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Ornis Hungarica 2022. 30(1): 126–134.
DOI: 10.2478/orhu-2022-0009

Threat status assessment and conservation recommendations for Ibisbill in Kashmir Himalaya

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Received: December 06, 2021 – Revised: May 06, 2022 – Accepted: May 07, 2022

Haq, I. Ul., Rehman, S., Sofi, I. I., Bhat, B. A. & Ahmad, K. 2022. Threat status assessment and conservation recommendations for Ibisbill in Kashmir Himalaya. – Ornis Hungarica 30(1): 126–134. DOI: 10.2478/orhu-2022-0009

Abstract The concern that population decline in wild species may lead to disruptions in the ecosystems has triggered numerous ecological studies across the globe. Therefore, monitoring biodiversity plays a key role in identifying priority species for evaluating the effectiveness of conservation measures. Ibisbill *(Ibidorhyncha struthersii)* is a habitat-specialist wader inhabiting high-altitude river rapids with cobbles, boulders and moderate flow of water in Asia. This study aimed to empirically assess the conservation and threat status of Ibisbill in the Kashmir Himalayan region (NW India). The species qualified as Endangered in the study region according to criterion B2 (area of occupancy < 500 km^2) of the IUCN Red List categories and criteria. Moreover, six priority sites for the conservation of Ibisbill were identified during extended field surveys in River Sindh, Kashmir, NW India. Threats faced by the Ibisbill along the priority sites were also recorded. Out of six sites, mining, livestock grazing and vehicle movement was observed at three sites, human interference including tourism activity at five sites and predation was observed at four sites. The results of this study suggest several conservation recommendations which need to be implemented to ensure the long-term persistence of the species.

Keywords: priority sites, disturbance, conservation, threat status, Himalaya, IUCN

Összefoglalás A felismerés, hogy a vadon élő fajok állományainak csökkenése az ökoszisztémák működését negatívan befolyásolhatja, számos ökológiai vizsgálatot eredményez világszerte. A biológiai sokféleség monitorozása ezért kulcsszerepet játszik a természetvédelmi beavatkozások hatékonyságának értékelésére alkalmas prioritás-fajok azonosításában. A kardcsőrű töcs *(Ibidorhyncha struthersii)* kavicsokkal és kisméretű kövekkel szegélyezett és lassan áramló vizű magashegységi folyók élőhely-specialista partimadár-faja Ázsiában. A jelen vizsgálat célja a kardcsőrű töcs természetvédelmi és fenyegetettségi helyzetének adatokon alapuló értékelése volt a Himalája Kasmír régiójában (ÉNY India). A faj az IUCN Vörös Lista kategóriái és kritériumai szerint a B2 kritérium (az előfordulások területe < 500 km^2) alapján a vizsgált régióban Veszélyeztetett helyzetűnek minősíthető. A vizsgálatban az északnyugat-indiai Kasmír régióban található Sindh folyó mentén végzett terepi felmérések során hat fő előfordulási helyet azonosítottunk, ahol felmértük a fajt fenyegető veszélyeztető tényezőket is. A hat helyszín közül a bányászat, legeltetés és gépjármű-közlekedés három helyen, emberi beavatkozás, beleértve a turizmust, öt helyen volt jelen, míg predációt négy helyen figyeltünk meg. A vizsgálat eredményei alapján több természetvédelmi javaslat fogalmazható meg, amelyek megvalósítása szükséges a faj hosszú távú fennmaradásának biztosításához.

Kulcsszavak: prioritás helyszínek, zavarás, természetvédelem, fenyegetettségi státusz, Himalája, Természetvédelmi Világszövetség

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Introduction

Biodiversity, in light of the growing pressure for numerous human activities, is facing a decline and increased risk of extinction globally (Butchart *et al.* 2010, Ceballos *et al.* 2017). Recently, 13% of bird species have been listed as globally threatened with extinction, whilst a further 9% are listed as 'Near Threatened' (BirdLife International 2015). Extinction rates estimated by the International Union for the Conservation of Nature (IUCN) are now 50 to 500 times higher than previous rates calculated from the fossil record (Baillie *et al.* 2004). The concern that population decline in wild species may lead to an imbalance in various ecosystems has triggered numerous ecological studies across the globe. Ecological studies are vital for providing information, prerequisite for initiating conservation action that ultimately help to alleviate the impact of developmental activities on the environment. Therefore, monitoring biodiversity plays a key role in identifying the priority conservation species for evaluating the effectiveness of restoration measures (Kéry & Schmid 2004).

All over the world, birds are known to utilise a plethora of habitats with a bewildering array of foraging strategies. Predominantly, a wide range among them makes use of the aquatic ecosystem as their specific habitat to carry out their life processes (Lovette & Fitzpatrick 2016). Being widely distributed, birds form a major component of biological diversity and are widely recognised as indicators for monitoring ecosystem quality and health of the environment (Gill 2007). Several birds are sensitive and do not tolerate even mild disturbances in the ecosystems and thus a slight change in their diversity and abundance may reflect ecological imbalance. Moreover, among a number of taxa, birds of river and riparian habitats are particularly important for monitoring, as they are relatively easily surveyable and identifiable, with little need of specific equipment or comprehensive knowledge.

The order Charadriiformes, also known as shorebirds are evolutionary important and phylogenetically enigmatic among the avian orders. Forming a morphologically diverse group, they are globally distributed, and largely migratory, representing a major part of aquatic bird diversity (Dehorter & Guillemain 2007). Charadriiformes belongs to a monophyletic group comprising of three monophyletic suborders; Lari, Scolopaci and Charadrii. These three suborders of the non-passerine birds are estimated to have been diverged from one another in the Cretaceous period (Paton *et al.* 2003).

Ibisbill *Ibidorhyncha struthersii* (Vigors, 1832), belonging to the order Charadriiformes, family Ibidorhynchidae, is considered a unique taxa for its perplexing apomorphies and plesiomorphies, resulting in challenges to the correct assessment of the systematic position of the species (Baker *et al.* 2007). Being morphologically unmistakable, the adult bird is characterised by a black face, crimson red bill and a black breast band (Pierce 1986, Knystautas 1996). Moreover, it shows little intraspecific variation with no subspecies described, is closely related to the oystercatchers, stilts, and avocets, and its name refers to a phenotypic resemblance to ibises.

The effective conservation measures that need to be taken for a species requires thorough understanding about its threat status. To this end, the current study was undertaken to evaluate the conservation status of Ibisbill by addressing the following questions; i) Which IUCN threat category does Ibisbill belong to? ii) What are the major threats that the species is facing in the study area?

Methods

Study area

The present study was carried out in the Kashmir division (NW Himalayas) of Union Territory of Jammu and Kashmir, India from August 2017 to July 2019. Surveys were also conducted to gather data on species presence in the Ladakh region as well. Sindh valley in central wildlife division (District Ganderbal) was selected as the intensive study site for identification of threats. River Sindh is located at 34.23 °N and 74.78 °E, with an average elevation of 1619 m (Dada *et al.* 2013). The river originates from Panjtarni snow fields (4250 m asl) and receives ample flow from the Amarnath (5003 m asl), Kolahoi (5425 m asl) and Thajwas Glacier (3000 m asl). Sindh is a fast-flowing torrential river in its upper and middle reaches while in the lower reaches it becomes calm and flows slowly (Siraj 2018, Haq *et al.* 2021a). The river comprises of small islands all along its course dominated by presence of huge rocks in the upper stretches. The beds of River Sindh comprise mainly of cobbles, boulders, with some underlying pebbles and sand at few places and thus provide an ideal habitat for riverine birds, especially for Ibisbill.

Criteria used for threat assessment

IUCN has defined five criteria (A–E) for the assessment of the threat status of any taxon in the world, however, only one of the five criteria needs to be fulfilled for assigning a threatened category. The five criteria (A–E) of the IUCN extinction risk assessment are based on the following three parameters: population reduction (criteria A and E), geographic range (criterion

Table 1. Summary of criterion B of the IUCN Red List Categories and Criteria (IUCN, 2019) for evaluating whether a taxon belongs to any of the threat category (Critically Endangered, Endangered and Vulnerable)

1. táblázat A Természetvédelmi Világszövetség (IUCN) Vörös Lista Kategóriák és Kritériumok (IUCN 2019) B kritériumának összegzése annak eldöntésére, hogy a vizsgált taxon megfelel-e bármelyik fenyegetettségi kategóriának (Súlyosan Veszélyeztetett, Veszélyeztetett, Sebezhető)

Geographic range in the form of either B1 (extent of occurrence) and/ or B2 (area of occupancy)				
	Critically Endangered (CR)	**Endangered (EN)**	**Vulnerable (VU)**	
B1 Extent of Occurrence	< 100 km^2	< 5000 km^2	< 20 000 km^2	
B2 Area of Occupancy	< 10 km^2	< 500 km^2	< 2000 km^2	
and at least two of the following three (a, b, c) conditions				
(a) severely fragmented or number of locations	=1	≤5	≤10	
(b) Continuing decline observed, estimated, inferred, or projected in any of (i) EOO; (ii) AOO area; (iii) extent and or quality of habitat; (iv) number of locations or subpopulations (v) number of mature individuals.				
(c) Extreme fluctuations in any of (i) EOO; (ii) AOO; (iii) number of locations or subpopulations; (iv) number of mature individuals.				

EOO: Extent of Occurrence, AOO: Area of Occupancy

B) and abundance (criteria C and D) (Le Breton *et al.* 2019). We assessed extinction risk for Ibisbill based on criterion B, i.e. geographic range. According to criterion B, a geographic range should be in the form of either B1: Extent of Occurrence (EOO) or B2: Area of Occupancy (AOO) and a taxon should also fulfil at least two of three conditions (a, b and c) *(Table 1)*.

Calculation of geographic range parameters

The R statistical software package ConR (Dauby *et al.* 2017) was used for calculating various parameters of criterion B (EOO, AOO) in order to assess the IUCN assessment of threat category for Ibisbill. EOO is a polygon that is drawn to include all the known locations and/or occurrences of a species and AOO is the total occupied area index, computed by summarising areas of standard size (2 × 2 km) grid cells (Bland *et al.* 2017, IUCN 2019).

Identification of threats

Based on previous studies (Haq *et al.* 2022), the threats faced by the Ibisbill were recorded at six sites along River Sindh *(Figure 1)*. We refer to threats here as "proximate human activities or processes that have impacted or may impact species" (Salafsky *et al.* 2008). The major threats that represented disturbance to the bird included (i) mining (including manual extraction of

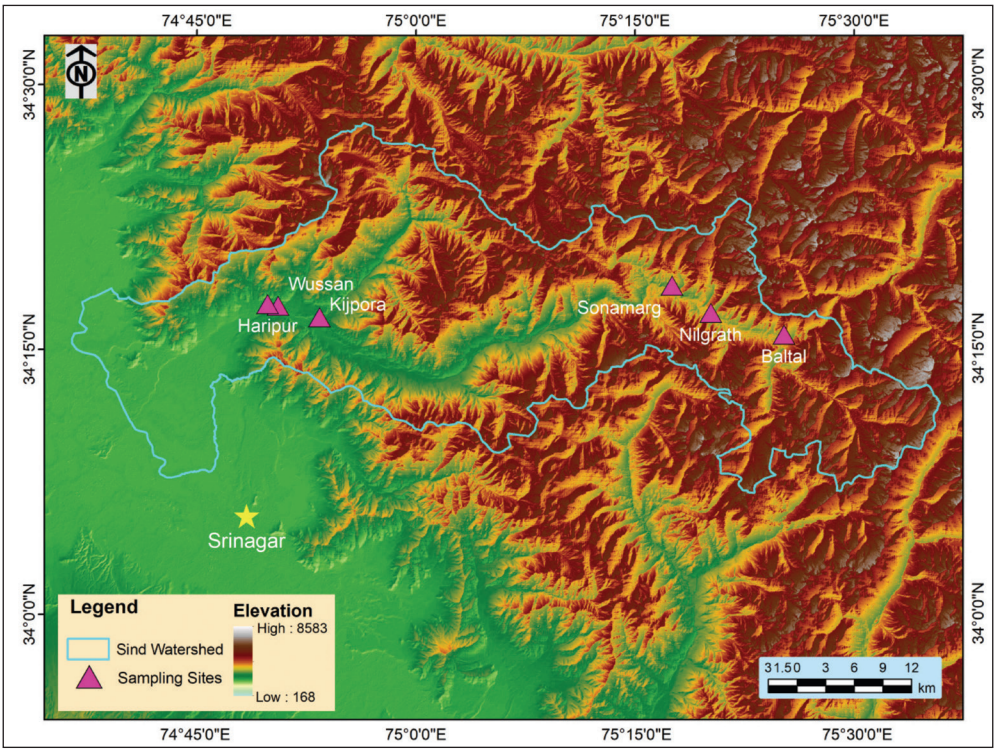

Figure 1. Map of the study area
1. ábra A vizsgálati terület térképe

sand, boulders and cobbles), (ii) human presence (movement of local inhabitants and tourists), (iii) grazing livestock (cattle and sheep), (iv) predation (presence of predators) and (v) vehicle movements near the stretches inhabited by Ibisbill (Haq *et al.* 2022). Conservation actions that need to be taken were compiled for implementation in order to propose areas for proper protection and to reduce the ongoing anthropogenic activities.

Results

Assessment of threat status

Calculations in the ConR package showed that the number of unique occurrences, sub-populations and locations for the Ibisbill turned out to be 27, 14 and 16, respectively. The calculated EOO and AOO were 35,927 km^2 and 100 km^2, respectively *(Figure 2)*. Based on

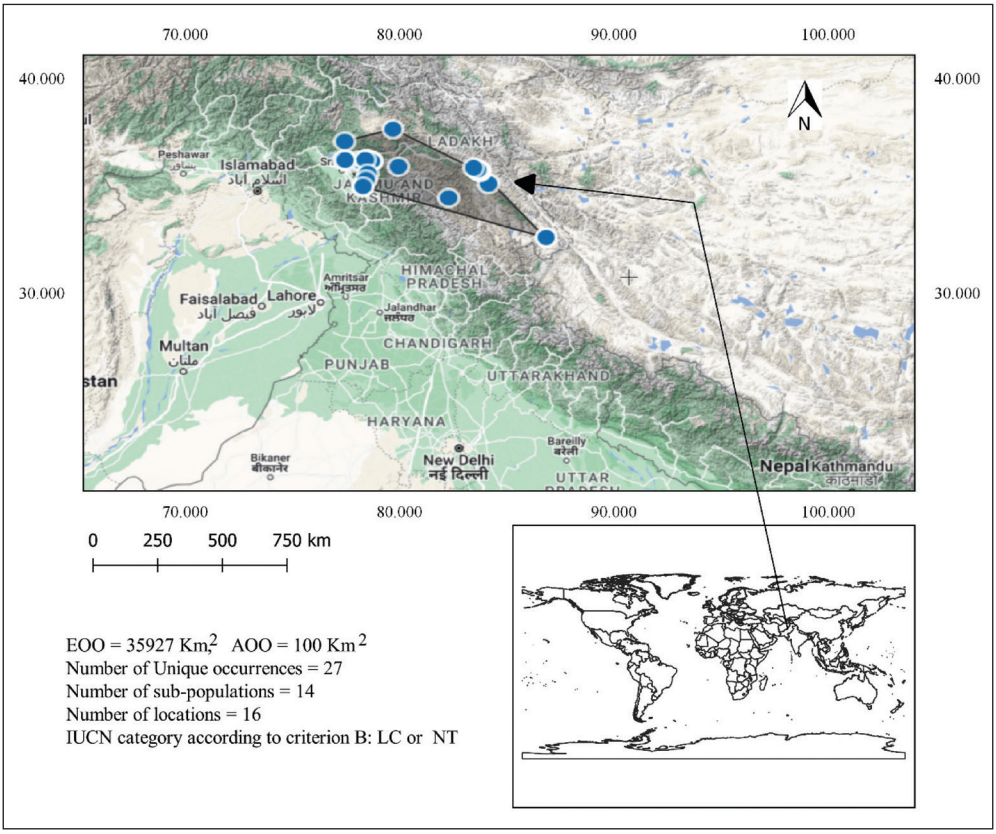

Figure 2. Occurrence sites of the Ibisbill in Kashmir and Ladakh Himalayan region are shown in blue dots. The convex hull used for calculating the EOO is shown as grey polygon

2. ábra A kardcsőrű töcs elfordulási helyei fekete pontokkal jelölve a Himalája Kasmír és Ladakh régiójában. A földrajzi elterjedés kiterjedésének (EOO) számítására használt konvex burok szürke poligonnal van jelölve

Table 2. EOO, AOO, occurrence sites, number of populations and locations, and threat status of Ibisbill in the Kashmir and Ladakh region of Indian Himalayas
2. táblázat A földrajzi elterjedés kiterjedése (EOO), az előfordulások összterülete (AOO), az egyedi előfordulások száma, a populációk és lokalitások száma, valamint a fenyegetettségi helyzet a kardcsőrű töcs esetén az indiai Himalája Kasmír és Ladakh régióiban

Taxa	EOO	AOO	No. of unique occurrences	No. of sub-populations	No. of locations	Category Criteria B
Ibisbill	35927 km^2	100 km^2	27	14	16	Endangered (by B2)

EOO: Extent of Occurrence, AOO: Area of Occupancy

the latter result, the Ibisbill qualifies as Endangered by criterion B2 (AOO < 500 km^2) in the study region *(Table 2)*. When the species is assessed globally (EOO = 7,440,000 km^2), the AOO value is likely to be much higher than the threshold of Endangered (500 km^2) or Vulnerable (2000 km^2), thus, the global status of the species is Least Concern (https://www.iucnredlist.org/species/22693672/93417952).

Threats identified

We recorded Ibisbill at six major sites along the 106-km-long River Sindh. These sites were discontinuous and more or less similar with respect to the presence of cobbles, boulders and having moderate flow of water. Ibisbill was not detected in the stretches with torrential flow and large stones. Human presence occurred most frequently (in five of six sites), followed by predation (four sites) and by mining and livestock grazing (three sites each) *(Table 3)*.

Table 3. Operative threats to Ibisbill in Sindh river of Kashmir Himalayan region
3. táblázat A kardcsőrű töcsöt fenyegető hatások a Sindh folyó mentén a himalájai Kasmír régióban

Taxa	Occurrence sites	Latitude	Longitude	Altitude (m) asl	Threats recorded
Ibisbill	Haripur	34.28729 N	75.82823 E	1695	Mining, Human presence, Livestock grazing
	Wussan	34.28127 N	74.85358 E	1723	Human presence, predation
	Kijpora	34.26884 N	74.88557 E	1757	Mining, Human presence, Livestock grazing, Predation, Vehicular movement
	Sonamarg	34.30405 N	75.29172 E	2678	Human presence, Vehicular movement
	Nilgrath	34.28923 N	75.3238 E	2718	Mining, Predation
	Baltal	34.25847 N	75.41225 E	2859	Human presence, Livestock grazing, Predation, Vehicular movement.

Discussion

Assessment of the threat status and identification of operative threats to a target species using standardised procedures plays a key role in formulating the appropriate conservation strategies and strengthens the planning of effective management (Collins-Kreiner *et al.*

2013). Factors to be considered when assessing impact of disturbance on bird species include frequency of the disturbance, whether rare or especially sensitive species are affected, and whether alternative habitats are available nearby (Hill *et al.* 1997).

The effect of anthropogenic activities on waders has been widely studied (Ruhlen *et al.* 2003, Lotze *et al.* 2011). However, no detailed or quantitative studies have been conducted on the ecology or the potential impacts of anthropogenic disturbances on Ibisbill from Indian Himalayan region. Disturbance has been observed to have direct impact on the behaviour of waterbirds including immediate response such as flushing, increased vigilance behaviour, calling and alteration in the ongoing acts like feeding, resting (Borgmann 2010). Besides other factors, tourism development may also influence the vulnerability of waders by predation (Clark & Nudds 1991). Ibisbill faces various anthropogenic threats emanating largely from mining, livestock grazing, human presence (fishing and tourism activities) and from other natural predators (Haq *et al.* 2022). While studying the response to a threat factor, the Ibisbill was found to take escape flights of more than 50 m during 35% (n=327) of the instances in Sindh river (Haq *et al.* 2022). An increase in the frequency of these defensive behaviours and in the associated physiological regulatory responses could potentially decrease nest attendance levels during the breeding season and result in an increased probability of breeding failure (Price 2008). The disturbances to Ibisbill in Sindh river were found to have a detrimental effect on the population size, as they were responsible for breeding failure and low recruitment rate of Ibisbill in the region (Haq *et al.* 2021b).

Extinction of a species is also forecasted by its small geographic range size (Harris & Pimm 2008), which is also relevant in the case of the highly specialized Ibisbill. Further, genetic, demographic and ecological events may strongly affect such species. Despite having a large geographic range in terms of EOO, the Ibisbill is known to inhabit specific habitats comprising of very small AOO. Thus, the current study contributes significantly to indices of global trends in threat status and identification of the areas for prioritisation of species for conservation.

Conclusions

The study assesses the threat status of the Ibisbill as Endangered based on IUCN criteria for threat assessment, in Kashmir and Ladakh region of Indian Himalaya. Furthermore, the threats faced by the bird was compiled and remedial measures and recommendations were formulated. Ibisbill, a habitat specialist bird, faces a threat from several ongoing anthropogenic activities in the river. If these continue unregulated, these activities may seriously affect the survival of the birds and the long-term persistence of the species.

Conservation recommendations

We have identified the areas which need immediate focus towards conserving Ibisbill and its habitat. The department of Wildlife protection, Jammu and Kashmir has to be informed and involved in protecting and releasing these sites from the disturbances. Since most of the area

inhabited by the Ibisbill is non-protected, there is a dire need to highlight the plight of the bird for safeguarding its potential habitat. Nesting areas of the Ibisbill need to be marked properly and appropriate care should be ensured during the breeding season for successful hatching and recruitment. Mining (sand and boulder extraction) needs to be checked properly at the sites inhabited by the bird. The camping sites should be managed properly at a distance away from the river. In many range countries, the disturbances such as hydropower development projects, pollution by communal waste from populated areas to Ibisbill habitats are increasing. Therefore, regional cooperation for conservation of Ibisbill among range countries need to be initiated which should start with (i) an assessment of the suitable habitats for the species throughout its distribution range, (ii) regular monitoring at target sites to estimate local and global population sizes and to quantitatively assess threat factors (human settlements, hydropower projects, mining sites, recreation/tourism centre) and (iii) culminate in a spatial prioritisation of where to allocate conservation effort (area protection, monitoring, restoration/ management efforts) for the long-term survival of the species.

Acknowledgements

Authors are thankful for the financial support provided by SERB Government of India under project number CRG/2021/006458. We would also like to thank Department of Wildlife Protection, Jammu and Kashmir for their cooperation. Our sincere thanks to two reviewers for their valuable suggestions.

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