

DISCONTINUOUS HABITAT OF THE WILD GOAT (*CAPRA AEGAGRUS ERXLEBEN*), NUCLEAR TYPE OF SPATIAL STRUCTURE OF THE SPECIES AND IMPLICATIONS FOR CONSERVATION OF THE WILD GOAT IN ARMENIA

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Abstract. In mountains of Alpine type, e.g. Eastern Greater Caucasus and Zangezur Range, wild goat (*Capra aegagrus* Erxl.) habitat is continuous and unbroken, because topography is continuously precipitous and rocky. In lowland and mid-mountain areas, where terrain is mainly hilly and rolling, there are separate local cliff massifs, or river canyons. Under such conditions, wild goat distribution is fragmentary and nuclear-type. Spatial and social structure of the population consists of the main site and peripheral sites are often situated within radius of 5 km. Main site, where major part of adult females lives, forms the reproductive nucleus containing 100–500 animals. This site is usually large and precipitous enough to secure survival of the nucleus, even under considerable anthropogenic pressure. Peripheral sites are much smaller and harbor 1–50 animals. Local populations fluctuate, due to the strengthening and weakening of anthropogenic pressure, often only central nucleus surviving during declines. Patchy discontinuous spatial structure of the wild goat population on the one hand makes protection easier, because the protected area is smaller, but increases risk of losing the local population on the other hand, in case of insufficient conservation.

Key words: discontinuous habitat, wild goat, *Capra aegagrus*, nuclear structure of the population, anthropogenic pressure, protection.

Ключевые слова: прерывистый биотоп, безоаровый козел, *Capra aegagrus*, очаговая структура популяции, антропогенный пресс, охрана.

Material for this paper was collected in Armenia in 2007–2013.

It is known that elevation isn't crucial for distribution of *Capra* species, because they are not so much highland inhabitants as cliff-dwelling animals, and even elevation zone and type of vegetation are not decisive. On the other hand, steepness of the slopes and presence of cliff massifs are essential for goats. Selectiveness towards mentioned environmental features often lead to patchy, fragmentary distribution of *Capra*, even in mountainous countries, especially under conditions of neighborhood with man and almost inevitable anthropogenic pressure. In mountains of Alpine type, e.g. Eastern Greater Caucasus and Zangezur Range, its southern part in particular, habitat of the wild goat (*Capra aegagrus* Erxl.) is mainly continuous and unbroken, because topography is almost uniformly precipitous and rocky. Situation is totally different in lowland and mid-mountain areas, where terrain is mainly hilly and rolling, with local small cliff massifs, rocky walls, or river canyons. Under such conditions, wild goat distribution is patchy and discontinuous. This type is most evident in females (with yearlings and juveniles) constituting the bulk of the population.

Separate dwelling of adult males (in case of the wild goat these are older than 5–6 years) and females outside the rutting season is characteristic of ungulates with pronounced sexual

dimorphism. It means that most part of the year these age/sex classes do not contact with each other. Demand of females for protective features of environment (which in case of *Capra* mostly means steepness and presence of cliffs) is higher than in males, and therefore adult males and females usually select different habitats. Such peculiarities of biology may result in partial, or sometimes full habitat separation between adult males and females, which may result in spatial segregation of adult males from the rest of the population outside the rut (Veinberg 1984, 1999; Magomedov et al. 2014).

In case of continuous habitat, as in Daghestan of the Greater Caucasus and in Zangezur Range of the Caucasus Minor, habitat separation of adult males and the rest of the population is evident in different types of terrain typically used by males and females, but they live side by side nevertheless, in the same territory in fact. Under conditions of discontinuous patchy distribution, adult males usually leave areas inhabited by females after the rut and may totally disappear from there until the next rutting season.

Nucleuses of female distribution may be separated by kilometers of “unsuitable”, usually rolling terrain, which animals do not inhabit, or where they show up irregularly. Even potentially suitable sites are not always inhabited. It may depend upon distances between them, the areas of the sites, occurrence of larger population nucleus in this district and level of anthropogenic pressure.

Thus, in several lowland and mid-mountain districts of Armenia, a peculiar spatial (and social) structure of wild goat population exists. This structure consists of the main site, where major part of adult females lives, the reproductive nucleus. It may contain 100–500 animals. This site is usually spacious and precipitous enough to secure survival of the nucleus, even under considerable anthropogenic pressure. Around the main nucleus, often within the radius of 5 km, peripheral sites are situated, much smaller and harboring 1–50 animals. These can be reproductive females, young females and males, and sometimes even adult males. Noravank Canyon and Yeghegis Gorge are good examples of such structure.

Yeghegis Gorge is a long valley, but only its 12 km long lower canyon-like part is precipitous and appropriate for goats. There are two large villages on the bottom of this section of the valley. Main part of the wild goat population inhabits the more forested north-facing left side of the valley. The slope is about 1000 m high on an average. Up to 150 animals had been counted there during the rut and in summer, but this figure cannot be precise because of broken and forested terrain, so the total population supposedly consists of no less than 300–400 animals. The surrounding territory is rolling with separate small cliff massifs. Two such massifs (Ardoikar and Soyanoys, about 1.5 and 0.5 km² large respectively) are situated in the neighboring valleys about 4 km southwards from Yeghegis Gorge (Fig.). The smaller massif harbored 2 adult and 3 younger males, while the larger Ardoikar had a growing local group of young males and females. Adult males were singular and difficult to spot in Yeghegis outside the rut, so presumably Soyanoys was not the only peripheral site harboring them.

Noravank Canyon is the central part of a long valley. Canyon is about 6 km long and 150–200 m deep. Total estimate was more than 200 animals living in the canyon in 2012–2013, but latest census carried out in 2019 revealed about twice higher numbers (including juveniles, yearlings and not so numerous adult males, visiting the area during the rut). During surveys of 2009–2013, only singular males older than 4 years had been observed there outside the rut. Small cliff massifs and canyons are situated within 5 km distance around Noravank Canyon, harboring small, sometimes temporary wild goat groups (Fig.). One of these massifs (Mayli Khan) may harbor adult males in summer. Unlike Yeghegis, where animals feed on the slopes of the valley, there is next to no forage on the walls of the Noravank canyon, so wild goats pasture either on the bottom of the canyon, or mostly climb up to the gentle slopes surrounding the canyon. Thus, if Yeghegis provides shelter and pastures, i.e. the whole habitat, Noravank is just exclusively a shelter site. This fact explains abnormally high population density in Noravank. The width of the canyon between the edges is merely some 500 m, so the total area of the 6 km long canyon is just 3 km². According to

the data from 2007–2013 (200 animals), the population density in the canyon is almost 70 animals/km². However, adding the adjoining slopes, where animals pasture, will increase the area to 24 km², and the density will be about 8 animals/km² (still rather high and considerably higher according to latest census data). Concentration of females in canyons amidst gentle and rolling slopes is also known in markhor (*C. falconeri* Wagner) in Kugitang, Turkmenistan. Adult males dwelt separately there, outside canyons, on higher and moderately precipitous parts of the mountain range (Weinberg, Fedosenko, Valdez 1999).

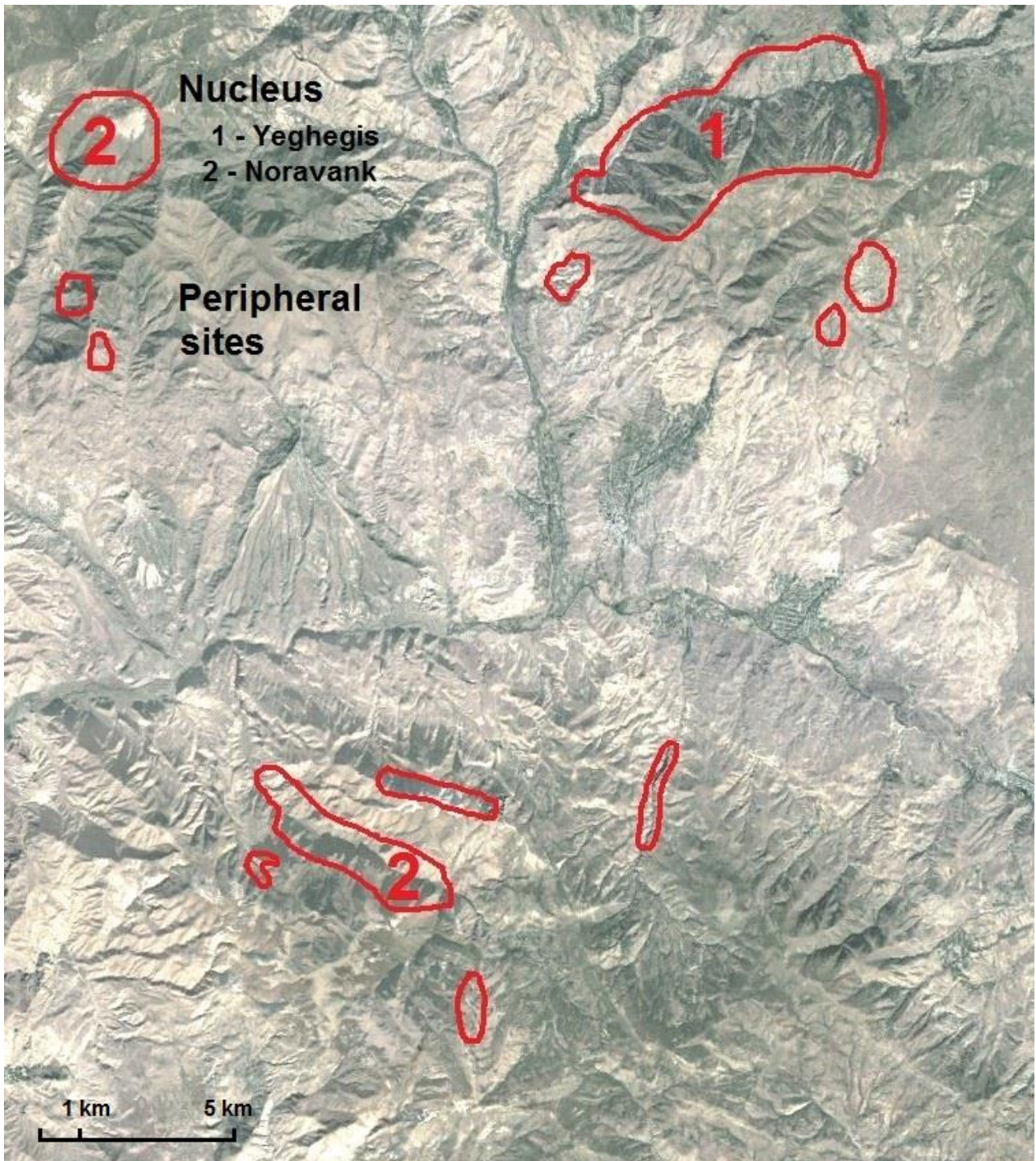


Fig. Nuclear structure of spatial organization of local wild goat populations in Central Armenia on the example of Yeghegis and Noravank.

The question is: to what extent concentration of animals may grow in a limited area like Noravank canyon without negative consequences, like decline of reproduction rates, worse survival of juveniles etc.? Also, in general, Yeghegis-type larger main site, with higher forested slopes and cliff walls, offers more protection and theoretically may harbor larger wild goat nucleus, and thus has better prospect and, hence, higher significance in conservation of its local wild goat population.

In case of excessive anthropogenic pressure wild goats vanish from peripheral secondary sites and only the main nucleus survives, in which animal numbers also drop to level when hunting (poaching in reality) becomes unproductive. When anthropogenic pressure weakens, population starts restoring. At first the main nucleus grows, and upon reaching sufficient density there, re-colonization of once-inhabited peripheral sites takes place. Since adult reproductive females are the most spatially conservative and residential part of the population, exploration of now-vacant sites is performed by more mobile young and yearling males. In that way, after re-establishing protection and stopping poaching in Yeghegis and its surroundings, young and yearling males started visiting Ardoikar massif. According to the owner/lease-holder of this rather smallish area, it was totally devoid of goats at least since the end of 1980s and until 2008, when first animals appeared there. In summer 2010, we surveyed the area for the first time and found 14 2-3-year-old males, 14 yearlings of both sex and two 2-year-old females. Young 2-3-year old males usually are accompanied by yearlings, mostly males, and by some females as well which often separate from their mothers and “hang out” with young males. An occasional 2-year old female may join them too. Such young male group wandered to Ardoikar. Probably animals did not stay there for the winter and returned to Yeghegis instead, but the site suited them. Therefore two years later, in summer 2012, there were already 15 young males, 8 females, 13 yearlings of both sex and, most important, 4 kids. So females started giving birth there. In summer 2013, there were 23 young males, 11 females, 16 yearlings and 7 kids. At least a part of these females stayed there during the rut, while majority of the young males didn't spend the winters there, unlike females. Probably they returned to the main site in Yeghegis for wintering because capacity of Ardoikar is insufficient for harboring more than 20–30 animals in winter. In that manner population expanded, re-colonizing their former living-places.

This example illustrates good potential for restoration of the population after decline, due to high fecundity, because twinning is usual in the species (Veinberg 1999, Magomedov et al. 2014), unlike tur (Veinberg 2002). But it also shows importance of preserving the main reproductive nucleus, because if that would have been exterminated, natural self-restoration of the population becomes more problematic, and possible only by immigration of animals from other, maybe quite distant areas. Meanwhile *Capra* species, especially females, are not inclined to distant migrations across unsuitable habitat crossed by roads and interrupted by human settlements and other anthropogenic objects.

Thus, local populations fluctuate periodically, reacting to strengthening and weakening of the anthropogenic pressure: only central nucleus often survives the decline, while during growth of the population, it re-colonizes peripheral sites around the central nucleus, sometimes very small rocky outcrops and mini-canyons.

Fragmentary habitat determining discontinuous spatial structure of the wild goat population enables animals to inhabit small areas, like standing-alone cliff mini-massifs close to human settlements. Such structure (1) makes wild goat protection easier on the one hand, because areas of concern are smaller and localized, and it is possible to concentrate on protection of exact areas of limited size, but it also (2) increases risk of losing the local population altogether on the other hand, in case of insufficient conservation and extermination of the reproductive nucleus.

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