

Main results of bird ringing (banding) in the Western Tien Shan in the 21st century (2001-2023)

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Abstract. This article presents the results of bird ringing in the Western Tien Shan from 2001 to 2023. Methods for tagging and studying the migration routes, biology and ecology of birds are described, including catching and ringing, studying morphometric parameters, tagging with GPS/GSM transmitters, and visual surveys. Data are presented on the number of marked orders, species and individuals of birds for the specified period. In the period from 2001 to 2023, the most numerous species of birds were identified, as well as rare species that were able to be marked. The timing of autumn and spring migrations has been established, and the peaks and deadlines for bird migration have been identified. Some results of bird tagging with trackers are presented as well. This article also contains information about the meeting of ringed birds and the return of rings from different countries. Ecological and geographical connections of some bird species flying along the foothills of the Western Tien Shan have been established.

1 Introduction

For more than 120 years, there has been an experimental method for studying bird migrations by banding them. It was first used for scientific purposes in Denmark in 1899 by Hans Mortensen. That summer, he ringed 165 individuals of the common starling with specially prepared aluminum rings indicating the address and individual numbers [1]. This method was developed in subsequent years. And by 1978, 30.5 million birds had already been ringed in the world [2].

To centralize the work of ringers, the International Committee for Bird Ringing “Euring” was established in 1962. Bird banding centers exist in more than 50 countries.

Over the years of application of this method, it has been constantly improved [3-6], thanks to which it was possible to find out a number of incredibly important aspects of the life of birds: flight routes, stopping places during periods of migration, wintering, important population indicators (survival, reproductive success, average life expectancy, mortality at different periods of the life cycle, etc.) [7-9].

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In Kazakhstan, in 1966, in the foothills of the Western Tien Shan at the Shakpak pass, the first ornithological station in Asia for the study of bird migration was created, which continues to function to this day. This place was not chosen in vain: every year thousands of birds, concentrating along the foothills of the Tien Shan, migrate through the Shakpak Pass [10]. This paper presents the results of bird ringing at the Shakpak station from 2001 to 2023.

2 Materials and Methods

In order to study migration routes. biology and ecology of birds at the ornithological station “Shakpak” a number of methods are used, the main ones are: catching and ringing, studying the morphometric characteristics of birds, GPS/GSM telemetry, visual bird counts.

Birds were caught for the purpose of banding using mist nets and stationary traps. For tagging birds, aluminum rings with individual numbers and the address ALMATY KZ are used. The ring is placed on the bird's paw. During banding, morphometric indicators were taken from the caught birds using measuring instruments (electronic scales and calipers). Information about each captured individual was recorded in a tagging sheet, the data of which was transferred to the electronic ringing data bank. Ringing is carried out during the seasons of mass migrations of birds: autumn - to wintering areas; spring - to the nesting area.

In addition to ringing, which has already become a classic method for studying bird migration routes, GPS/GSM telemetry has also begun to be used. The method involves installing a tracker on the bird’s back, which allows you to remotely monitor the bird’s movement. This method provides more complete information about the distances, speeds and stopping places of birds, but is quite expensive.

Despite the importance of annual continuous ringing for collecting more complete data on bird migrations, the work was carried out intermittently (for reasons beyond the control of ornithologists). For example, from 2007 to 2020, ringing work was not carried out during the spring migrations of birds. Also, complete data for 2014 and 2018 is not available.

3 Results and Discussion

3.1 Ringing (Banding)

During 2001-2023, 188,376 birds of 203 species of 14 orders were ringed at the Shakpak ornithological station (Table 1). According to visual observations, 226 species from 16 orders are found (representatives of the orders *Anseriformes* and *Pterocletiformes* were not caught).

Table 1. Number of ringed birds at Shakpak station (Western Tien Shan) for 2001-2023 (by order):

№	Order	Ringing						Visual observations
		Spring		Autumn		Total		
		Number of species	Number of individuals	Number of species	Number of individuals	Number of species	Number of individuals	Number of species
1	<i>Ciconiiformes</i>	1	2	0	0	1	2	3
2	<i>Anseriformes</i>	0	0	0	0	0	0	6
3	<i>Falconiformes</i>	13	160	23	3296	23	3456	28
4	<i>Galliformes</i>	2	12	3	92	3	104	3
5	<i>Gruiformes</i>	3	9	4	8	4	17	7

Continuation of Table 1

6	<i>Charadriiformes</i>	4	8	4	13	7	21	10
7	<i>Pterocletiformes</i>	0	0	0	0	0	0	1
8	<i>Columbiformes</i>	7	474	8	2538	8	3012	8
9	<i>Cuculiformes</i>	1	31	1	31	1	62	1
10	<i>Strigiformes</i>	3	51	5	211	5	262	5
11	<i>Caprimulgiformes</i>	1	156	1	315	1	471	1
12	<i>Apodiformes</i>	0	0	2	67	2	67	2
13	<i>Coraciiformes</i>	4	2060	4	6556	4	8616	4
14	<i>Upupiformes</i>	1	21	1	64	1	85	1
15	<i>Piciformes</i>	1	2	3	29	3	31	3
16	<i>Passeriformes</i>	98	57398	132	114772	140	172170	143
Total		139	60384	191	127992	203	188376	226

3.2 Spring migration

During the spring seasons, a total of 60,384 individuals of 139 species of 13 orders were tagged (*Charadriiformes* and *Apodiformes* were not caught at all). The first migratory birds appear in early April, but the bulk of them fly in the 2nd ten days of May. The flight ends at the end of May.

The maximum number of individuals was caught in 2004 (18,321 birds), the minimum in 2014 (330 birds). Over 24 years, the most individuals captured were the Spanish Sparrow *Passer hispaniolensis* (33,312 individuals), the Barn Swallow *Hirundo rustica* (11,298 individuals) and the Indian Sparrow *Passer indicus* (6,045 individuals). Of the rare species, the Steppe Eagle *Aquila nipalensis*, Golden Eagle *Aquila chrysaetos*, Demoiselle Crane *Anthropoides virgo*, Great Bustard *Otis tarda*, Little Bustard *Tetrax tetrax*, Black-bellied Sandgrouse *Pterocles orientalis*, Yellow-eyed Pigeon *Columba eversmanni* and Bluebird *Myophonus coeruleus* were ringed and observed.

The number of birds in open spaces has declined markedly over the 21st century (Fig. 1A). This was mainly due to a decrease in the number of sparrows. Dendrophilous birds tend to increase in abundance (Fig. 1B).

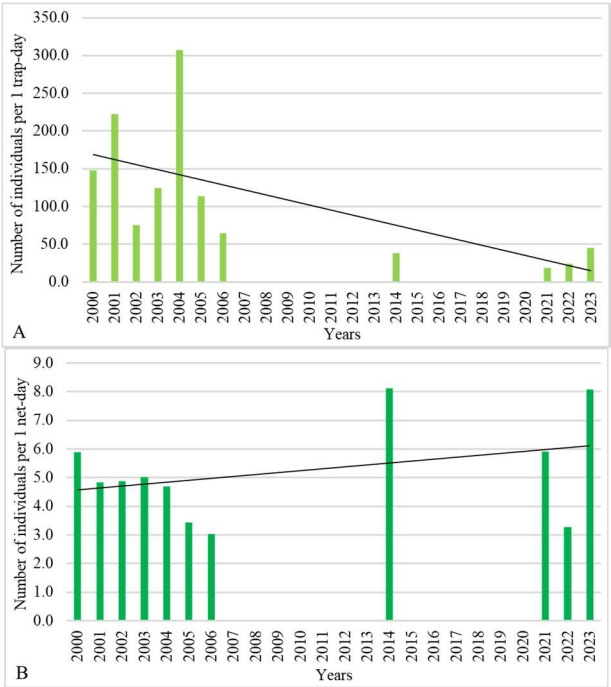


Fig. 1. Long-term dynamics of the relative abundance of birds caught in A) stationary traps and B) mistnets during spring migrations.

3.3 Autumn migration

During the autumn seasons, 127,992 individuals of 203 species of 13 orders were tagged (*Ciconiiformes* were not caught). Migration begins at the end of August and ends at the end of October.

The maximum number of birds was ringed in 2001 (14,938 individuals), the minimum - in 2017 (343 individuals). The most numerous species are Rook *Corvus frugilegus* (24393), Common chaffinch *Fringilla coelebs* (19035), Barn Swallow *Hirundo rustica* (16806) and Yellow Wagtail *Motacilla flava* (9577). Of the rare species, The short-toed snake eagle *Circaetus gallicus*, Booted Eagle *Hieraaetus pennatus*, Steppe Eagle *Aquila nipalensis*, Golden Eagle *Aquila chrysaetos*, Vulture *Neophron percnopterus*, Saker Falcon *Falco cherrug*, The Barbary falcon *Falco pelegrinoides*, Demoiselle Crane *Anthropoides virgo*, Yellow-eyed Pigeon *Columba eversmanni* and The Eurasian eagle-owl *Bubo bubo* were ringed and observed.

There was an increase in the number of birds in open spaces (Fig. 2A), and a decrease in dendrophilous birds, although it has increased sharply in the last year (Fig. 2B).

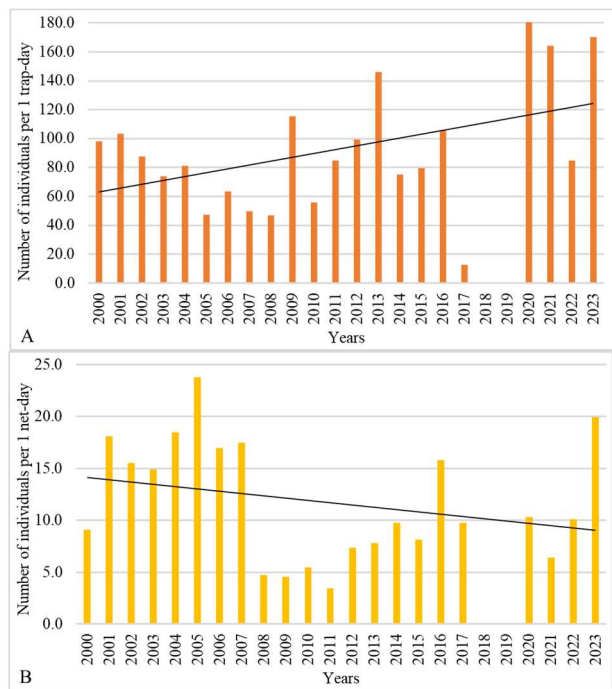


Fig. 2. Long-term dynamics of the number of birds caught in A) stationary traps and B) mistnets during the autumn migration period.

3.4 Territorial connections

In the 21st century from birds tagged at the Shapak station, 65 returns of rings were received from 23 bird species of 5 orders (*Falconiformes*, *Columbiformes*, *Strigiformes*, *Coraciiformes*, *Passeriformes*). Of these, 29 birds of 16 species were recaptured on Shapak. In other points of Kazakhstan, 7 birds of 4 species have ring returns (*Steppe Eagle* *Aquila nipalensis* (1), Common Starling *Sturnus vulgaris* (1), Jackdaw *Corvus monedula* (2) and Rook *Corvus frugilegus* (3)). Outside Kazakhstan, 29 returns of rings were received: from Russia - 23 individuals of 8 species; Uzbekistan - 2 individuals Rook *Corvus frugilegus*; from Kyrgyzstan - 1 individual Jackdaw *Corvus monedula*, from Kenya, Tanzania and South Africa - one individual each of the Barn Swallow *Hirundo rustica*. Also, Barn Swallows *Hirundo rustica* banded at Ngulia Station in Kenya were captured at Shapak Station.

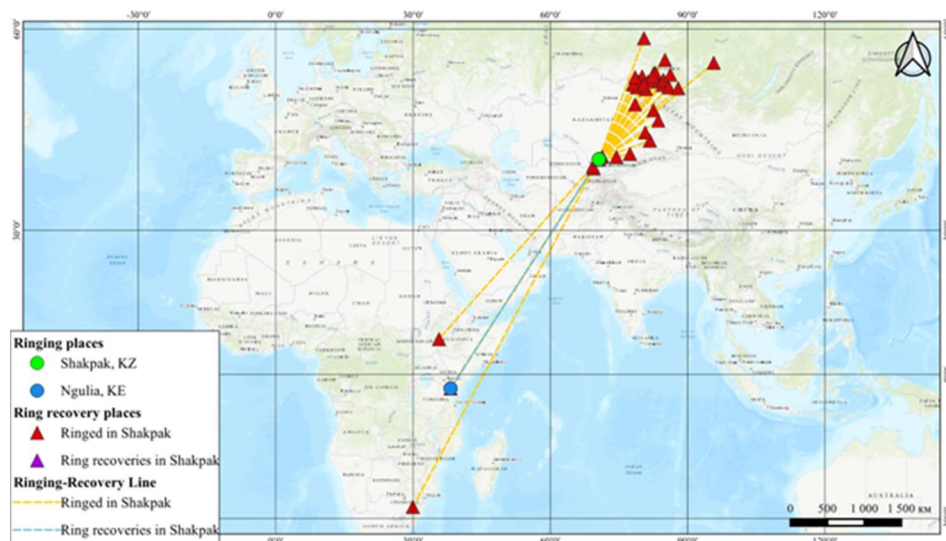


Fig. 3. Map of territorial connections of birds ringed and recaptured at the Shapkap station (Western Tien Shan) for 2001-2023.

3.5 GPS/GSM telemetry

In the period from 2019 to 2023, 18 birds of 13 species of 5 orders were tagged with GPS/GSM trackers at the station. In 2019, the following species were tagged: Ruddy Shelduck *Tadorna ferruginea*, Oriental Honey-buzzard *Pernis ptilorhynchus*, Black Kite, Wood Pigeon *Columba palumbus*, Stock Pigeon *Columba oenas*, Yellow-eyed Pigeon, Rook, Hooded Crow. In 2022 - Steppe Eagle, Eurasian Eagle Owl. In 2023 - European honey buzzard, Long-legged Buzzard *Buteo rufinus*, Booted Eagle (*Hieraaetus pennatus*).

The result of tagging was the identification of wintering sites, nesting territories and important stopovers during migration for some bird species. Thus, it became clear that Ruddy Shelduck can spend the winter in the southeast of Kazakhstan and in the northwest of China (the valley of the Muzart River); Oriental Honey-buzzard - in Ethiopia; European honey buzzard and Booted Eagle wintered in India, and the Black kite in Pakistan; the Long-legged Buzzard migrated to Afghanistan for the winter; The Steppe eagle winters in Saudi Arabia for the second year, and its nesting territory is in western Mongolia.

As stated earlier, during the period from 2001 to 2023, 188,376 birds of 203 species of 14 orders were ringed at Shapkap Pass, which amounts to an average of 8,190 individuals per year. Although the numbers are impressive, they could be much higher. Indeed, in some years, banding at the station was either not carried out at all, or was not carried out for a full season. For comparison, according to the results of bird ringing at Shapkap Pass from 1950 to 2012, the number of individuals ringed was 1,649,283. On average, about 26,179 individuals were tagged per year. The peak occurred in the 70-80s of the 20th century, when the number of ringed birds reached 100,000 individuals per year [11].

However, it is worth noting that during the entire period of bird ringing at the Shapkap Pass, such fluctuations have already occurred. Not only the number, but also the species diversity of birds changed. For example, the number of species tagged in 1952 was 13, in 1975 – 246, in 2012 – 34, in 2023 – 87. We are currently seeing a slight decline in the annual number and species diversity of tagged birds.

The use of the GPS/GSM telemetry method made it possible to clarify important aspects of the life of birds: timing, speed and daily activity of birds during migrations. Wintering

sites, important stops during migrations and nesting territories of some bird species migrating along the foothills of the Western Tien Shan have been clarified.

4 Conclusion

Thus, bird ringing is still one of the important methods for elucidating migration routes, biology and ecology of birds. It is especially necessary to carry out such work in known places of mass flights and concentrations of birds. Such a place for Kazakhstan and Central Asia is the Shakpak pass, located in the foothills of the Western Tien Shan. Work on bird ringing and analysis of flyway data has been carried out here since 1966 to this day.

Here, from 2001 to 2023, 188,376 birds of 203 species of 14 orders were ringed; According to visual surveys, representatives of 16 orders of birds were encountered. Over the entire period of operation of the Shakpak ornithological station, more than 2 million birds were ringed. All information obtained during the work is entered into the database.

Thanks to ringing, geographic connections of bird populations located in Kazakhstan during the nesting, summering or wintering periods with Russia, Uzbekistan, Kyrgyzstan, Kenya, Tanzania, and South Africa have been identified. From 2001 to 2023, 65 ring returns were received from 23 bird species of 5 orders.

Technological progress has not spared ornithology. The use of GPS/GSM telemetry helped to identify wintering sites, nesting territories, as well as territorial connections of populations of some bird species. Birds tagged with transmitters confirmed and expanded data on geographic connections with various countries in Asia and Africa. A particularly interesting example was the steppe eagle tagged with a tracker in 2022. Its breeding territory is in Western Mongolia, and its wintering place is Saudi Arabia. The eagle has been flying this route for two years now. Analysis of the data received from the tracker will allow us to learn more about the ecology of this bird species.

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