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Gender and age composition of the bezoar ibex populations in the Nagorno-Karabakh fauna

 Vahram T. Hayrapetyan¹,  Lusine G. Aydinyan^{1*},  Karine V. Balayan²,  Astghik S. Ghazaryan³,  Nonna M. Grigoryan¹,

¹Scientific Center of Zoology and Hydroecology, Paruyr Sevaki St. 7, Yerevan, 0014, Armenia.

²Takhtajyan Institute of Botany, Ajaryan street 1, Yerevan, 0063, Armenia.

³Yerevan State University, Alek Manukyan St., 1 Building, Yerevan, 0025, Armenia.

Corresponding author: Lusine G. Aydinyan (Email: luskarapetian@gmail.com)

Abstract

Evaluation and monitoring of ungulate populations, particularly the bezoar ibex (*Capra aegagrus* Erxleben, 1777). The study evaluated the distribution, gender-age composition, and altitudinal zonation of bezoar ibex populations in Nagorno-Karabakh's Mrav, Kusanats, and Bardutagh ranges (1999–2023). A total of 6,707 individuals were analyzed, revealing a female-biased gender ratio, high juvenile mortality, and age-specific survival trends. Poaching remains a significant threat to population dynamics.

Keywords: Artiodactyla, Ecology, Mammalia, Mountain goat, Mountain range, Nagorno-Karabakh, Ungulate.

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1. Introduction

In the mammalian fauna of Nagorno-Karabakh, the ungulates are represented by three families (Suidae Gray, 1821; Cervidae Goldfus, 1820; Bovidae Gray, 1821) and five species [1]. Species of *Cervidae* and *Bovidae* are listed in the local Red Book. All representatives of the discussed families are valuable hunting objects. In this regard, the research object is the population structure of the bezoar ibex (*Capra aegagrus* Erxleben, 1777), living in various mountain ranges of Nagorno-Karabakh (Figure 1).



Figure 1.
Capra aegagrus erxleben, 1777, ♂.

The sustainable functioning of populations is based on their structure: the relative number of individuals in different age groups, the regularity of the distribution depending on the time of year and day, and the systematicity of relationships between individuals.

Like all other ungulates, the structural formations of bezoar ibex populations are formed under the influence of several external and internal factors that ensure the populations' adaptation, provide an optimal operation mode, and allow populations to withstand changing environmental conditions.

This study aims to identify the distribution, age, and gender composition, as well as changes depending on the altitudinal zonation of northern, central, and southern populations of bezoar ibex in the Nagorno-Karabakh, to elucidate the features that determine the animals' demographic structure in our conditions.

2. Materials and Methods

2.1. Place Description and Study Stages

The research materials are the results of observations from 1999 to 2023 in various places of Nagorno-Karabakh, particularly in the Mrav (northwest part, N 40.266667°, E 46.316667°, the maximum height is 3724 m), Kusanats (central part, N 39.826112°, E 46.773889°, 2832 m), and Bardutagh (southeast part, N 38.961944°, E 46.508889°, 2270 m) mountain ranges, which can be divided into several stages. Topographic and descriptive observations were carried out in the first stage from 1999 to 2004. The second stage (2004–2014) was devoted to elucidating ecological features, and in the third stage, from 2014 to the present, along with other stages, studies of population structural formations were conducted.

2.2. Devices Used in Observation

Research materials were constantly replenished based on the results of annual expeditions. To assess and monitor the studied populations of bezoar ibex in their habitats, camera traps of the HC 200 type were used (Figure 2), which were charged with light batteries that allowed them to be left for 3–4 months. In addition, night vision devices and data from cameras located in border areas were applied. A Canon SX540HS camera was used to count animals in large groups. The altitude of settlements above sea level was determined using the Garmin 64s GPS altimeter. Navigator 12×50 binoculars and the 3PT-457 telescope were used for animal observation and counting.

2.3. Quantity Calculation Methodology

During the 1999–2023 periods, 6707 bezoar goats were counted, including: 2703 (1224 ♂♂, 1479 ♀♀) in Mrav, 2342 (1058 ♂♂, 1284 ♀♀) in Kusanats, and 1662 (762 ♂♂, 900 ♀♀) in Bardutagh. Calculations were carried out visually according to the method proposed by Weinger [2] according to which the observation points were placed on the cliffs of three mountain ranges, on the southern or northern slopes of which bezoar goats are found in the morning and evening. The Bezoar ibex was counted from these observation points from morning until noon (from 6:00 a.m. to 11:00 or 12:00 p.m.). The next count was made 1 hour before sunset when the animals go out to pasture in the evening. Large groups of bezoar ibex were counted from photographs. For calculations at different points of the range, we selected 3-5 calculated plots of the most characteristic areas of the species' range with a surface of 1000–2000 hectares, which were limited to mountain peaks and slopes as much as possible. We counted 3–4 or 5–6 (in some years) animals for 4–5 days [3] with fourfold repetitions to reduce the counting errors associated with animal movements.



Figure 2.
Installation of camera traps.

2.4. Age Determination

The age of the animals was determined by counting the annuli rings formed on the horns. In bezoar ibex, like all bovids, horns grow throughout life, although growth slows down with age [4]. Horn growth decelerates in winter and recovers in spring. As a result, the rings are created on the surface of the horn, and the animal's age is determined with an accuracy of up to a year. The large size of the horns of males and well-defined annuli rings make it possible to determine the age of ibex from photos or a long distance using optical equipment. This method is unacceptable for female bovids [5] and their age is determined by the horns of dead animals or by unique mathematical methods [6, 7]. Age estimation is also possible by using tooth wear, but it is pretty complicated due to the fact that live goats are hunted. The age of the Bezoar ibex was also determined by morphological characteristics (body size, shape and size of horns, fur cover, and color). Animals in which the back belt (a black strip along the spine with the withers) is not yet formed and has a golden-brown color are defined as 2–4 years of age; in goats, 5–9 years of age, the back and scapular belt are fully formed, black in color, reaching from the chest to the front legs (Figure 1); animals in which the belt gradually disappears and the fur cover from a light shade becomes grayish are ten years old and older [8].

2.5. Study of Sex–Age Structure

During the study of bezoar ibex populations conducted in Nagorno-Karabakh, the following gender-age groups were distinguished: under yearlings (up to 1-year-old), yearlings (1–3 years old), bucks and does (adults 4–7 years old), and older ibex (8–10 years and older). Similar to other members of the Caprinae subfamily, sexual dimorphism is quite well-defined. Adult males are approximately two times larger than females; they have beards and horns 90–120 cm long or more. Females are beardless and have horns 20–30 cm long. Hornless males and females are an exceptional phenomenon. Males and females also differ in their summer and winter fur. In summer, males and females have a gray-brown color, but males have a black band. In winter, males have a light, dirty gray tinge with a black stripe, and females have a grayish-gray color. The main criterion for determining the current year's generation is body size. In cases of difficulty in determining the gender of the current generation, the ratio of 1:1 is conventionally accepted. The most reliable data on age estimation were obtained in the male population and used in demographic tables, representing important statistical data for the population [9–11]. The smoothing of the age distribution was calculated using a log-polynomial function. $\text{Log}f(x)=a+bx+cx^2+dx^3+\dots$, where $f(x)$ is the frequency of x age in the group, and a, b, c, d are constants [9]. Statistical analyses were conducted using IBM SPSS version software 27.

Ecological observations were carried out using classical methods accepted in zoology [12–14]. The density (σ) of bezoar ibex was calculated by the formula $\sigma = a / l \times r$ [15] where a is the sample number, l - route length, r - depth of the view field. We also used classical topographic characteristics, such as slope degree, altitude above sea level, and slope location [16, 17].

3. Results

3.1. Sex and Age Composition of Ibex Depending on Altitude

In the studied areas, the gender ratio of bezoar ibex is 1:1.3 in favor of females. During the study, the under-yearlings were 0.54 per mother. Studies have shown that the gender and age composition of bezoar ibex populations changes depending on the habitat's altitude, the season, the number of hibernating animals, the forage abundance, etc. The analysis of variance (ANOVA) was performed to evaluate the relationship between the relative abundance of different genders and age groups of the bezoar ibex and the altitude above sea level. The means differ significantly, $F(5, 75) = 9.90, p < 0.001, \eta^2$

= 0.39. Tukey's HSD test at the 0.001 level was used to conduct post hoc analyses. The test indicated that the mean relative abundance of the 1300–1600 m above sea level ($M = 104.23$, $SD = 39.09$) was significantly higher than that of the 2900–3200 m ($M = 22.75$; $SD = 9.14$), the comparison revealed also significant difference between 1300–1600 m and 2500–2800 m ($M = 33.75$; $SD = 18.48$); between 800 – 1200 m ($M = 102.05$; $SD = 29.29$) and 2900–3200 m; 800 – 1200 m and 2500 – 2800 m. However, there was no statistically significant difference between 800 – 1200 m and 1300 – 1600 m ($p = 1.0$) or 1700 – 2000 ($p = 0.66$); 1300 – 1600 m and 1700 – 2000 m ($p = 0.50$); 1700 – 2000 m and 2100 – 2400 m ($p = 0.40$); 2100 – 2400 m and 2500 – 2800 m ($p = 0.55$) or 2900 – 3200 ($p = 0.41$); 2500 – 2800 m and 2900 – 3200 m ($p = 0.99$).

The box plots of the gender and age groups of bezoar ibex were constructed based on the results of the mean of the relative abundance in each altitude group and Tukey's HSD test (Figure 3).

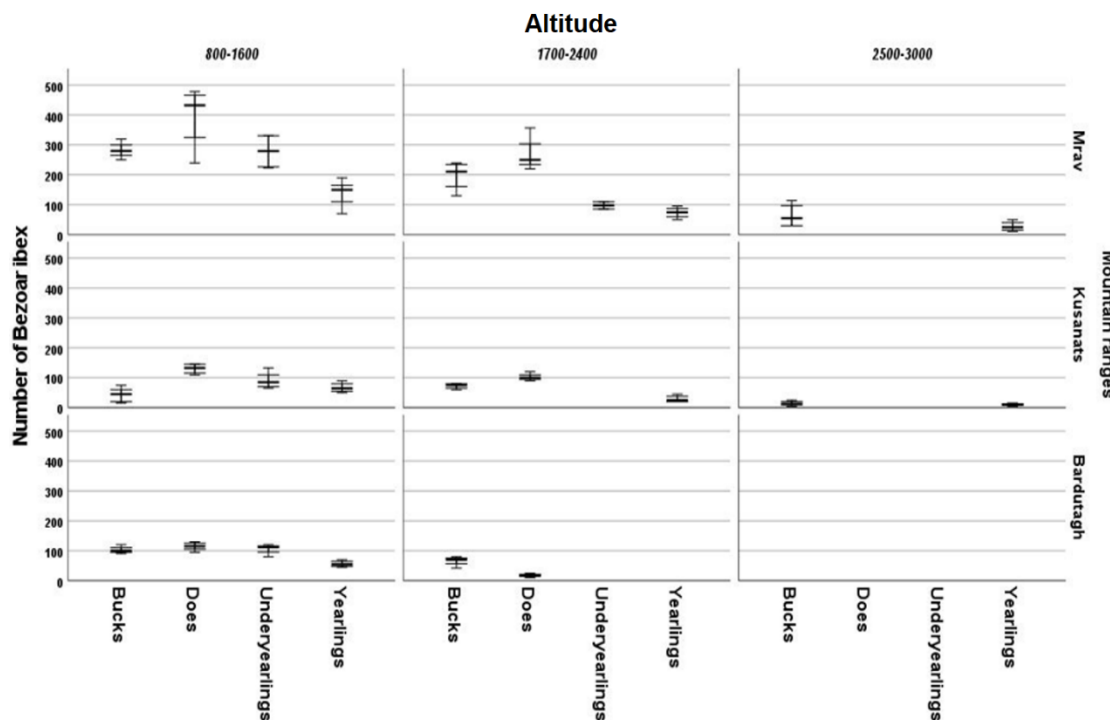


Figure 3.

Relative abundance of different gender and age groups of the bezoar ibex depending on altitude.

Changes in the quantitative distribution of different age groups of Bezoar goats in the discussed mountain ranges are caused by the presence of different landscapes and peaks in the mountain ranges. As shown in Figure 3, the relative abundance of goats in Mrav is more dispersed compared to the other two mountain ranges, where the relative abundance is less variable. This boxplot shows decreasing medians of bucks' relative numbers in Mrav with increasing altitude, but the abundance of yearlings doesn't change significantly. With increasing altitude, the relative abundance of does first increases (up to about 1900 m) and then decreases. At 2500–3000 m altitudes, adult females or lactating does, and under-yearlings haven't been recorded in the Mrav mountain range. In the Kusanats mountain range, the number of adult ibex and yearlings is less variable; the current year's goats haven't reached an altitude above 1700 m. Since the Bardutagh mountain range is only 2270 m high, no data is available at elevations between 2500 and 3000 m, and the number of bucks and does declines above 1700 m.

3.2. Age Distribution of Bezoar Ibex in Three Mountain Ranges

Despite the existing differences in population density, the overall picture of the gender and age structure of the population is almost the same. The composition of these populations mainly includes under-yearlings, which in the Mrav Mountains was 19.8 %, yearlings make up 35.2 %, adults – 27.6 %, senior goats – 17.4 %; in the Kusanats Mountains, respectively, 19.8, 37.9%, 26.6%, and 15.7 %, in the Bardutagh Mountain 18.8 %, 38.4 %, 31.9 %, and 10.9 %.

In the discussed areas, significant differences in gender composition are observed in the numerical ratios of the older bucks' cohort. In the Mrav Mountains, bucks aged seven years and older make up 20.2%, in Kusanats, 19.6%, in Bardutagh, 21% (Table 1).

Table 1.

Age distribution of males and females in three populations of bezoar ibex in Mrav, Kusanats, and Bardutagh mountains.

Age in years	Total number in Mrav	Mrav				Total number in Kusanats	Kusanats				Total number in Bardutagh	Bardutagh			
		Male		Female			Male		Female			Male		Female	
		n	%	n	%		n	%	N	%		n	%	n	%
0	535	253	47.3	282	52.7	463	224	48.4	239	51.6	312	150	48.0	162	52.0
1	451	211	46.8	240	53.2	415	200	48.2	215	51.8	225	110	48.8	115	51.2
2	260	115	44.2	145	55.8	244	115	47.2	129	52.8	216	104	48.1	112	51.9
3	239	108	45.1	131	54.9	229	107	46.8	122	53.2	196	96	48.9	100	51.1
4	226	103	45.5	123	54.5	198	86	43.4	112	56.6	169	81	47.9	88	52.1
5	214	99	43.8	115	53.7	171	65	38.0	106	62.0	149	77	51.6	72	48.4
6	173	83	48.0	90	52.0	145	54	37.2	91	62.8	117	52	44.4	65	55.6
7	134	61	45.5	73	54.4	110	49	44.5	61	55.5	96	45	46.8	51	53.2
8	129	60	46.6	69	53.4	92	37	40.2	55	59.8	54	12	22.2	42	77.8
9	94	41	43.6	53	56.4	76	32	42.10	44	57.9	39	8	20.5	31	79.5
10	71	29	40.8	42	59.1	62	29	46.7	33	53.3	27	7	25.9	20	74.1
11	48	20	41.6	28	58.4	46	20	43.4	26	56.6	20	6	30.0	14	70.0
12	39	17	43.6	22	56.4	29	14	48.2	15	51.8	20	5	55.0	15	45.0
13	32	14	43.8	18	56.2	20	10	50.0	10	50.0	13	5	38.4	8	61.6
14	25	10	40.0	15	60.0	17	8	47.0	9	53.0	9	4	44.4	5	55.6
15	11	-	-	11	-	12	5	41.6	7	58.4	-	-	-	-	-
16	9	-	-	9	-	8	3	37.5	5	62.5	-	-	-	-	-
17	7	-	-	7	-	3	-	-	3	-	-	-	-	-	-
18	6	-	-	6	-	2	-	-	2	-	-	-	-	-	-
Total	2703	1224	45.3	1479	54.7	2342	1058	45.2	1284	54.8	1662	762	45.8	900	54.2

3.3. Smoothed Rows

In all three populations, females outnumber males in single-age cohorts, and this difference grows with age (Figure 4), which can be attributed to selective hunting. There are no bucks older than 14 years old in Mrav, 16 years old in Kusanats, and in Bardutagh, the age of the goats is limited to 14 years old. No significant differences were recorded in the smoothed rows of the current year's goats in the three mountain ranges. Compared to the other two mountain ranges, Bardutagh has a higher percentage of bucks and does between the ages of 2 and 7 due to the favorable conditions of this mountain range, where the winter is mild, and fodder is available for goats. In contrast to Mrav and Kusanats, where the winter is more severe, the thick layer of snow makes feed inaccessible, leading to malnutrition, exhaustion, and, ultimately, animal death. Selective hunting and negligence during the breeding season are the causes of the dynamic decline in the percentage of bucks.

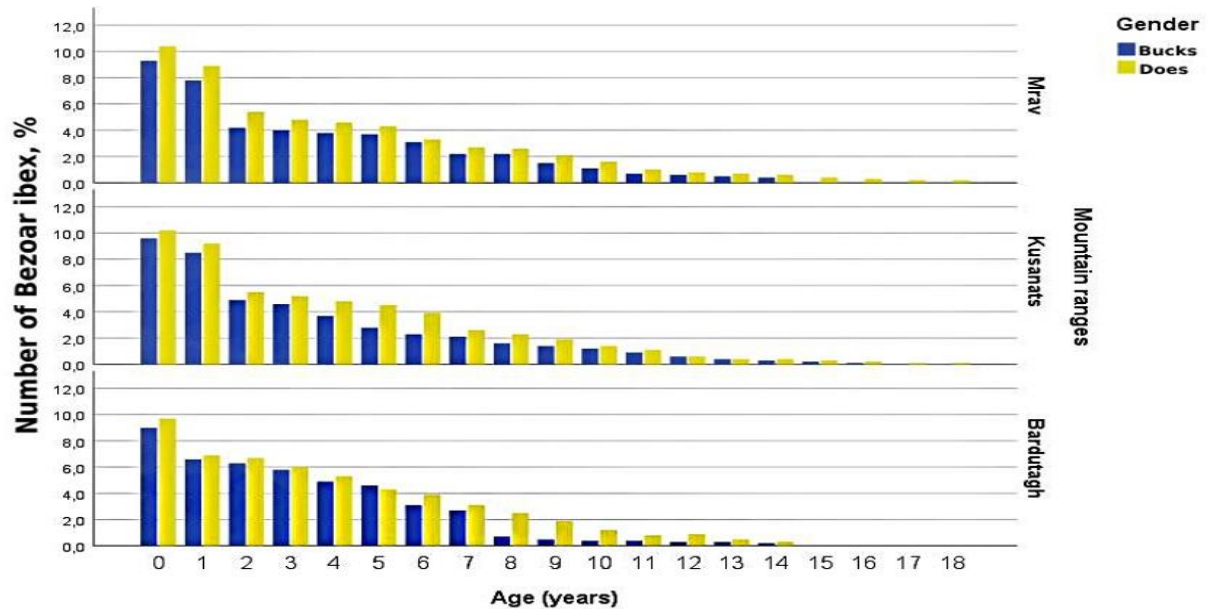


Figure 4.
Smoothed results of the population age distribution of bezoar ibex in the mountain ranges of Mrav, Kusanats, and Bardutagh (%).

3.4. Demographic Structure

The demographic structure of the population can also be expressed as an age pyramid (Figure 5). Figure 5 shows that in the three mountain ranges, the ratio of under-yearlings and yearlings is almost equal, with a slight predominance of females. The species number of both older age groups in the Kusanats Mountains is relatively higher than in the other two.

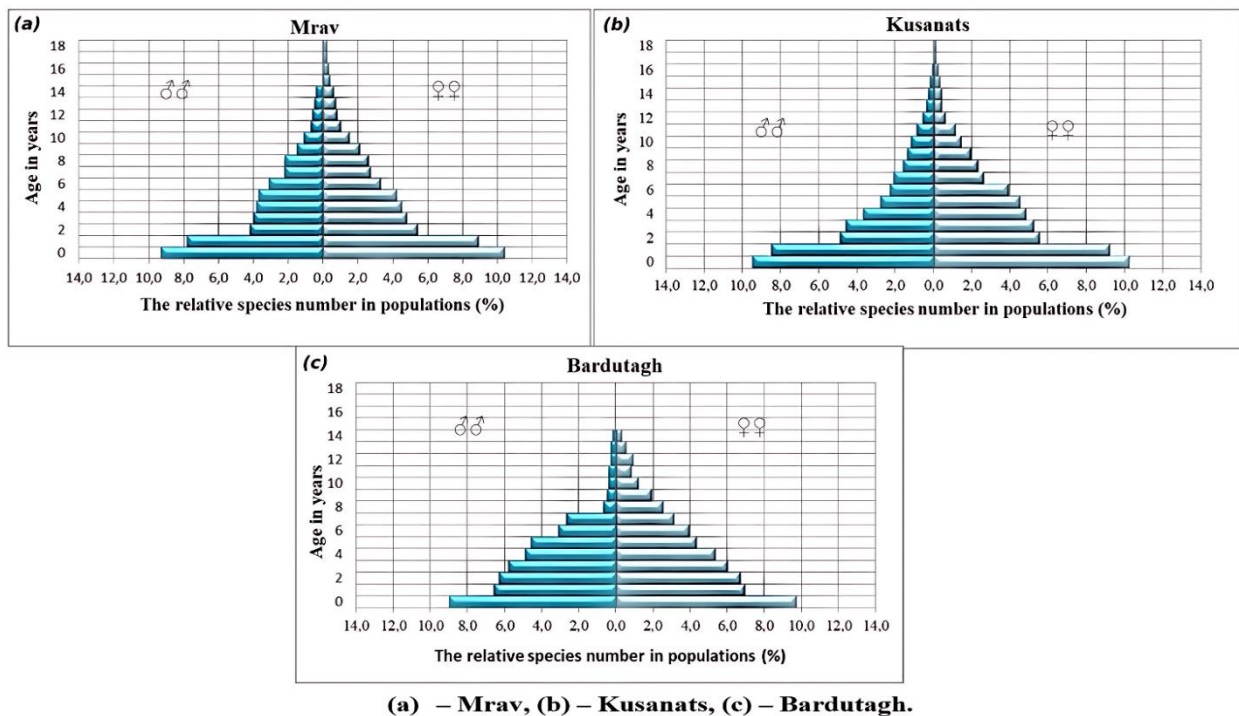


Figure 5.
Age pyramid of bezoar ibex populations in three mountain ranges.

It is known that the species' mortality and reproduction determine the demographic structure of populations. The mortality rate in the high age groups of the three populations differs significantly by location, which determines the demographic structure of these populations.

3.4. Reproduction

It can be assumed that the beginning and duration of mating vary from year to year within small limits and depending on climatic conditions. Thus, in 2009, in the Mrav Mountains, the mating process began in early November and ended in the second half of December. In 2012, mating was completed in the same mountain range in the second half of November. According to the observations made in the Kusanats mountain range in 2010, mating started in the second ten days of November and ended in the first ten days of December. Still, we recorded the mating process in some species at the beginning of January, which, in our opinion, are unfertilized or late sexually aroused females. In 2013, in the same mountain range, mating began in the first ten days of December and ended at the end of December. In 2018, mating in the Bardutagh Mountains started in the middle of December and ended in the first half of January; during that period, there was little snow in the winter; according to our observations, the duration of breeding periods for bezoar ibex is determined by the relative mildness of the early winter months. On the contrary, in cold and snowy years, the mating period is relatively shortened and begins in the second half of November and ends on December 20–25. As the mating season wanes, males separate from females and remain in small groups.

The gestation period of bezoar ibex is five months and can be extended for 10–15 days. Pregnant females separate from the flock shortly before giving birth, find quiet, peaceful, safe, suitable places, and graze. Birth begins in the second half of April and lasts until June 20–25. The same was noted in the Bardutag and Kusanats Mountains, resulting from late mating and fertilization.

During observations in the Mrav Mountains on July 8, 2013, we recorded a mother with her newborn twins, which is most likely associated either with a delay in the first mating or fertilization failure at the first mating and with the success of the second mating, which is repeated after 15–18 days.

Before giving birth, pregnant females gather in rocky places inaccessible to predators and form groups. One-year-old and newborn species can be found with mothers in "maternity houses." Similar places were found in the Kusanats (15/06/2009) and Mrav (19/06/2013) Mountains. During the study, the first newborn species was discovered in the Mrav Mountain range in 2005 on April 23. We recorded the first newborn in the Bardutagh Mountains on April 29, 2007. Mass births were observed in the second ten days of May in all the mountain ranges discussed. Females usually have two kids, in some cases one, and rarely three kids. This phenomenon in nature, even for a certain time, leads to a species number increase and, in some cases, a decrease in newborn numbers. Twins are physically weak and cannot gain sufficient weight and fully feed until the harsh winter, so the mortality rate of under-yearlings is high.

The most obvious indicator reflecting the nature of mortality by species' age groups is specific mortality: the proportion of animal deaths of a certain age or their death probability by a particular age.

Table 2.
Pearson correlation results of vitality and mortality rates in each mountain range.

		Mrav		Kusanats		Bardutagh	
		<i>a</i>	<i>b</i>	<i>a</i>	<i>b</i>	<i>a</i>	<i>b</i>
Descriptive statistics	Mean	0.31	0.06	0.28	0.06	0.35	0.07
	Std. deviation	0.28	0.09	0.29	0.08	0.30	0.08
	N	33	32	36	34	30	28
Pearson correlation	Age	-0.945**	-0.599**	-0.943**	-0.560**	-0.956**	-0.665**

Note: **. Correlation is significant at the 0.01 level (2-tailed).

a – vitality rate

b – mortality rate

3.5. Vitality and Mortality Rates

For each mountain range, the linear relationship between age and the rates of vitality and mortality was calculated using the Pearson correlation coefficient and linear regression. There was a negative correlation between age and two variables (vitality and mortality rates) at the 0.01 level (Table 2).

A simple linear regression analysis was conducted to evaluate the extent to which age could predict the rates of vitality and mortality in males and females, and a significant regression was found in each mountain range (Table 3). As can be seen from Figure 6, in the Mrav mountain range, there is a high mortality rate in the generations of the current year, which is also observed in the other two mountain ranges. Yearlings are mostly found in arbitrary groups, and separate groups are also created. They are distinguished by their carelessness and become victims of poachers. According to the regression equation in the Mrav Mountain range, for each one-year increase in age, the predicted vitality rates decrease by approximately 4.5 (♀) – 5.8 (♂) % ($y = 0.6866 - 0.0454x$ (♀); $y = 0.7264 - 0.0577x$ (♂)); from 8 years of age, there is an average 0.9 (♀) – 1.3 (♂) % ($y = 0.1319 - 0.0091x$ (♀); $y = 0.1531 - 0.013x$ (♂)) reduction in mortality due to increasing age. Both in the Mrav and Kusanants mountain ranges, the deviations of the decrease in the vitality of males and females with age are insignificant: 4.8 (♂)–5.2 (♀) % ($y = 0.7191 - 0.0485x$ (♂); $y = 0.6937 - 0.052x$ (♀)). However, it is necessary to note that in Mrav with age, there is a high decline in males' mortality rates and a low decline in females; in Kusanants mountain range, the opposite was observed; the mortality in females decreases by 1.1% from the age of 6 and by 0.9 % in males from the age of 4 ($y = 0.1475 - 0.0114x$ (♀); $y = 0.1284 - 0.0087x$ (♂)). In contrast to the other two

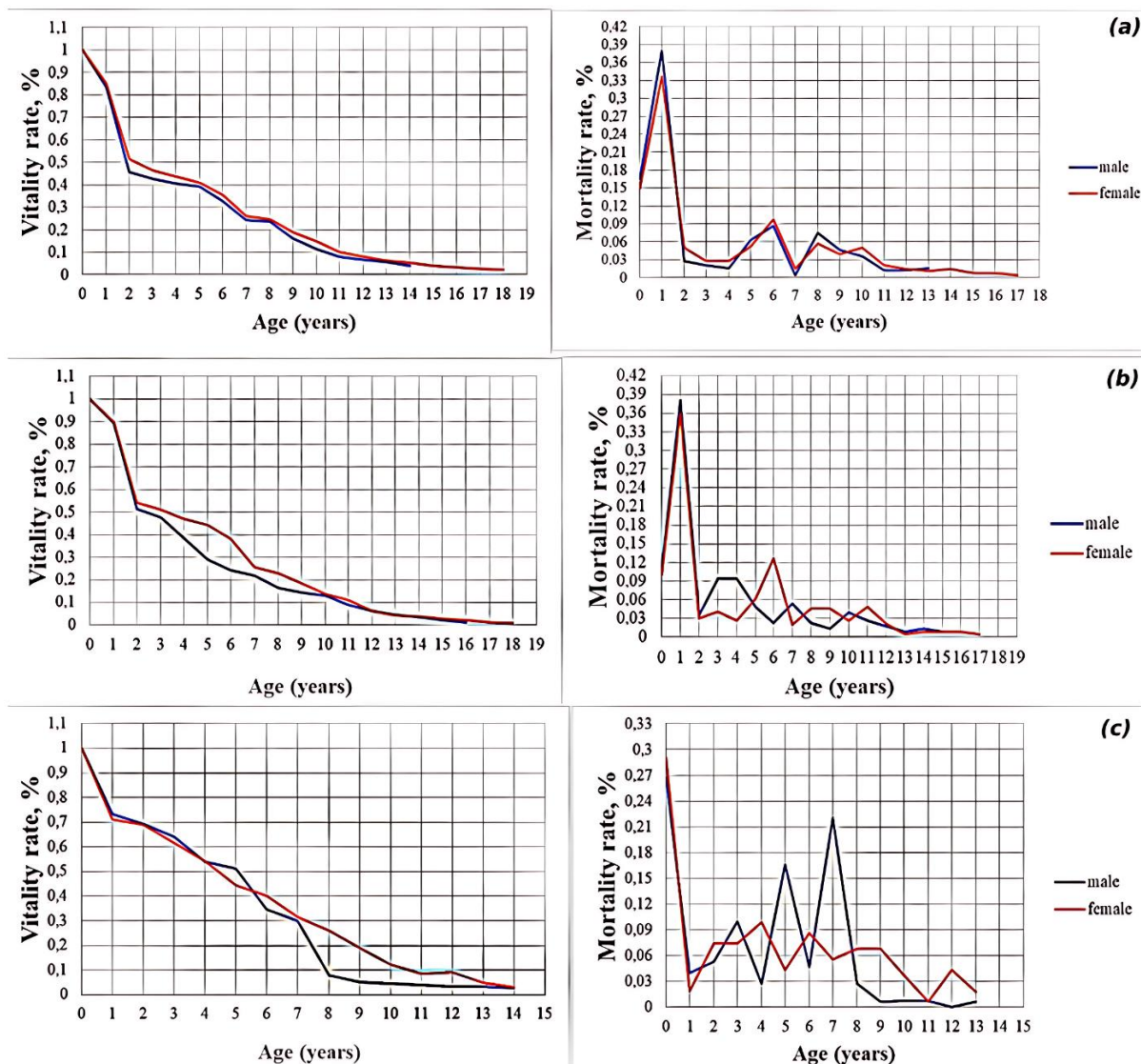
mountain ranges, in Bardutagh, for each one-year increase in age, the predicted vitality rates decreased accordingly by approximately 6,9% (♂) and 6,4% (♀) with age ($y = 0.823 - 0.0692x$ (♂); $y = 0.8145 - 0.0635x$ (♀)). Although there are wide variations in the mortality rates of males and females in Bardutagh, according to regression analysis, the mortality rates decrease with age by 0,9 (♀) – 1,2 (♂) % ($y = 0.1445 - 0.0115x$ (♂); $y = 0.1308 - 0.0093x$ (♀)). Unlike the other two mountain ranges, Bezoar goat populations are poorly protected in Bardutagh, as this mountain range has relatively few forested, bushy areas and lacks high cliffs, making these animals easy prey for both poachers and predators, also due to military activity in 2020.

Due to the intensive deaths, males over 13 years old in the Mrav Mountains, 15 years old in Kusanats, and 13 years old in the Bardutagh mountain ranges were not recorded.

Table 3.

Linear regression results of vitality and mortality rates predicted by age in each mountain range.

Mountain range	Gender	Vitality rate						Mortality rate					
		df1/df2	F	P-value	R ²	95% CI for mean		df1/df2	F	P-value	R ²	95% CI for mean	
						Lower bound	Upper bound					Lower bound	Upper bound
Mrav	Male	13-Jan	64.54	0.01	0.83	-7.3	-4.2	12-Jan	5.15	0.04	0.3	-2.5	-0.1
	Female	17-Jan	78.42	0.01	0.82	-5.6	-3.5	16-Jan	9.63	0.007	0.38	-1.5	-0.3
Kusanants	Male	15-Jan	56.56	0.01	0.79	-6.7	-3.7	14-Jan	7.9	0.014	0.36	-2	-0.3
	Female	17-Jan	89.77	0.01	0.84	-5.9	-3.8	16-Jan	7.27	0.016	0.31	-1.5	-2
Bardutagh	Male	13-Jan	118.16	0.01	0.9	-8.3	-5.5	12-Jan	5.37	0.039	0.31	-2.2	-0.1
	Female	13-Jan	213.57	0.01	0.94	-7.3	-5.4	12-Jan	6.1	0.03	0.34	0.2	3.4



(a) – Mrav, (b) – Kusanats, (c) – Bardutagh

Figure 6.

Vitality and mortality rates of bezoar ibex populations in three mountain ranges.

4. Discussion

It should be emphasized that detecting reliable patterns in analyzing the population's structural data of the bezoar ibex is insufficient; therefore, changing the gender and age composition with altitude above sea level is mainly informative. The most accurate information was obtained from a detailed analysis of the mountain populations of Mrav, Kusanats, and Bardutagh. These three mountain ranges are separated from each other by many obstacles, preventing the mixing of animals. The Mrav mountain range is located on the northwest border of Nagorno-Karabakh, with Kusanats in the central and Bardutagh in the southeast. This allows bezoar ibex populations to be considered isolated groups.

Research on the interactions between wild animals and their environments is critical to ecological studies and is required for managing and conserving wildlife [18]. Many factors contribute to bezoar goats' vertical migration above sea level, including frost, snow thickness, foraging, human economic activity, and chasing predators. However, it should be emphasized that, both in Bezoar ibex and in other ungulate species, under the influence of disturbing factors (anthropogenic or natural), vertical distribution occurs naturally. This feature is due to their lifestyle; with some deviations, it is recorded in all seasons of the year. The same is evidenced by the research results in Dagestan [19]. In addition to the mentioned factors, the relocation of animal habitats contributes to utilizing the energy required for growth and reproduction. In agreement with our perspective, some researchers from the Agh-Dagh Special Protected Area of Persia argued that ibex thermoregulation during migrations, particularly in winter, has enabled them to survive [20-22]. The selection of rocky, steep slopes as habitats in different seasons of the year is important for the protection of bezoar ibex, which is confirmed by several author studies [21, 23-26]. Accordingly, in our conditions, the vertical zonation of Bezoar ibex begins at an altitude of 800 m above sea level and reaches up to 3000 m; in Dagestan, it starts at 1000 m and ends at 2200 m. In Azerbaijan, these heights begin at an altitude of 500–600 m and end at 3500 m [27]. Based on statistical analysis, a comparatively high number of Bezoar goats in Nagorno-Karabakh have been recorded at 1300–1600 m altitude. Naturally, the lower elevations are favorable for the survival of these animals. However, at low altitudes, the effects of anthropogenic factors are greater, which contributes to the mandatory migrations of these animals.

According to our observations, in different years, the density of Bezoar ibex in the Mrav mountain range was 8–9 individuals/km², in the Kusanats mountains – 10–11 individuals/km², and in Bardutagh – 7–8 individuals/km². The density of Bezoar ibex in the entire range of Dagestan is 1.02 ± 0.19 individuals/km² [28] according to Magomedov, et al. [19] there are 11 individuals/km² in the Nukatl mountain range of Dagestan and 8.83 individuals/km² in the Bogos mountain range. The sex ratio in Nukatl is 1:1.53; in Bogos, it is 1:1.49 in favor of females. According to our data, the gender ratio of mature males and females in Mrav is 1♂♂:1.26♀♀, in Kusanats, 1♂♂:1.31♀♀, in Bardutagh, 1♂♂:1.24♀♀. The number of underyearlings per adult doe in Mrav is 0.56, one-year-old goats are 0.47; 0.56 and 0.5 in Kusanats; 0.5 and 0.36 in Bardutagh, respectively. Adult reproduction and juvenile viability are similar to those observed in Dagestan [29] and exceed levels recorded in Pakistan [30] and Turkmenistan [31].

The reproductive intensity of bezoar ibex is relatively constant and undergoes minor changes throughout the year. According to our observations, the reproduction of bezoar ibex in Nagorno-Karabakh fauna begins in early November. It continues until the first ten days of December, and in some cases, it can continue until January. Mating season in Dagestan starts at the end of December [19] while in the Nakhchivan Autonomous Republic, it occurs between December and February [32]. Meanwhile, the animals find secluded and suitable places in the mountains with little snow and frost and gather on the slopes facing south and east. Mating occurs at different times of the day.

The long-term observations in the discussed mountain ranges show that in the Mrav Mountains, mothers with two kids make up 68.3%, with one kid at 9.7%, with three kids at 6.5%, and sterile species at 15.5%. In the Kusanats Mountains, it is respectively 70.3%, 8.6%, 3.4%, and 17.7%; in Bardutagh, it was 63.6%, 28.3%, and 8.1% of sterile species. In these mountain ranges, mothers with three kids were not found. Consequently, the intensity of bezoar ibex breeding in these three mountain ranges doesn't differ significantly, and we have not recorded any visible differences in the demographic structure of these populations.

The statistical analyses conducted in all three mountain ranges revealed that under-yearlings and yearlings have the highest mortality rates, while the percentage of mortality declines with age. In the discussed mountain ranges, the high mortality of yearlings is a well-known phenomenon [33-35]. In our opinion, this is due to the consumption of roughage in autumn and, as a result, the deterioration of the energy balance of animals. However, unlike the other two mountain ranges, Bardutagh showed wide variations in Bezoar mortality by age and gender. It is known that the causes of mortality rates in ungulate populations in nature are diverse, often associated with a limited number of unfavorable factors, and, as a rule, differentiated by their influence on species' gender and age groups [36]. As a result of the observation on three mountain ranges and the statistical analysis data, a high negative correlation of viability was revealed; the viability of bezoar ibex decreases with age due to their natural death. The decrease in mortality with age is due to high adaptation to climatic conditions and habitat changes, increased resistance and life experience. Therefore, a moderate negative correlation of mortality with increasing age is observed in the three mountain ranges (Figure 6). This is evidenced by the high percentage of falls at the age of 0–2 years, which also coincides with the data of Magomedov and others in Dagestan [19].

Population studies have shown that poaching and illegal hunting have a significant impact on the demographic structure of bezoar ibex. Thus, from 1999 to the present, only 9 out of 56 deaths from natural causes have been registered in the Mrav Mountains, 47 from gunshot wounds, 63 out of 68 deaths on Mount Kusanats, and 51 out of 59 deaths on Mount Bardutagh. Hunting intensity and selectivity towards males were higher in all discussed populations. Hunting of Bezoar ibex, as everywhere, poses a serious threat to the survival of the species in our conditions and is classified by the International Union for Conservation of Nature as vulnerable species [37, 38]. As mentioned above, the mountain conditions and anthropogenic impacts of these slopes are significantly different. The western slopes of Mrav are steep and

rocky, and they are usually difficult for people to access. Rock ridges run from the top to the foothills, providing safe access for animals to the water. Animal hunting in this area is possible in winter when springs freeze, and animals descend into the floodplain for water. In winter, animals are mainly poached on the Mrav and Kusanats mountain slopes. In Iran, poaching is more prevalent in autumn, during the breeding season [39]. Bezoar ibex number in Iraq has been severely reduced since 1920 as a result of poaching [40, 41]. During the Azerbaijan-Karabakh conflicts in the discussed areas, the majority of Bezoar ibex populations suffered due to habitats destruction and disruption of their normal lifestyle, a similar fact was recorded in 1980, during the Iraq-Iran conflict [42].

4.1. Suggestions

1. One of the most important conditions for maintaining and increasing the number of Bezoar ibex is the creation of sanctuaries and reserves in their natural habitats; it is also necessary to preserve and restore valuable meadows, sparse forests, and springs. Additionally, the mechanisms protecting these animals within existing protected areas need to be modernized.
2. The South Caucasus, including Nagorno-Karabakh, is a mountainous region, and restoring the population and range of Bezoar goats requires organizing artificial propagation programs in several mountain systems.
3. Surveys using drones every two years are necessary to clarify the structure and dynamics of Bezoar ibex populations. Voluntary environmental groups from local residents should be created to fight against poaching and destruction of these animals' habitats.
4. To determine population growth, it is important to assess the sex and age composition of these populations, as well as the fertility rate per female. Monitor the processes of growth, development, reproduction, birth, and mortality control on a regular basis.
5. Tighten the law on the protection of Bezoar migration routes.

5. Conclusion

In three mountain ranges, from 1999 to the present, 6707 species of bezoar ibex have been calculated, including 1896 bucks, 2410 does, 1310 under-yearlings, and 1091 yearlings. In the discussed populations, the sex ratio is 1♂♂: 1.3♀♀.

Studies of bezoar ibex in altitudinal zonation show changes in the quantitative ratios of animals of different genders and ages. Analysis of variance (ANOVA) indicates that they are most densely distributed at 800-1600 m above sea level in all three mountain ranges.

For the first time in Nagorno-Karabakh, observations have established that the density of bezoar ibex in the Mrav Mountain range is 8–9 species/km², in the Kusanats Mountains, 10–11 species/km², in Bardutagh, 7–8 species/km². Although the population density of Bezoar goats in the three mountain ranges is significantly different, the quantitative deviations in the sex-age ratio in all three populations are insignificant: in the Mrav Mountains, under-yearlings account for 19.8%, yearlings – 35.2%, adult goats – 27.6%, and senior goats – 17.4%; in the Kusanats Mountains, respectively, 19.8%, 37.9%, 26.6%, and 15.7%; in the Bardutagh Mountains, 18.8%, 38.4%, 31.9%, and 10.9%.

In single-age cohorts in all three populations, females outnumber males, and this difference increases with age. This is due to selective hunting, male carelessness during reproduction, and malnutrition.

The mating of bezoar ibex in Nagorno-Karabakh begins in November and lasts until the first ten days of December; in some cases, it can be extended until January. Depending on climatic conditions, it can change, which affects the birthdates, but mass births have been recorded since May. They usually have two kids per generation, but one or three are the exception.

Based on observations carried out in three mountains, the highest specific mortality rate is observed in the current year's generations. In the Mrav mountain range, high specific mortality decreases with age from 8 years, in the Kusanats Mountains from 10 years, and from 8 to 9 years in Bardutagh. The leading causes of death in yearlings are malnutrition and poaching, which negatively affect the demographic structure of populations.

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