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Research Article

A survey of waterbirds of Khoh and Kohlu rivers of Lansdowne forest division (western Himalayas), Uttarakhand, India

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ABSTRACT

The present study was conducted in the Khoh and Kohlu rivers, which are the tributaries of the principal river Ramganga of the lower Garhwal Himalaya. During this study, we recorded 26 bird species belonging to 12 families of waterbirds and associated species. A total of 18 species were recorded in Khoh and 24 species were recorded from the Kohlu out of a total of 26 species. Among these 14 species are commonly found in both sites. 18 avian species were residents (69%) and 8 were winter migrants (31%). Analysis of RDi (relative diversity) results indicated that the family Accipitridae was the most diverse family, with the highest RDi value of 15.38. The species diversity indices comparison between Khoh and Kohlu rivers showed that the Kohlu river had a maximum diversity value (*H'* = 2.90) in comparison to the Khoh river (*H'* = 2.58). Five threatened bird species recorded in the survey were Pallas's Fish Eagle *Haliaeetus leucoryphus* (Endangered), River Lapwing *Vanellus duvaucelii* (Near Threatened), these two species common in Khoh and Kohlu, while Woolly-necked Stork *Ciconia episcopus* (Near Threatened), Painted Stork *Mycteria leucocephala* (Near Threatened), and River Tern *Sterna aurantia* (Near Threatened) seen only in Kohlu. These natural river stretches should be conserved to protect and enhance the abundance and diversity of waterbirds in their natural habitat.

Key words: Waterbirds, Lansdowne forest division, waterbirds conservation, Khoh river, Kolhu river

INTRODUCTION

Avifauna is the most diverse and important group in the entire globe, it has played a key role in maintaining the ecological balance and other important factors that are required for human survival (SoIB, 2020). Natural river systems are interfaces between land-aquatic systems with strong climatic variables, also they contain the most diverse, dynamic, and complex biophysical habitats on the planet (Naiman *et al*., 1993; Sinha *et al*., 2019). Indian Himalayan range has a large riverine system, and it has provided a suitable habitat for different types of fauna such as fish, amphibians, and avian species (Dudgeon, 2012). This range is also identified as a biological hotspot. It has contributed to about 13% of world avian fauna; about 1313 avian species have been reported in the Indian subcontinent (Grimmett *et al*., 2015). Also, the western Himalayan region was identified as an Endemic Bird Area (EBA 128) by Birdlife International (2022). It also has 27 Important Bird and Biodiversity Areas (Islam & Rahmani, 2004).

Uttarakhand state has a large diversity of avian fauna due to its bio-geographical and climatic suitability. The current checklist of Uttarakhand birds listed 693 avian species (Mohan and Sondhi, 2015). Many studies such as in Kedarnath Wildlife Sanctuary (Raza, 2006; Bhatnagar *et al*., 2020), Nanda Devi National Park (Sankaran, 1995; Uniyal, 2002; Sathyakumar, 2003; Bhattacharya & Sathyakumar, 2007), Kumaun Himalaya, (Sultana & Khan, 2000; Sultana *et al*., 2007; Bhatt & Joshi, 2011, Arya *et al*., 2021), Garhwal Himalaya (Naithani & Bhatt, 2012) and it's foothills (Mohan & Kumar, 2010; Arya *et al*., 2019), Dehradun Valley (Mohan, 1997; Singh, 2000; Singh, 2002; Vijay & Bhutia, 2010; Joshi & Bhatt, 2015; Rawat *et al*., 2021) and Bhagirathi Valley (Sinha *et al*., 2019) have been conducted in this region.

This study area comes under the Lansdowne forest division, located in the western part of the Uttarakhand state. There is no previous published literature on avifauna in the study area. Some studies such as those (Mohan & Kumar, 2010; Kukreti & Bhatt, 2014; Kukreti, 2020, 2021) have been conducted in the Lansdowne forest division. The primary objective of the present study is to provide baseline data about waterbird species of the Khoh and Kohlu rivers.

MATERIALS AND METHODS

Study area

The present survey was conducted in different locations along with the Khoh and Kohlu rivers. These rivers are the tributaries of the principal river Ramganga in the lower Garhwal Himalayas. River Khoh is situated in the southern part of the district Pauri Garhwal between 29° 45'25"-29° 48' 19" N and 78° 32' 18"-78° 36' 16.5" E, with an elevation of 338 m above sea level. Whereas the river Kolhu is situated between 29° 41'40"-29° 42' 48" N and 78° 31' 40'-78° 37'39" E and flows north-east of the Corbett Tiger Reserve at an elevation of 381 m asl (Figure 1).

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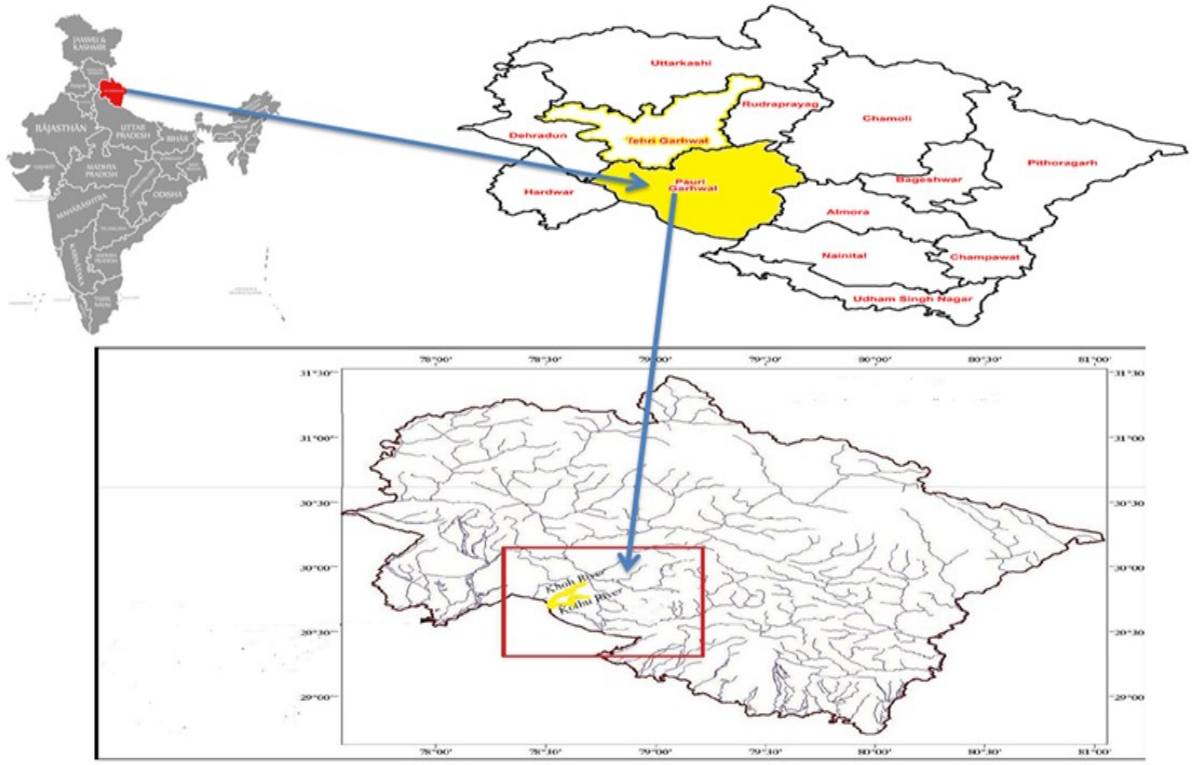

Figure 1. Study area in Lansdowne forest division (Khoh and Kohlu Rivers), Uttarkhand.

Methodology

The waterbird survey was conducted from November 2019 to May 2020. The field visits were carried out in mainly two phases, the morning phase (6:00 hrs to 10 hrs in summer and 8:00 hrs to 11:00 hrs in winter session) and the evening phase (15:00 hrs to 17:30 hrs in both summer and winter sessions). The point count method was used (Bibby *et al*., 2000) to estimate the abundance of species. During the survey, we walked along with the river bank and identified the different study points (2 points/km). We covered the 3 km stretch of both rivers during the study period. A pair of Nikon 10 × 50 prismatic field binoculars, and a Canon PowerShot SX60 HS camera was used for the observation and photography of the individuals. The avian species were identified with the help of field guides (Grimmett *et al*., 2001; Grimmett & Inskipp, 2018) and prepared a checklist of avian species recorded during the study period. The bird's nomenclature follows Praveen *et al*., 2016 & Praveen *et al*., 2020. The threatened categories of avian species were assigned according to the International Union for Conservation of Nature and Natural Resources (IUCN, 2022) Red Data Book. The avian species were also categorized with their protection schedule according to Indian Wildlife (Protection) Act, 1972 (IWPA) status and its subsequent amendments (WII-ENVIS, 2022). The assessment of resident and winter migratory avian species was done with the help of seasonal presence-absence data and the available literature (Grimmett *et al*., 2001, 2015; Grimmett & Inskipp, 2018). The avian species were classified based on their feeding guilds by direct observation and with the help of field guide literature (Ali & Ripley, 1974; Grimmett *et al*., 2015).

Data analysis

The Shannon-Wiener diversity index [$H' = -\Sigma pi\ (\ln pi)$] was used to calculate bird species diversity (Mac Arthur & MacArthur, 1961). The relative diversity (RDi) value of the families was calculated by the formula given by La Torre-Cuadros *et al*. (2007):

RDi = Number of species in a family/ Total number of species × 100

Microsoft Excel 2011 Software was used for calculating the mean abundance and percentage of avian species recorded in the area.

RESULTS

A total of 26 waterbird species belonging to 12 families were recorded during the study period. A total of 18 species were recorded in Khoh and 24 species were recorded from the Kohlu out of a total of 26 species. Among these, 14 species were commonly found in both sites (Table 3). 18 resident (69%) and 8 winter migratory (31%) species were identified in this study (Figure 2). Family Accipitridae is dominant with 4 species followed by Ardeidae (3), Ciconiidae (3), and Motacillidae (3) (Table 2). Analysis of RDi (Relative diversity) results indicated that the family Accipitridae most diverse family with the highest RDi value of 15.38 as compared to other families (Table 2 and Figure 3). The results also indicated the River Lapwing is the most dominant species in both study areas. The value of species diversity in Kohlu River was found higher ($H' = 2.90$) as compared to Khoh river ($H' = 2.58$) during the study period (Table 1). Carnivorous feeding guild was found dominant with maximum species (16) (Figure 4). Five threatened bird species recorded in the survey were

Table 1. Comparison of diversity indices between Khoh River and Kohlu River.

Parameters	Khoh River	Kohlu River
Location (latitude and longitude)	29°45'27" N, 78°32'22.4" E to 29°48'22.1" N, 78°36'18.5" E	29° 41'39.2" N, 78°31'42.3' E to 29°42'46.3" N 78°37'41" E
Elevation (m asl)	338 m asl	340 m asl
Shannon's Diversity (*H'*) (mean diversity)	2.58	2.90
No. of Individual	103	129
No. of species	18	24

Table 2. Family wise distribution and relative diversity of the birds.

Sl. No.	Family	No. of Species	Relative Diversity (RDi)
1.	Accipitridae	4	15.38
2.	Alcedinidae	2	7.69
3.	Ardeidae	3	11.54
4.	Anatidae	1	3.85
5.	Ciconiidae	3	11.54
6.	Charadriidae	2	7.69
7.	Laridae	1	3.85
8.	Motacillidae	3	11.54
9.	Phalacrocoracidae	2	7.69
10.	Rallidae	1	3.85
11.	Scolopacidae	2	7.69
12.	Turdidae	2	7.69

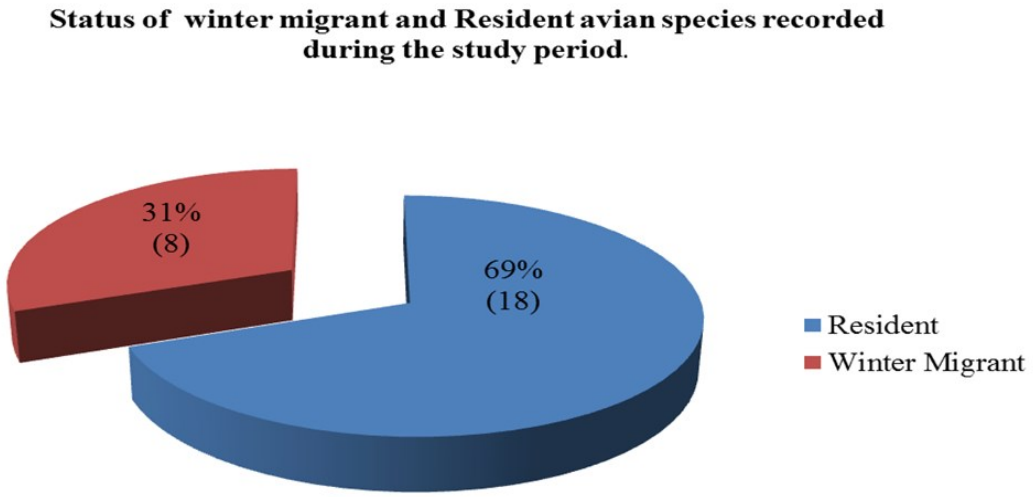

Figure 2. Status of bird species in the study area.

Table 3. Checklist of avifaunal species recorded in the study area.

Family	Common Name	Scientific Name	Khoh River	Kholu River	Migration Status	IUCN Status	IWPA	Feeding Habits
Accipitridae	Black Kite	*Milvus migrans*	+	+	R	LC	I	OV
	Palla's Fish Eagle	*Haliaeetus leucoryphus*	+	+	R	**EN**	III	CV
	Crested Serpent Eagle	*Spilornis cheela*	+	+	R	LC	III	CV
	Oriental Honey-buzzard	*Pernis ptilorhyncus*	+	+	R	LC	IV	OV
Alcedinidae	Pied Kingfisher	*Ceryle rudis*	+	+	R	LC	IV	CV
	White-throated Kingfisher	*Halcyon smyrnensis*	+	+	R	LC	IV	CV
Ardeidae	Black-crowned Night Heron	*Nycticorax nycticorax*	+		R	LC	IV	OV
	Indian Pond Heron	*Ardeola grayii*	+		R	LC	IV	OV
	Cattle Egret	*Bubulcus ibis*	+	+	R	LC	IV	OV
Anatidae	Common Merganser	*Mergus merganser*		+	WM	LC	IV	OV
Ciconiidae	Black Stork	*Ciconia nigra*	+	+	WM	LC	IV	CV
	Painted Stork	*Mycteria leucocephala*		+	R	**NT**	IV	CV
	Woolly-necked Stork	*Ciconia episcopus*	+	+	R	**NT**	IV	CV
Charadriidae	Red-wattled Lapwing	*Vanellus indicus*	+	+	R	LC	IV	CV
	River Lapwing	*Vanellus duvaucelii*		+	R	**NT**	IV	CV
Laridae	River Tern	*Sterna aurantia*		+	R	**NT**	IV	CV
Motacillidae	White Wagtail	*Motacilla alba*	+	+	WM	LC	IV	OV
	Western Yellow Wagtail	*Motacilla flava*	+	+	WM	LC	IV	OV
	Grey wagtail	*Motacilla cinerea*	+	+	WM	LC	IV	OV
Phalacrocoracidae	Little Cormorant	*Phalacrocorax niger*	+	+	R	LC	IV	CV
	Great Cormorant	*Phalacrocorax carbo*		+	WM	LC	IV	CV
Rallidae	White-breasted Waterhen	*Amaurornis phoenicurus*		+	R	LC	IV	OV
Scolopacidae	Common Sandpiper	*Actitis hypoleucos*		+	WM	LC	IV	CV
	Common Greenshank	*Tringa nebularia*		+	WM	LC	IV	CV
Turdidae	Black Redstart	*Phoenicurus ochruros*	+	+	R	LC	IV	CV
	Plumbeous Water Redstart	*Phoenicurus fuliginosus*	+	+	R	LC	IV	CV

Abbreviations: R—Resident | WM—Winter migrant | LC—Least concerned | NT—Near threatened | EN—Endangered | CV—Carnivorous || IV—Insectivorous | OV—Omnivorous

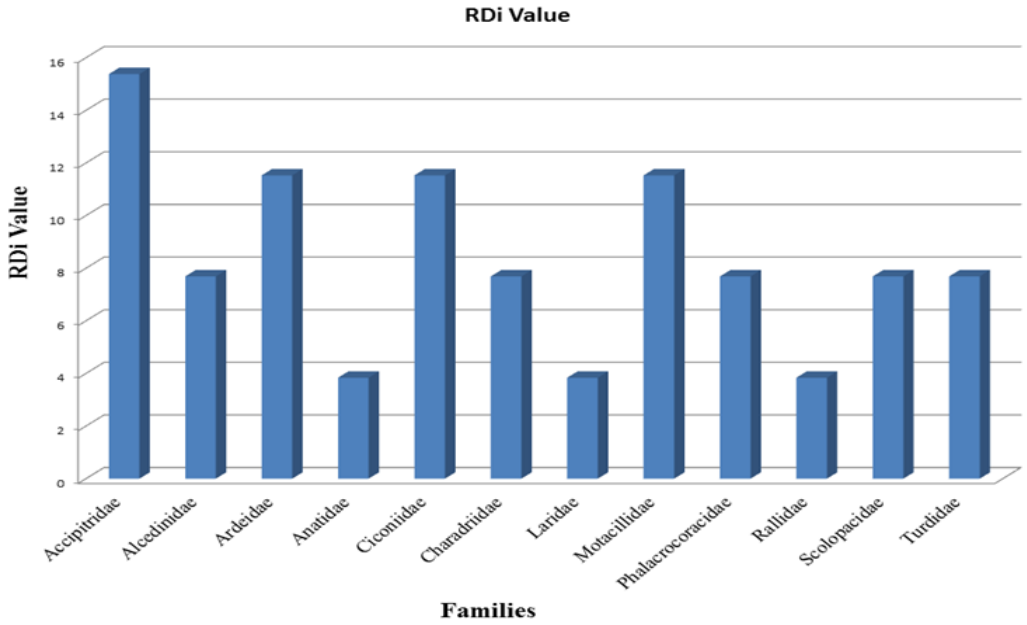

Figure 3. Relative diversity (RDi) value of the families during study.

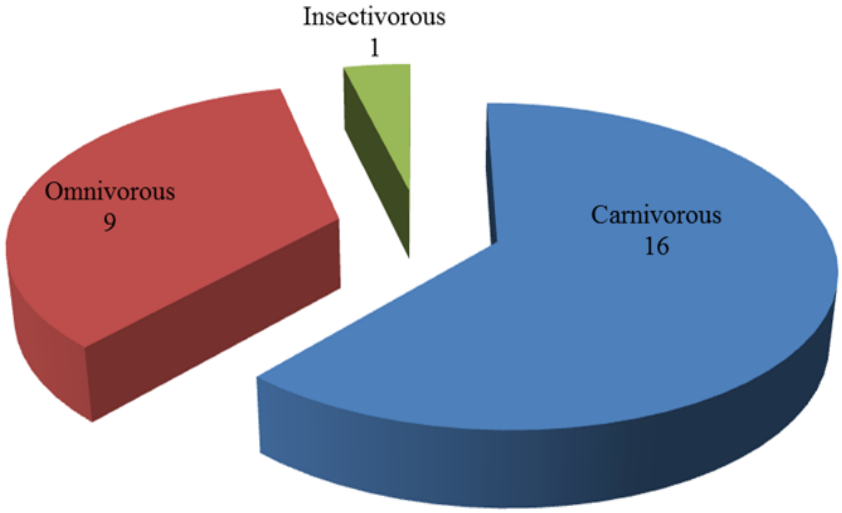

Figure 4. Distribution of bird species according to their feeding habits.

Pallas's Fish Eagle *Haliaeetus leucoryphus* (Endangered), River Lapwing *Vanellus duvaucelii* (Near Threatened), these two species common in Khoh and Kohlu, while Woolly-necked Stork *Ciconia episcopus* (Near Threatened), Painted Stork *Mycteria leucocephala* (Near Threatened), and River Tern *Sterna aurantia* (Near Threatened) seen only in Kohlu (Table 3). It is the first record of this species from the study area.

In the present study, Black kite *Milvus migrans* were documented under Schedule-I, while Pallas's Fish Eagle *Haliaeetus leucoryphus* and Crested Serpent Eagle *Spilornis cheela* were under Schedule-III. The remaining 23 species were under Schedule IV of the Wildlife Protection Act (WII-ENVIS, 2022) (Table 3). Photographs of some interesting avian species were recorded during the study period (Figure 5).

DISCUSSION

The riverine ecosystem is an appropriate habitat for avian communities all over the world (Sinha *et al*., 2019) because they have needed fresh water in different stages of life to complete their life cycle (Ormerod & Tyler, 1993; Buckton, 1998; Buckton & Ormerod,

Figure 5. A. Pallas's fish eagle, *Haliaeetus leucoryphus* (Endangered), **B.** Woolly-necked Stork, *Ciconia episcopus* (Near Threatened) **C.** River Lapwing, *Vanellus duvaucelii* (Near Threatened) **D.** Common Merganser (*Mergus merganser*).

2002). Also, the land use and its change in and around wetlands reflect the quality of habitat in terms of availability of food resources and predation risk (Arzel *et al*., 2015). The present study revealed that the Himalayan riverine system plays a critical role as a great host for avian communities with the representation of twelve families in only 3 km. stretch survey. As the study area is a protected area by law, forest patches situated along the rivers provide appropriate habitats for associated and waterbird species. The other study on Asian wetland by Rajpar & Zakir, 2010, suggested that herbaceous cover and aquatic plants are responsible for high waterbirds diversity; a similar study by Asri *et al*., 2020 proposed that the Mangrove forest plays a vital role in waterbirds life by giving shelter, food and protection from predators. In the present study, the occurrence of the maximum number of carnivorous bird species showed that the area has a large diversity of amphibians, crustaceans, fishes, reptiles, and other non-insect invertebrates, which constitute important food resources (Anderson & Smith, 2000).

A total of six riverine obligatory species were identified: Plumbeous water Redstart (*Phoenicurus fuliginosus*), White-throated Kingfisher (*Halcyon smyrenensis*), River Lapwing (*Vanellus duvaucelli*), Grey Wagtail (*Motacilla cinerea*), Common Sandpiper (*Actitis hyoleucos*) and White Wagtail (*Motacilla alba*) during this study as indicated that riverine system supports the avian species diversity (Arya *et al*., 2019). This study recorded high numbers of raptor species which play a key role in maintaining the dynamics of any ecosystem by reducing the dominant prey species and it is also an important indicator of suitable habitat (Thiollay, 1994). In our observation India and especially in Uttarakhand, where forests along with the riverine habitats were destroyed because of anthropogenic activities such as the construction of roads and mining activities for sand and boulder near the river, and new dams for hydropower, which resulted in many species-rich areas being, distracted (Pandit & Grumbine, 2012). However, we have not reported any disturbance or anthropogenic activities near the study area.

The purpose of this study is to provide baseline information about the presence of waterbird species in both rivers. The availability of near-threatened, and endangered species in the study area indicates that both the river are suitable and less disturbed habitats for the waterbird species. The presence of endangered and near -threatened waterbird species needs additional conservation efforts, future surveys are required to assist the additional species in the area. In addition, the enhancement of winter water migratory birds also indicates study area is a suitable site for the water migratory bird species. This baseline data of the available water bird species will be helpful for the avian biodiversity researchers and will also helpful be for future studies in study area.

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