



POPULATION ECOLOGY OF THE LEOPARD (*Panthera pardus*) IN DAGESTAN, RUSSIAN NORTH CAUCASUS

Final report

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INTRODUCTION

Research on population ecology of such a large and rare mammal in the Caucasus as the leopard (*Panthera pardus*) has been a challenge. During the past Rufford project we have found that in Dagestan leopards live in 3-5 areas as claimed by local people and supported by stuffed specimens and a claw harvested in 1981 in the Gumbetovsky District (Spasskaya & Saidalieva, 1983; 580 m, 42°46'225"N/46°40'339"E). There is no doubt that a few leopards still survive in Dagestan.

Implementation of targeted scientific studies and application of efficient conservation measures are impossible without obtaining reliable information about the spatial distribution and population structure of the leopard in Dagestan. As we already mentioned in the final report of the previous Rufford project, Dagestan has been the only region in the North Caucasus retaining favourable environmental conditions (thin snow cover, precipitous terrain, sufficient prey base and well-developed animal husbandry) for leopard existence.

The **goal** of this project was to obtain scientifically robust information about the structure of the leopard population living in Dagestan. Having data on sex/age structure of local leopards will promote implementation of follow-up research projects and development of concrete conservation measures in the eastern part of the Greater Caucasus Ridge. Production and dissemination of wall calendars with the image of the leopard will contribute to awareness-raising among local people, authorities and other stakeholders, thus promoting preservation of this species.



Figure 1. One of the main canyons where leopards are frequently recorded.

The leopard is placed atop the ecological pyramid and belongs to indigenous fauna of mountainous ecosystems of the Caucasus. For this reason, its rarity or imminent extinction would irrevocably lead to the breakdown of environmental processes, particularly to the increasing numbers of gray wolves (*Canis lupus*) which most often take over the areas left by leopards. So, a leopard killing 1 sheep per hunt will be replaced by a pack of wolves killing 20-30 sheep. Dissemination of such information among local pastoralist communities subsisting on animal husbandry has been a firm ground to better understand the economic benefits of leopard existence versus wolves which already terrorise livestock

and shepherds throughout Dagestan. This issue is vitally important for Dagestan where livestock numbers reach ca. 6 million (in late 2006 they included 862000 cattle and 4880000 sheep and goats).

Sufficient abundance of wild prey (13000-14000 eastern turs *Capra cylindricornis* and about 2000 bezoar goats *Capra aegagrus*) and domestic livestock ensure optimal conditions for leopard existence in Dagestan (Akhmedov, 1995; Nasrullaev & Akhmedov, 2000).



Figure 2. A shepherds' house on the brink of the cliff as a vantage point where local hunters and shepherds repeatedly recorded the leopards.



Figure 3. Project participants.

Historically, highlanders of Dagestan esteem the leopard for its courage and cunning, but only few of them still believe in its survival in the republic. During this project, we held numerous meetings with local elders, schoolchildren and local authorities in order to share information about this predator and select the best areas for studies and follow-up conservation.

WHAT DID WE KNOW ABOUT THE LEOPARD IN DAGESTAN AFTER THE FIRST RUFFORD PROJECT?

Leopards inhabit the most inaccessible and remotest areas of the republic. The crucial factor of leopard existence is sufficiency of prey – eastern tur, wild boar and bezoar goat. Poaching on leopards in most cases ensues from alleged attacks of predators on livestock, but given the meager numbers of leopards depredation on domestic animals is most likely caused by abundant wolves. Numerous secluded places and nooks (niches, grottos and caves on precipitous slopes) coupled with the predator's intrinsic secretiveness ensure its survival which in most cases remains undetected (Yarovenko, 1999).

The most optimal areas for leopard existence in Dagestan are located in the Andiiskoe Koisu riverside. In many sites rough terrain allows for safe living of the predator itself and its prey – bezoar goat, eastern tur (in headwaters), wild boar and roe deer. High densities of local people bear dual effect: negative as poaching and positive as high numbers of livestock.

Mountain slopes of northern exposure on both left and right banks of the Andiiskoe Koisu River, ranging from 900 to 2100 m a.s.l., are covered with woods. Most of them are spatially confined to the Chechen Republic and leopards might fare better there because of sparse population and limited infrastructure. However, during the snowy winters predators have to move to the snow-free southern slopes in Dagestan, attack livestock and die from human persecution.



Figure 4. The map of leopard records in Dagestan dated 1981-2006.

The areas of long-term and occasional presence of leopards that we have selected from sign records and poaching cases are located in the south-western and central parts of Dagestan on the boundary of Highland Dagestan and Inner Mountainous Dagestan. Just here the last known cases of leopard poaching were documented: 2 males in 1981 and 1985 and one female in 1995 (Fig. 4).

FIELD RESEARCH AND ITS RESULTS

We obtained and used 10 digital camera-traps: six Cuddeback® Capture IR 5.0 Megapixel scouting cameras and four Stealth Cam, STC-DVSIR5 Prowler DVS. Camera-traps were set up all in one study area for 3 months, then moved to the next area, and so on. The traps were mounted on trees in one site (20-60 days/site, with supplementary recharging), then moved to the other site. After 3 months of operation in the bottom of the canyon at ca. 1300 m a.s.l., devices were removed and placed upper at 2200-2300 m on the western slope of this canyon. In December-February most camera-traps failed to work or operated only 10-15 days because of cold weather which caused fast battery exhaustion. Because of rough terrain, unpredictable weather and remoteness from roads this work was quite hard (Figs. 3 and 5).



Figure 5. Setup of camera-traps in leopard habitats in Dagestan.

After initial technical problems with trap setup, camouflage, firm mounting and use of chargers the project activities went on smoothly and we have chosen the priority area for camera-trapping – Arzhuta Ridge, Kharakhinskoe Canyon (Figs. 1 and 2).

The study site, Kharakhinskoe Canyon, comprised 3 trails: 1st – bottom of the canyon; 2nd – eastern slopes of the canyon; 3rd – western slopes of the canyon. The first trail passed through the area intensively grazed by cattle and horses during the warm seasons. The second trail stretched through the pine forest (first 4 km) and then treeless slopes until the saddle on the ridgetop. The third trail ran along the crevices; just here the leopard photograph was taken by local hunter on his cell phone. During this project, each of these trails was surveyed 5 times.

Total sampling effort was 1030 trap-nights which comprised 10 operating camera-traps and specific efforts ranging from 85 to 120 nights/trap.

Having tested several models of portable chargers, we have decided to use the most quality models of capacities 7000 and 9000 Mha. The D batteries (used in Cuddeback) of Duracell brand were the best as they kept operating for more than 60 days in late autumn's cold and snow and still functioned 12 more days when removed from camera-traps. The NiCd batteries had low capacities and quickly discharged, so were most costly to use. The C batteries (used in Stealth Cam) worked no more than 15-20 days without recharging.

Our efforts have revealed the following technical problems with camera-traps. In two Stealth Cams infrared emitter did not work and 90% of night photographs (n = 270) were too dark without distinguishable contours. One Cuddeback placed on a rock was filled with water during 10 days, but fully recovered after desiccation and replacement of batteries.

The trigger time in both models is quite fast, 0.3-0.5 sec. As to our opinion, Stealth Cams have an advantage of programmed instantaneous shooting of 9 frames per trigger. However, Cuddebacks are easier to transport, set up and conceal in the wild what is very important in our environmental conditions (high potential detectability of camera-traps by wildlife and local people).

The weakest side of both models is night shooting. Even when photographed from as close as 4-5 m, animals cannot be individualized as only their contours are visible. One Stealth Cam produced only black images (up to 300 frames/sampling occasion). Possibly, flash gave some help but was very eye-catching to shepherds and hunters.

Results obtained from 4 camera-traps set up in this bottom of the canyon have shown that it is inhabited by prey species, but their abundance is not high. The bezoar goat (mostly males), roe deer, red fox and European hare were photographed here (Fig. 7). The rest camera-traps set up on wildlife trails on the western slopes of the canyon have confirmed the presence of wild boars (group of females and a male), bezoar goats (females with kids), as well as fox, stone marten, badger and gray wolf which are common (Fig. 8).

The most frequently camera-trapped species of particular interest to us (leopard prey and competitors) were bezoar goat and wild boar, but their distribution was spatially biased: goat captures were common on the western slopes and in the bottom of the Kharakhinskoe Canyon and wild boar captures were so on the eastern slopes (Fig. 6). Independent captures (different individuals captured or similarly looking individuals captured at least 0.5 hour apart in a site) were 76.5% in bezoar goat (52 out of 68 photographs; same percentage in the bottom and on the western slopes) and only 36.4% in wild boar (4 out of 11 photographs; all on the eastern slopes). This difference shows that bezoar goat population is represented by diverse individuals, so its size is indeed larger than that of wild boars. Wild boars are gregarious and frequent captures of the same individuals (mutually dependent captures) create the illusion of large population size – which is indeed scarcer. Goats prefer western slopes of the canyon up to 2400 m because of their rugged cliffy terrain and good feeding grounds located far away from shepherds and their livestock.

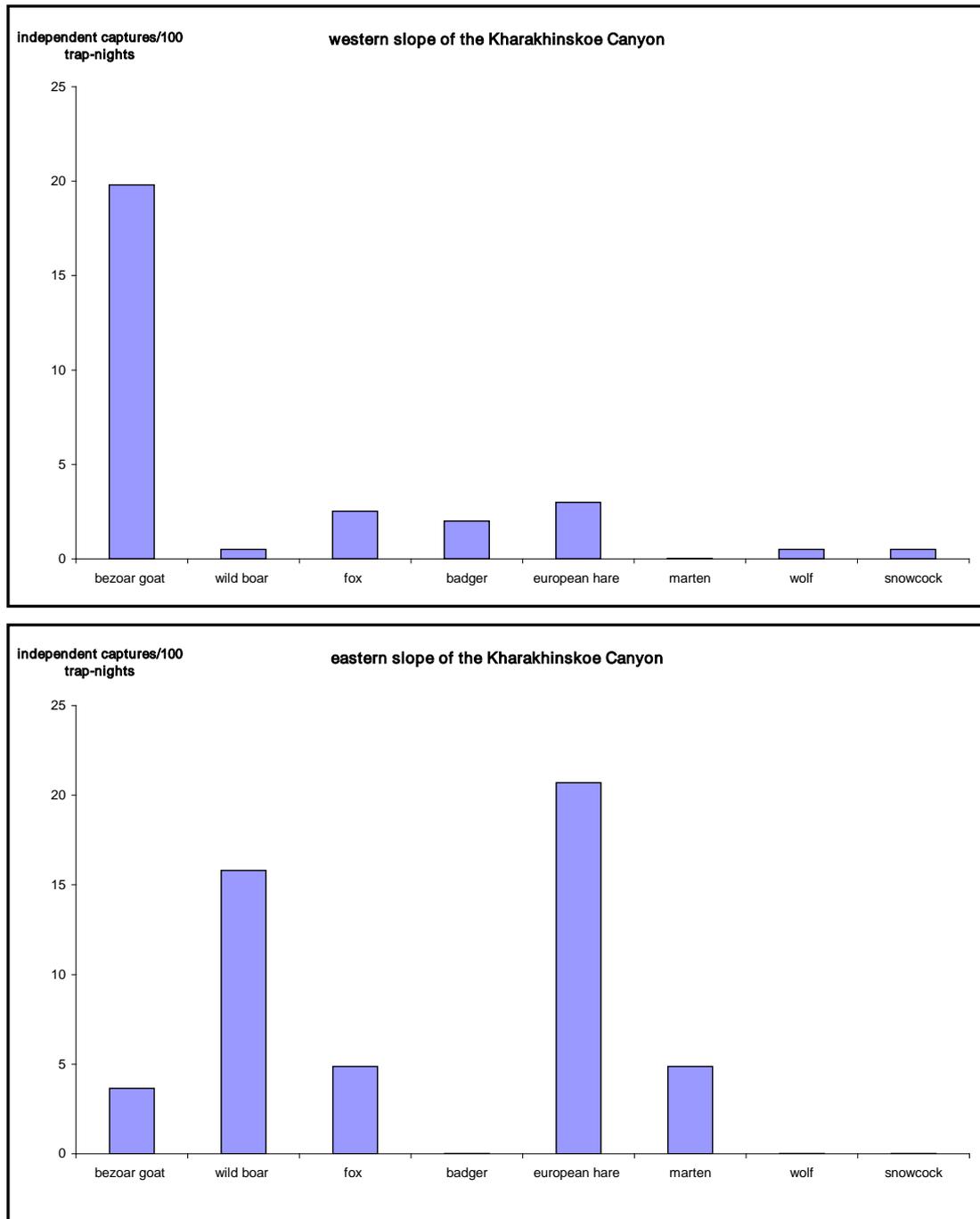


Figure 6. Distribution of relative abundance indices (No. independent captures/100 trap-nights) in the western (top) and eastern (bottom) slopes of the Kharakhinskoe Canyon.

We surmise that the real number of camera-trapped individuals could be higher because a significant number of captures was taken by Stealth Cams inappropriately; these photographs were blackened and useless for animal individualization.

The camera-traps placed in the upper parts of the canyon over the cliffs and in passes frequently captured badgers and wild boars.

As evident from hoof tracks and diggings, wild boars often move up from the bottom and slopes to the ridgetop plateaus where they actively forage in spring and autumn times (Fig. 9).

We used CDs and big feathers hung on fishing line beneath the branch as visual attractants for carnivores, but no noticeable effect was found.



Figure 7. The male bezoar goat (top left), roe deer (top right) and European hare (bottom) camera-trapped in the bottom of the Kharakhinskoe Canyon.





Figure 8. The male wild boar (top left), female bezoar goats (top centre), fox (top right), wolf (bottom left) and badger (bottom right) camera-trapped on the western slopes of the Kharakhinskoe Canyon.



Figure 9. Wild boar diggings (left) and tracks (right) on the plateau of the Arzhuta Ridge in winter 2009-2010.

LEOPARD RECORDS IN THE STUDY AREA

The surveys carried out in the vicinities of the Arakul village, southern Dagestan have proved the existence of at least one leopard here. Having walked the 8-km route that extended along the river course from the village to the junction of two streams, on a cliffy ridgetop near the trail we found a scrape that much resembled the leopard's territorial mark and recorded several scratches on a single tree standing away from the ridgetop (Fig. 10; 41°48'30.08"N/047°11'10.75"E).



Figure 10. The tree scratches (top right), scrape (bottom) and the locality (top left) where they were found.

Regular surveys conducted in the Kharakhinskoe Canyon where the camera-traps were set up allowed for seasonal comparisons of tracks imprinted on the soil and snow (Fig. 11). Nonetheless, changeable weather conditions impeded us (in most cases) to correctly identify the specific origin of tracks as temporary freezing was followed by thaw and snowfalls were often accompanied by strong winds.



Figure 11. The tentative leopard tracks.

The tracks displayed on Fig. 11 were found by us in November 2009 and April 2010. The first track set was recorded on a trail that stretched upwards from the forest along the slope at a distance 5.5 km to the west of the Siukh village, Khunzakhsky District. This site is located in the eastern part of the Kharakhinsky Canyon and, even though 2 camera-traps were positioned here, none were working.

The second track was documented in April. The animal was moving right in front of operating camera-traps, but the only ear tip photographed makes identification impossible (Fig. 12). Unfortunately, in both cases tracks were quite old (10-15 days) and we cannot claim that they unambiguously belong to the leopard.

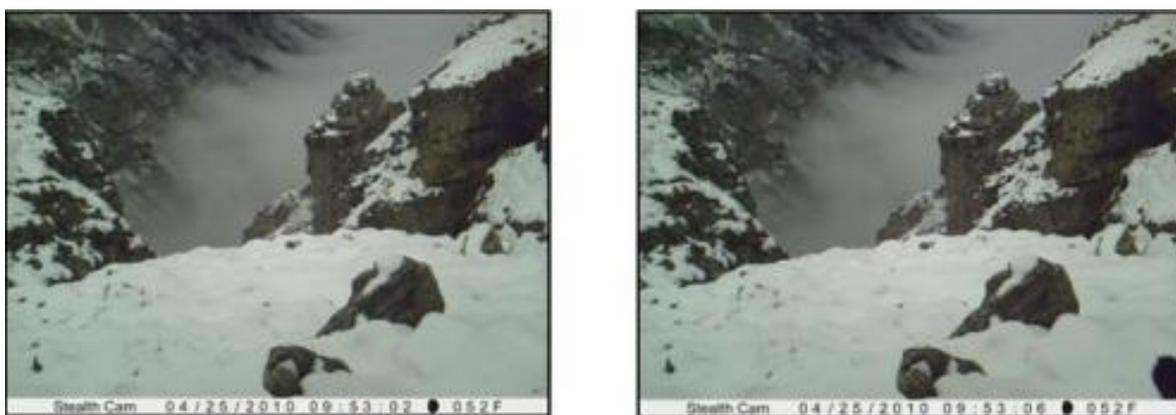


Figure 12. The ear tip (lower right angle) photographed on a site where the tentative leopard moved and left its snow track.



Figure 13. Project leader (in centre) and Chitl villagers who pursued and trapped the leopard near the Turki village, Gumbetovsky District in 1981.

NEW INFORMATION ABOUT LEOPARD IN DAGESTAN

Apart from the records provided above, we have gleaned also other information about leopard existence in Dagestan.

1. In August 2009, rumours were spread about a possibility to purchase a leopard skin for 17000 rubles in the Tsuntinsky District (boundary with Georgia). They also mentioned that local hunters encountered a strange large beast of unusual coat pattern, killed and skinned it. Negotiations about purchasing this skin were ended up by cautious allegations in its lynx origin.
2. In autumn 2008 or winter 2009, a leopard was possibly shot on the border of Dagestan and Chechnya by military personnel. This case was also mentioned in our previous Rufford report. Here the military also observed another leopard through the night vision binoculars. Later, in February-March 2009 a leopard was glimpsed on the left bank of the Sulak River near the reservoir of the Chirkeyskaaya Hydropower Plant which belongs to the Meleshtinsky Sanctuary in the Buinaksky District (42°54'27"N/046°51'44"E).
3. On 8-9 May 2009, the ranger of Laksy and Kulinsky districts and his brother observed the leopard hunt on turs on the Mt. Dultydag at a distance 300-400 m through the binocular. One minute later, the second individual appeared whose body size was slightly smaller. Possibly, that was a female with 1.5-year-old cub. This idea is logical, since in 2008 a female with small cub was recorded in the same area.
4. In the camera-trapped area, on 15 April 2009 the blurry leopard picture was taken by local hunter on his cell phone (Fig. 14). Information about observations and track records in this area came to us 3 times during the project course, indicating quite frequent visitations of a leopard (42°34'39.39"N/046°30'01.85"E). Most likely, this is an adult male having vast home range.
5. We also heard about observations of two leopards in autumn-winter 2008-2009 near the Sagada and Mitluda villages of the Tsuntinsky District in the headwaters of the Andiiskoe Koisu River on the border with Georgia not far from the Omalo village.

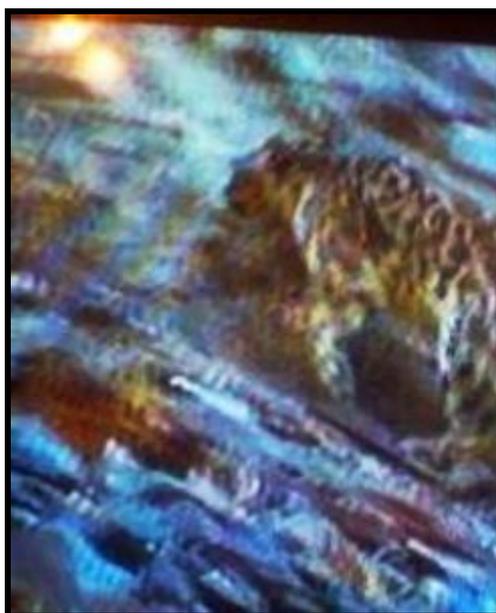


Figure 14. The photograph of a leopard in Dagestan taken by cell phone's camera with the maximum zoom.

PRELIMINARY ESTIMATION OF POPULATION SIZE AND STRUCTURE

Given the field and anecdotal records provided above, we consider it reasonable to surmise that the leopard population in Dagestan numbers 2-3 females, 1-2 males and 2 sub-adults (aged 1.5-2.5 years), in total 5-7 individuals. It consists of two neighbouring sub-populations: Andiysko-Bogos and Dultydag-Samur. Penetrations of individuals to the Inner Mountainous Dagestan may occur seasonally or during sub-adult dispersals.

SOME ADDITIONAL INFORMATION

1. In 2000-2001, a leopard was shot by chance on the Mt. Jufudag (right bank of the Ulluchai River, border of the Dakhadaevsky and Agulsky districts). Outworn after poor processing and 7 years of inadequate storage, in 2008 it was discarded to the garbage dump.
2. Having visited the Chitl village in the Mekhelta site of the Gumbetovskiy District, we have got to know the prehistory of killing a leopard in 1981, the last officially published leopard specimen in Dagestan (Spasskaya & Saidalieva, 1983). Eight months before the leopard was killed in winter 1981 near the Tantari village, an individual (the same leopard?) fell into the steel trap set for wolves near the Turki village, 6 km up from Chitl (Fig. 13). The leopard escaped and concealed in a small cave from where a villager tried to drive it out with pitchfork. The leopard attacked the villager and severely bit his legs, but left the fang in the wound. The folk arrived soon and drove the predator away downstream the Andiiskoe Koisu River where possibly it was trapped and killed. Now, local people claim that a leopard has killed 22 cows and a donkey and submitted to local authorities the request for support (see our previous Rufford report).

THE STATUS OF KEY PREY SPECIES

Information about the eastern tur is provided in the previous Rufford report. According to aerial surveys conducted in April 2009, tur population size in Dagestan is 12000-14000 individuals (Magomedov & Yarovenko, 2009).

Area No. 1. Arjukh-Meer Ridge (from 42°39'01.75N/046°17'58.68E to 42°32'00.35"N/046°33'41.91"E). Here, the bezoar goat density reaches 1.0-1.4 individuals/km², somewhere even to 3-4 individuals/km², being much higher than elsewhere. Goat abundance, along with presence of wild boars (12-15 individuals) and roe deer attracts leopards which are recorded by local people about 6-8 times per annum. Four to five thousand sheep and goats and 1500 cattle grazing here in the summer time should entice leopards, wolves and bears. This area is also permanently inhabited by Eurasian lynx which is more common in woodlands.

Area No. 2. Left bank of the Shinaz River (left tributary of Samur) with adjoining slopes (41°43'41.23"N/047°24'00.03"E). Local population of bezoar goats is very thinly distributed at densities as low as 0.5-0.8 individuals/km².

Area No. 3. Charodinsky District's cliffs in the Karakhsky Forest. 42°18'45.34N/046°46'42.52E. Local goat population is linked with that in the Kosobsko-Kelebsky Sanctuary through the mountain pass, but is sparse (0.5-1.0 individuals/km²).

Area No. 4. Clifly strongholds of Inner Dagestan's Gunibsky District.
 42°23'14.45N/047°01'18.30E. Only singular individuals of bezoar goats are recorded here.

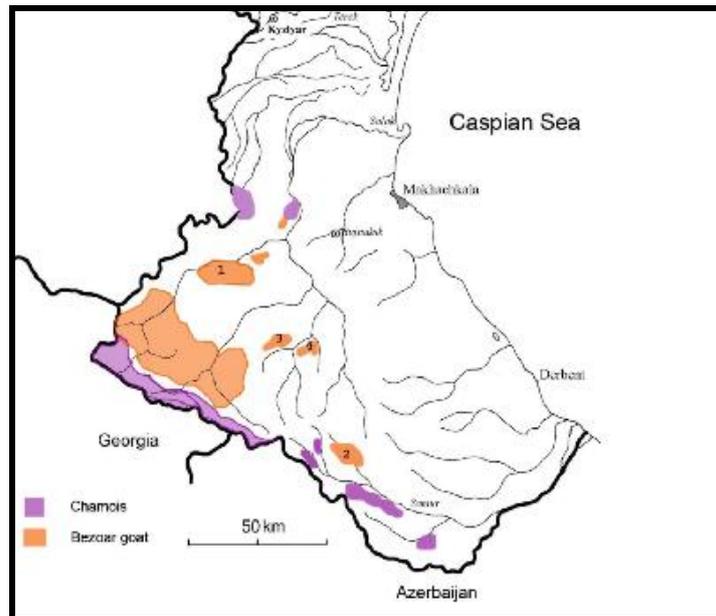


Figure 15. The ranges of the bezoar goat and chamois in Dagestan. Areas: 1 – Arjukh-Meer Ridge, Kharakhinskoe Canyon; 2 – Left bank of the Shinaz River; 3 – Charodinsky District's cliffs in the Karakhsky Forest; 4 – Clifly strongholds of Inner Dagestan's Gunibsky District.

Further surveys on leopard distribution in Dagestan have enabled to ascertain the fact of killing 4 individuals in the most recent times, of which two were harvested in 2008 (Fig. 16).

Also, we have found new areas of **chamois** distribution in Dagestan's Akhtynsky, Rutulsky, Gumbetovsky, Kazbekovsky and Gunibsky districts much away from its main range in the republic, but could not estimate its abundance and population density.

The ranges of bezoar goats and chamois in Dagestan are illustrated on Fig. 15.

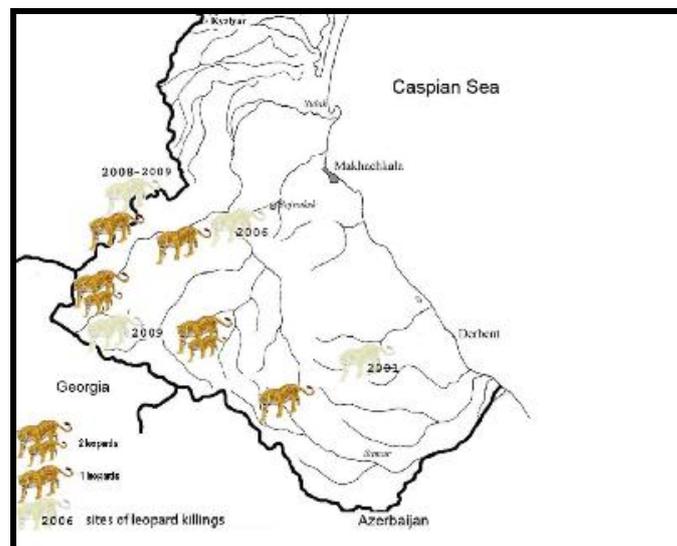


Figure 16. The areas of living and killed leopards in Dagestan in 2008-2010.

The principle threat to leopard survival in Dagestan is poaching promoted by poor conservation, high numbers of firearms in local ownership because of military conflicts, and involvement of military forces in illegal hunting (Fig. 17). Awareness-raising gives positive, but very short-term effects.



Figure 17. Two poachers camera-trapped in Dagestan.

CONCLUSION

The guesstimated leopard number in Dagestan is 5-7 individuals. The population's core part consists of 2 females and 1 male.

Leopards and other large carnivores have been killed for trophy skins at every available opportunity and there is little local awareness and initiative to protect them.

There are regular leopard sightings in the Meleshtinsky Sanctuary's northern slopes of the Salatau Ridge close to the border with Chechnya, but this area is closed to research because of military operations against terrorists.

Our data on leopard prey are preliminary, local and interpreted only from camera-trap records, so they may look as misleadingly indicating low densities of food resources. According to official records published by Ministry of Natural Resources of Dagestan, wild boar and roe deer populations in Dagestan's mountains number 1200-1300 and ca. 2000 individuals, respectively. The estimate of tur abundance is indicated above. Generally, turs fare much better than bezoar goats due to extremely rough terrain of their habitats allowing for hiding from human pressures (Magomedov & Yarovenko, 2009). The range of bezoar goats (2500 km²) is very fragmented and consisting of patches where goat densities may attain quite high levels. Goat densities vary from 1.22 to 5.1 individuals/km², on average 2.12 individuals/km² (Akhmedov et al., 2009; our data). Total population size of bezoar goats in Dagestan is estimated as 2000-2500 individuals (ibid).

FOLLOW-UP

1. Comprehensive mapping of actual and potential habitats for leopard in Dagestan which would display the distribution of natural (landscapes, terrain, prey densities etc.) and man-caused (settlements, infrastructure, human densities etc.) factors in Dagestan. This procedure has been an indispensable tool towards making reliable predictions and inferences about leopard presence/absence and spatial emphasis of conservation actions

2. Monitoring of leopard and its staple prey through field surveys (sign counts, camera-trapping, distance sampling of prey) in order to realize population trends in space and time
3. Studies of leopard diet so that to understand the real contribution of domestic livestock and to promote relevant ways of conservation (anti-predator tactics, prey recovery, compensation schemes etc.)
4. Use of computer modeling to describe leopard distribution in relation to natural and man-caused factors (e.g., occupancy modeling, GIS-based modeling)
5. Awareness-raising and provision of small-scale technical support (e.g., binoculars, GPS, rangefinders) as ways to stimulate motivation among local people, rangers and other stakeholders
6. Production and broadcast of documentary about the beauty and value of Dagestan's mountains and their biodiversity
7. Large-scale promotion of mountain biodiversity conservation in Dagestan's mass media (newspapers, radio, Internet, TV)

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