Results of markhor survey in six conservancies of Gilgilt-Baltistan, Pakistan, in winter 2019-2020

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Cover plate caption: A group of flare-horned markhor (*Capra falconeri falconeri*) observed in Bunji Conservancy during the winter markhor survey 2019-2020. Photo ©WCS-Pakistan.

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EXECUTIVE SUMMARY

In support of the sustainable management of markhor populations in Gilgit-Baltistan (GB), Pakistan, that includes an authorized and controlled annual harvest of four adult males, the Ministry of Climate Change (MoCC), Parks & Wildlife Department (P&W), GB, and concerned communities organized with technical support of WCS-Pakistan, a joint markhor survey during the rut season (15 December 2019 – 2 January 2020) in six community-managed conservancies. These conservancies are recognized by local authorities to host amongst the largest markhor populations in GB, and include Bunji, and Dashkin-Mushkin-Turbaling-Doyan (DMTD) in District Astore; Kargah, Jutial-Sakwar, and Sassi-Haramosh in District Gilgit; and Sokoyo-Karabathang-Basingo (SKB) in District Skardu, covering an area of around 2,050 km^2.

WCS, the MoCC, P&W, and concerned communities held comprehensive pre-survey consultations to develop a road map for the joint markhor survey and agree upon modalities for successfully conducting the census. The Fixed Point Count (FPC) method was selected and used, such as successfully used in the past in GB and in other areas (e.g. Tajikistan) across the markhor distribution range, also a method adopted for this species by the IUCN Species Survival Commission Caprinae Specialist Group. Two to eight survey teams, depending on the size of the conservancy, composed of four to six surveyors, conducted on foot simultaneous counts from 6:00 am to around 6:00 pm over one day. After discarding possible double counts, the sum of each Fixed Point counts and groups observed by all survey teams in each conservancy were taken as the minimum markhor population and number of groups for that conservancy.

Overall observations tallied up to 1,286 individual markhor in 121 groups ranging 1-35 animals (mean group size: 10.6, SD± 6.9), including 302 unsexed kids (23%), 205 unsexed yearlings (16%), 420 females (33%), 161 sub-adult males (12%), and 198 adult males (16%). The overall kid to female ratio was 72 to 100. The highest number of markhor and adult males were observed in Bunji (383) and Jutial-Sakwar (47), respectively.

Markhor in GB are distributed in areas covered by more than 15 community-managed conservancies, whereas the current survey was conducted in only six conservancies where markhor trophy hunting is being practiced, and encompassing perhaps 50% of the known distribution range of markhor. It was not possible to cover the entire markhor distribution range in GB with such standardized and high-quality methodology without raising considerably more human and logistic resources, given the time limitation of only three weeks for the rut season.

Further surveys are needed to assess trends in markhor populations in Gilgit-Baltistan. Based on the field observations and survey results, recommendations have been offered for further improvement in Caprinae surveys and sustaining community-based trophy hunting program in Gilgit-Baltistan.

1. INTRODUCTION

Gilgit-Baltistan (GB) region of northern Pakistan is considered a stronghold for mountain ungulates, including five wild Caprid species with wide distribution in the region. These species play an important role in the ecosystems they use, as primary grazers/browsers, and key prey species for wild carnivores. The flare-horned markhor (*Capra falconeri falconeri*) is one of these flagship species adapted to rugged and precipitous terrain, and is confined to the valleys adjacent to Gilgit, Hunza, and Indus rivers and their tributaries. Because of its majestic look and as a cultural icon to the people of Pakistan, markhor has been declared a 'National Animal of Pakistan'. Unfortunately, by the 1990's it suffered considerable decline in many core areas of its habitat in GB, mainly because of over-hunting, habitat loss, and competition with domestic livestock. At that time it was categorized as "Endangered" on the IUCN's Red List. However, its status was reassessed in 2015 as "Near Threatened", two steps down listing from Endangered. In Pakistan this remarkable recovery has been largely attributed to the successful implementation of community-based sustainable trophy hunting under the strictly enforced annual CITES quota of 12 markhor trophies authorized for exportation. Four of these trophies are allocated to Gilgit-Baltistan, helping the GB government to generate funds and providing a powerful economic incentive for local communities to protect markhor and their associated ecosystems.

Assessing markhor population size and trends over time is a prerequisite to evaluate the quality of community-based markhor conservation programs in Gilgit-Baltistan and guide sustainable harvest recommendations. Though GB Parks and Wildlife Department (P&W), WCS-Pakistan, and communities have conducted joint markhor surveys in GB in the past, but their results and reliability were sometimes questioned at various national and international fora because of their lack of comprehensiveness. To address these legitimate concerns, WCS-Pakistan assisted the Government of GB to organize and co-implement a large-scale, comprehensive, joint winter markhor surveys in winter 2019-2020 in six conservancies operating markhor trophy hunts, and involving as external "observers", two staff members from Zoological Survey of Pakistan, Ministry of Climate Change, Pakistan.

We present in this report the tallied and disaggregated markhor count results in six of the seven conservancies that have so far operated sustainable markhor trophy hunting in Gilgit-Baltistan (Sikandarabad Conservancy, District Nagar, was not surveyed). The report also lists the constraints and challenges faced during the surveys, and provides recommendations for bringing improvement to future markhor survey operations in GB.

1.1 Survey objectives

The main objectives of the surveys were to:

- Determine the current status of flare-horned markhor populations, and establish baseline population values in six conservancies/ CCHAs implementing trophy hunting programs;

- Promote joint—GB P&W, CWGs—wildlife surveys; strengthen local watch-and-ward and coordination mechanisms among stakeholders in support of a rigorous program to monitor community-based management plan in fulfillment of CITES resolution; and

- Provide solid scientific data and evidence to the provincial and federal governments for taking informed decisions for managing markhor population and allocating annual trophy hunting quotas in GB.

2. STUDY AREAS AND METHODOLOGY

2.1 Study Areas

Gilgit-Baltistan region (formerly Northern Areas) is situated in the extreme north of Pakistan, sharing international borders with three countries—Afghanistan, China and India. It spreads over an area of 72,971 km² and its mountain landscape is a unique blend of natural habitats and ecosystem types which support a rich variety of species (plants, mammals, birds, reptiles, and amphibians) that contribute to the overall biodiversity of Pakistan. Its deep valleys, steep gradients, immense climatic variation with temperatures varying from -20°C in the winter to +45°C in the summer, have shaped a unique assemblage of biodiversity. It has an estimated population of 1.9 million as per 2017 census and Gilgit is the capital of Gilgit-Baltistan with a population of ca. 216,760.

The flare-horned markhor has wide distribution in GB encompassing the lower valleys of five districts—Diamer, Astore, Gilgit, Nagar, and Skardu and a range of elevations between around 1,100 m and up to 5,700 m. Though markhor are found in more than 15 recognized conservancies in GB, the winter markhor surveys were conducted in only six conservancies, which have benefited from the community-based markhor trophy hunting in the recent past. These conservancies are also considered strongholds of markhor populations and prime markhor habitat in GB, and include Kargah, Jutial/Sakwar, Sassi-Haramosh in District Gilgit; Dashkin-Mushkin-Turbaling-Doyan (DMTD) and Bunji in District Astore and Sokoyo-Karabathang-Basingo (SKB) in District Skardu, covering an approximate cumulated area of 2,050 km² falling within three mountain ranges—Himalayas, Hindukush and Karakorum (Fig. 1).

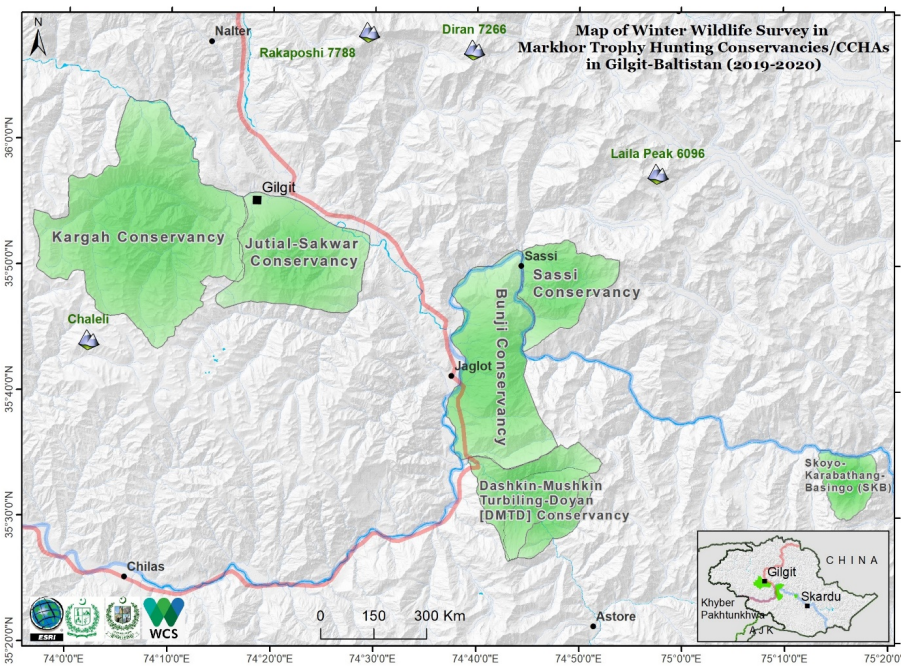

Figure 1: Map showing location of the six conservancies surveyed for markhor in winter 2019-2020 (the scale refers to the inset map).

2.2 Pre-surveys consultations

Pre-surveys consultations were crucial steps in coordinating the planned operation over a very large area and within a short window of survey time. They were held at three levels—Ministry of Climate Change in Islamabad, GB Government and P&W GB in Gilgit, and at community level represented by 15 Wildlife Conservation and Social Development Organization (WCSDOs) of the six selected conservancies. The main outcomes of these consultations are summarized below.

2.2.1 Ministry of Climate Change

The federal Ministry of Climate Change is the focal ministry for the implementation of CITES in Pakistan and coordinates with the provinces for the management of wildlife resources. It also houses CITES Management Authority of Pakistan, whereas its attached department, Zoological Survey of Pakistan (ZSP), serves as CITES Scientific Authority in the country. A pre-survey consultative meeting was held with the Inspector General of Forests and his team in early September 2019, and was also attended by WCS Senior Technical Advisor for Inner Asia Region. The survey was then endorsed at federal level and a team of ZSP observers nominated to attend.

2.2.2 Government of Gilgit-Baltistan

Forest, Wildlife and Environment Departments (FW&E), Government of GB, and WCS held a senior level meeting on 3 September 2019 in Gilgit to discuss and outline the process to organize the survey and reporting. Participants agreed on the significance of the markhor survey, especially in conservancies where markhor trophy hunting had already taken place. It was decided that staff from the P&W (lead), Community Wildlife Guards (CWGs), WCS, and ZSP as external observers would conduct jointly the survey. WCS agreed to finance the survey in six markhor conservancies with trophy-hunts, while the Department would arrange, if possible, funding for the remaining conservancies with markhor populations. The Government of GB gave its full support to the survey and agreed to engage staff and equipment in the survey. The Secretary FW&E recommended that P&W and WCS prepare a roadmap and have a close coordination during the process.

2.2.3 Parks and Wildlife Department

WCS-Pakistan conducted follow up working sessions with the Conservator Parks and Wildlife GB and his field team, including DFOs Wildlife of Gilgit, Astore, and Skardu to discuss the survey objectives and finalize logistical arrangements. Roles and responsibilities of participants, and detailed methodology were discussed and finalized. In addition, the Conservator of P&W chaired an orientation session on survey methodology, use of survey equipment (including GPS and spotting scopes), attended by its field staff, office bearers of selected WCSDOs, CWGs, and WCS field staff at the Forest Complex, Gilgit. On the basis of these session's P&W nominated field leaders for survey teams in each conservancy and issued special instructions to the concerned field officers (SDFOs and RFOs) of wildlife divisions of Gilgit, Astore, and Skardu.

2.2.4 Wildlife Conservation and Development Organizations (WCSDOs)

WCS held pre-survey meetings with representatives of 15 WCSDOs of the six conservancies covered by the survey. The purpose of these meetings was to share survey plans with office bearers, finalize survey team composition and survey routes, nominate capable CWGs, organize survey equipment, and define roles and responsibilities, including a financial contribution from each WCSDO for the partial payment of honorarium to the CWGs (PKR 500/day/CWG). Pre-

survey consultations contributed at building momentum and enthusiasm among community members to achieve best possible survey quality in their respective areas.

2.3 Timeframe

Considering the scale of the area, the best time for a comprehensive markhor survey in Gilgit-Baltistan is during the rut, which typically starts around the first week of December and lasts until the end of the month. The markhor survey was therefore planned to start at the end of the first week of December but was delayed by one week, and occurred between 15 December 2019 and 2 January 2020 (Table 1). It started at lower elevations in Bunji, and ended up at highest elevations in SKB.

2.4 Survey participants

Survey participants included field staff of the P&W, the field team of WCS, CWGs nominated by the concerned WCSDOs, and two PhD students nominated by ZSP, Ministry of Climate Change. WCS involved three experienced observers from its team and hired/trained six local observers with relevant education background and past experience in wildlife surveys (part of them ex-employees of WCS). The number of survey teams required for each conservancy was determined in consultation with the communities and P&W. Each survey team comprised three to six members, with the representative of P&W always leading (**Annex I**).

2.5 Methodology

Mountain ungulates are notoriously difficult to count. Standard survey techniques used for wild ungulates found in plains, such as line transects, stratified sampling, or even randomized block counts are generally impossible to undertake in the rugged and precipitous terrains prevailing in mountains of GB. Keeping in view these limitations P&W and WCS-Pakistan decided to use the Fixed Point Counts (FPC) method, an appropriate survey method for mountain ungulate surveys with which most participants were familiar. A Fixed Vantage Points (FVP) is an observation point (location) from where most of the surrounding mountain slopes are clearly visible and an unobstructed view for scanning maximum area is possible without disturbing the animals. In each conservancy best FVPs were selected in consultation with the respective WCSDOs and CWGs on predetermined routes frequented by markhor. The surveys were conducted on foot between 6:00 am and 6:00 pm and in general after one full day of observation, the team stayed overnight in the mountains and followed the same route while descending to the valley, but without counting the animals to avoid possible duplications in counts. Vehicles were only used to scan the slopes facing Gilgit-Skardu and Astore roads. The number of survey teams used in each conservancy depended on the size of the area and number of designated routes needed to cover the entire markhor habitat (Table 1). The survey was the first of its kind where multiple survey teams were operating simultaneously on different survey routes, and the designated survey routes and search sites were clearly explained to each survey team to avoid double counts. Each team was equipped with at least three binoculars (Nikon 10x-50 or 10x-42), one spotting scope (Nikon 20-60x-80 or Burris 15-45x-50), a GPS hand-held unit (provided by the P&W and used by their staff), compasses, and a digital camera. Team leaders recorded the altitude and coordinates of each FVP. In general, markhor groups were first located by CWGs using binoculars, and then sex and age composition was determined with the spotting scope. Pictures and video clips were taken whenever possible. Observations were made at distances varying between 400 m and 1,500 m. Observers in a team counted each group and determined its composition separately and reached consensus after comparisons of results. This helped to

reduce counting error and observer biases. A group was considered to be a gathering of animals within a radius of 50 m that didn't split during the time of observation. Efforts were made to categorize each observed markhor as unsexed kid (<1 year-old), unsexed yearling (1-2 year-old), adult female (>2 year-old), and using length of horns as an indicator of age, Class-I sub-adult male [2 to 4 year-old[, Class-II adult male [4 to 8 year- old[, Class-III trophy size adult male (≥8 year-old). The sum of all the FVPs counts by each survey team was taken as the minimum number of markhor observed by each team. In addition to group size and its composition, the teams recorded habitat condition, animal locations, activity of the animals, and direction of movement of the group (if any).

Table 1: Metadata on markhor surveys in each conservancy, Gilgit-Baltistan, December 2019 – January 2020

Name of conservancy	Size (km²)	Survey day	Start date	End date	No. of teams involved	Average # of obs. per team	Total # of observers	Average time spent (hr)
Bunji	378	1	16/12/2019	17/12/2019	8	4	32	10
		2	16/12/2019	17/12/2019	3	4	12	5.8
DMTD	316	1	18/12/2019	18/12/2019	6	4	24	9.6
Sassi	136	1	18/12/2019	18/12/2019	2	4	8	9.1
Jutail-Sakwar	201	1	24/12/2019	26/12/2019	1	4	4	1.8
		2	24/12/2019	26/12/2019	7	4	28	9.6
		3	24/12/2019	26/12/2019	5	4	20	6.1
Kargah	887	1	28/12/2019	30/12/2019	3	4	12	1.8
		2	28/12/2019	30/12/2019	5	4	20	9.9
		3	28/12/2019	30/12/2019	3	4	12	9.2
SKB	132	1	01/01/2020	02/01/2020	3	6	18	4.2
		2	01/01/2020	02/01/2020	3	4	12	8.9

2.6 Data analysis

Immediately upon completion of each survey, the lead observers of each survey team jointly examined recorded data, including group sizes, sex/age composition, time of observation, and direction of movement of groups. Special attention was paid to adjacent survey routes/blocks to eliminate duplicate counts. After analysis no duplication could be confirmed, as neither the same group size nor the same composition of any herd was observed in adjacent surveyed areas, and observations occurred simultaneously and within one day. However, it was noticed that number of females recorded by several survey teams was suspiciously high, potentially skewing the group composition, sex ratios, and kids/females ratio. It is suspected that this overestimation resulted from observers' confusion between yearlings and young females (2-3 year-old), especially from a long distance, and/or wrong categorization of yearlings as kids or vice versa. In order to overcome these errors, some adjustments were made in the survey data of less experienced survey teams. The age and sex ratio documented by the most experienced and reliable survey teams were taken as 'likely correct' and then extrapolated to suspicious datasets to adjust the age and sex ratios. We also noticed that many observers amongst CWGs had a tendency to categorize some Class II (5-8 year-old) adult males as Class III trophy-size (≥8 year-old) males, hence over-estimating the latter category. Because we could not correct this bias retrospectively, we decided to report Class II and III males as one category of "adult males". Survey data was

compiled, analyzed, and described in tabular and graphical forms with MS-Excel. Geographic information, weather conditions, habitat features, and activities of animals at time of observation were recorded on the survey sheet, but are not covered in this report.

3. RESULTS

3.1 Minimum numbers

The survey tallied a minimum of 1,286 markhor over a surveyed area of ca. 1,000 km² (i.e. 1.2-1.3 markhor/km^2). The highest number of counted markhor was in Bunji (383 markhor; ~29.8% of the markhor observed) as well as the highest number of sub-adult and adult males (85). The highest number of adult males (≥4 years) was reported in Jutial-Sakwar (47) (Table 2, Figure 2). In general, only counts made on pre-determined days were included in the totals. However, on very few occasions counts made by teams on their way to the start point were also included after controlling for possibility of duplication. It was the case for 12 markhor recorded by team F in Jutial-Sakwar Conservancy on its way to the starting point, and 33 markhor recorded by teams A, B and C in Kargah on 28 December 2019.

It is reasonable to assume that there were more markhor than actually detected, as only 50 to 60% of each conservancy could be covered during the surveys owing to inaccessibility of several areas, time limitation demanded by the method, and occasionally poor weather conditions.

Table 2: Minimum population size, age and sex composition of markhor observed during the winter 2019-2020 survey in Gilgit-Baltistan.

S#	Conservancy	Total	Age and sex composition					Kids to females ratio
			Kids	Yearlings	Females	Males		
						Sub-adult 2-4 years	Adult >4 years	
1	Bunji	383	101	66	131	42	43	0.77
2	DMTD	180	35	29	51	28	37	0.69
3	Sassi-Haramosh	31	6	2	13	5	5	0.46
4	Jutial-Sakwar	288	64	44	101	32	47	0.63
5	Kargah	269	66	41	87	34	41	0.76
6	SKB	135	30	23	37	20	25	0.81
	Total	**1286**	**302**	**205**	**420**	**161**	**198**	**0.72**

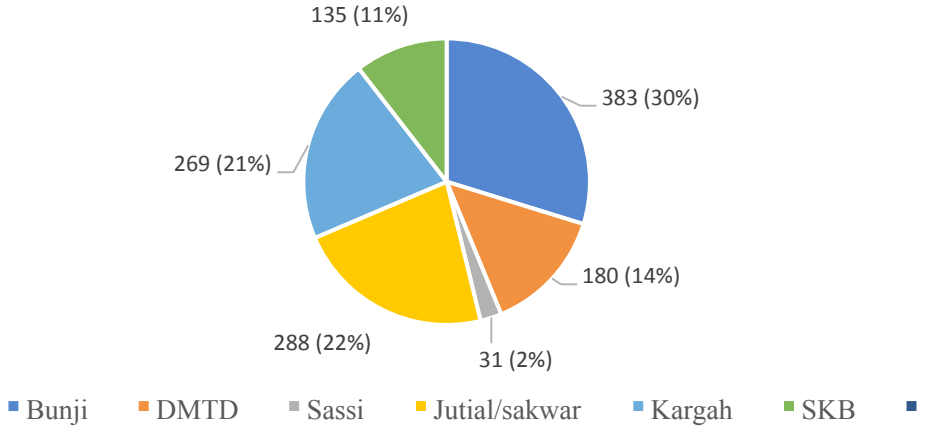

Figure 2: Minimum number of markhor recorded in six conservancies of Gilgit-Baltistan, Pakistan, winter 202ç-2020.

3.2 Sex and age composition

At the overall 302 (23.5%) markhor were kids, 205 (16%) yearlings, 420 (33%) females, 161 (12%) sub-adult Class-I males, and 198 (15.6%) adult (Class II/Class III) males.

3.3 Groups and group sizes

The survey tallied 121 markhor groups with an average size of 10.6 (SD ± 6.9). The group size ranged 1-35, the largest was observed in Doyan area of DMTD conservancy. Group sizes observed in each conservancy were classified into six categories: 1, 2–3, 4-6, 7-9, 10-15, and ≥16 (Table 3). The group size data was further analyzed to determine the number of markhor groups sighted in each conservancy, average (mean) group size, and deviation from the mean group size (Table 4) and distribution (Figure 4).

Table 3: Number of markhor groups sighted and group size ranges in six conservancies of Gilgit-Baltistan, Pakistan.

Conservancy	Group size categories						Total groups sighted
	1	2 - 3	4 - 6	7- 9	10 - 15	> 16	
Bunji	0	0	4	5	8	10	27
DMTD	0	0	1	2	2	6	11
Sassi-Haramosh	0	0	0	2	0	1	3
Jutial-Sakwar	1	8	10	7	8	3	37
Kargah	2	2	11	7	9	2	33
SKB	0	1	1	2	3	3	10
Total	**3**	**11**	**27**	**25**	**30**	**25**	**121**

Table 4: Number of markhor groups sighted, average group size and deviation from the mean in six conservancies of Gilgit-Baltistan, Pakistan.

	Bunji	DMTD	Sassi	Jutial-Sakwar	Kargah	SKB	Total
Population (n)	383	180	31	288	269	135	1286
No. of groups sighted (x)	27	11	3	37	33	10	121
Average group size ($\bar{x}$)	14.2	16.4	10.3	7.8	8.1	13.5	10.6
Standard Deviation (SD)	7.7	8.5	4.0	4.8	4.4	7.8	6.9

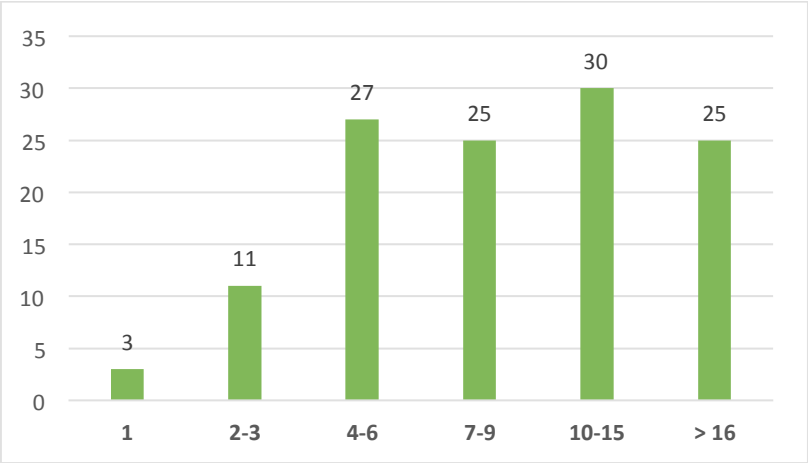

Figure 4: Distribution of group sizes of markhor herds observed in six conservancies of Gilgit-Baltistan, Pakistan.

4. DISCUSSION

The comprehensive markhor survey in Gilgit-Baltistan in winter 2019-2020 tallied a minimum number of 1,286 markhor in six conservancies where markhor trophy hunting is being practiced, and encompassing 50-60% of the known distribution range of markhor in GB. However, markhor in GB are distributed in areas covered by at least six to eight additional community-managed conservancies. It was not possible without raising considerably more human and logistic resources to cover the entire markhor distribution range in GB because of the adopted standardized and high quality methodology and the time limitation of only three weeks for the rut season. We believe that it would be very difficult to cover all the markhor conservancies in Gilgit-Baltistan during one discrete survey operation in a single rut season. An option to retrieve minimum numbers for the entire Gilgit-Baltistan would be to undertake winter surveys in alternate years covering half the conservancies in one year and the remaining half in the other year. Another option is to produce conservative interpolations for adjacent areas not surveyed. For example **if one assumes a conservative average of 70 markhor per population of non-surveyed conservancy (based on past counts carried out by WCS), the population of markhor in all conservancies hosting this species in Gilgit-Baltistan would total a minimum of 1,800-1,900 animals in winter 2019-2020**.

The number of counted markhor varied between surveyed conservancies. The highest number was observed in Bunji (383), followed by Jutial-Sakwar (288), and Kargah (269). Because Bunji and Kargah conservancies are larger areas, as compared to Jutial-Sakwar, it seems that Jutial-Sakwar conservancy has relatively higher density of markhor than Bunji and Kargah. It is possible, although not proven, that markhor prefers the habitat available in Jutial-Sakwar. Noticeably a low number of markhor (31) was recorded in Sassi-Haramosh, a conservancy that has operated so far three successful markhor trophy-hunts, the last one as recently as February 2019. One possible reason for this low number could result from disturbance from road construction operations and in turn inadequate detections. Prior and during the survey there have been rock blasts on the Gilgit-Skardu road, very close to the core wintering habitat of markhor in the area. As a result, animals might have moved at higher elevations to inaccessible locations and remained undetected by survey teams. Having said that, this explanation remains hypothetic, and if it appears proven, to what extent such disturbance might affect the markhor population in the future remains uncertain. **As a result, in the case of Sassi-Haramosh conservancy**, **there is justification for applying the precautionary principle and having due regard to the known biology of the species. Future actions should intensify monitoring of markhor population, and study the effect of road construction disturbance on markhor survival and productivity in this important area. The status of the markhor population in Sassi-Haramosh requires additional investigations to guide future trophy hunting quota allocation in this area.**

The present survey methodology aimed to maximize the detection of markhor and minimize duplicate counts, which are more likely to happen during rut season when male markhor are very mobile. **The following summarizes a number of conditions that we recommend to adopt in future similar surveys**. The survey plan was designed in such a way that multiple survey teams were operating simultaneous on different survey routes/blocks in each conservancy. Teams were deployed near the start point at least 6 hours prior to the start time of the survey in the early morning and they started and ended the surveys at roughly the same time, conducting simultaneously surveys along predetermined routes, to limit the risk of duplicate counts. To further reduce the risk of duplicate counts most surveys were designed as 'one-day counts', hence animals detected on the second day, when the team was returning to the valley, were not accounted in the total. Also, it was important to analyze the data with team leaders as soon as possible after the end of the survey. Most experienced personnel in each survey team carefully and jointly analyzed the post-survey data for each conservancy. If an obvious double observation is noticed, it should immediately be discarded.

The overall kids/females' ratio was 0.72. The highest ratio was recorded in SKB (0.81) markhor population, followed by Bunji (0.77) and Kargah (0.76). The lowest ratio was in Sassi-Haramosh conservancy (0.46), **another indication that the situation of markhor in this conservancy could be in jeopardy and requires immediate attention from the P&W and priority monitoring**. In SKB the relatively higher kids/females' ratio was probably due to higher likelihood in this conservancy to accurately differentiate kids from yearlings, and yearlings from adult females, as most groups are visible from relatively short distance on the slopes facing the Indus River. This ratio retrieved in late December is considered a good indicator of productivity and kids' survival 6-7 months after birth, it is therefore important to carefully differentiate and record kids during markhor surveys. Considering the operating biases mentioned above the proposed ratios should probably be considered as absolute minimum values.

The highest number and proportion (to population) of adult males were recorded in Jutial-Sakwar Conservancy (47 and 16.3%, respectively) followed by Bunji (43; 11.2%) and Kargah (41; 15.2%)(Table 2). The presence of a slightly higher number of adult males in Jutial-Sakwar supports a quality habitat and good escape cover in this area. Bunji and Kargah are also considered prime strongholds for breeding markhor in Gilgit-Baltistan even so there are evidences of continued poaching in these areas. The first census attempt in Kargah on 20-22 December 2019 was abandoned due to the presence of two local poachers and associated disturbance. These poachers were apprehended by the survey parties and handed over to the P&W for further investigation and prosecution.

Altogether survey teams observed 121 markhor herds in six conservancies, where group size ranged 1-35. The highest number (37) of markhor groups was reported in Jutial-Sakwar, followed by Kargah (33) and Bunji (27), where number of larger group sizes (≥16) was much higher (10) as compared to other conservancies. Aggregation of markhor in larger groups might have been the result of the presence of a snow leopard family of four in Rehman Nullah area. It was also noted that groups in Jutial-Sakwar and Kargah conservancies were more scattered, as compared to other conservancies, perhaps because these areas were surveyed during the peak of the rut when highly mobile males actively chase females and split larger groups into smaller ones. Aligned with this hypothesis group sizes were on average larger in Bunji and SKB, where surveys were conducted respectively at the beginning and end of the rut.

In addition to markhor, one survey team (H) also recorded about **70 Ladakh urial** (*Ovis vignei vignei*) in Neli area of Bunji conservancy, where this species has sympatric distribution with flare-horned markhor. Another survey team (E) recorded a family of **four snow leopards** (*Panthera uncia*) in Rehman Nullah, Bunji, during the survey on 16 December 2019, which may have affected the count results in this area and explained the relatively low number of kids detected in this area. A survey team (A) also observed **two snow leopards** in Shikiyot Nullah of Kargah, while other teams also sighted pugmarks of snow leopards, wolves, and foxes in different locations. Survey teams also reported a number of 'prominent' bird species, such as the monal pheasant (*Lophophorus impejanus*), Himalayan snowcock (*Tetraogallus himalayensis*), chukar partridge (*Alectoris chukar*), golden eagle (*Aquila chrysaetos*), and Alpine chough (*Pyrrhocorax graculus*).

5. LIMITATIONS

- The areas of some conservancies are very vast (e.g. Bunji and Kargah), and encompass rugged and broken terrains, which are difficult to survey accurately in one day, even with a large number of teams (e.g. eight teams were engaged simultaneously in Bunji). It is likely that more comprehensive survey results could be retrieved in these areas with more teams (e.g. 12-14 simultaneous teams), but at the expense of lower accuracy because of the risk of duplicate counts. Comprehensive and accurate markhor counts in these areas will probably remain a challenging objective with the validated methodologies and capacity currently available.

- Timing for markhor surveys is very critical to increase the probability of detection, but also for optimal survey results. The current survey was planned during the rut season, which in Gilgit-Baltistan happens from early to end of December. Unfortunately, the survey was delayed by one week and therefore decreased in effectiveness towards the end of it. It is also possible to conduct markhor survey in spring when animals are less mobile (i.e. lower

probability of duplicate counts), but it would require an even larger number of teams because of anticipated smaller group sizes, larger number of groups and the vastness of the area to cover, stretching over more than 150 km from west to east (Fig. 1)

- Construction works on the Gilgit - Skardu road, along the boundaries of Bunji, Sassi-Haramosh, and SKB conservancies, and on hydro power station in Rehman Nullah, Bunji, were in progress during the survey, where heavy machinery and dynamite were being used daily. As a result, markhor moved to the upper reaches of their habitat, which could not be easily scanned by surveyors. This may have affected the overall survey results.

- The community of Dashkin-Mushkin-Turbiling of DMTD conservancy did not allow the survey teams to survey the core markhor habitat, as they were expecting an international hunter during the survey days. Apparently, they claimed that the presence of the survey team might affect the accessibility of trophy size animals by the hunter.

- Presence of a snow leopard family of four in Rehman Nullah of Bunji Conservancy scared markhor herds and resulted in them moving to rough terrains difficult to scan by surveyors. This disturbed the assessment of group structures in part of Bunji, as kids had presumably retreated to inaccessible areas to escape snow leopards.

- The limited number of experienced field-staff of GB P&W and CWGs trained for mountain ungulate surveys was another limitation, especially in large conservancies where at least 6-8 survey teams were needed. This has affected survey results, particularly in determining sex and age composition of markhor groups.

- Markhor poaching is still ongoing in some conservancies. This could be due to weak watch and ward or lack of patrolling both on the part of the community and the Game Watchers deputed by the P&W for protection of wildlife in the conservancies. One such incident was noticed in Kargah Conservancy during the markhor survey initially scheduled 20-22 December, 2019, and that, as a result of the disturbance and diversion of the attention of surveyors, had to be abandoned in the midst of it. It was re-scheduled and successfully implemented on 28-30 December 2019, but then further delaying the survey in SKB to the very end of the rut season.

- It was very difficult to find consensus over number of trophy-size males because of the inclination of surveyors, for various reasons, to over-estimate these numbers. Such problem exists in all parts of the world where trophy animals are counted and could be overcome to some extent if photographs of each trophy-size individual are taken. This could not be achieved during the present survey because of the limited number of cameras and more importantly the great distances of many observations.

- We could not accurately estimate area coverage, and the proposed overall density of 1.2 – 1.3 animal/km^2, based on an estimated average coverage of 50% of conservancies, should be considered as indicative.

- The survey plan was very tight, as there was not enough time for key observers (WCS field team) to take proper rest before moving to the next conservancy. This resulted in observers' fatigue, and might have reduced to some extent the survey quality in Kargah and SKB.

6. CONCLUSION AND RECOMMENDATIONS

Results of the present survey support that all surveyed conservancies apart from Sassi-Haramosh maintain relatively large markhor populations. The markhor situation in Sassi-Haramosh requires to be further investigated because the survey results in this area might have been significantly affected by the disturbance caused by the ongoing road construction.

Regardless of this overall positive conclusion, it is essential to continue monitoring markhor populations in Gilgit-Baltistan to address possible negative trends. Poaching is one of the main concerns for the future, as it is the most likely factor that could jeopardize on the short-term the sustainability of a so far successful community-based trophy hunting program in GB.

The survey also observed that in several areas markhor herds, including trophy-size animals are now coming down to lower elevations, close to human settlements and seasonal homes in search of forage during winter, when higher elevations are covered with snow. This may indicate a reduced persecution pressure in these areas, and flags also new opportunities for wildlife sighting activities and winter tourism.

We have perceived that the existing quota of four exports of markhor trophies allocated to GB by the CITES management authority of Pakistan may not cater the demand of all the community-managed markhor conservancies in GB. The increase in this quota, though important to boost the revenues and morale of the communities engaged in wildlife conservation, should be based on the complete assessment of markhor population in the entire distribution range of this species, including in the conservancies that could not be covered during these winter surveys.

<u>We recommend the following</u>:

- A comprehensive markhor monitoring in Sassi-Haramosh should be conducted again to assess the reasons of low number of markhor sighted, and the effects of road construction disturbance on population productivity. Results of these additional investigations and monitoring should be used to lead future government's decision on allocation of markhor trophy hunting quotas in this conservancy.

- Future markhor surveys in Gilgit-Baltistan should incorporate areas not surveyed in winter 2019-2020 and seek to be as rigorous (or more) as the present survey. The number and composition of survey teams per area should be replicated or increased (in Kargah, Bunji and Jutial). Extending the number of survey days per area as a result of lower human resources should be avoided by all means (as it increases the likelihood of duplicate counts and population over-estimation), the survey should be started without delay at the beginning of the rut season, sufficient and good quality equipment should be used (particularly one spotting scope per team is mandatory), and coordination efforts not underestimated. Resuming a monitoring campaign at lower standards would appear as a collective failure of all stakeholders.

- Bunji and Sassi-Haramosh have procured survey equipment from funds generated from markhor trophy-hunting. This is an excellent initiative and an indication of their high commitment to markhor monitoring. Similarly, other conservancies receiving large sums of money from trophy-hunts should follow their example. It is no longer conceivable that

conservancies receiving large sums (>$USD60,000 per trophy) from trophy-hunts continue requesting support from other stakeholders/donors to equip their CWGs. Good investment is usually a mark of good management.

- We observed during the present survey that some observers among CWGs and field-staff of the P&W Dept. were not properly trained in conducting wildlife surveys, especially at determining sex and age composition of markhor groups and correctly estimating trophy-size animals. We therefore recommend increasing capacity building of these field workers or hiring more competent/motivated staff to overcome shortage of human resources during the surveys.

- The survey teams noticed several individual male markhor with 'unusual' horn shape both in SKB and Sassi-Haramosh conservancies. While odd horn shapes are often attractive to trophy collectors, they can also indicate a specific, potentially deleterious selective pressure or a genetic drift (or both). A research study (both with genetic and phenotypic reasoning) would be needed to investigate the reasons of 'unusual' horn shapes among male markhor in these two conservancies.

- To date total FPC survey technique in predetermined survey routes/blocks seems the most appropriate count method to assess markhor population trends, determine availability of trophy-size animals, and better understand population structure of markhor in Gilgit-Baltistan. In the future, associating it to a 'double-observer approach' that would allow to determine the precision of estimates would be a valid development. We recommend piloting such an approach, starting in areas where markhor react smoothly to the presence of surveyors. This technique has been piloted for markhor in Tajikistan and has provided interesting preliminary results but was expensive in money and time, and required high capacity and professionalism from survey teams.

- Developmental activities (like construction of roads, water channels and mini hydro-power stations or even gemstones mining) near or in markhor core habitat may generate disturbance for markhor populations and complicate the feasibility of counting surveys. We recommend researching possible negative effects of such activities in Sassi-Haramosh and other conservancies.

- We recommend estimating the size of actual area covered during the surveys by using GIS and RS technology, so that population density for each conservancy could be established and extrapolated to markhor habitat in the individual conservancies and at the overall for the area to be surveyed in future.

- New mechanisms should be instituted (e.g. control of released trophy-hunt payments) to establish an effective wildlife monitoring and patrolling system involving community institutions (WCSDOS) and Parks and Wildlife Department. Such a system is required by the CITES authority as per resolutions that enable Pakistan to export 12 markhor trophies annually. The lack of such mechanisms will inevitably lead an increasing number of people in the country and abroad to question the management effectiveness and sustainability of the community-based markhor trophy-hunting in Gilgit-Baltistan, Pakistan.

Annex - I

Survey teams and their composition during the winter markhor survey 2019-20					
S. No.	Survey team	Survey date	Conservancy	Valley/ Nullah	Name of observers
Bunji Conservancy					
1	A	16-12-2019	Bunji	Burchi Area	Sarmad P&W (TL), Khursheed (WCS), Inamullah, Aitizaz
2	B	16-12-2019	Bunji	Bulachi Area	Liaqat Ali P&W (TL), Hassan (WCS), Janan, Iliyas
3	C	16-12-2019	Bunji	Bunji Nullah	Zubair P&W (TL), Siraj WCS, Mushtaq, Burhan
4	D	16-12-2019	Bunji	House Nullah	Aziz P&W (TL), Saif uddin, Shujauddin, Azmatullah
5	E	16-12-2019	Bunji	Rehman Nullah	Sherbaz P&W (TL), Dr. Akbar WCS, Nadeem, Shujaul Haq
6	F	16-12-2019	Bunji	Bugreba	Ishaq P&W (TL), Saad WCS, Arsalan, Mohiddin
7	G	16-12-2019	Bunji	Burmai	Sher Afgan P&W (TL), Shams WCS, Khalil, Rashid
8	H	16-12-2019	Bunji	Neli	Ilyas P&W (TL), Hidayat WCS, Saeed, Haleem
1	E	17-12-2019	Bunji	Rehman Nullah	Sherbaz P&W (TL), Dr. Akbar WCS, Nadeem, Shujaul Haq
2	F	17-12-2019	Bunji	Bugreba	Ishaq P&W (TL), Saad WCS, Arsalan, Mohiddin
3	G	17-12-2019	Bunji	Burmai	Sher Afgan P&W (TL), Shams WCS, Khalil, Rashid
DMTD Conservancy					
1	A	18-12-2019	Doyan	Doyan Valley	Sarmad P&W (TL), Khursheed (WCS), Mehmood, Waseem, Irshad, Saifullah
2	B	18-12-2019	Doyan	Doyan Valley	Nazeem P&W (TL), Dr. Akbar, Maqbool
3	C	18-12-2019	Doyan	Shalter Nullah	Ishaq P&W (TL), Hidayat WCS, Khalid
1	A	18-12-2019	DMT	Shalter Nullah	Zubair P&W (TL), Siraj WCS, Younus, Abdul Wadood
2	B	18-12-2019	DMT	Obatiber Nullah	Aziz P&W (TL), Israr (WCS), Ihsan, Maraj
3	C	18-12-2019	DMT	Burduch Nullah	Ilyas P&W (TL), Saad WCS, Rehmat, Ahmed
1	C	19-12-2019	DMT	Burduch Nullah	Ilyas P&W (TL), Saad WCS, Rehmat, Ahmed
Sassi Conservancy					
1	A	18-12-2019	Sassi-Haramosh	Sassi	Sajjad Hussain P&W (TL), Hassan, Abdul Shah, Gushpur
2	B	18-12-2019	Sassi-Haramosh	Ishkapol Nullah	Sher Afgan P&W (TL), Shams WCS, Faqeer, Nad Ali
Jutial-Sakwar Conservancy					
1	F	24-12-2019	Jutial-Sakwar	Sakwar	Touseef P&W (TL), Hidayat WCS, Asim, Zameer
1	A	25-12-2019	Jutial-Sakwar	Jutial	Sarmad P&W (TL), Waseem MOCC, Hassan WCS, Shakoor Ali
2	B	25-12-2019	Jutial-Sakwar	Shanigah	Faizan P&W (TL), Saifullah MOCC, Khursheed WCS, Waseemullah, Nouman
3	C	25-12-2019	Jutial-Sakwar	Minawar	Aziz P&W (TL), Siraj WCS, Sangi Khan, Wajahat
4	D	25-12-2019	Jutial-Sakwar	Minawar	Amin P&W (TL), Israr WCS, Fareed, Saif
5	E	25-12-2019	Jutial-Sakwar	Sakwar	Zafar P&W (TL), Saad WCS, Nasir Basit Ali
6	F	25-12-2019	Jutial-Sakwar	Sakwar	Touseef P&W (TL), Hidayat WCS, Asim, Zameer
7	G	25-12-2019	Jutial-Sakwar	Barmas	Sher Afgan P&W (TL), Shamsuddin WCS, Amjad, Abrar
1	B	26-12-2019	Jutial-Sakwar	Jutial	Faizan P&W (TL), Saifullah MOCC, Khursheed WCS, Waseemullah, Nouman
2	E	26-12-2019	Jutial-Sakwar	Sakwar	Zafar P&W (TL), Saad WCS, Nasir Basit Ali
3	F	26-12-2019	Jutial-Sakwar	Sakwar	Touseef P&W (TL), Hidayat WCS, Asim, Zameer

4	G	26-12-2019	Jutial-Sakwar	Barmas	Sher Afgan P&W (TL), Shamsuddin WCS, Amjad, Abrar
Kargah Conservancy					
1	A	28-12-2019	Kargah	Shingaygah	Shanawaz P&W (TL), Siafullah MOCC, Zakir Hussain, Sirajud din WCS
2	B	28-12-2019	Kargah	Napura Shakogah	Aziz P&W (TL), Abudul Hadi, Rehmat Shah, Dr. Akbar WCS
3	C	28-12-2019	Kargah	Kargah Nullah	Khushal Khan P&W (TL), Hassan Abbas WCS, Sherwalli, Iqbal
1	A	29-12-2019	Kargah	Shingaygah	Shanawaz P&W (TL), Siafullah MOCC, Zakir Hussain, Sirajud din WCS
2	B	29-12-2019	Kargah	Napura Shakogah	Aziz P&W (TL), Abudul Hadi, Rehmat Shah, Dr. Akbar WCS
3	C	29-12-2019	Kargah	Kargah Nullah	Khushal Khan P&W (TL), Hassan Abbas WCS, Sherwalli, Iqbal
4	D	29-12-2019	Kargah	Kargah Nullah	Ishaq P&W (TL), Saad WCS, Iftikhar, Kamran
5	E	29-12-2019	Kargah	Hanzal	Sher Afgan P&W (TL), Israr and Shams WCS, Abdul Yaseen, Dudhu Hussain
1	A	30-12-2019	Kargah	Shingaygah	Shanawaz P&W (TL), Siafullah MOCC, Zakir Hussain, Sirajud din WCS
2	E	30-12-2019	Kargah	Hanzal	Sher Afgan P&W (TL), Israr and Shams WCS, Abdul Yaseen, Dudhu Hussain
SKB Conservancy					
1	A	1/1/2020	SKB	Bageecha	Gulam Mehdi P&W (TL), Siraj ud din WCS, Fida Ali, Gulam Rasool
2	B	1/1/2020	SKB	Karabathang	Gulam Mehdi P&W (TL), Dr. Akbar and Hassan Abbas WCS, Shakoor Ali, Ali madad, Yaqoob
3	C	1/1/2020	SKB	Sokoyo	M Ishaq P&W (TL), Shams ud din WCS, Suleiman, Akbar Hussain
1	A	2/1/2020	SKB	Bageecha	Inayat P&W (TL), Saifullah MOCC, Waseem MOCC, Siraj ud din WCS, Gulam rasool, Fida Ali
2	B	2/1/2020	SKB	Karabathang	Gulam Mehdi P&W (TL), Dr. Akbar and Hassan Abbas WCS, Shakoor Ali, Ali madad, Yaqoob
3	C	2/1/2020	SKB	Sokoyo	M Ishaq P&W (TL), Shams ud din WCS, Suleiman, Akbar Hussain