adult paler than bersa and Eurasian sparrowhawk. Under wing pale with fine barring on remiges and slightly darker wingtips. Male has blue grey upper parts, indistinct grey gular stripe, fine brownish orange barring on upper parts, unbarred white thighs and unbarred or only lightly barred central tail feathers. Upper parts of female are more brownish grey. Habitat: Open woods and groves.

Table 1. Continued.

Sl. No.	Name of the Avian Species (Local Name)	Scientific/Zoological Name	Description/Habits
42	Chestnut-bellied sandgrouse (Jam polanki)	<i>Pterocles exustus</i>	Both sexes have long, pointed central tail feathers and blackish under wing with white trailing edge. Male has blackish-chestnut belly and black breast line ; head and upper parts are comparatively uniform compared with male painted sand grouse. Female has a broad buff breast-band, which is a feature separating it from female painted (together with pin tail and under wing pattern). Habitat: Desert and sparse thorn scrub.
43	Short-eared Owl (Potti chevula gudlaguba)	<i>Asio flammeus</i>	Adult streaked under parts and short ear-tufts with buffish facial discs and yellow eyes. In flight, rather long and narrow wings buffish patch at base of primaries and dark carpal patches. Often seen hunting during the day, quartering low over the ground in a leisurely manner and hovering or gliding with wings. Habitat: Open scrub country.
44	Spotted Owl (Pagadi gante)	<i>Strix occidentalis</i>	White spotting on upper parts, including crown and diffuse spotting on under parts. Mainly crepuscular and nocturnal. Habitat: Habitation and cultivation.
45	Eurasian eagle-owl (Yerra gudlaguba)	<i>Bubo bubo</i>	Very large owl with up right ear-tufts. Upper parts mottled dark brown and tawny-buff ; under parts heavily streaked. Mainly nocturnal, but usually perches before sunset and after sunrise in a prominent position on cliff or rock. Habitat: Cliffs, rocky hills, ravines and wooded areas.

arated by crop fields and grazing lands. Traditional ways to manage these habitats are eroding due to rapid socio-ecological changes driven by state policies (Dutta *et al.* 2013). The number of GIB has been decreased from 1260 in India in 1969 to 150 in 2019 and further slight increase to about 200 in 2024. There were about 10 in number in both the States of Andhra Pradesh and Karnataka in 2019. To the surprise very few 2 to 3 nos. observed in 2022 in this Study area and almost not visible since then. But associated avian species with GIB since the establishment of the Sanctuary are observed now also, specific with the seasons during the year (Table 2).

Negative biodiversity impacts can be attributed

to land-use change and habitat disturbance occurring from the construction phase of the facilities and necessary structures (e.g., roads and power lines). Habitat disturbance can lead to the direct displacement of species through the loss of suitable habitat (Marques *et al.* 2020 ; Tolvanen *et al.* 2023), and to reductions in local abundance and population densities (Fernández-Bellón *et al.* 2019).

Indian conservation circles have voiced the need of recovery actions for bustards as flagships of dry grasslands since many years. The National Guidelines for Bustard Recovery Plans (Dutta *et al.* 2013) developed by MoEFCC recommend creating inviolate breeding areas to boost recruitment, pri-

Table 2. Findings in the Study area during the visit in the year.

Sl. No.	Month / Period of the year	Observation
1	January – March	I. Other Avian Species are available as mentioned in particular to their habits, habitats.
2	April–June	II. Not expected the presence of GIB due to temperature variations/unfavorable conditions and observed the same result.
3	July & August	
4	September–December	Though it is breeding season and expected to be present in the Sanctuary, no single individual of GIB is available there.

oritize areas in the landscape for mitigating threats and improving protection, engaging communities in conservation through incentives and implementing a conservation breeding program for insurance. State Forest Departments in collaboration with research and conservation institutions are implementing these actions with mixed success.

Having associated with this habitat by the other bird species can help in determining the factors responsible for the better conservation of GIB. Since these large landscapes cannot be freed from human uses, a mixed approach of Protected Area based conservation of breeding habitats and compatible human land uses / infrastructure in adjoining landscapes will be most effective.

The benefits natural systems provide to humans, defined as this 'nature for people' paradigm has been increasingly adopted by Governments and non-profit organizations to frame, plan and allocate resources (Posner *et al.* 2016). There is a demarcation between those that see ecosystem function that can be quantified in monetary terms and those that explicitly reject one dimensional valuation schema as being both impossible and undesirable (Pascual *et al.* 2017). Further investigation is necessary in determining the factors for not having expected increase in the number of GIB though other avian fauna adapting well to these conditions.

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