

Records of avian deformities in Nepal

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Abstract Avian deformities have been recorded in a variety of bird species all over the world. However, they have not been studied in Nepal, although there are increasing sightings of these deformities. Injuries, genetic mutations, environmental factors, infections, radiation, and other factors can cause deformities. In our study, we collected data from numerous field trips, conversations with bird watchers and experts, and social media posts in Nepal. We reported 24 cases of avian deformities in 16 different bird species across 12 districts in Nepal, suggesting that certain abnormalities persist in a high proportion of previously unstudied birds. We discovered different types of color abnormalities (6 cases of leucism, 3 albinism, 4 partial leucism, 1 brown mutation, 1 melanism, and 3 unidentified color aberration), 5 cases of avian keratin disorder (AKD), and 1 case of both leucism and AKD. The majority of these cases affected corvids and other birds frequently living and nesting near human settlements, indicating that causative agents such as anthropogenic toxicants and environmental degradation could be important contributors. There is a scarcity of research on avian deformities and diseases in Nepal, thus more research on avian abnormalities, such as the pathophysiology of AKD and genetic studies, should be performed.

Keywords: avian deformity, avian keratin disorder (AKD), albinism, leucism, melanism, environmental degradation

Összefoglalás Számos madárfajnál észleltek már változatos fizikai (testi) elváltozásokat a világ különböző részein. Nepálban azonban még nem vizsgálták ezeket, bár egyre gyakoribbak a megfigyelések ott is. Ezeket az elváltozásokat sérülések, genetikai mutációk, környezeti tényezők, fertőzések, sugárzás és egyéb tényezők okozhatják. Tanulmányunkhoz számos terepbejárásból, madármegfigyelőkkel és szakértőkkel folytatott beszélgetésekből, valamint a közösségi médiában közzétett bejegyzésekből gyűjtöttünk adatokat. Nepál 12 körzetében 16 madárfajnál összesen 24 elváltozásról számoltunk be, ami arra utalhat, hogy bizonyos rendellenességek a Nepálban fellelhető madárfajok populációiban nagy arányban és tartósan jelen lehetnek. A rendellenességek érintették a színezetet (6 esetben leucizmust, 3 esetben albinizmust, 4 esetben részleges leucizmust, 1 esetben barna mutációt, 1 esetben melanizmust és 3 esetben nem azonosított színváltozást), 5 esetben madárkeratin-deformitást (MKD) és 1 esetben együttesen leucizmust és MKD-t. Ezek az esetek többségében varjúféléknél és egyéb olyan madárfajoknál fordultak elő, amelyek gyakran találhatóak meg települések közelében. Ez azt sugallja, hogy az antropogén tényezők, mint például a mérgező anyagok és a környezeti degradáció, fontos szerepet játszanak a rendellenességek feltűnésében. Nepálban kevés a madárdeformitásokkal és -betegségekkel kapcsolatos kutatás, ezért több olyan vizsgálatra lenne szükség, mint például az MKD patofiziológiája és a betegségek genetikai hátterének feltárása.

Kulcsszavak: albinizmus, környezeti degradáció, leucizmus, madárrendellenesség, madárkeratin-deformitást (MKD), melanizmus

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Introduction

Avian species have been observed with different malformations that manifest as deformities developed during their embryonic stage or after hatching (Pourlis 2011). Relatively, birds are affected by severe physical defects more than other vertebrates because of the physiological needs of powered flight. And, birds with physical abnormalities merely survive longer in wild (Reynolds 2021). Habitat conditions and health of bird are reflected in the malformations. These anomalies have increased understanding whether normal or abnormal growth in avian species and by extension, other animals and people. The utilization of abnormality data might be a viable bio-monitoring technique for determining changes in environmental circumstances significant enough to have an influence on biology (Pourlis 2011).

Deformities have been recorded in a wide range of birds which can be caused by injuries, genetic defects, environmental factors, diseases, radiation, and unknown reasons (Rutz *et al.* 2004, Pourlis 2011, Zylberberg *et al.* 2018). Early lethal conditions, beak deformities, feather abnormalities, skeletal abnormalities, ocular malformations, and sublingual oral fistulas are primary malformations observed in avian species (Pourlis 2011, Reynolds

Table 1. List of bird species recorded with deformity in Nepal

1. táblázat A Nepálban található azon madárfajok, amelyeknél rendellenes egyed észlése történt

S.N.	Common Name	Scientific Name	IUCN Redlist	National Redlist	Migratory Status	Individuals Recorded
1	House Crow	<i>Corvus splendens</i>	LC	LC	R	5
2	House Sparrow	<i>Passer domesticus</i>	LC	LC	R	3
3	Eurasian Coot	<i>Fulica atra</i>	LC	LC	WM	1
4	Eurasian Cuckoo	<i>Cuculus canorus</i>	LC	LC	SM	1
5	Steppe Eagle	<i>Aquila nipalensis</i>	EN	VU	WM	1
6	Fulvous-breasted Woodpecker	<i>Dendrocopos macei</i>	LC	LC	R	1
7	Siberian Stonechat	<i>Saxicola torquatus</i>	LC	LC	R	1
8	Jungle Babbler	<i>Turdoides striata</i>	LC	LC	R	1
9	Red-vented Bulbul	<i>Pycnonotus cafer</i>	LC	LC	R	1
10	Barn Swallow	<i>Hirundo rustica</i>	LC	LC	R	2
11	Large-billed Crow	<i>Corvus macrorhynchos</i>	LC	LC	R	1
12	Rufous Treepie	<i>Dendrocitta vagabunda</i>	LC	LC	R	1
13	Great Barbet	<i>Megalaima virens</i>	LC	LC	R	1
14	Common Myna	<i>Acridotheres tristis</i>	LC	LC	R	2
15	Rufous-bellied Niltava	<i>Niltava sundara</i>	LC	LC	R	1
16	Indian Pond Heron	<i>Ardeola grayii</i>	LC	LC	R	1

Abbreviations: LC= Least Concern; EN= Endangered; VU= Vulnerable; R= Resident; SM= Summer Migrant; WM= Winter Migrant

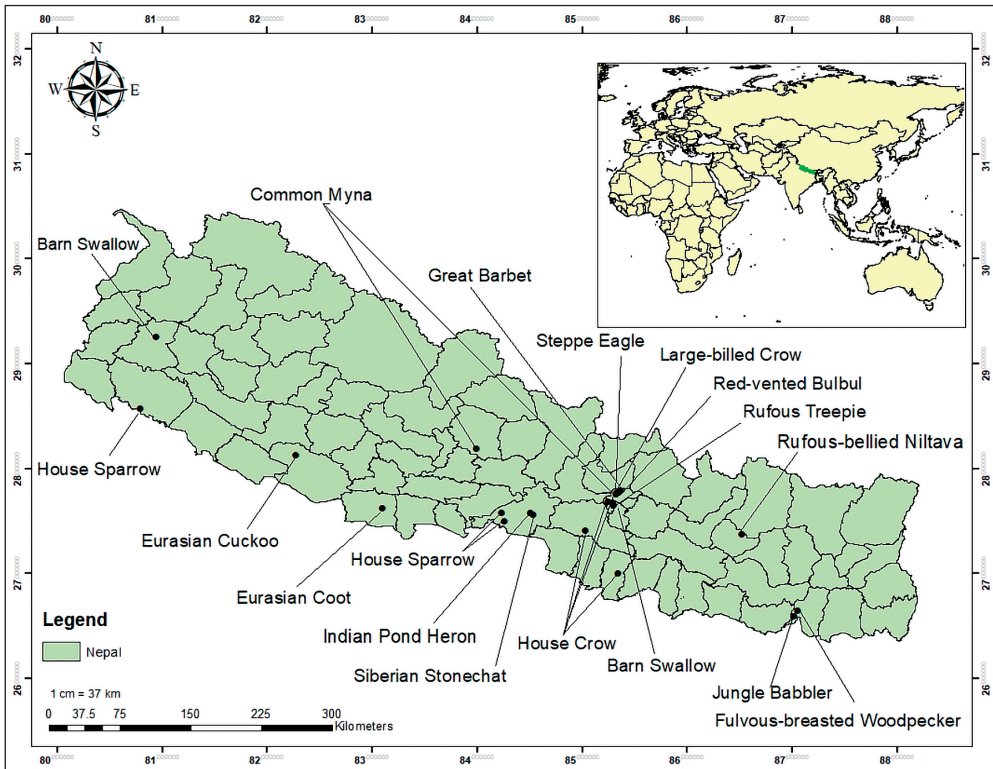


Figure 1. Avian deformities recorded from Nepal
 1. ábra Nepálban észlelt rendellenességek madaraknál

2021). While there are varied avian deformities documented across the world, the proper documentation of birds with deformities in Nepal is merely obtained. Birds with deformities have been sighted opportunistically in varied locations and in varied species in Nepal. This study presents records of avian deformities in Nepal and is the first attempt to unveil avian deformity data for Nepal.

Material and Methods

The opportunistic sightings records of avian deformities were gathered (Zylberberg *et al.* 2021) in Nepal. Avian deformities in this study were focused on beak deformities and feather color abnormalities since these can be identifiable with high certainty by visual observations and photographic records. The sighting records were gathered during various field visits, communication with bird watchers and researchers, and collected from social media posts. The species name, taxonomy, and conservation status were determined using Inskipp *et al.* (2016) and the IUCN Red List of Threatened Species (2023).

Results

Altogether, 24 cases of avian deformities in 16 species have been recorded in our study. The cases of deformities were found to be the highest in *Corvus splendens* (n=5), followed by *Passer domesticus* (n=3), then both *Hirundo rustica* and *Acridotheres tristis* (n=2) (Table 1). The highest number of recorded deformity was leucism (n=6), whilst the least were melanism and brown mutation (n=1).

The majority of the records (n=13) were noted in resident birds, while two deformity records were in winter migrants including the globally endangered Steppe Eagle (*Aquila nipalensis*), and one deformity record was in summer migrants. Partial leucistic Steppe Eagle was also recorded.

Altogether the deformities were recorded from 12 districts of Nepal (see Table 2 for detail). The majority of records were obtained from the Kathmandu Valley, which may be due to a greater number of bird watchers and researcher resident to the area (Figure 1).

1. *Corvus splendens* House Crow

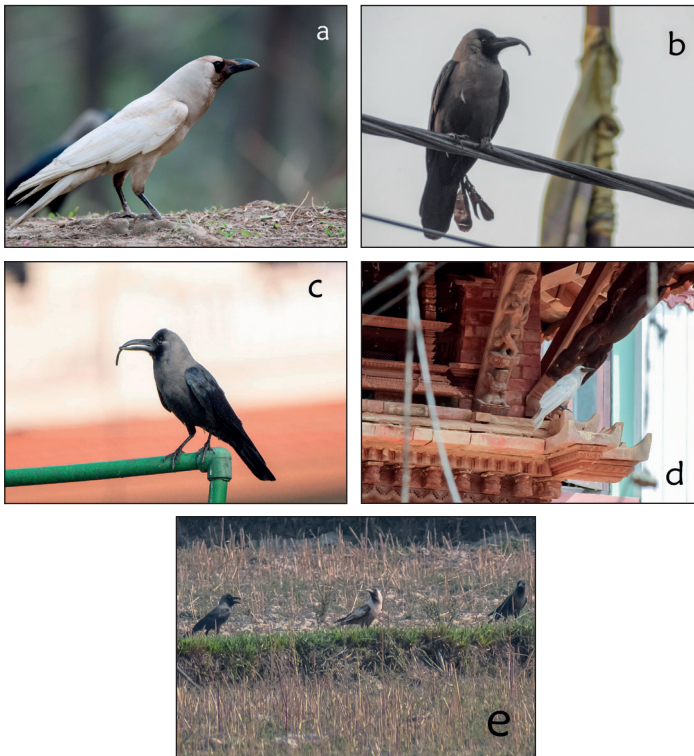


Figure 2. Avian deformities recorded in *Corvus splendens*. **a.** Leucism ©Aditya Pal **b.** Avian Keratin Disorder (AKD) ©Nikeet Pradhan **c.** AKD ©Sudeep K.C. **d.** Leucism ©Mohan Bikram Shrestha **e.** Mutation Brown ©Nikeet Pradhan

2. *ábra* *Corvus splendens* elváltozásai. **a.** Leucizmus ©Aditya Pal **b.** Madárkeratin-deformitás (MKD) (AKD) ©Nikeet Pradhan **c.** AKD ©Sudeep K.C. **d.** Leucizmus ©Mohan Bikram Shrestha **e.** Bar-na mutáció ©Nikeet Pradhan

2. *Passer domesticus* House Sparrow

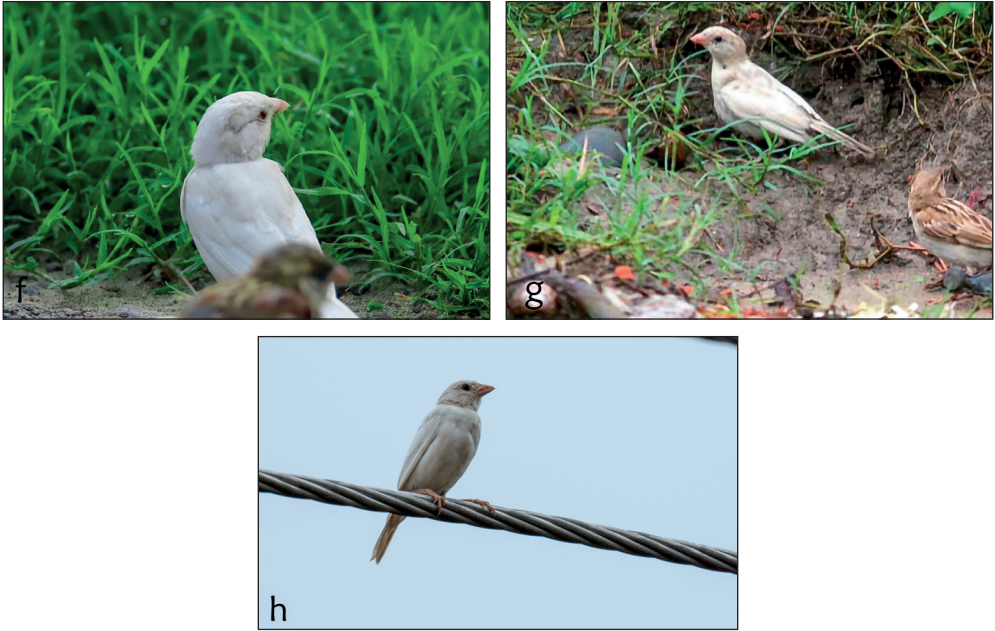


Figure 3. Avian deformities recorded in *Passer domesticus*. **f.** Albinism ©Kul Raj Chaudhary **g.** Unidentified color aberration (albinism or leucism) ©Manesh Limbu and Asbin Gurung **h.** Leucism ©Ram Krishna Mahato

3. ábra *Passer domesticus* elváltozásai. **f.** Albinizmus ©Kul Raj Chaudhary **g.** Nem meghatározható elváltozás (albinizmus vagy leucizmus) ©Manesh Limbu and Asbin Gurung **h.** Leucizmus ©Ram Krishna Mahato

3. *Hirundo rustica* Barn Swallow



Figure 4. Avian deformities recorded in *Hirundo rustica*. **i.** Unidentified color aberrations (albinism or leucism) ©Arend Van Riessen **j.** Unidentified color aberrations (albinism or leucism) ©Surat Pariyar

4. ábra *Hirundo rustica* elváltozásai. **i.** Nem meghatározható elváltozás (albinizmus vagy leucizmus) ©Arend Van Riessen **j.** Nem meghatározható elváltozás (albinizmus vagy leucizmus) ©Surat Pariyar

4. *Acridotheres tristis* Common Myna



Figure 5. Avian deformities recorded in *Acridotheres tristis*. **k.** AKD ©Mohan Bikram Shrestha **l.** Partial Leucism ©Sundar Oli

5. ábra *Acridotheres tristis* elváltozásai. **k.** MKD ©Mohan Bikram Shrestha **l.** Részleges leucizmus ©Sundar Oli

5. *Fulica atra* Eurasian Coot



Figure 6. Albinism recorded in *Fulica atra*
©Anil Chaudhary

6. ábra *Fulica atra* albinizmusa
©Anil Chaudhary

6. *Cuculus canorus* Eurasian Cuckoo



Figure 7. Leucism and AKD recorded in *Cuculus canorus* ©Suman Ghimire

7. ábra *Cuculus canorus* leucizmusa és MKD-ja
©Suman Ghimiref

7. *Aquila nipalensis* Steppe Eagle



Figure 8. Partial leucism recorded in *Aquila nipalensis* ©Ashish Shrestha

8. ábra *Aquila nipalensis* részleges leucizmusa ©Ashish Shrestha

**8. *Dendrocopos macei*
Fulvous-breasted Woodpecker**



Figure 9. Leucism recorded in *Dendrocopos macei* ©Nikeet Pradhan

9. ábra *Dendrocopos macei* leucizmusa ©Nikeet Pradhan

9. *Saxicola torquatus* Siberian Stonechat



Figure 10. Leucism recorded in *Saxicola torquatus* ©Ram Krishna Mahato

10. ábra *Saxicola torquatus* leucizmusa ©Ram Krishna Mahato

10. *Turdoides striata* Jungle Babbler



Figure 11. Leucism recorded in *Turdoides striata* ©Deven Kharel

11. ábra *Turdoides striata* leucizmusa ©Deven Kharel

11. *Pycnonotus cafer* Red-vented Bulbul



Figure 12. AKD recorded in *Pycnonotus cafer*
©Mohan Bikram Shrestha

12. ábra *Pycnonotus cafer* MKD-ja ©Mohan
Bikram Shrestha

**12. *Corvus macrorhynchos*
Large-billed Crow**



Figure 13. Albinism recorded in *Corvus macro-*
rhynchos ©Mohan Bikram Shrestha

13. ábra *Corvus macrorhynchos* albinizmusa
©Mohan Bikram Shrestha

**13. *Dendrocitta vagabunda*
Rufous Treepie**

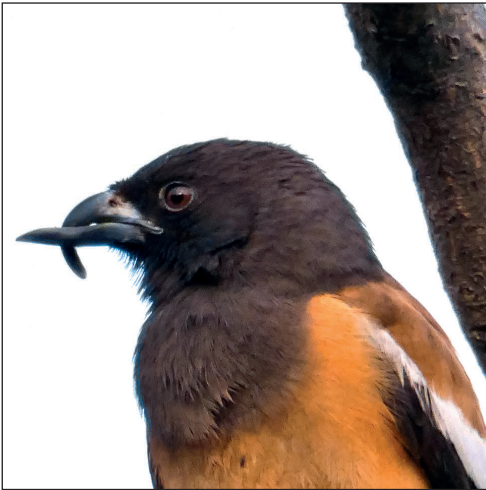


Figure 14. AKD recorded in *Dendrocitta vagabun-*
da ©Arend Van Riessen

14. ábra *Dendrocitta vagabunda* MKD-ja ©Arend
Van Riessen

14. *Megalaima virens* Great Barbet



Figure 15. Partial leucism recorded in *Megalaima*
virens ©Bikash Singh Lama

15. ábra *Megalaima virens* részleges leucizmusa
©Bikash Singh Lama

15. *Ardeola grayii* Indian Pond Heron

Figure 16. Melanism recorded in *Ardeola grayii*
©Sugam Tamrakar

16. ábra *Ardeola grayii* melanizmusa ©Sugam Tamrakar

**16. *Niltava sundara*
Rufous-bellied Niltava**

Figure 17. Partial leucism recorded in *Niltava Sundara*
©Mohan Bikram Shrestha

17. ábra *Niltava Sundara* részleges leucizmusa
©Mohan Bikram Shrestha

Discussion

Abnormal bill morphology in wild birds is extremely unusual, with a 0.5% incidence rate, and a broad epizootic of beak malformations compatible with AKD has been recorded in dozens of avian species throughout the world (Pomeroy 1962, Harrison 2011, Handel & Hemert 2015, Zylberberg *et al.* 2016). Beak deformities such as crossed mandibles, upper mandibles decurved, lower mandible upcurved, upper mandible upcurved and/or lower mandible decurved, elongation, lateral curvature, and locked bills have all been documented in various avian species over the world (Poullis 2011). Wild bird species with malformed beaks are becoming more frequent, and the occurrence of these severe deformities in populations is routinely utilized to diagnose underlying environmental health concerns (Hemert & Handel 2010). In our study, 6 cases of AKD with upper mandible decurved and crossed mandible were recorded in Nepal, and all the records were found in urban areas with anthropogenic disturbances, suggesting that the major cause could be environmental degradation by humans (Leveau 2021).

Aberrations of feather color or morphology can impact only a single feather or even the entire body, altering the overall appearance of the bearer. These occurrences are more frequently documented as compared to the common opinion, birds with color anomalies do not always die to natural predators and may often live for a long period (Poullis 2011, van Grouw 2012). Melanins (eumelanin and pheomelanin) are one of the primary pigments that contribute to plumage color production (Calhim *et al.* 2014, Laczi *et al.* 2019a), hence play important roles, for example, in communication (Bókony *et al.* 2003), camouflage

Table 2. Types of deformity observed in the bird species recorded
2. táblázat A madárfajoknál megfigyelt deformitás típusai

S.N.	Common Name	Scientific Name	Deformity Observed	Recorded Location	Recorded Date
1 (a)	House Crow	<i>Corvus splendens</i>	Leucism	Kirtipur, Kathmandu (27°40'45.03"N 85°17'18.67"E)	26 April 2018
1 (b)	House Crow	<i>Corvus splendens</i>	AKD	Hetauda, Makawanpur (27°25'0.30"N 85°1'58.32"E)	6 May 2023
1 (c)	House Crow	<i>Corvus splendens</i>	AKD	Chandragiri, Kathmandu (27°41'11.16"N 85°14'29.28"E)	6 May 2023
1 (d)	House Crow	<i>Corvus splendens</i>	Leucism	Tokha, Kathmandu (27°46'9.35"N 85°19'43.73"E)	31 August 2019
1 (e)	House Crow	<i>Corvus splendens</i>	Brown Mutation	Ramoli Bairita, Rautahat (27°0'27.65"N 85°20'39.08"E)	10 May 2023
2 (f)	House Sparrow	<i>Passer domesticus</i>	Albinism	Hulaki, Kailali (28°34'18.0"N, 80°47'12.0"E)	30 June 2022
2 (g)	House Sparrow	<i>Passer domesticus</i>	Unidentified color aberration	Meghauli, Chitwan (27°34'44"N, 84°13'42"E)	28 June 2020
2 (h)	House Sparrow	<i>Passer domesticus</i>	Leucism	Madi, Chitwan (27°30'13.92"N, 84°15'36.56"E)	25 September 2019
3 (i)	Barn Swallow	<i>Hirundo rustica</i>	Unidentified color aberration	Batsala Devi Mandir, Lalitpur (27°30'13.92"N, 84°15'36.56"E)	21 August 2021
3 (j)	Barn Swallow	<i>Hirundo rustica</i>	Unidentified color aberration	Dipayal silgadhi, Doti (29°15'31.88"N, 80°56'32.43"E)	14 April 2023
4 (k)	Common Myna	<i>Acridotheres tristis</i>	AKD	Tokha, Kathmandu (27°45'17.99"N, 85°19'38.00"E)	8 June 2020
4 (l)	Common Myna	<i>Acridotheres tristis</i>	Partial Leucism	Pokhara, Kaski (28°11'26.64"N, 83°59'23.34"E)	26 May 2023
5	Eurasian Coot	<i>Fulica atra</i>	Albinism	Jagdishpur reservoir, Kapilvastu (27°37'27"N, 83°05'39"E)	11 January 2019

S.N.	Common Name	Scientific Name	Deformity Observed	Recorded Location	Recorded Date
6	Eurasian Cuckoo	<i>Cuculus canorus</i>	Leucism and AKD	Ghorahi, Dang (28°07'54"N, 82°16'18"E)	1 February 2017
7	Steppe Eagle	<i>Aquila nipalensis</i>	Partial Leucism	Chobhar, Kathmandu (27°39'42.46"N, 85°17'42.21"E)	25 February 2017
8	Fulvous-breasted Woodpecker	<i>Dendrocopos macei</i>	Leucism	Koshi Tappu Wildlife Reserve, Sunsari (26°38'50.70"N, 87°2'55.98"E)	14 December 2022
9	Siberian Stonechat	<i>Saxicola torquatus</i>	Leucism	Kumroj Community Forest, Chitwan (27°33'37.39"N, 84°31'51.40"E)	3 February 2020
10	Jungle Babbler	<i>Turdoides striata</i>	Leucism	Koshi Tappu Wildlife Reserve, Sunsari (26°36'4.13"N, 87°0'50.24"E)	7 April 2022
11	Red-vented Bulbul	<i>Pycnonotus cafer</i>	AKD	Tokha, Kathmandu (27°46'5.99"N, 85°19'30.32"E)	31 July 2021
12	Large-billed Crow	<i>Corvus macrorhynchos</i>	Albinism	Tokha, Kathmandu (27°46'35.93"N, 85°20'21.31"E)	23 October 2022
13	Rufous Treepie	<i>Dendrocitta vagabunda</i>	AKD	Batsala Devi Temple, Lalitpur (27°39'14.14"N, 85°17'45.27"E)	5 April 2018
14	Great Barbet	<i>Megalaima virens</i>	Partial Leucism	Muhan pokhari, Kathmandu (27°47'30.06"N, 85°22'15.17"E)	19 January 2021
15	Indian Pond Heron	<i>Ardeola grayii</i>	Melanism	Bachhauli, Chitwan (27°34'40.60"N, 84°30'26.42"E)	8 December 2020
16	Rufous-bellied Niltava	<i>Niltava sundara</i>	Partial Leucism	Thade, Okhaldhunga (27°22'35.56"N, 86°31'15.30"E)	6 June 2022

(Surmacki *et al.* 2021) or thermoregulation (Margalida *et al.* 2008). There are common types of color aberrations found in birds which are: albinism (a total lack of both melanins or other pigments in all feathers, eyes, and skin; e.g. Mahabal *et al.* 2016, Laczi *et al.* 2019b), leucism (a total lack of pigments from parts of the plumage or the entire plumage, e.g. Gayen *et al.* 2022, Alby *et al.* 2023), brown (reduction only of eumelanin content, e.g. van Grouw *et al.* 2011), dilution (reduction of melanin content, e.g. Morrow & Morrow 2014), ino (strong qualitative reduction of both melanins with color change, Bende *et al.* 2019), and melanism (abnormal deposit of melanin in skin and/or feathers, e.g. Uy *et al.* 2016). Leucism was the most recorded color anomaly in our study compromising 26% (n=6) and melanism was the least recorded at 4% (n=1) out of the total 24 cases. Albinism was recorded at 13% (n=3). Albinos are less well-documented because their lack of melanin in the eyes could cause them to be extremely sensitive to light and have a restricted depth of vision and are prone to cancer due to a lack of UV-protecting melanin, which explains their seeming scarcity in the environment (Miller 2005, van Grouw *et al.* 2016). Many of the defects in wild avifauna that are easily recognized phenotypically have been primarily reported as being easily detectable, whereas many other genotypic malformations which are less detectable are not recorded in our study.

Species with bigger populations (e.g. *Passer domesticus*) may have more individuals with unique phenotypes owing to a higher likelihood of mutations, as well as a higher chance of encountering specimens of the species (Gross 1965, Sage 1963). Detecting such abnormalities in rarer species may be more fascinating evidence of environmental degradation, genetic degeneration owing to inbreeding, and so on.

The specimens g, i, and j have been observed with unidentified color aberration. However, it cannot be ascertained whether it is albinism or leucism as it is not clearly visible whether the eye is red or brown, however, red eyes would be served as a distinctive trait of albinism vs. total leucism. So, a further diagnostic is lacking to ascertain the deformity.

The majority of cases were corvids and other birds that often dwell and nest near human settlements and are thus more likely to be identified in the early days following fledging (van Grouw *et al.* 2016). The majority of avian defect cases were observed in Nepal's settlement region, implying that causative agents such as anthropogenic toxicants and environmental degradation are key factors.

Documented avian deformities record in a few instances in Nepal. These records are the baseline highlighting for the subject of further studies in Nepal.

Conclusion

In Nepal, there are very few records of these avian deformities. There is still little information on the prevalence, incidence, or causes of congenital abnormalities in Nepal's wild birds. As a result, more research on avian anomalies has to be done in Nepal. Lack of knowledge of the underlying physiological changes that result from the primary factors that produce beak deformities and feather color highlights the need for more research into the pathophysiology of avian keratin disease as well as genetic studies in Nepal.

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