



Bird Diversity in Gangrar, Chittorgarh Rajasthan, India

Abubakar Abdullahi Tijjani ^{a*} and Umesh Garu ^a

^a Department of Life Sciences, Mewar University, Chittorgarh, India.

Authors' contributions

This work was carried out in collaboration between both authors. Author AAT carried out the field work and computation of the data. Author UG provided crucial supervision throughout the process, offering advice and expertise that greatly improved the article's quality and trustworthiness. Both authors read and approved the final manuscript.

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ABSTRACT

Studying bird diversity in arid zones is vital for preserving biodiversity, understanding ecological processes, and addressing the environmental challenges specific to these unique and fragile ecosystems. This study aimed to investigate bird diversity in some selected places in Gangrar, examining the relationships between bird species and environmental factors. The study focused on three places, which are Nolagadri Ka Khera, Mansingh Ji Ka Khera, and Modsingh Ki Chawki. The study was conducted for 6 months (February 2024 – July 2024) weekly from 0600hrs to 1000hrs in the morning and 1600hrs to 1800hrs in the evening. The point count method was preferred and used for the survey. A total of 56 bird species which belong to 10 orders were identified in the study area. Order of Passeriformes was recorded with the highest species 33 (69.02%). While the order of Psittaciformes (2.45%), Gruiformes (1.23%), Accipitriformes (0.07%), and Bucerotiformes (0.07%) were recorded with the lowest species, (only one species) in the study area. Nolagadri Ka

*Corresponding author: E-mail: tijjaniabdallah84@gmail.com;

Khera has the highest number of individual species (527), while Modsingh Ki Chawki has 411 species and Mansingh Ji Ka Khera has 234 species. The bird diversity in Gangrar is influenced by many environmental and ecological factors which include, sparse vegetation consisting of grasses, shrubs, and scattered trees. The limitation of water in the Gangrar also contributes to the kind of species to thrive in the environment. Human influences affect the diversity of birds and they assist the birds and ensure the survival of the birds. The findings show the importance of acknowledging these kinds of ecosystems to maintain biodiversity and ensure the sustainability of bird populations.

Keywords: Bird diversity; point count; arid; ecosystems; biodiversity.

1. INTRODUCTION

Arid regions are characterized by low rainfall and scarcity of water reservoirs. Birds that thrive in these environments must adapt to the ecological stress and periodic shortage of resources [1]. Most of the resident birds in this kind of environment adjust their activities such as reproduction to the rainy season when resources are abundant [2]. The harsh conditions do not affect only animals, and birds in particular, but also cause many changes to the vegetation of the environment. Some plants become dormant, utilizing their internal water by discarding their leaves, which may have a great impact on the birds [2]. This is because plant species vegetation is crucial in determining the distribution and abundance of birds in an ecosystem [3].

There is a lack of detailed information on the present abundance and distribution of birds in arid ecosystems, there is also an insufficient understanding of the responses of arid birds to their environmental factors, specifically in the case study India. Gangrar of Chittorgarh which is semi-arid has unique vegetation structures and limited water resources and also supports a distinct avifauna, but the current understanding of bird species richness, abundance, and distribution patterns in this region is limited [4]. There are many kinds of research [5], (Himmat, 2021), [6] that mostly focus on the birds that are in a protected area or wetlands of Rajasthan. Although many studies on Great Indian deserts

(Thar) are conducted [7,8], more research is needed to checklist birds that are resident in open arid zones and investigate thoroughly their relationship with their harsh region environmental factors.

Gangrar of Chittorgarh which is semi-arid has unique vegetation structures and limited water resources and also supports a distinct avifauna, but the current understanding of bird species richness, abundance, and distribution patterns in this region is limited, no research was ever conducted before on the bird diversity in Gangrar. Therefore, this research aims to investigate bird diversity in selected places of Gangrar and examine the relationships between bird species and environmental factors. The selected places for the data collection may not fully represent the whole Gangrar but it will be a starting point for the compilation of the Gangrar data on bird species.

2. MATERIALS AND METHODS

2.1 Study Area

Gangrar is situated in Chittorgarh District of Rajasthan State, India. It is located 23 KM towards the North of District headquarters in Chittorgarh. Gangrar is bordered by Bhilwara and Suwana towards the North, Chittorgarh towards the South, and Rashmi towards the West. It lies between 25.061778 latitude and 74.6252136 longitudes, covering an area of 554 km² (Fig. 1).

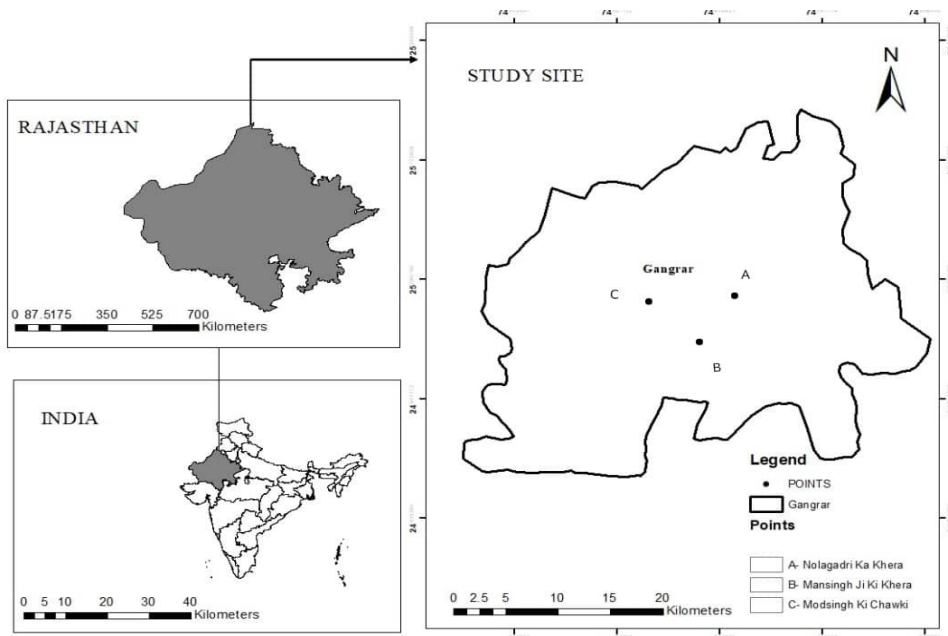


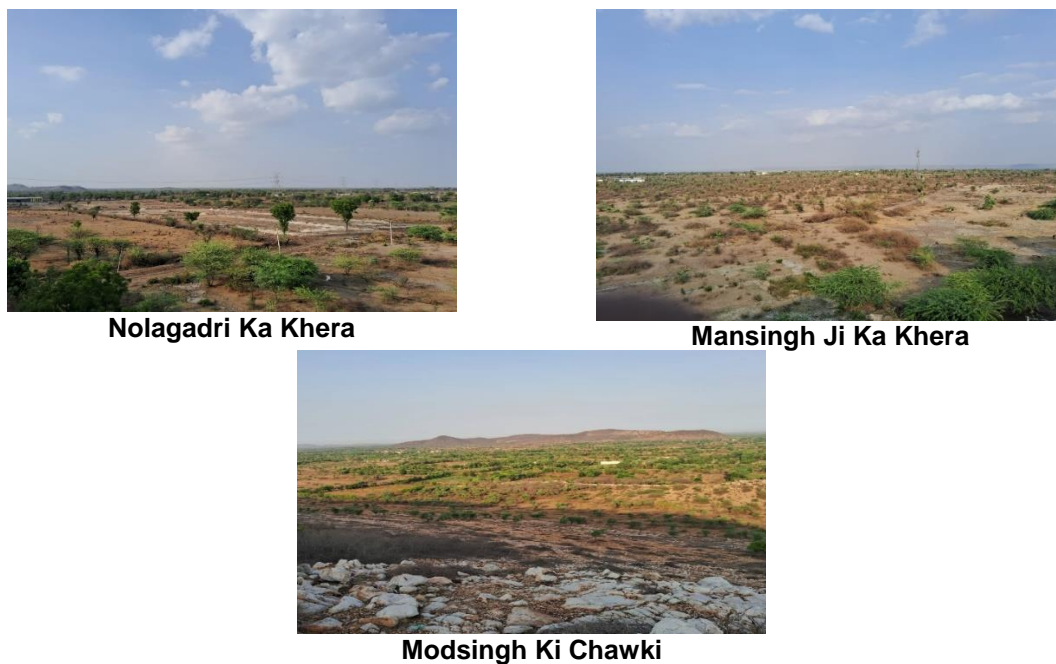
Fig. 1. Map of the selected places in Gangrar in Rajasthan State

2.2 Study Design

Before the data collection, a survey was conducted to identify various places to carry out the data collection within the Gangrar. The study was then focused on three places, which are;

	Study area	Latitude	Longitude
1	Nolagadri Ka Khera	25.038007	74.635188
2	Mansingh Ji Ka Khera	25.023586	74.644675
3	Modsingh Ki Chawki	25.030182	74.627371

Fig. 2. Table showing geographical location of study area



Nolagadri Ka Khera

Mansingh Ji Ka Khera

Modsingh Ki Chawki

Fig. 3. Showing the Study areas

2.3 Bird Survey

The study was conducted over six months (February 2024 – July 2024). The survey was conducted on a weekly basis (Sunday) within two distinct time intervals from 0600hrs to 1000hrs in the morning and 1600hrs to 1800hrs in the evening. Because it is the period in which birds are more active, birds tend to be less active at the middle of the day, the evening survey is to cover the other study areas that has not been cover in the morning period. Only one observer conducted the survey, and this was to ensure sampling bias was minimized and ensure consistency in data collection. During the survey, the bird species were identified visually and acoustically, counted, and recorded.

The point count method was preferred and used for the survey, this is because of it's efficiency, standardization, minimal disturbances, and the ability to provide good comparable data across a variety of settings. Each selected place was divided into 10 points, and the method includes identifying the bird species that are seen or heard within a 25m radius from a fixed point, this is to ensure the observer is closed enough to accurately identify the birds' point [9]. A great distance can be challenging in identifying similar species. Also to ensure accuracy in the data, birds that fly over a canopy were excluded. The observer when arrived at a point, waited for 1 minute for the birds to settle and resume their normal activities, this allowed the birds to acclimatize the observer's presence.

Precaution measures were taken in order not to disturb the birds or frighten them, this included

walking slowly and quietly and maintaining a distance that would not disrupt the birds. The survey point was also spaced at intervals of 100 m (to avoid recording the same birds) and each point is surveyed for at least 15 minutes point (Mark and Martin, 2000). The birds observed or heard were recorded using the BirdLasser App, a digital tool for efficient data collection. Their numbers and behavior was accurately recorded after multiple counts to improve accuracy and certainty [10].

A211 10 × 42 NIKON binocular was used to help in species identification, it provided a detailed observation of bird features. The Oxford's book "The Book of Indian Birds" by Salim Ali was used as the field guide, it contains detailed information and descriptions of birds found in India.

2.4 Bird Species Rate of Occurrence

The birds species rate of occurrence were group into four groups; Abundant (A), Common (C), Uncommon (U) and Rare. The bird is qualified for abundant when it is frequently encountered and have high reproductive rate with higher relative abundance. The common species are also frequently encountered but do not dominate the landscape. The uncommon birds have limiting distribution, or maybe they are seasonally migratory, while rare birds have low reproductive rates, or their survival is threatened. The rate of the occurrence was calculated using percentiles because of it is objective classification, contextualization, comparison across datasets, flexibility, and easy interpretation.

3. RESULTS AND DISCUSSION

3.1 Comprehensive Checklist of Bird Species in Some Selected Places in Gangrar

Table 1. Comprehensive checklist of bird species in some selected places in gangrar

SN	Common Name	Scientific Name	Families	Order	RA	RO
1	White-Eyed Buzzard	<i>Butastur teesa</i>	Accipitridae	Accipitriformes	0.07	R
2	Crested Lark	<i>Galerida cristata</i>	Alaudidae		0.29	R
3	Common Iora	<i>Aegithina tiphia</i>	Aegithinidae		1.23	U
4	Black Drongo	<i>Dicrurus macrocerus</i>	Dicruridae		1.30	U
5	House Crow	<i>Corvus splendens</i>	Corvidae		2.32	C
6	Rufous Treepie	<i>Dendrocitta vagabunda</i>			0.29	R
7	Large Gray Babbler	<i>Argya malcolmi</i>	Leiothrichidae		3.99	A
8	Red-Vented Bulbul	<i>Pycnonotus cafer</i>	Pycnonotidae		5.37	A
9	Common Myna	<i>Acridotheres tristis</i>	Sturnidae		2.03	C

SN	Common Name	Scientific Name	Families	Order	RA	RO
10	Bank Myna	<i>Acridotheres ginginianus</i>			1.81	C
11	Brahminy Starling	<i>Sturnia pagodarum</i>		Passeriformes	0.88	U
12	Indian Pied Myna	<i>Gracupica contra</i>			1.74	C
13	Indian Robin	<i>Copsychus fulicatus</i>	Muscicapidae		4.35	A
14	Oriental Magpie	<i>Copsychus saularis</i>			0.43	R
15	Taigo Flycatcher	<i>Ficedula albicilla</i>			2.03	C
16	Siberian Stonechat	<i>Saxicola maurus</i>			1.23	U
17	House Sparrow	<i>Passer domesticus</i>	Passeridae		15.7	A
18	Long-Tailed Shrike	<i>Lanius schach</i>	Laniidae		0.88	R
19	Indian Silverbill	<i>Euodice malabarica</i>	Estrildidae		1.23	U
20	White Wagtail	<i>Motacilla alba</i>	Motacillidae		1.08	U
21	Paddyfield Pipit	<i>Anthus rufulus</i>			2.17	C
22	Grey Wagtail	<i>Motacilla cinerea</i>			1.23	U
23	Hume's Warbler	<i>Phylloscopus humei</i>	Phylloscopidae		3.26	A
24	Greenish Warbler	<i>Phylloscopus trochiloides</i>			2.62	C
25	Chiffchaff	<i>Phylloscopus collybita</i>			2.54	C
26	Common Quail	<i>Coturnix coturnix</i>	Phasianidae		0.88	R
27	Ashy Prinia	<i>Prinia socialis</i>	Cisticolidae		1.30	U
28	Lesser Whitethroat	<i>Curruca curruca</i>	Sylviidae	1.96	C	
29	Indian Black-Lored Tit	<i>Machlolophus aplonotus</i>	Paridae	1.08	U	
30	Purple Sunbird	<i>Cinnyris asiaticus</i>	Nectariniidae	0.58	R	
31	Barn Swallow	<i>Hirundo rustica</i>	Hirundinidae	0.79	U	
32	Red-Rumped Swallow	<i>Cecropis daurica</i>		1.01	U	
33	Wire-Tailed Swallow	<i>Hirundo smithii</i>		0.50	R	
34	Dusky Crag Martin	<i>Ptyonoprogne concolor</i>		0.87	U	
35	Greater Coucal	<i>Centropus sinensis</i>	Cuculidae	Cuculiformes	0.94	U
36	Asian Koel	<i>Eudynamys scolopaceus</i>		1.23	U	
37	Black-Winged Stilt	<i>Himantopus himantopus</i>	Recurvirostridae	Charadriiformes	1.96	C
38	Red Wattled Lapwing	<i>Vanellus indicus</i>	Charadriidae		2.10	C
39	Green Sandpiper	<i>Tringa ochropus</i>	Scolopacidae		1.16	U
40	Eurasian Curlew	<i>Numenius arquata</i>		0.94	U	
41	Spotted Redshank	<i>Tringa erythropus</i>		0.72	U	
42	Wood Sandpiper	<i>Tringa glareola</i>		0.65	R	
43	Common Sandpiper	<i>Actitis hypoleucos</i>		0.72	U	
44	Rosed Ringed Parakeet	<i>Psittacula krameri</i>	Psittacidae	Psittaciformes	2.45	C
45	Rock Pigeon	<i>Columba livia</i>	Columbidae	Columbiformes.	9.80	A
46	Eurasian Collared Dove	<i>Streptopelia decaocto</i>		0.65	R	
47	Spotted Dove	<i>Spilopelia chinensis</i>		0.65	R	
48	Laughing Dove	<i>Spilopelia senegalensis</i>		0.15	R	
49	Eurasian Hoopoe	<i>Upupa epops</i>	Upupidae	Bucerotiformes	0.07	R
50	White-Breasted Water Hen	<i>Amauornis phoenicurus</i>	Rallidae	Gruiformes	1.23	U
51	Asian Green Bee-Eater	<i>Merops orientalis</i>	Meropidae	Coraciiformes	2.83	C
52	White-Throated Kingfisher	<i>Halcyon smyrnensis</i>	Alcedinidae		0.07	R
53	Indian Roller	<i>Coracias</i>	Coraciidae		0.14	R

SN	Common Name	Scientific Name	Families	Order	RA	RO
54	Black Crown Night Heron	<i>Nycticorax nycticorax benghalensis</i>	Ardeidae	Pelecaniformes	0.07	R
55	Eastern Cattle Egret	<i>Bubulcus ibis</i>			2.54	C
56	Indian Pond Heron	<i>Ardeola grayii</i>			0.07	R

KEYS: RA= Relative abundance, RO= Rate of Occurrence, A= Abundant, C= Common, U= Uncommon, R= Rare

3.2 Birds Abundance in the Selected Places

Table 2. Bird's abundance in different study area

SN	Study area	Abundance	Relative abundance
1	Nolagadri Ka Khera	527	44.96
2	Mansingh Ji Ka Khera	234	19.98
3	Modsingh Ki Chawki	411	35.06

The total number of birds(Abundance) = 1172

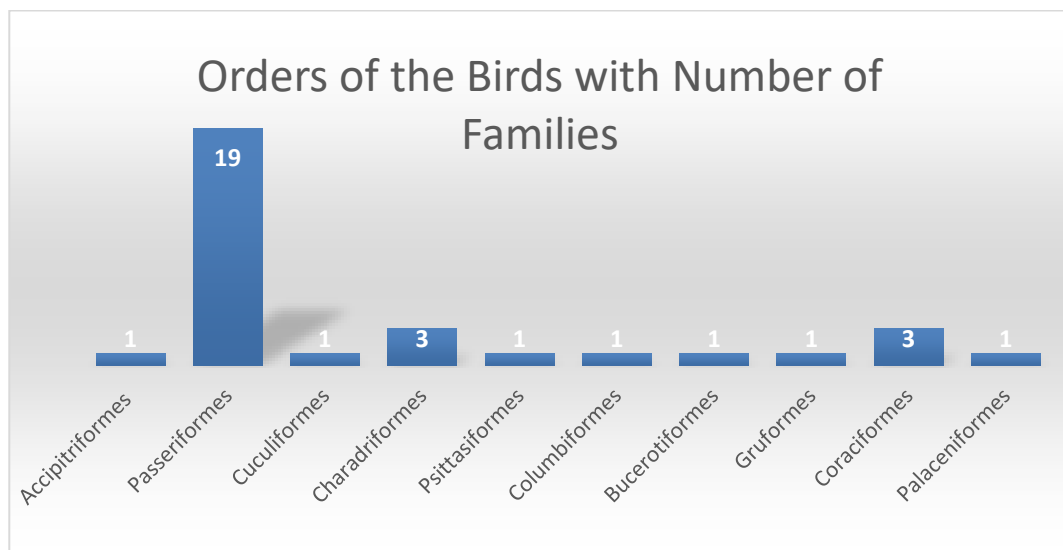


Fig. 4. Orders of the birds with number of families

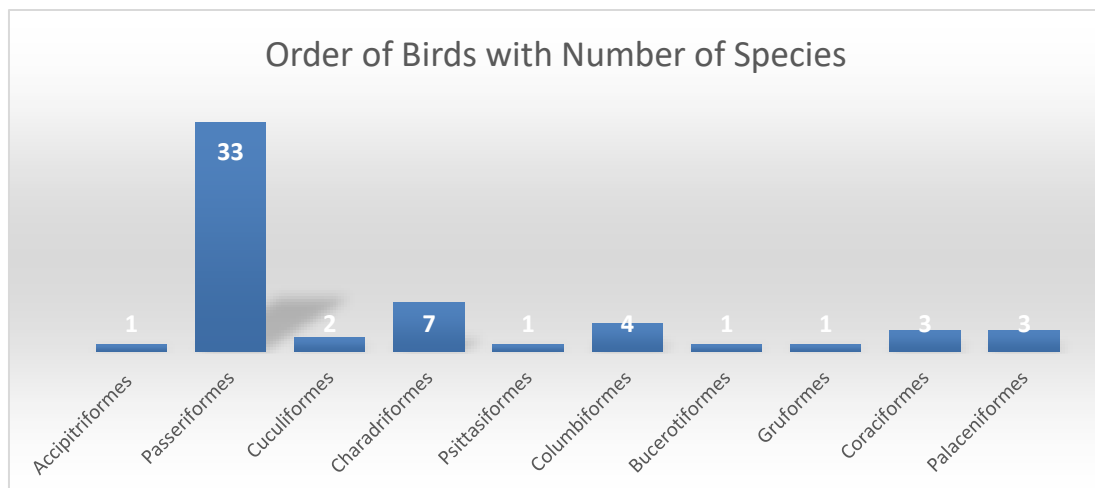


Fig. 5. Order of birds with number of species

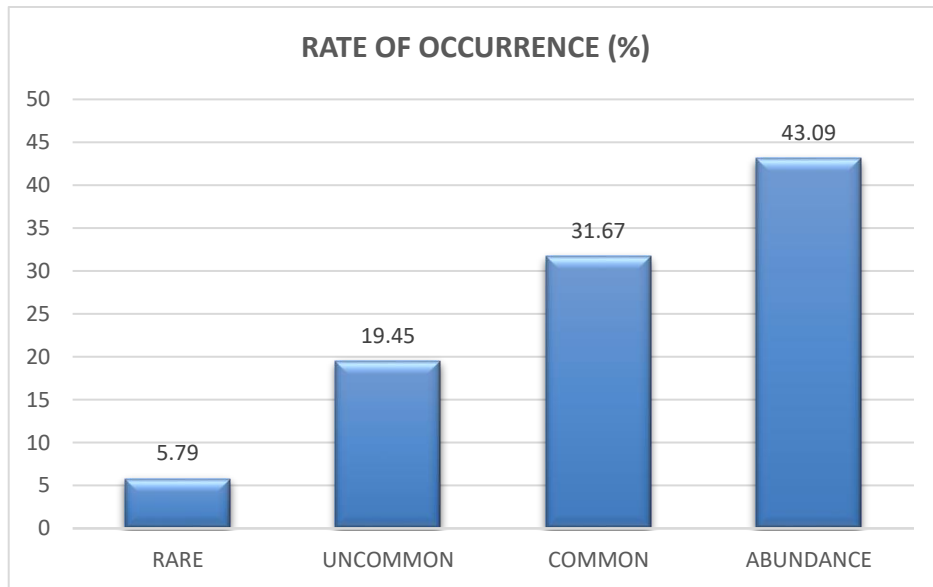


Fig. 6. Bird Species Rate of Occurrence

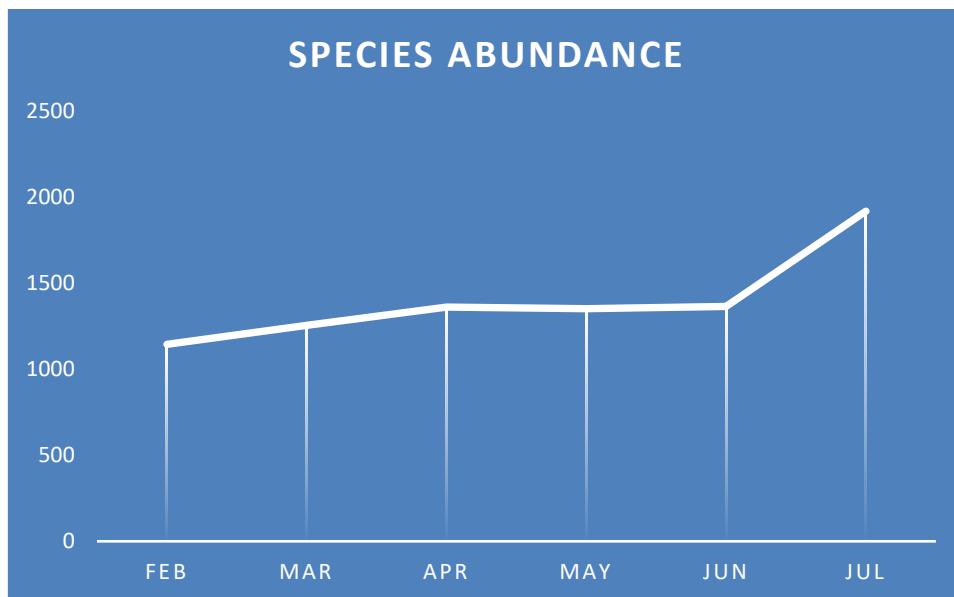


Fig. 7. Bird species abundance variation during the study period

3.3 Species Richness and Abundance

During the study period, a total of 56 bird species that belong to ten orders were identified in the study area (Table 1). From the identified species, the order of Passeriformes was recorded with the highest species 33 (69.02%). While the order of Psittaciformes (2.45%), Gruiformes (1.23%), Accipitriformes (0.07%), and Bucerotiformes (0.07%) were recorded with the lowest species, (only one species) in the study area (Fig. 4 and Fig. 5).

3.4 Discussion

3.4.1 Checklist of bird species in some selected places in Gangrar

A total of 56 bird species belonging to 10 orders and 32 families were recorded throughout the study period in the selected places in Gangrar (Table 1). The Passerine birds dominated the diversity with 33 species compared to non-passerine birds which are 23 species. The study revealed that the Passeriformes has the highest

diversity with 19 families, while Charadriiformes and Coraciiform have 3 families and Accipitriformes, Cuculiformes, Psittasiformes, Columbiformes, Bucerotoformes and Pelacaniiformes with one family each.

The Families Sturnidae, Muscicapidae, and Hirundinidae are the highest passerine families with 4 species each. While Columbidae and Scolopacidae from non-passerine also have 4 species. Phylloscopidae and Corvidae which are passerines have 3 and 2 species respectively. The rest of the Families Upupidae, Psittacidae,

Charadriidae, Nectrinidae, Paridae, Sylviidae, Cisticolidae, Phasianidae, Motacillidae, Estrildidae, Laniidae, Passeridae, Pycnonotidae, Dicruridae, Aegithinidae, Alaudidae, Accipitridae has one species each one.

These are the species that were discovered, there is a possibility that some species (ground small birds) are not to be discovered due to their ability to hide in the bush and also their sensitivity to approach. The flying birds that are not fully identified are neglected during the survey. This is to ensure the result is accurate.



Fig. 8. Black winged Stilt



Fig. 9. a) Red wattle lapwing *Vanellus indicus* b) eastern cattle egret *Bubulcus ibis*



Fig. 10. Some vegetation which also support the existence of bird species



Fig. 11. Water reserve in Gangrar community

3.4.2 Bird species richness and abundance in the selected places in Gangrar

The bird species abundance within the study periods is not linear (Fig. 7), it reaches the highest point in the last study month (July) this is because of the rainfall that cools the highest temperature and provides water to the various places that aid the proliferation of the birds. The total number of birds counted within the study period is 1172. Nologadri Ka Khera has the highest number of individual species (527), while Modsingh Ki Chawki has 411 species and Mansingh Ji Ka Khera has 234 (Table 2).

House Sparrow *Passer domesticus* has the highest relative abundance with 15.75 followed by Rock Pigeon with 9.80. The least relative

abundance is 0.07 from White-Eyed Buzzard *Butastur teesa* and Eurasian Hoopoe *Upupa epops* who were sighted only once (Table 1). The bird species' rate of occurrence were grouped into Abundance (43.09%), Common (31.67%), Uncommon (19.45%), and Rare (5.79%) (Fig. 6). This was calculated using percentiles because percentiles provide objective classification, contextualization, comparison across datasets, flexibility, and easy interpretation.

3.4.3 Relationship between bird species and environmental factors in Gangrar

The bird diversity in Gangrar is influenced by some environmental factors. Gangrar is a semi-arid region, therefore it is characterized by limited

water resources due to little rainfall and high temperatures during summer. Despite these challenges, the study discovered many species of bird that are resident in the region. The relationship between the bird and the environment can be as a result of the following;

Vegetation: Gangrar has sparse vegetation which includes grasses, shrubs, and scattered trees. These give support to a variety of bird species by providing them with shelter, feeding, and nesting. Most of the resident birds of Gangrar use trees as their shelter especially during summer to avoid the excess sun radiation. Since Gangrar is an open environment with distant trees (grassland), predatory birds also use certain trees to view the environment and search for prey.

Water resources: The limitation of water in the Gangrar also contributes to the kind of species that thrive in the environment. The species adapt the minimizing water loss, such as utilizing metabolic water produced during food breakdown. Gangrar does not have a big river or lake but there are water resources at Mataji Ka Khera and a passing river around Chawandiya. A lot of species use those water resources. During the dry season, most of the birds become less active and do not breed, they exhibit adaptations to cope with reduced food and water availability. Some birds, such as the Indian Robin, reduce their activity levels and seek shade to conserve energy and water. The discharge water from buildings and irrigation water for agriculture remains the source of water for the resident species. These help the birds to cope with the environment, especially during summer. During rainy periods, there is a temporary water reserve that holds water for many months, the water remains available for the birds through the winter period.

Human influences: Human has a positive influence on the diversity of birds in Gangrar, they assist the birds and ensure the survival of the birds intentionally or unintentionally. Some of the human activities result in the provision of needed resources to the birds for them to cope in the environment. Afforestation helps the bird community by providing them with shelter and food. Traditional farming which is less intensive preserves a range of bird diversity. The agricultural activities also provide food and water resources especially to insectivorous and granivorous. Some of the farmers rely on irrigation farming, thus they have their artificial

source of water, which also beneficial to many bird species.

4. CONCLUSION

The study of bird diversity in the Gangrar has highlighted the richness and variety of avian species present, reflecting the ecological health and complexity of the habitat despite being a semi-arid region. The findings show the importance of acknowledging these kinds of ecosystems to maintain biodiversity and ensure the sustainability of bird populations.

Conducting bird surveys in arid habitats provides crucial insights into the bird species that inhabit these challenging environments. These habitats, characterized by extreme temperatures and limited water resources, often support specialized bird species that are adapted to survive in such conditions.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Authors hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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