EVALUATING THE IMPORTANCE OF TSAGHKUNYATS MOUNTAIN FOR BIRD AND BUTTERFLY PROTECTION IN ARMENIA

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ABSTRACT

The Tsaghkunyats Mountain of Armenia (26,354 ha) doesn't have a legally protected status and requires evaluation as a potential Important Bird and Biodiversity Area (IBA) and Prime Butterfly Area (PBA). Recent surveys have found that 136 species of birds are recorded in, among which 113 are breeding and 23 occur during migration or stay in the area over winter. The area meets the criteria A1, B1a, B1b, and B2a of IBAs, hosting significant populations of Caucasian grouse *Tetrao mlokosiewiczi* Taczanowski (55-65 lekking males), semi-collared flycatcher *Ficedula semitorquata* Homeyer (41-56 pairs), green warbler *Phylloscopus nitidus* Blyth (108-363 pairs), and Egyptian vulture *Neophron percnopterus* L. (2 pairs). Among butterflies, 141 species have been recorded in the area, including several species of global, regional, and national importance, such as *Phengaris arion* L. and *Phengaris nausithous* Bergsträsser, listed in IUCN Global Red List; ten species listed in the European Red Book of Butterflies, and eight species listed in the Red Book of Animals of Armenia. Also, the area hosts relict populations of temperate species such as *Nymphalis antiopa* L., *Proclossiana eunomia tenera* Morgun (endemic subspecies) and *Melitaea diamina* Lang. The site, therefore, qualifies for designation as a PBA. In addition, the area qualifies as an Emerald Site under the Bern Convention, hosting essential populations of 23 bird species listed in Resolution 6. Existence of several threats, such as overgrazing, poorly controlled water abstraction, uncontrolled haymaking, illegal logging and snag removal, illegal hunting, and human-induced fires, require designation of the area as protected.

Keywords: Important Bird and Biodiversity Area, Prime Butterfly Area, Emerald Site, Conservation, Threats.

INTRODUCTION

The observed global biodiversity loss and human-induced degradation of habitats are exacerbated by climate change, speeding up the entire process of ecosystem degradation and a species diversity decline (Shivanna, 2022). In response to the unprecedented loss of the species and their habitats, the Kunming-Montreal Global Biodiversity Framework of the Convention on Biological Diversity (CBD, 2022) was developed to focus on the health of species and ecosystems and the sustainable use of biodiversity, aimed at halting human-induced species extinction. The biodiversity hotspots have been designated globally to prioritize the protection of the species and ecosystems (CEPF, 2004; Myers *et al*., 2000) not only due to high species diversity and endemism but also because the high endemism is often combined with a high vulnerability (Mittermeier *et al*., 2011). However, the conservation networks often give way to the occupation of lands for economic activity and the degradation of the ecosystems (Brooks *et al*., 2002); this becomes especially critical when the biodiversity hotspots remain unrecognized at the national or local levels due to a lack of scientific research or political will (Noss *et al*., 2015).

Various conservation networks have been developed to help in recognizing the biodiversity hotspots. Those include but are not limited to, Important Bird and Biodiversity Areas (BirdLife International, 2020), Prime Butterfly Areas (van Swaay & Warren, 2006), Important Plant Areas (Plantlife, 2010), and a number of others.

Human expansion throughout Asia causes loss of habitat and species diversity, posing a widespread threat to biodiversity in the continent (Yang *et al*., 2023) that is especially critical for South and Southeast Asian countries (IPBES, 2018), but is also significant in northern parts of Asia (Wallenius *et al*., 2010).

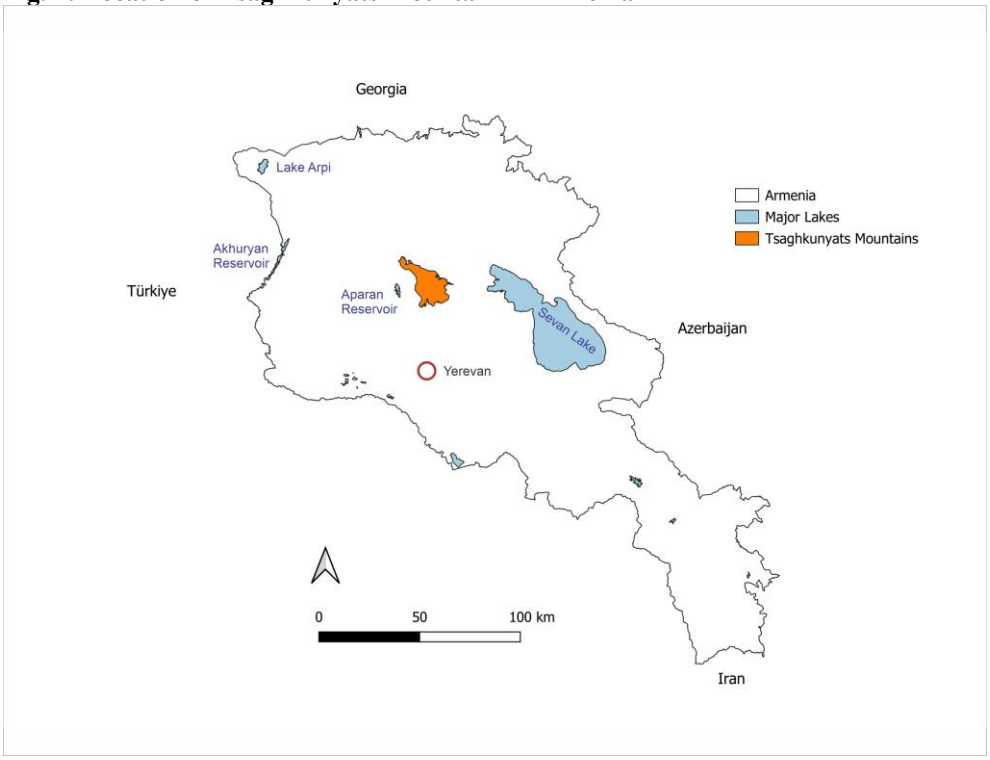
The Caucasus ecoregion was designated as one of the global biodiversity hotspots, covering 586,800 km^2 and hosting a high number of plant, animal, and fungi species with a high rate of endemism (Zazanashvili *et al*., 2020). Armenia, as a part of the Caucasus biodiversity hotspot (CEPF, 2004), hosts over 17,700 species of animals, including 495 endemic species, and over 3,800 species of vascular plants, including 142 endemic species (CBD Armenia, 2014). In the meantime, only 13 % of the country is covered by the network of National Protected Areas (CBD Armenia, 2014).

Currently, there are 18 Important Bird and Biodiversity Areas (IBA) recognized in Armenia (BirdLife International, 2022; Heath *et al*., 2000), and 12 Prime Butterfly Areas (PBA) identified (Khanamirian & Aghababyan, 2019). The recent revision of IBAs shows the need to increase their number in the country (Aghababyan *et al*., 2022). At the same time, the preliminary screening of the country's butterfly fauna demonstrated the potential for at least 20 additional PBAs to be evaluated (Butterfly Conservation Armenia, 2022). One such area is the Tsaghkunyats Mountain, located in the Kotayk province in the central part of the country (Fig. 1). The mountain ridge is situated mainly within a relatively wide elevation range and is presented by a variety of habitats: tragacanth mountain steppe, alpine meadows and carpets, oak woodland, and juniper woodland (Fayvush & Aleksanyan, 2016).

A preliminary screening of the area shows the presence of several threatened and endemic species of birds and butterflies. Although it is included in the national protected areas as Arzakan-Meghradzor State Sanctuary, it is also necessary to evaluate the area according to the criteria of IBAs and PBAs. Such evaluation will allow a more accurate reassessment of the area's conservation importance at the national level and its assessment at the international level as an Emerald Site protected under the Bern Convention (Fayvush *et al.,* 2016).

Therefore, the current article is aimed at answering the question of how the Tsaghkunyats Mountain meets the requirements and criteria of an Important Bird and Biodiversity Area (IBA) and a Prime Butterfly Area (PBA).

Fig. 1: Location of Tsaghkunyats Mountain in Armenia



MATERIALS AND METHODS

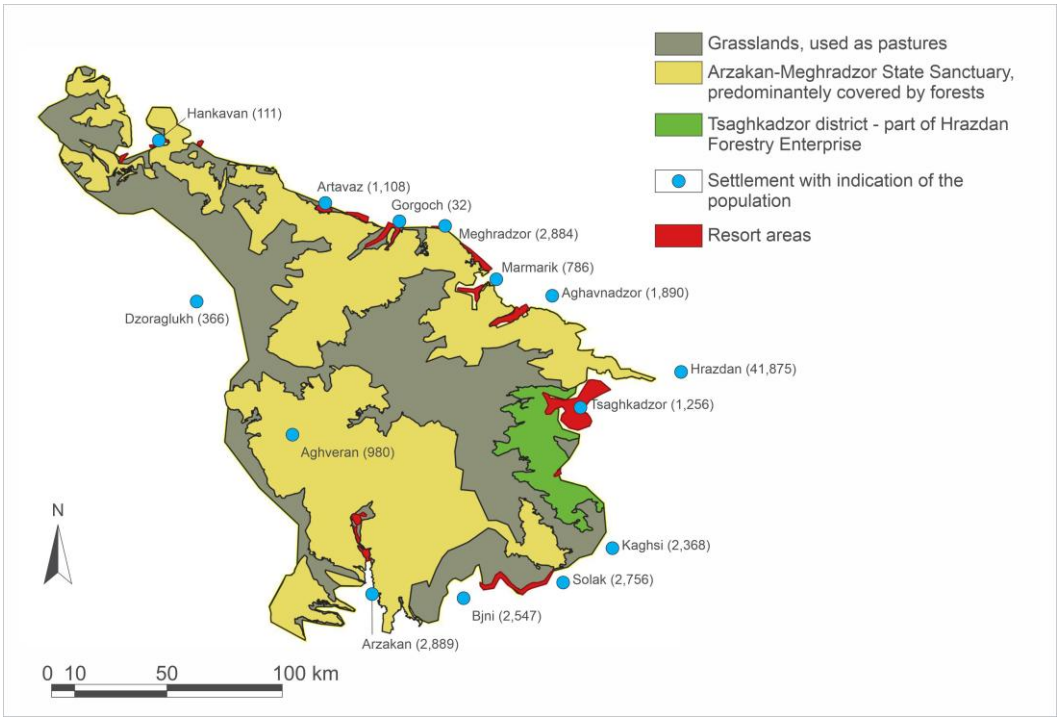
Study area

The study area comprises the entire Tsaghkunyats Mountain, a relatively separate mountain chain located in the central part of Armenia in Kotayk province. It has an elevation range from 1,520 m to 2,838 m above sea level (Fig. 1) and covers about 26,354 ha. Roughly 10,937 ha (45 %) is covered by various grasslands and is used as pastureland by the surrounding communities; 1,236 ha (5 %) is covered by deciduous forest and belongs to Hrazdan Forestry Enterprise; and deciduous forests cover the remaining 14,181 ha (59 %) falling within the Arzaqan-Meghradzor State Sanctuary (Government of RA, 2009). No public hunting lands are designated in the area, so hunting is prohibited (Table 1). There are 13 settlements in the vicinity of the area (Fig. 3), with a total population of 61,848 people.

Table 1: Allocation of the land at the Tsaghkunyats Mountain area

Name of Site	Area (ha)	Hunting Lands		Protected Areas		Forestry Enterprise		Community lands	
		ha	%	ha	%	ha	%	ha	%
Tsaghkunyats Mountain	26,354	0	0%	14,181	59%	1,236	5%	10,937	45%

Fig 3: Various types of land use and the disposition of the settlements related to the Tsakhkunyats Mountain site. The numbers next to the settlements' names indicate the human population according to the last census implemented in 2021



Mio-Pliocene lavas are essential in relieving the Tsaghkunyats mountains, representing gently sloping, almost undivided saravands (Gabrielyan, 1971). Several types of habitats represent the area. At altitudes of 1,850 m to 2,360 m, most of the land is covered by a deciduous forest, which at the lower elevation is dominated by oak (*Quercus macranthera* Fisch. & C.A.Mey. ex Hohen.) and hornbeam (*Carpinus betulus* L.). In contrast, higher elevations are dominated by the birch (*Betula litwinowii* Doluch.) and willow (*Salix caprea* L.) trees. Some of the southern slopes at the same elevation are covered by tragacanth mountain steppes, replacing degraded forests. The area above the timberline is occupied by wet meadows, which gradually turn into subalpine grasslands, alternating with rocky outcrops and screes. The southeastern corner of the area is covered by juniper woodland, dominated by *Juniperus polycarpos* K.Koch, *Onobrychis cornuta* Desv. and other arid vegetation. The area contains several small rivers and streams, which in the northern and

eastern parts flow into the river Marmarik, in the southern part – to river Hrazdan, and in the western part – to the river Kasakh. The rivers are essential in water abstraction for drinking, technical, and irrigation needs. The riparian ecosystems are mainly destroyed, being widely used for recreation; however, a few wild areas remain (Fayvush & Aleksanyan, 2016). The entire area is included in the Aparan floristic region (Takhtajian, 1954), being represented by over 500 plant species, among which there are all the necessary host plants for 140 resident and one migratory butterfly species.

The area is located in two climate classification zones (Beck *et al*., 2018): (1) cold, no dry season, warm summer (Dfb), and (2) cold, no dry season, cold summer (Dfc). In the first zone, the average annual temperature varies from +0.08°C to +12.75°C and mid-summer temperature varies from +10.00°C to +24.33°C, while average annual precipitation makes 1,050 to 1,350 mm. In the second zone, the average annual temperature varies from -4.42°C to +6.83°C and mid-summer temperature varies from +5.67°C to +18.67°C, and average annual precipitation makes 600 to 800 mm (Hydrometeorology and Monitoring Center SNCO, unpublished data).

Data

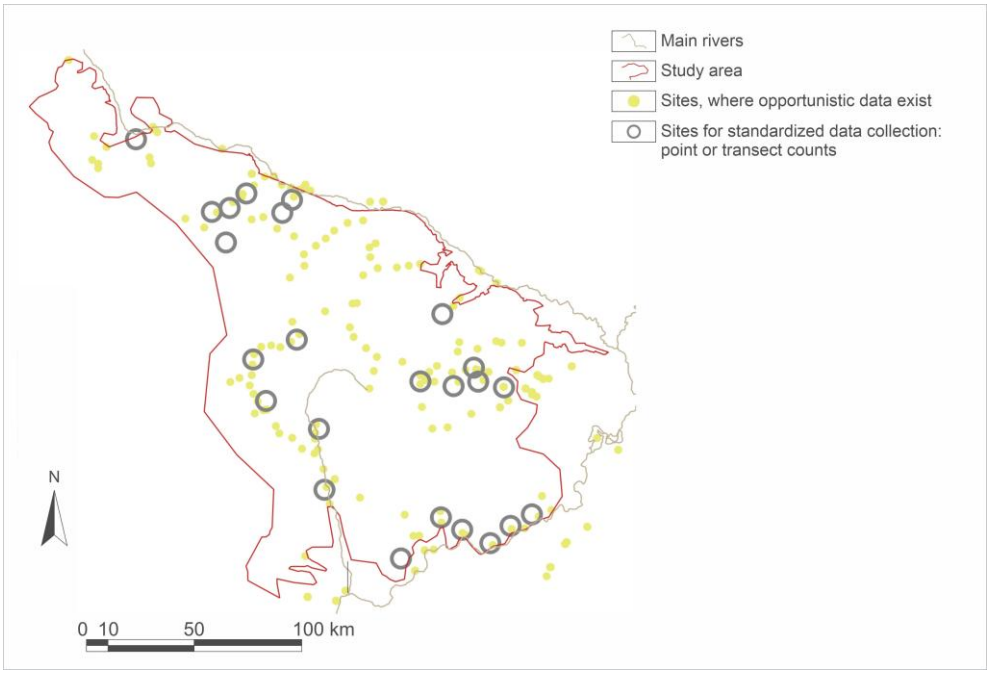
The information needed for the area assessment includes the data on bird and butterfly fauna; data on existing and potential threats to the birds, butterflies, and their habitats; spatial data on land use; and spatial data on nationally protected areas and areas of international conservation concern.

Bird data collection

For the current assessment of Tsaghkunyats Mountain, we used our own data collected from 2003 to 2022 and the data provided by various nature lovers in the framework of the National Bird Monitoring Scheme (BirdLinks Armenia, 2019). The scheme adopted an existing methodology (Voříšek *et al*., 2008), and is based on (1) unstandardized observations (i.e. opportunistic data) and (2) standardized counts (data that is collected according to standard methodology). Both types of data were used for mapping species distributions, but only standardized counts were used for estimating species abundance.

1. Unstandardized observations (opportunistic data) are provided by birdwatchers and contain minimum data requirements: precise identification of species, observation date, geographic coordinates, name of nearest locality (human settlement, mountain, historical site, etc.), breeding code, name of observer and his contact information. It is desirable to mention whether all observations have been recorded or the list represents only a selection of species. Every additional comment is useful (time, observation duration, number of people in the group, etc.). Since it's not always possible to record precise geographical coordinates on the spot, information may be provided according to the 10x10 km square code. In total, during 2003-2022, there were 12,936 opportunistic bird records (Fig. 2) accumulated in eBird Basic Dataset (2022), Armenia.Observation.Org (2022), and the Database of National Bird Monitoring owned by BirdLinks Armenia NGO and available upon request. The experts of BirdLinks Armenia are the national validators for both eBird and Observation.Org.

Fig. 2: Sites with existing opportunistic data and sites for standardized data collection. Yellow dots indicate the sites where records of birds and butterflies have been done by nature lovers. Grey circles indicate the sites where standardized counts were implemented for both birds and butterflies



The opportunistic data have some restrictions related to spatial bias (Bowler *et al*., 2022), resulting from behavioural specifics of the citizen scientists in the lack of promotion of adaptive sampling (Callaghan *et al*., 2023), and thus have been used only for the estimation of the distribution of the species but not their abundance.

2. Standardized counts (counts conducted within a certain time frame), are led both by specialists and birdwatchers with appropriate skills. Counts are implemented during a fixed period of 1 or 2 hours when an observer passes the route in slow motion. It is desirable to make such counts early in the morning when birds are most active (as a rule, early in the morning). The best season for bird count is the period between the 25th of April and the 10th of June; nevertheless, data collected in February-March are used as well because for some species, e.g., bearded vulture (*Gypaetus barbatus* L.) and eagle owl (*Bubo bubo* L.), the best period for counting breeding pairs is January-March. Standardized counts have been made of three types.

2.1. Count of breeding pairs of wide-ranged and colonial species. For wide-ranged species, we applied a count of breeding pairs. For colonial birds (such as bee-eaters, martins, and swallows), we counted occupied nests at the colonies that we found. The search for such colonies was done opportunistically while travelling throughout the area and during standardized counts. Once fixed, the colony was then visited at least every two years. To minimize disturbance for the birds, the observations were done from about 100-700 meters (depending on the sensitivity of the species) using binoculars 8-10x and spotting scopes 40x mounted on the tripods. Search of occupied territories of wide-ranged species (raptors and

storks) was done purposefully and opportunistically. To prove the breeding status of a pair, some observations of the birds' behaviour were undertaken, and the breeding codes were recorded (Voříšek *et al*., 2008). The territory was considered occupied if the recorded breeding codes were equal to or higher than 5 (Courtship and display). To minimize disturbance of the birds near the nests, we didn't conduct a nest search and usually observed birds' behavior from a distance of 500 meters and more.

2.2. Count of lekking species. Among lekking species, there are two, the Caucasian grouse and *Tetrao mlokosiewiczi* (Taczanowski, 1875) and corn crake *Crex crex* L. To count Caucasian grouse, the known lekking sites were visited in late April – early May, and the males were counted either before sunrise (when they are lekking) or in the evening (when they move to the lekking sites). To minimize the species disturbance, the observations were made from at least 500 meters using 40x spotting scopes. Count of corn crakes included point counts implemented in the first half of May, at 20:00-21:00. The count was registering vocalizing males.

2.3. Transect and point counts of uniformly distributed species. The selection of the type of count depended on the type of habitat and the walking opportunity. Thus, in the open habitats (grasslands and juniper woodlands), we usually implemented transect counts, and in the habitats with restricted view and difficult walking (deciduous forests), we implemented point counts. The sites where the counts were implemented (sampling sites) were selected to be within the core habitat (to avoid the edge effect) and outside the roads. In total, we have selected 24 sampling sites, which cover all the habitat types (Table 2). The transect routes extend for 500 to 1,000 m as parallel to the slopes as possible. The width of each route was 400 meters. The transects were walked at a slow pace, and all the bird individuals spotted by naked eyes or listened to without special acoustic devices within 200 meters from each side were recorded, specifying the highest breeding code. The points had a counting radius of 200 m and a 360° angle. Each point count was done within 10 minutes of recording, and all the bird individuals spotted by naked eyes or listened to without special acoustic devices within a 200-meter radius were recorded specifying the highest breeding code. Both types of counts were implemented in 06:00-11:00 under lack of precipitations, the visibility of at least one km, and a wind speed of less than 5 by the Beaufort Scale.

Collected data were entered into the standardized protocols, and after finishing the seasonal fieldwork, the data were inputted into the Database of National Bird Monitoring. The opportunistic and standardized counts were implemented by the ornithologists and over 300 BirdLinks volunteers from Armenia and abroad.

Table 2: Sampling sites for standardized counts

No	Code	Habitat	Type	Length	Width	Radius
1	AGVR001	Forest	Point	NA	NA	200
2	AGVR002	Forest	Point	NA	NA	200
3	AGVR003	Forest	Point	NA	NA	200
4	AGVR004	Forest	Point	NA	NA	200
5	AGVR005	Grassland	Transect	500	400	NA
6	BJNI001	Juniper woodland	Transect	500	400	NA
7	BJNI	Juniper woodland	Transect	500	400	NA
8	BJNI003	Juniper woodland	Transect	500	400	NA

9	BJNI004	Juniper woodland	Transect	500	400	NA
10	BJNI004	Juniper woodland	Transect	500	400	NA
11	BJNI005	Juniper woodland	Radius	NA	NA	200
12	TSDZ001	Forest	Point	NA	NA	200
13	TSDZ002	Forest	Point	NA	NA	200
14	TSDZ004	Grassland	Transect	500	400	NA
15	TSDZ003	Forest	Point	NA	NA	200
16	TSDZ005	Grassland	Transect	500	400	NA
17	AGVN001	Forest	Point	NA	NA	200
18	ARVZ001	Forest	Point	NA	NA	200
19	ARVZ002	Forest	Point	NA	NA	200
20	ARVZ003	Forest	Point	NA	NA	200
21	ARVZ004	Grassland	Point	NA	NA	200
22	ARVZ005	Grassland	Transect	900	400	NA
23	ARVZ006	Grassland	Transect	1000	400	NA
24	HNKV001	Forest	Point	NA	NA	200

Butterfly data collection

For the current assessment of the Tsaghkunyats Mountain, we used data that was collected from 2003 to 2022 in frames of the National Butterfly Monitoring Scheme, developed by BirdLinks Armenia NGO. Like the bird data, it includes (1) unstandardized observations and (2) standardized counts.

1. Nature enthusiasts usually provide unstandardized observations, similar to the opportunistic data on birds. In total, we have used 3,458 opportunistic records of butterflies (Fig. 2) accumulated in the Database of National Butterfly Monitoring owned by BirdLinks Armenia NGO and available upon request.

2. Standardized counts in the zone below the timberline are conducted three times per year: from early April to mid-May, from late May to late June, and from early July to late August. In the zone above the timberline, they are conducted two times per year: from late May to late June, and from early July to late August. They are led both by specialists and nature enthusiasts who have the proper skills. The Standardized Transect Counts are better known as Pollard Walks (Pollard & Yates 1993). In total, we have selected 24 transects, which cover all the habitat types in the same areas where bird sampling sites have been selected (Table 2). These transect routes were laid out to sample representative habitats and extend for 100 m parallel to the slopes. The width of each route was 5 meters. These walks occurred from 11:00-13:00 in sunny weather, with a wind speed of less than 3 by the Beaufort Scale. Collected data are entered following standardized protocols and later into the Database of the National Butterfly Monitoring Scheme.

Both types of data have been collected by volunteers – over 20 people in total.

Geographical data collection

The spatial data on the Key Biodiversity Areas (hereinafter KBAs) were taken from the online platform on KBAs (Key Biodiversity Areas Partnership 2024). The data on candidate Emerald Sites, Specially Protected Natural Areas (hereinafter SPNAs), and Public Hunting Lands were provided by the Ministry of Environment of RA.

Data on threats

To collect data on existing and potential threats, we evaluated land ownership status, types, and scale of human activities, and we organized interviews for target groups.

The data on land ownership was collected through the National Cadaster and the Department of Protected Areas of the Ministry of Environment.

The data on human activities was collected through the National Statistical Agency and supplemented with data from field site visits.

The data on direct threats were collected through open-ended interviews with local farmers and hunters. Before each interview, the interviewees were informed about the goal of the survey, the use of the obtained information, the voluntary nature of their participation, confidentiality, and anonymity of the conducted interviews. Only then, the informed consent was obtained. In total, 154 interviews were conducted, including 137 interviews with the farmer landowners and 17 interviews with the active local hunters. The information about the active local hunters and their contacts was provided by the local Hunting Union. The interviews were conducted informally to maintain a confident and relaxed atmosphere. The main questions that were (eventually) asked from the farmers and hunters are listed in the Table 3 From the information obtained, the answers were summed up into specific threats.

Table 3: List of questions addressed to the farmers and hunters

Questions for the farmers
(1) how and in which areas do they ranch the livestock (if any)
(2) how and in which areas do they implement mowing
(3) where do they obtain the water for irrigation
(4) is there any control over the amount of the irrigation water that they uptake from the streams
(5) how do they heat their houses
(6) what is the volume of fuelwood they use per annum (if they do)
(7) how do they get the fuelwood (if they do)
(8) how much fuelwood do they get from the forest and how much do they purchase from the forestry enterprises
(9) do they cut the wood or just collect the snag
(10) do they often go for picnics in the forest areas and light a fire (e.g., for barbeque)
(11) what they do with the fire after the picnics
Questions for the hunters
(1) how often do they hunt
(2) what are the species that they usually harvest
(3) in which season do they usually hunt
(4) what are their favourite areas for hunting

(5) do they use dogs, projector light, or any other supporting means
(6) have they ever harvested any unusual bird species
(7) what was the most difficult species for them to harvest
(8) do they follow the official sources to learn information about hunting season, allowed hunting means, allowed game species, and the official Public Hunting Lands
(9) do they use the harvested game for domestic consumption or also for selling (e.g., to the local restaurants)
(10) are there only locals who hunt or there are visiting hunters too
(11) do they often use a fire in the forest
(12) what they do with the fire after the break.

From 2013 through 2023, additional information on the direct threats was accumulated through social media, specifically the Armenian Ornithological Society (formerly Birding Association of Armenia) group.

The threats to the birds and their habitats were assessed and scored according to IBA guidelines (BirdLife International, 2006). The process involves assigning simple scores to selected indicators for the pressure (threat). The scores vary between 0 and 3 and are assigned for the Timing, Scope, and Severity of each pressure indicator (threat). The sum of the scores for these categories makes the total score of the impact.

Since the study area was assumed to support 'trigger' species that depend on habitats (that are changing in different ways), we used a 'weakest link' approach for the scoring system, meaning that the score is based on the 'worst' case indicator score (e.g. the most threatened species or the least intact habitat).

We used the following guidelines to assign scores for Timing, Scope, and Severity.

For the timing of the selected threat: if it is happening now, it is assigned score 3; if it is likely to happen in the short term (within 4 years), it is assigned score 2; if it is likely to happen in the long term (beyond 4 years), score 1; and if it happened in the past, unlikely to return, and is no longer limiting, it is assigned score 0.

For the scope of the selected threat: if it is supposed to affect the whole area or a population of the trigger species (>90 %), score 3, if 50 % – 90 % of the area/population, score 2, if 10 % – 50 % of the area/population score 1, if less than 10 % of the of area/population, score 0.

For the severity of the selected threat, if it is supposed to cause a rapid deterioration (>30 % over 10 years or 3 generations, whichever is the longer), score 3, if moderate deterioration (10–30 % over 10 years or 3 generations), score 2, if slow deterioration (1–10% over 10 years or 3 generations), score 1, if no or imperceptible deterioration (<1 % over 10 years), it is assigned score 0.

We have considered the 11 categories of threats (BirdLife International, 2006) trying to be as specific as possible within the categories (Table 4):

To evaluate the presence of a specific threat for a particular species or its habitat, we conducted spatial analysis by overlapping the area where the human activity (that generates the threat) exists with the species' distribution range.

As this is the baseline assessment, it doesn't allow assessing and scoring the other two parameters: State and Response, for which several years of monitoring are needed.

The threats to the butterflies and their habitats were just interpreted from the information gathered.

Table 4: Threats of the birds and butterflies recorded within the study area

Name of a threat and its specification to the study area
(1) Agricultural expansion and intensification – threats from farming and ranching
(2) Residential and commercial development – threats from human settlements or other non-agricultural land uses with a substantial footprint
(3) Energy production and mining – threats from production of non-biological resources
(4) Transportation and service corridors – threats from long narrow transport corridors and the vehicles that use them
(5) Over-exploitation, persecution and control – threats from consumptive use of wild biological resources including both deliberate and unintentional harvesting effects
(6) Human intrusions and disturbance - threats from human activities that alter, destroy, and disturb habitats and species associated with non-consumptive uses of biological resources
(7) Natural system modifications – threats from actions that convert or degrade habitat in service of managing natural or semi-natural systems
(8) Invasive and other problematic species and genes - threats from non-native and native plants, animals, pathogens, or genetic materials that have or are predicted to have harmful effects on biodiversity
(9) Pollution threats from introduction of exotic and/or excess materials from point and non-point sources causing mortality of species or alteration of habitats
(10) Geological events - threats from catastrophic geological events that have the potential to cause severe damage to habitats and species
(11) Climate change and severe weather - threats from long-term climatic changes which may be linked to global warming and other severe weather events.

Data processing

The first part of the data processing included preparation of the area's account, listing the general description of the site, description of characteristics of avifauna and butterfly fauna and the priority species of global and national concern, features of land use and current threats, as well as existing and necessary conservation measures.

The second part of the processing included the evaluation of the features of the area versus criteria of the area as IBA and as PBA (see below), and analysis of the area's overlap with the public hunting lands, with the areas on national and global conservation concern, namely: SPNAs, candidate Emerald Sites, and by KBAs. This part of the processing was implemented using QGIS 3.30.2.

The delineation of the target area was implemented as initial boundaries based on ecological data, according to the KBA Standards and Appeals Committee of IUCN SSC/WCPA (2022). As the base map, the satellite imagery provided by Google Earth Pro, from the sources of Airbus 2024 and Maxar Technologies 2024 with the 0.5 m resolution, was used. The ground truthing process was implemented during the field expeditions using the hand-held GPS Garmin 64S units. During delineation, the boundaries of SPNAs, candidate Emerald Sites, and KBAs were considered.

The last part of the data processing included analysis of the overlap of the areas, where human activities, which can generate threats to the birds and their habitats, are represented with the distribution range of the priority bird species and their habitats. The analysis was implemented in QGIS 3.30.2.

Evaluation of the area as IBA

According to the methodology for recognition of the IBAs, areas should fit one or several criteria listed below (BirdLife International, 2020):

- Places of international significance for the conservation of birds and other biodiversity
- Recognized worldwide as a practical tool for conservation.
- Distinct areas amenable to practical conservation action.
- Identified using robust, standardized criteria.
- Sites that together form part of a more comprehensive integrated approach to the conservation and sustainable use of the natural environment.

Evaluation of the area as PBA

The recognition of PBA is based on methodology developed for Europe (van Swaay & Warren, 2006) and local adaptations, such as in Turkey (Zeydanlı *et al*., 2012) and Bulgaria (Abadjiev, 2003). The methodology allows PBAs to be evaluated if they meet at least two of the following criteria:

- species included in the Red Data book of European butterflies (van Swaay & Warren, 1999),
- species included in Appendix II of the Bern Convention (on the conservation of European wildlife and natural habitats)
- and species included in the EU Habitats and Species Directive and species of national concern listed in the Red Book of Animals of the Republic of Armenia (Aghasyan & Kalashyan, 2010).

RESULTS AND DISCUSSION

Bird Fauna

Surveys recorded 136 species of birds in the area (see Annex 1, Table 1), among which 113 are breeding and 23 occur during migration or stay in the area over winter. Among the mentioned species, the area hosts populations of several IBA trigger bird species listed in Table 5. The Caucasian grouse is a resident of the area, its population is represented by 55-65 lekking males and corresponds to criteria B1a – over 30 individuals. The semi-collared flycatcher *Ficedula semitorquata* (Homeyer, 1885) breeds in the area, and having 41-56 pairs, corresponds to B1b – over 15 breeding pairs. The green warbler *Phylloscopus nitidus* Blyth, 1843 breeds with a population of 108-363 pairs, corresponding to B2a – 100 breeding pairs. The application of B1b and B2a criteria requires having no more than five sites for each of the species within a country (BirdLife International, 2020). In the current case, these criteria are justified as there are only four other IBAs, where the semi-collared flycatcher passes the threshold of 15 breeding pairs, and the green warbler passes the threshold of 100 breeding pairs. For both species, those IBAs are AM008-Dsegh, AM009-Haghartsin, AM002-Pambak mountain chain, and AM018-Meghri (BirdLinks Armenia, unpublished data). Two pairs of Egyptian vulture *Neophron percnopterus* L. use the area as a part of their foraging range, although their nests are located outside the Tsaghkunyats area; the criteria which can be applied is A1 – one pair. In conclusion, the results indicate that the current outline of Tsaghkunyats Mountains fits the criteria A1, B1a, B1b, and B2a of Important Bird and Biodiversity Areas. However, the BirdLife Secretariat should give final approval for the correspondence of species' populations to the IBA thresholds.

Table 5: Evaluation of the bird species of Tsaghkunyats Mountains versus IBA criteria. The species are grouped according to their IBA criteria.
Within the same group, the species are listed in alphabetical order (scientific names). Units in the column Threshold mean: ind – individuals; p – pairs. RDB means conservation status of the species in the Red Data Book of Animals of Armenia; IUCN – conservation status in IUCN Red List (2023). For both red lists, the following abbreviations are used: LC – Least Concern, NT – Near Threatened, VU – Vulnerable, EN – Endangered, NE – Not Evaluated.

English name	Scientific name	Number	Population units	Indivi-duals	IBA Criteria	Threshold	Season	RDB	IUCN
Egyptian vulture	*Neophron percnopterus*	2	pairs	6	A1	1 p	Breeding	EN	EN
Caucasian grouse	*Tetrao mlokosiewiczi*	55-65	lekking males	165-195	B1a	30 ind	Resident	VU	NT
Semi-collared flycatcher	*Ficedula semitorquata*	41-56	pairs	123-168	B1b	15 p	Breeding	DD	LC
Green warbler	*Phylloscopus nitidus*	108-363	pairs	324-1089	B2a	100 p	Breeding	NE	LC

Also, the area is inhabited by many species listed in Resolution 6 of the Bern Convention and shown in Table 6. Among them the boreal owl *Aegolius funereus* L. (5-6 pairs) and black stork *Ciconia nigra* L. (1 pair) correspond to criteria a; the black kite *Milvus migrans* (Boddaert, 1783) (4-5 pairs), short-toed snake-eagle *Circaetus gallicus* (Gmelin, JF, 1788) (3 pairs), lesser spotted eagle *Clanga pomarina* (Brehm, CL, 1831) (4 pairs), golden eagle *Aquila chrysaetos* L. (1 pair), booted eagle *Hieraaetus pennatus* (Gmelin, 1788) (5 pairs), peregrine falcon *Falco peregrinus* Tunstall, 1771 (1 pair), corn crake (101-152 calling/lekking males), Eurasian eagle-owl (1 pair), semi-collared flycatcher (41-56 pairs), red-backed shrike *Lanius collurio* L. (464-892 pairs), and ortolan bunting *Emberiza hortulana* L. (1,071-1,517 pairs) correspond to criteria b. The lammergeier, and Egyptian vulture occur in the breeding season but don't have any nests within the Tsakhkunyats range and use the area as part of their foraging area.

Table 6: Evaluation of the bird species of Tsaghkunyats Mountains versus criteria for Emerald Sites. The species are grouped according to their Emerald criteria.
Within the same group, the species are listed in alphabetical order (scientific names). The Emerald criteria: a = population of the species on the site is between 15%-100% of the species' population in the country; b = 2%-15% of the population; c = 1%-2%; d < 1%.

English name	Scientific name	Number	Units	Emerald criteria	Use of the site
Boreal owl	*Aegolius funereus*	5-6	pairs	a	Breeding
Black stork	*Ciconia nigra*	1	pairs	a	Breeding
Lammergeyer	*Gypaetus barbatus*	2	pairs	a	Foraging range
Golden eagle	*Aquila chrysaetos*	1	pairs	b	Breeding
Lesser spotted eagle	*Aquila pomarina*	4	pairs	b	Breeding
Eurasian eagle-owl	*Bubo bubo*	1	pairs	b	Breeding
Short-toed snake-eagle	*Circaetus gallicus*	3	pairs	b	Breeding
Corn crake	*Crex crex*	101-152	calling/lekking males	b	Breeding

Ortolan bunting	*Emberiza hortulana*	1,071-1,517	pairs	b	Breeding
Peregrine Falcon	*Falco peregrinus*	1	pairs	b	Breeding
Semi-collared flycatcher	*Ficedula semitorquata*	41-56	pairs	b	Breeding
Booted eagle	*Hieraaetus pennatus*	5	pairs	b	Breeding
Red-backed shrike	*Lanius collurio*	464-892	pairs	b	Breeding
Black kite	*Milvus migrans*	4-5	pairs	b	Breeding
Egyptian vulture	*Neophron percnopterus*	2	pairs	b	Foraging range
Wood lark	*Lullula arborea*	544-950	pairs	c	Breeding
Bluethroat	*Luscinia svecica*	19-39	pairs	c	Breeding
European honey-buzzard	*Pernis apivorus*	13-16	pairs	c	Breeding
Red-billed chough	*Pyrrhocorax pyrrhocorax*	12-16	pairs	c	Breeding
Long-legged buzzard	*Buteo rufinus*	6-7	pairs	d	Breeding
Eurasian nightjar	*Caprimulgus europaeus*	12-22	pairs	d	Breeding
Common kingfisher	*Alcedo atthis*	4-6	pairs	d	Breeding
European roller	*Coracias garrulus*	3-5	pairs	d	Breeding

Concluding this part, it is possible to state that the area fits the criteria of Emerald Sites having one species of Category a and 11 species of Category b. It is essential to state the importance of the site for the boreal owl, as the area hosts c. 17 % of its population. The site can, therefore, significantly contribute to the network of Emerald Sites of Armenia (Fayvush *et al*., 2014, 2016).

Among the other species, which are either listed in the Red Data Book of Armenia (Aghasyan & Kalashyan, 2010) or are regional endemics, there are Radde's accentor *Prunella ocularis* (Radde, 1884), regional endemic (32-71 pairs), mountain chiffchaff *Phylloscopus sindianus* W.E. Brooks, 1880, another regional endemic (1,186-2,200 pairs), wallcreeper *Tichodroma muraria* L., listed as Vulnerable in the Red Data Book of Armenia (8-11 pairs), and Eurasian goshawk *Accipiter gentilis* L., another Vulnerable species in the Red Data Book of Armenia (2 pairs).

Butterfly Fauna

A total of 141 species of butterflies have been recorded in the Tsaghkunyats Mountain and its close vicinity (Annex 1, Table 2). Among the mentioned species, the area hosts several species of global, regional, and national importance. Two species are listed in IUCN Global Red List as Near Threatened – *Phengaris arion* L. and *Phengaris nausithous* (Bergsträsser 1779); ten species are listed in the European Red Book of Butterflies, including one Endangered – *Phengaris arion* and nine Near Threatened; one species, *Phengaris nausithous* is listed in the Resolution 6 of Bern convention, and eight species are listed in the Red Book of Animals of Armenia as Vulnerable. None of the species are listed in the Mediterranean Red Book of Butterflies. Also, the area is the only known spot in Armenia that hosts relict populations of such temperate species as *Nymphalis antiopa* L., *Proclossiana eunomia* Esper, 1799, and *Melitaea diamina* (Lang 1789). These species are priorities for the

assessment of their national conservation status for the next issue of the Red Data Book of Armenia since *Nymphalis antiopa* demonstrates a steep population decline, while Proclossiana eunomia and *Melitaea diamina* have not been recorded in the country for a while. *Proclossiana eunomia* is known only from the collections of V. Gamburaev in 1925 (Morgun 2011); and the collected specimens became a foundation for describing a new subspecies P. e. tenera Morgun, 2011 which makes the Tsaghkunyats Mountains especially valuable. The records of another species, *Melitaea diamina*, are also scarce, as the only mention of it was made by N.M. Romanoff (1884).

Also, the site hosts a large population of regional endemics, such as *Colias thisoa* Ménétriés, 1832, *Erebia graucasica* Jachontov, 1909, *Thaleropis ionia* (Fischer von Waldheim & Eversmann, 1851), *Boloria caucasica* (Lederer, 1852), *Mellicta caucasogenita* Vérity, 1930, *Callophrys danchenkoi* Zhdanko, 1998, *Polyommatus firdussii* (Forster, 1956), *Polyommatus vanensis* (de Lesse, 1957), and *Polyommatus altivagans* (Forster, 1956). Other threatened species (Aghasyan & Kalashian, 2010) include *Parnassius apollo* L., listed as Vulnerable in the Red Data Book of Armenia, *Phengaris rebeli* (Hirschke, 1904), Vulnerable, *Papilio alexanor* Esper, 1799, Vulnerable, *Colias aurorina* Herrich-Schäffer, 1850, Vulnerable, and Brenthis ino Rottemburg, 1775, Vulnerable.

Threats

Several activities have been identified as potential threats to the bird and butterfly diversity of the area.

Analysis of the overgrazed areas shows they overlap with the distribution of several priority ground-nesting bird species of grasslands, such as the Caucasian grouse, corn crake, ortolan bunting, woodlark, bluethroat, and *Eurasian nightjar*, as well as with the distribution of the priority butterfly *Phengaris arion* (Fig. 4a).

Analysis of the areas of uncontrolled haymaking shows they overlap with the distribution of several priority ground-nesting bird species of grasslands, such as the corn crake, ortolan bunting, and bluethroat, as well as the priority butterflies *Phengaris nausithous* and *Phengaris arion* (Figs. 4b and 5b).

Analysis of Illegal logging and snag removal areas shows they overlap with the distribution of priority species of forests, such as Boreal owl and Semi-collared flycatcher, which are strongly linked to the habitat, and with the breeding habitats of the large-ranged species, as the Black stork, Lesser spotted eagle, Booted eagle, and European honey-buzzard (Fig. 4c).

Analysis of areas of illegal hunting reveals that they overlap with the distribution of priority Galliformes and Crakes, specifically with the Caucasian grouse and corn crake (Fig. 4d), as well as with the distribution of all large-ranged raptor species.

Analysis of poorly controlled water acquisition sites shows that they overlap with the wet meadows and the distribution range of *Phengaris nausithous* (5a).

Fig. 4: Overlap of the human activities with the distribution of priority bird species: 4a, overgrazed areas and grassland species; 4b, areas of uncontrolled haymaking and grassland species; 4c, areas of Illegal logging and snag removal, and forest species; 4d, areas of illegal hunting and distribution of priority Galliformes and Crakes.

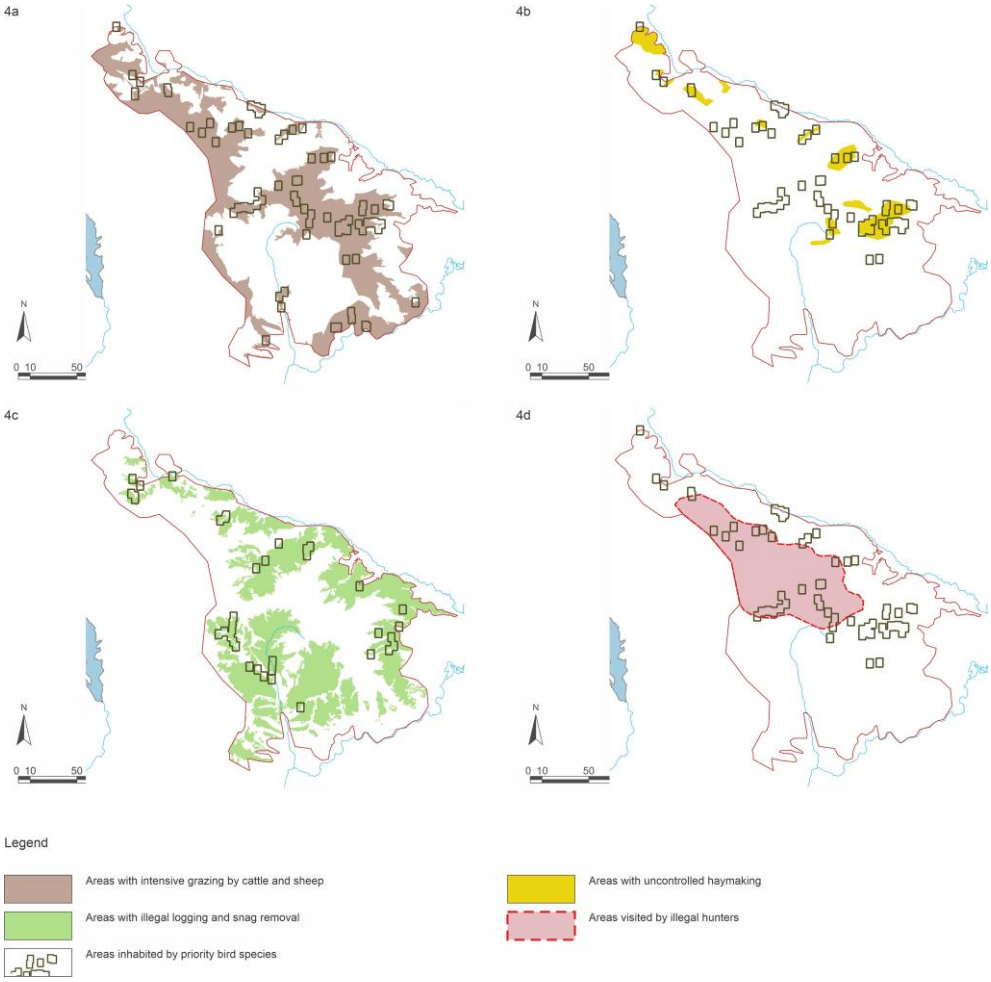
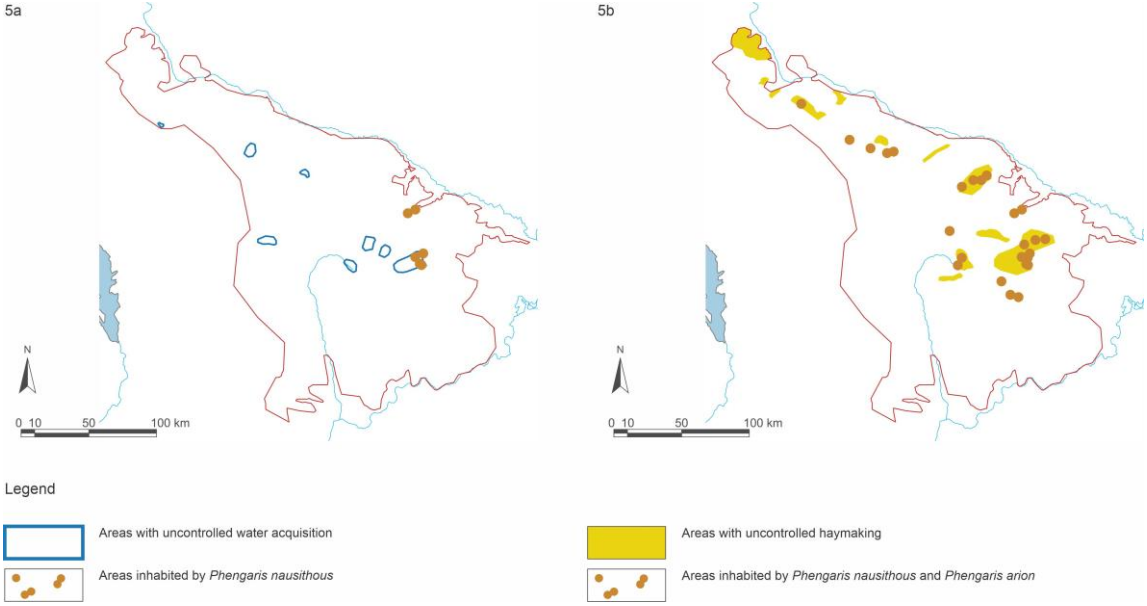


Fig. 5: Overlap of the human activities with the distribution of priority butterfly species: 4a, poorly controlled water acquisition sites and distribution range of *Phengaris nausithous*; 4b, areas of uncontrolled haymaking and distribution range of *Phengaris nausithous* and *Phengaris arion*.



The spatial analysis of potential human-induced fires was not implemented, as it can occur almost everywhere, becoming widely distributed and affecting all species and their habitats, which renders such an analysis meaningless. Similarly, the spatial analysis of the climate change impact was not implemented, as it appears not to provide site-specific information.

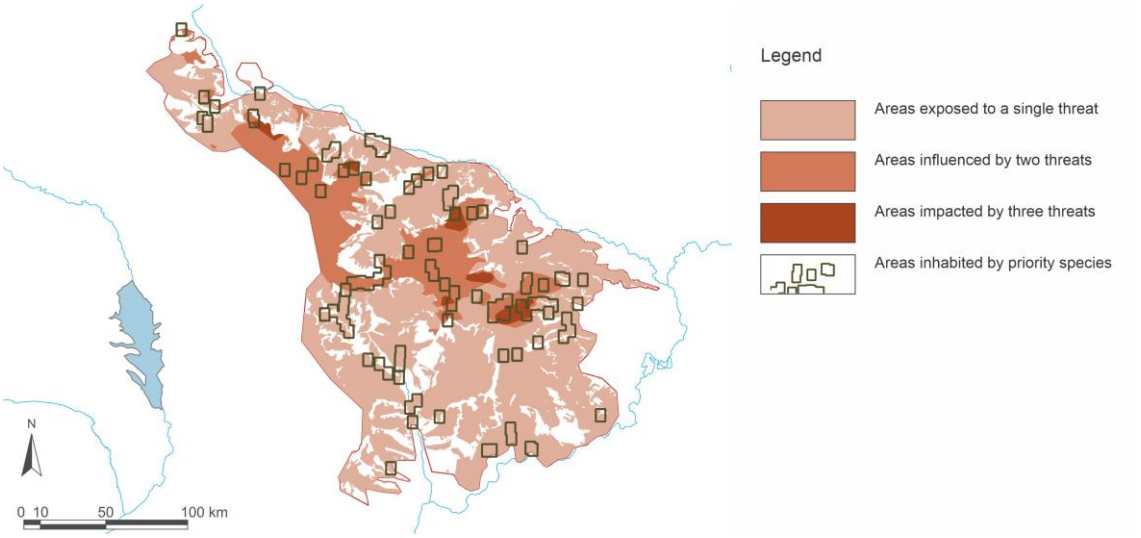
Overlapping of the threats throughout the study area (Fig. 6) shows that 16,894 ha are exposed to a single threat, 5,045 ha are exposed to two threats, and 464 ha are exposed to three threats simultaneously. None of the areas are exposed to four or five threats.

The current pressure of the described activities is summarized in Table 7.

Table 7: Scoring of the pressure (threats)

Threat	Timing	Scope	Severity	Total Impact
Overgrazing	3	3	2	**8**
Poorly controlled water acquisition	2	3	3	**8**
Uncontrolled haymaking	2	2	3	**7**
Climate change	3	3	1	**7**
Illegal logging and snag removal	2	2	2	**6**
Illegal hunting	2	2	1	**5**
Human-induced fires	1	1	2	**4**

Fig. 6: Areas of overlapped threats versus the distribution of priority species. The pale purple color indicates areas with a single threat recorded; the middle purple color indicates areas with two overlapping threats recorded; the dark purple color indicates areas with three overlapping threats recorded. The dark gray outline indicates consolidated distribution of the priority bird and butterfly species.



Almost all steppes and meadows in the area are used as pastureland for nomadic grazing or haymaking by surrounding communities. The nomadic grazing in the area results in overgrazing, which has negative consequences. In the first stage, it causes a change of plant composition when the fodder herbs, such as *Poaceae* sp. and *Fabaceae* sp., are replaced by thorny plants, like *Astracantha* sp., or poisonous (for livestock) plants, like *Achillea* sp. In the second stage, soil erosion on the slopes occurs. The scale of the negative impact of overgrazing on birds has already been studied in the context of the identification of bird bioindicators for terrestrial ecosystems (Aghababyan, 2024). In the framework of that research, the numerical values were designated for the various stages of grassland degradation, which were then used as independent variables. Specifically, the grasslands were categorized from 1 to 6, where 6 means an area with restricted livestock access; 5 means the areas where grazing just started changing the composition of the plants, so the proportion of poisonous plants, like chamomile or thorny species like thistle, is increasing; 4 means the area, where the proportion of poisonous or thorny plants is about or above 50 %; 3 means the area where the overgrazing begins causing development of permanent terrasses at paths of livestock moving; 2 means the area, where terrasses make a network that covers at least 20 % of the slopes; and 1 means the areas, where the cases of erosion have been observed. The bird species composition, total number of bird individuals, and abundance of the selected species were taken as dependent variables, and a linear regression model was applied to identify possible correlations. The research didn't show a strong correlation between the total number of bird individuals and the grassland category (R^2 = 0.327, df = 17), but it did however suggest an overall significance of the regression model (Sureiman & Mangera, 2020) and explanation of the dependent variable by the explanatory one (F = 8.275, df = 17, P = 0.010). A similar pattern was obtained between some indicator bird species and the grassland

category, when the R^2 value is below 0.5, but the F statistic shows a high value: common quail *Coturnix coturnix* L. doesn't show a strong correlation but demonstrates the overall significance of the model (R^2 = 0.493, df = 16; F = 15.550, P = 0.001), skylark *Alauda arvensis* L. shows both, significant correlation and overall significance of the model (R^2 = 0.618, df = 17; F = 27.499, P < 0.001), whinchat *Saxicola rubetra* L. shows both, significant correlation and overall significance of the model (R^2 = 0.712, df = 17; F = 41.955, P < 0.001), bluethroat *Luscinia svecica* L. doesn't show a strong correlation but demonstrates the overall significance of the model (R^2 = 0.341, df = 17; F = 8.778, P = 0.009), common rosefinch *Carpodacus erythrinus* (Pallas, 1770) shows both, significant correlation and overall significance of the model (R^2 = 0.701, df = 17; F = 39.871, P < 0.001), and ortolan bunting shows marginally significant correlation and overall significance of the model (R^2 = 0.535, df = 17; F = 19.567, P < 0.001) (Aghababyan, 2024). Some trigger species, such as Caucasian grouse, have not been included in that study because, due to their patchy distribution and a lower determination rate, they cannot be used as indicator species (Aghababyan, 2024). Nevertheless, the impact of the degradation on the species' abundance can be computed using the linear relation between species abundance and the grassland category. For example, for the trigger species ortolan bunting, the function is y = 1.757*x - 0.55, where y is an abundance of ortolan bunting, and x is the grassland category. Application of the function provides the following results: in the areas where grazing just started changing the composition of the plants (category 5), the abundance of ortolan bunting decreased by 18 %; in the area where the proportion of poisonous or thorny plants is about or above 50 % (category 4) by 35 %; in the area where the overgrazing creates permanent terrasses (category 3) by 53 %; in the area, where terrasses cover at least 20 % of the slopes (category 2) by 70 %; and in the areas, where erosion observed (category 1) by 88 %. Obviously, the negative impact on more sensitive species, like Caucasian grouse, should be more substantial.

The haymaking takes place in the flowering period of many of the plants, which basically reduces their reproduction abilities, as was shown for Inner Mongolia (Gao *et al*., 2014), and decreases the diversity of nectar suppliers, as was shown for Iran (Mahmoudi et al. 2021), China (Deng *et al*. ,2014), and Tibet (Yang & Sun, 2021). Also, haymaking in the flowering period is dangerous for the carpophagous species, such as *Phengaris nausithous*, whose first to third instar larvae feed in the flowers of *Sanguisorba officinalis* (Fiedler 1990). Also, the haymaking machinery (which is becoming more and more common in Armenia) is dangerous for ground-nesting birds, such as corn crake, as shown in species-specific studies in Armenia (Aghababyan *et al*., 2021) and other countries (Green & Stowe, 1993, Green, 2020). The scale of impact of mowing can be estimated as high for the corn crake, as it is considered the main factor that caused the species' 19 % decline in 17 years (Aghababyan *et al*., 2021).

Thus, intensive livestock husbandry causes a strong negative influence through overgrazing and uncontrolled mowing, although low-intensity grazing might be beneficial in maintaining open habitats (Rosenthal *et al*., 2012).

Another threat is related to water acquisition. The whole area is surrounded by various resorts, which take water from the mountain streams. Such an activity results in a decrease in overall humidity of the entire area, a decrease in grassy marshes, and the drying out of the wet meadows. The results of this activity are already visible on *Phengaris nausithous*, which disappeared in some of the sites near Tsaghkadzor town, most probably due to a decrease in areas of grassy marshes and wet meadows (Khanamirian *et al*., in review). It means that in some areas, the threat can cause up to 100 % decline of the species, which depends on the humid areas, such as wet meadows and marshes. Considering the high density of resorts and

settlements in the study area and poor control of water abstraction, the scale of impact of the threat can be considered high, resulting in overall aridification of the ecosystems and having a solid negative influence on the species and habitats.

These threats are exacerbated by climate change. In Armenia, there has been an increase in annual and summer temperatures, a decrease in precipitation, and an increase in the frequency of abnormal atmospheric events. The first two factors can strengthen the impact of human influence and speed up the processes of landscape aridification and habitat degradation.

Illegal hunting is one additional threat. None of the areas are allocated for public hunting, and nevertheless, the local hunters from the surrounding towns and villages, as well as visiting hunters from Yerevan, regularly hunt in this area. While the main objects could be the grey partridge *Perdix perdix* L., common quail, wood pigeon *Columba palumbus* L., and European hare *Lepus europaeus* Pallas, 1778, the hunters sometimes also target the Caucasian grouse and corn crake for food and all the raptors for a trophy. At times, some local restaurants (the names are not articulated) purchase common quail but this is not a regular income. They usually hunt in fall and winter, as they are aware of the hunting season. The State Inspection Body regularly visits the area but not very often, which gives the hunters a good window to harvest birds and the European hare. The potential scale of influence of illegal hunting can be considered as high because, in the case of Caucasian grouse, it can cause a significant decline in the population, while in the case of raptors, it can just annihilate the local breeding pairs. However, it should be stated that, at present, illegal hunting is not frequent.

Illegal logging and snag removal is another threat to the area. While the settlements of the area are provided with natural gas, wood remains a significantly cheaper fuel. As a result, cases of illegal wood cutting and removal of snags from the forest are being recorded. The scale of illegal logging can involve over 1200 households, which annually can use about 9,800 cubic meters of fuelwood (on average (± SE) 8.17 ± 0.10 cubic meters per annum per family). With an average tree capacity of 1.24 cubic meters of wood in this area (Hovhannes Abarahamyan, Hrazdan Forestry Unit of Arm Forest SNCO, personal communication), it means a demand of about 7,900 trees (or their equivalent as snag) per annum. Out of 137 questioned farmers, only nine (7 %) stated that they use gas only, 47 (34 %) stated using fuelwood only, and 81 (59 %) stated using both gas and fuelwood. Among the 128 fuelwood users, most obtain it from two sources: purchasing fuelwood from the Forestry Unit, and collecting it themselves. The amount of purchased fuelwood makes on average (± SE), 61 % ± 0.36% of the total volume of fuelwood they use. The rest is collected by cutting the "seek" trees (in the farmers' opinion) or collecting deadwood and snags. According to both Hovhannes Abarahamyan (Hrazdan Forestry Unit of Arm Forest SNCO) and interviews with local residents, the "seek" trees are usually rich with hollows. Such a practice eliminates breeding niches for 13 hollow-nesting bird species, which can significantly harm the boreal owl and semi-collared flycatcher populations.

The final threat is human-induced fires, which can emerge due to unattended picnic fires. While it is a minor influence at the moment, its threat level remains relatively high considering the large number of picnic areas and the visitors' lack of responsible behaviour.

All these threats require further monitoring of the species and habitats to improve the analysis and knowledge of the state of the species and habitats and their response (BirdLife International, 2006). Such information would also greatly help the adaptive management process.

The threat analysis of this paper focuses on a very limited area, but it seems clear that nature conservation in Armenia would greatly benefit from an in-depth Armenia-wide threat analysis. Future steps should include a larger geographical area, and potentially analyze areas that are deemed most threatened, most ecologically valuable and therefore offer a prioritization mechanism for nationwide nature conservation.

Existing and proposed conservation measures

Part of the area is recognized as Arzakan-Meghradzor State Sanctuary, but this doesn't have its own administration or a management plan. The Sanctuary's administration is implemented by the Forest Committee, which, however, doesn't have the appropriate staff to cover this entire area (Arusyak Siradeghyan, Forest Committee of RA Ministry of Environment, personal communication).

The area can be assessed as an Important Bird Area according to the criteria A1/B1a, A4, B1b, B2a. Also, the area qualifies as a Prime Butterfly Area, as it hosts a number of globally threatened and nationally threatened species, as well as important relict species. The current criteria (mainly based on the birds) demonstrate the area's significance as the Emerald Site, although a full assessment of the area which would involve the rest of the animals and plants is still required. After such assessment, it would be essential to implement the next step of delineation and to refine the ecological boundaries to yield practical boundaries (KBA Standards and Appeals Committee of IUCN SSC/WCPA 2022). It would then be necessary to develop an integrated management plan that considers the priorities of both the State Sanctuary and the interests of local communities. Specifically, such a plan could define the conservation priorities, focusing on threatened species and habitats, and then, based on the requirements of the selected species, consider the following priority activities: (a) strict protection of the nesting sites of sensitive bird species and the core areas of the patchily distributed butterfly species; (b) sustainable grazing schemes and their benefits for nature and people; (c) development of wildlife tourism (birdwatching, butterfly-watching, mammal watching, flower-watching, etc.), which help create a new value for wildlife amongst local communities; (d) opportunities for the marketing of local non-timber forest production (such as edible herbs, fruits, berries, and honey) and increasing its value in the supply chain; e) education/training program for local people to raise their awareness about the importance of surrounding nature for the local economy.

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CONFLICT OF INTEREST

The authors declare that they have no competing interests.

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ANNEX

Table 1:136 bird species observed in the Tsaghkunyats Mountain.
The species are listed in taxonomic order. RDB means conservation status of the species in Red Data Book of Animals of Armenia; IUCN – conservation status in IUCN Red List (2023); Bern – inclusion of the species in Resolution 6 of the Bern Convention; EU – inclusion of the species in Annex I of EU Directive on the conservation of wild birds; RRS – whether the species has a restricted range distribution. For both red lists, the following abbreviations are used: LC – Least Concern, NT – Near Threatened, VU – Vulnerable, EN - Endangered. The figures under columns RDB, IUCN Bern, EU, RRS – mean the total number of species protected under each agreement (for IUCN, the LC is not included).

	Scientific name	English name	Breeding Status	RDB	IUCN	Bern	EU	RRS
				25	8	36	36	3
	TETRAONIDAE							
1	*Tetrao mlokosiewiczi*	Caucasian Grouse	Breeding	VU	NT			X
	PHASIANIDAE							
2	*Alectoris chukar*	Chukar	Breeding		LC			
3	*Perdix perdix*	Grey Partridge	Breeding		LC			
4	*Coturnix coturnix*	Common Quail	Breeding		LC			
	CICONIIDAE							
5	*Ciconia nigra*	Black Stork	Breeding	EN	LC	X	X	
	ACCIPITRIDAE							
6	*Pernis apivorus*	European Honey-buzzard	Breeding		LC	X	X	
7	*Milvus migrans*	Black Kite	Breeding		LC	X	X	
8	*Gypaetus barbatus*	Lammergeyer	Breeding	VU	NT	X	X	
9	*Neophron percnopterus*	Egyptian Vulture	Breeding	EN	EN	X	X	
10	*Gyps fulvus*	Eurasian Griffon Vulture	Non-breeding	VU	LC	X	X	
11	*Aegypius monachus*	Eurasian Black Vulture	Non-breeding	EN	NT	X	X	
12	*Circaetus gallicus*	Short-toed Snake-eagle	Breeding	VU	LC	X	X	
13	*Circus aeruginosus*	Western Marsh-harrier	Non-breeding		LC	X	X	
14	*Circus cyaneus*	Northern Harrier	Non-breeding		LC	X	X	
15	*Circus macrourus*	Pallid Harrier	Non-breeding	VU	NT	X	X	
16	*Circus pygargus*	Montagu's Harrier	Non-breeding	VU	LC	X	X	
17	*Accipiter gentilis*	Eurasian Goshawk	Breeding	VU	LC			
18	*Accipiter nisus*	Eurasian Sparrowhawk	Breeding		LC			
19	*Accipiter brevipes*	Levant Sparrowhawk	Non-breeding	VU	LC	X	X	
20	*Buteo buteo*	Common Buzzard	Breeding		LC			
21	*Buteo rufinus*	Long-legged Buzzard	Breeding		LC	X	X	
22	*Aquila pomarina*	Lesser Spotted Eagle	Breeding	VU	LC	X	X	
23	*Aquila nipalensis*	Steppe Eagle	Non-breeding	VU	EN	X	X	
24	*Aquila chrysaetos*	Golden Eagle	Breeding	VU	LC	X	X	
25	*Hieraaetus pennatus*	Booted Eagle	Breeding	VU	LC	X	X	
	FALCONIDAE							
26	*Falco naumanni*	Lesser Kestrel	Non-breeding	VU	LC	X	X	
27	*Falco tinnunculus*	Common Kestrel	Breeding		LC			
28	*Falco subbuteo*	Eurasian Hobby	Non-breeding		LC			
29	*Falco peregrinus*	Peregrine Falcon	Breeding	VU	LC	X	X	

	RALLIDAE							
30	*Crex crex*	Corn Crake	Breeding	VU	LC	X	X	
	GRUIDAE							
31	*Grus grus*	Common Crane	Non-breeding	EN	LC	X	X	
32	*Anthropoides virgo*	Demoiselle Crane	Non-breeding	VU	LC			
	SCOLOPACIDAE							
33	*Actitis hypoleucos*	Common Sandpiper	Breeding		LC			
	COLUMBIDAE							
34	*Columba livia*	Rock Dove	Breeding		LC			
35	*Columba oenas*	Stock Dove	Non-breeding		LC			
36	*Columba palumbus*	Common Wood-pigeon	Breeding		LC			
	CUCULIDAE							
37	*Cuculus canorus*	Common Cuckoo	Breeding		LC			
	STRIGIDAE							
38	*Otus scops*	Common Scops-owl	Breeding		LC			
39	*Bubo bubo*	Eurasian Eagle-owl	Breeding	VU	LC	X	X	
40	*Athene noctua*	Little Owl	Breeding		LC			
41	*Strix aluco*	Tawny Owl	Breeding		LC			
42	*Asio otus*	Long-eared Owl	Breeding		LC			
43	*Aegolius funereus*	Boreal Owl	Breeding	EN	LC	X	X	
	CAPRIMULGIDAE							
44	*Caprimulgus europaeus*	Eurasian Nightjar	Breeding		LC	X	X	
	APODIDAE							
45	*Apus melba*	Alpine Swift	Breeding		LC			
46	*Apus apus*	Common Swift	Breeding		LC			
	ALCEDINIDAE							
47	*Alcedo atthis*	Common Kingfisher	Breeding		LC	X	X	
	MEROPIDAE							
48	*Merops apiaster*	European Bee-eater	Breeding		LC			
	CORACIIDAE							
49	*Coracias garrulus*	European Roller	Non-breeding	VU	LC	X	X	
	UPUPIDAE							
50	*Upupa epops*	Eurasian Hoopoe	Breeding		LC			
	PICIDAE							
51	*Jynx torquilla*	Eurasian Wryneck	Breeding		LC			
52	*Picus viridis*	Eurasian Green Woodpecker	Breeding		LC			
53	*Dendrocopos major*	Greater Spotted Woodpecker	Breeding		LC			
54	*Dendrocopos syriacus*	Syrian Woodpecker	Breeding		LC	X	X	
	ALAUDIDAE							
55	*Melanocorypha calandra*	Calandra Lark	Non-breeding		LC	X	X	
56	*Lullula arborea*	Wood Lark	Breeding		LC	X	X	
57	*Alauda arvensis*	Eurasian Skylark	Breeding		LC			
58	*Eremophila alpestris*	Horned Lark	Breeding		LC			
	HIRUNDINIDAE							
59	*Ptyonoprogne rupestris*	Eurasian Crag Martin	Breeding		LC			
60	*Hirundo rustica*	Barn Swallow	Breeding		LC			
61	*Delichon urbica*	Northern House-martin	Breeding		LC			

	MOTACILLIDAE							
62	*Anthus trivialis*	Tree Pipit	Breeding		LC			
63	*Anthus spinoletta*	Water Pipit	Breeding		LC			
64	*Motacilla flava*	Yellow Wagtail	Breeding		LC			
65	*Motacilla cinerea*	Grey Wagtail	Breeding		LC			
66	*Motacilla alba*	White Wagtail	Breeding		LC			
	CINCLIDAE							
67	*Cinclus cinclus*	White-throated Dipper	Breeding		LC			
	TROGLODYTIDAE							
68	*Troglodytes troglodytes*	Winter Wren	Breeding		LC			
	PRUNELLIDAE							
69	*Prunella modularis*	Dunnock	Breeding		LC			
70	*Prunella ocularis*	Radde's Accentor	Breeding		LC			X
	MUSCICAPIDAE							
71	*Erithacus rubecula*	European Robin	Breeding		LC			
72	*Luscinia megarhynchos*	Common Nightingale	Breeding		LC			
73	*Luscinia svecica*	Bluethroat	Breeding		LC	X	X	
74	*Phoenicurus ochruros*	Black Redstart	Breeding		LC			
75	*Phoenicurus phoenicurus*	Common Redstart	Breeding		LC			
76	*Muscicapa striata*	Spotted Flycatcher	Breeding		LC			
77	*Ficedula parva*	Red-breasted Flycatcher	Non-breeding		LC	X	X	
78	*Ficedula semitorquata*	Semicollared Flycatcher	Breeding	VU	LC	X	X	
79	*Saxicola rubetra*	Whinchat	Breeding		LC			
80	*Saxicola maura*	Syberian Stonechat	Breeding		LC			
81	*Oenanthe oenanthe*	Northern Wheatear	Breeding		LC			
82	*Monticola saxatilis*	Rufous-tailed Rock-thrush	Breeding		LC			
83	*Monticola solitarius*	Blue Rock-thrush	Breeding		LC			
	TURDIDAE							
84	*Turdus torquatus*	Ring Ouzel	Breeding		LC			
85	*Turdus merula*	Eurasian Blackbird	Breeding		LC			
86	*Turdus philomelos*	Song Thrush	Breeding		LC			
87	*Turdus viscivorus*	Mistle Thrush	Breeding		LC			
88	*Turdus pilaris*	Fieldfare	Non-breeding		LC			
	SCOTOCERCIDAE							
89	*Cettia cetti*	Cetti's Warbler	Breeding		LC			
	LOCUSTELLIDAE							
90	*Locustella naevia*	Grasshopper Warbler	Breeding		LC			
	ACROCEPHALIDAE							
91	*Acrocephalus palustris*	Marsh Warbler	Breeding		LC			
92	*Iduna pallida*	Olivaceous Warbler	Breeding		LC			
93	*Hippolais languida*	Upcher's Warbler	Breeding		LC			
	SYLVIIDAE							
94	*Sylvia atricapilla*	Blackcap	Breeding		LC			
95	*Sylvia borin*	Garden Warbler	Breeding		LC			
96	*Sylvia curruca*	Lesser Whitethroat	Breeding		LC			
97	*Sylvia communis*	Greater Whitethroat	Breeding		LC			
	PHYLLOSCOPIDAE							

98	*Phylloscopus trochilus*	Willow Warbler	Non-breeding		LC			
99	*Phylloscopus collybita*	Eurasian Chiffchaff	Non-breeding		LC			
100	*Phylloscopus sindianus*	Mountain Chiffchaff	Breeding		LC			X
101	*Phylloscopus nitidus*	Green Warbler	Breeding		LC			
	AEGITHALIDAE							
102	*Aegithalos caudatus*	Long-tailed Tit	Breeding		LC			
	PARIDAE							
103	*Parus ater*	Coal Tit	Breeding		LC			
104	*Parus caeruleus*	Blue Tit	Breeding		LC			
105	*Parus major*	Great Tit	Breeding		LC			
	SITTIDAE							
106	*Sitta europaea*	Eurasian Nuthatch	Breeding		LC			
107	*Sitta neumayer*	Western Rock-nuthatch	Breeding		LC			
	TICHODROMIDAE							
108	*Tichodroma muraria*	Wallcreeper	Breeding	VU	LC			
	CERTHIIDAE							
109	*Certhia familiaris*	Eurasian Tree-creeper	Breeding		LC			
	REMIZIDAE							
110	*Remiz pendulinus*	Eurasian Penduline-tit	Breeding		LC			
	LANIIDAE							
111	*Lanius collurio*	Red-backed Shrike	Breeding		LC	X	X	
112	*Lanius excubitor*	Great Grey Shrike	Non-breeding		LC			
	CORVIDAE							
113	*Garrulus glandarius*	Eurasian Jay	Breeding		LC			
114	*Pica pica*	Black-billed Magpie	Breeding		LC			
115	*Pyrrhocorax pyrrhocorax*	Red-billed Chough	Breeding		LC	X	X	
116	*Corvus corone*	Carrion Crow	Breeding		LC			
117	*Corvus corax*	Common Raven	Breeding		LC			
	PASSERIDAE							
118	*Passer domesticus*	House Sparrow	Breeding		LC			
119	*Passer montanus*	Eurasian Tree Sparrow	Breeding		LC			
120	*Petronia petronia*	Rock Sparrow	Breeding		LC			
	FRINGILLIDAE							
121	*Fringilla coelebs*	Chaffinch	Breeding		LC			
122	*Fringilla montifringilla*	Brambling	Non-breeding		LC			
123	*Serinus pusillus*	Red-fronted Serin	Breeding		LC			
124	*Carduelis chloris*	European Greenfinch	Breeding		LC			
125	*Carduelis carduelis*	European Goldfinch	Breeding		LC			
126	*Carduelis spinus*	Eurasian Siskin	Non-breeding		LC			
127	*Carduelis cannabina*	Eurasian Linnet	Breeding		LC			
128	*Carduelis flavirostris*	Twite	Breeding		LC			
129	*Carpodacus erythrinus*	Common Rosefinch	Breeding		LC			
130	*Pyrrhula pyrrhula*	Eurasian Bullfinch	Breeding		LC			
131	*Coccothraustes coccothraustes*	Hawfinch	Breeding		LC			
	EMBERIZIDAE							
132	*Emberiza citrinella*	Yellowhammer	Non-breeding		LC			
133	*Emberiza cia*	Rock Bunting	Breeding		LC			

134	*Emberiza hortulana*	Ortolan Bunting	Breeding		LC	X	X	
135	*Emberiza melanocephala*	Black-headed Bunting	Breeding		LC			
136	*Miliaria calandra*	Corn Bunting	Breeding		LC			

Table 2: 141 observed butterfly species inhabiting Tsaghkunyats Mountain.
The species are listed in taxonomic order. RDB means conservation status of the species in Red Data Book of Animals of Armenia; IUCN – conservation status in IUCN Red List; Bern – inclusion of the species in Resolution 6 of the Bern Convention; EU – inclusion of the species in Annex I of EU Directive on the conservation of wild birds; RRS – whether the species is considered having a restricted range distribution. For both red lists, the following abbreviations are used: LC – Least Concern, NT – Near Threatened, VU – Vulnerable, EN – Endangered, NE – Not Evaluated.

N	Species	IUCN Global	IUCN European	IUCN Mediterranean	Bern Res6	RDB Armenia	Regional endemic
Hesperiidae							
1	*Erynnis tages*	NE	LC	LC		NE	
2	*Carcharodus alceae*	NE	LC	LC		NE	
3	*Carcharodus flocciferus*	NE	NE	LC		NE	
4	*Carcharodus orientalis*	NE	LC	LC		NE	
5	*Muschampia tessellum*	NE	NE	NE		NE	
6	*Spialia orbifer*	NE	LC	LC		NE	
7	*Pyrgus melotis*	NE	NE	LC		NE	
8	*Pyrgus sidae*	NE	LC	LC		NE	
9	*Pyrgus serratulae*	NE	LC	LC		NE	
10	*Purgus armoricanus*	NE	LC	LC		NE	
11	*Pyrgus alveus*	NE	LC	LC		NE	
12	*Ochlodes sylvanus*	NE	LC	LC		NE	
13	*Thymelicus lineola*	NE	LC	LC		NE	
14	*Thymelicus sylvestris*	NE	LC	LC		NE	
15	*Hesperia comma*	NE	LC	LC		NE	
Papilionidae							
16	*Parnassius apollo*	LC	LC	LC		VU	
17	*Parnassius mnemosyne*	LC	NT	LC		VU	
18	*Iphiclides podalirius*	NE	LC	LC		NE	
19	*Papilio alexanor*	NE	LC	LC		VU	
20	*Papilio machaon*	NE	LC	LC		NE	
Pieridae							
21	*Leptidea sinapis*	NE	NE	LC		NE	

22	*Leptidea duponcheli*	NE	LC	LC		NE	
23	*Anthocharis cardamines*	NE	LC	LC		NE	
24	*Anthocharis damone*	NE	LC	LC		NE	
25	*Anthocharis gruneri*	NE	LC	LC		NE	
26	*Euchloe ausonia*	NE	LC	LC		NE	
27	*Pontia edusa*	NE	LC	LC		NE	
28	*Aporia crataegi*	NE	LC	LC		NE	
29	*Pieris brassicae*	NE	LC	LC		NE	
30	*Pieris pseudorapae*	NE	NE	NE		NE	
31	*Pieris ergane*	NE	LC	LC		NE	
32	*Pieris rapae*	NE	LC	LC		NE	
33	*Colias alfacariensis*	NE	LC	LC		NE	
34	*Colias aurorina*	NE	LC	LC		VU	
35	*Colias croceus*	NE	LC	LC		NE	
36	*Colias thisoa*	NE	NE	NE		NE	X
37	*Gonepteryx farinosa*	NE	LC	LC		NE	
38	*Gonepteryx rhamni*	NE	LC	LC		NE	
Nymphalidae							
39	*Kirinia climene*	NE	LC	NE		NE	
40	*Lasiommata maera*	NE	LC	LC		NE	
41	*Lasiommata megera*	NE	LC	LC		NE	
42	*Melanargia galathea*	NE	LC	NE		NE	
43	*Melanargia larissa*	NE	LC	LC		NE	
44	*Melanargia russiae*	NE	LC	LC		NE	
45	*Arethusana arethusa*	NE	LC	LC		NE	
46	*Coenonympha arcania*	NE	LC	LC		NE	
47	*Coenonympha glycerion*	NE	LC	LC		NE	
48	*Coenonympha pamphilus*	NE	LC	LC		NE	
49	*Erebia aethiops*	NE	LC	NA		NE	
50	*Erebia graucasica*	NE	NE	NE		NE	X
51	*Erebia medusa*	NE	LC	LC		NE	
52	*Hyponephele lupine*	NE	LC	LC		NE	
53	*Hyponephele lycaon*	NE	LC	LC		NE	
54	*Maniola jurtina*	NE	LC	LC		NE	
55	*Hipparchia pellucida*	NE	LC	LC		NE	
56	*Hipparchia syriaca*	NE	LC	LC		NE	
57	*Hipparchia parisatis*	NE	NE	LC		NE	

58	*Hipparchia statilinus*	NE	NT	LC		NE	
59	*Brintesia circe*	NE	LC	LC		NE	
60	*Satyrus dryas*	NE	LC	NA		NE	
61	*Pseudochazara beroe*	NE	NE	LC		NE	
62	*Pseudochazara geyeri*	NE	LC	NA		NE	
63	*Pseudochazara pelopea*	NE	NE	LC		NE	
64	*Chazara briseis*	NE	NT	LC		NE	
65	*Chazara persephone*	NE	LC	LC		NE	
66	*Chazara bischoffi*	NE	NE	LC		NE	
67	*Thaleropis ionia*	NE	NE	NE		NE	X
68	*Limenitis reducta*	NE	NE	NE		NE	
69	*Limenitis camilla*	NE	NE	NE		NE	
70	*Neptis rivularis*	NE	LC	NA		NE	
71	*Vanessa atalanta*	LC	LC	LC		NE	
72	*Vanessa cardui*	LC	LC	LC		NE	
73	*Inachis io*	NE	LC	LC		NE	
74	*Polygonia c-album*	NE	LC	LC		NE	
75	*Nymphalis antiopa*	LC	LC	LC		NE	
76	*Nymphalis xanthomeles*	NE	LC	NA		NE	
77	*Nymphalis polychloros*	NE	LC	LC		NE	
78	*Aglais urticae*	NE	LC	LC		NE	
79	*Argynnis pandora*	NE	LC	LC		NE	
80	*Argynnis paphia*	NE	LC	LC		NE	
81	*Argynnis aglaja*	NE	LC	LC		NE	
82	*Argynnis adippe*	NE	LC	LC		NE	
83	*Boloria caucasica*	NE	LC	LC		NE	X
84	*Brenthis hecate*	NE	LC	NE		NE	
85	*Brenthis ino*	NE	LC	LC		VU	
86	*Clossiana euphrosyne*	NE	LC	LC		NE	
87	*Proclossiana eunomia**	NE	LC	NE		NE	
88	*Issoria lathonia*	NE	LC	LC		NE	
89	*Euphydryas aurinia*	NE	LC	LC		NE	
90	*Melitaea diamina**	NE	LC	LC		NE	
91	*Melitaea didyma*	NE	LC	LC		NE	
92	*Melitaea persea*	NE	NE	LC		NE	
93	*Melitaea cinxia*	NE	LC	LC		NE	

94	*Melitaea phoebe*	NE	LC	LC		NE	
95	*Melitaea athalia*	NE	LC	LC		NE	
96	*Mellicta caucasogenita*	NE	NE	NE		NE	X
Lycaenidae							
97	*Thecla betulae*	NE	LC	LC		NE	
98	*Favonius quercus*	NE	LC	LC		NE	
99	*Satyrium ilicis*	NE	LC	LC		NE	
100	*Satyrium spini*	NE	LC	LC		NE	
101	*Callophrys danchenkoi*	NE	NE	NE		NE	X
102	*Callophrys paulae*	NE	NE	LC		NE	
103	*Tomares callimachus*	NE	LC	NE		NE	
104	*Lycaena phlaeas*	NE	LC	LC		NE	
105	*Lycaena virgaureae*	NE	LC	LC		NE	
106	*Lycaena tityrus*	NE	LC	LC		NE	
107	*Lycaena candens*	NE	LC	NE		NE	
108	*Lycaena alciphron*	NE	LC	LC		NE	
109	*Lycaena thersamon*	NE	LC	LC		NE	
110	*Lycaena thetis*	NE	NA	LC		NE	
111	*Lampides boeticus*	LC	LC	LC		NE	
112	*Cupido minima*	NE	LC	LC		NE	
113	*Cupido osiris*	NE	LC	LC		NE	
114	*Celastrina argiolus*	NE	LC	LC		NE	
115	*Pseudophilotes vicrama*	NE	NT	LC		NE	
116	*Glaucopsyche alexis*	NE	LC	LC		NE	
117	*Maculinea alcon*	NE	LC	LC		VU	
118	*Maculinea arion*	NT	EN	NE		VU	
119	*Maculinea nausithous*	NT	NT	NA	X	VU	
120	*Plebejus argus*	NE	LC	LC		NE	
121	*Plebeius idas*	NE	LC	LC		NE	
122	*Kretania sephirus*	NE	LC	NE		NE	
123	*Aricia eumedon*	NE	LC	LC		NE	
124	*Aricia agestis*	NE	LC	LC		NE	
125	*Aricia allous*	NE	NE	NE		NE	
126	*Aricia anteros*	NE	NT	LC		NE	
127	*Cyaniris bellis*	NE	NE	NE		NE	
128	*Agriades dardanus*	NE	NT	LC		NE	
129	*Polyommatus coelestina*	NE	LC	LC		NE	

130	*Polyommatus bellargus*	NE	LC	LC		NE	
131	*Polyommatus corydonius*	NE	LC	LC		NE	
132	*Polyommatus daphnis*	NE	LC	LC		NE	
133	*Polyommatus icarus*	NE	LC	LC		NE	
134	*Polyommatus amandus*	NE	LC	LC		NE	
135	*Polyommatus dorylas*	NE	NT	LC		NE	
136	*Polyommatus thersites*	NE	LC	LC		NE	
137	*Polyommatus ripartii*	NE	LC	LC		NE	
138	*Polyommatus damon*	NE	NT	LC		NE	
139	*Polyommatus firdussii*	NE	NE	NE		NE	X
140	*Polyommatus vanensis*	NE	NE	NE		NE	X
141	*Polyommatus altivagans*	NE	NE	NE		NE	X