

**ECOLOGY AND MORPHOLOGY OF WILD GOAT POPULATIONS AND THEIR
IMPLICATIONS FOR CONSERVATION OF ARMENIA'S MOUNTAIN ECOSYSTEMS**

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Proposed primary objectives of the project were:

Wild goat is among the most persecuted by poachers in Armenia. Our studies of sex and age structure, reproduction rates and kid survival rates vs. habitat quality and man-caused pressure in different study areas (sites) will enable to check the population health, develop targeted conservation measures and propose methods of sustainable use (e.g., trophy hunting) for each particular site and for Armenia in general. Morphological aberrations, such as hornlessness, are also of conservation concern.

This project was planned to be implemented in close cooperation with local people and conservation authorities which will ensure the efficiency of follow-up conservation activities after the project is finished. Local participants had to be trained to field techniques used in this project and consulted for recommended conservation actions.

The project output will include scientific articles, popular papers and reports with descriptions of current status and recommendations for wild goat conservation in Armenia. They will be submitted to the national Ministry of Nature Protection to amend the existing wild goat conservation strategy and thus make a long-term contribution to conservation of mountain ecosystems.

Introduction

Transcaucasian population of the wild (bezoar) goat (*Capra aegagrus*) occupies the north-westernmost borderlands of the species range which occurs mainly in Iran (Lay, 1967; Ziaie, 1997), Pakistan (Hess et al., 1997) and Turkey (Kence and Tarhan, 1997). Only the totally isolated Greater Caucasian population is situated more to the north. Wild goat belongs to Front-Asian mammalian fauna, together with Armenian mouflon (*Ovis [orientalis] gmelini*), leopard (*Panthera pardus*), (*Capra aegagrus*), hyena (*Hyena hyena*), jackal (*Canis aureus*) and porcupine (*Hystrix leucura*) which also inhabit Caucasus Minor and even reach Greater Caucasus (except mouflon). Until mid-20th century, Transcaucasian part of the range was connected with Iranian part by regular and irregular migrations across the Arax River, but enforcement of border-line defence systems terminated these migrations after the WW II, and population of the wild goat in Armenia and Nakhchivan became isolated from the main range (Gasparyan, 1974). Wild goat is the principal large mammal species of Armenia and, as such, is probably the best indicator of the overall status of wildlife in Armenian mountains.

Material and methods

The field work on this project started in November 2009 and terminated in December 2010. In the course of the project, we conducted 3 surveys each encompassing four areas of wild goat distribution in Armenia as revealed by preliminary projects supported by CEPF (Critical Ecosystems Partnership Fund, US) in Armenia and Azerbaijan in 2006-2007 (Talybov et al., 2007,

2009; Khorozyan, Weinberg and Malkhasyan, 2009), and PTES (Peoples Trust for Endangered Species, UK) in Armenia in 2008-2009.

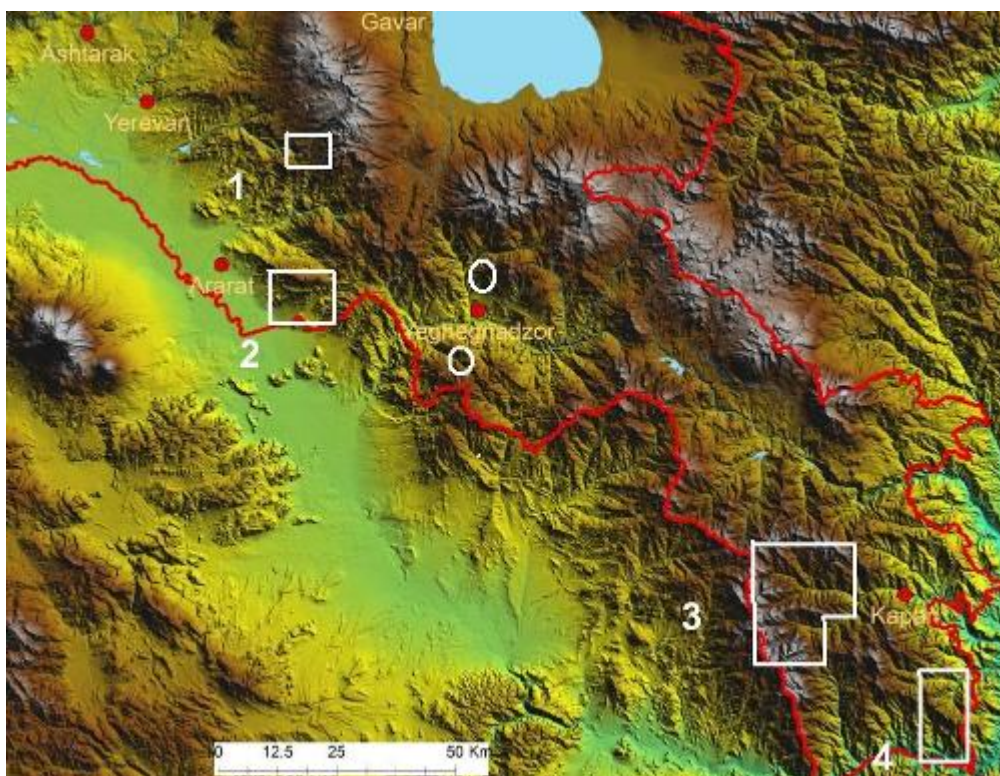


Fig. 1. Wild goat study areas in Armenia (constant: 1- Kakavaberd, 2 - Urts and Jainamdarasi, 3 - Zangezur, 4 – Nuvadi; sporadic: ovals – Yeghegis and Noravank).

Two of these areas neighbour Nakhchivan Autonomous Republic of Azerbaijan: one being Urts Range (called also Saraibulag Range, formerly a part of Khosrov Nature Reserve, now in private lease to several lease-holders) and the adjoining Jainamdarasi Gorge on westernmost part of Aiotszor Range; the second situated on Zangezur and Bargushat Ranges. Two others are: Kakavaberd branch of Khosrov NR (on an offshoot of Gegama Range) and Nuvadi area on southeastern end of Megri Range. We also non-repeatedly visited some other areas, such as Yeghegis Valley and adjoining areas on Vardenis Range, and Noravank Valley on the eastern part of Aiotszor Range (fig. 1). We also incorporated some data collected during previous research starting from 2004 (Table 1.).

Surveys took place in November – December (rutting season) 2009, June – July (post-parturition period) 2010 and November – December 2010, 63 days in the field altogether.

Field data were collected while routing the survey areas on foot and scanning them through binoculars. When animals were found, a spotting scope was used for aging and sexing them. Sites of encounters were fixed by GPS; elevation, exposure of the slope, vegetation type, terrain type (cliffs, meadows, scree) and presence of snow were put down.

Table 1
Age and sex classes of counted wild goats in post-parturition and rutting seasons

Age and sex classes		Year, season and site																					
		2004			2007	2008		2009					2010										
		winter*			summer	winter		summer					winter										
		Noravank	Khosrov	Nuvadi	Zangezur	Zangezur	Nuvadi	Yeghegis	Noravank	Urts	Zangezur	Nuvadi	Kakavaberd	Zangezur	Nuvadi	Kakavaberd	Urts Jainandarasi	Zangezur	Nuvadi	Kakavaberd	Zangezur	Bargushat	Nuvadi
Males	≥ 6 yrs	2	7		71	17	9				43			1	22			32	2	4	13		18
	4-5 yrs				19	7	13			1	34		2	4	10	1		19	1	1	3		10
	3 yrs	2	4	2	17	4	16			4	25			5	22	4	1	22	1	10	4	8	5
	2 yrs	4	2	3	14	5	15		1	9	36	7		9	25	8	1	23	5	5	4		9
	yearlings	1	1	3	7	9	22	3		1	9		2	6	28	7	2	20	7	3		3	12
	unspecified				8													32			8		
	Total ≥ 2 yrs	8	13	5	129	33	53		1	14	138	7	2	19	79	13	2	128	9	20	32	8	42
Females	adult	8	3	19	17	31	54	22	5		26	3	14	25	116	26	26	41	36	18	4	21	54
	yearlings	2		6	7	11	20	4	3		11			6	22	5	5	5	9	3		4	13
	total																						
Kids		6	4	12	21	25	51	26	3		21		15	22	69	30	12	41	41	17	3	12	53
Total		25	21	47	189	109	200	55	13	15	205	17	33	78	314	81	47	235	102	61	39	48	174

Note: * January.



Fig. 2. Wild goat habitat in Kakavaberd.



Fig. 3. Typical wild goat (cliffs above) and mouflon (rolling hills below) habitats on Urts Range.



Fig.4 .Wild goat females' habitat in Zangezur highest zone.

Age and sex classes: kids or juveniles (under the age of 1 year), yearlings of both sexes (between 1 and 2 years old), females, 2-year old males, 3-year old males, 4-5-year old males and fully mature males older than 6 years. Males of different age could be distinguished by size and shape of horns (number of knobs on the frontal keel situated on the borders of annual segments until the 7-8th segments), and development of light-coloured background coloration.

Three types of groups were recognized: male groups (consisting of males of all age classes), female groups (females, yearlings of both sex, kids and young males, up to 5 years old) and mixed groups (including adult males ≥ 6 years and females, beside other classes).

Results

Description of study areas

The four mentioned areas are rather different in geology and vegetation.

Kakavaberd branch of Khosrov NR occupies a valley, in fact two confluent canyons, with oak forest and various shrubbery (*Spiraea*, *Rosa* etc.) on very steep and precipitous slopes (with innumerable caves and grottos) cut in rather low (up to 2300 m a.s.l.) limestone and sandstone range with flat, plateau-like ridges (fig. 2). Goats inhabit only the canyons itself, occasionally showing up on the edges of the plateau which harbours livestock in spring and summer. Summers are hot but winters are usually rather cold and snowy, though significant snow-cover seldom occurs before January.

Urts Range is separated by Jainamdarasi Valley from Aiotszor Massif. It is low (up to 2445 m a.s.l.) and composed of limestone with reddish outcrops on south slope which is of principal interest. Woody vegetation is mainly exterminated but, where present, is represented mainly by

sparse juniper stands and *Spiraea* shrubbery (fig. 3). Summers may be oppressively hot, especially in the foothills which are semi-desert, winters are severe and sometimes snowy. Zangezur and the adjoining Bargushat are crystalline ranges up to 3900 m a.s.l., displaying all altitudinal zones typical for Alp-like mountains (fig. 4). Forests – where present – are mainly oak. Summers are quite cool in the highlands and winters are typically cold and snowy.



Fig. 5. Wild goat summer habitat on Megri Range.

Nuvadi Valley is situated on the south-east end of crystalline Megri Range reaching 2270 m a.s.l. in the given area. Forests are mainly oak on shady slopes and sparse juniper stands on sunny ones (fig. 5), with several magnificent cliff massifs, Darbara (near the ridge) being the largest. Summers are very hot and winters are usually warm and poor in snow though winds are chilling. Fresh green grass is found throughout the year.

Seasonal distribution and habitat use

These features determine possibilities of characterizing local populations more fully and adequately. That is why they are being described before distribution, population size and density, and age/sex structure etc.

On the whole, females are the sedentary part of any population, adult males being more mobile and differing ecologically from females with offspring, often even spatially segregated from them outside the rutting season. That is why in some places adult males are very difficult to find in the summers. Wild goats use all altitudinal zones occurring both in forest and open habitat but the actual distribution depends upon local conditions and population characteristics including density and level of anthropogenic disturbance.

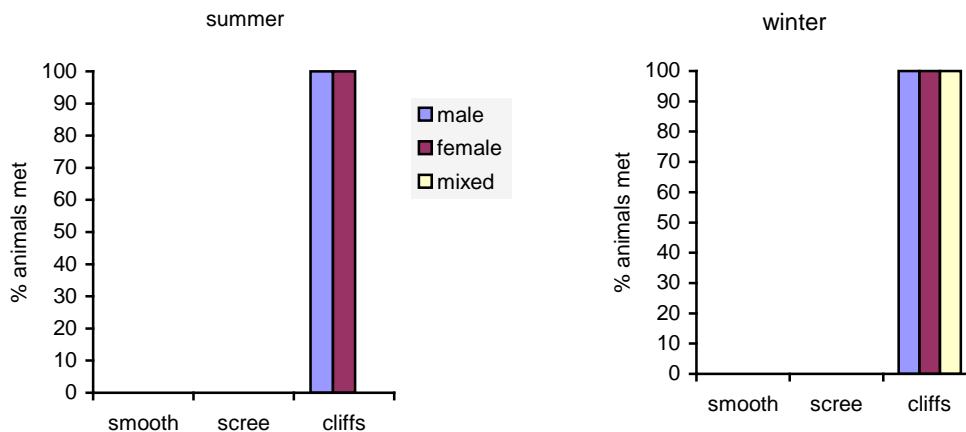
In Kakavaberd, vertical distribution is limited by the valley-bottom below and plateau above, and thus occurs wholly within the forest zone. Animals never leave cliffs (fig. 6) and can only shift slopes of different exposures, and their summer choice is almost even (fig. 7), so distribution might seem rather dull. In winters, animals, males in particular, quite understandably display preference of sunny slopes. Females dwell in the same area all year round, but there is at least one interesting feature in Kakavaberd, absent in the rest of our study sites: extensive use of caves and grottos in hot summer months. No female with kids could be found outside some kind of cavity between 10

a.m. and 17 p.m. As for adult males, only immature ones younger than 6 yrs could be spotted there in the summers 2009 and 2010 (see below) so we cannot tell where they have been staying then.

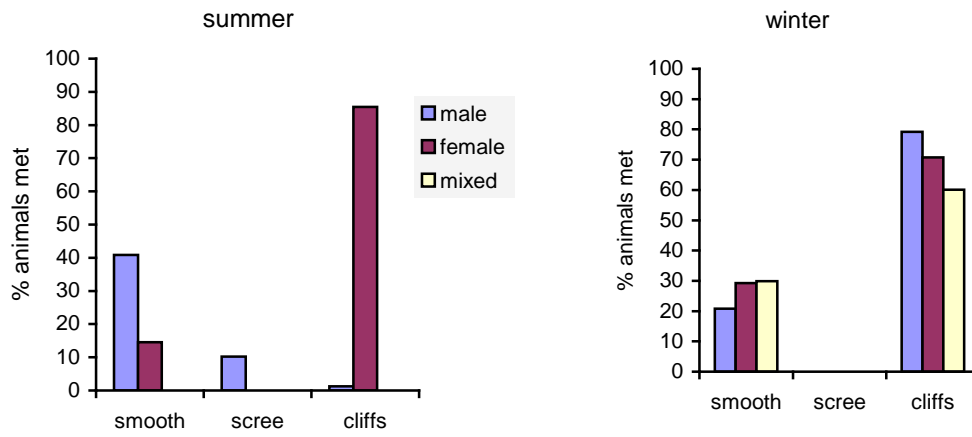
Only small number of youngish males was found on Urts Range, though local people reported about occasional encounters with females. In any case, all animals occur within forest zone presented only by sparse juniper stands and occasional *Spiraea* shrubbery. The choice of exposures is also very limited: if it's cliffs, then it can be only southern exposure; if it's smooth slope, then south or north exposure. The same goes for Jainamdarasi Gorge: it's either southern slope (69% of all animals) or the northern one (31%).

Habitat in Zangezur is more diverse due to wider elevation range there. However, animals choose between alpine and subalpine zones, males preferring the former, females with offspring choosing the latter (fig. 8). This pattern is even more marked during the pre-rut and rut with females and males which haven't formed mixed groups (fig. 8). Preference of higher elevations by males combines with their dwelling near snow-fields in summer (fig. 9). Females, yearlings and kids absolutely favour precipitous slopes (fig. 6) which provide better shelter from various threats, both natural and anthropogenic. Females with kids almost never can be seen grazing on open and smooth slopes or even on valley-bottoms as can be observed in males. Choice of lower and more precipitous areas is typical for females with offspring in all *Capra* dwelling above timberline in summers (e.g. Weinberg, 2002). However, there is a certain peculiarity in female summer habitat in the given section of Zangezur Range. Offshoots of the main mountain chain run in west – east direction and near the main chain have very steep, almost vertical, precipitous north slope, a plateau-like, though not wide, ridge which gradually gets steeper descending into south slope. Female groups typically lie down on the northern precipices just below the plateau to where they ascend for grazing, not mowing far away from the edge (fig. 10).

Kakavaberd



Zangezur

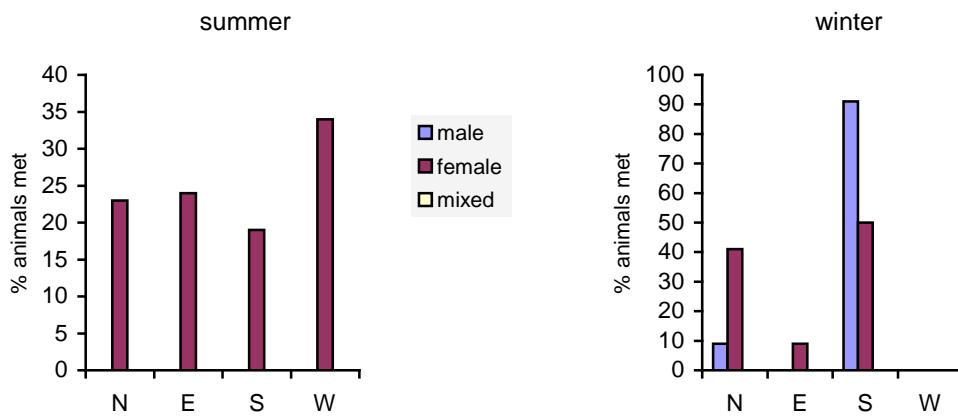


Nuvadi

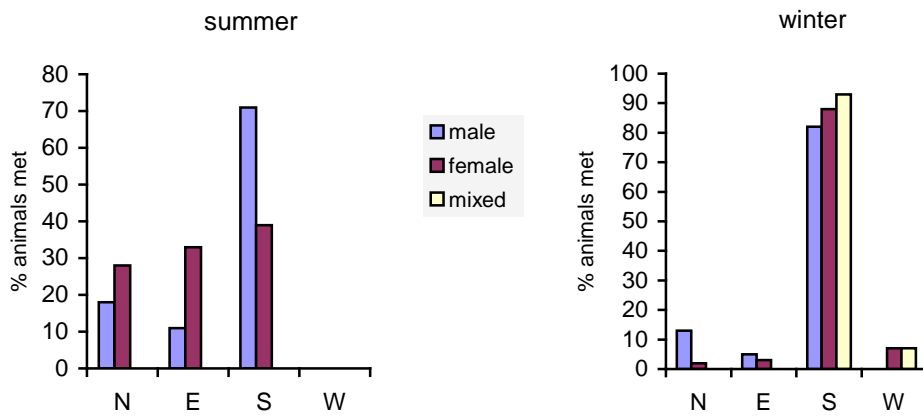


Fig. 6. Choice of terrain by animals from different types of groups.

Kakavaberd



Zangezur



Nuvadi

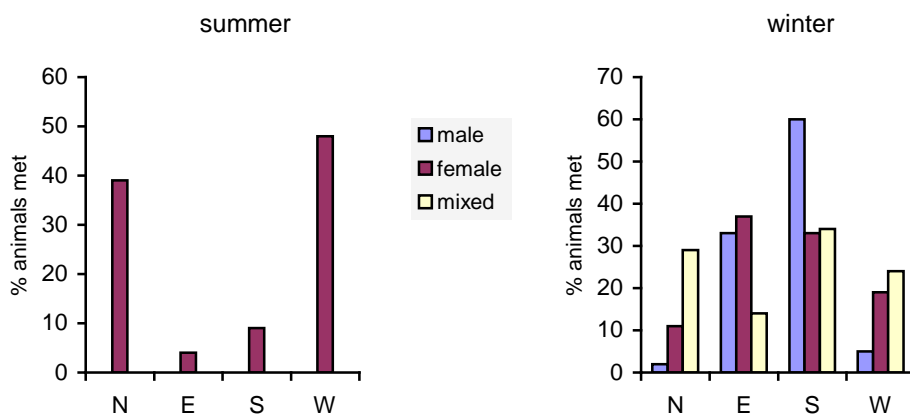


Fig. 7. Choice of slopes of various exposures by animals from different types of groups.

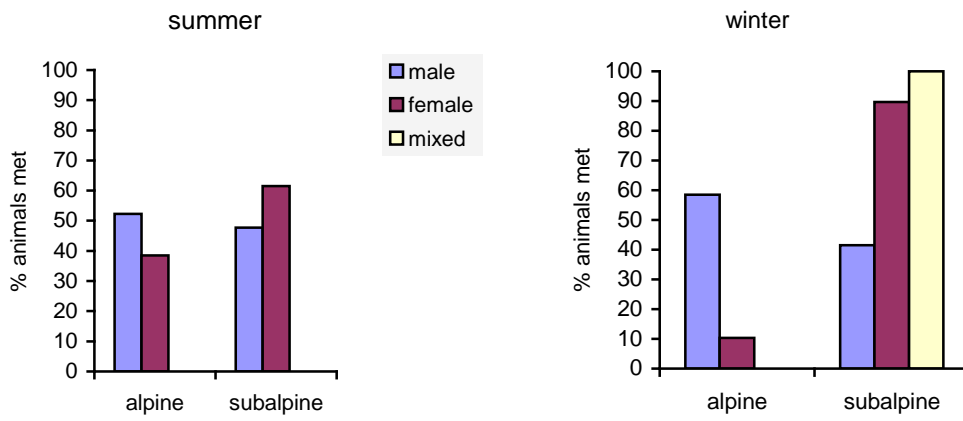


Fig. 8. Altitudinal distribution of animals from different types of groups on Zangezur Range.

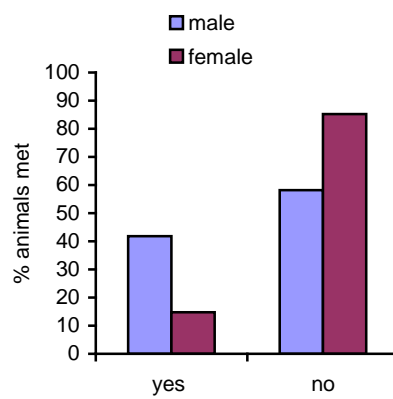


Fig. 9. Choice of snowy areas by different groups on Zangezur Range in summer.



Fig. 10. A bunch of wild goat females with a kid and several yearling males on the edge of a plateau-like ridge.

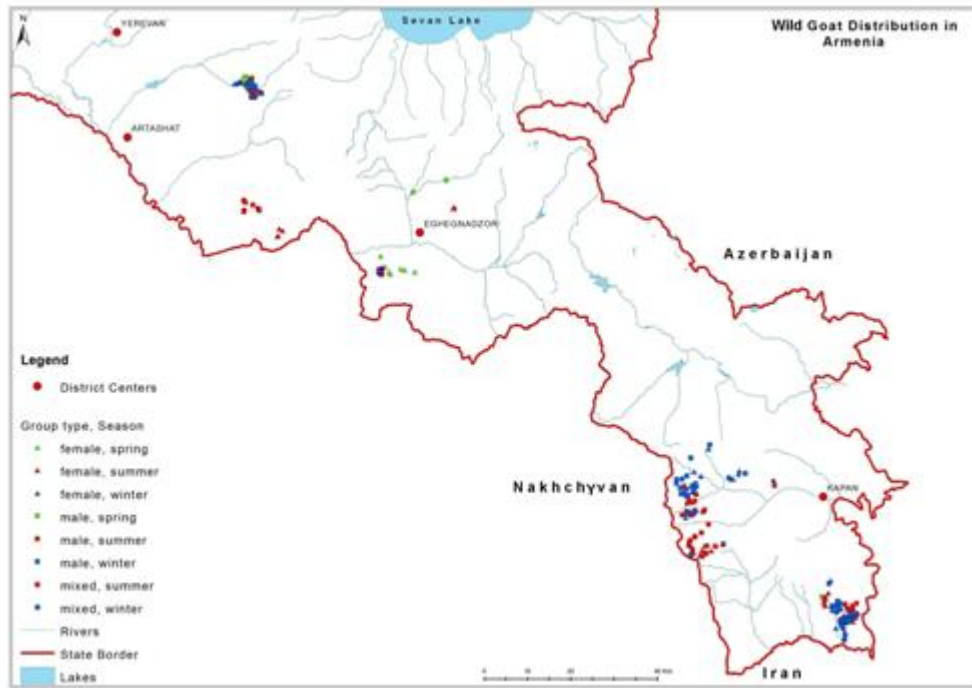


Fig. 11. Wild goat distribution in study areas.

Wild goats choose different habitat on Bargushat Range which is the major offshoot of Zangezur Range in Armenia, namely cliff massifs in the forest zone, such as Darmanadzor (fig. 12) or Giratakh. This preference depends upon smoother topography of higher elevations on Bargushat, as compared to Zangezur, though both ranges seem quite alike at first look.

Choice of different exposures is rather even in summers, males preferring southern exposures, while during the rut, all animals quite understandably favour southern slopes (fig. 7) trying to avoid deep snow. However, November and December 2010 were abnormally snowless everywhere in Armenia. Even ridge-tops were free of snow, and there were very few goats in Zangezur, males and females alike. One explanation might be their migration over the ridge to the western, Nakhchivan slope of the range, where it is warmer and, thus, more opportunity of finding fresh green grass. Even on the eastern, Armenian slope, on lower elevations, patches of green grass could be found due to warm weather and lack of snow. Such migration to Nakhchivan might be very short-distanced – merely some 500 m or a bit more in a bee-line. If such migration really happened, it is certainly not very typical, especially for females. However, we did find goats in Darmanadzor and Giratakh cliff massifs of Bargushat Range (some 20 km from Zangezur ridge), occurring within the forest zone, where animals are probably less mobile. Also green grass was easier to find there, so animals might be less tempted to migrate. The limited number of animals found there does not allow us to suggest that these might be migrants from Zangezur, and we did not find wild goats in rocky parts of Zangezur forest zone.



Fig. 12. Darmanadzor Cliffs of Bargushat Range.

Nuvadi Valley on the south-east end of Megri Range is again more like Kakavaberd, being lowland and practically lacking subalpine and alpine zones, so animals dwell all year round in the forest zone. Nuvadi is the warmest of all study areas, therefore preference of northern and western exposures is natural, animals trying to avoid sunny slopes where grassy vegetation dries out already by June. Distribution over slopes of different exposures is more or less even during the rut. Female preference of precipitous areas is as pronounced in lowland Nuvadi area as in Kakavaberd, in comparison to Zangezour (fig. 6). Even during the rut, females do not leave cliffs, which is why even mixed groups are observed only on cliffs there (fig. 6). Males older than 2 yrs partly leave Nuvadi valley for summer, crossing over the ridge and dispersing over rocky outcrops in oak forests of the neighbouring Shikahokh NR (fig. 13). However, some males do remain in Nuvadi valley living singly or in twos, as in Kakavaberd ($M=1.4$ $n=5$). This pattern is very different from that in Zangezour, where males, on the contrary, form large and conspicuous summer groups ($M=14.6$ $n=19$), while solitary secretive males in Kakavaberd and Nuvadi are difficult to find.

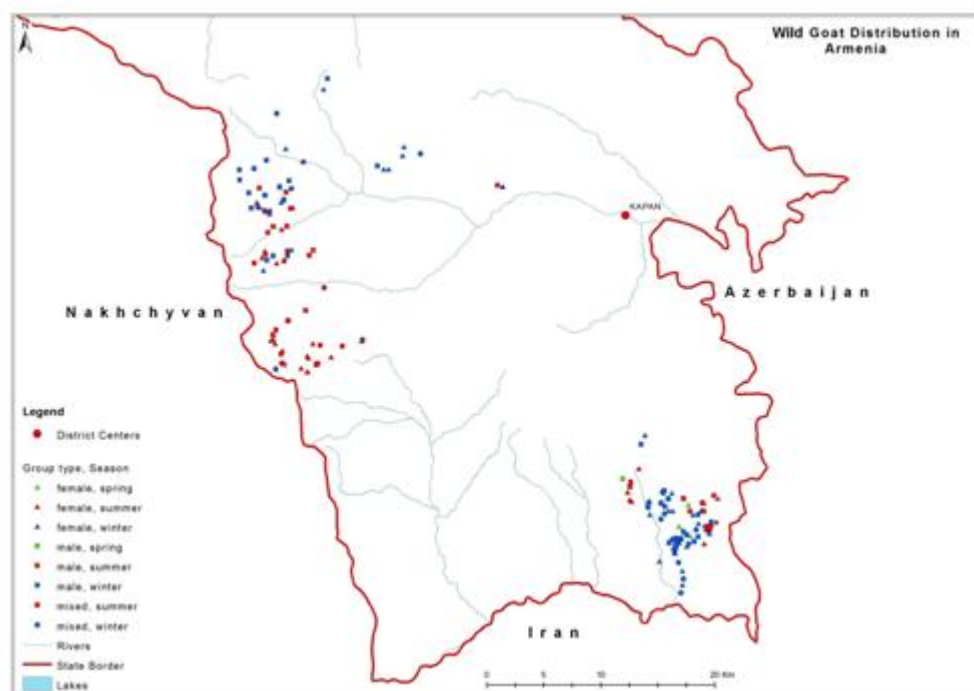


Fig. 13. Wild goat distribution in study areas of South-East Armenia.

On the whole, summer and winter distribution doesn't differ very much. Figs. 12 and 13 depend not so much upon peculiarities of distribution, as on our routes in different seasons. E. g. there are lots of blue marks on Bargushat Range but less on southern part of our survey area on Zangezur Range, which is caused by inaccessibility of Sakhkasu valley in winter. Only for Nuvadi and Urts maps show real seasonal differences, the latter lacking wild goat observations during the rut (fig. 12.), the former indicating at animal dispersal in the central and lower parts of the valley during the rut, instead of concentration on several cliff massifs in summer (fig.13.).

Distribution, population size and density

Distribution of wild goat in Central and East Armenia is much wider than that of mouflon but is rather patchy and uneven nevertheless and displays different population densities.

Kakavaberd Valley is very limited in space consisting of two confluent canyons cut deep in a plateau which is used as spring and summer pastures for livestock. Wild goats just ascend the edges of the plateau, males most certainly occasionally crossing it in narrower places between the neighbouring canyons during pre-rut and post-rut migrations. Strictly speaking, the plateau itself (except between the two canyons) can hardly be regarded as wild goat habitat, therefore the actual area of the site is small. Thus, even rather small local population displays the largest summer population density of all 4 sites (table 2). Also at least 13 males older than 3 yrs that were present during the rut 2010 were not found in the summers. Maybe they are very secretive, or maybe their summer range is someplace outside Kakavaberd Valley. Winter density is slightly but insignificantly lower than that during the summers, though logically it should have been other way around, exactly because of the males showing up for rut.

Table 2
 Sizes and densities of the studied populations

Parameters		Surveyed sites			
		Kakavaberd Valley	Urts Range (surveyed section with Jainamdarasi Valley)	Zangezur Range (surveyed section without Bargushat Range)	Nuvadi Valley
Area (approx.), km ²		35	70	160 (120 without Sakhkasu and, partly, Yaghludara Valleys)	80
Counted animals	summer	94 (at least 13 males ≥ 3yrs not found)	47 (plus maybe 12 males)	235	101
	rut	81		117 (without Sakhkasu and, partly, Yaghludara Valleys)	211
Density per km ²	summer	2.7	0.8 (1.0)	1.5	1.3
	rut	2.3		1.0	2.6

Urts Range – once famous in Armenian zoological literature for abundance of wild goats and mouflon (Dahl, 1951; Gasparyan, 1964) – is almost devoid of wild goats now. In 2009-2010, next to no wild goats were found there (table 2). Only in Jainamdarasi Gorge that, strictly speaking, does not belong to Urts Range itself goats were common, though only females with young. The area is small, so the resulting population density is quite acceptable.

Section of Zangezur Range – even without Bargushat Range – is the largest site examined in this research and harbours the largest wild goat population, which is just a part of the whole Zangezur Range population. Due to open habitat, animals are easily seen and density seems even higher than it actually is (table 2). Table 2 definitely indicates at pre-rut emigration from Armenian slope (see **Seasonal distribution and habitat use** and **Sex/age structure and reproductive performance of the population**).

Nuvadi Valley is a limited area and – according to certain information – neighbouring valleys are noticeably poorer in wild goats, maybe due to worse protection, larger human population and smoother topography. There is a significant difference between summer and rut densities (table 2), which may be caused by concentration of animals in Nuvadi Valley during the rut due to better protection and temporal immigration of additional males (see below).

While comparing densities in different areas, we must keep in mind that these depend not only on the size of local goat population but also on the proportion of actual goat habitat in the given area. E.g. wild goats do not actually inhabit plateaus between the canyons in Kakavaberd, smooth sections of lower slopes in Zangezur, or smooth forested slopes in Nuvadi, but these cannot effectively be excluded from the calculation, since are being used by goats at least moving between the rocky massifs. Nevertheless, exactly the opposite was done previously: densities were calculated only for the small areas of rocky massifs of the Urts Range and thus reached 5 animals/km² (Dahl, 1951).

It should also be noted that all these local populations are not independent and the numbers we present do not mean whole and separate entities, because even Nuvadi and Kakavaberd populations are undoubtedly connected with the neighbouring ones at least by migratory males.

Unfortunately, it's difficult to see trends, because it needs comparison of our data with some previous ones and that is hardly possible because of their absence or imprecision. All information is very back-dated and estimates 400-500 animals for Armenia altogether in 1960s (Gasparyan, 1974). As for specific areas in question, only for Urts and the adjoining Jainamdarasi Gorge, there are data for several decades, and according to these, population has reduced from about 150 animals in 1940s-50s (Dahl, 1951) to merely some 40 at best in 1960s (Gasparyan, 1974). We have counted a bit more than that (table 2), but mainly in Jainamdarasi, not on Urts Range itself, as by previous researchers. Numbers for other areas of interest are: about 100 goats on all of Zangezur Range and about 40 animals, maybe a bit more, in Khosrov, Mangyuk and Garni (including Kakavaberd) territories of Khosrov NR, according to repeated on-land and aerial counts (Gasparyan, 1974). It should be noted that aerial counts of wild *Capra* proved ineffective in the mountains, to say the least. Comparison of our data with the mentioned above would show 2-3-fold increase of wild goat numbers in all the examined sites and briefly visited areas (except Urts Range), which is hardly possible, as all our respondents unanimously stated that wild goat numbers had reduced noticeably since 1960s-70s. In fact, in just 4 sites, we counted more animals than were the total estimates for whole of Armenia in 1960s (Gasparyan, 1974). This proves that data for 1960s are hardly reliable.

Sex/age structure and reproductive performance of the population (fecundity, birth rate, juvenile mortality)

Quite a number of sites and their local populations have been surveyed during our expeditions since 2004 (table 1), but just 4 of them on regular basis, producing sufficient, reliable and comparable data for at least a couple of years. This last feature is very important because population parameters vary quite significantly over the years as shown by this research (table 3). Also some of them can be obtained only during a certain season of the year, e.g. sex ratio, regardless of total number of encountered animals, can be valid only if obtained during the rut because outside this period, rarely lasting longer than a month, not only fully mature wild goat males, but even those older than 2 yrs, almost invariably live separately from females, preferring different habitats (figs. 6-8) and even different areas. However, even observations performed during the "right" seasons may fail to produce correct data, as in November-December 2010, when abnormally snowless winter delayed beginning of rut and probably prevented from encountering animals on Zangezur Range. Even a slight miscalculation may trouble the survey, as in the end of November 2009 when it turned out that rut has not yet begun in Kakavaberd area and, consequently, no mature males were present there (table 3). This mistake was corrected in 2011, when survey was scheduled for the second half of December.

The pattern of sex ratio is very different for Zangezur Range versus Kakavaberd and Nuvadi (table 4): males absolutely dominate females numerically in summer on yearly basis in the former, while in both latter the situation is reverse. Thus, we can suggest that some substantial number of males – mature as well – emigrate from our study area in Zangezur before the rut, most certainly partly to Bargushat Range that – according to our sporadic data – harbours more females than males, and partly over the ridge to Nakhchivan slope. Consequently, eastern, Armenian, slope serves as summer habitat for males that rut in Nakhchivan. The possible explanation for this pattern will be suggested further. And it is more or less clear that at least a part of rutting males yearly immigrates to Kakavaberd and Nuvadi areas.

Comparing rut-season sex ratios, we can see that these hardly differ statistically for Zangezur and

Nuvadi, but again, even on yearly basis this ratio is better for males in Zangezur than in Nuvadi. High ♂/♀ ratio approaching 1:1 or even a bit higher is preferable and characterizes healthy and protected populations (Veinberg, 2001; Weinberg, 2002). Data from 2010 was not calculated for Zangezur because of definitely abnormal absence of animals (see in **Seasonal distribution and habitat use**). Data for Kakavaberd are hardly comparable with the former, originating from just one season and being insufficient at that. On the whole, ♂/♀ ratio is quite satisfactory in all the 3 mentioned sites, but indicates at higher mortality in males. Usually, such mortality is man-caused (Veinberg, 2002).

Speaking of kid index (juv/♀ ratio), it should be noted that fecundity is 1-2 kids per birth, and twice we even observed triplets, though this is really a singular event. Only such high fecundity can result in juv/♀ ratio exceeding 0.75 (Weinberg, 2002). Juv/♀ ratio is slightly and mathematically insignificantly higher in Nuvadi and Kakavaberd than in Zangezur, though considering that even the yearly differences between Nuvadi and Zangezur hold the pattern, the ratio must be really somewhat higher in Nuvadi. Kid index quite understandably decreases by the rut and is transitional between the summer index of the given year and the summer yearling index of the following year; the only discrepancy being the rise of yearling summer index by the rut in Nuvadi. Higher juv/♀ ratio indicates at higher reproduction rate and more favourable living conditions in Nuvadi and Kakavaberd as compared to highland and harsh Zangezur Range. Nevertheless, it is still lower than in Daghestan (Weinberg, 2001) though higher than in Turkmenistan (Korshunov, 1995) and in Pakistan (Edge and Olson-Edge, 1990; Schaller, 1977). However, yearling index is higher in Zangezur than in Nuvadi, which controversially means that kid survival is better in Zangezur. This irregularity may be explained by large numbers of males present on the Armenian side of the range in summers, accompanied by yearlings not belonging to local, resident females, and pushing up the yearling index.

Table 3
Population structure indices of different wild goat populations in Armenia

Index	Year, season and site																	
	2004*	2007	2008		2009						2010							
	winter	summer	rutting season		summer			rutting season			summer				rutting season			
	Nuvadi	Zangezur	Zangezur	Nuvadi	Yeghegis	Zangezur	Nuvadi	Kakavaberd	Zangezur	Nuvadi	Kakavaberd	Urts Jainamdarasi	Zangezur	Nuvadi	Kakavaberd	Zangezur	Bargushat	Nuvadi
♂/♀	0.26	7.58	1.06	0.98		<i>5.31</i>	2.33	0.14	0.76	0.68	<i>0.50</i>	<i>0.08</i>	<i>3.12</i>	<i>0.25</i>	1.11	8.00	0.38	0.78
Yr ♂/yr♀	-	1.0	0.82	1.10	0.75	0.82		-	1.00	1.27	1.40	0.40	1.00	0.78	1.00	-	0.75	0.92
Yr/♀	0.47	0.82	0.65	0.78	0.32	0.77		0.14	0.48	0.43	0.46	0.27	0.61	0.42	0.33	0	0.33	0.46
Juv/♀	0.63	1.24	0.81	0.94	1.18	0.81		1.07	0.88	0.59	1.15	0.46	1.00	1.14	0.94	0.75	0.57	0.98
N♀	19	17	31	54	22	26	3	14	25	116	26	26	41	36	18	4	21	54

Notes: 1) * – January; italics – data biologically invalid; bold figures – data statistically sufficient and biologically valid; red – deviations (see in the text).

Table 4

Average population structure indices in main observation areas

Index (ratio)	Kakavaberd		Urts Jainamdarasi		Zangezur		Nuvadi	
	summer*	winter	summer*	winter	summer	winter**	summer*	winter
♂/♀	0.68	<i>1.11*</i>			4.8	0.93	0.41	0.78
Yr/♀	0.46	0.25	0.27		0.70	0.53	0.41	0.52
Juv/♀	1.15	1.00	0.46		0.99	0.83	1.05	0.82
N♀	26	32	26		84	56	39	224

Notes: * – data from just 1 season 2010; ** 2010 excluded (see in the text); index in italics definitely unreliable statistically.



Fig. 14. Rutting group of wild goats in Nuvadi.

Proportion of yearlings in the population equals its natural increase (minus yearly adult mortality). This should be better calculated from the summer data, but, as all age and sex classes are better represented during the rut, we used rutting-period data: 9.8% Kakavaberd, 17.1% Zangezur and 17.0% Nuvadi. The first figure is rather low for the wild goat and corresponds to that of tur that very rarely has twins (Weinberg, 2002), while the other two are quite satisfactory and approach the one for Daghestan (18.8, in Weinberg, 2001). In any case, these figures show potentially high growth rate, especially in Nuvadi and Zangezur.

On the whole, high kid and yearling indices for Zangezur, equalling and sometimes even slightly exceeding those for Nuvadi and Kakavaberd, is a bit of surprise, as we expected lower figures for harsh highland environment. However, it may happen that exactly this harshness stimulates reproduction.

Horn growth rates in wild goat males

Horns are significant indicators of the status of a given ungulate population. From the very start we had an impression that those of Nuvadi, or better say, Megri Range population were different.

Table 5

Horn growth rates in wild goat males (precision 0.5 cm)

Site and parameters		Annual segments											
		1	2	3	4	5	6	7	8	9	10	11	12
Nuvadi	n	13	13	12	10	7	5	3	2	1			
	length (cm)	16	23.0	18.0	16.0	14.5	13.0	9.5	7.0	6.5			
Zangezur	n	8	8	8	8	8	7	4	3	3	2	2	2
	length (cm)	11.0	18.0	15.5	16.5	14.0	11.0	10.0	8.0	6.0	4.5	4.0	2.5

Firstly, there are knobs on frontal keel at the borders of annual segments which usually merge

starting with the 7-8th segment (Weinberg, 2001). However in Nuvadi, these knobs start merging (horn gets uniformly wide) from 3-4th segment on. Secondly, we had a feeling that growth rate is higher in Nuvadi due to better life conditions (year-round availability of green grass and fresh water, mild winters etc.). Nevertheless, our measurements show that while there really is some advantage during the first 3 years, it disappears by the fourth year and horns of Zangezur catch up in growth rate with those of Nuvadi.

Transboundary Armenian-Nakhchyvan migrations, their pattern and effect on the status of wild goat in Armenia

These migrations are quite natural and common in Zangezur due to their easiness. What is a natural and administrative border for humans, is actually a habitat of wild goats. Animals just have to cross over the ridge, and that may take them merely some 5-15 minutes. Without collar-tracking etc., it would be premature stating that males move regularly and seasonally over the ridge, though judging by seasonal sex ratio, this is really the case. And very low numbers of wild goats encountered during rutting season of 2010 have also most certainly been caused by temporal emigration to Nakhchyvan.

In any case, animals on the eastern, Armenian slope of Zangezur can hardly be regarded as an independent local population. This should certainly be considered when and if planning conservation measures or hunting.

Situation is slightly different and much less clear in lowland Urts Range that is separated from Jainamdarasi Gorge and the adjoining Nakhchyvan territory by a busy highway. Anyway, unlike Zangezur, the local population is in such a low state now (especially on Urts Range itself) that only total protection can be considered appropriate for it.

Impact of different natural and man-caused factors on the status of the wild goat in Armenia

Wild goat is listed as 'vulnerable' in the latest Red Data Book of Armenia (2010). There are 3 main threats to wild mountain ungulates in Armenia: *hunting* – legal or illegal, *competition with livestock*, and *loss and degradation of habitat* due to various human activities, such as road or pipeline construction, mining etc. Wild goat (together with the wild boar *Sus scrofa*) is the most hunted, or better say poached, ungulate in Armenia, only wild boar fecundity is at least 2-3 times higher. Wild goat hunting is an ancient tradition and will be difficult to limit by regulations. Poaching had increased during the war with Azerbaijan and subsequent down-break of the Soviet Union accompanied by accessibility of firearms, general disorder and very difficult socio-economic situation in Armenia when people just had to survive somehow. All this led to decrease of many local wild goat populations and complete extermination of others. Even existence of strict nature reserves could not protect animals as it happened on Urts Range which used to be a part of Khosrov NR until the beginning of 2000s. Armenia is small, and there are practically no places there inaccessible by ordinary vehicles or on horse-back.

Zangezur Range is a better illustration of human-caused impact upon wild goats. Situation is strikingly different on east (Armenian) and west (Nakhchyvan) slopes. Zangezur and adjoining foothills used to be traditional livestock pastures, and this situation still exists in Nakhchyvan, even strengthens there, while Armenian slope is almost totally devoid of livestock due to emigration of local Azeri population (main livestock breeders) in the course of war. It's easier for wild goat females, due to their preference of cliffs, to find free-of-livestock rocky patches in Nakhchyvan, while males seemingly prefer continuous stretch of totally free-of-livestock summer habitat on the Armenian side, returning to Nakhchyvan for rut.

As for pipelines and roads, these directly affect mouflon more than wild goats; however, indirect threat is quite important, as in the case of mining activity, which is also increasing on Zangezur, because all these objects facilitate accessibility of wild goat habitat for poachers and simply increase disturbance.

Poaching affects primarily males, though poachers kill whatever possible, including females and kids. Numerical dominance of females during the rut indicates at larger pressure upon males, which is usually due to hunting.

Another factor which may include all three types of threat for the animals but may also protect them, is border-line defense. Border-guards often poach or simply disturb animals by their mere presence within the habitat, and this presence means additional roads and traffic. However, there is a hope that, when the border-line defense system will stabilize and border-guards get more disciplined and better supplied, it may really protect not only the animals but their habitat as well by preventing unauthorized entrance to the border-line area. It is a widely known fact that main wildlife survival areas in the Soviet Union were situated exactly within the border-line regime area along the “touchy” and severely guarded borders, as with China and Afghanistan.

Existing conservation strategies

Wild goat is listed in the Red Data Book of Armenia as ‘vulnerable’ according to IUCN criteria and is totally protected, but this protection in reality means just hunting ban and nothing more.

New nature conservation areas are being established in Armenia in the last years: south-eastern part of Megri Range (including Nuvadi Valley) and the surveyed section of Zangezur Range are now encompassed by nature reserves, national parks or sanctuaries with different regimes. However, actual protection is often conditioned by the attitude of local people – whether they care or not. The other important factor is actual claim for the given area by different land-users, because in reality even nature reserve can hardly stop mining or road and pipe-line construction. Also all the protected territories are rather small, often consist of cluster areas which cover about 50-100 km². Considering the size of the country and density of its human population, all nature reserves or sanctuaries are almost invariably close to towns, including the large city of Yerevan, as is the case with the whole of Khosrov NR, part of which Kakavaberd is and Urts used to be. There is no serious tradition of preventing any land-use within protected areas and, consequently, wild goat habitat is not being protected.

Another thing is that wild goat distribution is disrupted and patchy in Armenia, and most local wild goat populations are small, and vulnerable just because of that. A pair of new and active poachers may endanger a whole local population, while a caring village-head or director of a nature reserve can similarly improve situation in just a few years, due to high reproductive potential of the wild goat.

On the whole, the situation reminds multiple swings: it goes up and down independently in different areas due to local conditions, not to some general strategy etc.

Summing up our results,

Modeling in PRESENCE showed:

- the species range occupies almost 100% of the studied areas;
- extinction probability is seasonal and equals 0;
- probability of local colonization is seasonal and equals 0.92-0.99 depending on specific areas, and because of intense seasonal re-colonization, probability of extinction is 0;
- probability of spotting animals is either constant or seasonal and equals 1;

- no trends found, population stable;
- impact of snow cover is insignificant.

Expressing a personal opinion, I must say that PRESENCE modeling is disappointing.

On the whole, all the studied populations are in quite satisfactory state, except Urts, though Jainamdarasi Gorge harbours a decent local population. Nuvadi population may create an over-optimistic view of the general population on Megri Range, but that is certainly not the case. There are some other concentration areas on Megri Range, such as Khustup Mnt. Massif, but the overall situation is by far not so sunny.

Quite a number of areas are in private lease now, and planned to function as safari parks and/or trophy hunting outfits, despite wild goat being red-listed. Some of these show good results in wild goat protection, and our preliminary surveys even produced evidence of wild goats repopulating areas abandoned in 1990s. We consider that populations of such privately leased areas should be one of our primary aim of the planned follow-up project.

It would be a bit premature to propose a general wild goat conservation strategy for all Armenia, as further research is clearly necessary, but it is quite evident already by now that wild goat conservation in Armenia should not end up with total protection. It should include sustainable use in form of trophy hunting and limited hunting for meat by local population (of course outside strict nature reserves), because just ecotourism and goat-watching can hardly bring serious income now and will not change local attitude to wild goat as a mere source of free meat or an object for target-shooting. Status of the species in Armenia and its high reproductive potential allow such use.

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