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RESULTS OF REMOTE SENSING OF A LEOPARD (*PANTHERA PARDUS SAXICOLOR*, POCOCK, 1927) IN THE ALIYEV ZANGEZUR NATIONAL PARK OF THE NAKHCHIVAN AUTONOMOUS REPUBLIC OF AZERBAIJAN

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РЕЗУЛЬТАТЫ ДИСТАНЦИОННОГО ИССЛЕДОВАНИЯ ЛЕОПАРДА (*PANTHERA PARDUS SAXICOLOR*, POCOCK, 1927) В ЗАНГЕЗУРСКОМ НАЦИОНАЛЬНОМ ПАРКЕ ИМ. АКАД. Г. А. АЛИЕВА НАХИЧЕВАНСКОЙ АВТОНОМНОЙ РЕСПУБЛИКИ АЗЕРБАЙДЖАНА

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Abstract. Since 2006, with the support of WWF (World Wide Fund for Nature) and IDEA (International Dialogue for Environmental Action), remote research of leopards (*Panthera pardus saxicolor*, Pocock, 1927 = *P. p. ciscaucasica*, Satunin, 1924). The main research is carried out on the eastern slopes of the Zangezur Mountains in the Aliyev Zangezur National Park of the Nakhchivan Autonomous Republic of Azerbaijan. To study the leopard, photographic traps of the Cudde Back (17 pieces), Panthera (5 pieces) and Bushnel (64 pieces) brands in the amount of 86 pieces are used. In 2019 alone, 373,622 photos and 45,553 videos were taken. On 340 photos and 71 video materials, adult leopards were recorded, and on 20 photos and 5 video materials, a female leopard with cubs was filmed, and a photo of a female and a male was found on 7 photos and 4 video materials. During this period, 12 adults and 3 calves were identified.

Аннотация. Начиная с 2006 года при поддержке Всемирного фонда дикой природы (WWF) и IDEA (Международный диалог во имя охраны окружающей среды) на территории Нахичеванской автономной республики на 11 стационарных пунктах ведется дистанционное исследование леопарда (*Panthera pardus saxicolor*, Pocock, 1927 = *P. p. ciscaucasica*, Satunin, 1924). Основное исследование ведется на восточных склонах Зангезурского хребта в Зангезурском национальном парке им. акад. Г. А. Алиева на территории Нахичеванской

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автономной республики Азербайджана. Для исследования леопарда используются фотокапканы марки Cudde Back (17 штук), Panthera (5 штук) и Bushnel (64 штук) в количестве 86 штук. Только за 2019 год было снято 373622 фото и 45553 видео материалов. На 340 фото и 71 видео материалах были зафиксированы взрослые леопарды, на 20 фото и 5 видео материалах снята самка леопарда с детенышами и на 7 фото и 4 видео материалах обнаружены самка и самец. За этот период определено 12 взрослых особей и 3 детеныша.

Keywords: WWF, IDEA, fauna, *Panthera pardus*, Nakhchivan Autonomous Republic, Zangezur National Park.

Ключевые слова: WWF, IDEA, фауна, *Panthera pardus*, Нахичеванская автономная республика, Зангезурский национальный парк.

The Nakhchivan Autonomous Republic, an inseparable part of Azerbaijan Republic, has a total area of 5502,75 km^2, or 6.35% of the territory of Azerbaijan. Its climate is extremely continental and split at 5 patterns with respective 4 landscape types. Only here across the country, we can observe the absolute maximum (+44 °C) and absolute minimum (−32 °C) temperatures. The soil mantle is diverse and includes 15 types.

Known for its exceptional position in the Caucasus ecoregion and specific soil and climate peculiarities, the Autonomous Republic of Nakhchivan is also distinct with its rich biodiversity. Recent studies showed the distribution of rare plant and animal species in Nakhchivan. Fauna studies over the last few years in the Azerbaijan Republic revealed 728 vertebrate species found in the country. Nakhchivan — related studies resulted in sighting 403 vertebrate species across the Autonomous Republic (55.4% of the country's total) [1, p. 74–83; 2, p. 27–32]. 33 fish species out of 110 affected the country, 7 amphibian species out of 11 inhabiting Azerbaijan, 39 reptilian species out of 63 occurred in Azerbaijan, 254 bird species out of the country's 429, and 70 mammal species out of 114 distributed in Azerbaijan were found in the Autonomous Republic of Nakhchivan (Table 1). Of the above-stated species, 71 are listed in the Red Book of Autonomous Republic of Nakhchivan and 142 in the Red Book of Azerbaijan Republic [3–4; 5, p. 53–72].

As for invertebrates, they play a crucial role in the biodiversity of the Autonomous Republic and represented by 5 kingdoms, 18 phyla, 45 classes, 126 orders, 607 families, 2,030 genera, and 4,598 species. Many of them are relict, endemic, and threatened species [6; 7, p. 5–12]. The same pattern may be applied to plant life, e. g. it is believed some 5,000 higher sporophyte, gymnosperm, and metasperm species grow in the Azerbaijan Republic, while the number of plant species in the Autonomous Republic of Nakhchivan exceeds 3,021 and grouped in 176 families and 908 genera (60.4% of the country's total) [4]. Despite tiny territory, the Republic has a rich biodiversity, which is undoubtedly related to its history of formation.

As is clearly seen from the Table, amphibians are the most endangered class (54.5%), followed by mammals (36.8%), reptiles (22.2%), birds (16.6%), and fish species (8.2%). It is of common knowledge that large and easily sighted animals disliked by the public are stronger affected by anthropogenous factors. The Table from the second edition of the Red Book of Azerbaijan Republic (2013) clearly indicates a sharp increase in the number of threatened species, in particular when it comes to more than half of amphibians and up to 37% of mammals that listed as specially protected species. Most recently, substantial activities focused on environmental conservation in the Autonomous Republic led to a notable rise in the aforementioned protected species populations.

Table 1.

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TAXONOMIC HIERARCHY OF VERTEBRATE FAUNA IN AZERBAIJAN, INCLUDING NAKHCHIVAN AUTONOMOUS REPUBLIC

Classis		*Azerbaijan*	*Nakhchivan*	*Ordo*		*Familia*		*Genus*		*Threatened species*		
				Azerbaijan	*Nakhchivan*	*Azerbaijan*	*Nakhchivan*	*Azerbaijan*	*Nakhchivan*	*Azerbaijan*		*Nakhchivan (2006)*
										1989	*2013*	
Cyclostomata		1	—	1	—	1	—	1	—	1	—	—
Osteichthyes		110	33	13	6	16	8	52	27	4	9	1
Amphibia		11	7	2	1	6	4	9	6	5	6	1
Reptilia	*Testudines*	3	3	1	1	3	3	3	3	1	1	1
	Sauria	32	15	1	1	5	5	13	11	4	5	5
	Serpentes	28	21	1	1	4	4	18	17	3	8	4
Aves		429	254	18	18	58	51	187	143	36	71	39
Mammalia		114	70	7	7	25	21	57	45	14	42	20
Total:		728	403	44	35	118	96	340	252	68	142	71

As an outcome of substantial natural conservation measures in the autonomous republic, the status of threatened flora and fauna species improved; visible positive changes were also observed in population dynamics and structure. The Autonomous Republic hosts specially protected nature areas — Zangezur National Park named after academician Hasan Aliyev, Ordubad, Arazboyu and Arpachay state nature sanctuaries with total area of 148.695,58 hectares, or 27.02% of the territory of the Autonomous Republic of Nakhchivan (Figure 1).

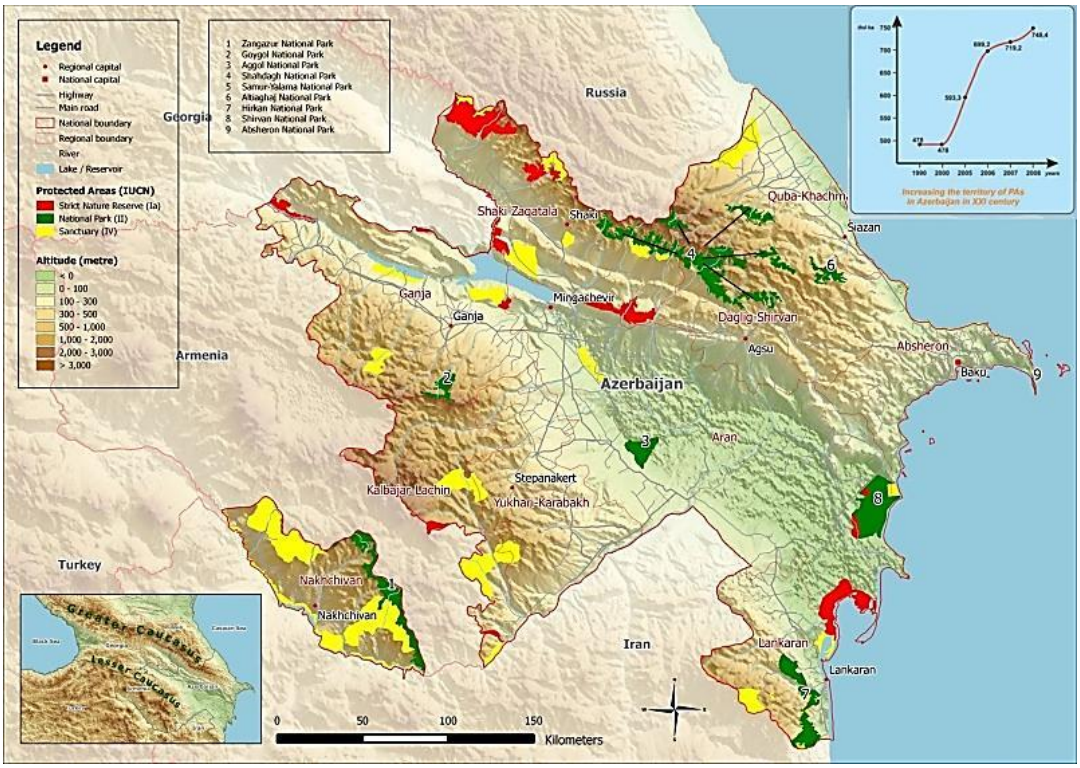

Figure 1. Specially protected nature areas in Azerbaijan.

Felidae family is traditionally divided into five subfamilies: *Pantherinae*, *Felinae*, *Acinonychinae* and extinct *Machairodontinae* and *Proailurinae*. Extant cats fall into eight

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evolutionary lineages and 41 species. Nuclear DNA genotyping of studied species showed cross-species hybridization occurred in the course of evolution within the majority of eight clades. Fur patterns modelling revealed that virtually all patterns originated from small spots.

41 species fall under *Felinae* (Cats) family of carnivores and affect the entire Globe but Australia and some small insular territories. This family includes 4 genera: large cats, snow leopards, cats and cheetahs. Cats genus is composed of 30 species occurring in Eurasia, Africa, and Americas, of them, 6 species inhabit Caucasus. Most of above-stated six species are listed in the Red Books of Azerbaijan and the Autonomous Republic of Nakhchivan, some of them even have international conservation status and that makes us really proud for indispensable natural wealth of or country. Studies on the current status of the species above, their habitats and conservation strategies are of paramount necessity. These species are as follows:

Familia: *Felidae* Fischer de Waldheim, 1817 — Cats
1. Subfamilia: *Felinae* Fischer de Waldheim, 1817
1. Genus: *Felis* Linnaeus,1758 — Cat
1. *Felis chaus* Guldenstaedt, 1776 — Jungle cat
2. *F. libyca* Forster, 1817 — African wildcat
3. *F. silvestris* Schreber, 1777 — European wildcat

2. Genus: *Otocolobus* Brandt, 1841
4. *Otocolobus manul* Pallas, 1776 — Pallas's cat or Manul

3. Genus: *Lynx* Linnaeus, 1758 — Lynx
5. *Lynx lynx* Linnaeus, 1758 — Lynx

2. Subfamilia: *Pantherinae* Pocock,1917

4. Genus: *Panthera* Pocock, 1917 — Leopard
6. *Panthera pardus* Linnaeus, 1758 — Leopard

Historically, almost all genera used to affect Azerbaijan, however, only two genera managed to survive till present (large cats and cats). Caspian tigers were believed to be a subspecies of Tigers species yet 2009 mitochondrial DNA analysis revealed they were very close to Siberian tigers. Caspian tigers used to occur near western boundaries of Siberian tiger habitats. Caspian tigers were reported extinct in 70th of XX century in Turkey, Iran, Iraq, Kazakhstan, Uzbekistan, Tajikistan, Turkmenistan, Afghanistan and Mongolia. The last individuals of Caspian tiger — *Panthera tigris virgata* Illiger, 1815, representatives of large cats, were killed in Azerbaijan Republic in 1928–1932 (Figure 2) and in South Azerbaijan in 1953 (Figure 3) respectively. A Caspian tiger individual lived in Berlin Zoo in 1899 (Figure 4). Caspian tigers went thereby extinct.

Persian or Caucasian leopard is the largest subspecies of leopard and its distribution area covers Azerbaijan, Iran, Iraq, Turkey, Russia, Afghanistan, Pakistan, Turkmenistan and some other areas. Globally, population of Persian leopard roughly accounts for 1,000 individuals (between 870 and 1,300) and the biggest population is supposed to be found in Iran (from 550 to 850 individuals). Once leopard widely occurred in thick forests and rocky landscapes of Azerbaijan as a carnivore, but nowadays its population declined dramatically. The taxonomy of the Persian leopard as disputed during the XX century. Some time it was believed that two subspecies inhabit the Caucasus region:

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P. p. ciscaucasicus Satunin and *P. p. tullianus* Valenciennes. However, Heptner, V. G. noted that only *P. p. ciscaucasicus* subspecies occurs in the Caucasus. By the end of XX century researchers believed that leopard does not inhabit the Greater Caucasus anymore. According to references, few individuals had survived in the Autonomous Republic of Nakhchivan and they all were hunted in 80th of XX century [8].

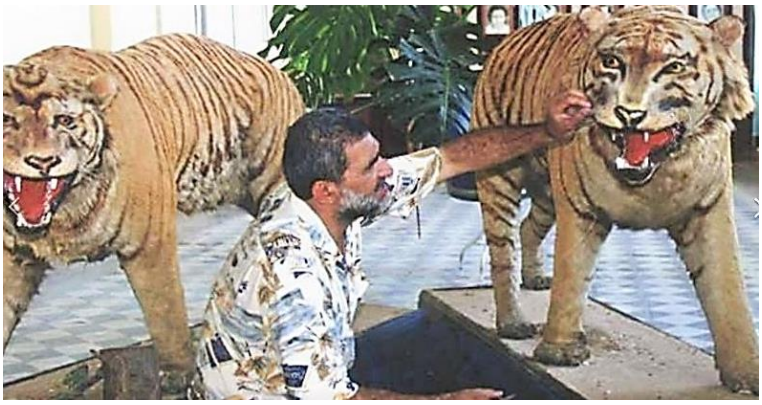

Figure 2. The museum specimens of the last Caspian tiger killed in Azerbaijan in 1928–1932.

Figure 3. The last Caspian tiger (*Panthera tigris virgata*) individual killed in South Azerbaijan in 1953.

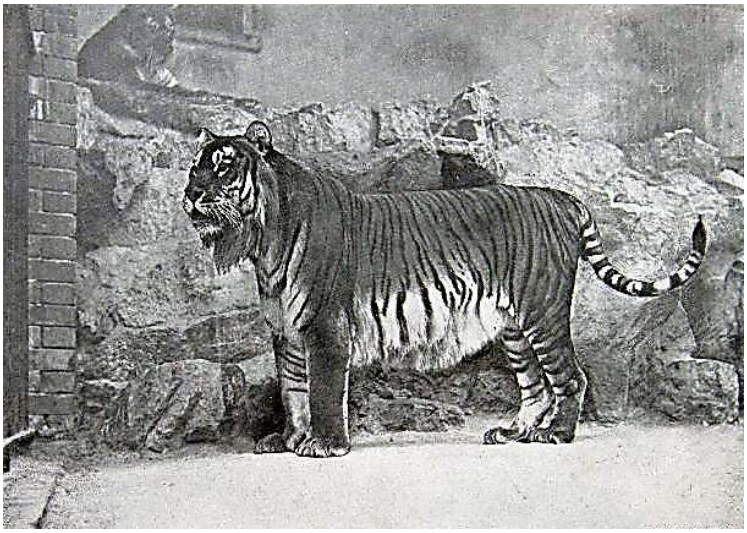

Figure 4. Turanian, or South Caucasian tiger (*Panthera tigris virgata* Illiger, 1815) in Berlin Zoo (1899).

During the period 2003–2007, by the team of T. H. Talibov, E. K. Askarov, V. S. Lukarevsky and B. Avgan several fieldworks were organised and according to the signs of leopard presence, by

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questionereing local population, borderguards etc on Nakhchivan the local population was estimated as 3–5 individuals. These few individuals inhabited large areas ranging from Ardijdag mountain in Sharur district till Soyugdag mountain in Ordubad especially in Kotam valley and Kechi Aghili hillsides close to Gamigaya-Gapijig and Ayrichay river estuary within Zangezur National Park. The habitats of leopard in Nakhchivan autonomy repeats habitats of the Bezoar goat (*Capra aegagrus*) and partly Moufflon (*Ovis orientalis*).

The surveys revealed no serious conflict in human-leopard interaction in the Republic. There are few cases of leopard attack on human during the XX century, in 70th the leopard jumped on a resident of Nasirvaz village hunter Bashir when crossing the rocky slopes of Gapijig mountain on Zangezur range. Fortunately, they rolled down the rock and then the leopard run away. The hunter had a hand injury but managed to survive. A leopard was hunted near a cave in Balligaya area of Ardijdag mountain by a hunter residing in Danyeri (Danzik) village located on the bank of Arpachay river in Sharur district. A local shepard of the village of Nus-nus of Ordubad district stated a leopard attacked a flock of sheep in Gaplangaya neighborhood of Sari ravines on the bank of Ordubadchay river early in the morning, caught and suffocated a sheep and then escaped leaving the prey on the river bank. Besides these recorded encounters, no other human-leopard interaction cases were ever been reported though local residents normally ascend to the mountains to collect wild herbs and medicinal plants to meet their needs in early spring. Also, shepherds at summer pastures, who settle in highland farms for 5 to 6 months annually reported they accidentally spotted leopards or even heard their roaring but never interacted with them closely. In our opinion, this happenned due to sufficient prey availability in the area. Moreover, shepards, hunters and local residents in Talysh Mountains confirmed sighting leopards in woodlands, but very rarely.

For recent decades there were no reliable scientific references on leopards in Azerbaijan, but starting from 2006, Institute of Bioresources of Nakhchivan Division of ANAS initiated fundamental studies on the issue above with support of World Wildlife Fund (WWF). The first field investigations were led by the well-known leopard specialist V. Lukarevsky. The other experts P. I. Veyenberg and Y. A. Yarevenko helped in studying Bezoar goat and moufflon populations, key prey species of leopard [9; 10, p. 46–52].

As a kick-off activity that resulted in design of relevant conservation strategies reported to the Ministry of Ecology and Natural Resources of Autonomous Republic of Nakhchivan. Starting from 2007 WWF supported the Institute team by camera traps. As a result of studies, the camera trap installed in the neighborhood of Kilit village of Ordubad district took the first ever photo of a female leopard in September 2012. A respective article was published in 57th edition of CAT NEWS newsletter in 2012 [11, p. 33].

Next year 2 more male leopards were captured by photo traps and in 2014 a leopard couple was trapped together in mating period. The first reproduction case was documented in 2015 when the female Eve was captured with 3 cubs [12, p. 26–31].

According to the scientific literature, herbivore mammals (Bezoar goat, Moufflon, Roe deer, Wild boar, Red deer, etc.) are deemed to be the key prey base for Persian leopard. As for porcupine, hare, snowcock, pheasant, quail, etc., they play the secondary role in feeding of leopard. The populations of Bezoar goat and Mouflon in the autonomic republic increased after hunting ban introduced in 2001. The number of goats was estimated as 1800–2000, and mouflons — about 400–450.

Leopard individuals strongly differ by fur color, thickness and hair length. Skin color varies between individuals from pale to dark and pattern varies from small spots to stripes and rosettes.

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Cat species cubs are mainly born with spotted skin, excluding jaguarundi (*Herpailurus yagouaroundi*), Asian golden cat (*Catopuma temminckii*) and caracal (*Caracal caracal*). Cubs of lion (*Panthera leo*) and cougar (*Puma concolor*) are born with fur spots changed its color to light brown due to ontogenesis. Snow leopard (*Panthera uncia*) and Pallas's cat (*Felis manul*) have thick and long-haired fur if they occur in areas with cold climate, while they have short-haired fur once settled in tropical areas and areas with warm climate. Some leopard individuals experience melanism, so we can sight fully black-colored leopards.

Tail of the vast majority of cats compose one third to half of body length, however, there exclusions like lynx. Cat species also differ by head-and-body length and weight. Tiger (*Panthera tigris*) has the longest body among cats (390 cm), weighs from 65 to 325 kg and its head length ranges 316–413 mm. Although lion has a maximum length of skull of 419 mm, its body length and weight is less than those ones of tiger. The smallest cats are rusty-spotted cat (*Prionailurus rubiginosus*) with body length range of 35–48 cm and weight of 0.9 to 1.6 kg, and black-footed cat (*Felis nigripes*) with body length from 36.7 to 43.3 cm weighing 2.45 kg. Their tongues have corneous papillae, which aid rasping prey meat from bones and grooming. Cat species have five toes on each forepaw and four toes on each back paw. They also have developed and highly sensitive fur and tactile whiskers above eyes, on their muzzle, around and under jaws that better their night movement and ease nocturnal hunting. Their eyes are comparatively big and have binocular vision. Their night vision is superior as their eyes have *Tapetum lucidum* tissue layer retroreflecting the light and giving the cats a specific eyeshine. Because of this layer availability, cats' eyes are six time more light-sensitive than human ones and many cat species are nocturnal animals. Their retina has a larger number of rod cells and also contains cones giving them ability to detect animal motions more accurately in dim light. Their outer ears are large enough and in case of small cat species are very sensitive to high-frequency sounds. The sensitivity above helps cats detect rodents and small prey species easily. Cats have compact and strong muscles and lithe physique, their tongue does not have sweet taste buds, so they do not have ability to discern sweet tastes.

As cats consume prey meat, their teeth formula is $i\frac{3}{3}, c\frac{1}{1}, p\frac{3(2)}{2}, \mathrm{m}\frac{1}{1} = 30(28)$. They also have specific hunting behavior (prey stalking, hide, prey headlock and dispatch by asphyxiation, etc.). Since leopards have a compact body, sharp claws, and strong legs, they sometimes may climb trees with a prey much heavier than they are. Leopard body length is 2.5 to 3.0 meters including tail. Leopards can easily walk on both tree crown and steep rocks. From this point of view, Persian wild goats that affect steep rocky landscapes of Zangezur range and represent key prey item for leopards are not that inaccessible. However, surveillance findings show leopards prefer hiding near water springs while hunting. No limiting factors for this species were identified, but no doubt prey base shortage and other disturbing factors play a crucial role.

Leopard was announced as a protected species in Azerbaijan from 1967. And in 1989 it was included into the first edition of the Red book of Azerbaijan. Leopard habitats are protected within all 4 PAs in Nakhchivan. The overall size of PAs in Azerbaijan was doubled during the last decades.

In 2009 the first Action Plan for Conservation of the Leopard was developed in Azerbaijan and approved by the government. Besides to governmental organizations, non-government and scientific sector is also interested in conserving of this endangered species. Ms. Leyla Aliyeva, Vice President of Heydar Aliyev Foundation launched international environmental campaign IDEA (*The initiative international dialogue for environment protection*) on 12 July 2011 aimed at endangered local Big Five (bear, wolf, gazelle, eagle and leopard) conservation and the activities she implemented produced big effect.

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Besides all above-stated achievements, the war outbroken against Azerbaijan strongly affected nature conservation area among many others. Position of armament and technical equipment in the Autonomous Republic of Nakhchivan from Sadarak to Daralayaz and Zangezur ranges as well as pavement of new important roads kept animals away from the territory. Therefore, leopards once occured in Ardijdag mountain had to resettle in new and safe areas. As for Shahbuz and Babak districts, if there are no occassional trails for leopard passing there, there is no chance of sustainable leopard populations survival as the neighborhoods are densely populated and strongly affected by anthropogenous factor. Ordubad and Julfa districts are the other way round less subject to anthropogenous impact, so there are good chances for availability of sustainable leopard populations there.

For 08–11 October 2014, Caucasian Ecoregion of World Wildlife Fund (WWF) and International Union for Conservation of Nature (IUCN) held a broad workshop "Cats in the Caucasus" in Tbilisi. IUCN experts dealing with endangered cats' conservation closely participated and contributed to design of National Action Plan on Leopard Protection in Caucasian ecoregion. The Ministry of Environment and Natural Resources of Azerbaijan approved the National Action Plan on Leopard Protection in Azerbaijan as an outcome of the above-mentioned cooperation. The Plan designed specified activities in two mainstream areas: enhancement of leopard conservation in leopard habitats in specially protected nature reservations and country monitoring of leopard populations. It is worth stating, large landscape areas (wildlife corridors) are supposed to get allocated in the country for gene exchange between isolated leopard populations [13, p. 95–101; 14].

The relevant research activities were implemented in Zangezur National Park of the Autonomous Republic of Nakhchivan (11 camera traps were installed in Soyugdag-Ajnovur area, 10 in the vicinity of Ganza village, 8 close to Gilanchay, 7 near Paragachay, 11 in Mamadeyin neighborhood of Kotam village and 15 cameras near the village of Kilid) and in Babak and Julfa districts (3 camera traps in Darasham-I, 3 in Darasham-II and 5 cameras in Daridag). Of the camera traps installed across Zangezur National Park, 51 devices were Bushnell, 16 — Cuddle Back and 1— Panthera, that's 68 camera traps totally. 5 Bushnell, 4 Panthera and 2 Cuddle Back type cameras (totally 11) were installed in Babak and Julfa districts. Totally, 79 camera traps were installed in 10 sites of the Autonomous Republic of Nakhchivan (Figure 5).

Leopard conservation activities started in Azerbaijan with passing a law banning hunt on leopards in 1967. Red Books of the former USSR (1984), Azerbaijan (1989, 2013) and the Autonomous Republic of Nakhchivan (2006), the inseparable part of Azerbaijan listed leopard as endangered species and banned hunt on leopards without indication of any subspecies. Leopard biology is not well studied, however, according to scientific references, cats' mate in January in the Caucasus and cubs are born in April or May 2 to 3 cubs are usually born in one litter.

For recent years, photos and videos taken by camera traps across the Autonomous Republic have been analyzed and posted in respective materials.

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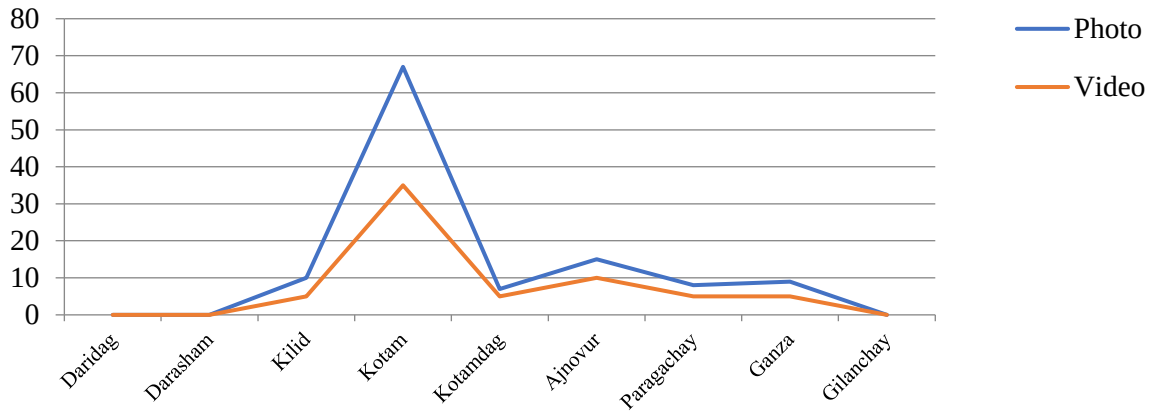

Figure 5. Leopard camera capture frequency by areas, 2018.

Camera traps-taken photos and videos analysis showed leopards walked in pairs for 08 January — 20 February, mating occurred in Ordubad district for 12 March — 06 April and cubs walking with the mother leopard were spotted for 15 October — 18 November. Due to climatic factors leopard mating in the Autonomous Republic of Nakhchivan falls on early spring and cubs freely walking with their mother can be sighted in early fall.

Figure 6.

Figure 7.

Figure 8.

Figure 9.

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Table 2.

PHOTO AND VIDEO MATERIALS FROM CAMERA TRAPS INSTALLED IN DIFFERENT REGIONS OF THE AUTONOMOUS REPUBLIC IN 2019

Region	*Territory*	*Photo*	*Video*	*Leopard*			
				photo	*video*	*together with cubs*	*couple*
Sadarak	Gunnut	61784	—	—	—	—	—
Ordubad	Kotamdaq	28244	8950	10	4	1	—
Ordubad	Soyuqdaq	54826	8476	40	16	7	—
Ordubad	Gilancay	32090	3146	—	—	—	—
Ordubad	Ganza	49558	1796	11	2	—	—
Ordubad	Paragacay	13757	7723	5	2	—	—
Ordubad	Kotam	52181	6435	274	46	17	11
Sharur	Qizilqaya	32138	—	—	—	—	—
Culfa	Daridaq	26532	3973	—	—	—	—
Babek	Darasham	7216	2651	—	—	—	—
Ordubad	Kilid	15296	2403	16	1	—	—
Total		*373622*	*45553*	*356*	*71*	*25*	*11*

In 2019, in the territory of the Nakhchivan Autonomous Republic, 11 different places, remote research of the leopard is being conducted. The main research is carried out in the Aliyev Zangezur National Park of the Nakhchivan Autonomous Republic of Azerbaijan. For this we use photocaps for the Cudde Back, Panthera and Bushnel brands in the amount of 86 pieces, of which 64 pieces are Bushnel, 17 pieces are Cudde Back and 5 pieces are Panthera. In 2019 alone, 373,622 photos and 45,553 videos were taken. Of these, 340 photos and 71 video materials were adult leopards, 20 photos and 5 video materials were a female leopard with cubs, and 7 photos and 4 video materials were a female and a male (Table 2, Figure 6–9).

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