



An Updated Checklist of Bird Species in the Arjin Mountain Nature Reserve, China: Conservation Implications

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ABSTRACT

An updated checklist of bird species that occur in the Arjin Mountain Nature Reserve and its adjacent areas, including parts of Kunlun Mountain, Qimantagh and Kumkul Basin, is provided as part of the basic data for a second nation-wide field survey of wildlife resources of China (2010-2020). The information provided is based on field observations made from 2010 to 2017. A total of 172 bird species belonging to 95 genera of 42 families of 19 orders were identified as occurring in the reserve, accounting for 37.9% of the total bird species in Xinjiang Uyghur Autonomous Region. Among them, 85 species are migrants, 49 species resident, 33 species summer visitors and 5 species winter visitors. Six species of birds viz., Red-rumped Swallow (*Cecropis daurica*), Eastren Crowned Warbler (*Phylloscopus coronatus*), Blue-cheeked Bee-eater (*Merops persicus*), Robin Accentor (*Prunella rubeculoides*), Tibetan Rosefinch (*Carpodacus roborowskii*) and Japanese Sparrowhawk (*Accipiter gularis*) are being reported for the first time from Xinjiang. Among them, Blue-cheeked Bee-eater is reported from China for the first time.

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Authors' Contribution

MAT executed the project. RM supervised of the project. LW was responsible for the correct taxonomy of species. DJ monitored bird species. XG did field observation and data analysis

Key words

Bird species, Diversity, Arjin Mountain, Nature Reserve, Conservation

INTRODUCTION

The Arjin Mountain Nature Reserve (Fig. 1), part of one of the last great expanses of wilderness left on Earth, is located in Qarkilik County, Xinjiang Uyghur Autonomous Region, in western China (E87°10'~91°18', N36°00'~37°49') (Mardan *et al.*, 2013). It was established in 1983 in order to protect its mountain ecosystem and was later upgraded to a National Nature Reserve in 1986 (Ablimit, 2004). Bordering the Qinghai-Tibetan Plateau to the north and covering an area of 45,000 km², it is the second largest Nature Reserve in China after the Chang Tang Nature Reserve in Tibet, with which it is contiguous along its southern boundary (Ablimit, 2004; Ma *et al.*, 2005). The altitude ranges from 3876 m at Ayak Kum to over 6973 m at Mount Muztagh (Chen, 1985). The entire area remains under snow cover from November to March. Broad, rolling alpine steppes broken by hills, glacier-capped mountains and large basins studded with wetlands and salt lakes are the visible forms of landscape in the region. The climate is characterized by dry, cold winters, strong winds, high levels of solar radiation, a wide range

of temperature between day and night, a short frost-free period, low precipitation and high evaporation. Annual precipitation varies from 200 ± 300 mm while the annual evapotranspiration is about seven times greater. Precipitation is mainly concentrated in July and August. Annual temperature ranges from -31 °C in January to 28 °C in July; the recorded lowest temperature is -41°C (Mardan *et al.*, 2013).

The remote and largely uninhabited reserve, characterized by high elevations, low annual precipitation, low nutrient levels and extremely cold weather in the winter, provides protection for a unique assemblage of wildlife (Schaller, 1998). The bird community inhabiting the reserve is unusual and diverse due to their geographic position as a part of the Tibetan Plateau and being situated at the junction of high mountains in the south and the Taklimakan Basin in the north. These varied habitats in terms of altitudinal and precipitation ranges and other environmental and topographic features, create an ideal setting for the high diversity of avifauna.

Bird species are an important indicator in biodiversity monitoring, and countries in Europe and North America have already been carrying out systematic surveys and monitoring of wild birds for more than 100 years, and bird diversity indices have become an official biodiversity monitoring tool in some of these countries (Cu *et al.*,

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2013). However, China's Xinjiang province has not yet developed any formalized wild bird monitoring program, except for a few regional monitoring projects set up in the past decades. As for the research area, a broad view of the terrestrial vertebrates of the reserve has been given by previous researchers; however, few formal and specific scientific studies on bird species of the reserve are available (Qian *et al.*, 1965; Zheng, 1976; Zhou and Cheng, 1985; Butler and Achuff, 1986; Gao, 1987; Achuff and Petocz, 1988; Huang and Gao, 1989; Feng, 1991; Ma *et al.*, 2010). Furthermore, the main emphasis has been given to the eastern part of the reserve, which is relatively accessible, and it was roughly estimated that the reserve harbors 90 bird species belonging to 14 orders and 27 families (Gao, 1987). Because the current status and trends of bird species in the reserve are inadequately recorded or researched, it is difficult to come up with one set of data that may apply to all the bird species and their range, and, it must be stressed, that these figures come from several surveys conducted using different methods over a period of more than 20 years with the main focus on rare and endangered species, which are not representative of the overall status of wild birds, and have paid less attention to common wild birds. This situation called for a comprehensive survey of bird species of the reserve to better understand the species composition and their habitat associations so that a comprehensive management plan could be prepared for the conservation of this vital component of China's bird species biodiversity. For this reason, study on their current status is urgently required. The purpose of this article is to evaluate the current status of bird species in the Arjin Mountain Nature Reserve, as well as to document the major threats to their conservation.

MATERIALS AND METHODS

Fifteen field surveys were conducted, spanning a period of seven years, during spring and autumn respectively (2010-2017), at various localities that include selected representative habitats of Arjin Mountain Nature Reserve and its surrounding areas (Table I). The study area was divided into seven sites (Fig. 1) viz., 1. Atkhan (asbestos mines/settlements), 2. Kara Qokka (grazing areas/denser settlement), 3. Kara Dong (desert/sparse vegetation/iron mines/scattered settlement), 4. Ixak Patti (wetland/scattered settlement), 5. Ayak Kum (desert steppe/sand hills/lake/no settlement), 6. Aqqik Kul (higher altitude above 4000m, alpine meadows/scattered settlement) and 7. Whale Lake (higher altitude above 5000 m, altitude/ridges/alpine meadows/no settlement), which permitted complete coverage of the reserve. Each site represents a pre-existing administrative unit used as a

protection station.

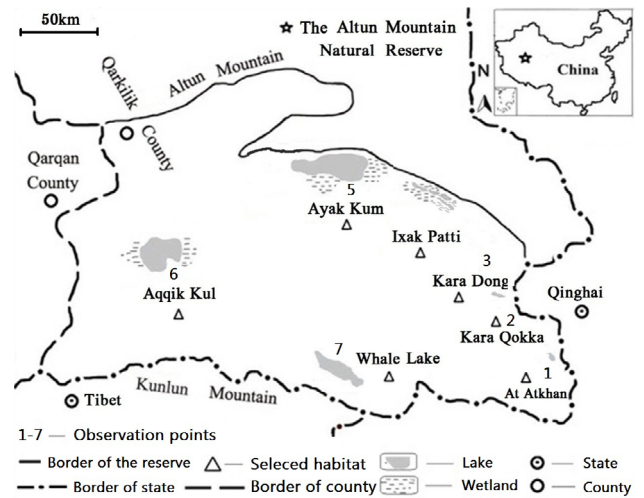


Fig. 1. The study sites of birds in the Altun Mountain Natural Reserve.

Seven observation points were chosen based on the representative habitats (Atkhan→Kara Qokka→Kara Dong→Ixak Patti→Ayak Kum→Aqqik Kul→Whale Lake). Point surveys were undertaken employing visual observation method (Mardan *et al.*, 2013) at each location by a pair of observers between 07:00 and 11:30 hour when the birds were most active. Birds were counted at each observation point of each location (Fig. 1), and recounted on a second visit on different days. This census period was seen as appropriate, because during the practice surveys, bird activity tended to be high during the whole morning. Birds were recorded at each census station for a period of 10 minutes. The distance from the recorder to each bird encountered by sight or by sound was estimated. The number of individuals in each encounter was recorded, if ascertainable. When approaching a census site, if any birds were disturbed (flushed) from the plot, these were recorded as being present during the census period. The census period commenced immediately on arrival at the sites. To avoid repeat counts of the same individuals, disturbing the birds was avoided as far as possible, and the direction of the movements of birds was carefully observed. Data recorded included date, time, GPS location, groups and population size, vegetation type, water sources, grassland fences, mining sites, roads and domestic sheep as well as signs of birds such as foot prints, feather, nests, feces, eggs etc.

Secondly, interviews with local wardens and pastoralists, and officials of the administrative bureau of the reserve, were administered to get information on the long-term population dynamics of avifauna of the reserve.

The severities the potential threats to the avifauna at different sites were estimated based on literature reviews, preliminary interviews and field assessment (Mardan *et al.*, 2011).

RESULTS AND DISCUSSION

Bird species were distributed in all the survey sites in the Arjin Mountain Nature Reserve.

Population status

A total of 172 bird species belonging to 95 genera of 42 families of 19 orders were identified as occurring in the reserve and its surrounding areas, accounting for 37.9% of the total bird species reported in Xinjiang Uyghur Autonomous Region (Xinjiang).

Six species of birds viz., Japanese sparrowhawk (*Accipiter gularis*), Eastern crowned warbler (*Phylloscopus coronatus*), blue-cheeked bee-eater (*Merops persicus*), robin accentor (*Prunella rubeculoides*) and tibetan rosefinch (*Carpodacus roborowskii*) are being reported for the first time from Xinjiang. Among them, blue-cheeked bee-eater is reported for the first time in China. In comparison to previous reports, more than 80 species belonging to 11 families of three orders are newly added in our updated checklist, while seven species, ring-necked (common) pheasant (*Phasianus colchicus*), white-backed woodpecker (*Dendrocopos leucotos*), Xinjiang ground-jay (*Podoces biddulphi*), white-browed bush-dweller (*Rhopophilus pekinensis*), saxaul sparrow (*Passer ammodendri*), desert finch (*Rhodospiza obsoleta*) and tawny-headed mountain finch (*Leucosticte sillemi*) are removed from the checklist based on the fact that their known range does not overlap with the territory of the reserve (Gao, 1987).

The abundance of avifauna of the reserve was deduced from the relative proportions of the number of individuals of the species, which were recorded in each encounter at all 15x7 sampling events (Table II). However, not all points were sampled at all time periods (Table I). In addition, the sampling and statistical methods employed were not robust, suggesting that our result on the abundance of avifauna of the reserve may not quite accurate. Further research with more robust sampling method including randomly located sample points was recommended to generate a more scientifically conducted population estimate.

The Passeriformes, which comprised 80 of the species accounted for 46.5% of the total bird species richness in the reserve. The Charadriiformes had the second highest species richness with 22 species (12.8%), followed by Falconiformes with 19 species (11%), Anseriformes

with 17 species (9.9%), and the remaining 34 species (19.8%) are represented by other 15 orders.

The birds living in residential areas have a tendency of declining in recent years, implying that threats such as urbanization, over-grazing and illegal access into the reserve has not been effectively under control.

Distribution pattern

The study area falls between Tibetan and Xinjiang bio-regions. Consequently, the distribution pattern of its avifauna is characterized by inter-permeation between Tibetan Pattern (27 species, 15.7%) and Central Asian pattern (49 species, 28.5%). About 71 (41.3%) species belong to the Northern pattern, including 52 species of Palaearctic (Ancient Northern) pattern, 17 species of Holarctic pattern and 2 species of Northeastern pattern. Most of the Northern pattern species are migrants, which account for the highest species richness and highest bird abundance of the reserve. Forty nine (28.5%) species belong to the Central-Asian pattern. Twenty seven (15.7%) species belong to the plateau (Highland) pattern, including the endemic species of the Tibetan Plateau such as black-necked crane (*Grus nigricollis*), Tibetan snowcock (*Tetraogallus tibetanus*), bar-headed goose (*Anser indicus*), brown-headed gull (*Larus brunnicephalus*), and *Montifringilla* species, and in spite of their relatively lower species richness, the highland birds account for considerably higher bird abundance, being the dominant avifauna throughout the reserve. Twenty three species (13.4%) belong to the Circumboreal pattern. Long-tailed shrike (*Lanius schach*), which is widely distributed in China, was recorded as the single species belonging to Oriental pattern.

Residence types and conservation status

Among the 172 species recorded, 85 species are migrants (49.4%), 49 species residents (28.4 %), 33 species summer visitors (19.2%) and 5 species winter visitors (2.9%). According to their residence types; the number of migrants is the largest, followed by residents and summer visitors, while the number of winter migrant birds is the least. There is a variety of rare and endangered bird species inhabiting the reserve. Among them, 6 and 23 species were listed respectively as category I and II Key National Protected Species under the Chinese Wild Animal Protection Law (Jiang, 2020). Two, 6, 7 and 2 species are listed as globally Endangered, Vulnerable, Near Threatened and Data Deficient respectively on the IUCN Red list (<https://www.iucnredlist.org/>).

Table I. Dates of surveys of birds in Arjin Mountain Nature Reserve on the basis of their preferred habitats (2010-2017).

Year	Date of survey	At Atkhan	Kara Qokka	Kara Dong	Ixak Patti	Ayak Kum	Aqqik Kul	Whale Lake
Spr. 2010	May8-25	+	+	+	+	+	+	-
Aut.2010	Sept 13-Sept29	+	+	+	+	+	+	+
Spr. 2011	May24-June 13	+	+	+	+	+	+	+
Aut.2011	Aug28-Sept14	+	+	+	+	+	+	+
Spr. 2012	May11-28	+	+	+	+	+	+	-
Aut.2012	Oct6-23	+	+	+	+	+	+	-
Aut.2013	Sept 06-22	+	+	+	+	+	+	+
Spr. 2014	May16-June 6	+	+	+	+	+	+	-
Aut.2014	Oct11-28	+	+	+	+	+	+	-
Spr. 2015	May 05-23	+	+	+	+	+	-	-
Aut.2015	Sept 01-21	+	+	+	+	+	+	+
Spr. 2016	May15-June 2	+	+	+	+	+	+	-
Aut.2016	Sept 1-Sept 20	+	+	+	+	+	+	+
Spr. 2017	June 2-20	+	+	+	+	+	+	+

+, Surveyed; -, Not surveyed; mainly for the extreme weather conditions and high altitude.

Table II. Distribution of birds in Arjin Mountain Nature Reserve on the basis of their preferred habitats.

Classification ORDER/ Family Scientific name	Fauna	Status	Preferred habitat	Relative abundance	Conservation/ Protection IUCN/CN
I Podicipediformes					
1 Podicipedidae					
<i>Podiceps cristatus</i> (Great crested grebe)	O	S	V, VI	R	
<i>Podiceps nigricollis</i> (Black-necked grebe)	C	M	V, VI	R	
II Suliformes					
2 Phalacrocoracidae					
<i>Phalacrocorax carbo</i> (Great cormorant)	O	M	IV	R	
III Pelecaniformes					
3 Ardeidae					
<i>Ardea cinerea</i> (Grey heron)	U	M	IV	C	II
<i>Egretta alba</i> (Great egret)	O	M	IV	C	
<i>Ixobrychus minutus</i> (Little bittern)	D	M	IV	R	
IV Ciconiiformes					
4 Ciconiidae					
<i>Ciconia nigra</i> * (Black stork)					I
V Anseriformes					
5 Anatidae					
<i>Anas acuta</i> (Northern pintail)	C	M	V, VI	A	VU II
<i>Anas clypeata</i> (Northern shoveler)	C	M	V, VI	C	
<i>Anas crecca</i> (Common teal)	C	M	V, VI	R	NT II
<i>Anas penelope</i> (Eurasian wigeon)	U	M	V, VI,	C	
<i>Anas platyrhynchos</i> (Common mallard)	C	M	V, VI	A	
<i>Anas strepera</i> (Gadwall)	C	M	V, VI	C	
<i>Anser anser</i> (Greylag goose)	U	M	V, VI	A	
<i>Anser indicus</i> (Bar-headed goose)	P	S	V, VI	A	
<i>Aythya ferina</i> (Common pochard)	U	S	V, VI	C	
<i>Aythya fuligula</i> (Tufted duck)	U	M	V, VI	C	
<i>Aythya nyroca</i> (Ferruginous duck)	D	M	V, VI	R	
<i>Cygnus cygnus</i> (Whooper swan)	C	W	VI	R	
<i>Mergellus albellus</i> (Smew)	U	M	IV	R	
<i>Mergus merganser</i> (Common merganser)	C	M	VI	R	
<i>Netta rufina</i> (Red-crested pochard)	D	S	V, VI	C	
<i>Tadorna ferruginea</i> (Ruddy shelduck)	U	S	IV, V, VI	A	
<i>Tadorna tadorna</i> (Common shelduck)	D	M	V, VI	C	

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Classification ORDER/ Family scientific name	Fauna	Status	Preferred habitat	Relative abundance	Conservation/ Protection IUCN/CN
VI Falconiformes					
6 Accipitridae					
<i>Accipiter gularis</i> (Japanese sparrowhawk)	U	M	III, VI, VII	R	NT II
<i>Accipiter nisus</i> (Eurasian sparrowhawk)	U	M	II, III	R	II
<i>Aegypius monachus</i> (Cinereous vulture)	D	R	III, VI, VII	R	VU II
<i>Aquila chrysaetos</i> (Golden eagle)	C	R	III, VI, VII	R	VU I
<i>Aquila heliaca</i> (Eastern imperial eagle)	D	M	III, VI, VII	R	II
<i>Aquila rapax</i> (Steppe eagle)	D	M	III, VI, VII	R	I
<i>Buteo hemilasius</i> (Upland buzzard)	D	R	III, VI, VII, R	R	II
<i>Buteo lagopus</i> (Rough-legged buzzard)	C	M	III, VI, VII	R	I
<i>Buteo rufinus</i> (Long-legged buzzard)	D	M	III, VI, VII	R	II
<i>Circus macrourus</i> * (Pallid harrier)	D	R	III, VI, VII		NT II
<i>Gypaetus barbatus</i> (Bearded vulture)	D	R	III, VI, VII	R	II
<i>Gyps himalayensis</i> (Himalayan vulture)	P	R	III, VI, VII	R	EN I
<i>Haliaeetus leucoryphus</i> (Pallas's fish eagle)	D	M	III, VI, VII	R	II
<i>Milvus migrans</i> (Black kite)	U	M	VI, VII		II
7 Falconidae					
<i>Falco cherrug</i> (Saker falcon)	D	W	II, III, V	R	EN II
<i>Falco pelegrinoides</i> (Barbary falcon)	O	M	I, III, V	R	II
<i>Falco peregrines</i> * (Peregrine falcon)	O	M	I, II, II		II
<i>Falco subbuteo</i> (Eurasian hobby)	U	M	II, III, V	R	II
<i>Falco tinnunculus</i> (Common kestrel)	O	R	I, II, III	R	II
VII Galliformes					
8 Phasianidae					
<i>Alectoris chukar</i> (Chukar partridge)	D	R	II, III, V	R	II
<i>Coturnix coturnix</i> * (Common quail)	O	M	VI		
<i>Tetraogallus himalayensis</i> (Himalayan snowcock)	P	R	VI, VII	R	II
<i>Tetraogallus tibetanus</i> (Tibetan snowcock)	P	R	VI, VII	R	
VIII Gruiformes					
9 Gruidae					
<i>Grus grus</i> (Common crane)	U	M	IV	R	VU I
<i>Grus nigricollis</i> (Black-necked crane)	P	S	IV	C	II
<i>Grus virgo</i> (Demoiselle crane)	D	M	IV	C	
10 Rallidae					
<i>Fulica atra</i> (Eurasian coot)	O	S	V, VI	C	
IX Charadriiformes					
11 Charadriida					
<i>Charadrius alexandrinus</i> (Kentish plover)	O	S	IV	A	NT
<i>Charadrius dubius</i> (Little ringed plover)	O	S	IV	R	
<i>Charadrius mongolus</i> (Lesser sand plover)	D	S	IV	C	
<i>Pluvialis fulva</i> (Pacific golden plover)	C	M	IV	R	
<i>Pluvialis squatarola</i> (Grey plover)	D	M	IV	R	
<i>Vanellus vanellus</i> (Northern lapwing)	U	S	IV	R	
12 Recurvirostridae					
<i>Himantopus himantopus</i> * (Black-winged stilt)	O	M	IV	A	NT
<i>Recurvirostra avosetta</i> (Pied avocet)	D	S	IV		
13 Scolopacidae					
<i>Actitis hypoleucos</i> (Common sandpiper)	C	S	IV	R	NT
<i>Calidris alpina</i> (Dunlin)	U	M	IV	R	
<i>Calidris ferruginea</i> (Curlew sandpiper)	U	M	IV	R	
<i>Calidris temminckii</i> (Temminck's stint)	U	M	IV	R	
<i>Gallinago gallinago</i> (Common snipe)	U	M	IV	R	
<i>Philomachus pugnax</i> (Ruff)	U	M	IV	R	
<i>Limosa limosa</i> (Black-tailed godwit)	U	M	IV	R	
<i>Tringa erythropus</i> (Spotted redshank)	U	M	IV	R	
<i>Tringa glareola</i> (Wood sandpiper)	U	S	IV	R	
<i>Tringa nebularia</i> * (Common greenshank)	U	M	IV		
<i>Tringa ochropus</i> (Green sandpiper)	U	M	IV	R	
<i>Tringa totanus</i> (Common redshank)	U	S	IV	A	

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Classification ORDER/ Family Scientific name	Fauna	Status	Preferred habitat	Relative abundance	Conservation/ Protection IUCN/CN
14 Sternidae					
<i>Sterna albifrons</i> (Little tern)	O	M	V, VI	R	
<i>Sterna hirundo</i> (Common tern)	C	M	V, VI	R	
X Lariformes					
15 Laridae					
<i>Chlidonias hybridus</i> (Whiskered tern)	O	M	IV	R	
<i>Chlidonias leucoptera</i> (White-winged black tern)	U	M	IV, V	R	
<i>Larus brunnicephalus</i> (Brown-headed gull)	P	S	IV, V, VI	A	
<i>Larus cachinnans</i> (Caspian gull)	P	M	IV	R	
<i>Larus ichthyaetus</i> (Pallas's gull)	D	M	IV	R	
<i>Larus ridibundus</i> (Black-headed gull)	U	M	IV	R	
XI Pteroclidiformes					
16 Pteroclididae					
<i>Syrrhaptes paradoxus</i> * (Pallas's sandgrouse)	D	R	II, III, V	R	
<i>Syrrhaptes tibetanus</i> (Tibetan sandgrouse)	P	R	II, III, V		
XII Columbiformes					
17 Columbidae					
<i>Columba rupestris</i> (Hill pigeon)	D	R	II, III, V	C	VU
<i>Streptopelia decaocto</i> (Collared dove)	U	M	I, II, III	R	
<i>Streptopelia orientalis</i> (Oriental turtle dove)	U	M	I, II, III	R	
<i>Streptopelia turtur</i> * (European turtle dove)	D	R	II, III, V		
XIII Cuculiformes					
18 Cuculidae					
<i>Cuculus canorus</i> * (Common cuckoo)	O	M	I, II, III		II
XIV Strigiformes					
19 Strigidae					
<i>Bubo bubo</i> (Northern eagle owl)	U	R	VI, VII	R	
<i>Athene noctua</i> (Little owl)	U	R	VI, VII		
XV Apodiformes					
20 Apodidae					
<i>Apus apus</i> (Common swift)	O	S	I, II, III	R	
XVI Coraciiformes					
21 Meropidae					
<i>Merops persicus</i> (Blue-cheeked-bee-eater)	O	S	III	R	
XVII Upupiformes					
22 Upupidae					
<i>Upupa epops</i> (Common hoopoe)	O	S	I, II, III	R	
XVIII Piciformes					
23 Picidae					
<i>Jynx torquilla</i> (Eurasian wryneck)	U	S	III	R	
XIX Passeriformes					
24 Aegithalidae					
<i>Leptopoeile sophiae</i> (White-browed) (Tit-warbler)	P	R	III, IV, V	R	
25 Alaudidae					
<i>Alauda gulgula</i> (Small skylark)	P	R	III, IV, V	R	
<i>Calandrella acutirostris</i> (Hume's short-toed lark)	P	R	III, IV, V	C	
<i>Calandrella brachydactyla</i> (Greater short-toed lark)	O	R	III, V, VI	C	
<i>Calandrella cheleensis</i> (Asian short-toiled lark)	D	R	III, V, VI	C	
<i>Eremophila alpestris</i> (Horned lark)	C	R	III, V, VI	A	
<i>Galerida cristata</i> (Crested lark)	O	R	III, V, VI	C	
<i>Melanocorypha maxima</i> (Tibetan lark)	P	R	III, V, VI	C	
26 Corvidae					
<i>Corvus corax</i> (Northern raven)	C	R	II, III, VI	C	
<i>Corvus corone</i> * (Carrion crow)	U	R	VI, VII		
<i>Podoces hendersoni</i> (Mongolian ground-jay)	D	R	III, V, VI	R	
<i>Pyrrhocorax pyrrhocorax</i> (Red-billed chough)	D	R	VI, VII	C	
27 Emberizidae					

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Classification ORDER/ Family Scientific name	Fauna	Status	Preferred habitat	Relative abundance	Conservation/ Protection IUCN/CN
<i>Emberiza buchanani</i> (Grey-necked bunting)	U	M	III, V, VI	R	
<i>Emberiza hortulana</i> * (Ortolan bunting)	D	M	III, V, VI		
<i>Emberiza pusilla</i> (Little bunting)	U	W	IV	R	
<i>Emberiza Schoeniclus</i> (Common reed bunting)	U	M	IV	R	
28 Fringillidae					
<i>Bucanetes mongolicus</i> (Mongolian finch)	P	R	I, II, III	C	
<i>Carpodacus erythrinus</i> (Common rosefinch)	D	M	IV	R	
<i>Carpodacus roborowskii</i> (Tibetan rosefinch)	U	R	I, II, III	R	
<i>Carpodacus rubicilla</i> (Great rosefinch)	P	R	III, V, VI	R	
<i>Carpodacus sillemi</i> (Sillem's mountain finch)	D	R	II, III, VI	C	DD
<i>Fringilla montifringilla</i> (Brambling)	U	W	II, V, VI	C	
<i>Leucosticte brandii</i> (Brandt's mountain finch)	D	R	III, V, VI	C	DD
<i>Leucosticte nemoricola</i> (Plain mountain finch)	P	R	II, V, VI	R	
<i>Linaria cannabina</i> (Common linnet)	P	R	III, VI, VI	R	
<i>Linaria flavirostris</i> (Twite)	P	R	I, II, VI	R	
29 Hirundinidae					
<i>Cecropis daurica</i> (Red-rumped swallow)	O	M	I, II, III	R	
<i>Hirundo rustica</i> (Barn swallow)	C	S	I, II, III	C	
<i>Ptyonoprogne rupestris</i> (Eurasian crag martin)	D	S	I, II, III	C	
<i>Riparia riparia</i> (Sand martin)	C	S	I, II, III	R	
30 Laniidae					
<i>Lanius isabellinus</i> (Red-tailed shrike)	D	S	III, V, VI	R	
<i>Lanius schach</i> (Long-tailed shrike)	W	S	I, II, III	C	
31 Motacillidae					
<i>Anthus richardi</i> (Richard's pipit)	U	M	IV	R	
<i>Anthus trivialis</i> (Tree pipit)	U	M	IV	R	
<i>Motacilla alba</i> (White wagtail)	O	S	II, III, IV	C	
<i>Motacilla cinerea</i> (Grey wagtail)	O	M	VI	R	
<i>Motacilla citreola</i> (Citrine wagtail)	U	S	IV	R	
<i>Motacilla flava</i> (Western yellow wagtail)	U	M	IV	R	
32 Muscipidae					
<i>Ficedula albicilla</i> (Taiga flycatcher)	U	M	I, II, III	R	
<i>Luscinia pectoralis</i> (White-tailed rubythroat)	H	M	II, III,	R	
<i>Luscinia svecica</i> * (Bluethroat)	U	M	II, III, V		
<i>Monticola saxatilis</i> (Common rock thrush)	D	M	I, II, III	R	
<i>Oenanthe deserti</i> (Desert wheatear)	D	R	II, III, V	C	
<i>Oenanthe oenanthe</i> * (Northern wheatear)	U	M	III, V, VI		
<i>Oenanthe pleschanka</i> (Pied wheatear)	D	S	III, V, VI	R	
<i>Phoenicurus erythrogasterus</i> (Guldenstadt's redstart)	P	S	I, II, VII	C	
<i>Phoenicurus ochruros</i> (Black redstart)	D	S	III, V, VI	R	
<i>Saxicola torquata</i> * (African stonechat)	U	M	I, II, III		
<i>Tarsiger cyanurus</i> (Red-flanked bluetail)	M	M	I, II, III	R	
33 Paridae					
<i>Pseudopodoces humilis</i> (Ground tit)	P	R	I, II, III	R	
34 Panuridae					
<i>Panurus biarmicus</i> (Bearded reedling)	P	R	III, V, VI		
35 Passeridae					
<i>Montifringilla adamsi</i> * (Tibetan snowfinch)	P	R	III, V, VI		
<i>Montifringilla nivalis</i> * (White-winged snowfinch)	P	R	III, V, VI		
<i>Onychostruthus taczanowskii</i> (White-rumped snowfinch)	P	R	II, III, V	C	
<i>Passer domesticus</i> (House sparrow)	O	R	I, II, III	R	
<i>Passer montanus</i> (Tree sparrow)	D	R	I, II, III	C	
<i>Petronia petronia</i> (Rock sparrow)	P	R	I, II, III	R	
<i>Pyrgilauda blanfordi</i> (Blanford's snowfinch)	U	R	I, II, III	R	
<i>Pyrgilauda ruficollis</i> (Rufous-necked snowfinch)	P	R	III, V, VI	C	
36 Phylloscopidae					
<i>Phylloscopus collybita</i> (Chiff-chaff)	U	M	III, V, VI	R	
<i>Phylloscopus coronatus</i> (Eastern crowned warbler)	M	M	II, III, V	R	
<i>Phylloscopus griseolus</i> * (Sulphur-bellied warbler)	P	S	VI, VII		
<i>Phylloscopus humei</i> (Hume's leaf warbler)	D	M	III, V, VI	R	

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Classification ORDER/ Family Scientific name	Fauna	Status	Preferred habitat	Relative abundance	Conservation/ Protection IUCN/CN
37 Prunellidae					
<i>Prunella atrogularis</i> * (Black-throated accentor)	P	M	IV		
<i>Prunella fulvescens</i> (Brown accentor)	P	R	VI, VII	C	
<i>Prunella rubeculoides</i> (Robin accentor)	U	S	III	R	
38 Remizidae					
<i>Remiz coronatus</i> (White-crowned penduline tit)	D	M	II, III, V	R	R
39 Sturnidae					
<i>Sturnus roseus</i> (Rosy starling)	D	M	I, II, III	R	
<i>Sturnus vulgaris</i> (Common starling)	D	M	I, II, III	C	
40 Sylviidae					
<i>Sylvia communis</i> * (Common whitethroat)	D	M	II, III, V		
<i>Sylvia curruca</i> (Lesser whitethroat)	D	S	II, III, V	R	
<i>Sylvia nana</i> * (Asian desert warbler)	D	M	II, III, V		
41 Tichodromidae					
<i>Tichodroma muraria</i> (Wallcreeper)	D	R	VI, VII	R	
42 Turdidae					
<i>Turdus atrogularis</i> (Black-throated thrush)	U	M	I, II, III	R	
<i>Turdus eunomus</i> (Dusky thrush)	D	M	II, III	R	
<i>Turdus iliacus</i> (Redwing)	D	M	I, II, III	R	NT
<i>Turdus naumanni</i> (Naumann's thrush)	D	M	II, III	R	
<i>Turdus pilaris</i> (Fieldfare)	U	W	III, V, VI	R	
<i>Turdus ruficollis</i> (Red-throated thrush)	U	M	I, II, III	R	
<i>Turdus viscivorus</i> (Mistle thrush)	D	M	I, II, III	R	

Fauna (distribution pattern): C, Holarctic pattern; O, Circumboreal pattern; U, Palearctic (Ancient Northern) pattern; D, Central Asian pattern; P-Plateau (Highland) pattern, W-Oriental pattern; H, Mnt. Himalaya-Hengduan pattern; M, Northeastern pattern. Status (residential type): S, summer visitor; W, winter visitor; R, resident; M, migrant (passing migrant). Preferred habitat (Study sites): I, At Athkan; II, Kara Qokka; III, Kara Dong; IV, Ixak Patti; V, Ayak Kum; VI, Aqqik Kul; VII, Whale Lake; Relative abundance (relative proportion of the number of individuals of the species that were observed at all 15x7 sampling events): A, Abundant (> 1%); C, Common (0.01-1%); R, Rare (<0.01%). Conservation status: (CN-China), I, Category I Key National Protected Species; II, Category II Key National Protected Species; VU, Vulnerable; NT, Near Threatened; EN, Endangered; DD, Data Deficient (<https://www.iucnredlist.org/>, https://commons.wikimedia.org/wiki/Main_Page). *, Based on literature reviews.

CONCLUSION

The Arjin Mountain Nature Reserve provides protection to a unique assemblage of bird species which may play a critical role in the sustenance of the vulnerable mountain ecosystem. In spite of conservation efforts, however, the bird species are still threatened and have become increasingly vulnerable because of hunting and habitat alteration as human populations in nearby areas have increased and as improved access and increased wealth generally have allowed incursions. In addition to traditional hunting and over-grazing, this area has also witnessed a continuing influx of iron and asbestos miners from the adjacent provinces moving into the reserve. Consequently, rare and endangered bird species, such as raptors, are now absent or scattered in different areas as a result of heavy human disturbances. However, over the last decade, government intervention to control the miners and progressive wildlife protection policy measures have resulted in a significant recovery, especially of raptor populations, for which densities were reported to be very low in the past, as they

were illegally hunted by local people for sport and trading. Our surveys suggest that the real conservation issue for birds at present is related to intensifying human-wildlife conflicts resulting in increasing human presence and movements in key wildlife areas along with increasing livestock numbers. We recommend that threats such as hunting, over-grazing, road construction and mining be closely monitored to avoid degradation of protected bird species populations and their natural habitats.

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Statement of conflict of interest

The authors have declared is no conflict of interests.

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