

Survey of markhor in Tajikistan 2017

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Results and management recommendations



Tino Broghammer, Clemens Herche, Sandro Lovari

Survey of populations of Heptner's markhor *Capra falconeri heptneri* in Tajikistan: 13th February – 6th March 2017



IUCN Species Survival Commission Caprinae Specialist Group

in cooperation with



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A. Survey participants

Group #1:

- Alidodov, Munnavar: NGO Panthera
- Broghammer, Tino: Biologist and independent observer for the IUCN SSC Caprinae Specialist Group
- Rahmatov, Khurshed: Department of State Control on Use and Protection of Flora and Fauna of the Committee for Environmental Protection under the Government of Tajikistan
- Saidov, Komiljon: Institute of Zoology and Parasitology of the Academy of Sciences
- Mulloyorov, Odil: LLC M-Sayod

Group #2:

- Guzenfarov, Kosumsho: Institute of Forestry
- Khudoidodov, Behruz: Institute of Zoology and Parasitology of the Academy of Sciences
- Oshurmamadov, Nuhzar: Pamir Biological Institute of the Academy of Sciences / NGO Panthera
- Vandenberg, Blake: Independent observer for the Wild Sheep Foundation
- Zuhurov, Shodmon: Forestry Agency under the Government of the Republic of Tajikistan

Group #3:

- Amirov, Zayniddin: Institute of Zoology and Parasitology of the Academy of Sciences
- Bahriev, Jura: NGO Panthera
- Herche, Clemens: Biologist and independent observer for the IUCN SSC Caprinae Specialist Group
- Mulloyorov, Khudoydod: LLC M-Sayod
- Talbanov, Khursand: Institute of Zoology and Parasitology of the Academy of Sciences
- Vatanov Jamshed: Department of State Control on Use and Protection of Flora and Fauna of the Committee for Environmental Protection under the Government of Tajikistan

Additionally, local rangers and conservancy heads supported the survey groups in their respective areas.

B. Introduction

The markhor *Capra falconeri* is a near-threatened wild goat species in the subfamily of *Caprinae*. Its geographic range includes southern Tajikistan, northeastern Afghanistan, southwestern Turkmenistan, northern India, northern and central Pakistan and southern Uzbekistan (Grubb 2005). The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) lists this species in Appendix I, which includes species threatened to extinction (CITES Appendix I). In The IUCN (International Union for Conservation of Nature) Red List of Threatened Species™ the markhor was listed as "endangered" from 1994 till 2015. Due to international conservation success on the recovery of the population in protected areas and areas with sustainable hunting management, the global population has grown substantially during the last decades and the species could be down listed from "Endangered" (EN) to "near threatened" (NT) (Michel and Rosen 2015).

The Republic of Tajikistan is the most important range state of the subspecies Heptner's markhor *Capra falconeri heptneri* (also known as Bukharan or Tajik markhor). Tajikistan and its local communities are key players in the ongoing process of conserving the markhor, and the growing population size substantially contributed to the positive global trend reflected in the improved IUCN Red List status. This positive development and the outstanding work of the Committee on Environmental Protection under the Government of Tajikistan in collaboration with other agencies, national and international scientific and non-governmental organizations and especially the local communities of the markhor range in Darvaz and Shamsiddin Shohin (former Shuroabad) districts have been recognized by various scientific and management authorities in the international conservation community. As a result, the Tajik community-based conservancies, which play an important role in the recovery of the markhor, are mentioned as an exemplary case study in "Informing decisions on trophy hunting – A Briefing Paper for European Union Decision-makers regarding potential plans for restriction of imports of hunting trophies" (IUCN 2016).

A significant tool in the conservation of the species is the community-based trophy hunting, since old markhor males are highly valuable in the worldwide trophy hunting business.

Considering that large parts of the society and political decision-makers mainly in the European Union and the United States of America refuse trophy hunting and hunting in general, it is more important than ever to promote the "IUCN SSC (Species Survival Commission) Guiding Principles on Trophy Hunting as a Tool for Creating Conservation Incentives" (IUCN 2012) to ensure the legitimacy of sustainable trophy hunting as a component in conservation programs. Key principles in this guideline are "Biological Sustainability" in the meaning that trophy hunting does not affect the population in a negative way (e.g. population decline, artificial selection, poaching, etc.) and "Net Conservation Benefit" like creating incentives to conserve the species by producing revenues or employment for local communities living with wildlife. Moreover the IUCN promotes trophy hunting when there is a "Socio-Economic-Cultural Benefit" where trophy hunting respects the needs and values of the local communities and is accepted and co-managed by them. A further principle is "Adaptive Management: Planning, Monitoring, and Reporting". This principle includes ways of assessing and managing the resource adaptively. This includes animal counts, trophy quotas, hunting plans and a monitoring of the trophy hunting. The last principle is "Accountable and Effective Governance" which should provide transparency how decisions are made; revenues are distributed to local communities and steps taken to wipe out corruption. Obeying these guideline will also ensure the acceptance of trophy hunting of Heptner's markhor by CITES organs, national CITES authorities of importing countries and the United States Fish and Wildlife Service (USFWS), which regulate the export and import of trophies.

To assess the population status of Heptner's markhor in Tajikistan, the Committee on Environmental Protection under the Government of the Republic of Tajikistan organized a range-wide survey which took place from the 13th February till 6th March 2017. The results of this survey are used to determine and allocate the trophy hunting quotas for the hunting season of 2017/2018 and will be suggested at the CITES CoP19 as quotas for the next 5 years. In accordance to the Resolution of the "International Round Table on Sustainable Use and Conservation of Wildlife in Tajikistan (2-3 November 2016, Dushanbe-Tajikistan), Khairullo Ibodzoda, Chairman of the Committee on Environmental Protection under the Government of Tajikistan, invited the IUCN SSC Caprinae Specialist Group as an international observer and organization being recognized as impartial science-based agency, to participate in this year's survey.

C. Survey Methods

C.1. Study area

The survey took place in the known markhor distribution range located in the Darvaz and Shamsiddin Shohin (former Shuroabad) districts. It covers the areas of six conservancies managed by the following legal entities: LLC Morkhur, LLC Saidi Tagnob (collaborating with LLC M-Bukhori, the owner of which, Nurali Latipov, manages one section), LLC Safari Dashtijum, NGO Muhofiz, LLC M-Sayod and LLC Bars, Dashtijum Strictly Protected Area (*Zapovednik* Dashtijum) and few adjacent parts of local forestry enterprises, not assigned to hunting management entities. The range area of markhor has a size of about 1,177 km² and includes the south-western edge of the Darvaz mountain range, the mid part and the southern edge of the Hazratishoh range and the mountains east of Parvor village.

The survey teams were not able to survey the area east and south of Parvor village as locals and especially the border police informed us that during the time of the survey the risk of landmines and Afghan intruders was too high and heavy snow made access to these areas more difficult. For these reasons the survey team decided it would be neither responsible nor effective to continue the survey in the southern parts of the mountains east of Parvor village, reportedly assigned to NGO Muhofiz and LLC Bars. Similarly Dashtijum Strictly Protected Area could not be surveyed, except a minor section of 30 km² in the south-western part bordering the area managed by LLC Morkhur.

The altitude in the survey area ranges from 600 m in the south-west at the Panj River, which forms the border between Tajikistan and Afghanistan, to 4,573 m at Kuhifrush peak in the north (Darvaz district). In the lower parts open woodland and shrub communities with pistachio (*Pistacia vera*), redbud (*Cercis griffithii*) and other shrubs, among them pomegranate (*Punica granatum*) and almond (*Amygdalus bucharica*), *Artemisia* spp. and umbelliferous plants (*Prangos pabularia*, *Ferula* spp.) and a large number herbaceous and grass species form the vegetation cover. In higher altitude juniper (*Juniperus seravschanica*, *Juniperus semiglobosa*) occurs in scattered stands, mixed with shrubs of maple (*Acer regelii*, *Acer turkestanicum*), rose (*Rosa kokanica*) and honeysuckle (*Lonicera nummulariifolia* and *Cotoneaster* spp.).

During the survey, the weather was mild with some precipitation and fog occurring

occasionally. Temperatures below 0°C were noted in early morning hours and shady canyons. Local people are agro-pastoralists and own small numbers of livestock (goats, sheep and cattle).

C.2. Survey process

Upon arrival the three international survey participants on behalf of the IUCN SSC Caprinae Specialist Group and the Wild Sheep Foundation had a meeting with Mr. Nematullo Safarov (Research Laboratory for Nature Protection; National Center for Biodiversity and Biosafety), Mr. Rustam Muratov (Institute for Zoology and Parasitology of the Academy of Sciences), Mr. Alikhon Latifi (Association of Hunters of Tajikistan) and Mr. Karakul Sohibkulov (LLC Bars). We had a discussion about the survey method we planned to use and different other approaches to count animals like air flight survey and the SMART patrol system. Since we wanted to keep the results as comparable as possible with results from previous years, we decided to retain the standard method for counting *Caprinae* which is explained below.

The survey data sheets implied different topics:

General information:

- Name of survey (area, month, year)
- Survey team number
- GPS navigation device number
- Participants (Head of the group and other observers)
- Sheet number
- Date, Starting time, End time, Total time, Location
- Comment section for each waypoint

General information for each observation:

- Waypoint number
- Time (and search time)
- Latitude and Longitude of the observer position (in decimal degree)
- Elevation of the observer position

- Weather (sky coverage from 1/8 to 8/8, precipitation) and Visibility (Good, Medium, Bad)
- Distance, Azimuth (clockwise in degree with North = 0°) and Vertical angle to the observed animals

Information on observed animals:

- Species code (e.g. CAFAHE for *Capra falconeri heptneri*)
- Total number of observed animals (in the given waypoint)
- Number of Kids, Yearlings, Females, Subadult males (2 - 3 years), Adult males (> 3 years), Number of trophy age males (8+ years) among the age group of adult males, Unidentified by sex and age animals
- Signs of presence (Dead animals, Bone remnants, Tracks, Feces)
- Behavior (Feeding, Resting (standing), Resting (lying), Alert, Walking, Running (gallop), Running (trot))

Habitat information for each animal observation:

- Position of the animals at the slope (Ridgeline, Upper third, Mid third, Lower third, Valley)
- Steepness at the slope (in degree)
- Aspect of the slope (North, North-East, etc.)
- Substrate (Fine earth, Talus (debris), Boulder field (larger debris), Rock outcrops, Cliff)
- Vegetation (Forest, Woodland, Shrub vegetation, Tall herbs, Meadows, Dry steppe, Semi-shrubs, (Almost) bare)

The survey was carried out in three groups. In the teams participated people from the Department on State Control for Protection of Fauna and Flora Fauna of the Committee for Environmental Protection under the Government of Tajikistan, the Institute of Zoology and Parasitology of the Academy of Sciences, the Pamir Biological Institute of the Academy of Sciences, the Forest Agency under the Government of the Republic of Tajikistan, the Institute of Forestry and the NGO Panthera. Mr. Tino Broghammer (Germany), Mr. Clemens Herche (Germany), both on behalf of Prof. Sandro Lovari (Chairman of the IUCN SSC Caprinae Specialist Group), and Mr. Blake Vandenberg (USA) on behalf of the Wild Sheep Foundation participated as international, independent observers at the invitation of Khairullo Ibodzoda,

Chairman of the Committee on Environmental Protection under the Government of Tajikistan. Each group had at least one international observer, one scientist from the Academy of Sciences and one local ranger. The teams recorded data in the following conservancies:

- LLC Morkhur: 13/02/2017 - 17/02/2017
- LLC Saidi Tagnob: 19/02/2017 - 21/02/2017
- LLC Safari Dashtijum: 23/02/2017 - 24/02/2017
- LLC Saidi Tagnob (Nur): 25/02/2017 - 26/02/2017
- NGO Muhofiz: 27/02/2017 and 06/03/2017
- LLC M-Sayod: 28/02/2017 - 05/03/2017
- LLC Bars 06/03/2017

The time spent in a specific territory of a LLC or NGO was scheduled by Tajik scientists as agreed with the conservancy managers. Observation points were selected by conservancy managers and local rangers to get the best possible view over the markhor home-ranges. The survey aimed at providing a minimum count of markhor present in the surveyed areas. Hence, the three groups were distributed in a manner to get the largest area coverage of each management unit without causing too many faulty repeated records. All survey teams were equipped with a data sheet book, a GPS navigation device (Garmin), a spotting scope (Meopta 20 – 60 x 65) and binoculars with a magnification factor of 8 or 10 and a 42 or 50 mm objective diameter (different brands). We calibrated the compass of the GPS navigation devices every morning before data collection.

Markhor flocks were mainly spotted by local rangers who know the place well. In case we were aware of the risk that another observer group could have seen the same flock, we called each other if possible via mobile phone to discuss our observation event. For every spotted animal group or sign of presence (markhor or any other species) we marked a waypoint in the GPS navigation device and noted the given waypoint number, time, observer elevation, observer longitude and latitude in our data sheet. Within an observer group we shared the different tasks. The most experienced observer identified the animals by sex and age, the rest of the group discussed and corrected the results if necessary. It was compulsory to take photos of trophy age males together with a photo of the current waypoint on the GPS navigation device screen. We estimated and discussed the actual weather, visibility, distance and vertical angle

to the observed animals. We used topographic maps to optimize our distance estimate. The azimuth was determined by adjusting the GPS navigation device to the spotting scope direction. Furthermore we recorded the behavior of the animals and information about the habitat (see list above) in which they were observed.

If possible, we discussed all recorded data with all three groups at the end of each survey day or at least within a week. With the help of topographic maps and GPS navigation device we estimated the positions of the markhor flocks and marked them on a map. Obvious double observations were deleted immediately in consultation with all present scientists. The observer group that counted more animals in the repeatedly observed flock kept the waypoint; missed animals were added if necessary. We transferred all data into an Excel spreadsheet for further data analysis.

After finishing the survey Clemens Herche and Tino Broghammer were invited by Mr. Khairullo Ibodzoda, Chairman of the Committee on Environmental Protection under the Government of Tajikistan, to talk about the survey and further plans of the Committee for conserving the wildlife of Tajikistan. Mr. Alikhon Latifi, Mr. Rustam Muratov, Mr. Nematullo Safarov, Mr. Abdulkodirkhon Maskaeu (Head of the Department on State Control for Protection of Fauna and Flora of the Committee for Environmental Protection under the Government of Tajikistan), Mr. Ayub Mulloyorov (LLC M-Sayod) and Mrs. Tanya Rosen (NGO Panthera) also participated in this meeting.

All observer waypoints and computed locations of recorded flocks were inserted in a Graphical Information System (GIS QuantumGIS and ArcGIS 10.2). We digitized simplified viewsheds based on observer waypoints and topography. Obviously wrong distances and azimuths of animal records were corrected. We then used the GIS for another check for possible repeated records and after discussing with other team members excluded all detected double observations from the animal count to determine the minimum absolute numbers of markhor in the surveyed areas and calculated the density of markhor in relation to the size of the viewshed in the respective areas. With the assistance of the GIS we created a point map of recorded markhor groups and computed kernel densities of total numbers per record provided in the results section. We discussed pictures of trophy age males and excluded falsely identified trophy age males from the count of this class. The results were discussed with members of the IUCN SSC Caprinae Specialist Group.

D. Results

D.1. Overall numbers and population density at the survey sites

Under exclusion of double counts of same markhor flocks, our final analysis results in an overall number of 1901 markhor observed in a survey area of 552 km². This number is composed of 428 kids, 323 yearlings, 522 females, 179 subadult males (2-3 years), 322 adult males (older than 3 years) and 63 unidentified animals. The number of adult males includes 81 trophy age males of 8 years or older. We counted the highest number of markhor in the territories of LLC Saidi Tagnob (738 markhor; 38.8% of the population (Table 1; Fig. 1)); the highest number of adult males we counted was in LLC M-Sayod with 137 adult males including 45 trophy age males (Table 1).

Table 1: Results of the survey of Heptner's markhor 2017. **Red** = minimum value; **Black** = maximum value

Unit (name)	Total number	% of pop.	Survey area (km ²)	Average density (N/km ²)	Kids	Year- lings	Females	Sub- adult males 2-3 years	Adult males > 3 years (included trophy age males)	Un- identified	Kid- to- female ratio
Zapovednik Dashtijum	25	1.3	30.2	0.8	9	2	6	2	6 (1)	0	1.5
Morkhur	400	21.0	174.2	2.3	91	69	136	35	57 (12)	12	0.7
Saidi Tagnob	738	38.8	122.0	6.0	217	127	211	68	93 (19)	22	1.0
Safari Dashtijum	137	7.2	75.3	1.8	28	31	35	16	16 (2)	11	0.8
Muhofiz	67	3.5	23.4	2.9	15	12	12	6	22 (2)	0	1.3
Bars	5	0.3	1.9	2.6	0	2	2	0	1 (0)	0	0
M-Sayod	529	27.8	125.0	4.2	122	80	120	52	137 (45)	18	1.0
Total	<u>1901</u>	<u>100</u>	<u>552</u>	<u>3.4</u>	<u>482</u>	<u>323</u>	<u>522</u>	<u>179</u>	<u>332 (81)</u>	<u>63</u>	<u>0.9</u>

In total 275 markhor flocks have been registered. Hence, the average markhor group size is 6.9 (SD: ± 6.1). The most common group size was 4 animals per group; the largest counted group consisted of 57 markhor and was recorded in the territory of LLC M-Sayod downstream of Zighar village (Fig. 2).

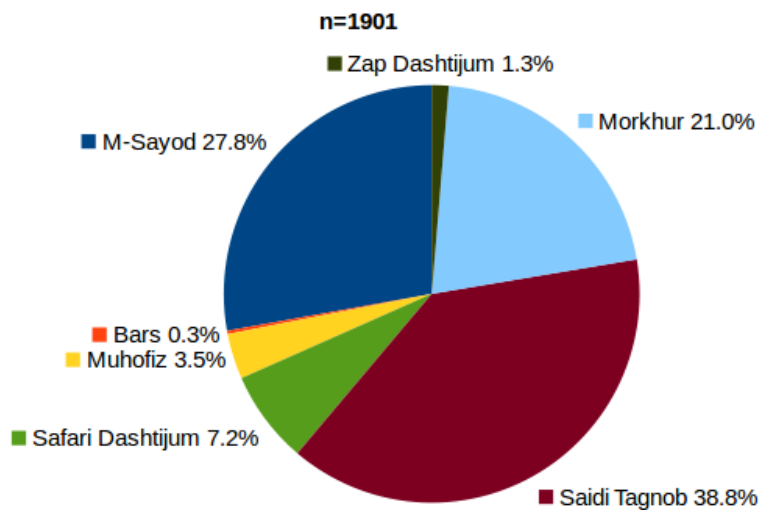


Fig. 1: The percentage distribution of markhor in the different management units.

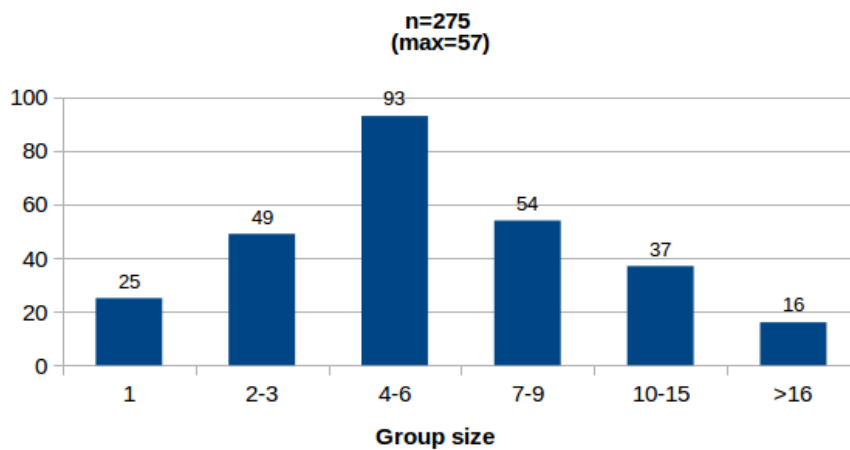


Fig. 2: Distribution of group sizes for all markhor flocks.

D.2. Sex and age composition of the markhor population

The composition of sex and age of the determined animals excluding the number of unidentified markhor was 26.2% kids, 17.6% yearlings, 28.4% females, 9.7% subadult males and 18.1% adult males ($n = 1838$; Fig. 3).

The population density in the surveyed areas ranges from 0.8 markhor per km^2 (100 ha) in Zap Dashtijum to 6.6 markhor per km^2 in M-Sayod, downstream of Zighar village. Upstream of Zighar village the density is just 1.3 markhor per km^2 . The overall average density for all surveyed areas is 3.4 markhor per km^2 (Table 1).

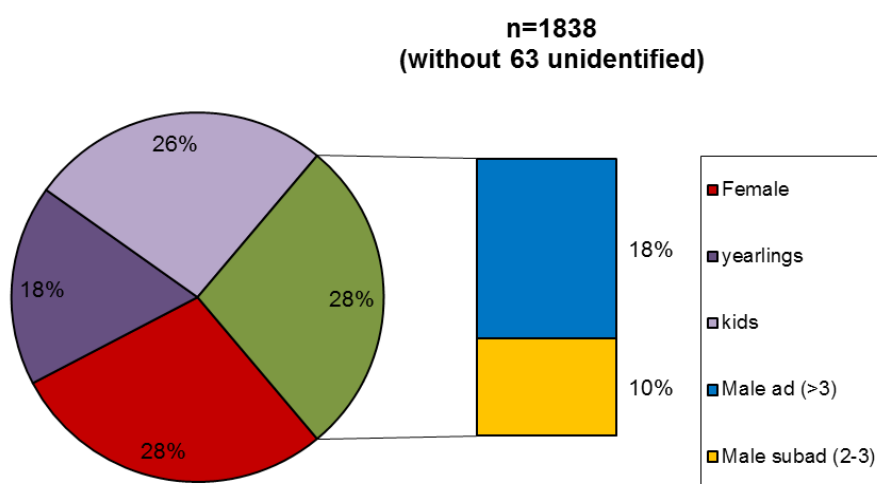


Fig. 3: Composition of sex and age of the determined markhor (unidentified markhor excluded).

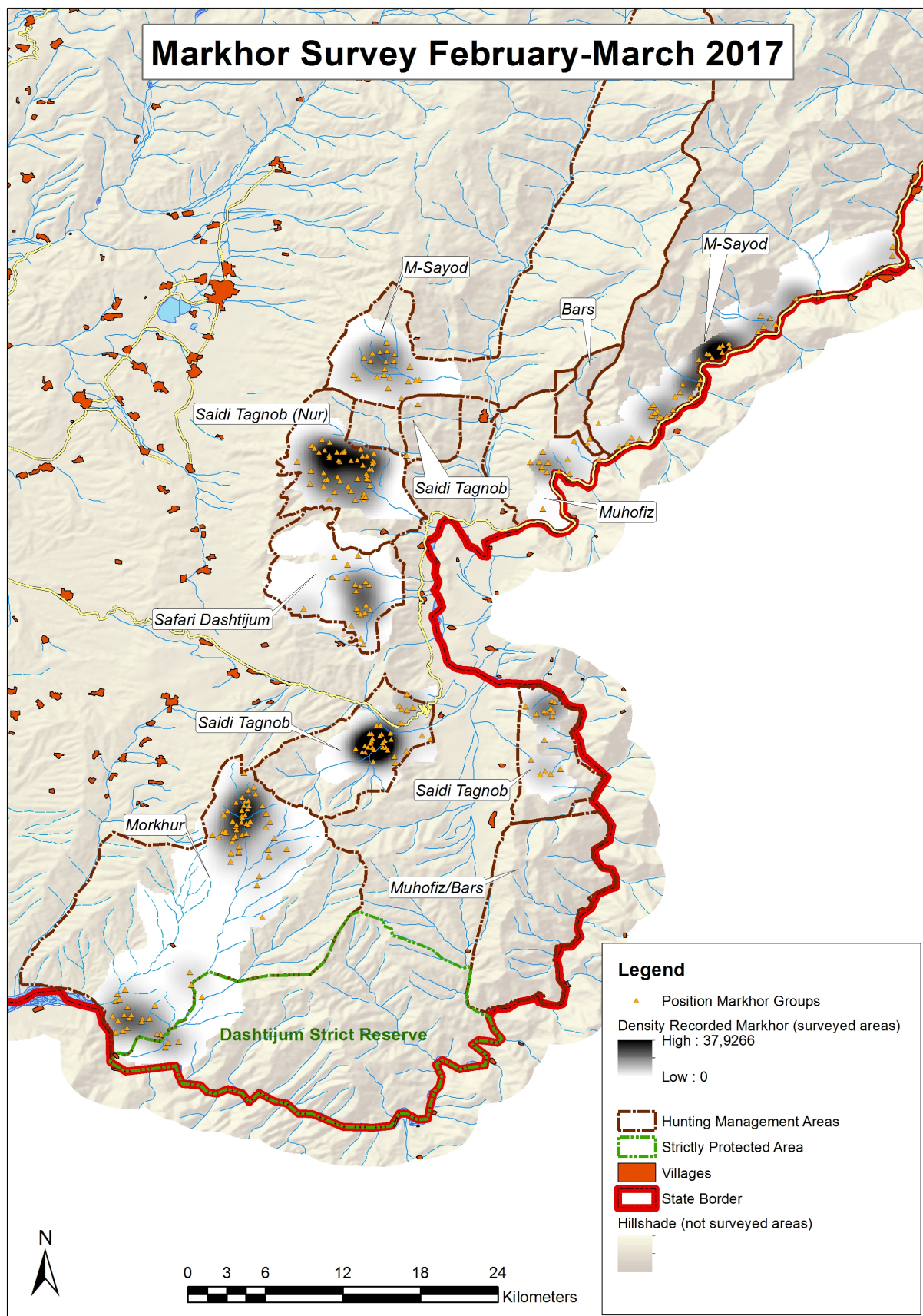


Fig. 4: Density map of Heptner's markhor in the surveyed areas.

E. Discussion

E.1. Survey method

The method we used in the survey is well established and has been used during the last surveys from 2009 to 2016. In our opinion, conducting the survey in early spring (end of February - March) is adequate for several reasons. Firstly, the survey was implemented in this time of the year for several years. To keep data comparable and assess the population growth, the time of the survey needs to be always the same. Because of following the first green herbs, grasses and opening buds markhor concentrate in lower elevations, which makes them easier observable than during other seasons. Furthermore, markhor do not move a lot during this time of the year which minimizes the risk of double counts (Parrini *et al.* 2003). On top of that, weak animals and kids, which had not survived the winter, do not get counted. Despite the generally positive assessment of the method, there appeared some issues, which need to be optimized in future surveys.

The time of all GPS navigation devices, cameras and mobile phones should be set to manual to prevent an automatical time change to Afghan time. This prevents possible mistakes and simplifies the analysis of trophy pictures. Furthermore, the focus of cameras should be checked and tripods should be used for cameras to ensure sharp photos. The photographer should also make sure to have enough memory space on the memory card and a sufficient battery status. The purchase of phone adapters for digiscoping with mobile phone cameras through spotting scopes should be considered. This would have the advantage to carry just one tripod for the spotting scope and receive pictures with a better quality which can be used for analysis, discussion within and between observer groups and marketing.

The survey method is well known by the scientists who worked with the GIZ wildlife management project and the NGO Panthera, including Nuhzar Oshurmamadov and Komiljon Saidov from the Academy of Sciences. Especially the scientists from Panthera imparted their knowledge to participants that were less familiar with the survey method. A brief method training with all participants before starting to record data would upgrade the survey significantly. This could also strengthen the motivation of unexperienced experts from national agencies to improve their skills in identifying age and sex of markhor.

The rangers and heads of LLC Morkhur, LLC Safari Dashtijum, LLC Saidi Tagnob (section

managed by Nurali Latifov and his team) and LLC M-Sayod were highly motivated to show as many animals and trophy age males as possible. Double counts and over-aging adult males was the result. Overlap of surveyed areas between survey teams and repeated coverage during different days should be avoided, as it increases the risk to detect repeated records. Time efficiency was also influenced by the fact that in LLC Morkhur, LLC Safari Dashtijum and LLC Saidi Taghob (section managed by Nurali Latipov and his team) survey teams stayed longer than necessary and some valleys were observed by all three survey teams, while one or two observer groups would have been more efficient. To prevent these methodical mistakes in the future, fixed viewing points with defined observation times and adaptation of observer group numbers are recommended to be optimized.

If time and availability of survey teams allows the coverage of survey areas by more than one team, the double-observer method (Suryawanshi et al. 2012) would provide a good opportunity to estimate detectability of markhor flocks, such allowing to assess the population size under consideration of undetected animals. Two approaches are possible. Approach 1: One survey team follows the first survey team with a time lag of 30 minutes. Both teams count animals on fixed observation points with set times. Approach 2: Two survey teams search and count animals parallel with some spatial distance between them to avoid influence from the other group. Approach 1 is applicable when animals can be recorded along a transect. An exemplary conservancy for approach 1 is LLC M-Sayod. There is a potential risk in approach 1 that the first group startles the animals which leads to a decreased detectability for the second survey team. Approach 2 is considerable more applicable in the other conservancies where animals need to be recorded from the top of the counter slope to gain the best possible view.

Over- and underestimation of distances from survey teams to animals became visible in GIS. The individual experience of distance determination varied between the participants. The mentioned method training can equalize distance determinations within the groups.

To exclude repeated records, which cannot be detected in the very important daily discussions between groups, the use of GIS for post-survey analysis is the best possible tool. The position of markhor flocks observed by different groups can be made visible on a virtual map. Very close markhor flocks, for example, can be checked in the database and in case the age and

sex structure is identical, one markhor flock gets excluded from the database as it is a double count.

E.2. Area coverage

The survey was exceptionally well organized by Tajik officials, hunting area managers and scientists. Upcoming personnel or weather-related issues were solved diplomatically. As the results show, we could observe a population growth of Heptner's markhor compared to the data from the previous surveys. This growth is owed to the management of certain conservancies, which are on the right track to get excellent. In this case, LLC M-Sayod should serve as a prime example for other conservancies. It was recognized that local rangers especially coming from the conservancies LLC Morkhur, LLC Saidi Tagnob and LLC M-Sayod feel accountable for their areas and give their best to prevent poaching. According to conservancy managers and other locals, poaching is already be minimized in these territories.

The surveyed study area represents almost half of the known distribution of Heptner's markhor in Tajikistan and includes most of the prime habitat of the species. As mentioned before, it was impossible for us to access the markhor areas south-east of Parvor village and most of Dashtijum Strictly Protected Area due to the high risk of landmines, Afghan intruders and heavy snow. In a personal conversation, Mr Sayfiddin Sayfuloev (Leader of NGO Muhofiz) explained that there is not much information known about the possible numbers of markhor in their territory southeast of Parvor village. Furthermore, various locals confirmed in private conversations that the markhor population in these areas belonging to NGO Muhofiz and LLC Bars is negligible. On the other hand, we assume that despite the comparably low density of markhor found by us in Dashtijum Strictly Protected Area an unknown, but possibly substantial number of markhor could inhabit the not surveyed sections of this protected area (212 km² in total, about 30 km² surveyed).

E.3. Population trend of Heptner's markhor in Tajikistan

We conclude that the recorded numbers of markhor represent the minimum absolute population size and indicate the population growth of Heptner's markhor in Tajikistan. However, it must be said that despite careful screening still undetected repeated counts cannot entirely be excluded and may cause an overestimation of our markhor count, which could lead to rushed management decisions. This would pose a great danger for a threatened species like the Heptner's markhor.

In comparison to 2012 (Michel *et al.* 2015), 2014 (Forest Agency under the Government of the Republic of Tajikistan 2014) and 2016 (Academy of Sciences of the Republic of Tajikistan 2016) the minimum absolute population size is higher (Fig. 5). This can be explained by an actual population growth and the fact that a larger area was surveyed in 2017 (522 km² in comparison to 381 km² in 2016).

The average population density assessed in 2017 (3.4 markhor per km²) is higher than in 2012 (2.84 markhor per km²) and 2014 (2.32 markhor per km²) but a bit lower than in 2016 (3.7 markhor per km²) explained by inclusion of areas with lower markhor numbers and not covered in the 2016 survey. We found the highest density of Heptner's markhor downstream of Zighar village with 6.6 markhor per km² (LLC M-Sayod). Upstream of Zighar village the density was just 1.3 markhor per km² (LLC M-Sayod). In consideration of the circumstances that the competition for resources in this, by markhor newly populated, area is high due to massive fire wood cutting and grazing of livestock the result is pretty good.

The lowest densities was recorded in *Zapovednik* Dashtijum (0.8 markhor per km²) and LLC Safari Dashtijum (1.8 markhor per km²). The low density in *Zapovednik* Dashtijum could be related to past (and possibly still ongoing) poaching by Afghan intruders, the poor density in LLC Safari Dashtijum reflects the performance of the management in this territory which remains below its full potential. The surveyed area of LLC Bars is too small to draw conclusions from the density (2.6 markhor per km²) and should be assessed together with the surveyed area of NGO Muhofiz. Considering that the surveyed area of NGO Muhofiz has a comparable habitat to the immediately adjacent downstream parts of LLC M-Sayod, the density of 2.9 markhor per km² stays far below its capacity. In LLC Morkhur we surveyed many areas with less suitable habitat for markhor. This and/or the poaching by Afghan intruders could have resulted in a lower population density in the area managed by this LLC.

Overall, the densities reflect pretty much the conservation effort of the different management

units. Thereby the habitat quality and effects from surrounding areas must be considered.

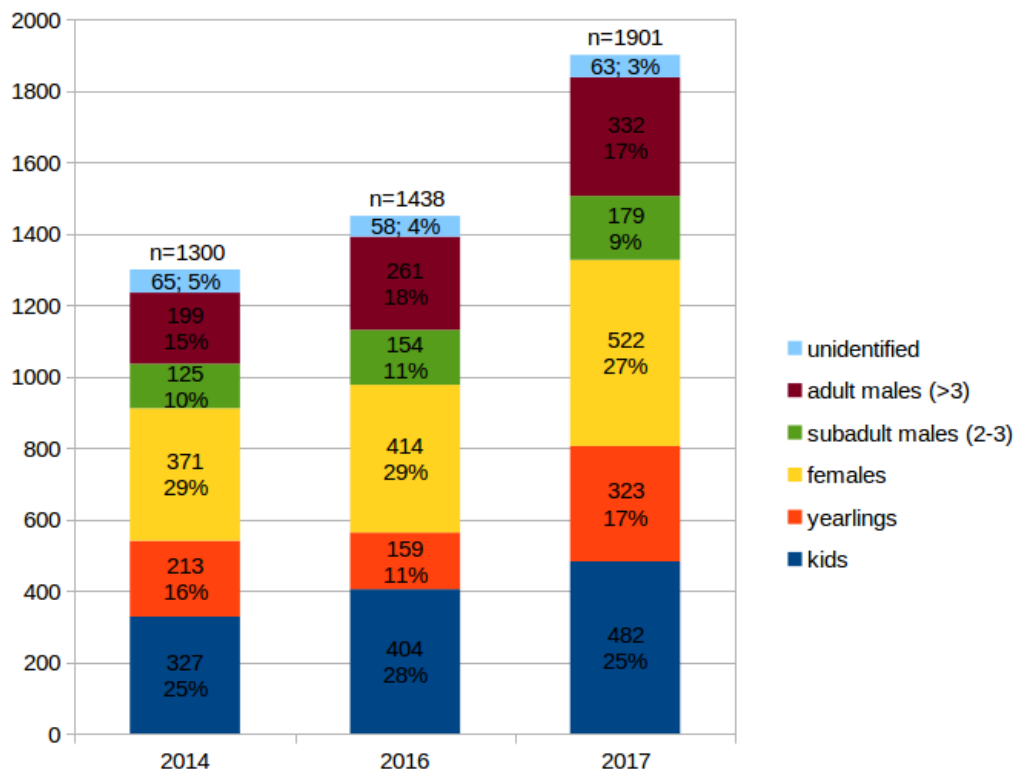


Fig. 5: Comparison of survey results from 2014, 2016 and 2017.

E.4. Limiting factors for an optimal markhor population development

The survey results suggest that different factors in various extent limit the further growth of the markhor population. Key factors seem to be habitat quality and poaching pressure. In some areas the population density may be close to the carrying capacity of the habitat. In the area with the highest density of markhor per survey area size, the slopes of Darvaz range between Yakhshipun and Zighar, managed by LLC M-Sayod, the population did not grow since the last survey and vegetation shows signs of intensive browsing. In the nearby located areas upstream along the Panj river markhor had reportedly been absent for decades and only since around 2012 increasingly markhor expand into this area. Here habitat quality is heavily affected by intensive livestock grazing, with goats being the predominant species, combined with intensive harvest of shrubs, including the important forage species redbud (*Cercis griffithii*). Pasturing and domestic livestock can negatively influence markhor populations.

Ashraf (2010) found a diet overlap between domestic goat and Kashmir markhor *Capra falconeri cashmiriensis* and recommended that there has to be a ban on livestock grazing in core habitats of markhor.

In the part of the Darvaz range downstream of Yakhshipun, managed by NGO Muhofiz and LLC Bars, habitat conditions are virtually the same as upstream from Yakhshipun in the M-Sayod managed areas. Furthermore, one can expect that high population density in the latter area would cause immigration of markhor into this unit. The extremely lower density of markhor there can best be explained by poaching. Poaching is also a problem in other parts of the markhor range and may limit the growth of markhor populations and the expansion of range area. Poachers do not follow any hunting quotas and hunting season, this causes wildlife harassment that has a negative impact on mortality rates and the reproductive success of markhor. The compared to other areas extremely low numbers and density in the surveyed section of Dashtijum Strictly Protected Area and also comparably low densities and low percentage of trophy aged males in adjacent areas might be related to past (and possibly still ongoing) poaching, in particular reportedly by Afghan intruders in this difficult to control border area (Michel and Rosen 2015, Moheb 2011).

Share of the same habitat by markhor and domestic livestock increases the ability of disease transmission. 64 markhor died in 2010 because of *Mycoplasma-pneumonia* outbreak. Ostrowski et al. (2011) conclude that in all probability, domestic goats were the source of the infection. The infectious agent can be present in domestic goat herds without clinical symptoms and no effective vaccination exists for preventing this latent presence and transmission risk. We found signs of grazing goats and thus of acute risk of disease transmission in most markhor habitats. Minimizing the risk of disease transmission is a big challenge for Tajik agriculture authorities and veterinarians as well as conservancy managers.

The results of the survey confirm that regulated trophy hunting on markhor in the survey areas since 2014 has not have had any direct negative impact on the markhor population size. Current numbers and population structure show that in the areas for which the Academy of Sciences had recommended the allocation of quotas during the hunting season 2016/2017 numbers and population structure, including the recorded presence of trophy age males, indicate that the hunts not only did not have any detrimental influence on the conservation of the species, but actually were highly supportive to the active conservation management. This

concerns the conservancies of LLC M-Sayod, LLC Saidi Tagnob and LLC Morkhur. Talks with rangers of these entities and with local community members as well as observations in the respective villages suggest that these entities invest substantial shares of the income earned from the hunts into conservation activities, like anti-poaching, continuous surveillance of their areas and the wildlife, and into community development and support, for instance the construction of pipes and tanks for clean drinking water, the expansion of streets, scholarships for students and materials for farming.

On the other hand, trophy hunting without clear conservation investment and use of income for the benefits of local communities can have disastrous adverse impacts. Especially if people from outside of the local villages capture most of the income, there is a high risk that local people feeling disenfranchised, will not support protection from poaching and habitat conservation and even start poaching themselves. We could not find any information about community support and benefit sharing of the companies LLC Safari Dashtijum, NGO Muhofiz and LLC Bars. People living in surrounding villages of these conservancies do not get any incentive to protect wildlife and especially the markhor because they do not benefit from its conservation. This lack of support by local people combined with insufficient protection by rangers of these agencies leads by all means to poaching. In addition to that, we were made aware by locals that non-sustainable hunts, including some by international hunters, may have occurred in areas of LLC Safari Dashtijum, NGO Muhofiz and LLC Bars. Further investigations should be conducted to test this allegation; however, our results suggest that population numbers and trends in the surveyed areas of LLC Safari Dashtijum and NGO Muhofiz remain far below their natural potential. This is a clear sign of the lack of effective conservation effort.

There is a high risk in small conservancy units like NGO Muhofiz, LLC Bars or LLC Safari Dashtijum, that a particular trophy age male may be pursued too long without any success and, thus, the hunting location may not be changed for a new trophy hunting attempt. If there are not enough accessible trophy age males in a specific area, younger males will get hunted illegally to satisfy the paying trophy hunter. This will lead to a quite negative impact on the local population of Heptner's markhor, with population growth remaining under its full potential. From an economical point of view, large hunting territories provide the opportunity to have more markhor and therefore more trophy age males. Hence, more trophy licenses may be justified, in an optimal situation. Moreover, non-scattered territories are easier to patrol for local rangers.

F. Management recommendations

In the following text, we shall provide recommendations especially on trophy hunting quotas for each conservancy unit for the hunting season of 2017/2018. Furthermore, these quotas should be suggested at the CITES CoP19 as export quotas for the next 5 years. This would support the sustainable use of Heptner's markhor by community-based trophy hunting, according to the IUCN Caprinae Specialist Group. Following these recommendations would also ensure the acceptance of CITES authorities and the USFWS, thus allowing a smooth trophy import back to the hunters' home countries.

F.1. Assessment of LLC Morkhur

Biological Sustainability: Our results suggest that the subpopulation inhabiting the territory of LLC Morkhur is growing. Rangers work with different methods e.g. patrolling and deploying camera traps to prevent poaching. The territory is large enough to change the location of hunting during a trip and reduce wildlife harassment. We also recorded 5 Bukhara urials *Ovis orientalis bochariensis*. A good protection of the territory of LLC Morkhur also ensures the protection of Dashtijum Strictly Protected Area.

Net Conservation Benefit: LLC Morkhur employs 12 rangers, mostly former poachers, from local villages. Furthermore, there is a community support which creates incentives to protect wildlife. However, this LLC should aim for more community support. The head of this conservancy unit lives close to his territory and his family has been cooperative for many years.

Markhor trophy quota: From a biological and socio-economic-cultural point of view, the harvest of two trophy age markhor can be sustainable. Therefore, we **recommend and support a trophy hunting quota of two** trophy age Heptner's markhor to be allocated to LLC Morkhur.

F.2. Assessment of LLC Saidi Tagnob

Biological Sustainability: The comparison of our results with previous surveys suggest that the local population numbers in the territory of LLC Saidi Tagnob are growing. We also observed 2 wolves *Canis lupus*. Rangers patrol the territory to prevent poaching. The total territory is large enough to shift the location of hunting during a trip to reduce wildlife harassment.

Net Conservation Benefit: LLC Saidi Tagnob employs 15 local rangers, mostly former poachers from surrounding villages. The community support by this company is exemplary.

Incentives for the local community to protect wildlife are given not only by supplying villages with resources, but also by employing local people in community-based gardens. LLC Saidi Tagnob supports the local border police, which also prevents poaching by Afghan intruders. The head of Saidi Tagnob and his family are traditional hunters, part of the community and live directly next to the hunting territory and patrol the areas every day.

Markhor trophy quota: From a biological and socio-economic-cultural point of view, the harvest of three trophy age markhor can be sustainable. Therefore, we **recommend and support a trophy hunting quota of three** trophy age Heptner's markhor for LLC Saidi Tagnob.

F.3. Assessment of LLC Safari Dashtijum

Biological Sustainability: Our results show a small population number with two trophy age males. The area had not been surveyed in 2016. Because of the small size of this territory, a change of the location during a hunting trip would be impossible. In our opinion, the size of the area managed by LLC Safari Dashitjum is too small to effectively manage a species like Heptner's markhor, because suitable habitat is insufficient to support a larger, sustainably huntable population size. Nothing is known of the work to prevent poaching. According to locals, non-sustainable markhor hunts have occurred in LLC Safari Dashtijum. Further investigations should be done to substantiate this allegation. Non-sustainable trophy hunting puts at risk the success of the whole conservation project and it should be prevented.

Net Conservation Benefit: LLC Safari Dashtijum claims to employ six rangers occasionally as they do not get paid regularly, and we had a chance to meet two or three of them. There is no community support in any form. However, the head of LLC Safari Dashtijum lives close to his territory.

Markhor trophy quota: From a biological and socio-economic-cultural point of view, we **cannot recommend or support any trophy hunting quota** for this conservancy. Changes in the management of the areas currently assigned to LLC Safari Dashitjum should be considered by decision-makers to ensure a long term community-based conservation hunting success of Heptner's markhor in Tajikistan. We recommend facilitating a closer collaboration and involvement of LLC Saidi Tagnob as a co-manager and example for community-based trophy hunting in the management of LLC Safari Dashtijum. On top of that, the involvement of other local hunters from the Khirmanjo village would be necessary to make them stop poaching and to ensure an improved net conservation benefit.

F.4. Assessment of NGO Muhofiz

Biological Sustainability: Our results show a small number of animals with just two trophy age males. According to the head of NGO Muhofiz, not much information on the status of markhor in their second area is available. Reportedly, six rangers patrol the areas of NGO Muhofiz and LLC Bars. Nothing is known about their approach to minimize poaching. According to locals, members of NGO Muhofiz are hunting markhor in a non-sustainable way or organize such hunts. Further investigations should be done to provide evidence for this allegation. Non-sustainable trophy hunting jeopardises the success of the whole conservation project and should be prevented. The territories of NGO Muhofiz are too small and highly fragmented for an effective markhor management.

Net Conservation Benefit: There is no community support in any form. Instead of employing more rangers and giving incentives to locals for conservation, the rangers are shared between NGO Muhofiz and LLC Bars.

Markhor trophy quota: From a biological and socio-economic-cultural point of view, we **cannot recommend or support any trophy** license for this conservancy. Changes in the management of the areas currently assigned to NGO Muhofiz should be considered by decision-makers to ensure a long term community-based conservation hunting success of Heptner's markhor in Tajikistan. We recommend a closer collaboration and involvement of LLC Saidi Tagnob as a co-manager and example for community-based trophy hunting in the management of NGO Muhofiz. LLC Saidi Tagnob could contribute from the trophy hunting incomes to the protection of all Parvor mountain (involving inhabitants from following villages: Parvor, Yol, Sarigor) without conducting hunts here.

F.5. Assessment of LLC M-Sayod

Biological Sustainability: Our results suggest that the subpopulation inhabiting the territory LLC M-Sayod is growing. There are a significant high number of adult markhor males in this territory. An enlargement of the markhor home ranges could be proved. We also recorded one snow leopard *Panthera uncia*, one Tien Shan brown bear *Ursus arctos isabellinus* and several Asiatic ibexes *Capra sibirica*. Rangers patrol frequently and minimize poaching. The area is large enough that a hunter could change hunting location during his trip and thus reduce wildlife harassment.

Net Conservation Benefit: LLC M-Sayod employs 20 rangers (all of them local people of

various villages), many of them had a special staff training. The family of LLC M-Sayod is part of the local community and they have been into conservation for many years. The community support is exemplary as LLC M-Sayod not only creates incentives for the local community to protect wildlife but also supports students with scholarships to enhance the educational status of people living in this community. On top of that, LLC M-Sayod supports the local border police.

Markhor trophy quota: From a biological and socio-economic-cultural point of view, the harvest of four trophy age markhor is sustainable. Therefore, we **recommend and support a trophy hunting quota of four** trophy age Heptner's markhor to be allocated to LLC M-Sayod.

F.6. Assessment of LLC-Bars

Biological Sustainability: We do not have any valuable data or estimates for the population status of Heptner's markhor inhabiting the territory of LLC Bars. Because of the small size of this territory, a change of the hunting location during a trip would be impossible. In our opinion, the size of LLC Bars is too small and fragmented to manage the Heptner's markhor to a population size that would allow sustainable hunting.

Six rangers are shared between LLC Bars and NGO Muhofiz. Nothing is known about their approach to obstruct poaching. According to locals, non-sustainable markhor hunts have been organized by LLC Bars for many years. Further investigations are required to prove this statement. Non-sustainable trophy hunting jeopardises the success of the whole conservation project and should be prevented.

Net Conservation Benefit: There is no valuable community support. The head of LLC Bars is not a local traditional hunter coming from the community. His family originates in another part of Tajikistan, never lived in the area and according to his son, they are living primarily in Russia. This does not fulfil our understanding and requirements of a community-based conservancy.

Markhor trophy quota: From a biological and socio-economic-cultural point of view, we **cannot recommend or support any trophy** license for LLC Bars. Significant changes in the administration of the areas currently assigned to LLC Bars should be introduced by decision-makers to ensure a long term community-based conservation hunting success of Heptner's markhor in Tajikistan.

F.7. Grazing and firewood cutting

Outside of core areas without any extractive resource use, livestock grazing needs to be regulated and habitats with preferred plant species should be protected from overly intensive fuel wood harvest, with slow growing *Juniper* being entirely excluded from any cutting. Overall awareness of the public about importance of biodiversity in general and threatened species in particular should be raised to win their support and cooperation in conservation efforts.

F.8. Territory size

We promote the approach of large hunting territories (minimum 10,000 ha) connected into one unit, under management of local and traditional hunters living in or very close to their hunting ground. Local and traditional hunters are part of the community; they should feel more responsible for wildlife inhabiting their territory and, as conservancy managers, they should provide incentives for the local community to support conservation. In our understanding, these criteria are required for a LLC or NGO head who gets supported by the international conservation community. The administration of a large and connected territory also has ecological and economic advantages. From an ecological point of view a sufficiently large area with natural boundaries provides enough habitat and forage to a local subpopulation of at least several hundred markhor, with sufficient old-age males to allow for sustainable and successful trophy hunting. A larger area allows the markhor to select year-round most suitable habitat for foraging, rut, giving birth and escaping from predators. Small areas may not cover year-round habitat and leave the markhor and other animals unprotected during large parts of the year. Furthermore, a large territory of the size of LLC Morkhur, LLC Saidi Tagnob or LLC M-Sayod gives the possibility to choose the location of hunting (valley, canyon, etc.). After an unsuccessful stalking of a specific old age markhor or wild boar *Sus scrofa*, hunters can continue their stalk in another area sufficiently far away from the first one. This increases hunting success, while reducing the hunting pressure, which is a stressful form of wildlife harassment, with negative impacts on animals in a specific area.

F.9. Hunting enclosures

In a meeting at the beginning of the survey, Mr. Zafar Bekmurodi, head of the Hot Spring Company for Marco Polo Hunting and member of the Association of Hunters of Tajikistan, reported about introductions of different animal species (mouflon, ring-necked pheasants, fallow deer, sika deer) to establish hunting enclosures. In general, the creation of hunting enclosures is regulated by law and thus legal. However, non-native species and subspecies may have very negative impacts on the local biodiversity in these areas and, if they escape from fenced areas, their long term impact can upset the local animal and plant communities.

Introducing non-native animals should be discouraged, as most likely long-term negative and unpredictable impacts on native ecosystems and species will occur. We do not support the establishment of hunting enclosures, including the possible captive breeding of markhor and urial for trophy hunting purposes. Such practices can cause massive damage to the successful community-based markhor conservation programme and to biodiversity conservation in Tajikistan. Examples of these consequences include:

- Harm to ecosystems caused by non-native herbivores like fallow or sika deer;
- Harm to native species, if these are outcompeted by introduced ones e.g. for feeding on similar forage;
- Hybridization of non-native ring-necked pheasants with the native pheasant subspecies will occur if the former escape from captivity, are released for hunting or are crossbred in the aviary. This bears the very high risk of irreversible loss of the pure endemic pheasant subspecies *Phasianus colchicus colchicus*, for which Tajikistan is one of the few remaining areas in the World where this pheasant subspecies has survived in purity until the present time. Also Mediterranean mouflons can readily hybridize with native urial, and sika deer and other red deer ssp can hybridize with the endemic Bukhara deer. Even one single hybridisation event can cause genetic pollution of native populations and their extinction through the loss of their genetic identity;
- Economic damage can be caused at several levels: generally, hunting enclosures have a poor cost-benefit ratio as they provide little return for high investment and maintenance costs; most foreign hunters prefer native, free-ranging populations for hunting and are rarely interested to shoot animals in fenced areas or animals released from an enclosure; the existence of hunting enclosures puts at risk the good reputation of Tajikistan as a hunting

destination with exclusively free ranging and well managed native animal populations; the risks of hybridization may lead to the perception that animals offered for hunting are not the pure wild forms but hybrids, which are of much less value to hunters; ecosystem degradation inside the hunting enclosures caused by non-native animals and impact of escaped or purposefully released animals can cause further damage.

- Impacts on human health can be caused if animals are hand-reared or habituated to humans and become aggressive when adult. Especially deer can be very dangerous and deaths and serious injuries of keepers and of unrelated visitors may occur.

G. Acknowledgements

We would like to thank Mr. Khairullo Ibodzoda, Chairman of the Committee on Environmental Protection under the Government of Tajikistan, Mr. Abdulkodirkhon Maskaeu, Head of the Department on State Control for Protection of Fauna and Flora of the Committee for Environmental Protection under the Government of Tajikistan, and other Tajik officials for their friendly invitation and collaboration. Furthermore, we would like to thank the heads and collaborators of all conservancies for their hospitality and all survey participants for their active cooperation to conserve the Heptner's markhor. Special thanks goes to Blake Vandenberg for his great job as an independent observer.

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