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Diversity & abundance of avifauna in four different habitats Boudh district Odisha, India

Rekha Rani*, Sandeep Kampa
Associate Professor & Head, Department of Zoology, Indira Gandhi National Tribal University (A Central University), Amarkantak, Madhya Pradesh, India

Abstract
Birds are very good remarker for the environmental health and ecosystem degradation deforestation. It's necessary to monitor their habitats, control the deforestation activities and fire activities in urban, rural and wild area to balance the nature. Boudh district, is a small district which is situated in the western part of Odisha. To know bird diversity, the study area divided into 5 different study sites; study site-A Madhapur, study site -B Purunakatak, study site -C Boudh, study site -D Manamunda, study site-E Kantamal. by applying line transect count method. a total no of 56 bird species belonging to 27 families and 11 orders have founded. Study site -E Kantamal have higher number of bird species with 25 species belonging to 14 families and 8 orders followed by, study sites – B Purunakatak have 24 species belonging to 15 orders and 8 orders, study site - C Boudh have 21 species belonging to 15 families and 8 orders, study site -D Manamunda have 12 species belonging to 5 families and 5 orders, study site -A Madhapur have 9 species belonging to 6 families and 5 orders. Out of 56 birds, 20 bird's species are aquatic birds and maximum number of birds belong to order Passeriformes and Anseriformes respectively. Bird species diversity was quantified throughout 5 different study sites of the study area by applying Shannon wiener index for diversity and Pielou's index for evenness. Out of 56 birds three species are Nearly Threatened (NT) and two species are Vulnerable (VU). This bird count survey study gave very fruitful result regarding semi urban and forest area.

Keywords: Birds, Diversity, Kantamal, Boudh, Manamunda, Madhapur, Purunakatak, Odisha

Introduction
Birds and plants are mutually reliant in an ecosystem. Plants offer food and shelter for the birds, so the bird diversity directly can correlated with the trees variation and different vegetation. In reverse birds help in moving supplements, pollination and breaking the seed dormancy. Many birds species feed on plant products like fruit, seed while others eat earthworms, insects other small creatures. Birds, such as parrots and songbirds, are kept as pets playing a enjoyment role for human being, also working as a scavengers and the postman of the environment. Many bird species have been extinct as a result of illegal human activity.
Because of their abundance and sensitivity to environmental changes, birds are excellent markers of ecological health (Pearce & Femier, 2001). Many relevant concerns about the geographical distribution of biodiversity may be answered through vegetation analysis and behavioural investigations. Moreover, such studies have the potential to pave the path for better and more sustainable resource development and management.
The climatic condition of Boudh district abundantly changed. The area goes under the Western Central Table Land portrayed by warm and soggy sub-sticky environment. The period of May as the sultriest month reach to a daily maximum temperature of 440−460Celsius. The district is very much associated with other districts. The bounties of nature have blessed the region with rich timberland have large amounts of Sal, Sisal, Bija, Asana, Mahua bloom trees and so forth. In terms of vegetation, the forest is a part of the studyarea known as the best habitat for varieties of wild animals, birds, butterflies etc. Boudh district has diverse areas for avifaunal diversity. Many avian species that can be found in Boudh district due to the different habitats.
However, all studies have focused on avifauna diversity and distribution. Boudh district is said to be lagging behind in avifaunal diversity. As a result, a details study of avifauna diversity of Boudh district is necessary in order to protect biodiversity and the environment. The study area is a previously undiscovered place for avifauna diversity. The sites need to be explored for varieties of birds, because it is located inside one of the natural ecological zones.

Materials & methods
Study area
Geographically, Boudh district situated on the bank of the Mahanadi and Tel-river, in the western part of Odisha. Boudh district is arranged between 20 degrees 22' and 20 degrees 50' north scope and 83 degrees 34' and 84 degrees 49' east longitude, covering 3444.8 square kilometres. The river Mahanadi and Anugul district line the district in the north, Kandhmal district in the south, Nayagad district in the east and the river Tel and Subarnapur district on the west. The study area has a wide scope of climatic circumstances. The typical temperature goes from C in December toC in June. The study area is comprised of rich fields and bumpy regions.
During this field survey, the study area divided into five different study sites as shown in fig.1.

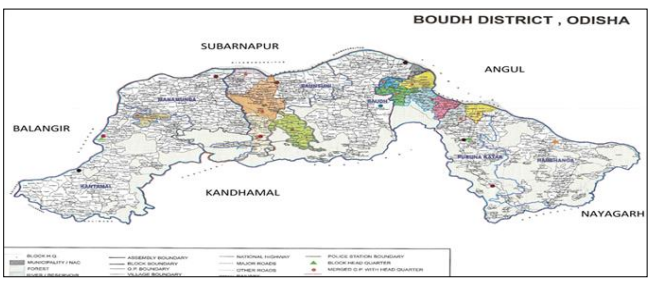

Fig 1: Map of Boudh district, showing the different study sites (A, B, C, D, E).

Study site A: Madhapur
This is hilly area containing large forest patches, Mountains, Human habitation (small colonies). There is Sal, Mahua flower trees, Kendu trees in forest. Kumbhidhar waterfall is the main attaraction of this area.
Study site

B: Purunakatak
It is a large Colony, containing small forest patches, running water, reservoir and human habitation. This area also famous for Mata Bhairabi temple. main flora are mango tree, tamarind tree, sal tree.
Study site

C: Boudh
This is the district head quarter of Boudh district. There are so many religious places like Nayakpada cave, Charisambhu temple, Old buddha heritage sites. Throughout the year so many tourists are coming there. Also small forest area, running water of Mahanadi, small ponds and Dams are present.
Study site

D: Manamunda
This area consisting large colonies; Forest area, running water of Telriver, Small ponds etc. This area is famous for Khandi Kanpa Waterfall.
Study site

E: Kantamal
There are crop lands, grass lands, Dams are present. Forest patches includes Lakhparbat region and Bhai bohu dedhsura hill station is main attraction of this area containing Mahua flower trees, Sal, Bija, Asana, Peepal tree, Kendu tree etc.

Study Site A: Madhapur (Adenigad Jungle)

Study site B: Purunakatak (Surundi Pond,Reserve Forest)

Study Site C: Boudh (The Mahanadi)

Study Site D: Manamunda (Agriculture Land) **Study Site E:** Kantamal (Padhel Dam)

Fig 2: Figure showing different study sites A, B, C, D, E.

Bird identification method

The observation of birds was completed by line transect count method 0.160 kilometres transect line was drawn across the study area. The transect line is then split into five study sites A Madhapur, study site B Purunakatak, study site C Boudh, study site D Manamunda, study site E Kantamal, in 40 kms distance coverage. The birds were counted within 100 metres to the observer's left and right, as well as 50 metres in front of the observer. Clear photographs were taken by professional camera (Nikon D3300) and some birds were observed by CASON professional 8*40 Dps binoculars. On regular basis, I have observed on their mobility, colour, size, feeding habits. Also, I have documented length of the legs, size, form, distinguishing stripes and patches of colour; such as crown strips, eye lines, nape colour, eye arcs or rings, The observed species were identified on the field by 'The Book of Indian birds' by Ali S. (2002) [2] and some local peoples.

Table 1: Observation period

S.N.	Study sites	Date	Time duration
1	Site A-Madhapur	26/01/2022 to 05/02/2022	6.30 am to 9.30 am & 3.30 pm to 5.30pm
2	Site B-Purunakatak	06/02/2022 to 16/02/2022	5.30 am to 7.30 am & 4.30pm to 6.30 pm
3	Site C-Boudh	17/02/2022 to 27/03/2022	5.30 am to 7.30 am & 4.30pm to 6.30pm
4	Site D-Manamunda	28/03/2022 to 10/03/2022	5.30 am to 7.30 am & 4.30pm to 6.30pm
5	Site E-Kantamal	02/04/2022 to 12/04/2022	5.30 am to 7.30 am & 4.30pm to 6.30pm

Data analysis

During the field survey, the observed bird species were categorized into 3 categories on the basis of abundance. Their abundance is considered as Common (C) if the no. of individual is more than 30, Un-common (UC) if the no. of index has individuals between 11-30, Rare (R) if the no. of individual is less than equal to 10(Krushna *et al*., 2020).

Common (< 30), Uncommon (11-30), Rare (≤10)

For calculating the diversity and evenness of the bird species of the study area, Shannon -wiener Diversity index and Pielou's evenness been applied.

Observation

The observation of birds done four hours each day in five different study sites, study site A- Madhapur three hours in the morning from 6.30 am to 9.30 am and two hours in the evening from 3.30 pm to 5.30 pm., study site B Purunakatak, study site C Boudh, study site D Manamunda, i.e., two hours in the morning from 5.30am to 7.30 am and 2 hours in the evening from 4.30 pm to 6.30 pm. During the field survey, a total no of 56 bird species belonging to 27 families and 11 orders have been identified. Among 56 birds 20 are aquatic birds. Out of 56 no of birds 51 are Least Concern, three are Nearly Threatened and two are Vulnerable. The site wise distribution of species according to orders, families, species is given in the Table-1,2,3,4,5,) site wise.

Table 2: List of birds and their status of study site A, Madhapur.

S N	Common Name	Local name	Scientific name	Order	Family	Resident status	Abundance	IUCN status
1	Cattle Egret	Gotha baguli	*Bubulcus ibis*	Pelecaniformes	Ardeidae	R	R	LC
2	Little egret	Chhota baga	*Egretta garzetta*	Pelecaniformes	Ardeidae	R	R	LC
3	Indian pond heron	Kanti baga	*Ardeola grayii*	Pelecaniformes	Ardeidae	R	UC	LC
4	Little Cormorant	Chhota panikua	*Microcarbo niger*	Suliformes	Phalacrocoracidae	R	R	LC
5	Great Cormorant	Bada Panikua	*Phalacrocorax carbo*	Suliformes	Phalacrocoracidae	R	R	LC
6	Common Kingfisher	Machha ranka	*Alcedo atthis*	Coraciiformes	Alcedinidae	R	UC	LC
7	Common Myna	Bani	*Acridotheres tristis*	Passeriformes	Sturnidae	R	R	LC
8	Black Drongo	Kajalapati	*Dicrurus macrocercus*	Passeriformes	Dicruidae	R	R	LC
9	Water rail	Rail	*Rallus aquaticus*	Gruiformes	Rallidae	M	UC	LC

Abbreviation; Status; Abundance; - Common (C), Uncommon (UC), Rare (R), Resident Status; Resident (R), Migratory (M); IUCN status; Least concern (LC).

Table 3: List of bird and their status of study site B Purunakatak.

S N	Common Name	Local name	Scientific name	Order	Family	Resident status	Abundance	IUCN status
1	Little cormorant	Chhota panikua	*Microcarbo niger*	Suliformes	Phalacrocoracidae	R	C	LC
2	Little egret	Chhota baga	*Egretta garzetta*	Pelecaniformes	Ardeidae	R	C	LC
3	Cattle egret	Gotha baguli	*Bubulcus ibis*	Pelecaniformes	Ardeidae	R	C	LC
4	Indian pondheron	Kanti baga	*Ardeola grayii*	Pelecaniformes	Ardeidae	R	UC	LC
5	Ruddy shelduck	Chakua chakoi	*Todorna ferruginea*	Anseriformes	Anatidae	M	R	LC
6	Northern shoveler	Panichia gendi	*Spatula clypeata*	Anseriformes	Anantidae	M	R	LC
7	Red-wattled lapwing	Tin tia	*Vanellus indicus*	Charadriiformes	Charadriidae	R	C	LC
8	Kentish plover	Kuji giria	*Charadrius alexandrinus*	Charadriiformes	Charadriidae	M	R	LC
9	Rock pegion	Para	*Columba livia*	Columbiformes	Columbidae	R	C	LC
10	Spotted dove	Kapota	*Spilopelia chinrnsis*	Columbiformes	Columbidae	R	C	LC
11	Laughing dove	Jungle kopata	*Spilopelia senegalensis*	Columbiformes	Columbidae	R	C	LC
12	House crow	Kau	*Corvus splendens*	Passeriformes	Corvidae	R	C	LC
13	Large billedcrow	Kala kau	*Corvus macrorhynchos*	Passeriformes	Corvidae	R	C	LC
14	Eurasian Hoopoe	Hoope	*Upupa epops*	Bucerotiformes	Upupidae	R	R	LC
15	Green bee eater	Sabuja baliasua	*Merops orientails*	Coraciiformes	Meropidae	R	C	LC
16	Yellow throated sparrow	Ghara chatia	*Gymnoris xanthocollis*	Passeriformes	Passeridae	R	UC	LC
17	House sparrow	Ghara chatia	*Passer domesticus*	Passeriformes	Passeridae	R	C	LC
18	Jerdons bushlark	Mirafra	*Mirafra affinis*	Passeriformes	Alaudidae	R	R	LC
19	Jerdons leaf bird	Sari	*Chloropsis jerdoni*	Passeriformes	Chloropseidae	R	UC	LC
20	White – throated kingfisher	Machharanka	*Halcyon smyrnesis*	Coraciiformes	Alcedinidae	R	R	LC
21	Common myna	Bani	*Acridotheres tristis*	Passeriformes	Sturnidae	R	C	LC
22	Jungle babbler	Kunda khai	*Argya striata*	Passeriformes	Leiothrichidae	R	C	LC
23	Scaly breasted munia	Munia	*Lonchura punctulata*	Passeriformes	Estrildidae	R	C	LC
24	Indian silverbill	Liti chadhei	*Euodice malabarica*	Passeriformes	Estrildidae	R	C	LC

Abbreviation; Status; Abundance; - Common (C), Uncommon (UC), Rare (R), Resident Status; Resident (R), Migratory (M); IUCN status; Least concern (LC)

Table 4: List of birds and their status of study site C Boudh.

S N	Common Name	Local name	Scientific name	Order	Family	Resident status	Abundance	IUCN status
1	Great cormorant	Bada pani kua	*Phalacrocorax carbo*	Suliformes	Phalacrocoracdae	R	R	LC
2	Little cormorant	Chhota pani kua	*Microcarbo niger*	Suliformes	Phalacrocoracdae	R	UC	LC
3	Indian pond heron	Kanti baga	*Ardeola grayii*	Pelecaniformes	Ardeidae	R	UC	LC
4	Greate egret	*Bada baga*	*Ardea alba*	Pelecaniformes	Ardeidae	R	UC	LC
5	White-breasted waterhen	Dahuka	*Amaurornis phoenicurus*	Gruiformes	Rallidae	R	R	LC
6	Kentish plover	Kuji giria	*Charadrius alexandrinus*	Charadriiformes	Charadriidae	M	R	LC
7	Red – wattled lapwing	Tin tiha	*Vanellus indicus*	Charadriiformes	Charadriidae	R	UC	LC
8	River lapwing	Nadi tin t Iha	*Vanellus duvaucelii*	Charadriiformes	Charadriidae	R	R	NT
9	Small pranticole	Kuji batahana	*Glareola lactea*	Charadriiformes	Glreolidae	R	UC	LC
10	Black drongo	Kajalapati	*Dicrurus macrocercus*	Passeriformes	Dicruridae	R	R	LC
11	Green bee eater	Sabuja balisua	*Merops orientails*	Coraciiformes	Meropidae	R	C	LC
12	River tern	Ghana tala gangoi	*Sterna aurantia*	Charadriiformes	Laridae	R	UC	VU
13	Common kingfisher	Chhota machharanka	*Alcedo atthis*	Coraciiformes	Alcedinidae	R	R	LC
14	White- throated kingfisher	Machha ranka	*Halcyon smyrnensis*	Coraciiformes	Alcedinidae	R	R	LC
15	Indian robin	Liti chadhei	*Copsychus fulicatus*	Passeriformes	Muscicapidae	R	R	LC
16	Rock pegion	Para	*Columba livia*	Columbiformes	Columbidae	R	C	LC
17	Spotted dove	Kapota	*Spilopelia chinensis*	Columbiformes	Columbidae	R	C	LC
18	Common myna	Bani	*Acridotheres tristis*	Passeriformes	Sturnidae	R	C	LC
19	House crow	Kau	*Corvus splendens*	Passeriformes	Corvidae	R	C	LC
20	Greater coucal	Kala kajalapati	*Centropus sinensis*	Cuculiformes	Cuculidae	R	R	LC
21	White wagtail	Chitra lanja hala	*Motacilla alba*	Passeriformes	Motacillidae	R	R	LC

Abbreviation; Status; Abundance; - Common (C), Uncommon (UC), Rare (R), Resident Status; Resident (R), Migratory (M),; IUCN status; Least concern (LC), (NT) Nearly threatened, (VU) Vulnerable.Table 4; List of birds and their status of Study site D (Manamunda).

Table 5: List of birds and their status of Study site D Manamunda.

S N	Common Name	Local name	Scientific name	Order	Family	Resident status	Abundance	IUCN status
1	Lesser whistling duch	Hansarali	*Dendrocygna javanica*	Anseriformes	Anatidae	R	C	LC
2	Spot -billed duck	Dabbling duck	*Anas poecilorhyncha*	Anseriformes	Anatidae	R	C	LC
3	Indian cotton teal	Dhala gendi	*Nettapus coromandelianus*	Anseriformes	Anatidae	R	C	LC
4	Common teal	Bataka	*Anas crecca*	Anseriformes	Anatidae	M	C	LC
5	Red creasted pochard	Ranga gendi	*Netta rufina*	Anseriformes	Anatidae	M	UC	LC
6	Tufted duck	Jatia gendi	*Aythya fuligula*	Anseriformes	Anatidae	M	UC	LC

7	Little stint	Sima	*Calidris minuta*	Charadriiformes	Scolopacidae	M	UC	LC
8	Little cormorant	Chhota panikua	*Microcarbo niger*	Suliformes	Phalacrocoracdae	R	C	LC
9	White breasted waterhen	Dahuka	*Amaurornis phoenicurus*	Gruiformes	Rallidae	R	C	LC
10	Great egeret	Bada baga	*Ardea alba*	Pelecaniformes	Ardeidae	R	C	LC
11	Little egret	Chhota baga	*Egretta garzetta*	Pelecaniformes	Ardeidae	R	C	LC
12	Indian pond heron	Kanti baga	*Ardeola grayii*	Pelecaniformes	Ardeidae	R	C	LC

Abbreviation; Status; Abundance; - Common (C), Uncommon (UC), Rare (R), Resident Status; Resident (R), Migratory (M); IUCN status; Least concern (LC).

Table 6: List of birds and their status of study site E Kantamal

S N	Common Name	Local name	Scientific name	Order	Family	Resident status	Abund-ance	IUCN status
1	Great cormorant	Bada panikua	*Phalacrocorax carbo*	Suliformes	Phalacrocoracdae	R	UC	LC
2	Little cormorant	Chhota panikua	*Microcarbo niger*	Suliformes	Phalacrocoracdae	R	C	LC
3	Indian shag	Panikua	*Phalacrocorax fuscicollis*	Suliformes	Phalacrocoracdae	R	R	LC
4	Oriental Darter	Khapara khai	*Anhinga melanogaster*	Suliformes	Anhigidae	R	R	NT
5	Indian Pondheron	Kanti baga	*Ardeola grayii*	Pelecaniformes	Ardeidae	R	C	LC
6	Little egret	Chhota baga	*Egretta garzetta*	Pelecaniformes	Ardeidae	R	C	LC
7	Great egret	Bada baga	*Ardea alba*	Pelecaniformes	Ardeidae	M	UC	LC
8	Painted Stork	Kaka	*Mycteria leucocephala*	Ciconiiformes	Ciconiidae	M	R	NT
9	White Stork	Kaka	*Ciconia ciconia*	Ciconiiformes	Ciconiidae	M	UC	LC
10	Asian Openbill	Gendalia	*Anastomus oscitans*	Ciconiiformes	Ciconiidae	M	R	LC
11	Marbled Teal	Hansa	*Marmaronetta angustrirostris*	Anseriformes	Anatidae	M	R	VU
12	Lesser Whistling Duck	Hansarali	*Dendrocygna javanica*	Anseriformes	Anatidae	R	R	LC
13	Common Shelduck	Bataka	*Tadorna tadorna*	Anseriformes	Anatidae	M	C	LC
14	Red Wattled Lapwing	Tin tia	*Vanellus indicus*	Charadriiformes	Charadriidae	R	C	LC
15	Long Billed Plover	Thuk	*Charadridus placidus*	Charadriiformes	Charadriidae	R	C	LC
16	Green Sandpiper	Chaha chadhei	*Tringa ochropus*	Charadriiformes	Scolopacidae	M	C	LC
17	Common Sandpiper	Chaha chadhei	*Actitis hypoleucos*	Charadriiformes	Scolopacidae	R	UC	LC
18	White Breasted Water Hen	Dahuka	*Amaurornis phoenicurus*	Gruiformes	Rallidae	R	R	LC
19	Common Kingfisher	Chhota machharanka	*Alcedo atthis*	Coraciiformes	Alcedinidae	R	R	LC
20	White Throated Kingfisher	Machharanka	*Halcyon smyrnensis*	Coraciiformes	Alcedinidae	R	R	LC
21	Cheshunt Headed Bee eater	Balisua	*Merops leschenaulti*	Coraciiformes	Meropidae	R	R	LC
22	Pied myna	Dhala bani	*Gracupica contra*	Passeriformes	Sturnidae	R	R	LC
23	Black Drongo	Kajalapati	*Dicrurus macrocercus*	Passeriformes	Dicruidae	R	R	LC
24	Indian Roller	Vadavadalia	*Coracias benghalensis*	Coraciiformes	Coraciidae	R	R	LC
25	Jungle crow	Jungle kau	*Corvus macrorhynchos*	Passeriformes	Corvidae	R	R	LC

Abbreviation; Status; Abundance; - Common (C), Uncommon (UC), Rare (R), Resident Status; Resident (R), Migratory (M); IUCN status; Least concern (LC), (NT) Nearly threatened, (VU) Vulnerable.

Among the five study sites, study site B Purunakatak is the most diverse habitat as shown in fig 4. This site has the higher Shannon Weiner index value 2.841, followed by study site -E Kantamal got 2.604, study site-C Boudh got 2.488, study site-A Madhapur got 1.856, study site -D Manamunda got 1.769, Pielou's index was also calculated to find evenness during the study among all the five sites. In this study, site B again showed highest value highest value 0.894, followed by study site -A Madhapur received 0.845, study site -C Boudh got 0.817, study site – E Kantamal got 0.809, study site – D Manamunda got 0.712, as a result, the study site B is more uniformly dispersed.

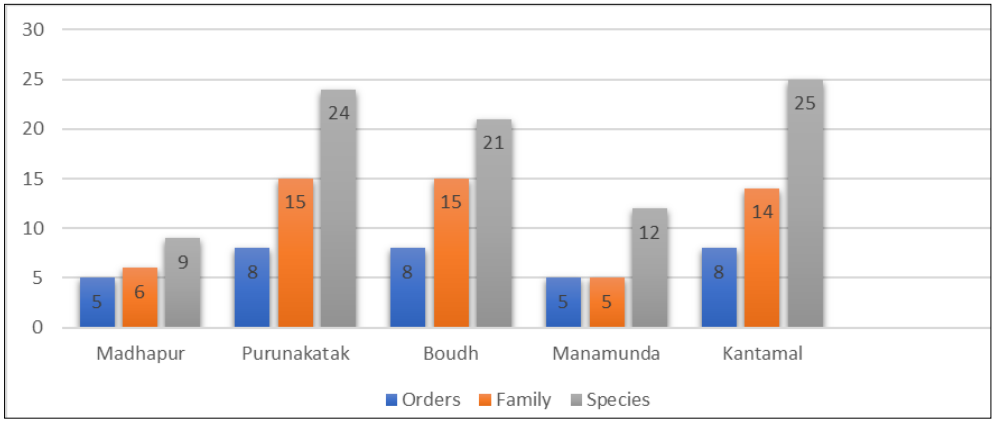

Fig 3: Comparative study of birds species according orders, family and species of 5 different study sites A, B, C, D, E.

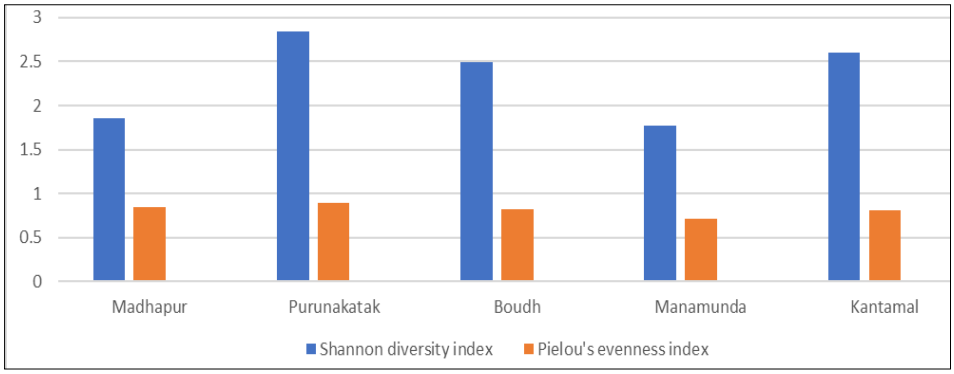

Fig 4: Comparative chart of diversity index of five different study sites A, B, C, D, E

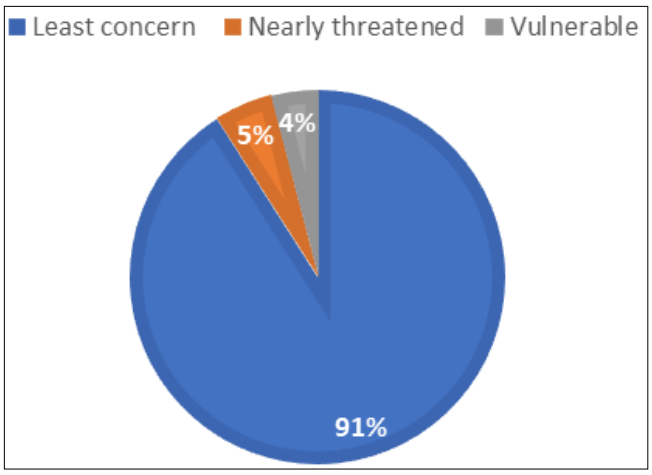

Fig 5: Avifaunal distribution of 5 different study sites A, B, C, D, E based on IUCN status.

Result and discussion

During the field survey, a total no of 56 species of birds have been counted belonging to 27 families and 11 orders. The study site A Madhapur have 9 species belonging to 6 families and 5 orders (Table- 1), the study site B Purunakatak have 24 species belonging to 15 families and 8 orders (Table -2), the study site C Boudh have 21species belonging to 15 families and 8 orders (Table -3)the study site D Manamunda have 12 species belonging to 5 families and 5 orders (Table- 4,) and study site E Kantamal have 25 species belonging to 14 families and 8 orders(Table-5,).Out of 56 no of birds 51 species are Least concern(LC),three species are nearly threatened (NT) and two are vulnerable(VU) as shown fig 5. Maximum number of birds belong to orders Passeriformes and Anseriformes respectively.

Out of 56 varieties of birds, 14 species of birds belonging to 10 families of Passeriformes, 10 species of birds belonging to 1 family of Anseriformes, 4 species belonging to 1 family of Pelecaniformes, 4 species of birds belonging to 2 families of Suliformes, 3 species belonging to 2 families of Coraciformes, 2 species belonging to 1 family of Gruiformes, 9 no of species belonging to 5 family of Charadriiformes, 3 species of birds belonging to 1 family of Columbiformes, 1 species belonging to 1 family of Bucerotiformes, 3 Species of birds belonging to 1 family of Ciconiformes.

Out of 56 species 20 birds are aquatic. They are, Lesser whistling duck (*Dendrocygna javanica*), Common teal(*Anas crecca*), Indian spot billed duck(*Anas poecilorhyncha*), Ruddy shelduck(*Todorna ferruginea*), Oriental darter (*Anhinga melanogaster*), Little cormorant(*Microcarbo niger*), River tern(*Sterna aurantia*), White – breasted waterhen(*Amaurornis phoenicurus*), Indian pond heron(*Ardeola grayii*), Cattle egret(*Bubulcus ibis*), Little egret(*Egretta garzetta*), Great egret(*Ardea alba*), Painted stork(*Mycteria leucocephala*), Asian openbill(*Anastomus oscitans*), Common kingfisher(*Alcedo atthis*), White – breasted kingfisher(*Halcyon smyrnensis*), Common sandpiper(*Actitis hypoleucos*), Green sandpiper(*Tringa ochropu*), Red wattled lapwing(*Vanellus indicus*), River lapwing(*Vanellus duvaucelii*), details listed in (Table-7). The common birds, seen in most of the study sites are Little-egret (*Egretta garzetta*), cattle egret (*Bubulcus ibis*), Indian Pond heron (*Ardeola grayii)*, House crow (*Corvus splendens*), House Sparrow (*Passer domesticus*), Red wattled lapwing (*Vanellus indicus*), Common myna (*Acridotheres tristis*), Black drongo (*Dicrurus macrocercus)*, Common kingfisher (*Alcedo atthis)*, White - throated kingfisher (*Halcyon smyrnesis).*

The Shannon- weiner index for species diversity, and Pielou's index for evenness were also calculated. Study site -B Purunakatak has a greater diversity of species (2.841) followed by study study site -E Kantamal (2.604), study site-C Boudh (2.488), site – A Madhapur (1.856), study site -D (1.769). Pielou's index result showed higher for study site B Purunakatak (0.894) followed by study site-A Madhapur (0.845), study site -C Boudh (0.817), study site - E Kantamal (0.809) and least one study site-D (0.712), details provided in (fig.4).

Among 5 different sites (A, B, C, D, E) of the study area;study site -B Purunakatak addresses a high avifaunal diversity. The high richness of birds in this study site can be credited to high natural surroundings heterogeneity of both inland aquatic and earthbound territories. This site lies in a significant natural zone, having high Sal trees, Mahua flower trees and Kendu trees. Subsequently, various environments of this site draw in attract and support assortment of bird species. The study area has a different variety of fruiting trees, rich in diversity and plenty of insects, which give food to the variety of birds. Seasonal and lasting natural product bearing trees and plants like *Ficus benghalensis, Ficus religiosa, F. Zizyphus* are general. Subsequently, a few types of frugivorous birds were seen as resident here.

Albeit large numbers of the birds were insectivores, food contest was diminished by the usage of various territory types, feeding habitat and food things. It has been shown that distinct feeding possibilities exist for birds where plant morphologies or plant species change with height in a forest or between forest stands and the same was studied before by Palei *et al*., (2017) [29]. The makeup of the bird community inside and between backwoods environments is generally

depend on the actual construction of the vegetation, distribution types of foraging substrate and the species composition of the plant ecosystem influences the availability and quantity of insect resources. Similar observations were made by Sodhi *et al*., (2011) and Pradhan *et al*., (2016) [31] noticed that highest bird activity was seen near the forest's openings and edges, as well as around human habitation.

According to Sahu, (2013) [36], the majority of the species discovered were insectivores or omnivores that usually ate on the ground in open areas and the birds preferred the edge forest because it provided them with a variety of habitats as well as appropriate perches for catching flying prey. Such an environment was present in the Mahanadi and Tel rivers provides an adequate habitat for aquatic birds. The addition of water birds to the entire population contributed to the area's bird population's diversity. Similar research has been done by Mohanta *et al*., (2014) [26].

Migratory water birds in the study area such as the Red-crested Pochard (*Netta rufina*), Northern Shoveler (*Spatula clypeata*), Ruddy shelduck (*Tadorna ferruginea*), Common teal (*Anas crecca*), and Tufted duck (*Aythya fuligula*) have been discovered eating in bodies of water. Certain species will visit the study area for foraging purposes observed by Jyethi (2019). Cormorants, egrets, and herons are common residents in the region's rivers and different bodies of water. From the reservoirs and dams, they eat planktons, fish, amphibians, invertebrates and similar was suggested by Jethy (2019).

Three stork species Asian openbill, White stork, Painted stork have been observed in study site E (Table – 6) and are dependent on diverse water bodies for nesting, roosting, and feeding. The same was studied by Gopi *et al*., (2007). The bulk of the birds are listed in this survey, is similar to Palei *et al*., (2017) [29] and Prdhan *et al*., (2017). Due to a lack of insects in the study area, jungle babblers and black drongos were seen eating fruits and seeds during the winter season, similar to what was observed by Mishra *et al*., (2020). Additionally, as previously observed by Kumar *et al*. (2009) [20], excessive use of pesticides and fertilisers in agricultural fields of the study area reduces avifaunal variety. Human-generated waste makes its way into water streams, contaminating the available water. Similar studies had been done by Virendra *et al* (2015) and according to Issa (2019) [15], the number and abundance of bird species in the study area grew as environmental conditions improved.

The highest number of migratory species are detected in the study area during the winter, when the water level is high and food is abundantly accessible, as observed by Anurag *et al*., (2020). During the field survey, Passeriformes was discovered to be the dominant order with 10 families and 14 species. Narvey *et al*., (2021) discovered Passeriformes to be the dominant order with 16 families and 36 species and M. Rajesh *et al*., (2021) discovered Passeriformes to be the dominant order with 41 species. Birds in the study area chose to build their nests out of manmade materials, as observed by Osho *et al* (2018). During the field survey, it was discovered that shrubs attract a bigger number of insectivores birds by providing them with food, and Laxmi Narayan *et al*. (2015) made the same discovery. The presence of Near Threatened and Vulnerable species highlights the importance of maintaining natural ecosystems in the study area. Joshi *et al*. (2021) [16] made a similar observation.

Conclusion

During the present field survey, a total no of 56 species of birds belonging to 27 families and 11 orders have founded. Out of 56 species 20 birds are aquatic. Lack of ornithological knowledge and continuous surveys in earlier years, the actual status of avifauna diversity in Boudh district in the ongoing time is obscure. Birds have an important ecological role in addition to their economic importance. Birds also play a major role in our day-to-day life by chirping and rainbow colours. Birds are very good remarker for the environmental health and ecosystem. Changes in birds population sometimes the first sign of environmental issues as degradation and deforestation. Birds also play major role in the society as pest-control agents, pollinators and seed dispersal. It's necessary to monitor their habitats, control the deforestation activities and fire activities in urban, rural and wild area to balance the nature. This bird count survey study gave very fruitful result regarding semi urban and forest area. So, its need to conserve their diversity. This is a short-term study on avifauna diversity of Boudh district, Odisha, more thorough studies will give the actual data about additional varieties of birds species. May this study will supportive to many researchers for further studies.

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Conflict of interest

The authors declare that there is no conflict of interest.

Ethical Approval

not applicable

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