Implementation report format

The format below follows the structure of the *CITES Strategic Vision: 2008-2020* and aims to collect information to enable the Strategic Vision indicators to be implemented.

CITES vision statement

Conserve biodiversity and contribute to its sustainable use by ensuring that no species of wild fauna or flora becomes or remains subject to unsustainable exploitation through international trade, thereby contributing to the significant reduction of the rate of biodiversity loss and making a significant contribution towards achieving the relevant Aichi Biodiversity Targets.

Article VIII, paragraph 7 (b), of the Convention requires each Party to submit to the CITES Secretariat a report on legislative, regulatory and administrative measures taken to enforce the provisions of the Convention.

The report format allows Parties to present information in a standard manner, so that it can be easily collated, with three main objectives:

i) To enable monitoring of the implementation and effectiveness of the Convention;

ii) To facilitate the identification of major achievements, significant developments, or trends, gaps or problems and possible solutions; and

iii) Provide a basis for substantive and procedural decision-making by the Conference of the Parties and various subsidiary bodies.

Information on the nature and extent of CITES trade should be incorporated into the annual report [Article VIII paragraph 7 (a)], whereas the report provided under Article VIII paragraph 7 (b) should focus on measures taken to implement the Convention.

The report should cover the period indicated in Resolution Conf. 11.17 (Rev. CoP16) which urges that the report should be submitted to the Secretariat one year before each meeting of the Conference of the Parties (CoP). The reason for setting the report to be due a year in advance of the following CoP is to allow information to be collated so it can be considered by the Standing Committee in advance of CoP, and enable publication of the Strategic Vision indicators in advance of CoP.

Reports should be prepared in one of the three working languages of the Convention (English, French, Spanish).

Parties are *strongly* encouraged to prepare and submit their reports in electronic form. This will facilitate timely integration of information from Parties into publication of the Strategic Vision Indicators. If reports are only provided in hard copy, resources will be needed at the Secretariat to make an electronic copy, and this is not good use of Secretariat resources.

The completed report should be sent to:

CITES Secretariat
International Environment House
Chemin des Anémones 11-13
CH-1219 Châtelaine-Geneva
Switzerland

Email: info@cites.org
Tel: +41-(0)22-917-81-39/40
Fax: +41-(0)22-797-34-17

If a Party requires further guidance on completing their report, please contact the CITES Secretariat at the address above.

Party	Pakistan
Period covered in this report	1st January, 2021 – 31st December, 2022
Department or agency preparing this report	Ministry of Climate Change & Environmental Coordination, Government of Pakistan, Islamabad, Pakistan.
Contributing departments, agencies and organizations	Wildlife and Forest Departments of Provinces/Territories, Pakistan Customs, Zoological Survey of Pakistan, WWF Pakistan, IUCN-Pakistan.

GOAL 1 ENSURE COMPLIANCE WITH AND IMPLEMENTATION AND ENFORCEMENT OF THE CONVENTION

Objective 1.1 Parties comply with their obligations under the Convention through appropriate policies, legislation and procedures.
All Aichi Targets relevant to CITES, particularly Aichi Target 2, Target 6, Target 9, Target 12, Target 17 and Target 18.

Indicator 1.1.1: The number of Parties that are in category 1 under the national legislation project.

1.1.1a	Have any CITES relevant policies or legislation been developed during the period covered in this report? Yes ☒ No ☐ If 'Yes', have you shared information with the Secretariat? Yes ☒ No ☐ Not Applicable ☐ If 'No', please provide details to the Secretariat with this report:
1.1.1b	Does your legislation or legislative process allow easy amendment of your national law(s) to reflect changes in the CITES Appendices (e.g. to meet the 90 day implementation guidelines)? Yes ☒ No ☐ If 'No', please provide details of the constraints faced:

Objective 1.2 Parties have in place administrative procedures that are transparent, practical, coherent and user-friendly, and reduce unnecessary administrative burdens.
Aichi Target 3.

Indicator 1.2.1: The number of Parties that have adopted standard transparent procedures for the timely issuance of permits in accordance with Article VI of the Convention.

		Yes	No	No information
1.2.1a	Do you have standard operating procedures for application for and issuance of permits?	☒	☐	☐
	Are the procedures publicly available?	☒	☐	☐
1.2.1b	Do you have: Electronic data management and a paper-based permit issuance system?	☐	☒	☐
	Electronic permit information exchange between Management Authorities of some countries If 'Yes', please list countries	☐	☒	☐
	Electronic permit information exchange to Management Authorities of all countries?	☐	☒	☐
	Electronic permit data exchange between Management Authorities and customs?	☐	☒	☐

	Electronic permit used to cross border with electronic validation by customs?	☐	☒	☐
	If 'Yes' to any of the above, please provide information on challenges faced or issues overcome:			
	If 'No', do you have any plans to move towards e-permitting[1]?	☐	☒	☐
	If you are planning to move towards e-permitting, please explain what might help you to do so:			

Indicator 1.2.2: The number of Parties making use of the simplified procedures provided for in Resolution Conf. 12.3 (Rev. CoP16).

1.2.2a	Has your country developed simplified procedures for any of the following?	Tick all applicable		
		Yes	No	No information
	Where biological samples of the type and size specified in Annex 4 of Resolution Conf. 12.3 (Rev. CoP16) are urgently required.	☒	☐	☐
	For the issuance of pre-Convention certificates or equivalent documents in accordance with Article VII, paragraph 2.	☒	☐	☐
	For the issuance of certificates of captive breeding or artificial propagation in accordance with Article VII, paragraph 5.	☒	☐	☐
	For the issuance of export permits or re-export certificates in accordance with Article IV for specimens referred to in Article VII, paragraph 4.	☒	☐	☐
	Are there other cases judged by a Management Authority to merit the use of simplified procedures? If 'Yes', please provide details: *Issuance of permits for specimens for scietific research pupose.*	☒	☐	☐

Objective 1.3 Implementation of the Convention at the national level is consistent with decisions adopted by the Conference of the Parties.
All Aichi targets relevant to CITES, particularly Target 9, Target 14 and Target 18.

Indicator 1.3.1: The number of Parties that have implemented relevant reporting under Resolutions and Decisions of the Conference of the Parties and/or Standing Committee recommendations.

1.3.1a	Has your country responded to all relevant special reporting requirements that are active during the period covered in this report, including those in the Resolutions and Decisions of the Conference of the Parties, Standing Committee recommendations, and Notifications issued by the Secretariat (see [link to location on the CITES website where the reporting requirements are listed])? Responses provided to ALL relevant reporting requirements ☒ Responses provided to SOME of the relevant reporting requirements ☐ Responses provided to NONE of the relevant reporting requirements ☐ No special reporting requirements applicable ☐
1.3.1b	Were any difficulties encountered during the period covered in this report in implementing specific Resolutions or Decisions adopted by the Conference of the Parties? Yes ☐ No ☒ If 'Yes', please provide details of which Resolution(s) or Decision(s), and, for each, what difficulties were / are being encountered?

[1] *e-permitting refers to the electronic (paperless) management of the permit business process, including permit application, Management Authority – Scientific Authority consultations, permit issuance, notification to customs and reporting.*

Objective 1.4 The Appendices correctly reflect the conservation needs of species.
Aichi Target 1, Target12, Target 14 and Target 19.

1.4.1: The number and proportion of species that have been found to meet the criteria contained in Resolution Conf. 9.24 or its successors. This includes both the periodic review and amendment proposals.

1.4.1a	Have you undertaken any reviews of whether species would benefit from listing on the CITES Appendices? Yes ☐ No ☒ If 'Yes', please provide a summary here, or a link to the report of the work (or a copy of that report to the Secretariat if the work is not available online):

Objective 1.5 Best available scientific information is the basis for non-detriment findings.
Aichi Target 2, Target 4, Target 5, Target 6, Target 7, Target 9, Target 12 and Target 14.

Indicator 1.5.1: The number of surveys, studies or other analyses undertaken by exporting countries based on the sources of information cited in Resolution Conf. 16.7 on Non-detriment findings related to:
a) the population status of Appendix-II species;
b) the trends and impact of trade upon Appendix-II species; and
c) the status of and trend in naturally-occurring Appendix I species and the impact of any recovery plans.

1.5.1a	Have any surveys, studies or other analyses been undertaken <u>in your country</u> in relation to:	Yes	No	Not Applicable	If Yes, How many?
	- the population status of Appendix II species?	☒	☐	☐	☒
	- the trends and impact of trade on Appendix II species?	☐	☒	☐	☐
	- the status of and trend in naturally-occurring Appendix I species?	☒	☐	☐	☒9
	- the impact of any recovery plans on Appendix I species?	☐	☒	☐	☐
	Have the surveys, studies or analyses integrated relevant knowledge and expertise of local and indigenous communities?	☒	☐	☐	☒12

	If there are such studies that you are willing to share, please provide: Species name (scientific) *Capra falconeri* *Ovis sp.*	A brief summary of the results of the survey, study or other analysis (e.g. population status, decline / stable / increase, off-take levels etc), or provide links to published reference material. *Under community-based trophy hunting programme, regular surveys are conducted annually. The status of the species was stable during the reporting period. The relevant survey reports are attached along-with details at Annex-I.* *Under community-based trophy hunting programme, regular surveys are conducted annually. The status of the species was stable to increasing during the reporting period. The relevant survey reports are attached along-with details at Annex-I.*
1.5.1b	How are the results of such surveys, studies or other analyses used in making non-detriment findings (NDFs)? Please tick all that apply Revised harvest or export quotas ☒ Banning export ☐ Stricter domestic measures ☐ Changed management of the species ☐ Discussion with Management Authorities ☐ Discussion with other stakeholders? ☒ Other (please provide a short summary):	
1.5.1c	Do you have specific conservation measures or recovery plans for naturally occurring Appendix-I listed species?	Yes ☒ No ☐ Not Applicable ☐ No information ☐
	If 'Yes', please provide a brief summary, including, if possible, an evaluation of their impact: *All native Appendix-I species are protected under wildlife laws of provinces / territories, and are being conserved through establishment of protected areas, protection through watch and ward and awareness raising activities.*	
1.5.1d	Have you published any non-detriment findings that can be shared? Yes ☐ No ☒ If 'Yes', please provide links or examples to the Secretariat within this report:	
1.5.1e	Which of the following (A to F of paragraph a) x) of Resolution Conf. 16.7) do you use in making non-detriment findings?	Yes / No
	A. relevant scientific literature concerning species biology, life history, distribution and population trends.	☒ / ☐
	B. details of any ecological risk assessments conducted.	☒ / ☐
	C. scientific surveys conducted at harvest locations and at sites protected from harvest and other impacts.	☒ / ☐
	D. relevant knowledge and expertise of local and indigenous communities.	☒ / ☐
	E. consultations with relevant local, regional and international experts.	☒ / ☐
	F. national and international trade information such as that available via the CITES trade database maintained by UNEP World Conservation Monitoring Centre (UNEP-WCMC), publications on trade, local knowledge on trade and investigations of sales at markets or through the Internet for example.	☒ / ☐

Indicator 1.5.2: The number of Parties that have adopted standard procedures for making non-detriment findings.

1.5.2a		Yes	No	No information
	Do you have standard procedures for making non-detriment findings in line with Resolution Conf. 16.7?	☐	☒	☐
	If 'Yes', please briefly describe your procedures for making non-detriment findings, or attach as an annex to this report, or provide a link to where the information can be found on the internet:			
1.5.2b	When establishing non-detriment findings, have any of the following guidance been used?		Please tick all that apply	
	Virtual College		☒	
	IUCN Checklist		☒	
	Resolution Conf. 16.7		☒	
	2008 NDF workshop		☐	
	Species specific guidance		☒	
	Other		☒	
	If 'Other' or 'Species specific guidance', please specify details: *Written advice from the CITES Secretariat.*			
1.5.2c	How often do you review and/or change your non-detriment findings?	Case by case		☒
		Annually		☐
		Every two years		☐
		Less frequently		☐
		A mix of the above		☐
	Please describe the circumstances under which non-detriment findings would be changed:			

Indicator 1.5.3: The number and proportion of annual export quotas based on population surveys.

1.5.3a	Do you set annual export quotas?	Yes	☒
		No	☐
	If 'Yes', do you set quotas based on population survey, or by other means? Please specify, for each species, how quotas are set:		
	Species Name (scientific)	Population Survey?	Other, please specify
	Capra falconeri	☒	
	Ovis sp.	☒	
	Pseudois nayaur	☒	
	Capra hircus aegagrus	☒	
1.5.3b	Have annual export quotas been set at levels which will ensure sustainable production and consumption?	Yes	☒
		No	☐
	If 'Yes', please describe how this fits into your non-detriment finding process: CITES Management Authority allocates quotas on recommendations of wildlife departments of provinces/territories based on annual surveys usually conducted in collaboration with NGOs and local communities.		

Objective 1.6 Parties cooperate in managing shared wildlife resources.
Aichi Target 4, Target 5, Target 6, Target 7, Target 10, Target 12 and Target 19.

Indicator 1.6.1: The number of bilateral and multilateral agreements that specifically provide for co-management of shared CITES listed species by range States.

1.6.1a	Is your country a signatory to any bilateral and/or multilateral agreements for co-management of shared species? Yes ☒ No ☐ If 'Yes', please provide brief details, including the names of the agreements, and which other countries are involved: *Pakistan is signatory to three MoUs signed under auspices of the Bonn Convention viz. Siberian Crane MoU, IOSEA Marine Turtles MoU and Raptors MoU. Moreover, Pakistan is a member to the Asia (South Asia) Vulture Recovery Programme and Global Snow Leopard and Ecosystem Protection Programme (GSLEP).*

Indicator 1.6.2: The number of cooperative management plans, including recovery plans, in place for shared populations of CITES-listed species.

1.6.2a	Do you have any cooperative management plans, including recovery plans, in place for shared populations of CITES-listed species? Yes ☒ No ☐ If 'Yes', please list the species for which these plans are in place and provide a link or reference to a published plan for each species.

Species Name (scientific)	Link or reference to a published plan
Grus leucogeranus	https://www.cms.int/en/document/conservation-plan-western-central-and-eastern-populations-siberian-crane-2007-2010
Falco cherrug	https://www.cms.int/raptors/siberian-crane/en/publication/saker-falcon-global-action-plan-sakergap
Birds of Prey	https://www.cms.int/siberian-crane/sites/default/files/document/Raptors_Action_Plan_E_0.pdf
Vultures	https://www.cms.int/siberian-crane/sites/default/files/document/cms-raptors_vulture-ow_doc3_vulture-msap-draft1_rev1.pdf
Marine turtles	https://www.cms.int/siberian crane/sites/default/files/document/iosea_cmp_e_0.pdf
Panthera uncia	https://globalsnowleopard.org/wp-content/uploads/2020/09/2_GSLEP_Ocober-2013_Annex.pdf

Indicator 1.6.3: The number of workshops and other capacity-building activities that bring range States together to address the conservation and management needs of shared, CITES listed, species.

1.6.3a Have the CITES authorities *received or benefited* from any of the following capacity-building activities provided by external sources?

Please tick boxes to indicate which target group and which activity. Target group	Oral or written advice/guidance	Technical assistance	Financial assistance	Training	Other (specify)	What were the external sources[1]?

[1] *Please provide the names of Parties, and any non-Parties, involved.*

	Staff of Management Authority	☒	☐	☐	☒	☐	Workshops arranged by South Asia Wildlife Enforcement Network (SAWEN) and NGOs.
	Staff of Scientific Authority	☒	☐	☐	☒	☐	Workshops arranged by South Asia Wildlife Enforcement Network (SAWEN) and NGOs.
	Staff of enforcement authorities	☒	☐	☐	☒	☐	Workshops arranged by South Asia Wildlife Enforcement Network (SAWEN) and NGOs.
	Traders	☐	☐	☐	☐	☐	
	NGOs	☐	☐	☐	☐	☐	
	Public	☐	☐	☐	☐	☐	
	Other (please specify):	☐	☐	☐	☐	☐	

1.6.3b	Have the CITES authorities been the *providers* of any of the following capacity-building activities to other range States?						
	Please tick boxes to indicate which target group and which activity. Target group	Oral or written advice/guidance	Technical assistance	Financial assistance	Training	Other (specify)	Details
	Staff of Management Authority	☐	☐	☐	☐	☐	
	Staff of Scientific Authority	☐	☐	☐	☐	☐	
	Staff of enforcement authorities	☐	☐	☐	☐	☐	
	Traders	☐	☐	☐	☐	☐	
	NGOs	☐	☐	☐	☐	☐	
	Public	☐	☐	☐	☐	☐	
	Other Parties/International meetings	☐	☐	☐	☐	☐	
	Other (please specify)	☐	☐	☐	☐	☐	
1.6.3c	In what ways do you collaborate with other CITES Parties?						
		Never	Rarely	Sometimes	Very Often	Always	Further detail / examples
	Information exchange	☐	☐	☒	☐	☐	
	Monitoring / survey	☐	☐	☐	☐	☐	
	Habitat management	☐	☐	☐	☐	☐	
	Species management	☐	☐	☐	☐	☐	
	Law enforcement	☐	☐	☐	☒	☐	For verification of CITES permits and other documents other Parties have been frequently contacted through email.
	Capacity building	☐	☐	☐	☐	☐	
	Other (please provide details)						

Objective 1.7 Parties are enforcing the Convention to reduce illegal wildlife trade.
Aichi Target 4, Target 5, Target 6, Target 7, Target 9, Target 10, Target 12 and Target 19.

Indicator 1.7.1: The number of Parties that have, are covered by, or engaged with:
- an international enforcement strategy and/or action plan;
- formal international cooperation, such as an international enforcement network;
- a national enforcement strategy and/or action plan; and
- formal national interagency cooperation, such as a national interagency enforcement committee.

1.7.1a	Do you have, are you engaged in, or covered by:	Yes	No	No Information
	– an international enforcement strategy and/or action plan?	☐	☒	☐
	– formal international cooperation, such as an international enforcement network?	☒	☐	☐

	– a national enforcement strategy and/or action plan?	☐	☒	☐
	– formal national interagency cooperation, such as a national interagency enforcement committee?	☒	☐	☐
	If 'Yes' to any of the above, please specify the level of engagement and provide additional details: details: *At regional level Pakistan is a member of the South Asia Wildlife Enforcement Network (SAWEN). At national level CITES Management Authority has representation of all stakeholders for policy making and coordination on implementation of CITES in Pakistan.*			

Indicator 1.7.2: The number of Parties with a process or mechanism for reviewing their enforcement strategies, and the activities taken to implement their strategies.

1.7.2a	Do you have a process or mechanism for reviewing your enforcement strategy(ies) and the activities taken to implement your strategy(ies)? If 'Yes', what do you do? If 'Yes' or 'No, but review is under consideration', which tools do you find of value?	Yes ☐ No, but review is under consideration ☐ No ☒ No information ☐
1.7.2b	Have you used the International Consortium on Combating Wildlife Crime (ICCWC) Wildlife and Forest Crime Analytic Toolkit, or equivalent tools? If 'Yes', please provide feedback on the parts of the toolkit used and how useful the toolkit or equivalent tools have been. Please specify improvements that could be made: If 'No', please provide feedback on why not or what is needed to make the toolkit or equivalent tools useful to you:	Yes ☐ No, but toolkit use is under consideration ☐ No ☐ No information ☒

Indicator 1.7.3: The number of Parties that have criminal (penal) law and procedures, capacity to use forensic technology, and capacity to use specialized investigation techniques, for investigating, prosecuting, and penalizing CITES offences.

1.7.3a	Do you have law and procedures in place for investigating, prosecuting, and penalizing CITES offences as a crime? If 'Yes', please provide the title of the legislation and a summary of the penalties available: *The Pakistan Trade Control of Wild Fauna and Flora Act, 2012. Summary of the penalties: Imprisonment for a term not less than one year or more than two years or fine not less than 0.500 million PKR or more than 1.000 million PKR.*	Yes ☒ No ☐ No information ☐
1.7.3b	Are criminal offences such as poaching and wildlife trafficking recognized as serious crime[1] in your country? If 'Yes', please explain what criteria must be met for poaching or wildlife trafficking offences to be treated as serious crimes:	Yes ☐ No ☒ No information ☐

[1] *The United Nations Convention against Transnational Organized Crime defines serious crime as conduct constituting an offence punishable by imprisonment for at least four years or a more serious penalty.*

1.7.3c	Do you have capacity to use forensic technology[1] to support the investigation of CITES offences?			Yes ☐ No ☒ No information ☐	
	If 'Yes', please provide a brief summary of any samples from CITES-listed species that were collected and submitted to an appropriate forensic analysis facility (located in your country and/or another country) during the period covered in this report: If 'Yes', and your country has an appropriate forensic analysis facility for CITES-listed species, please indicate which species it applies to:				
1.7.3d	Did your authorities participate in or initiate any multi-disciplinary[2] law enforcement operation(s) targeting CITES-listed species during the period covered in this report?			Yes ☐ No ☒ No information ☐	
	If 'Yes', please provide a brief summary, including any lessons learned which might be helpful for other Parties:				
1.7.3e	Do you have a standard operating procedure among relevant agencies for submitting information related to CITES offences to INTERPOL and/or the World Customs Organization?			Yes ☒ No ☐ No information ☐	
1.7.3f	Do you have legislative provisions for any of the following that can be applied to the investigation, prosecution and/or sentencing of CITES offences as appropriate?	Yes	No	No information	If yes, how many times was this used during the period covered by this report?
	General crime[3]	☒	☐	☐	
	Predicate offences[4]	☐	☒	☐	
	Asset forfeiture[5]	☒	☐	☐	
	Corruption[6]	☐	☒	☐	
	International cooperation in criminal matters[7]	☒	☐	☐	
	Organized crime[8]	☐	☒	☐	
	Specialized investigation techniques[9]	☐	☒	☐	
	If 'Yes' to any of the above, please explain how each is used for CITES offences? Please provide a brief summary, including any lessons learned which might be helpful for other Parties: *: The Pakistan Trade Control of Wild Fauna and Flora Act, 2012. Summary of the penalties: Imprisonment for a term not less than one year or more than two years or fine not less than 0.500 million PKR or more than 1.000 million PKR.Moreover there is provision of confiscation of the seized specimens .*				

[1] *Capacity to use forensic technology means the ability to collect, handle and submit samples from crime scenes involving CITES-listed species to an appropriate forensic analysis facility, located either in your country or in another country(ies).*

[2] *A multi-disciplinary law enforcement operation is one that involves officers from all relevant enforcement disciplines as appropriate, for example officers from Police, Customs and the wildlife regulatory authority. It could be either sub-national, national or international in scope.*

[3] *General crime laws relate to offences such as fraud, conspiracy, possession of weapons, and other matters as set out in the national criminal code.*

[4] Article 2, paragraph (h) of the United Nations Convention against Transnational Organized Crime defines a predicate offence is an offence whose proceeds may become the subject of any of the money-laundering offences established under the Convention.

[5] *Asset forfeiture is the seizure and confiscation of assets obtained from criminal activities to ensure that criminals do not benefit from the proceeds of their crimes.*

[6] *Provisions against corruption include national laws to implement the United Nations Convention against Corruption covering offences such as bribery of officials, embezzlement or misappropriation of public funds, trading in influence and abuse of functions by public officials.*

[7] *International cooperation in criminal matters includes legislation through which a formal request for mutual legal assistance and/or extradition of a person for criminal prosecution can be forwarded to another country.*

[8] *Article 2, paragraph (a) of the United Nations Convention against Transnational Organized Crime defines an organized criminal group as a structured group of three or more persons, existing for a period of time and acting in concert with the aim of committing one or more serious crimes or offences established in accordance with the Convention, in order to obtain, directly or indirectly, a financial or other material benefit.*

[9] *Specialized investigation techniques are techniques that are deployed against serious and/or organized crime when conventional law enforcement techniques fail to adequately address the activities of crime groups. Examples include controlled deliveries and covert operations.*

1.7.3g	Do you have institutional capacity to implement the legislative provisions listed in question 1.7.3f against CITES offences?	Yes No No information	☒ ☐ ☐
	If 'No', please provide a brief summary of your major capacity-building needs:		

Indicator 1.7.4: The number of Parties using risk assessment and intelligence to combat illegal trade in CITES-listed species.

1.7.4a	Do you use risk assessment to target CITES enforcement effort?	Always Very often Sometimes Rarely Never No information	☐ ☐ ☒ ☐ ☐ ☐
1.7.4b	Do you have capacity to analyse information gathered on illegal trade in CITES-listed species?	Yes No No information	☒ ☐ ☐
1.7.4c	Do you use criminal intelligence[1] to inform investigations into illegal trade in CITES-listed species?	Always Very often Sometimes Rarely Never No information	☐ ☐ ☒ ☐ ☐ ☐
1.74d	Have you implemented any supply-side activities to address illegal trade in CITES-listed species during the period covered in this report?	Yes No, but activities are under development No No information	☐ ☐ ☒ ☐
1.7.4e	Have you implemented any demand-side activities to address illegal trade in CITES-listed species during the period covered in this report?	Yes No, but activities are under development No No information	☐ ☐ ☒ ☐

[1] *Criminal intelligence is information that is compiled, analyzed and disseminated in an effort to anticipate, prevent and/or monitor criminal activity. Examples include information on potential suspects held in a secure database and inferences about the methods, capabilities and intentions of specific criminal networks or individuals that are used to support effective law enforcement action.*

Indicator 1.7.5: The number of administrative measures, criminal prosecutions and other court actions for CITES-related offences.

During the period covered in this report:		Yes	No	No Information
1.7.5a	Have any administrative measures (e.g. fines, bans, suspensions) been imposed for CITES-related offences?	☒	☐	☐
	If 'Yes', please indicate how many and for what types of offences. If available, please attach details: *Registration of wildlife trading firms which provide fake CITES documents or found to be involved in illegal activities are suspended or blacklisted. However no such actions were taken during the current reporting period.*			
1.7.5b	Have there been any criminal prosecutions of CITES-related offences?	☒	☐	☐
	If 'Yes', how many and for what types of offences? If available, please attach details: *57 cases were reported during the reporting period. Details / list of WIldlife Seizures is attached. Annex-II*			
1.7.5c	Have there been any other court actions against CITES-related offences?	☐	☒	☐
	If 'Yes', what were the offences involved and what were the results? Please attach details:			
1.7.5d	How were any confiscated specimens disposed of?			Tick all that apply
	– Return to country of export			☒
	– Public zoos or botanical gardens			☒
	– Designated rescue centres			☒
	– Approved private facilities			☐
	– Euthanasia			☐
	– Other (please specify): Release in wild			☒
	Have you encountered any challenges in disposing of confiscated specimens? *Yes. For live specimens of sensitive species like falcons etc.*			
	Do you have good practice that you would like to share with other Parties? *No*			

Objective 1.8 Parties and the Secretariat have adequate capacity-building programmes in place. Aichi Target 1, Target 12 and Target 19.

Indicator 1.8.1: The number of Parties with national and regional training programmes and information resources in place to implement CITES including the making of non-detriment findings, issuance of permits and enforcement.

1.8.1a	Do you have information resources or training in place to support: YesNo The making of non-detriment findings? ☐ ☒ Permit officers? ☐ ☒ Enforcement officers? ☐ ☒		
1.8.1b	Is the CITES Virtual College used as part of your capacity building work?	Yes No No information	☒ ☐ ☐
	What improvements could be made in using the Virtual College for capacity building?		
1.8.1c	Is the ICCWC Wildlife and Forest Crime Toolkit used in the development of capacity-building programmes, or does it form part of the curriculum of such programmes?	Yes No No information	☐ ☐ ☒
	What improvements could be made in using the ICCWC Toolkit for capacity building?		

GOAL 2 SECURE THE NECESSARY FINANCIAL RESOURCES AND MEANS FOR THE OPERATION AND IMPLEMENTATION OF THE CONVENTION

Objective 2.1 Financial resources are sufficient to ensure operation of the Convention.

Information to be provided through records held by the Secretariat on financial management of the Convention.

Objective 2.2 Sufficient resources are secured at the national and international levels to ensure compliance with and implementation and enforcement of the Convention.
Aichi Target 1, Target 2, Target 3, Target 12, Target 19 and Target 20.

Indicator 2.2.1: The number of Parties with dedicated staff and funding for Management Authorities, Scientific Authorities and wildlife trade enforcement agencies.

2.2.1a	Do you have an approved service standard(s)[1] for your Management Authority(ies)?	Yes No	☒ ☐
	If 'No', please go to Question 2.2.1d.		
	If 'Yes', for which services are there standards, and what are those standards?	Guidelines for issuance of CITES-related documents are there in which timeline has been given for issuance of such documents.	
	If 'Yes', do you have performance targets for these standards[2]? If 'Yes', what are your performance targets?	Yes No	☐ ☒
	Do you publish your performance against service standard targets?	Yes No	☐ ☒
	If possible, please provide your performance against service standards during the period covered in this report:		
	If you did not meet your performance targets then was this shortfall a result of:	Yes	No
	– availability of funding?	☐	☐
	– number of staff?	☐	☐
	– a shortage of skills?	☐	☐
	If 'Yes' to a shortage of skills, which skills do you need more of?		
2.2.1b	Do you have an approved service standard(s)[47] for your Scientific Authority(ies)?	Yes No	☒ ☐
	If 'No', please go to Question 2.2.1d.		
	If 'Yes', for which services are there standards, and what are those standards?	There are designated offices to recommend cases of import and export to CITES Management Authority for	

[1] *For example, a time frame in which you are required to provide a response on a decision to issue or not issue a permit, certificate, or re-export certificate.*

[2] *For example, 85% of all decisions will take place within the service standard.*

	issuance of documents accordingly. There are relevant laws in place.	
	If 'Yes', do you have performance targets for these standards[48]?	Yes ☐
	If 'Yes', what are your performance targets?	No ☒
	If possible, please provide your performance against service standards during the period covered in this report:	
	If you did not meet your performance targets then was this shortfall a result of:	Yes / No
	– availability of funding?	☐ / ☐
	– number of staff?	☐ / ☐
	– a shortage of skills?	☐ / ☐
	If 'Yes' to a shortage of skills, which skills do you need more of?	
2.2.1c	Do you have an approved service standard(s)[47] for your enforcement authority(ies)?	Yes ☒
	If 'No', please go to Question 2.2.1d.	No ☐
	If 'Yes', for which services are there standards, and what are those standards?	There are designated offices to carryout enforcement activities. There are relevant laws in place.
	If 'Yes', do you have performance targets for these standards[48]?	Yes ☐
	If 'Yes', what are your performance targets?	No ☒
	If possible, please provide your performance against service standards during the period covered in this report:	
	If you did not meet your performance targets then was this shortfall a result of:	Yes / No
	– availability of funding?	☐ / ☐
	– number of staff?	☐ / ☐
	– a shortage of skills?	☐ / ☐
	If 'Yes' to a shortage of skills, which skills do you need more of?	
2.2.1d	Please only complete this question if your answered 'No' to the first part of question 2.2.1a, 2.2.1b, or 2.2.1c, relating to the existence of approved service standards for your authorities:	
	Do you have sufficient of the following for your authorities to function effectively?	

	Management Authority(ies)	Scientific Authority(ies)	Enforcement Authority(ies)
Funding?	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐
Staff?	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐
Skills?	Yes ☐ No ☐	Yes ☐ No ☐	Yes ☐ No ☐

Indicator 2.2.2: The number of Parties that have undertaken one or more of the following activities:

– changed the budget for activities;
– hired more staff;
– developed implementation tools;
– purchased technical equipment for implementation, monitoring or enforcement.

2.2.2a	Have any of the following activities been undertaken during the period covered in this report to enhance the effectiveness of CITES implementation at the national level?			Tick if applicable
	Hiring of more staff			☐
	Development of implementation tools			☐
	Purchase of technical equipment for implementation, monitoring or enforcement			☐
	Other (please specify):			
2.2.2b	During the period covered in this report, was the budget for your:	Increased	Stable	Decreased
	Management Authority(ies)	☐	☒	☐
	Scientific Authority(ies)	☐	☒	☐
	Enforcement authorities	☐	☒	☐
2.2.2c	Have you been able to use international development funding assistance to increase the level of implementation of your	Yes	No	Not applicable
	Management Authority(ies)?	☐	☒	☐
	Scientific Authority(ies)?	☐	☒	☐
	Enforcement authorities?	☐	☒	☐
2.2.2d	What is the respective level of priority for enhancing the effectiveness of CITES implementation at the national level through the following activities?			
	Activity	High	Medium	Low	Not a Priority
	Hiring of more staff	☐	☐	☒	☐
	Development of implementation tools	☐	☒	☐	☐
	Purchase of new technical equipment for implementation, monitoring or enforcement	☐	☒	☐	☐
	e-permitting	☐	☐	☐	☒
	Other (please specify):	☐	☐	☐	☐
2.2.2e	Do you have a operational system (e.g. electronic database) for managing		Yes	Under development	No
	Species information		☐	☐	☒
	Trade information		☐	☐	☒
	Non-detriment findings		☐	☐	☒

Indicator 2.2.3: The number of Parties raising funds for CITES implementation through user fees or other mechanisms.

2.2.3a	Does the Management Authority charge fees for:	Tick all that are applicable
	– Administrative procedures	☐
	– Issuance of CITES documents (e.g. for import, exports, re-export, or introduction from the sea)	☒
	– Shipment clearance (e.g. for the import, export, re-export, or introduction from the sea of CITES-listed species)	☐
	– Licensing or registration of operations that produce CITES species	☐
	– Harvesting of CITES-listed species	☐

	– Use of CITES-listed species ☐ – Assignment of quotas for CITES-listed species ☐ – Other (please specify): *Registration of firms dealing in import and export of wild fauna and flora.* ☒
2.2.3b	Is a fee schedule publicly available? Yes ☒ No ☐ If 'Yes', please provide an internet link, or a copy of the schedule to the Secretariat: Copy Attached – Annex-III
2.2.3c	Have revenues from fees been used for the implementation of CITES or wildlife conservation? Entirely ☐ Partly ☐ Not at all ☐ Not relevant ☒
2.2.3d	Yes / No Do you raise funds for CITES management through charging user fees? ☐ ☒ Do your fees recover the full economic cost of issuing permits? ☒ ☐ Do you have case studies on charging or using fees? ☐ ☒ If 'Yes' to any of the above, please provide brief details: *Fee schedule for import and export of wild fauna and flora is decided by the CITES Management Authority and is changes from time to time.* Do you use innovative financial mechanisms to raise funds for CITES implementation? ☐ ☒ If 'Yes', please provide brief details:

Indicator 2.2.4: The number of Parties using incentive measures as part of their implementation of the Convention.

2.2.4a	Do you use incentive measures[1] such as those described in CoP14 Doc 14.32 to implement the Convention? Yes / No Due diligence ☒ ☐ Compensatory mechanisms ☒ ☐ Certification ☒ ☐ Communal property rights ☐ ☐ Auctioning of quotas ☒ ☐ Cost recovery or environmental charges ☐ ☒ Enforcement incentives ☒ ☐ If 'Yes' to any of the above, or if you use other measures, please provide a summary or link to further information: *Under community-based trophy hunting programme 80% of the revenues generated are spent on socio-economic uplift of the local communities. In return communities protect wildlife species. Moreover, rewards are given to informants and enforcement staff in wildlife law enforcement activities.*
2.2.4b	Have incentives harmful to biodiversity been eliminated? Not at all ☐ Very little ☐ Somewhat ☒ Completely ☐

[1] *Defined as 'Social and economic incentives that promote and regulate sustainable management of and responsible trade in, wild flora and flora and promote effective enforcement of the Convention'. The intent of such measures is not to promote wildlife trade as such, but rather to ensure that any wildlife trade undertaken is conducted in a sustainable manner.*

Objective 2.3 Sufficient resources are secured at the national and international levels to implement capacity-building programmes.
Aichi Target 12, Target 19 and Target 20.

Indicator 2.3.1: The number of capacity building activities mandated by Resolutions and Decisions that are fully funded.

2.3.1a	How many training and capacity building activities[1] have you run during the period covered in this report?	Without assistance from the Secretariat	Conducted or assisted by the Secretariat
	None	☒	☐
	1	☐	☐
	2-5	☐	☐
	6-10	☐	☐
	11-20	☐	☐
	More than 20	☐	☐
	Please list the Resolutions or Decisions involved:		
2.3.1b	What sorts of capacity building activities have taken place?		
2.3.1c	What capacity building needs do you have?		

Please tick all boxes which apply to indicate which target group and which activity. Target group	Oral or written advice/guidance	Technical assistance	Financial assistance	Training	Other (specify)	Details
Staff of Management Authority	☒	☐	☐	☒	☐	Provision of training on; NDF, identification of specimens, wildlife forensic, surveys and monitoring of species.
Staff of Scientific Authority	☒	☐	☐	☒	☐	Provision of training on; NDF, identification of specimens, wildlife forensic, surveys and monitoring of species.
Staff of enforcement authorities	☒	☐	☐	☒	☐	Provision of training on; NDF, identification of specimens, wildlife forensic, surveys and monitoring of species.
Traders / other user groups	☒	☐	☐	☐	☐	
NGOs	☒	☐	☐	☒	☐	
Public	☐	☐	☐	☐	☐	
Other (please specify)	☐	☐	☐	☐	☐	

[1] *An activity might be a single day training e.g. for a group of staff from the Management Authority, or a longer course / project undertaken by an individual.*

GOAL 3CONTRIBUTE TO SIGNIFICANTLY REDUCING THE RATE OF BIODIVERSITY LOSS AND TO ACHIEVING RELEVANT GLOBALLY-AGREED GOALS AND TARGETS BY ENSURING THAT CITES AND OTHER MULTILATERAL INSTRUMENTS AND PROCESSES ARE COHERENT AND MUTUALLY SUPPORTIVE

Objective 3.1 Cooperation between CITES and international financial mechanisms and other related institutions is enhanced in order to support CITES-related conservation and sustainable development projects, without diminishing funding for currently prioritized activities.
Aichi Target 2 and Target 20.

Indicator 3.1.1: The number of Parties funded by international financial mechanisms and other related institutions to develop activities that include CITES-related conservation and sustainable development elements.

3.1.1a	Has funding from international financial mechanisms and other related institutions been used to develop activities that include CITES-related conservation and sustainable development elements? If 'Yes', please provide brief details:	Yes No Not applicable No information	☐ ☒ ☐ ☐
3.1.1b	During the period covered in this report, has funding for your country from international funding mechanisms and other related institutions:	Increased Remained stable Decreased	☐ ☐ ☐

Indicator 3.1.2: The number of countries and institutions that have provided additional funding from CITES Authorities to another country or activity for conservation and sustainable development projects in order to further the objectives of the Convention.

3.1.2a	Have you provided technical or financial assistance to another country or countries in relation to CITES?						Yes No No information	☐ ☒ ☐	
	If 'Yes', please tick boxes to indicate type of assistance provided Country(ies)	Species Management[1]	Habitat Management[2]	Sustainable use	Law Enforcement	Livelihoods	Other (specify)	Details (provide more information in an Appendix if necessary)	
		☐	☐	☐	☐	☐	☐		
		☐	☐	☐	☐	☐	☐		
		☐	☐	☐	☐	☐	☐		
		☐	☐	☐	☐	☐	☐		
		☐	☐	☐	☐	☐	☐		
		☐	☐	☐	☐	☐	☐		
		☐	☐	☐	☐	☐	☐		

[1] *Use species conservation column for work directly related to species – e.g. population surveys, education programmes, conflict resolution, etc.*

[2] *Use habitat conservation column for work that will indirectly support species conservation – e.g. habitat management, development of policy frameworks for how land is managed, etc.*

Objective 3.2 Awareness of the role and purpose of CITES is increased globally.
Aichi Target 1, Target 4, Target 12 and Target 18.

Indicator 3.2.1: The number of Parties that have been involved in CITES awareness raising activities to bring about better awareness by the wider public and relevant user groups of the Convention requirements.

3.2.1a	Have CITES authorities been involved in any of the following activities to bring about better awareness of the Convention's requirements by the wider public and relevant user groups?	Wider public	Relevant User Groups
	– Press conferences	☐	☐
	– Press releases	☐	☐
	– Newspaper articles, brochures, leaflets	☒	☐
	– Television appearances	☒	☐
	– Radio appearances	☒	☐
	– Presentations	☒	☐
	– Public consultations / meetings	☒	☐
	– Market surveys	☒	☐
	– Displays	☒	☐
	– Information at border crossing points	☐	☐
	– Telephone hotline	☐	☐
	– Website(s) – if so please provide link(s)	☐	☐
	– Other (specify):	☐	☐
	Please attach copies of any items or describe examples:		

Indicator 3.2.2: The number of visits to the CITES website.

3.2.2a	How regularly do your Authorities consult the CITES website?					
	Please tick boxes to indicate the most frequent usage (decide on an average amongst staff if necessary). Target group	Daily	Weekly	Monthly	Less frequently	Not known
	Staff of Management Authority	☐	☒	☐	☐	☐
	Staff of Scientific Authority	☐	☒	☐	☐	☐
	Staff of enforcement authorities	☐	☒	☐	☐	☐
3.2.2b	What has been your experience with using the CITES website?					
		Excellent ☐ Good ☒ Average ☐ Poor ☐ Very Poor ☐ No information ☐				
	Any further comments on the CITES Website? (e.g. useful aspects, any difficulties encountered, which authorities find which functions/tools most useful, what is missing, etc):					

Indicator 3.2.3: The number of Parties with web pages on CITES and its requirements.

A question relating to this indicator is within question 3.2.1a.

Objective 3.3 Cooperation with relevant international environmental, trade and development organizations is enhanced.

Indicator 3.3.1 The number of Parties which report that they have achieved synergies in their implementation of CITES, other biodiversity-related conventions and other relevant multilateral environmental, trade and development agreements.

3.3.1a	Have measures been taken to achieve coordination and reduce duplication of activities between the national CITES authorities and national focal points for other multilateral environmental agreements (e.g. the other biodiversity-related conventions: CBD, CMS, ITPGR, Ramsar, WHC)[1] to which your country is party?	Yes No No information	☒ ☐ ☐
	If 'Yes', please give a brief description: *All biodiversity related MEAs are dealt by the same office in the Ministry of Climate Change and Environmental Coordination.*		

Indicator 3.3.2: The number of biodiversity conservation or sustainable use projects, trade and development goals, or scientific and technical programmes that integrate CITES requirements.

3.3.2a	How many international projects which integrate CITES issues has your country contributed towards?		Nill
3.3.2b	In addition to 3.2.2a, how many national level projects has your country implemented which integrate CITES issues?		Nill
3.3.2c	Have there been any efforts at a national scale for your CITES Management or Scientific Authorities to collaborate with:	Yes	No
	Agencies for development?	☐	☐
	Agencies for trade?	☐	☐
	Provincial, state or territorial authorities?	☒	☐
	Local authorities or communities?	☒	☐
	Indigenous or local peoples?	☒	☐
	Trade or other private sector associations?	☒	☐
	NGOs?	☒	☐
	Other (please specify)	☐	☐
3.3.2d	Are CITES requirements integrated into?	Yes	No
	National and local development strategies?	☒	☒
	National and local poverty reduction strategies?	☐	☒
	Planning processes?	☒	☐
	National accounting?	☐	☒

[1] *CBD = Convention on Biological Diversity; CMS = Convention on the Conservation of Migratory Species of Wild Animals, ITPGR = International Treaty on Plant Genetic Resources for Food and Agriculture, Ramsar = The Convention on Wetlands of International Importance, WHC = World Heritage Convention.*

Indicator 3.3.3: The number of Parties cooperating / collaborating with intergovernmental and non-governmental organizations to participate in and/or fund CITES workshops and other training and capacity-building activities.

3.3.3a	Has funding been provided or received to facilitate CITES workshops, training or other capacity building activities to / from:	Tick if applicable	Which organizations?
	Inter-governmental organizations?	☐	
	Non-governmental organizations?	☒	WWF-Pakistan, Snow Leopard Foundation Pakistan.

Objective 3.4 The contribution of CITES to the relevant Millennium Development Goals, the sustainable development goals set at WSSD, the *Strategic Plan for Biodiversity 2011-2020* and the relevant *Aichi Biodiversity Targets,* and the relevant outcomes of the United Nations Conference on Sustainable Development is strengthened by ensuring that international trade in wild fauna and flora is conducted at sustainable levels.

This objective may also be assessed by a variety of means beyond the reporting format, including action taken to implement many of the CITES resolutions and decisions.
Aichi Target 1, Target 2, Target 3, Target 4, Target 5, Target 6, Target 7, Target 12, Target 14, Target 17, Target 18 and Target 19.

Indicator 3.4.1: The conservation status of species listed on the CITES Appendices has stabilized or improved.

3.4.1a	Do you have data which shows that the conservation status of naturally occurring species in your country listed on the CITES Appendices has stabilized or improved?	Yes	No	Not Applicable
	Appendix I	☒	☐	☐
	Appendix II	☒	☐	☐
	Appendix III	☒	☐	☐

If there are such studies that you are willing to share, please provide:

Species name (scientific)	Link to the data, or a brief summary
Platanista gangetica minor	*Surveys have shown the species status has improved.*
Capra falconeri	*Surveys have shown the species status is stable to increasing.*
Ovis sp.	*Surveys have shown the species status is stable.*
Capra sibirica	*Surveys have shown the species status is stable.*

3.4.1b	Do you have examples of specific examples of success stories or emerging problems with any CITES listed species?	Yes	☒
		No	☐
		No information	☐
	If 'Yes', please provide details: Community-based trophy hunting of ungulates such as Markhor (Capra alconeri), Urial (Ovis sp.), Blue sheep (Pseudois nayaur), Himlayan ibex (Capra sibirica), Sindh goat (Capra hircus aegagrus), is being implemented in Pakistan and is success story. Communities get 80% revenue generated and in return they protect wildlife species with a sense of ownership. As a result, the species status has improved besides socio-economic uplift of the communities. Moreover; Blind Indus Dolphin (*Platanista gangetica minor*) endemic species to Pakistan, has shown improvement in population from 1200 dolphins in 2001 to 2000 plus dolphins now.		

Indicator 3.4.2: The number of Parties incorporating CITES into their National Biodiversity Strategy and Action Plan (NBSAP).

3.4.2a	Has CITES been incorporated into your country's National Biodiversity Strategy and Action Plan (NBSAP)?	Yes No No information	☒ ☐ ☐
3.4.2b	Have you been able to obtain funds from the Global Environment Facility (GEF) or other sources to support CITES aspects of NBSAP implementation?	Yes No No information	☐ ☒ ☐

Objective 3.5 Parties and the Secretariat cooperate with other relevant international organizations and agreements dealing with natural resources, as appropriate, in order to achieve a coherent and collaborative approach to species which can be endangered by unsustainable trade, including those which are commercially exploited.
Aichi Target 2, Target 4, Target 5, Target 6, Target 7, Target 10, Target 12, Target 14 and Target 19.

Indicator 3.5.1: The number of cooperative actions taken under established bilateral or multilateral agreements to prevent species from being unsustainably exploited through international trade.

3.5.1a	Has your country taken action under established bilateral or multilateral agreements other than CITES to prevent species from being unsustainably exploited through international trade? If 'Yes', please provide details:	Yes No No information	☐ ☒ ☐

Indicator 3.5.2: The number of times other relevant international organizations and agreements dealing with natural resources are consulted on issues relevant to species subject to unsustainable trade.

3.5.2a	Average number of times per year that international organizations or agreements have been consulted by CITES Authorities	Once	2-5 times	6-20 times	More than 20 times	No consultation	Optional comment about which organizations and issues consulted on
	Management Authority(ies)	☐	☐	☒	☐	☐	
	Scientific Authority(ies)	☐	☒	☐	☐	☐	
	Enforcement Authority(ies)	☐	☒	☐	☐	☐	

General feedback

Please provide any additional comments you would like to make, including comments on this format.

Item		
Copy of full text of CITES-relevant legislation if changed Web link(s)	Enclosed Not available Previously provided	☐ ☐ ☒
Please list any materials annexed to the report, e.g. fee schedules, awareness raising materials, etc: Survey Reports (Annex-I) List of wildlife seizures (Annex-II) Fee Schedule (Annex-III)		
Have any constraints to implementation of the Convention arisen in your country requiring attention or assistance?	Yes No No Information	☒ ☐ ☐
If 'Yes', please describe the constraint and the type of attention or assistance that is required. *There is a need to provide of training on; NDF, identification of specimens, wildlife forensic, surveys and monitoring of species, provision of education and awareness material.*		
Are there examples of good practice you would like to share with other Parties?	Yes No No Information	☒ ☒ ☐

*If 'Yes' please provide details / links: Community based trophy hunting of ungulates; Markhor (*Capra falconeri*), Urial* (Ovis vignei) *Blue Sheep (Pseudois schaeferi), Himalayan Ibex (*Capra sibirica*), Sindh Goat (*Capra aegagrus*) is being successfully implemented in Pakistan and is world recognized. The local communities get 80% shares of the revenue generated, which is used for community-based conservation activities and socio-economic uplift. 20% of the revenue goes to government as administrative fee. In return the communities protect wildlife with a sense of ownership. Benefits of Community Based Trophy Hunting Programme*

- *Increase in ungulate populations*
- *Reduction in illegal hunting and poaching*
- *Habitat improvement activities*
- *Socio-economic uplift of local communities*
- *Sense of ownership in local communities*
- *Involvement of local communities in watch and ward and surveys*
- *Livelihood opportunities*
- *Awareness raising about importance of species*
- *Awareness raising /positive attitude for wildlife (Reduction in retaliatory killing of wildlife in cases of livestock depredation or crop damage)*

How could this report format be improved? *The provided format appears to be fine. It is suggested that; there should be option to add boxes automatically to include more species in the following sub-sections: 1.5.3a,1.6.2a, 3.4.1a.*

Thank you for completing the report. Please remember to include relevant attachments referred to in the report when it is submitted to the Secretariat.

Annex-I

CITES Biennial Report

List of Survey Reports of CITES Listed Species:

i. Density Pattern of Flare-Horned Markhor (Capra falconeri) in Northern Pakistan; Annex-I(A).
ii. Rut Season Survey Report 2022-23, Himalayan Ibex and Blue Sheep in Gilgit Baltistan; Annex-I(B).
iii. Spatial density pattern of Himalayan Ibex (Capra sibirica) in Pakistan; Annex-I(C).
iv. Rut Season Survey Report 2022-23, Astor Markhor and Ladakh Urial in Gilgit Baltistan; Annex-I(D).
v. Markhor & Ibex Population during 2021, Sawat Wildlife Division; Annex-I(E).
vi. Annual Survey Report for the Year 2022, Kohistan Wildlife Division; Annex-I(F).
vii. Report on Wildlife Survey in Bahrain Wildlife Range Upper Swat Wildlife Division Matta, December, 2022; Annex-I(G).
viii. Kashmir Markhor & Himalayan Ibex Rut Season Survey, Chitral Gol National Park, December, 2022; Annex-I(H).
ix. Markhor & Ibex Rut Season Survey, Chitral Wildlife Division, December, 2021- January, 2022; Annex-I(I).
x. Markhor & Ibex Rut Season Survey, December, 2022- January, 2023; Annex-I(J).
xi. Rut Season Survey Report 2020-21, Himalayan Ibex (*Capra ibex sibirica*) in Gojal, Ghizar and Skardu in Gilgit Baltistan; Annex-I(K).
xii. Lambing and Rut Season Survey Report 2020-21, Astor Markhor and Ladakh Urial in Gilgit Baltistan. Annex-I(L).

sustainability

MDPI

Article

Density Pattern of Flare-Horned Markhor (*Capra falconeri*) in Northern Pakistan

Shakeel Ahmad [1], Ejaz Ur Rehman [2], Hussain Ali [1,3,4], Nazakat Din [3], Jibran Haider [5], Jaffar Ud Din [3,4] and Muhammad Ali Nawaz [6,*]

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Abstract: Wild ungulates play vital roles in maintaining a balanced ecosystem through herbivory and are also an important determinant of carnivores' density. The flare-horned markhor (*Capra falconeri*) is a threatened wild goat distributed across the mountain ranges of Pakistan, India, Afghanistan, Russia, Turkmenistan, Uzbekistan, and Tajikistan. The remote terrain and fragmented population limit our understanding of the population ecology of markhor, though knowledge of the target species population is vital for making informed management decisions. Therefore, the current study was designed to determine the markhor population across their range in Northern Pakistan and to evaluate the efforts made by the government and non-government organizations for the conservation of markhor. Double-observer surveys were conducted during 2019–2021 in nine major watersheds of Khyber Pakhtunkhwa and Gilgit-Baltistan covering an area of 4664 km^2. Secondary data were collected for unassessed areas to gain a holistic overview of the markhor population and density in the region. Results revealed a markhor population of 7579, with a density of 0.30 animals per km^2 in Northern Pakistan. Our analysis of the double-observer data through the Bayesian behavioral capture–recapture model estimated a population of 5993 individuals (95% CI) of markhor across nine study sites, with a density of 1.28 animals per km^2. A review of secondary data revealed that a population of about 1586 was present in the un-surveyed area (20,033.33 km^2), with a density of 0.08 per km^2. A total of 146 groups of markhor were counted, with a mean group size of 23 (3–58) individuals. There were 109 males and 108 young per 100 females in the population. Among 1936 recorded males, Class I males accounted for 27.74%, followed by Class II (26.45%), Class IV (trophy-size) (23.40%), and Class III (22.42%). The overall detection probability was recorded as 0.87 and 0.68 for the first observer and second observer, respectively. Compared with the past reports, the population of markhor in Northern Pakistan appears to be increasing, particularly in protected areas (PAs) such as national parks and community-controlled hunting areas (CCHAs). Conservation programs, notably trophy hunting and PA networks, appear to be vital in sustaining markhor populations in parts of the species range. We recommend expansion in such programs in the markhor range in order to maintain a viable population of this majestic wild goat in the region.

Keywords: markhor; *Capra falconeri*; Gilgit-Baltistan; Karakoram; population; double-observer; CGNP

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1. Introduction

Wild ungulates (hoofed mammals) are adapted for life in high mountainous areas, particularly the mountain ungulates in the family *Caprinae* [1]. These species play an important role in maintaining ecosystems through nutrient recycling and influencing plant species composition and vegetation structure [2,3]. They are important prey species for

large carnivores [4], and predators' population density depends on their availability [5]. The depletion of ungulate prey is thus a major threat to the survival of carnivores [6]. For example, with the global focus on the conservation of snow leopard (*Panthera uncia*) [7,8], the monitoring of large ungulate species in the snow leopard range is essential because it has been documented that the density of snow leopard increases with an increase in the density of available wild prey species [3].

The population size of many large-sized herbivore species can be an important indicator of their conservation [9]. Therefore, conservation biologists and wildlife managers often try to evaluate management protocols by assessing the population dynamics of wildlife species [10] and also evaluating the management effects in a given area [11]. Wildlife managers identify population trends by estimating the abundance of target species [12,13]. Therefore, knowledge of population trends is vital for assessing or implementing conservation actions. The extinction risk assessment of species at the global or national level depends on strong assessments of species population sizes and trends [8].

Mammal diversity in the northern parts of Pakistan is higher than in other parts of the country [14]. The mountains in Northern Pakistan are home to several species of wild ungulates, including the flare-horned markhor (*Capra falconeri*), Himalayan ibex (*Capra ibex sibirica*), blue sheep (*Pseudois nayaur*), Marco Polo sheep (*Ovis ammon polii*), Ladakh urial (*Ovis vignei vignei*), and Kashmir musk deer (*Moscus cupreus*) [15].

The flare-horned markhor (hereafter markhor) is a wild goat of the family *Bovidae* that lives in the Hindu Kush, Himalayan, and Karakoram ranges [16,17] in Pakistan, India, and Afghanistan and the mountains of Russia, Turkmenistan, Uzbekistan, and Tajikistan in Central Asia [18–20] at an elevation of 600–3600 m [21]. In Pakistan, the distribution range of markhor extends from the mountains of Balochistan to the north of Khyber Pakhtunkhwa and Gilgit-Baltistan [17]. Globally, the markhor was listed as 'Endangered' in the IUCN red list from 1994–2015. However, in 2015, the status of markhor was downlisted to 'Near Threatened' on the IUCN Red List [21]. The main justification behind this downlisting was an increasing population trend (>5000 mature individuals) due to international conservation success in the recovery of the markhor population in protected and sustainable hunting management areas [21]. In Pakistan, very little information is available about the species' range-wide population status as the populations are highly fragmented—they are listed as 'Endangered' on the Mammals National Red List [22]. Markhor is listed in the CITES Appendix I, which includes species threatened with extinction.

Four subspecies of markhor are documented in Pakistan. The Pir Panjal or Kashmir markhor (*Capra falconeri cashmiriensis*) has corkscrew-shaped horns and is endemic to Kashmir and the northern areas (Chitral, Swat, Upper Dir, and Kohistan districts) of Khyber Pakhtunkhwa. The Astor markhor (*Capra falconeri falconeri*) has one and a half twist, out-flaring horns and is endemic to Gilgit-Baltistan [23,24]. These two subspecies are considered different subspecies of the flare-horned markhor [25]. The third subspecies is the Suleiman markhor (*Capra falconeri jerdoni*), which has tight multi-spiral horns and is endemic to Balochistan [26]. The fourth is the Kabul markhor (*Capra falconeri megaceros*), which has 2–3 straight spiral horns and is endemic to Khyber Pakhtunkhwa (Koh Safed range of the Khyber Valley) and Balochistan [26]. However, the Kashmir and Astore markhor are considered one subspecies, while the Kabul and Suleiman markhor is also considered one subspecies [25]. The Chiltan wild goat (*Capra aegagrus chialtensis*), which is described as a wild goat or rather a hybrid, is considered a fifth subspecies [25]. Apart from this, one subspecies of markhor is the Tajik markhor (*Capra falconeri heptneri*) which is found in Tajikistan, Turkmenistan, Afghanistan, and Uzbekistan [21,27].

The markhor is facing many threats, including deforestation, competition with livestock for food resources, decreased specialized habitat in which to forage, intensified local resource use, habitat fragmentation, increased human population, poaching, largescale development, border fencing [17,20,22], genetically isolated populations due to poor connectivity among subpopulations, hybridization, and low reproductive rates [17] throughout its distribution range. The ongoing war and social conflict make the future of the species

indeterminate [20]. In addition, Khattak et al. [28] documented feral dogs' depredation as an important threat to markhor in Pakistan. Across its distribution range, markhors forage close to domestic goats [29], which are possible carriers of *Mycoplasma capricolum* which caused a fatal pneumonia outbreak in the markhor population [30]. Asia's rangelands and mountains are strongholds for several endemic ungulate species [31], many of which are listed as globally threatened [32], and information related to their population sizes and trends is patchy due to the inaccessibility of their habitats and the absence of strong studies [31]. Several techniques have been established for the monitoring of large herbivores and ungulate species, e.g., distance sampling and strip transects. However, rugged habitats and the lack of sufficient expertise have posed challenges to the reliable estimation and monitoring of wild ungulate populations in Asia's mountains [31]. Many standardized methods for the assessment of wild ungulate populations, such as distance sampling, are difficult to use in mountainous areas because of the impracticality of their assumptions [33]. On the other hand, aerial surveys can be effective but are costly and even dangerous in mountainous areas [34].

The double-observer survey technique was introduced [33] to ensure the reliable population estimation of mountain ungulates. The principles of the technique are based on the theory of capture–mark–recapture [35]. A capture history can be built for each observed individual, and data can be analyzed in a capture–mark–recapture fashion [36]. The method has been successfully applied to mountain ungulates in different regions in the range of the snow leopard [1,8,34]. In Pakistan, the double-observer method has been used for the population estimation of Marco Polo sheep [37], blue sheep [38], and Himalayan ibex [39].

The establishment of protected areas (PAs) with a high level of protection plays an important role in the conservation of threatened species. Across the globe, the number of threatened ungulate species and populations have recovered through PAs and incentive programs that directly benefit the local communities and engage them in the conservation of targeted and non-targeted wildlife species. The current study was designed to determine (1) the markhor population across their range in Northern Pakistan and (2) to assess the impacts of conservation initiatives on the density pattern of markhor. This study was carried out in Northern Pakistan, across three mountain ranges (Karakoram, Hindu Kush, and Himalaya) and two provinces (Khyber Pakhtunkhwa and Gilgit-Baltistan) to determine the range-wide population status of markhor. This study will inform future conservation strategies for the species by providing benchmark population estimates and identifying major strongholds of the species in the country.

2. Materials and Methods

2.1. Study Area

This study was conducted in nine different study sites in the markhor distribution range falling in two administrative regions (Khyber Pakhtunkhwa and Gilgit-Baltistan) of Northern Pakistan (Figure 1, Table 1). In Khyber Pakhtunkhwa, the survey was conducted in Chitral Gol National Park (CGNP), the buffer zone of CGNP, and Chitral Wildlife Division (Chitral WD), while in Gilgit-Baltistan, it was carried out in six valleys, including Haramosh, Sikandarabad, Danyor (Jutal, Jaglot Gooro, and Danyor), Skoyo Karabathang Basing (SKB), Astak Tormik, and Bagrote (Figure 1). In Chitral, the winter is cold, with temperatures ranging from 11 to 2 °C. The winter is severe, with frequent snowfall. Summertime is considered pleasant, with a mean temperature of 28 °C [40]. In Gilgit-Baltistan, the overall climate varies greatly from tropical desert to barren and arid desert. The average annual rainfall is less than 20 mm, and temperatures are between 40 °C in summer and –10 °C in winter. Natural vegetation is divided into four distinct categories—sub-tropical scrub forest, dry temperate broadleaved forest, mountain dry temperate coniferous forest, and northern dry scrub forest [14]. The mammalian species found in the area are represented by the common leopard (*Panthera pardus*), snow leopard, Himalayan lynx (*Lynx lynx*), Asiatic

black bear (*Ursus thibetanus*), wolf (*Canis lupus*), red fox (*Vulpes vulpes*), Himalayan ibex, and markhor.

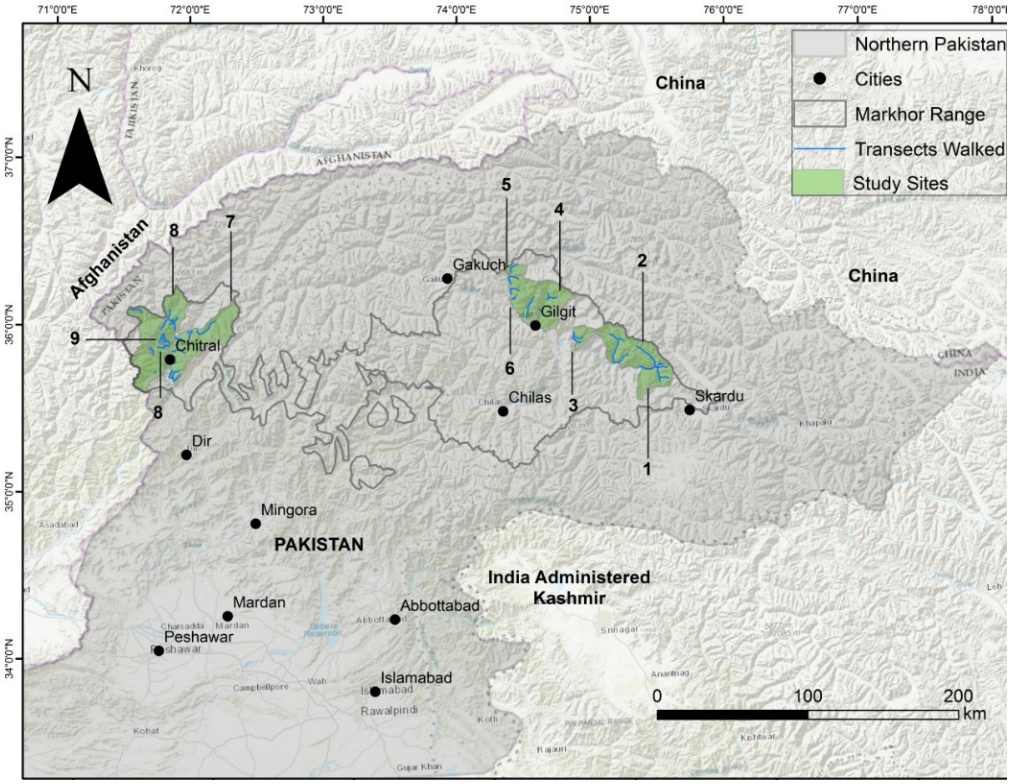

Figure 1. Map showing the distribution of markhor in the northern areas of Pakistan and sites where the double-observer survey was carried out. 1 = SKB; 2 = Astak Tormik; 3 = Haramosh; 4 = Danyor; 5 = Sikandarabad; 6 = Bagrote; 7 = Chitral WD; 8 = CGNP buffer; 9 = CGNP.

Table 1. Study sites where double-observer surveys were conducted for different ungulate species.

Study Blocks	Area Size (km^2)	Month/Year	Effort (km)
Chitral WD	1930	Jan 2020	113
Astak Tormik	801	Apr 2019	62
Bagrote	523	Dec 2020	16
Haramosh	142	Apr 2019	15
SKB	335	Jan 2021	44
CGNP	79	Jan 2020	23
CGNP buffer zone	279	Jan 2020	32
Sikandarabad	87	Dec 2020	10
Danyor	488	Jan 2021	43
Total	**4664**		**357**

2.2. Data Collection

2.2.1. Double-Observer Survey

The double-observer survey was conducted in nine valleys (study sites) within the distribution range of markhor in Northern Pakistan with the primary aim of determining the animal population and density (Figure 1). Surveys were conducted in April 2019, December 2019–January 2020, and January 2021, covering an area of 4664 km^2 (about 19% of the known markhor range in Northern Pakistan) by walking a total of 44 transects of the length of 357 km (Table 1). The mean transect length was 8.1 km ranging from 0.9 to 23 km (SD = 5.53). Study blocks were identified based on natural watersheds and high ridges. The tough, rugged terrain was delineated as boundaries as there was little chance of crossing into the next block during the survey period. In the double-observer

technique, two observers (teams) scan and count animals simultaneously by keeping a spatial or temporal distance between them to ensure that they do not give each other any clue about animals or herd locations. This approach allows population estimates based on just two surveys [33]. The identification of individual mountain ungulates is difficult due to the absence of unique identification marks, but herds can be identified based on specific identification features such as herd size, the age-sex composition of a herd, location of the sighted herd, distance to herd, name of the pasture where the herd was encountered, and time at which group was observed [41]. The unit is 'marked' and 'recaptured' in the double-observer survey as the individual group [42]. Following the assumptions of Suryawanshi et al. [33] of the double-observer method, the team was divided into two sets of observers—observers A and observers B. A temporal distance of about 15 min was maintained between observers A and B while walking through the watershed. Each team was equipped with a spotting scope (20 × 60 Swarovski), binoculars (10 × 50 Pentax XCF), DSLR camera, and GPS device (Garmin 62S). Observed animals in each herd were categorized as female (>2 years), young (<2 years), and male. Males were classified into four different age classes; Class I (2 1/2 years), Class II (3 1/2), Class III (4 1/2), and Class IV (5 1/2), based on their horn size [24]. At the end of the day, both observers compared their data on herd size and sex/age, time of the sighting, and other specific characteristics and herd composition (e.g., male groups only). These data were used to confirm common (recapture) and unique herds and avoid double counting [41].

2.2.2. Secondary Data Collection

Secondary data on markhor populations in the watersheds not covered by the direct surveys were obtained from the published literature [24,43–46] and wildlife department officials. The purpose was to project a single density map of the species across its distribution range.

2.3. Data Analysis

The data obtained for each study through the double-observer survey were arranged in a capture–mark–recapture pattern. Three formats were used depending on herd sightings. A code of '11' was used if a herd was sighted by both observers, '10' if sighted by observer A, and '01' if sighted by observer B. The data were analyzed in a Bayesian behavioral capture–recapture model (BBRecapture package) using the software R [47] to estimate each study site's markhor population. We followed Suryawanshi et al. [8] and Khanyari et al. [42] for the estimation of the number of markhor groups, mean group size, total population, confidence intervals (CIs), and detection probability for both observers.

Markhor density within each study site was calculated by dividing the estimated population by the total site area. The density map was developed in ArcGIS 10.8 (ESRI, Redland, CA, USA) to depict low- (0.00–0.12 animals per km^2), medium- (0.13–0.24), and high-density areas (>0.24).

3. Results

3.1. Markhor Sighting Record

In the current study, markhor herds were observed in seven blocks at 133 locations (Table 2); none were found in Bagrote or Astak Tormak. The sightings comprised single animals to as many as 111 in a herd. Most of the larger herds were observed in CGNP and its buffer areas. Of the observed herds, about 95.5% were mixed herds (consisting of male, female, and young).

Table 2. Estimated population of markhor in different study sites using the double-observer technique.

Variables	CGNP	CGNP Buffer	Chitral WD	Sikandarabad	SKB	Danyor	Haramosh	Total
No. of herds recorded by team A	20	4	19	0	0	3	0	**46**
No. of herds recorded by team B	6	2	2	0	0	2	0	**12**
No. of herds recorded by both teams	26	13	24	2	4	5	0	**74**
Estimated no. of groups	56	20	47	2	4	12	5	**146**
Mean group size	44.26	30.47	57.82	3	10.75	9.1	5.8	**23.02**
Estimated population	2479.0	609.0	2718	6	43	109	29	**5993**
±95% confidence interval	2047.6–2976.2	458.9–801.0	2096.1–3499.7	4.0–16.0	26.0–81.0	68.20–194.40	18.0–46.0	
Total area (km^2)	78.61	279	1930	86.76	335	488	142	**3339.4**
Detection probability of team A	0.81	0.81	0.89	0.70	0.80	0.64	0.83	**0.78**
Detection probability of team B	0.63	0.72	0.54	0.70	0.80	0.57	0.83	**0.68**
Density/km^2	**31.54**	**2.18**	**1.41**	**0.07**	**0.13**	**0.22**	**0.20**	**1.79**

3.2. Markhor Population and Density

The analysis yielded an estimated population of 5993 individuals (95% CI). The mean density was 1.28 individuals per km^2 (1.79 in sighting blocks). The highest population was estimated in Chitral WD where the estimated population was 2718 animals (95% CI 2096–3500), followed by CGNP (2479 animals, 95% CI 2048–2976), CGNP buffer area (609, 95% CI 459–801), and Danyor (109, 95% CI 68–194) (Table 2). The lowest population of markhor was estimated in Sikandarabad and Haramosh where a population of 6 (95% CI 4–16) and 29 (95% CI 18–46) individuals was estimated, respectively (Table 2). The highest markhor density was estimated in CGNP at 31.54 animals per km^2, while the lowest was estimated in Sikandarabad (0.07) (Figure 2, Table 2).

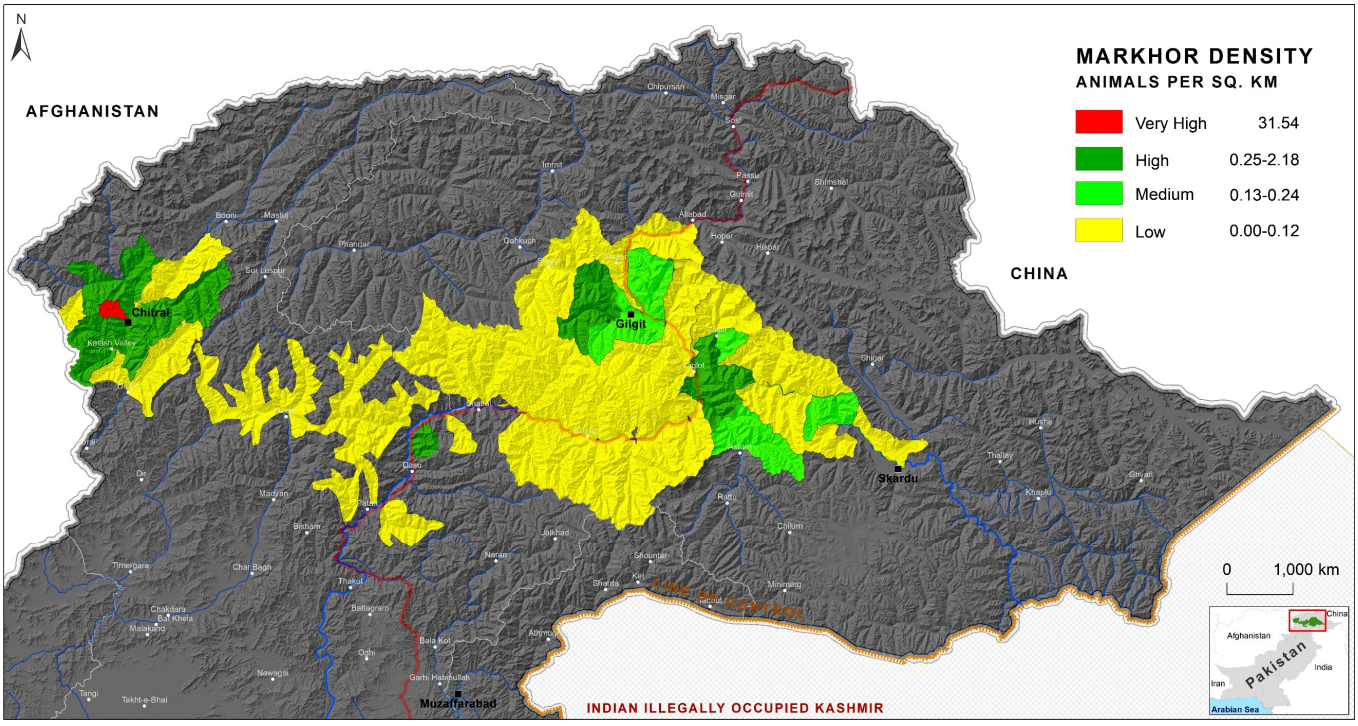

Figure 2. Range-wide density pattern of markhor in Northern Pakistan.

Based on secondary data, the total population of markhor in an un-surveyed area of 20,033 km^2 was about 1586, with an average density of 0.08 per km^2. The high-density areas of markhor in the un-surveyed area included Kiagah (1.90 animals per km^2), Ramgaht (0.79), Doyan (0.72), Bonji (0.54), and Henzal (0.37) (Supplementary Materials and Figure 2). Most of the un-surveyed areas fell in the low-density class (Figure 2).

3.3. Estimated Number of Groups and Group Size

The estimated number of markhor groups was 146, with a mean group size of 23 (3.00–57.82 individuals). The numbers of markhor groups observed by team A, team B, and both teams are shown in Table 3. The largest number of estimated groups was recorded in CGNP (56 groups) and Chitral WD (47), while the smallest numbers were found in Sikandarabad (4), SKB (4), and Haramosh (5). The highest mean estimated group size was observed in Chitral WD (57.82 animals/herd), followed by CGNP (44.26 animals/herd) and CGNP buffer (30.47 animals/herd). The lowest number of animals per herd was found in Sikandarabad (3 animals/herd) and Haramosh (5.8 animals/herd) (Table 3).

Table 3. Sex ratio and fecundity in markhor population in Northern Pakistan.

	Ratio to 100 Female Individuals	
Study Block	**Male**	**Young**
Chitral WD	151	208
CGNP	146	144
CGNP buffer	100	181
Haramosh	67	67
SKB	55	41
Sikandarabad	150	50
Danyor	91	67

3.4. Detection Probability

The overall detection probability was 0.87 and 0.68 for the first observer and second observer, respectively. The highest detection probability of observer A was recorded in Chitral WD (0.89), followed by Haramosh (0.83), CGNP and buffer area (0.81 each), and SKB (0.80). In the case of observer B, the highest detection probability was observed in Haramosh (0.83), followed by SKB (0.80), CGNP buffer (0.72), and Sikandarabad (0.70) (Table 3).

3.5. Sex Ratio

The male-to-female ratio for markhor across the surveyed areas was estimated as 109 per 100 females, while the young-to-female ratio was estimated as 108 per 100 females (Table 3). The highest male-to-female ratio was observed in Chitral WD, Sikandarabad, and CGNP, while the highest young-to-female ratio was recorded in Chitral WD, CGNP buffer, and CGNP (Table 3).

3.6. Male Population Structure

A total of 1936 male markhors of different classes were observed in this study (Table 4). Class I males accounted for about 27.74%, followed by Class II (26.45%), Class IV (23.40%), and Class III (22.42%). The highest number of trophy-sized males (Class IV) was observed in CGNP (225 individuals), followed by Chitral WD (180), CGNP buffer (32), and Danyor (8) (Table 4). A photograph of male markhor of Class III is given in Figure 3.

Table 4. Age structure of male markhors in Northern Pakistan.

Study Site	Class I (%)	Class II (%)	Class III (%)	Class IV (%)	Total
Chitral WD	257 (29.7)	238 (27.5)	191 (22.1)	180 (20.8)	866
CGNP	236 (27.5)	216 (25.2)	181 (21.1)	225 (26.2)	858
CGNP buffer	31 (20.7)	44 (29.3)	43 (28.7)	32 (21.3)	150
Haramosh	3 (37.5)	2 (25)	2 (25)	1 (12.5)	8
SKB	0	0	6 (50)	6 (50)	12
Sikandarabad	0	1 (25)	2 (50)	1 (25)	4
Danyor	10 (26.3)	11 (28.9)	9 (23.7)	8 (21.1)	38
Total	**537 (27.7)**	**512 (26.4)**	**434 (22.4)**	**453 (23.4)**	**1936**

Figure 3. Markhor photographed in CGNP (photo credit: Abdullah Khan).

4. Discussion

This study provides the first-ever range-wide density estimates of markhor in Pakistan, constructed on empirical data. The double-observer technique has been used successfully for mountain ungulates in Pakistan [37–39] and in neighboring countries such as India [3], Nepal [48], Bhutan [49], and Kyrgyzstan [42]. This technique has not been used for the population assessment of markhor, except by Michel et al. [27], who carried out a double-observer survey for markhor in a small area in Tajikistan. Previous population assessments in Pakistan were carried out in limited parts of the species' distribution range using the point count/vantage point method. The double observe method was tested for the first time during the current study in two administrative regions: Khyber Pakhtunkhwa province and Gilgit-Baltistan. We estimated the population of markhor in the surveyed area to be about 5993 individuals with a density of 1.28 individuals per km^2. The high density was documented in study blocks of Chitral (CGNP and buffer area of CGNP). In Gilgit-Baltistan, we estimated a population of about 187 individuals across six different study sites with a density range from 0.07 to 0.22 animals per km^2. The density of markhor varies from region to region depending upon the protection level measures and quality of available habitats.

Information about markhor population and density pattern across their range is patchy. A density of 2.91–3.12 animals per km^2 was documented by Bhatnagar et al. [20] from an area of 120 km^2 of Jammu and Kashmir. In Tajikistan, a mean density of 2.84 animals per km^2 was documented by Michel et al. [27] in 2014, while Broghammer et al. [50] documented a mean density of 3.4 individuals per km^2 for several study sites in Tajikistan in 2017. We cannot compare our study results with the aforementioned density of markhor from different regions due to the differences in the survey methodologies.

The largest population was estimated in Chitral: 5806 animals in CGNP, the buffer of CGNP, and Chitral WD. According to wildlife department officials, about 67 individuals were present in the remaining (un-surveyed area) valleys of this district (DFO Wildlife Chitral Pers. Comm.). Compared with historical records, our estimates suggest an increasing trend in the population of CGNP. Before the establishment of CGNP, a maximum number of 520 animals in CGNP area were recorded by Aleem [51]. The area was established as a national park in 1984. The CGNP's estimated markhor population during 1985–1986 was 160–300 animals. Arshad [52] documented 373 in 2003 and 590 in 2005–2006. Ali [53] confirmed the increasing population trend, recording a total of 612 animals in 2006, with an annual growth rate of 7.7%. The Chitral area has been observed to be a markhor stronghold, with an increasing population trend. We documented an increase in Chitral's markhor population and attribute it to the establishment of CGNP and two community-managed game reserves called Tooshi-Sasha Community-Managed Game Reserve (TSCMGR) and Gehraite-Golain Community-Managed Game Reserve (GGCMGR), in addition to active protection measures taken by wildlife departments and communities. These game reserves fall within Chitral WD, covering an area of about 1150 km^2 (GGCMR = 950 km^2 and TSCMGR = 200 km^2). The establishment of these game reserves allowed local communities to play an active role in markhor conservation—they receive benefits through trophy hunting programs. Moreover, a proposal has been submitted for the establishment of a community-based conservancy program in CGNP's buffer area (DFO Wildlife Chitral Pers. Comm.). Similarly, the increasing trend in the population of markhor in Tajikistan is attributed to the expanding network of protected areas and the establishment of trophy hunting reserves. The population of markhor was about 350 individuals in 1997, but due to the increased level of protection in already existing protected areas, the establishment of more conservancies in 2005, and the trophy hunting program commencing in 2014, the population of markhor increased to 1901 in 2017, and 85% of markhors were in the conservancy areas [54].

Combining the markhor populations estimated through the double-observer method and from data obtained from the published literature and Gilgit-Baltistan wildlife officials, a total population of about 1238 individuals can be assumed across the species range in Gilgit-Baltistan. Haider et al. [24] reported a population of about 1087 individuals. There was a sharp decline in markhor populations in Gilgit-Baltistan up to the mid-1990s, but community-based conservation efforts led to an eventual increase [24]. Most of the high markhor densities were observed in community-based conservation areas. The social and economic benefits of trophy hunting have persuaded local communities to become stewards of wildlife populations, especially of the highly prized markhor [24,55].

In this study, we recorded detection probabilities of 0.87 and 0.68 for observers A and B, respectively, though in some study sites, it was the same for both observers. Using the double-observer technique to study mountain ungulates, most researchers have reported high detection probabilities for observer A [34,38,39,42]. In most of these studies, the low detection of the second observer is attributed to the escape behavior of wild ungulates due to the first observer. In this study, the same detection probabilities of both observers across almost all study sites may be attributed to high protection levels and relatively low poaching pressures as the study was conducted in mostly protected areas or community-controlled hunting areas (CCHAs). Michel et al. [56] used the double-observer technique for the markhor survey in Tajikistan and reported very low detection probabilities for

observer B. This low detection probability was linked with the escape behavior of markhor because of the first observer team.

The markhor population in Pakistan shows a well-balanced sex ratio structure. The hunting of selective males in the population results in a low ratio of males to females [57]. In our study, the high ratio of males to females indicated that illegal hunting or poaching targeting adult males is very low [27]. The main reason for this is active protection by relevant wildlife departments and the involvement of local communities. In the current study, we documented a high ratio of young to female (108:100) for markhor. A high ratio of young to females in the markhor population was also documented by Michel et al. [56] in Tajikistan (117:100) and Haider et al. [24] in the Gilglit-Baltistan region of Pakistan (112:100). This high ratio of young indicates a high reproduction rate and survival of kids [56].

The most important factor contributing to the high ratio of male markhor is the trophy hunting program through which local communities are actively involved in the protection and conservation of markhor, a high-price trophy animal in Pakistan compared to Himalayan ibex and blue sheep. In this study, a total of 1936 males of different age classes were observed at various study sites. About 23.4% of males were trophy-sized (Class IV). Hunting of trophy-size males could have a huge impact on the population size and structure of the target species if the trophy quota is not allocated based on ground truth. In Pakistan, the trophy hunting quota is allocated at 1–2% of the target population for sustainable harvesting [58]. In the case of markhor, two trophy-size males could be harvested if the total population is about 150 individuals, and about 8 trophy-size males were observed in two consecutive winters. Our results show that there are enough trophy-size males available for suitable harvesting, particularly in the Chitral region, but most of the trophy-size males are present in protected areas such as CGNP and buffer areas of CGNP where trophy hunting is not allowed as per the wildlife act. Therefore, the current harvesting ratio of trophy-size males in both Chitral (three trophies each year) and Gilgit-Baltistan (four trophies each year) is sustainable and should not have a disastrous impact on the structure of and ratio of the male population.

The trophy hunting of markhor was allowed to promote the conservation of endangered species through community-based conservation programs after the 10th meeting of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) in 1997 [58]. Trophy hunting programs give residing communities direct benefits. Successful community-based markhor hunting conservancies are well-established in Pakistan, where 80% of hunting fees are invested in participating communities [29,58,59]. Markhor trophy hunting is currently taking place in 8 of the 15 CCHAs in Gilgit-Baltistan, namely Kargah, Sakwar-Jutial-Barmas, Harmosh-Sassi, Sikandarabad, Bunji, Dashkin-Mushkin-Turbuling, Doyan, and SKB.

A total of four markhor trophies are harvested in Gilgit-Baltistan each year, usually one per catchment, with an interval of one to several years [24]. Moreover, the establishment of TSCMGR and GGCMGR in Chitral WD contributed significantly to markhor conservation. A maximum of three markhors are hunted through trophy hunting programs in these two community-managed game reserves each year.

The Chitral Wildlife Department has proposed the establishment of a new conservancy in the buffer area of CGNP to strengthen markhor conservation in Chitral—the buffer area has a sufficiently large population, with a density of 2.18 animals per km^2. The relevant department proposes a trophy allowance of one animal per year (DFO Wildlife Chitral Pers. Comm.).

Markhor trophy hunting also takes place in Kiagah Valley of district Kohistan (Khyber Pakhtunkhwa) where the population has increased since the valley's establishment as a community-managed game reserve in 2005. A total of 74 markhors were present in the valley during 2005 which expanded to a population of 291 in 2018 [43]. However, the surrounding valleys had no community conservation programs, so poaching and human interference directly affected the population and led to a significant decrease [43].

In mountain ungulates, the ratio of kids to females is important for determining the fecundity rate, while the ratio of yearlings to females is critical for calculating the chances of kids reaching the yearling stage [60]. In this study, we recorded a high ratio of young to females (108 per 100 females), which indicates a high reproductive rate and survival rate of young in the study area. Markhor inhabits lower elevations than blue sheep and Himalayan ibex. Higher elevations have minimal plant cover and severe temperatures due to heavy snowfall. The opposite is true of lower elevations [43]. The high survival rate of young markhors may be due to food availability and the moderate temperatures of lower elevations.

5. Conclusions

This study concludes that Pakistan's markhor population is increasing, particularly in protected areas such as CGNP, its buffer zone, and CCHAs. The increasing population trend, particularly in the Chitral area, is due to the active protection measures of the Wildlife Department and the involvement of local communities in conservation activities through trophy hunting programs. Based on our findings, we recommend that more surveys be carried out in other areas of the markhor's distribution range using the double-observer technique, e.g., Kumrat Valley (Upper Dir), Kalam Valley (Swat), and the valleys of district Kohistan. In addition to this, we also recommend that future surveys should be carried out through the double-observer and vantage point method to test the validity of both survey methods. The trophy hunting program should be extended to other areas after extensive population surveys. In addition, the protected area network should be extended to include high markhor density areas.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/su14159567/s1, Secondary data obtained from published literature and concerned Wildlife Officials.

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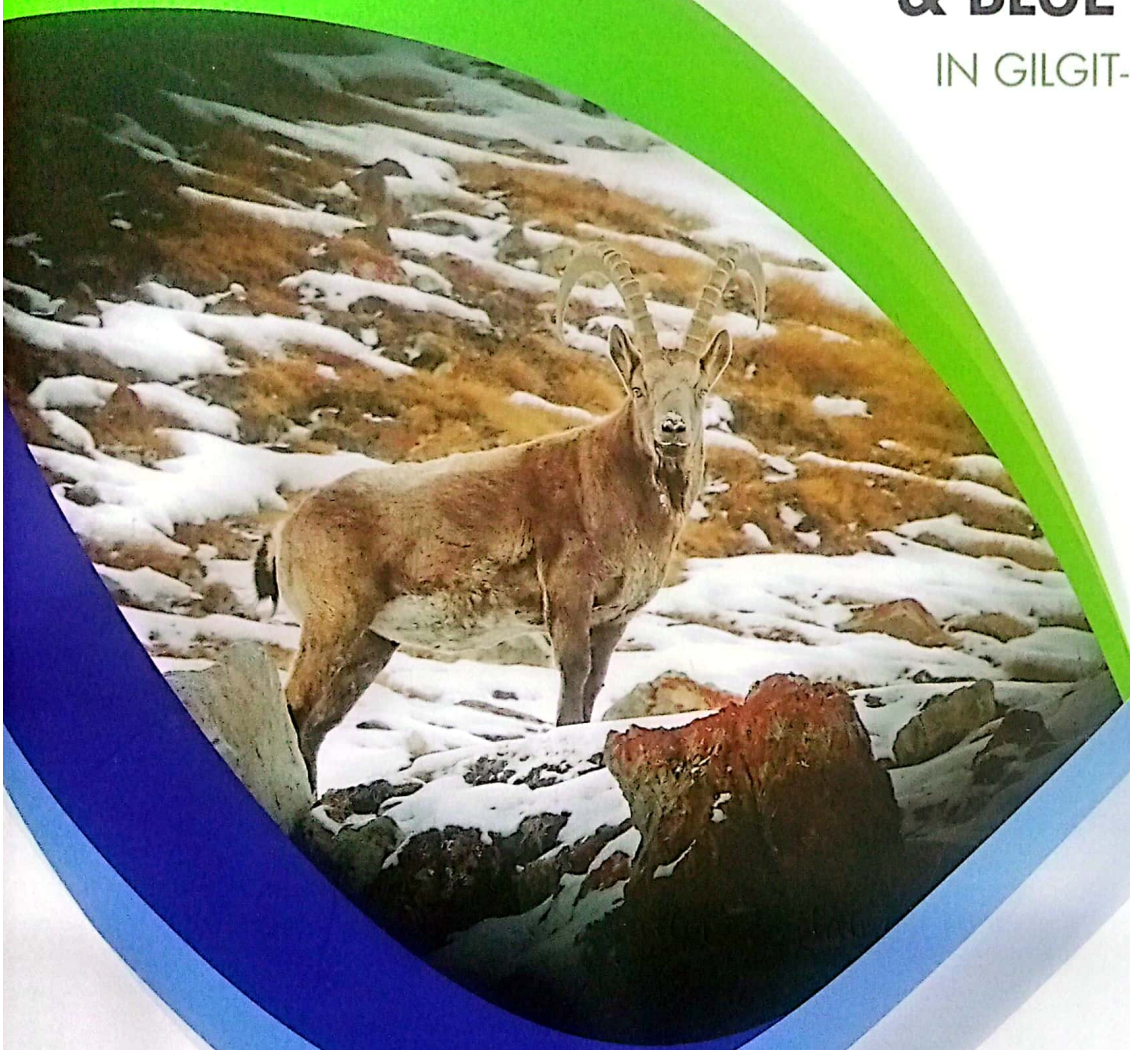
Forest, Parks and Wildlife Department
Government of Gilgit-Baltistan

RUT SEASON SURVEY REPORT 2022-23

HIMALAYAN IBEX & BLUE SHEEP

IN GILGIT-BALTISTAN



PARKS & WILDLIFE Gilgit Baltistan

FOREST DEPARTMENT Gilgit Baltistan

10 Billion Tree Tsunami 2020

SNOW LEOPARD FOUNDATION

DARWIN INITIATIVE

RUT SEASON SURVEY REPORT 2022-23

HIMALAYAN IBEX *(Capra sibirica)*

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IN GILGIT-BALTISTAN, PAKISTAN

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RUT SEASON SURVEY REPORT 2022-23

HIMALAYAN IBEX *(Capra sibirica)* & BLUE SHEEP *(Pseudois nayaur)* IN GILGIT-BALTISTAN, PAKISTAN

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Table of Contents

List of Tables

List of Figures

List of Plates

REPORT SUMMARY

Plate 1: Herd of male Himalayan ibex prior to rut season

Trophy hunting is a controversial issue with varying opinions regarding its impact on wildlife conservation. On one hand, some experts argue that the revenue generated from hunting can be used to fund conservation efforts and anti-poaching measures, making it a valuable tool for protecting animal populations. Furthermore, hunting can help control animal populations and prevent overgrazing, which can have negative effects on the local ecosystem. However, others contend that hunting can harm animal populations and be inhumane. Despite the potential benefits of trophy hunting, it is important to carefully consider its potential consequences. Negative impacts on animal populations and ecosystems must be weighed against the benefits of generating revenue for conservation efforts.

Despite this common debate, trophy hunting has been successful in Gilgit-Baltistan, where communities have benefited from millions of PKRs in revenue generated by trophy hunting. The Parks and Wildlife Department ensures that, prior to allocating trophy quotas, the impact of trophy hunting is assessed through population estimation surveys. These surveys are used to ensure that the population of wildlife is increasing and to allocate trophy quotas for the following year.

Using the double observer method, the population of blue sheep*(Pseudois nayaur)* was estimate in district Hunza and that of Himalayan ibex *(Capra sibirica)* was estimated in nine districts, including Hunza, Nagar, Ghizer, Gilgit, Astor, Shigar, Skardu, Karmang, and Ghanche.

Using Bayesian statistics in BBRecapture package of R, the estimated population of blue sheep was 695 (380 – 1,154 at 95% confidence interval) and the ibex estimated population was 6,055 (5,185 – 7,192 at 95% confidence interval). The number of individuals sighted in different demographic categories of blue sheep were 199 females, 112 young, 99 yearling, 82 class 1, 74 class 2, 48 class 3, 81 class 4, and 45 trophy size animals within class, 4 the male to female ratio was 1:1.43, while in case of Himalayanibex there were 2,317 females, 1,032 young, 814 yearling, 329 class 1, 336 class 2, 369 class 3, 807 class 4, and 505 trophy males within class 4 males, the male to female ratio was 1:1.25.

The number of both species has increased compared to previous year survey, and we recommend that 14 blue sheep and 121 Himalayan ibex can be harvested using the 2% of the population rule, and 12 blue sheep and 127 Himalayan ibex can be harvested using the 25% of trophy males rule.

1. INTRODUCTION

Gilgit-Baltistan (GB), the northernmost entity in Pakistan, has many attractions owing to its landscape, such as the world's largest mountain ranges, the Himalayas, Hindu Kush, and Karakoram-Pamir, which bask in the shadow of the world's second-highest peak, K2. These mountain ranges also have many glaciers, which are considered the longest glaciers outside of the North Pole.

Plate 2: Blue sheep in its habitat

On the mountain ranges of Gilgit-Baltistan, some of the world's rarest wildlife species, such as the snow leopard *(Panthera uncia)*, brown bear *(Ursus arctos isabellinus)*, Asiatic black bear *(Ursus thibetanus)*, and grey wolf *(Canus lupus)*, roam. These carnivore species feed on some of the most coveted trophies, such as the Astor markhor *(Capra falconeri falconeri)*, Himalayan ibex *(Capra sibirica)*, blue sheep *(Pseudois nayaur)* , Ladakh urial *(Ovis vignei vignei)*, and Marco Polo sheep *(Ovis ammon polli)* (Ali et al., 2021).

Since the inception of the trophy hunting program in GB, not only has the population of wild ungulates increased, but the number of carnivores has also increased, and the number of ungulates offered as trophy animals is increasing (Ahmad et al., 2022; Haider et al., 2021; Khattak et al., 2019). However, the number of non trophy animals has not increased at the same rate (Ali et al., 2019; Din et al., 2016; Haider et al., 2021).

The trophy hunting program is a mutually beneficial agreement in which custodian communities pledge to protect wildlife and, in return, receive 80% of the proceeds from legal hunts, which they use for social development in their valley. There are many successful stories of how these proceeds have been used for education and health development (Shackleton, 2001). The program has also helped to recover the population of the once widely distributed Himalayan ibex and blue sheep from the brink of extinction.

1.1 Himalayan Ibex

The Himalayan ibex, also known as the Asiatic or Siberian ibex, occurs in the mountain ranges starting from the Eastern Siyan to the Himalayas, making it a widespread presence in the northern ranges of many countries including Afghanistan, China, India, Kazakhstan, Kyrgyzstan, Pakistan, Russia, Tajikistan, and Uzbekistan (Figure 1 A). In Pakistan, it is the most numerous species of genus *Capra* and mostly occurs in the northern parts of the country on the mountain ranges of the Himalayas, Karakoram, Pamir, and Hindu Kush in the provinces of Gilgit-Baltistan, Khyber Pakhtunkhwa (KPK), and in the state of Azad Jammu and Kashmir (AJ&K) (Figure 1 B). Despite its wide range distribution, the population of ibex is in decline globally and it has recently been up listed from "Least Concern" to "Near Threatened" on the IUCN (International Union for Conservation of Nature) red list (Reading et al., 2020), while in Pakistan the ibex has been listed as "Least Concern" (Sheikh & Molur, 2004).

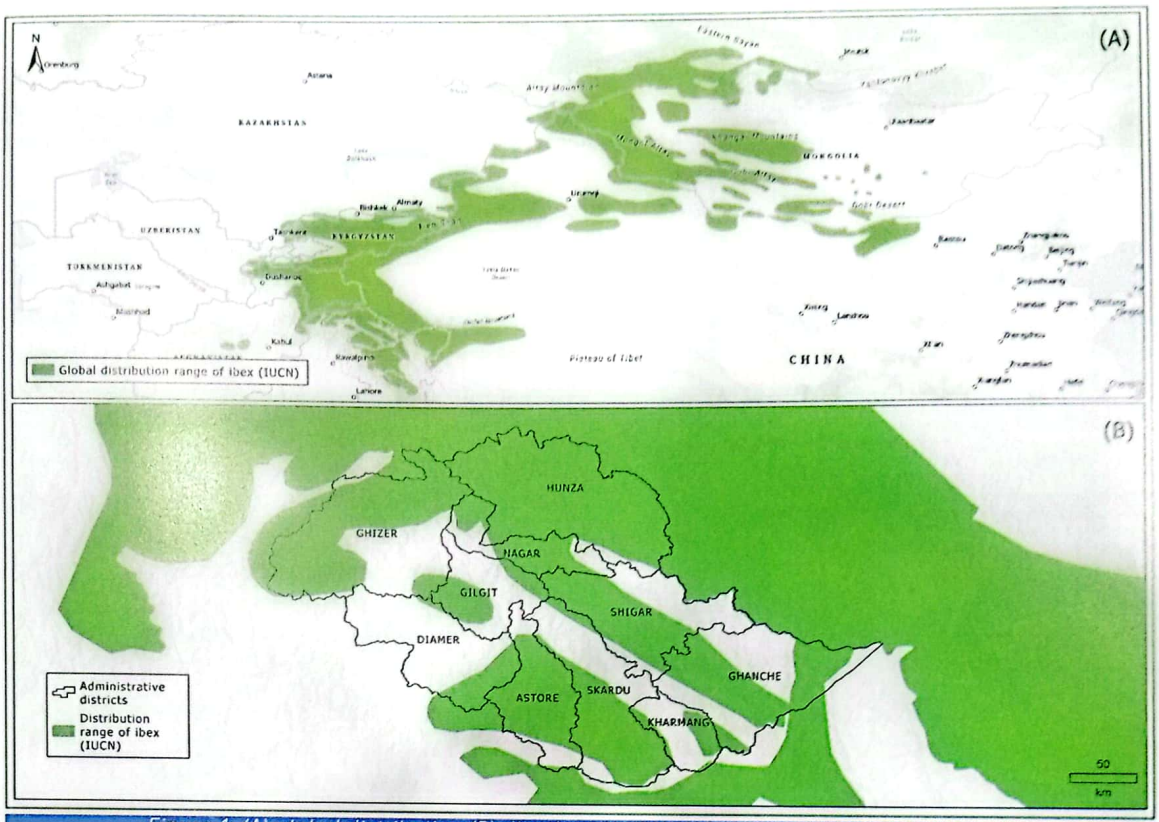


Figure 1: (A) global distribution (B) distribution of Himalayan ibex in Gilgit-Baltistan

The Himalayan ibex is a highly dimorphic animal with males of the species being heavily built within the genus *Capra*, having large elegant backward horns, and with an adult male's body weight reaching up to 130 kg (about 286.6 lb.) and that of females up to 60 kg (Schaller, 1977) (Figure 2).

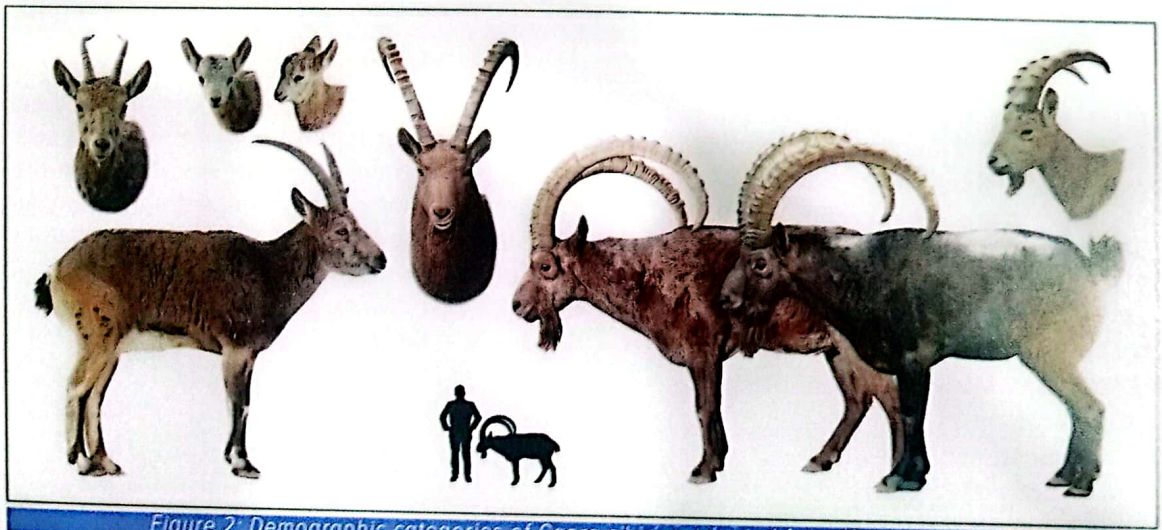


Figure 2: Demographic categories of Capra sibirica adopted from (Castelló, 2016)

1.2 Blue Sheep

Blue sheep, also known as bharal in local languages, is an Intermediate between a goat and sheep, the morphology of the blue sheep looks like a sheep, but its behavior and habitat requirements are more like a goat (Schaller, 1977). It is found in the high-altitude regions of the Himalayas in China, India, Nepal, Pakistan, and Bhutan (Figure 3 A). In Pakistan, it is endemic to the northernmost parts of the district of Hunza in Gilgit-Baltistan (Figure 3 B).

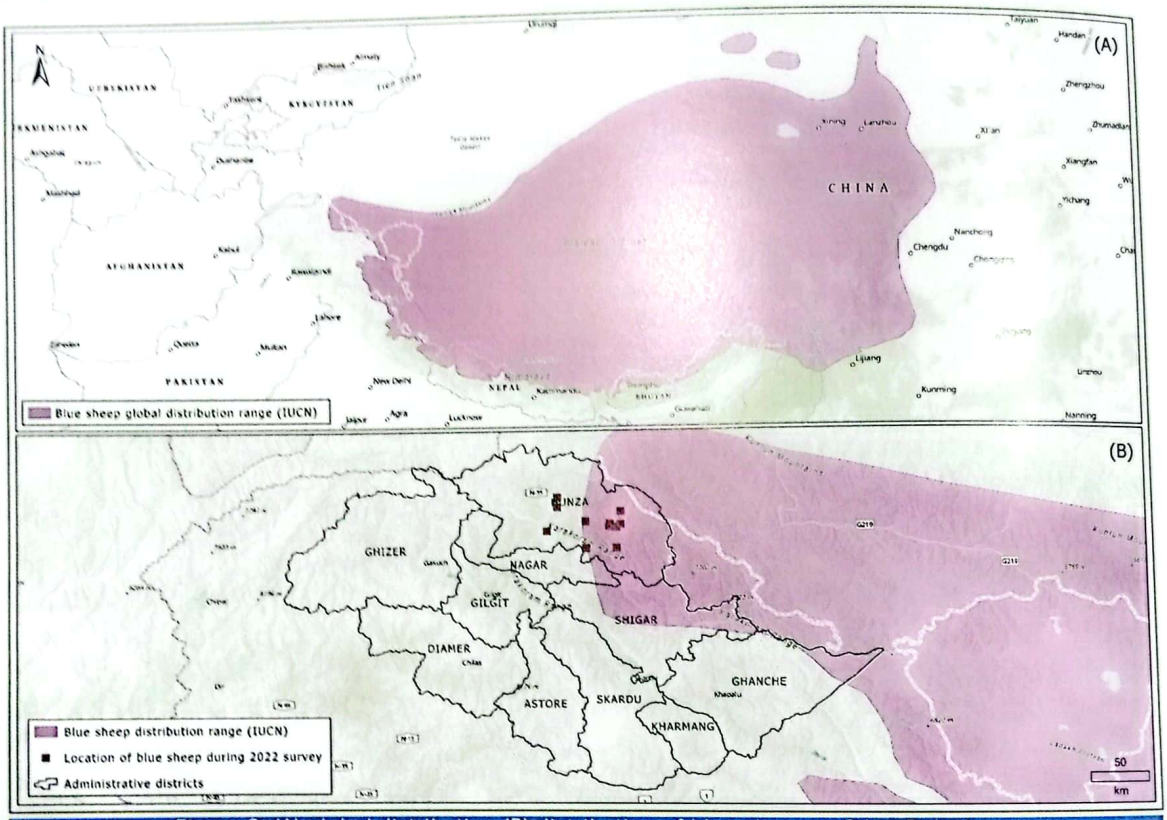


Figure 3: (A) global distribution (B) distribution of blue sheep in Gilgit-Baltistan

Blue sheep inhabit rugged terrain and steep rocky slopes at elevations between 3,000 and 5,500 meters. They are adapted to survive in harsh environments, including extreme cold and high winds. Blue sheep have a thick, woolly coat that can range in color from gray blue to reddish-brown. They are gregarious animals and form herds of up to 100 individuals. They are herbivores and feed on a variety of grasses, herbs, and shrubs (Schaller, 1977). It is a dimorphic animal, with males having larger horns and body size than females. Males may weigh up to 75 kg, while females may weigh up to 45 kg (Schaller, 1977) (Figure 4). The blue sheep is listed as "Least Concern" on the IUCN red list (Harris, 2014), while in Pakistan it is listed as "Endangered" (Sheikh and Molur, 2004).

...graphic categories of Pseudois nayyaur adopted from (Castelló, 2016)

1.3 Objectives of Study

The Himalayan ibex and blue sheep are the most numerous and abundant wild ungulates in Gilgit-Baltistan, and the trophy hunting program depends largely on these two species. Over 100 ibex and 14 blue sheep trophies are offered for auction each year. To ensure the sustainability of this natural resource, it is important to check the effectiveness of trophy hunting on wild ungulates and the ecosystem (Singh & Milner-Gulland, 2011). This can only be achieved through annual monitoring surveys. Therefore, this survey was undertaken with the following objectives:

1) To assess the distribution and population of Himalayan ibex and blue sheep in Gilgit-Baltistan.
2) To document the trophy size animals in different community-controlled hunting areas and recommend trophy quotas for 2023-2024.
3) To predict the estimated population of Himalayan ibex and blue sheep using Bayesian statistics.

2. MATERIALS AND METHODS

2.1 Study Area

The survey was conducted in the 52 Community Controlled Hunting Areas (CCHAs) of district Astore, Diamer, Hunza, Ghizer, Ghanche, Gilgit, Karmang, Nagar, and Skardu (Figure 6), the number of CCHAs in each district is shown in (Figure 6). The survey for blue sheep was conducted from 29th November 2022 to 10th December 2022 in Shimshal and 17th February 2023 to 22nd February 2023 in Sockterabad Nullah of KVO, while the teams conducted surveys for Himalayan ibex from 29th November 2022 to 25th December 2022.

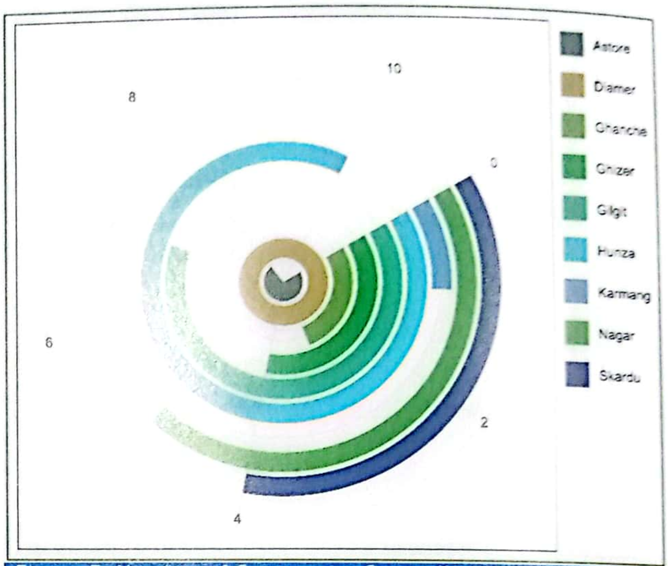


Figure 5: Number of Community-Controlled Hunting Areas in each district

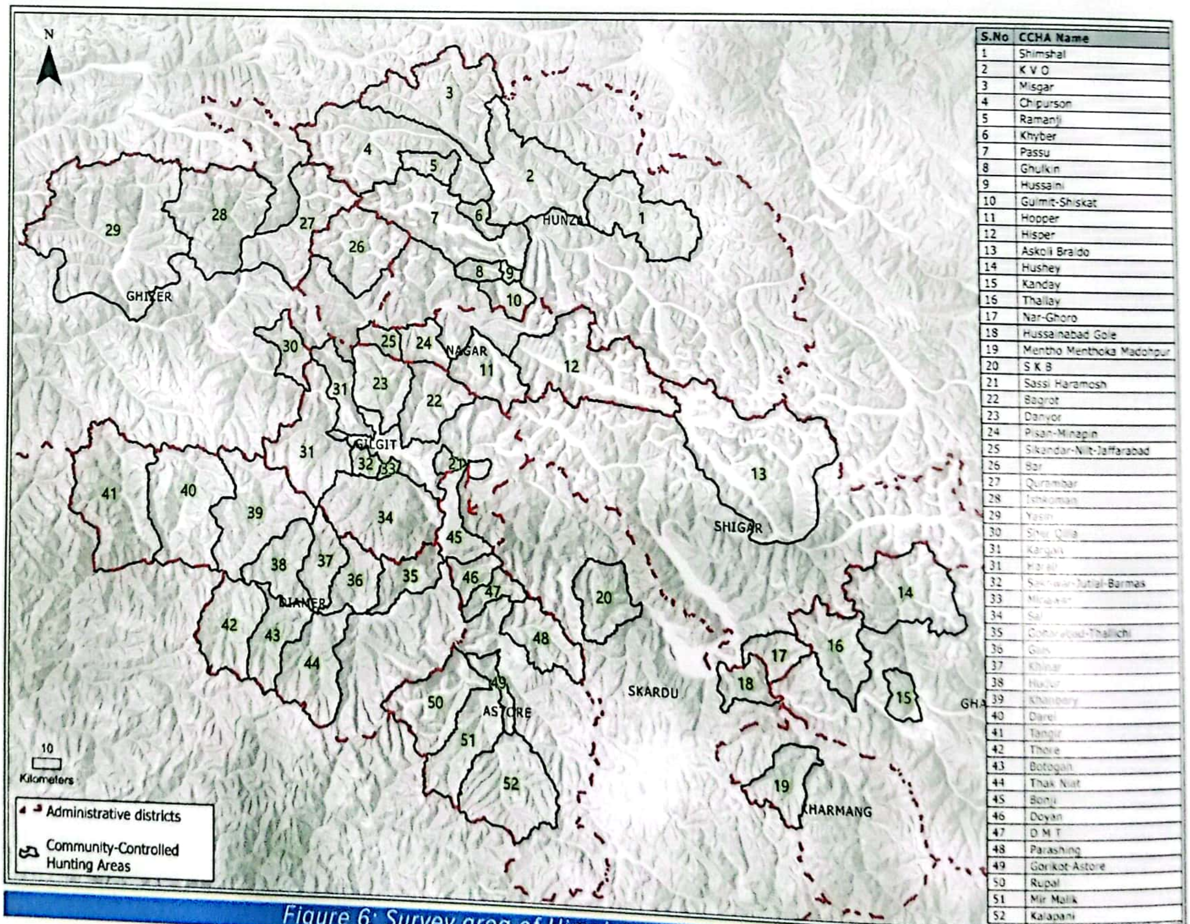


Figure 6: Survey area of Himalayan ibex and blue sheep

2.2 Double Observer Method

The double observer method (DOM) was used, which is based on the principles of mark-recapture. The method was originally developed to estimate the detection probabilities of aerial surveys for various wildlife species (Caughley, 1977), the DOM equation was modified by Magnusson et al. (1978) to account for observer differences in detecting the target species. Forsyth and Hickling (1997) applied the DOM to ground surveys for the first time, to estimate Himalayan Thar in New Zealand.

The method involves two observers who scan and count animals, either separated by space or time in survey blocks not larger than the daily movement range of humans or animals. The blocks are defined by physical features, such as high ridges and rivers that may prevent animals from moving between blocks.

2.3 Data Collection in the Field

The survey maps were developed by dividing each CCHA (Community Controlled Hunting Areas) into small blocks of area (25 – 40 km2) using Arc GIS Pro *version* 3.1.0 (ESRI, Redland, California USA).

2.4 Scanning for Animals

Mountain ungulates are crepuscular (Roberts, 1997; Schaller, 1977, 1980), so scans were conducted at dawn and dusk. Spotting scopes (Swarovski 30 x 70) and binoculars (Nikon 10x50) aided the scanning effort. Whenever a herd was sighted, the necessary information (size, type, demography, location, elevation etc) was recorded on a field data collection sheet. Geographical Positioning System (GPS) device, such as Garmin 64S, 66S, or 66ST, was used to record the observer's location, and the location of herd was delineated on the map.

2.5 Demographic Classification

The "Capture Recapture" method can only be accurately applied to wild ungulates if they are dimorphic and can be identified based on age classes (Suryawanshi et al., 2012). By using the demographic classification suggested by Schaller (1977) shown in Table 1, the herds were identified. The composition of the herds, such as female herds (females and young), male herds (only males), and mixed herds (males, females, and young), was recorded to aid in identifying repeated captures and single captures. The number of trophy-sized animals within class IV was separately recorded.

Table 1: Demographic classification proposed by Schaller (1977) for mountain ungulates

Female Classification	Kids Classification		Males Classification				
Female > 2	Young < 1	Yearling 1 < 2	Class I ($2^{1/2}$) years	Class II ($3^{1/2}$) Years	Class III ($4^{1/2}$) Years	Class IV ($5^{1/2}$) Years	Trophy Size Within Class IV

2.6 Habitat Features of Herds Location

To distinguish the herds sighted by both observers, the habitat features, such as snow, bare rock, glacier, rangeland, shrubs, mixed forest, and slope (North, South, East, and West), were recorded. The behavior of the herd at the time of sighting, such as feeding, walking, running, or resting, was also noted to ensure that the animals had given the observer a chance to count them well.

2.7 Post Survey Discussion

Both observers cross-checked field records in the evening, noting repeated and single groups based on herd size, composition, habitat type, location, and behavior. The data was then compiled in summary sheets for later population estimation analysis.

2.8 Data Analysis Approach

The total number of Astore markhor and Ladakh urial groups was estimated using the two-survey mark-recapture in the "BBRecapture" package that uses the Bayesian framework in R statistical and programming environment (Fegatelli & Tardella, 2013) version 4.2.2, R Core Team, 2022.

We analyzed group size following (Ahmad et al., 2022; Khanyari et al., 2021; Suryawanshi et al., 2012). We used age-sex composition and location of sightings to determine if the groups were seen by one or both teams. Groups seen by both teams were coded as "11", groups seen only by the first observer as "10", and groups seen only by the second team as "01".

We modeled the detection of the two teams separately ("mt" model). To estimate the number of ibex and blue sheep groups ($\hat{G}$) in our study areas, we used the "BBRecap" function with a "uniform prior" for each species. The "mt" model was chosen because detection probability was expected to differ between the two surveys (Suryawanshi et al. 2012). The model was run for 10,000 mcmc iterations with a 1000 burn-in (Fegatelli & Tardella, 2013).

The model "mt" estimated detection probabilities for observer teams one and two for occasions one and two. We calculated the total population (Nest) of each ungulate species by multiplying the estimated number of groups ($\hat{G}$) and the estimated mean group size (μ). To estimate the confidence intervals for the population, we created a distribution of estimated group size by resampling it 10,000 times with replacement. Then, we generated a distribution of estimated population by multiplying 10,000 random draws of estimated number of groups ($\hat{G}$) weighted by posterior probability and draws of mean group size (μ). The median of the resulting distribution was taken as the estimated ungulate population (Nest) with the 2.5 and 97.5 percentiles as the confidence intervals.

To determine the 95% confidence intervals of the proportion of individuals from different age-sex classes (adult male, adult female, and young), we performed 10,000 bootstraps using the herd as the sampling unit. The median values were taken as the estimates, and the 0.025 and 0.975 quartiles served as the 95% confidence intervals.

To calculate densities, we divided the estimated abundance by the total area sampled. The total area was obtained by summing the areas of all surveyed blocks, which were demarcated as the visible areas in each block using Arc GIS Pro *version* 3.1.0 by the survey team after the survey.

3. RESULTS

3.1 Population of Himalayan Ibex and Blue Sheep

Using the double-observer survey, we counted 695 blue sheep in Shimshal and Sockterabad. The estimated population was 695, with a range of 380 – 1,154 at a 95% confidence interval (Table 2). The blue sheep were sighted in 13 herds (Figure 10), with a median herd size of 35 animals, and the herd size ranged from 1 – 230 animals per herd. The highest number of blue sheep were sighted in Shimshal (633 animals) followed by Sockterabad Valley (62, animals) (Table 3 and Figure 7).

We also counted 6,012 ibex across Gilgit-Baltistan, with an estimated population of 6,055 ranging from 5,085 – 7,192 at a 95% confidence interval (Table 2). The ibex was sighted in 277 herds (Figure 9), with a median herd size of 13 and a range of 1 – 348 animals per herd. The highest number of ibex was found in the Hunza district (Table 4 and Figure 8), followed by the district of Nagar (657).

Table 2: Information about Blue sheep and Himalayan ibex in Gilgit-Baltistan.

Statistics	Blue sheep	Himalayan ibex
Number of Community-Controlled Hunting Areas	2	52
Detection Probability of Observer ONE	0.92	0.96
Detection Probability of Observer TWO	0.92	0.77
Observer ONE total	695	5,843
Observer ONE total groups	13	59
Observer TWO total	695	4,741
Observer TWO total groups	13	7
Common groups	13	209
Total groups	13	277
Mean group size	53.46	21.86
Estimated population	**695**	**6,055**
± 95% Confidence interval	**380 – 1,154**	**5,085 – 7,192**
Percentage of male	41.00	30.62
Percentage of trophy males within males	15.78	27.43
Percentage of female	28.63	38.53
Percentage of young	16.11	17.16
Percentage of yearlings	14.24	13.59
Ratio (Male: Female)	1:1.43	1:1.25
Ratio (Female: Young)	1:1.77	1:2.24
Ratio (Young: Yearling)	1:1.13	1:1.26

Table 3: Population of blue shee in Shimshal and Sockhterabad district Hunza

Valley	Female	Young	Yearling	Class1	Class2	Class3	Class4	Total	Trophies
Shimshal	176	100	92	78	68	44	75	633	40
Sockterabad	23	12	7	4	6	4	6	62	5
Total	**119**	**112**	**99**	**82**	**74**	**48**	**81**	**695**	**45**

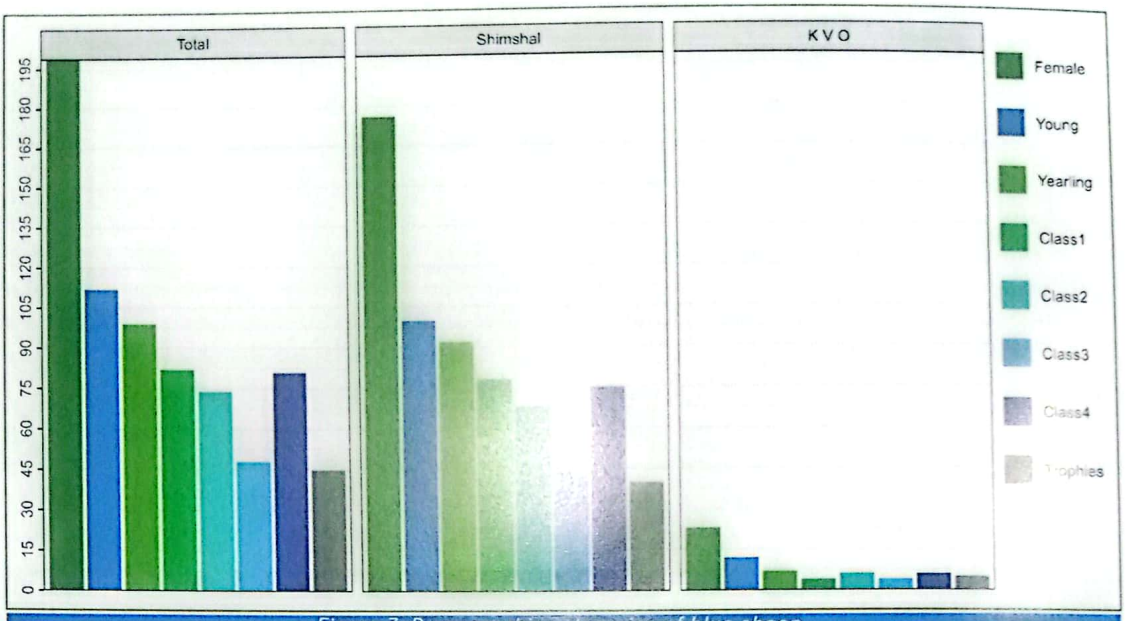


Figure 7: Demographic categories of blue sheep

Plate 3: Herd of blue sheep in Sockterabad (Photo: Snow Leopard Foundation)

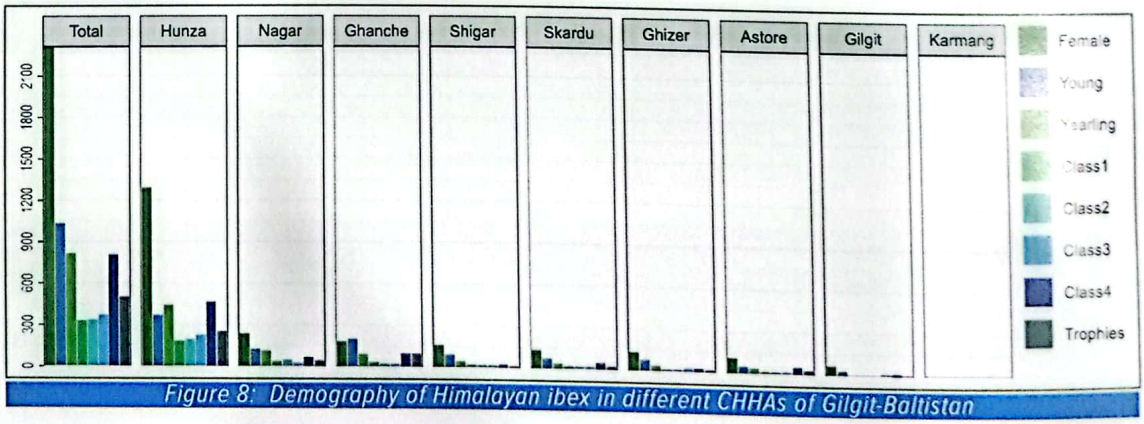
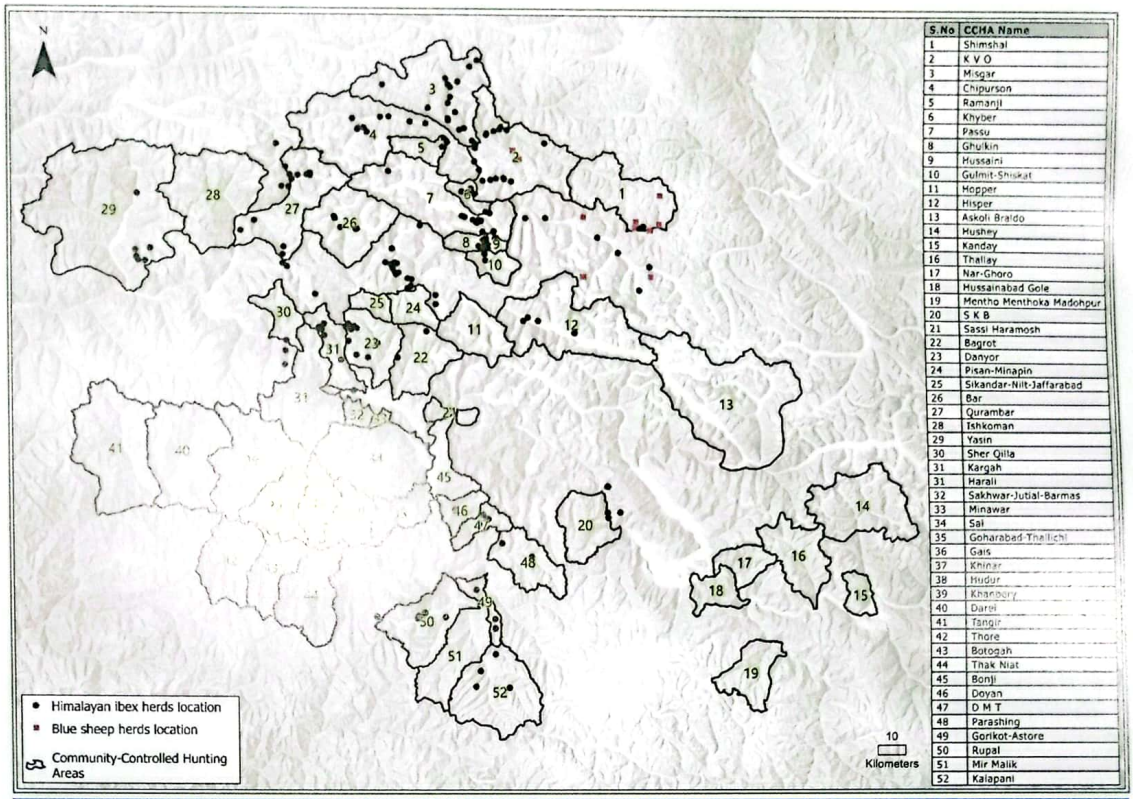


Figure 8: Demography of Himalayan ibex in different CHHAs of Gilgit-Baltistan

Table 4: Population of Himalayan Ibex in different Community-Controlled Hunting Areas, Gilgit-Baltistan

District	Valley	Female	Young	Yearling	Class1	Class2	Class3	Class4	Total	Trophies
Hunza	Misgar	201	110	70	62	55	59	142	699	89
	Passu	196	68	36	23	32	28	67	450	34
	KVO	190	53	99	18	20	30	56	466	26
	Khyber	153	24	60	37	37	32	53	396	26
	Ghulkin	141	24	32	13	10	12	50	282	24
	Hussaini	169	11	45	14	9	14	19	281	11
	Shimshal	85	23	22	2	9	22	28	191	9
	Chipurson	64	25	39	11	11	13	17	180	10
	Gulmit	56	21	20	3	6	5	26	137	20
	Ramonji	34	12	19	0	6	11	10	92	6
	District Total	**1289**	**371**	**442**	**183**	**195**	**226**	**468**	**3174**	**255**
Nagar	Hisper	155	83	84	23	31	13	31	420	23
	Bar	22	6	14	3	3	2	25	75	17
	Hopper	18	20	8	8	5	6	7	72	4
	Sikanderabad-Nilt-Jaffarabad	17	7	5	2	3	3	1	38	1
	Sumayar Valley	8	3	3	1	1	1	1	18	0
	Pissan-Minapin	16	8	0	2	4	1	4	35	2
	District Total	**236**	**127**	**114**	**39**	**47**	**26**	**69**	**658**	**47**
Gilgit	Bagrot	32	15	0	1	3	6	10	67	5
	Sassi Haramosh	15	8	0	0	1	2	4	30	4
	Danyor	23	9	3	2	1	5	2	45	1
	District Total	**70**	**32**	**3**	**3**	**5**	**13**	**16**	**142**	**10**
Astore	Rupal	43	20	10	12	6	2	24	117	17
	Kala Pani	17	10	12	1	0	7	15	62	8
	Gorikot-Astore	15	7	6	0	4	4	0	36	0
	Parashing	9	4	4	0	1	1	2	21	0
	D M T	20	8	6	2	2	2	8	48	8
	Mir Malik	6	1	0	1	1	1	4	14	1
	District Total	**110**	**50**	**38**	**16**	**14**	**17**	**53**	**298**	**34**
Ghanche	Hushey	103	110	47	16	10	10	52	348	52
	Kandy	23	45	18	6	6	6	25	129	25
	Thallay	56	45	25	11	6	6	21	170	21
	District Total	**182**	**200**	**90**	**33**	**22**	**22**	**98**	**647**	**98**
Shigar	Askoli Braldo	161	93	46	20	18	18	24	380	16
	District Total	**161**	**93**	**46**	**20**	**18**	**18**	**24**	**380**	**16**
Skardu	S K B	51	30	25	0	0	10	30	146	10
	Bagicha and Khomera	84	44	14	19	18	11	21	211	15
	District Total	**135**	**74**	**39**	**19**	**18**	**21**	51	357	25
Kharmang	Mehdiabad Manthoka-Manthu	8	4	2	3	4	3	2	26	2
	District Total		**4**	**2**	**3**	**4**	**3**	2	26	2
Ghizer	Qurambar	108	72	36	9	10	22	21	278	17
	Ishkoman	19	7	4	3	2	1	1	37	1
	Yaseen	4	2	0	1	1	0	1	9	0
	Sher Qillah	3	0	0	0	0	0	3	6	0
	District Total	**134**	**81**	**40**	**13**	**13**	**23**	**26**	**330**	**18**



S.No	CCHA Name
1	Shimshal
2	K V O
3	Misgar
4	Chipurson
5	Ramanji
6	Khyber
7	Passu
8	Ghulkin
9	Hussaini
10	Gulmit-Shiskat
11	Hopper
12	Hisper
13	Askoli Braldo
14	Hushey
15	Kanday
16	Thallay
17	Nar-Ghoro
18	Hussainabad Gole
19	Mentho Menthoka Madohpur
20	S K B
21	Sassi Haramosh
22	Bagrot
23	Danyor
24	Pisan-Minapin
25	Sikandar-Nilt-Jaffarabad
26	Bar
27	Qurambar
28	Ishkoman
29	Yasin
30	Sher Qilla
31	Kargah
31	Harali
32	Sakhwar-Jutial-Barmas
33	Minawar
34	Sai
35	Goharabad-Thalichi
36	Gais
37	Khinar
38	Hudur
39	Khanbory
40	Darel
41	Tangir
42	Thore
43	Botogah
44	Thak Niat
45	Bonji
46	Doyan
47	D M T
48	Parashing
49	Gorikot-Astore
50	Rupal
51	Mir Malik
52	Kalapani

Figure 9: Herd locations of Himalayan ibex and blue sheep in different CCHAs

3.2 Population Density

The highest per square kilometer occupancy of blue sheep was observed in the CCHA of Shimshal Valley i.e., 0.95, followed by Sockterabad Nullah of KVO CCHA with 0.06 animals/km^2 (Figure 10). The highest density of Himalayan ibex was recorded in Hussaini CCHA e.g., 7.88 animals/km^2 followed by Khyber with 3.82 and Ghulkin 2.84 animals/km^2 (Figure 11).

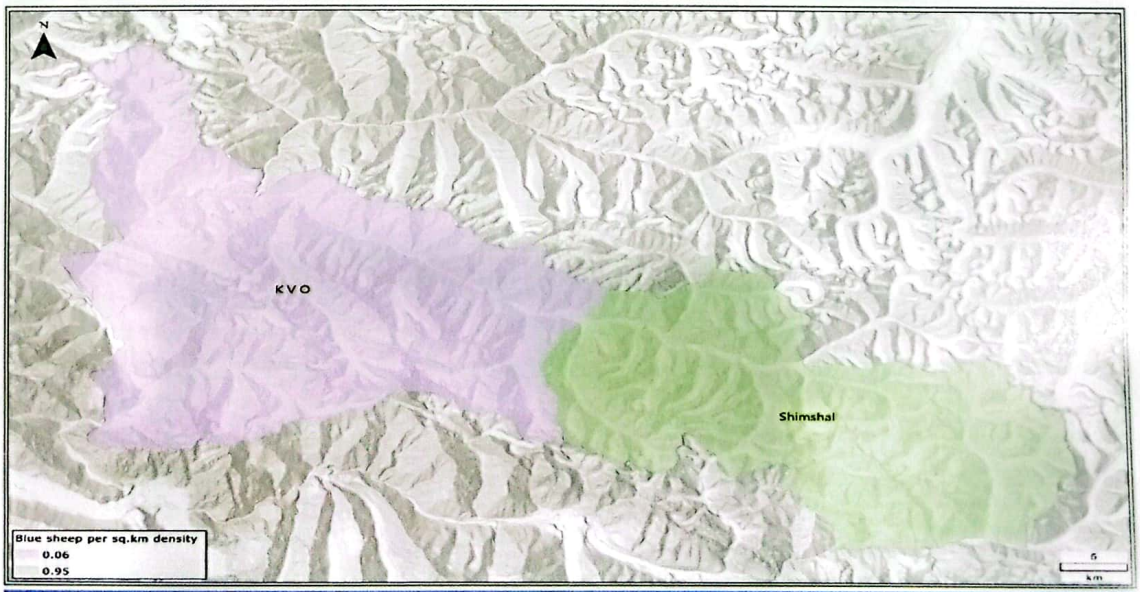


Figure 10: Population density of blue sheep in the surveyed CCHAs

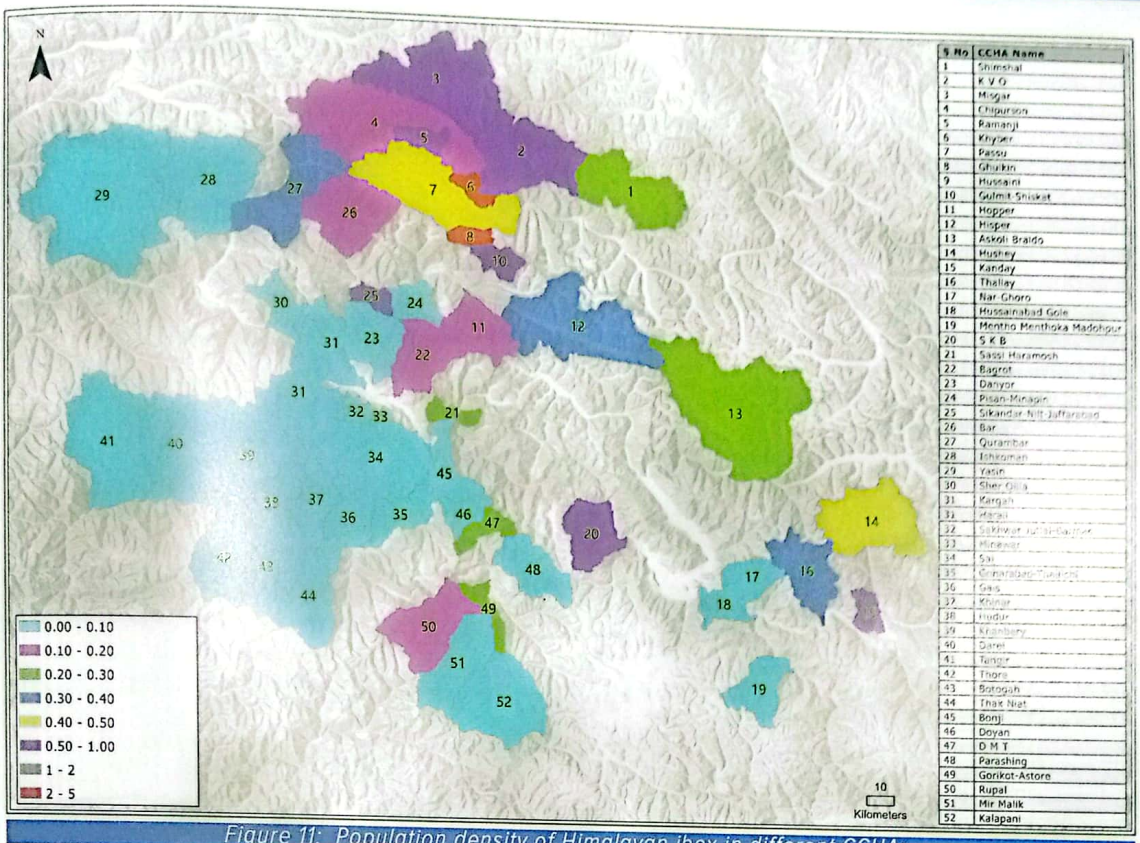


Figure 11: Population density of Himalayan ibex in different CCHAs

3.3 Population Trend

Compared to the 2021 survey, more blue sheep were sighted in Shimshal CCHA, and fewer blue sheep were sighted in Sockterabad Nullah of KVO CCHA (Figure 13). The population of Himalayan ibex has increased in the districts of Hunza, Nagar, Ghizer, Gilgit, Astore, and Skardu, while decreased in the districts of Ghanche and Shigar, while no change was observed in the district of Karmang (Figure 12).

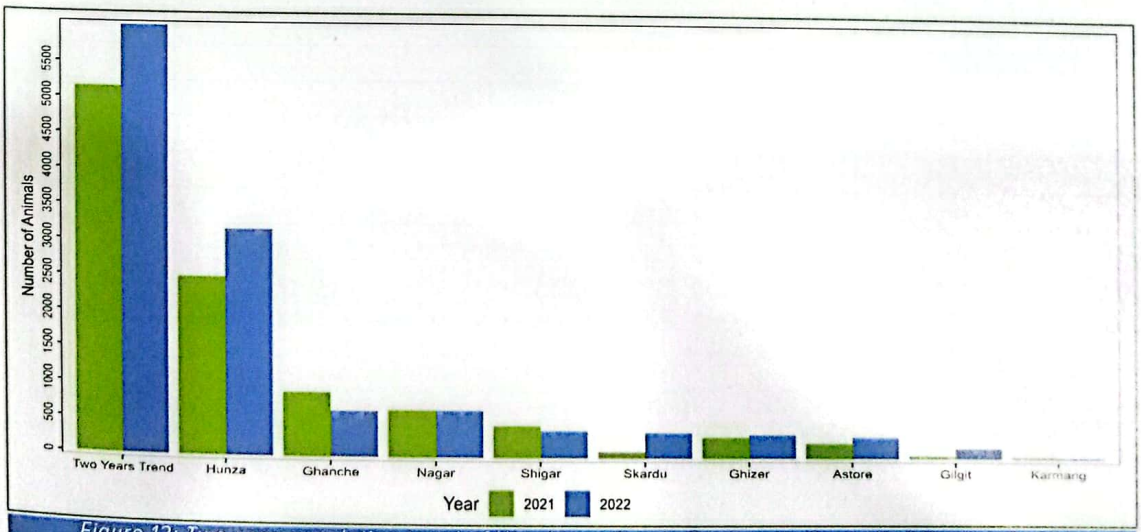


Figure 12: Two-year population trend of Himalayan ibex in Community-Controlled Hunting Areas

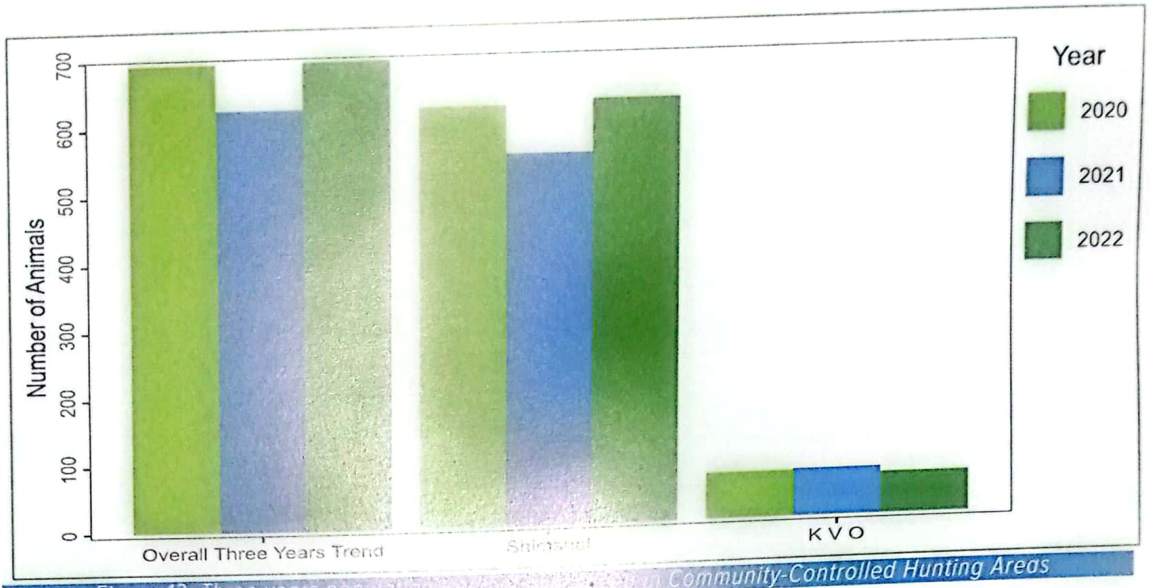


Figure 13: Three years population ... Community-Controlled Hunting Areas

3.4. Number of Harvestable Animals for Year 2024

Using the 2% of the total population rule (i.e., 695 blue sheep), fourteen blue sheep can be harvested. However, if the 25% of trophy animals (45) rule is followed, then only 12 blue sheep may be harvested in the year 2023-2024. Using the same rules, either 121 (2% of 6,012 animals) or 127 (25% of 505 trophy males) Himalayan ibex can be harvested during the same year (Adhikari et al., 2021; Zaman et al., 2019).

4. DISCUSSION

Globally, the population of wild ungulates is decreasing due to a combination of poaching and climate-related pressures (Ali et al., 2021). However, in many places, ungulate populations have not only recovered from the brink of extinction, but their numbers have also increased substantially. Gilgit-Baltistan is one of those places where the population of wild ungulates has increased from almost zero to hundreds in just two decades, thanks to the success of trophy hunting (Ali et al., 2022).

At present, the government of Gilgit-Baltistan offers trophies of Astor markhor, Himalayan ibex, and blue sheep (Ali et al., 2022; Asif et al., 2022). Prior to allocating trophies, the Parks and Wildlife Department of Gilgit-Baltistan conducts annual monitoring surveys of wild ungulates to assess the effectiveness of trophy hunting on ecosystems and species. These surveys are considered equally important to ensure the continuity of trophy hunting as well as providing socio-economic benefits to impoverished communities (Singh & Milner-Gulland, 2011).

Plate 4: Herd of Himalayan ibex in its hibitat

We counted 695 blue sheep, with an estimated population of 695 (380 – 1,154 CI). This total count of blue sheep is higher than that reported by Ali et al. (2022). Additionally, we counted 6,012 Himalayan ibex, with an estimated population of 6,055 (5,085 – 7,192 CI), Ali et al. (2022) reported 5,114 Himalayan ibex.

Plate 5: A Himalayan red fox seen near ibex herd

The populations of both blue sheep and Himalayan ibex are on the rise. We observed male to female ratios of blue sheep that were more or less similar to those reported by Ali et al. (2022), i.e., 1:1.43, and male to female ratios of 1:1.25 for Himalayan ibex.

During the year 2023-2024, 14 blue sheep and 121 Himalayan ibex can be harvested using the 2% of total population rule, and 12 blue sheep and 127 Himalayan ibex can be harvested using the 25% of trophy males rule (Adhikari et al., 2021; Zaman et al., 2019).

The populations of both blue sheep and Himalayan ibex have increased compared to the numbers reported by Ali et al. (2022). This is an evidence that trophy hunting is having a positive impact on the species, the ecosystem, and the socio-economy of the local people.

4.1 Recommendations

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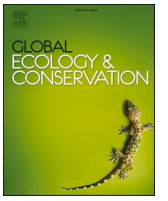

Spatial density pattern of Himalayan Ibex *(Capra sibirica)* in Pakistan

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ABSTRACT

Mountain ungulates perform a key role in maintaining the balance of ecosystems as they are the primary consumers of vegetation and prey for large predators. The mountain ranges of northern Pakistan are home to six species of mountain ungulates, and the Himalayan ibex *(Capra sibirica)*, hereafter ibex, is the most abundant among them. This study was conducted in three administrative regions of northern Pakistan, viz. Gilgit-Baltistan (GB), Azad Jammu and Kashmir (AJK), and Khyber Pakhtunkhwa (KP), to generate a range-wide density pattern map of ibex. A double-observer survey was conducted in 25 study sites during 2018–2021 across the ibex distribution range, covering an area of about 35,307 km^2, by walking transects totaling 1647 km. Within the ibex range where the survey was not conducted due to financial and logistical constraints, we obtained species population information from local wildlife departments' most recent annual survey data. The aim was to generate a density map for the entire ibex range. Using the BBRecapture package in program R, we estimated an ibex population of 7639 (95 % CI) with a mean density of 0.21/km^2 in the surveyed area. Combining with the secondary data from un-surveyed areas, the total population estimate for the country came to 10,242 ibex. The largest population densities were observed in four valleys (Shimshal, Gulkin-Hussaini, Khyber, and Khunjerab) of the Karakoram-Pamir range, followed by the Hindu Kush range (Chitral Wildlife Division [WD]). The central and eastern parts of the Karakoram range had moderate to low densities, while the Himalayan range (e.g., Astore Valley) supported a small population. The mean herd size was 15 individuals (range: 5–41), and the average detection probability of observers A and B was 0.69 and 0.48, respectively. The average male and young ratios per 100 females were estimated to be 75 and 81, respectively. The range-wide density map developed during the study provided an evidence for the impact of trophy hunting programs and an objective tool for range-wide conservation planning of the species.

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1. Introduction

Wild ungulates play a vital and vigorous role in maintaining a balance in ecosystems through nutrient recycling, by influencing vegetation structures and species composition and serving as prey for large carnivores (Karanth et al., 2004; Suryawanshi et al., 2017, 2012). The conservation of ungulates has a direct relationship with the conservation of their predators (Khara et al., 2021) because the former constitute a major portion of large carnivores' diets (Bagchi et al., 2003; Jathanna et al., 2003). The available density of ungulate prey is an important determinant of the density of large predators (Karanth et al., 2004; Tumursukh et al., 2016). For example, declines in the populations of tigers *(Panthera tigris)* were attributed to low prey populations (Dinerstein et al., 2007). A clear connection between the number of tigers and their prey densities has been established in previous studies (Karanth and Stith, 1999; Karanth, 1995; Schaller, 2013).

The mountains ecosystem of Central and South Asia has a rich diversity of mountain ungulate species (Schaller, 1998). However, these ungulate species are insufficiently studied, and information about their distribution and population is patchy, thus undermining the need for conservation efforts in this region (Singh and Milner-Gulland, 2011). In Pakistan, 11 ungulate species were found occupying diverse habitats in high-altitude areas in the north to the hills in desert areas in the south (Hess et al., 1997). The Himalayan, Hindu Kush, and Karakoram mountain ranges in Pakistan have significant diversity of globally recognized wild ungulates that are deemed important from a conservation standpoint (Khan et al., 2014). Six of the 11 ungulate species share habitats with snow leopards, including blue sheep *(Pseudois nayaur),* Marco Polo sheep *(Ovis ammon polii),* Ladakh urial *(Ovis vignei vignei),* Himalayan ibex *(Capra sibirica),* markhor *(Capra falconeri),* and Kashmir musk deer *(Moschus cupreus)*.

The global distribution range of Himalayan ibex (hereafter ibex) is spread across India, China, Afghanistan, Pakistan, Mongolia, Russia, Kazakhstan, Tajikistan, Uzbekistan, and Kyrgyzstan (Reading et al., 2020). In northern Pakistan, ibex are the most abundant wild ungulate species present in the snow leopard distribution range, although their numbers have contracted, limiting them to the extreme northern parts of the country—their distribution range extends from Khunjerab in the north to Swat district, Azad Jammu and Kashmir (AJK) to the south, and Chitral district to the west (Hess et al., 1997). In Pakistan, the ibex are well adapted to rough terrain and live above the tree line at an altitude range of 3500–5000 m in precipitous mountainous ranges (Roberts, 1977). They predominantly inhabit rocky mountainous regions, cliffs, open meadows, and low-elevation areas during heavy snowfall in winter (Fedosenko and Blank, 2001). The species mostly avoid areas of dense forest; during high-temperature periods in summer, it likes shaded areas beneath rocks or vegetation, and lives and remains near steep and escape terrain (Fedosenko and Blank, 2001). Globally, the species was recently declared 'Near Threatened' in the IUCN red data book (Reading et al., 2020). It is receiving limited attention in Pakistan where native population trends throughout its distribution range cannot correctly define its conservation status (Sheikh and Molur, 2005). The overall population status of ibex in Pakistan is unknown. Studies related to the population status of ibex *do* exist (Ahmad et al., 2020; Khan et al., 2016, 2020), but they are limited to small portions of the species' range.

Estimating the density or abundance of mountain ungulates is arduous and not generally conducted using statistically robust methods (Huapeng et al., 1997). The rough terrain they inhabit, the remoteness of the area, climate, financial support, logistics, commitment, technical capacity, low species density, their group-living habits, and the absence of clear identification marks on individuals, make population estimation a challenging task (Singh and Milner-Gulland, 2011; Wingard et al., 2011). The accurate population estimation of ungulate species is highly important for their conservation, although most existing methods are difficult to implement in mountainous areas (Pal et al., 2021). For example, distance sampling is a widely used method for the population and density estimation of large herbivorous species in tropical and temperate forests (Buckland et al., 2017), but meeting this method assumptions are difficult in mountainous areas (Corlatti et al., 2015; Suryawanshi et al., 2012). The distance sampling method was used by Wingard et al. (2011) in Mongolia for the density estimation of argali and found this method to be imprecise even in relatively accessible mountainous terrain. An alternative is aerial surveys, but they are expensive and unsafe in mountainous areas (Tumursukh et al., 2016). Suryawanshi et al. (2012) standardized the double-observer technique for the population estimation of mountain ungulates in the Himalayas; it was initially established by Forsyth and Hickling (1997) for the Himalayan tahr *(Hemitragus jemlahicus)*. The principle of the double-observer technique is based on the theory of capture-mark-recapture (CMR) (Forsyth and Hickling, 1997). A capture-recapture history can be built for each observed individual or group, and data can be analyzed in a CMR-like fashion (Williams et al., 2002).

Successful strategies for managing wide-ranging species need reliable information on population and density trends (Marques et al., 2001). This study was conducted in the ibex range of the Himalaya, Karakoram, and Hindu Kush mountain ranges in northern Pakistan using the double-observer technique to determine the spatial density of this key ungulate species. Secondary data was also collected for the un-surveyed area to develop a single density map for the species' entire distribution range in northern Pakistan. This study aims to construct the first-ever range-wide density map of ibex in Pakistan, based on empirical data. The spatial density pattern identified through this study will aid conservation planning for ibex across its range in Pakistan.

2. Materials and methods

2.1. Study area

This study was conducted in the ibex distribution range (Reading et al., 2020) in Gilgit-Baltistan (GB), AJK, and district Chitral of Khyber Pakhtunkhwa (KP) province in northern Pakistan (Fig. 1). Additionally, new areas reported as probably suitable habitat for ibex (Ali et al., 2021) and suggested by wildlife department officials were also searched for ibex occupancy, especially in GB. The study

area fell in the Karakoram, Himalayas, and Hindu Kush mountain ranges, connecting with China to the north, Afghanistan to the west, and India to the east. It is characterized by narrow valleys, steep, rugged, and high mountain peaks, and highland plateau (Abbas et al., 2013). The mountain ecosystem in the study area supports a unique diversity of flora and fauna. Climatic conditions vary widely across the study area, ranging from the Himalayas to the cold, semi-arid deserts of the northern Karakorams and the Hindu Kush, to a monsoon-influenced, moist temperate zone in the west. Winter rainfall and snowfall contribute to glacier ice accumulation and the recharge of groundwater resources (Abbas et al., 2013). Four vegetation zones are identified along with altitudinal ascents: alpine meadows, sub-alpine scrub zones, alpine dry steppes, and permanent snowfields (Hameed et al., 2020). Large mammalian carnivore species found in the study area include the common leopard *(Panthera pardus),* snow leopard, Himalayan lynx *(Lynx lynx),* wolf, brown bear, and Asiatic black bear *(Ursus thibetanus)*. Large-sized prey species are represented by markhor, blue sheep, ibex, Marco Polo sheep, musk deer, and Ladakh urial. The livestock reared by locals in the study areas includes domestic goat (*Capra hircus*), sheep (*Ovis aries*), cow (*Bostaurus indicus*), yak (*Bos grunniens*), horse (*Equus caballus*), and donkey (*Equus asinus*).

2.2. Survey methods

2.2.1. Double-observer technique

Using the double-observer survey, 25 study sites were surveyed (Fig. 2) within the ibex distribution range in northern Pakistan from 2019 to 2021 with the primary aim of determining the abundance and density of ibex. The surveys were carried out in different seasons (Table 1). Winter and spring are the most suitable survey seasons for the robust population estimation of ibex however in the current study we also conducted surveys in a few sites during summer to observe the new recruitment to the ibex population. The double-observer method is built on the same principles as the two-sample CMR technique (Williams et al., 2002) which capitalizes on the fact that theory allows for population size to be estimated based on just two surveys (Suryawanshi et al., 2012). The double observer method involves two observers scanning and counting the animals while ensuring that both teams do not give any clue to each other about animals sighting. Each study site was further divided into watershed blocks 1) of unequal size that were large enough for the ibex to cross easily in a single day movement; 2) not larger than daily human effort, and 3) that had high ridges as boundaries and were

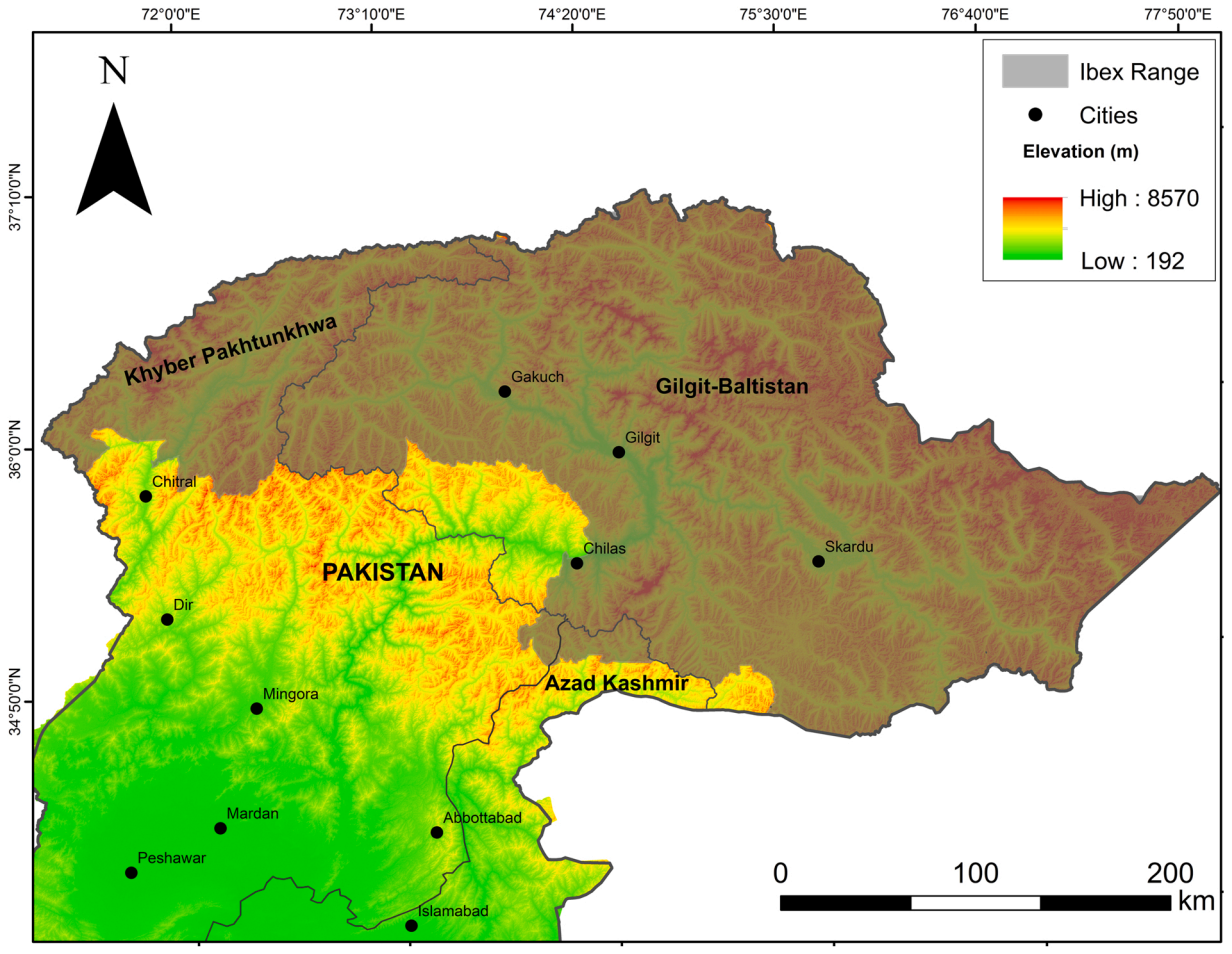

Fig. 1. Geographic distribution range of Himalayan ibex in northern Pakistan (study area).

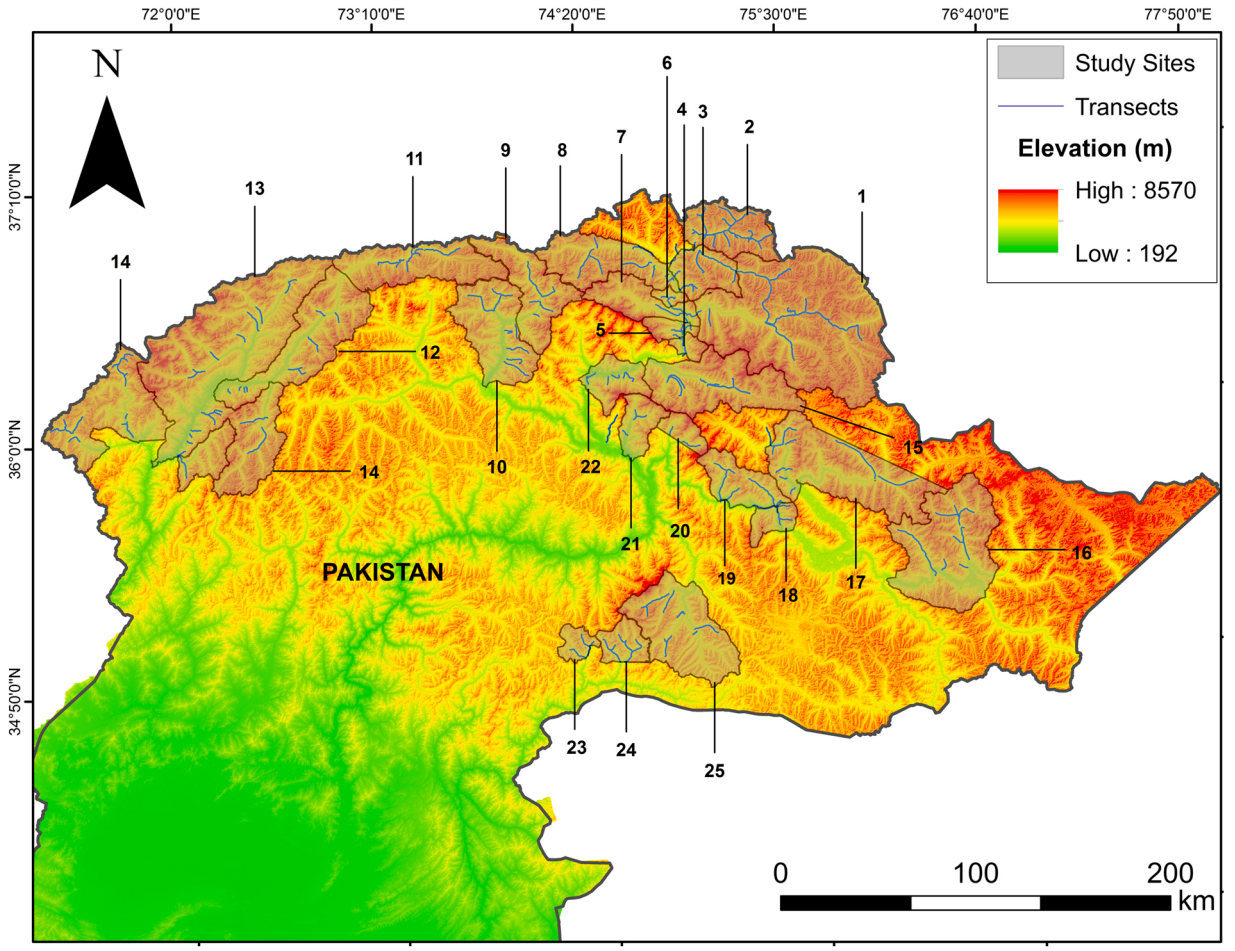

Fig. 2. Study area map showing survey sites where the double-observer survey was conducted for the population estimation of Himalayan ibex in northern Pakistan. 1 = Shimshal, 2 = Khunjerab National Park (KNP), 3 = Khunjerab Village Organization (KVO), 4 = Gulmit, 5 = Gulkin and Hussaini, 6 = Khyber, 7 = Passu, 8 = Chipurson, 9 = Qurumber National Park (QNP), 10 = Ishkoman, 11 = Broghil National Park (BNP), 12 = Mastuj Wildlife Range (WR), 13 = Booni Wildlife Range (WR), 14 = Chitral Wildlife Division (WD), 15 = Hoper-Hisper, 16 = Thalay and Hushey, 17 = Basha Baraldu, 18 = Skoyo-Karabathang-Basingo (SKB), 19 = Astak Tormak, 20 = Haramosh, 21 = Bagrote, 22 = Rakaposhi, 23 = Surgan Valley, 24 = Shounter, 25 = Astore.

difficult for animals to cross. Mountain ungulates are difficult to identify based on their coat pattern, however, the logic of applying the capture-recapture method as the double-observer method was that mountain ungulates can be identified based on their herd composition, herd size, herd sighting location, time of herd sighting, etc. (Khanal et al., 2020). The individual group of ungulate become the units that is being 'marked' and 'recaptured' in the double-observer method.

Both observers scan the surrounding area while walking along predefined trails and observations were made mostly during dawn and dusk (Ahmad et al., 2020). In keeping with the double-observer method, our teams were divided into observers A and B and separated by time or space. In the case of spatial separation, both observers started walking in the same block at the same time but different tracks while in the case of temporal separation both observers started tracking at the same trail but the distance was maintained between the two observers (Second observer began trekking the block 15 min after the first observer) (Tumursukh et al., 2016). Each observer team was equipped with binoculars (10 × 50 Pentax XCF), a spotting scope (20 × 60 Swarovski), DSLR camera (for photography of herds and associated habitats), and GPS device (Garmin 62 S). Both observers scanned the areas with binoculars every 100 m. On sighting herds, they would identify the species, count the individuals, and classify them by body size and horns. Observed ibex individuals in each herd were categorized as female (>2 years), young (<2 years), and male. At the end of the day, both sets of observers would cross-tally their data using herd sighting location, composition, time, and unique characteristics, such as male-only herds, to verify unique and common herds and avoid double-counting (Khanal et al., 2020).

2.2.2. Secondary data collection

We covered 46 % of the ibex range in our field surveys and obtained secondary data about the population of the targeted species for the remaining part of the range. The double observer survey was not carried out in the remaining parts due to various constraints such

Table 1
Chronology of double observer surveys conducted for Himalayan ibex population estimation in Pakistan.

S.NO	Study Sites	Size (km^2)	Year	Season	Effort (km)
1	Astak-Tormak valleys, Gilgit-Baltistan	801	Apr-19	Spring	62
2	Astore valley, Gilgit-Baltistan	1955	Sep-20	Summer	73
3	Bagrote valley, Gilgit-Baltistan	523	Dec-20	Winter	16
4	Basha-Baraldu valleys, Gilgit-Baltistan	1513	Apr-19	Spring	110
5	Broghil National Park (BNP), Khyber Pakhtunkhwa	1515	Aug-20	Summer	62
6	Booni Wildlife Range, Khyber Pakhtunkhwa	5764	Jan-20	Winter	92
7	Chipurson valley, Gilgit-Baltistan	1261	Aug-20	Summer	74
8	Chitral Wildlife Division, Khyber Pakhtunkhwa	2444	Jan-20	Winter	113
9	Gulkin-Hussaini valleys, Gilgit-Baltistan	229	Jan-20	Winter	20
10	Gulmit valley, Gilgit-Baltistan	167	Dec-20	Winter	19
11	Haramosh valley Gilgit-Baltistan	304	Apr-19	Spring	15
12	Hoper-Hisper valleys, Gilgit-Baltistan	1534	Nov-20	Winter	70
13	Ishkoman valley, Gilgit-Baltistan	1566	Aug-20	Summer	87
14	Khyber valley, Gilgit-Baltistan	117	Dec-20	Winter	14
15	Khunjerab National Park (KNP), Gilgit-Baltistan	1061	Aug-20	Summer	143
16	Khunjerab Village Organization (KVO), Gilgit-Baltistan	939	Dec-20	Winter	93
17	Mastuj Wildlife Range, Khyber Pakhtunkhwa	1959	Jan-20	Winter	69
18	Passu valley, Gilgit-Baltistan	785	Jan-20	Winter	42
19	Qurumber National Park (QNP), Gilgit-Baltistan	1259	Aug-20	Summer	55
20	Rakaposhi valley, Gilgit-Baltistan	617	Apr-19	Spring	21
21	Shimshal valley, Gilgit-Baltistan	5269	Nov-20	Winter	177
22	Shounter valley, Azad Kashmir	452	Dec-18	Winter	50
23	Skoyo-Karabathang-Basingo (SKB), Gilgit-Baltistan	335	Jan-21	Winter	44
24	Surgan valley, Azad Kashmir	266	Dec-19	Winter	27
25	Thalay and Hushey valleys, Gilgit-Baltistan	2672	Apr-19	Spring	104
Total		**35,307**			**1647**

as financial and logistic constraints. For some sites, we were unable to obtain NOC from the security agency due to the sensitivity of the area. Secondary data was collected with the purpose to develop a single density map for the species and to determine ibex population in areas where the double-observer survey was not conducted. Secondary data was obtained from wildlife census data available from wildlife department officials.

2.3. Data analysis

The ibex population in each study site was estimated using the mark-recapture feature of the BBRecapture package (R Core Team, 2019). Following Suryawanshi et al. (2012), we analyzed the number of groups, group sizes, age-sex composition, and sighting locations to evaluate whether a herd had been re-sighted by observer B. The data was arranged in the form of '10' if the group was sighted by observer A only, '01' if sighted by observer B only, and '11' if recorded by both (Tumursukh et al., 2016). We modelled the detection for the two observer groups separately—mt model; i.e. the detection probability varied across the two surveys. To estimate the number of groups ($\hat{G}$) of ibex in each study area, we fit the mt model using the function BBRecap with a uniform prior (Khanyari et al., 2021). We used the mt model because we expected the detection probability to be different across the two surveys (Suryawanshi et al., 2012).

We performed 10,000 MCMC iterations with a burn-in of 1000 followings (Suryawanshi et al., 2021). The estimated detection probability by model mt for occasions one and two was interpreted as the detection probability for observer teams A and B. We estimated the total population (N_{est}) for ibex within each study site as a product of the estimated number of groups ($\hat{G}$) and the estimated mean group size (μ). To estimate the confidence intervals (CI) of the population using the variance in the estimated number of groups and the mean group size, we generated a distribution of estimated group size by bootstrapping it 10,000 times with replacement. The distribution of the estimated population (Nest) was generated by multiplying 10,000 random draws of the estimated number of groups ($\hat{G}$) weighted by the posterior probability and draws of mean group size (μ). The median of the resultant distribution was the estimated population (Nest), and the 2.5 and 97.5 percentiles were used as the boundaries of the 95 % CI (Suryawanshi et al., 2021).

The density of ibex within each study site was calculated by dividing the estimated population within each study site by the total area of the corresponding study site. The density map for the species was projected in ArcGIS 10.8. Density across the range was categorized into low- (0–0.09 animals/km^2), medium- (0.10–0.28), and high-density (>0.28), and plotted on the map. The categorization of density was based on the average density value (0.20 per km^2) of ibex throughout its range in Pakistan. Sites with density of "< 1/2 average" were categorized as low while those areas with density of "average ± 1/2 average" were categorized as medium. Areas with density "> 1.5 x average" were categorized as high-density areas.

Table 2
Population structure of Himalayan ibex in different study sites in Northern Pakistan.

Study sites	No. of herds sighted by A	No. of herds sighted by B	No. of herds sighted by A and B	Estimated no. of herds	Mean herd size	Estimated population	95 % confidence interval	Detection probability (A)	Detection probability (B)	Density/ km^2	Ratio to 100 females	
											Male	Young
Astak-Tormak valleys, Gilgit-Baltistan	6	0	0	18	9.50	171	38.0–725.9	0.51	0.07	0.21	205	132
Astore valley, Gilgit-Baltistan	3	2	2	13	3.57	46	17.1–127.3	0.46	0.39	0.02	42	38
Bagrote valley, Gilgit-Baltistan	1	1	0	2	19.00	38	1.0–80.0	0.59	0.59	0.07	83	133
Basha-Baraldu valleys, Gilgit-Baltistan	9	0	5	16	20.00	320	216.0–502.5	0.85	0.34	0.21	85	106
Broghil National Park (BNP), Khyber Pakhtunkhwa	7	8	8	32	6.04	193	135.8–300.0	0.48	0.51	0.14	59	94
Booni Wildlife Range, Khyber Pakhtunkhwa	3	4	30	38	17.90	681	550.4–807.4	0.85	0.88	0.12	55	100
Chipurson valley, Gilgit-Baltistan	6	1	2	16	5.22	84	31.0–211.1	0.58	0.25	0.07	50	64
Chitral Wildlife Division, Khyber Pakhtunkhwa	21	3	31	58	20.20	1172	1010.4–1347.5	0.88	0.58	0.48	70	128
Gulkin-Hussaini valleys, Gilgit-Baltistan	8	3	14	28	25.20	706	481.0–961.3	0.78	0.61	3.08	85	61
Gulmit valley, Gilgit-Baltistan	2	0	6	8	16.25	130	70.0–230.6	0.86	0.67	0.78	72	38
Haramosh valley Gilgit-Baltistan	0	0	1	2	23.00	46	1.0–95.0	0.59	0.59	0.15	42	50
Hoper-Hisper valleys, Gilgit-Baltistan	4	1	15	21	17.75	373	278.0–474.0	0.88	0.75	0.24	88	93
Ishkoman valley, Gilgit-Baltistan	8	3	2	29	3.23	94	42.7–246.1	0.41	0.22	0.06	47	35
Khyber valley, Gilgit-Baltistan	2	0	7	9	41.30	372	210.0–617.2	0.87	0.70	3.18	88	91
Khunjerab National Park (KNP), Gilgit-Baltistan	15	5	7	41	16.48	676	392.0–1167.7	0.56	0.31	0.64	118	76
Khunjerab Village Organization (KVO), Gilgit-Baltistan	6	4	18	30	11.92	358	291.0–443.2	0.78	0.72	0.38	61	59
Mastuj Wildlife Range, Khyber Pakhtunkhwa	16	10	23	57	6.55	373	303.0–468.7	0.68	0.57	0.19	53	48

(*continued on next page*)

Table 2 (*continued*)

Study sites	No. of herds sighted by A	No. of herds sighted by B	No. of herds sighted by A and B	Estimated no. of herds	Mean herd size	Estimated population	95 % confidence interval	Detection probability (A)	Detection probability (B)	Density/ km^2	Ratio to 100 females	
											Male	Young
Passu valley, Gilgit-Baltistan	4	0	9	14	15.76	221	91.0–418.2	0.90	0.64	0.28	72	71
Qurumber National Park (QNP), Gilgit-Baltistan	5	2	6	16	7.15	114	60.3–200.8	0.68	0.51	0.09	20	85
Rakaposhi valley, Gilgit-Baltistan	7	0	4	11	10.22	112	68.0–226.7	0.78	0.31	0.18	75	80
Shimshal valley, Gilgit-Baltistan	18	3	3	49	16.37	802	382.6–1943.0	0.49	0.15	0.15	90	56
Shounter valley, Azad Kashmir	1	0	0	6	18.00	108	2.0–378.0	0.45	0.22	0.24	50	40
Skoyo-Karabathang-Basingo (SKB), Gilgit-Baltistan	0	0	12	12	11.75	141	107.0–179.7	0.92	0.92	0.42	93	62
Thalay and Hushey valleys, Gilgit-Baltistan	25	0	1	43	7.15	308	172.0–724.0	0.68	0.05	0.11	85	202
Total/*average*	**177**	**50**	**206**	**569**	***15.00***	**7639**		***0.68***	***0.48***	***0.48***	***75***	***81***

3. Results

3.1. Ibex sightings

A total of 25 different study sites covering an area of about 35,307 km^2 were surveyed (1647 km of transects) (Table 1). Ibex were sighted at 430 locations across 24 study sites—Surgan Valley was the exception.

3.2. Estimated population

Our analysis estimated a population of 7639 ibex in the surveyed area, with a density of 0.21 animals/km^2 (Table 2). The largest population was estimated in the Karakoram-Pamir range, followed by the Hindu Kush and Himalayan ranges. Study site-wise, the largest population was estimated for Chitral WD, with an estimated population of 1172 (95 % CI, 1010.4–1347.5). This was followed by Shimshal (802 animals, 95 % CI, 382.6–1943.0), Gulkin-Hussaini (706.0, 95 % CI, 481.0–961.3), Booni WR (681, 95 % CI, 550.4–807.4), KNP (676, 95 % CI, 392.0–1167.7), Khyber (372, 95 % CI, 210.0–617.2), and KVO (358, 95 % CI, 291.0–443.2) (Table 2). The smallest populations were estimated for Bagrote (38, 95 % CI, 1.0–80.0), Astore (46, 95 % CI, 17.1–127.3), and Haramosh (46, 95 % CI, 1.0–95.0) (Table 2). The highest density of ibex was estimated for Khyber (3.18 animals/km^2), Gulkin-Hussaini (3.08), Gulmit (0.78), KNP (0.64), and KVO (0.38), while the lowest densities were estimated for Astore (0.02), Ishkoman (0.06), Bagrote (0.07), and QNP (0.09) (Table 2, Fig. 3).

Based on secondary data, about 2603 individuals (density = 0.06/km^2) across a total area of 41,828.71 km^2 were recorded in un-surveyed areas in the ibex distribution range in northern Pakistan. Using this data, the highest population was found in Misgar Valley, where about 500 animals were present with a density of 0.40 individuals/km^2 (Supplementary materials and Fig. 3). Other un-surveyed areas with high populations included Biafo-Hisper (300 individuals with a density of 0.11), Shigar (300 individuals with a density of 0.33), and Kharmang (200 individuals with a density of 0.08). Most un-surveyed areas fell in the low-density class, while only a few sites fell in the medium- and high-density class (Fig. 3).

3.3. Detection probability and sex ratio

Observers A sighted a total of 177 herds of ibex, while observers B sighted 50. Both observers sighted 206 herds (Table 2). Only a single individual was sighted at some locations, while the largest herd observed was 102 in Hushey-Thalay Valley. Of the observed herds, about 75 % were classified as a mixed herd (having male, female and young) while 19 % and 6 % herds were classified as female (only female individuals) and male herds (only male individuals). The total estimated groups of ibex in the surveyed area were 569, while the estimated mean group size of ibex across 24 study sites was 15 individuals (5.22–41.0) (Table 2). The average detection probability was 0.68 (0.41–0.92) and 0.48 (0.22–0.88) for observers A and B, respectively (Table 2). The average male-to-female ratio across the surveyed areas was estimated to be 75 per 100 females, while the young-to-female ratio was estimated to be 81 per 100 females (Table 2).

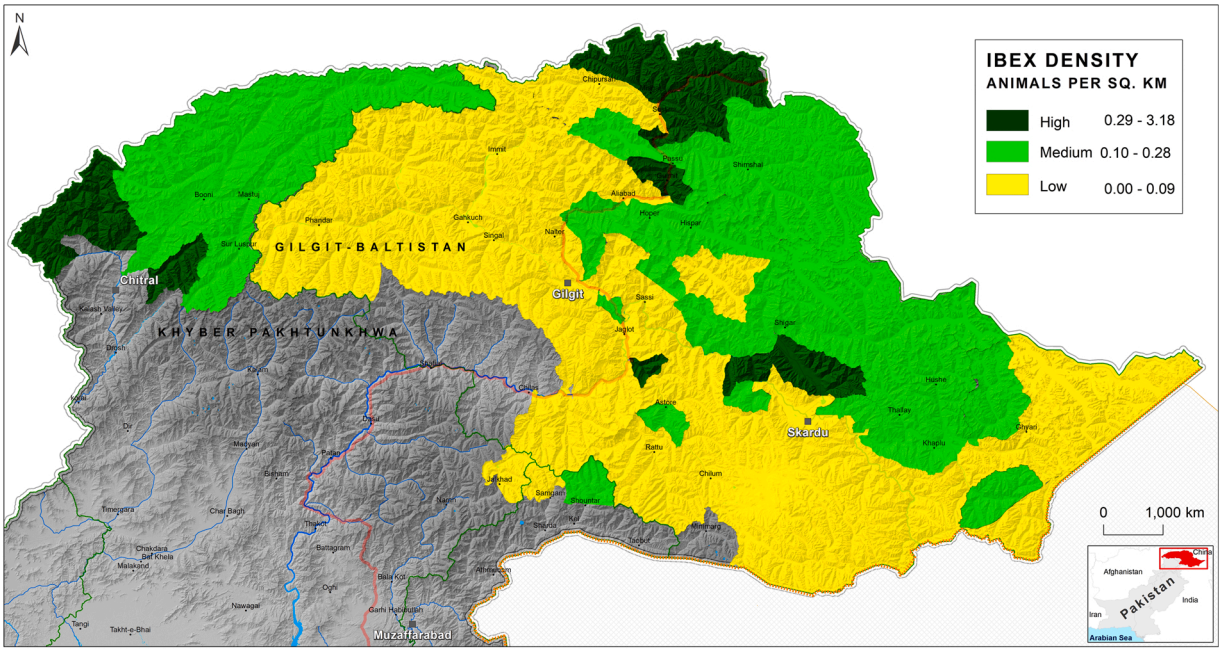

Fig. 3. Density pattern of Himalayan ibex in northern Pakistan.

4. Discussion

The main objective of the current study was to assess the range-wide population and density pattern of ibex across northern Pakistan. We covered about 46 % of the range through extensive double-observer surveys and collected data from concerned wildlife departments for the remaining parts to develop a single-density map. Ibex are the most common and widely distributed ungulate species in northern Pakistan (Hess, 1990). They were rampantly poached throughout their range in GB before the introduction of the country's trophy hunting program in 1995 (Shackleton, 2001). However, poaching then decreased (Jackson and Hunter, 1996), leading to a rise in ibex numbers. Monitoring the populations of wildlife species through robust scientific methods is vital for the evaluation of the success of conservation programs, and also for assessing the conservation of species from a trophy hunting perspective (Singh and Milner-Gulland, 2011). The double-observer approach for population estimation uses the mark-recapture framework (Caughley, 1974). This method has been proven effective in the study of ibex in the harsh and rugged terrain of our study area. It was developed as a more robust and rigorous method based on CMR to address gaps in the monitoring of mountain ungulate species in rugged terrains (Suryawanshi et al. (2012).

Based on the double-observer technique, we estimated a population of 7639 individuals of ibex with a density of 0.21 animals/km^2 across 25 different survey sites. Spatial variation in the density across the study blocks has been observed. In KNP, we recorded a density of 0.64 animals/km^2. This was in contrast to Ahmad et al. (2020) who recorded 0.40 animals/km^2 and Khan et al. (2014) who reported 0.04–0.71 animals/km^2 in some watersheds of KNP using a fixed-point count method. In the KVO area, Ahmad et al. (2020) reported a density of 1.32 animals/km^2, while this study estimated a density of 0.38/km^2. Rahman and Jaffar (2016) recorded a higher ibex density of 0.26 in Chipursan Valley as compared to the density we documented in the current study. The possible reason for this may be the time difference in both surveys—we surveyed in summer while Rahman and Jaffar (2016) conducted theirs in winter. In Hushey Valley, Raza et al. (2015) reported high density, but we cannot compare our estimate because they used the total count method (Singh and Milner-Gulland, 2011).

Density estimates for ibex across its global range are variable, depending on habitat quality and protection level. Throughout the ibex distribution range, high density has been mostly documented from the protected areas. For example, Tumursukh et al. (2016) documented a density of 0.75 ibex/km^2 in the Tost Local Protected Area of Mongolia. Suryawanshi et al. (2012) recorded ibex density of 0.35 individuals/km^2 in Pin Valley National Park, India. Khanyari et al.'s (2021) documented ibex density of 0.75 and 2.26 individuals/km^2 in Koiluu and Sarychat protected areas of Kyrgyzstan. In the current study, the estimated density range from 0.02 to 3.18 ibex/km^2 and suggests that area with a high level of protection (KNP) or area managed by local communities such as Khyber Valley, KVO, Gulmit, Gulkin Hussaini, and Chitral WD have the highest densities.

Ali et al. (2021) have identified suitable habitats for ibex in Pakistan. High-density areas identified in this study lie within good habitat predicted in this study, however, we find that a major chunk of suitable habitat supports the species in low densities. This is probably because of lack of conservation work in these areas, poor control over poaching, and higher stress on habitat. In the current study, a high density of ibex was either found in protected areas with high levels of protection (e.g., KNP) or in areas where trophy hunting programs exist (e.g., Chitral WD, Khyber Valley, Passu Valley, Gulmit, Gulkin-Hussaini, KVO, and SKB). This shows that trophy hunting plays an essential role in the conservation of mountain ungulates in northern Pakistan. Similarly, the increase in the population of markhor in district Chitral, Pakistan, has been attributed to the establishment of Chitral Gol National Park (CGNP) and two game reserves. Due to the establishment of game reserves, local communities also play an active role in the conservation of markhor, blue sheep, and ibex in the area, as they receive benefits through trophy hunting programs. Economic incentives through trophy hunting play an important role in changing human attitudes toward large carnivore species (Mishra et al., 2003) and enable locally supported conservation actions.

Survey season is an important factor that can potentially influence the detection of wild ungulates and their density estimates. The majority of surveys during the current study were carried out in November-April, which is the most appropriate time for sighting ibex in northern Pakistan. During this time ibex occupy lower elevations, make larger herds, and human disturbance is minimal in the habitat (Schaller, 1977). Winter is the rut season when animals aggregate; spring is time for fresh sprouting and attracts animals towards pastures. Surveys in three valleys (Chipurson, Ishkoman, and QNP) in summer (July-August) yielded lower detection and low population estimates. Summer is a time of higher disturbance in the ibex habitat due to increased grazing and tourism activities. Grazing by livestock on shared resources with wild herbivores causes competition for food and reduces forage availability for wild herbivores (Bagchi et al., 2003). During summer, the locals in the study area move to the upper reaches of watersheds along with their livestock and stay there for a few months of summer. During this period their livestock uses the pastures at middle elevations and competes with ibex for forage or displaces them altogether (Bagchi et al., 2004). As a result, the ibex herds are pushed to extreme elevations and in inaccessible areas, thus reducing the chances to find them. Similarly, the study carried out by Bhandari et al. (2022) in Nepal found a negative correlation between ungulate and domestic livestock abundance. Summer is also the post-lambing season when females with their newborns move to remote and secure areas (Schaller, 1977). In consideration of these factors, we believe that our study has underestimated the population in these valleys. Factors like the availability and distribution of food resources, predation risk, and biological events significantly impact the shaping of wild ungulate group sizes (White et al., 2012). We estimated 569 herds of ibex in the surveyed area, with a mean group size of 15 individuals (5.22–41). Ahmad et al. (2020) estimated ibex mean group sizes of 19.0, 16.5, and 16.07 in the Gojal watershed, KVO, and KNP areas of GB respectively. We estimated corresponding figures of 24.56, 11.92, and 16.46 ibex per herd, respectively. Another study by Khanyari et al. (2021) reported the estimated mean group size of ibex as 25 and 29 in Sarychat and Koiluu (Kyrgyzstan), respectively. In Tost Local Protected Area (Mongolia), mean group sizes of 5.24 and 5.04 were documented for 2012 and 2013, respectively, by Tumursukh et al. (2016). According to a study conducted by Han et al. (2019) in the Eastern Tien-Shan Mountains, Xinjiang, China, the ibex group sizes ranged from 1 to 201 individuals, but groups of 1–5

animals were most frequent. The commonly accepted argument for large ungulate aggregation is that it decreases predation risk by increasing predator detection and the dilution effect (Roberts, 1996). Solitary animals spend more time scanning for risk while foraging compared to animals foraging in groups (Berger and Cunningham, 1998).

The social organization of the observed groups shows that about 75 % of the ibex herds in the study area were mixed herds. The numbers of individuals counted in mixed herds were normally larger than male or female herds (Han et al., 2019). Mostly ibex form mixed herds during rut season (November-December), and after rut season they split into male and female herds (Wang et al., 2018). However, there are still a significant number of males and females that stay in mixed-sex groups throughout the year (Fedosenko, 2003). In the present study, seven individuals were observed as a single individual across six study sites. Most (5) of the solitary ibex were identified as males (Class IV = 3, Class II and I = 1) while on one occasion it was identified as an adult female. The possible explanation for solitary individuals could be due to predator attacks that dispersed the herd, human disturbance or male searching for receptive females (Han et al., 2019), or old or sick individuals abandoned by their herd (Zhu et al., 2016). The average detection probability recorded by observer A's (0.68, 0.41–0.92) in the present study was higher than observer B's (0.48, 0.22–0.88). Similarly, Ahmad et al. (2020) also recorded high detection probabilities for observer A in KNP, Gojal (Khyber, Passu, Gulmit, and Gulkin-Hussaini in our study), and Socterabad (KVO), respectively in northern Pakistan. In regions other than Pakistan, the higher detection probabilities for observer A were also recorded by Tumursukh et al. (2016), Khanyari et al. (2021), and Suryawanshi et al. (2021) for ibex in Mongolia, Kyrgyzstan, and India, respectively. The overall higher detection of observer A in the present study showed that the sighting of the first observer by ibex affected the detection probability of observer B in the double-observer method. Ibex are sensitive to human presence—this sensitivity may be attributed to observer A provoking ibex retreat behaviour (Suryawanshi et al., 2012). Observer detection rates are also influenced by animal activity patterns and factors like climate, topography, survey time, and observer efficiency (Thompson, 2004).

In our study, the overall ratio of males and young per 100 females across the surveyed area were recorded as 75 and 81, respectively. This showed that the overall population of ibex in our study area was female-biased. Although, in some study sites, the ratio of males (KNP, 118 males per 100 females), young (Hushey-Thalay, 202 young per 100 females; Chitral WD, 128; and Bagrote, 133), or both males and young (Astak Tormak, 205 males and 132 young) were observed to be higher than females. Similar results were obtained by Ahmad et al. (2020) for the KVO and Gojal watersheds (Khyber, Gulmit, Passu). However, they recorded a low ratio of males to females in the KNP area, while our study recorded a higher ratio (about 20 %). This difference could be due to variations in population size, as Ahmad et al. (2020) estimated a population of 473 ibex, while we estimated a population of 676 individuals. Other possible reasons for this higher ratio of males in KNP could be factors like bans on selective hunting such as trophy hunting and other illegal hunting of large-size males due to the high level of protection in KNP. Khanyari et al. (2021) recorded the ibex population as female-biased in two different study sites in Kyrgyzstan, while Tumursukh et al. (2016) documented a higher ratio of females to males and young in Mongolia. The populations of mountain ungulates are generally known to be female-biased (Berger and Gompper, 1999). Not only are males excessively preyed upon (Berger and Gompper, 1999), but as polygynous species, ibex males incur greater expenses during the rut than females, lowering male survival. Factors such as the hunting of prime-aged males can further exacerbate the female bias.

The population size of large carnivore species depends on the availability of wild ungulates (Karanth et al., 2006; Suryawanshi et al., 2017). Ibex in northern Pakistan are an important source of food for snow leopards and other large carnivores such as the wolf. According to Jackson and Ahlborni (1984), adult snow leopards require about 1.3–2.0 kg of food per day, and 600–900 kg of prey species biomass are required for one adult snow leopard for one year. Oli (1994) documented a ratio of 1:114–159 for snow leopards vs. blue sheep, by weight. Considering the mean weight of ibex to be 60 kg (Hess, 1990) and of snow leopards to be 40 kg (Oli, 1994), the estimated biomass of ibex in the current study is 614,520 kg (surveyed area biomass = 458,340 kg, un-surveyed area biomass = 156,180 kg). Following the formula of Oli (1994) for predator-prey ratios, we estimated that the ibex populations in northern Pakistan could support a population of adult snow leopards ranging from 97 to 135 (surveyed area = 72–101, un-surveyed area 25–34).

5. Conclusions and recommendations

This study estimates a population of 7639 ibex in a 35,307 km^2 surveyed area, with a density of 0.21 animals/km^2. High densities of ibex in northern Pakistan are found mostly in protected areas with high levels of protection, such as KNP, or areas where trophy hunting programs exist, such as Chitral WD, KVO, Khyber, Gulmit, Gulkin-Hussaini, Passu, and SKB. This illustrates the role of trophy hunting programs in the conservation of mountain ungulates and consequently, carnivore species in the area. The density map provides an objective rationale for extended protection in northern to safeguard key populations of ibex. A conservation and protection effort needs to be initiated in low-density areas to help recover the declining populations in those areas. The effectiveness of protected areas need to be enhanced to protect higher concentrations of ibex. We also recommend that study on habitat partitioning between ibex and other sympatric species should be conducted in the future.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data is available in the MS.

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Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.gecco.2022.e02288.

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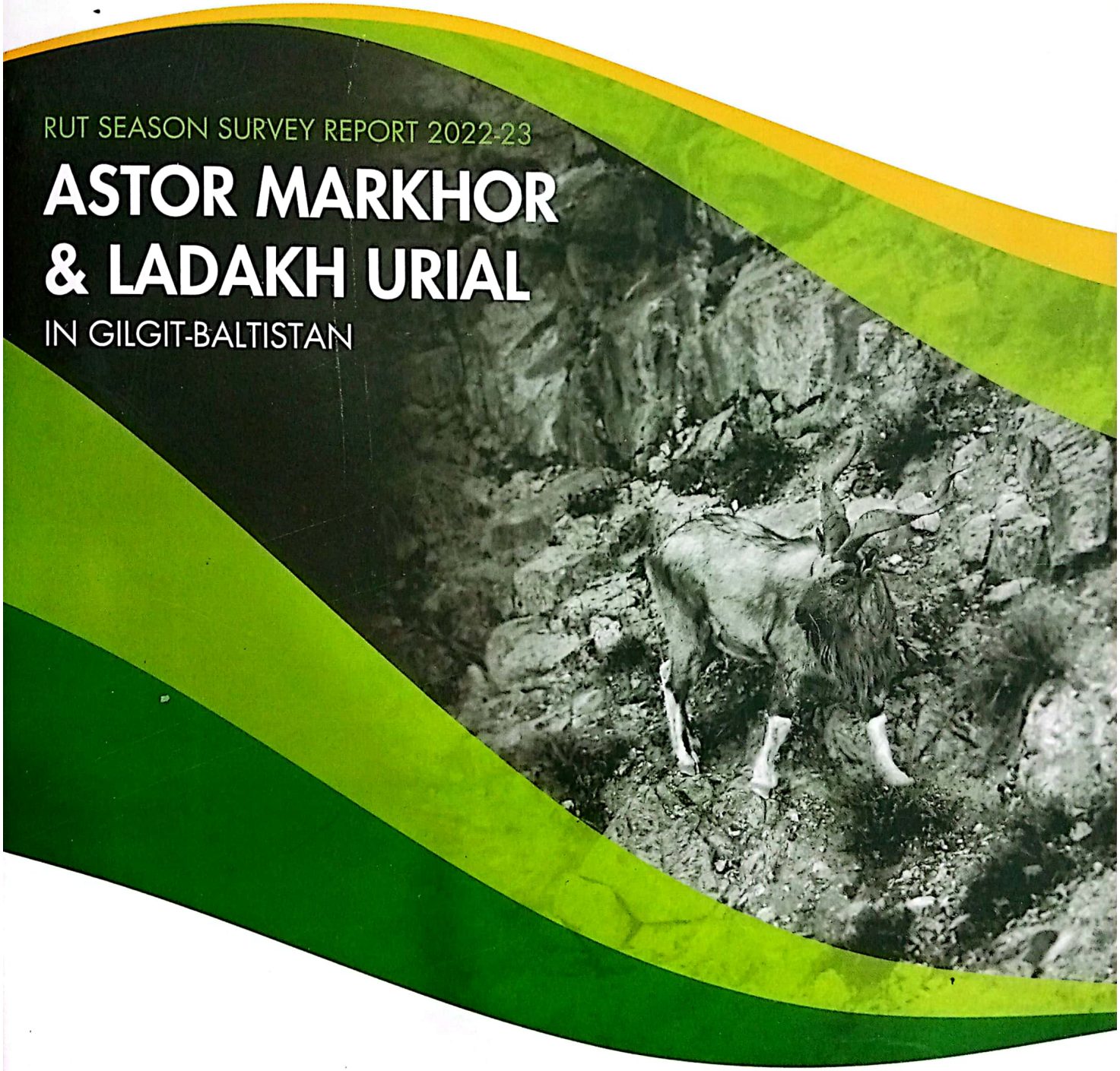
Forest, Parks and Wildlife Department
Government of Gilgit-Baltistan

RUT SEASON SURVEY REPORT 2022-23

ASTOR MARKHOR & LADAKH URIAL

IN GILGIT-BALTISTAN



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ASTOR MARKHOR (*Capra falconeri falconeri*) & LADAKH URIAL (*Ovis vignei vignei*)

IN GILGIT-BALTISTAN, PAKISTAN

Report Published by:

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RUT SEASON SURVEY REPORT 2022-23

ASTOR MARKHOR (*Capra falconeri falconeri*) & LADAKH URIAL (*Ovis vignei vignei*)

IN GILGIT-BALTISTAN, PAKISTAN

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Table of Contents

List of Tables

List of Figures

List of Plates

REPORT SUMMARY

The gigantic and spiral horns of the Astor markhor *(Capra falconeri falconeri)* and the curl-shaped horns of the Ladakh urial *(Ovis vignei vignei)* have long been a coveted trophy for game hunters. However, along with habitat degradation and climate change, hunting has driven their populations to the verge of extinction. The introduction of a trophy hunting program has not only helped in the recovery of the markhor but also other associated wildlife, including the Ladakh urial. Each year, local communities earn millions of PKRs through trophy hunting, which demonstrates the social benefits of this practice. However, population assessment is the only tool that can determine the effectiveness of trophy hunting for wildlife and ecosystems.

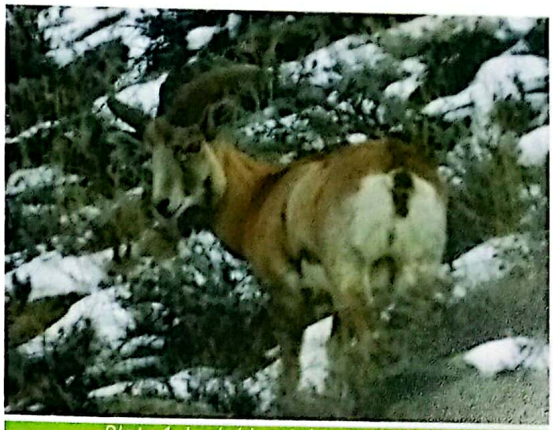

Plate 1: Ladakh urial in its habitat

To evaluate the populations of markhor and Ladakh urial, we conducted population estimates using the double observer method during November and December 2022. Using Bayesian statistics in the "BBRecature" package of R, we predicted estimated populations and 95% confidence intervals (CIs). The estimated population of markhor was 1,463 individuals, which could be (1,212 – 1,739 at 95% CI). The estimated population of Ladakh urial was 151 individuals, which could be (62 - 282 at 95% CI).

Plate 2: Astor markhor in its habitat

Using the 2% rule of total population, 29 markhors may be harvested, or 21 markhors may be harvested using the 25% rule of total trophy size males.

1. INTRODUCTION

Animals with hooves as their locomotory organs are called ungulates. Ungulates like horses, cattle, deer, and camels play important roles in many ecosystems and have been domesticated by humans for various purposes such as transportation, food, and recreation. In the ecosystem, they play important roles as herbivores, controlling the growth of vegetation and serving as prey for predators. Their grazing habits can also shape the landscape and create habitats for other species (Chapin III et al., 2000). Ungulates are also important in many cultures and are revered for their beauty and grace. They play a role in art, literature, and mythology, and their images can be found in various forms of media and cultural artifacts (DeMello, 2012).

Plate 3: Astor markhor with Yearling

Since 1990, Gilgit-Baltistan (GB) has become a living museum for some of the world's rarest species, including the snow leopard *(Panther unica)*, brown bear *(Ursus arctos isabellinus)*, and black bear*(Ursus thibetanus)* , as well as highly prized trophies such as the Astor markhor *(Capra falconeri falconeri)*, Himalayan ibex *(Capra sibirica)*, Ladakh urial *(Ovis vignei vignei)*, blue sheep *(Pseudois nayyaur)* and Marco Polo sheep *(Ovis ammon polii)*. The trophy hunting program has been proven to be one of the most successful programs in the world, leading to an increase in the population of wild ungulates and wildlife in general (Ahmad et al., 2022; Haider et al., 2021) .

1.1 Astor Markhor

The markhor, a wild goat native to central Asia and the Himalayas, including Afghanistan, India, Tajikistan, and Pakistan (Figure 1), is known for its long, spiral horns which can reach up to a meter in length and its shaggy gray fur. Based on horn morphology Schaller and Khan (1975) identified five sub-species of markhor and grouped them into two categories: straight horned and flare horned markhor. The Sulaiman markhor, Kabul markhor, and Bukhara markhor are considered straight-horned markhors, while the Astor and Kashmir markhor are considered flare-horned markhors (Schaller and Khan, 1975) (Figure 2).

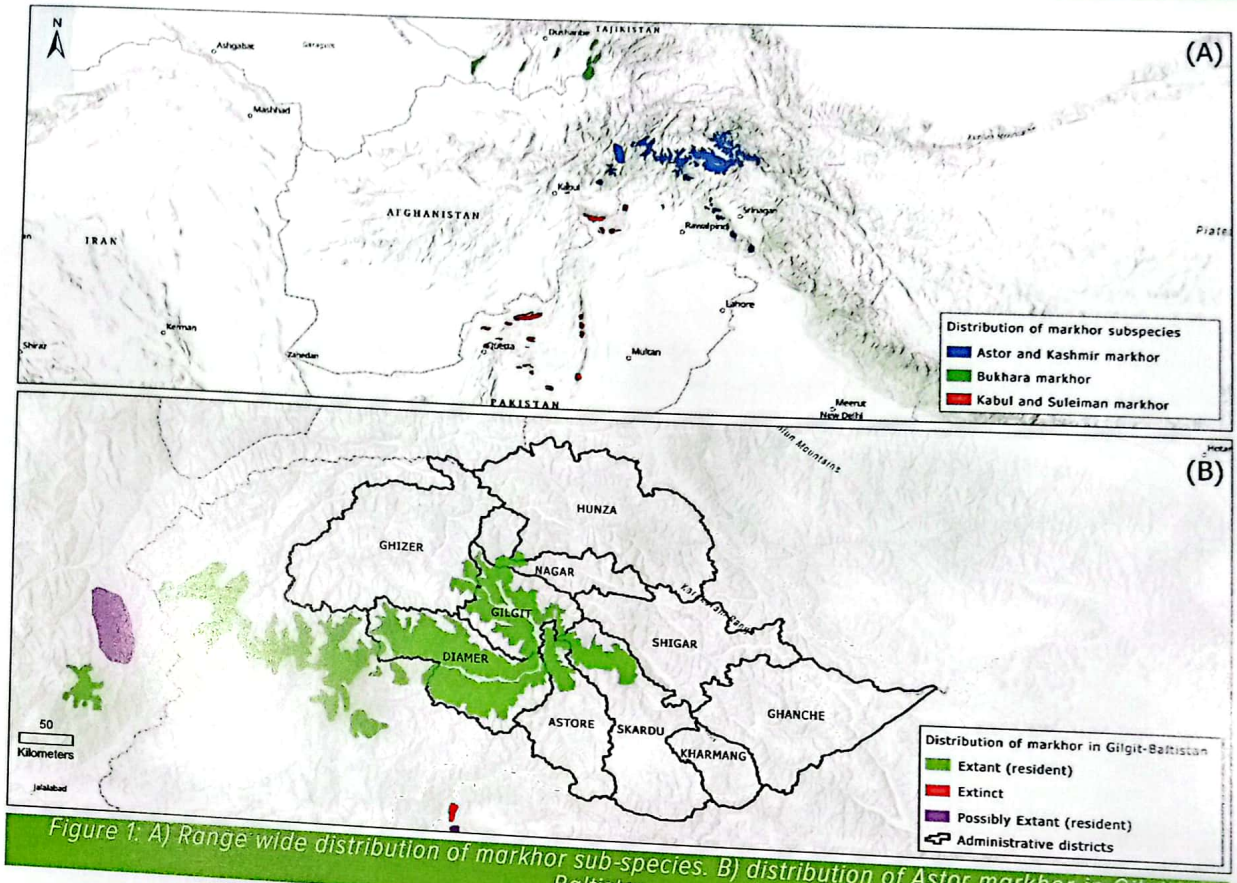

Figure 1: A) Range wide distribution of markhor sub-species. B) distribution of Astor markhor in Gilgit-Baltistan.

Astor markhor is also a dimorphic species like other wild ungulates (Figure 3). Markhors are admirably adapted to the rugged mountain terrain, and they are known for their agility and climbing abilities. They feed on various vegetation, including leaves, shoots, and lichen, and are important prey species for predators like snow leopards and wolves.

The markhor population has experienced significant declines in recent decades, and the species is now considered threatened. Threats to the markhor include habitat loss, poaching, and competition with domestic livestock. Conservation efforts are underway to protect the markhor and its habitat, including the establishment of protected areas, regulation of hunting, and habitat restoration, which helped in restoration of markhor populations, making its conservation status improve on the International Union for Conservation of Nature (IUCN) Red list from "Endangered" to "Near Threatened" (Michel and Rosen Michel, 2016).

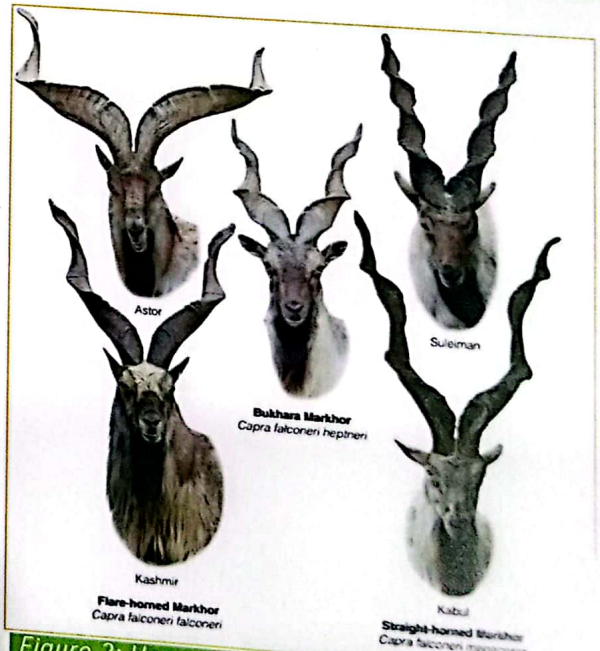

Figure 2: Horns morphology of different markhor sub-species (Adopted from (Castello, 2016)

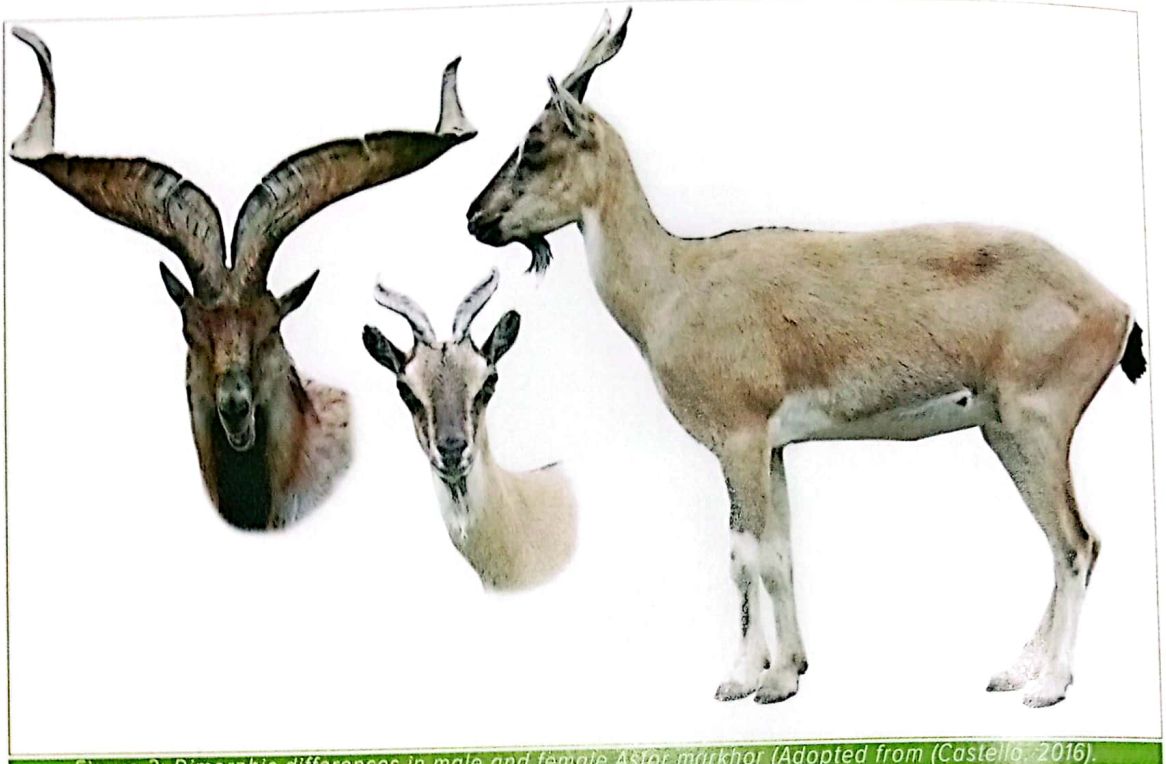

Figure 3: Dimorphic differences in male and female Astor markhor (Adopted from (Castello, 2016).

1.2 Ladakh Urial

The Ladakh urial *(Ovis vignei vignei)*, also known as Shapu, is a species of wild sheep found in the Ladakh region of India and the Gilgit-Baltistan region of Pakistan (Figure 4 A and B).

It is a medium-sized animal characterized by its reddish brown fur and horns that curve upwards and backwards. The Ladakh urial is a dimorphic animal and gender can easily be identified based on its horns and body size (Figure 5). The Ladakh urial is highly valued by poachers due to its impressive horns and scarcity. Unregulated hunting, habitat degradation, and climate change have pushed the Ladakh urial population to the brink of extinction and the species has been listed as "Endangered" on the IUCN Red List (Valdez, 2008). Conservation efforts, such as regulated hunting programs and habitat protection, can help ensure the survival of the Ladakh urial and maintain its population.

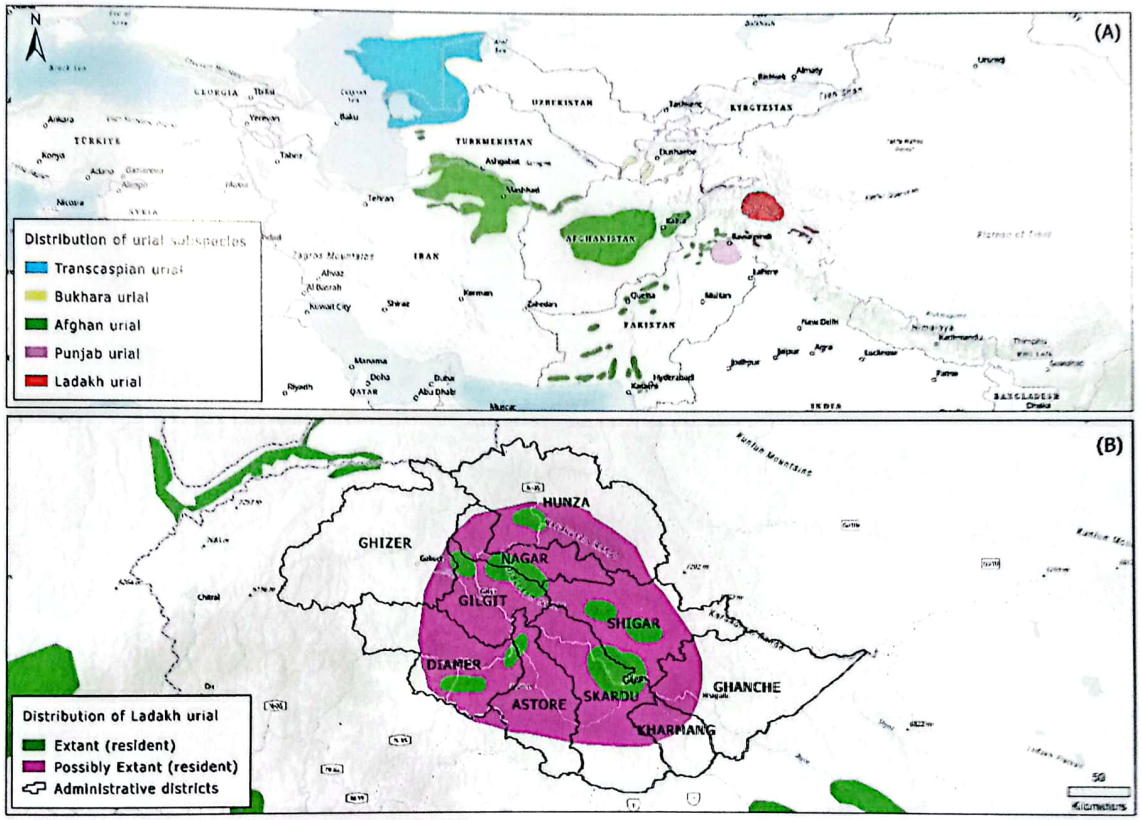

Figure 4: A) Distribution range of urial sub-species. B) distribution of Ladakh urial in Gilgit-Baltistan

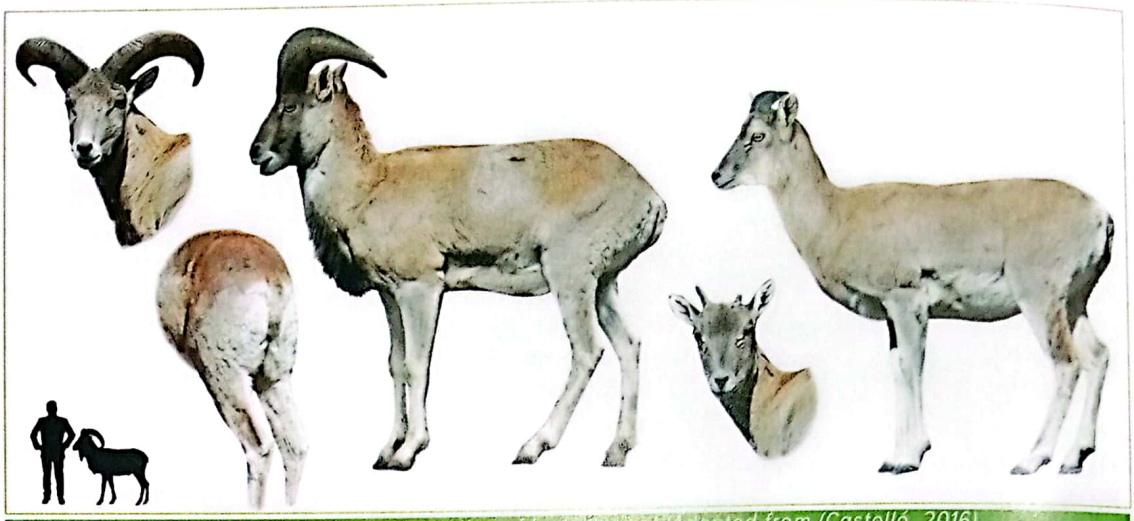

Figure 5: Dimorphic presentation of Ladakh Urial (Adopted from (Castelló, 2016)

1.3 Objectives of study

- To assess the distribution and population status of Astor markhor in Gilgit-Baltistan
- Identifying trophy size animals in different conservancies to allocate trophy quota in Gilgit Baltistan
- To assess the distribution and population status of Ladakh Urial in Gilgit-Baltistan

2. MATERIALS AND METHODS

2.1 Study Area

The survey was conducted from November 29, 2022, to December 02, 2022, for Ladakh urial, and from December 13, 2022 to 28 December, 2022 for Astor markhor in fifteen Community Controlled Hunting Areas (CCHAs) located in the districts of Gilgit, Astor, Diamer, Skardu, Nagar, and in Shigar (Figure 6).

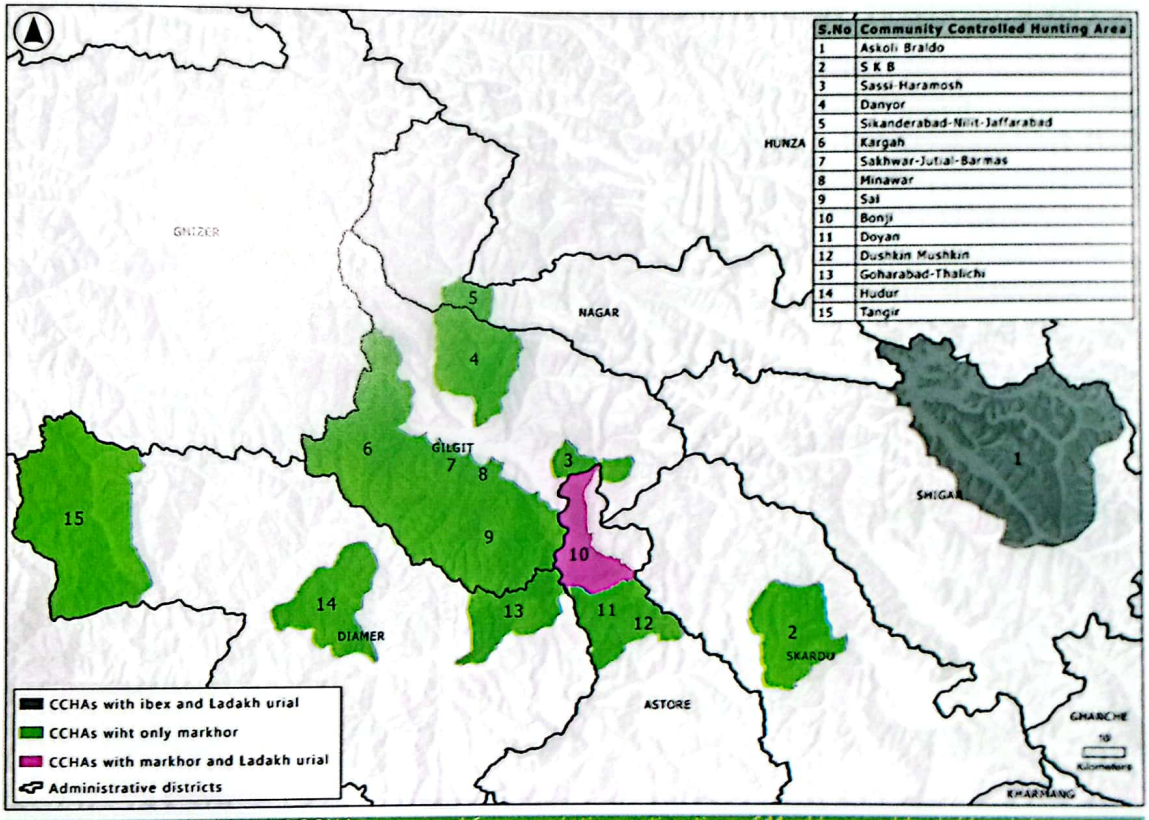

Figure 6: Map of CCHAs surveyed for population estimation of Markhor and Ladakh urial

2.2 Double Observer Method

The double observer method (DOM) was used, which is based on the principles of mark-recapture. The method was originally developed to estimate the detection probabilities of aerial surveys for various wildlife species (Caughley, 1977), the DOM equation was modified by Magnusson et al. (1978) to account for observer differences in detecting the target species. Forsyth and Hickling (1997) applied the DOM to ground surveys for the first time, to estimate Himalayan Thar in New Zealand.

The method involves two observers who scan and count animals, either separated by space or time in survey blocks not larger than the daily movement range of humans or animals. The blocks are defined by physical features, such as high ridges and rivers that may prevent animals from moving between blocks.

2.3 Data Collection

The survey maps were developed by dividing each CCHA (Community Controlled Hunting Areas) into small blocks of area (25 – 40 km^2) using Arc GIS Pro 3.0.4 (ESRI, Redland, California USA).

2.4 Scanning for Animals

Mountain ungulates are crepuscular (Roberts, 1997; Schaller, 1980, 1977), so scans were conducted at dawn and dusk. Spotting scopes (Swarovski 30 x 70) and binoculars (Nikon 10x50) aided the scanning effort. Whenever a herd was sighted, the necessary information (size, type, demography, location, elevation etc) was recorded on a field data collection sheet. Geographical Positioning System (GPS) device, such as Garmin 64S, 66S, or 66ST, was used to record the observer's location, and the location of herd was delineated on the map.

2.5 Demographic Classification

The "Capture Recapture" method can only be accurately applied to wild ungulates if they are dimorphic and can be identified based on age classes (Suryawanshi et al., 2012). By using the demographic classification suggested by Schaller (1977) shown in Table 1, the herds were identified. The composition of the herds, such as female herds (females and young), male herds (only males), and mixed herds (males, females, and young), was recorded to aid in identifying repeated captures and single captures. The number of trophy-sized animals within class IV was separately recorded.

Table 1: Demographic classification proposed by Schaller (1977) for mountain ungulates.

Female Classification	Kids Classification		Males Classification				
Female > 2	Young < 1	Yearling 1 < 2	Class I ($2^{1/2}$) years	Class II ($3^{1/2}$) Years	Class III ($4^{1/2}$) Years	Class IV ($5^{1/2}$) Years	Trophy Size Within Class IV

2.6 Habitat Features of Herds Location

To distinguish the herds sighted by both observers, the habitat features, such as snow, bare rock, glacier, rangeland, shrubs, mixed forest, and slope (North, South, East, and West), were recorded. The behavior of the herd at the time of sighting, such as feeding, walking, running, or resting, was also noted to ensure that the animals had given the observer a chance to count them well.

2.7 Post Survey Discussion

Both observers cross-checked field records in the evening, noting repeated and single groups based on herd size, composition, habitat type, location, and behavior. The data was then compiled in summary sheets for later population estimation analysis.

2.8 Data Analysis Approach

The total number of Astore markhor and Ladakh urial groups was estimated using the two-survey mark-recapture in the "BBRecapture" package that uses the Bayesian framework in R statistical and programming environment (Fegatelli and Tardella, 2013) Version 4.2.2, R Core Team, 2022.

We analyzed group size following (Ahmad et al., 2022; Khanyari et al., 2021; Suryawanshi et al., 2012). We used age-sex composition and location of sightings to determine if the groups were seen by one or both teams. Groups seen by both teams were coded as "11", groups seen only by the first observer as "10", and groups seen only by the second team as "01".

We modeled the detection of the two teams separately ("mt" model). To estimate the number of ibex and blue sheep groups ($\hat{G}$) in our study areas, we used the "BBRecap" function with a "uniform prior" for each species. The "mt" model was chosen because detection probability was expected to differ between the two surveys (Suryawanshi et al. 2012). The model was run for 10,000 mcmc iterations with a 1000 burn-in (Fegatelli and Tardella, 2013).

The model "mt" estimated detection probabilities for observer teams one and two for occasions one and two. We calculated the total population (Nest) of each ungulate species by multiplying the estimated number of groups ($\hat{G}$) and the estimated mean group size (μ). To estimate the confidence intervals for the population, we created a distribution of estimated group size by resampling it 10,000 times with replacement. Then, we generated a distribution of estimated population by multiplying 10,000 random draws of estimated number of groups ($\hat{G}$) weighted by posterior probability and draws of mean group size (μ). The median of the resulting distribution was taken as the estimated ungulate population (Nest) with the 2.5 and 97.5 percentiles as the confidence intervals.

To determine the 95% confidence intervals of the proportion of individuals from different age-sex classes (adult male, adult female, and young), we performed 10,000 bootstraps using the herd as the sampling unit. The median values were taken as the estimates, and the 0.025 and 0.975 quartiles served as the 95% confidence intervals.

To calculate densities, we divided the estimated abundance by the total area sampled. The total area was obtained by summing the areas of all surveyed blocks, which were demarcated as the visible areas in each block using Arc GIS Pro version 3.0.4 by the survey team after the survey.

3. RESULTS

3.1 Population Estimates of Astor Markhor and Ladakh Urial

A total of 1,449 markhors were counted in 15 CCHAs using the double-count method in 97 herds with mean herd size of 15.08 (Figure 7). The estimated population of markhor was 1,463 individuals, at 95% confidence interval the estimated population may range 1,212 to 1,739 individuals (Table 2). The district of Gilgit had the highest population of markhor, with 729 individuals, followed by Astor with 543 individuals (Table 3 and Figure 8).

Two locations were surveyed for Ladakh urial, with 133 individuals counted in Bonji and 3 individuals in the Durumdo valley of district Shigar in 10 herds with mean herd size of 15.11 (Figure 8). The estimated population of Ladakh urial was 151 individuals that may range at 95% confidence interval 62 to 282 individuals (Table 2). The only viable population of Ladakh urial was found in Bonji Valley (Table 4 and Figure 9).

Table 2: Information about population of markhor and Ladakh urial population in Gilgit-Baltistan.

Statistics	Astor markhor	Ladakh urial
Number of CCHAs surveyed	15	02
Detection Probability of Observer ONE	0.98	0.84
Detection Probability of Observer TWO	0.65	0.50
Observer one total	1,449	136
Groups sighted by observer one only	32	4
Observer two total	765	90
Groups sighted by observer two only	0	0
Common groups	64	5
Total groups	97	10
Mean group size	15.08	15.11
Estimated population	1,463	151
± 95% Confidence interval	1,212 – 1,739	62 - 282
Percentage of male	27.12	22.79
Percentage of trophy males within males	5.86	6.45
Percentage of female	41.26	54.41
Percentage of young	17.04	13.23
Percentage of yearlings	14.56	9.55
Ratio (Male: Female)	1:1.56	1:2.38
Ratio (Female: Young)	1:2.45	1:4.11
Ratio (Young: Yearling)	1:1.18	1:1.38

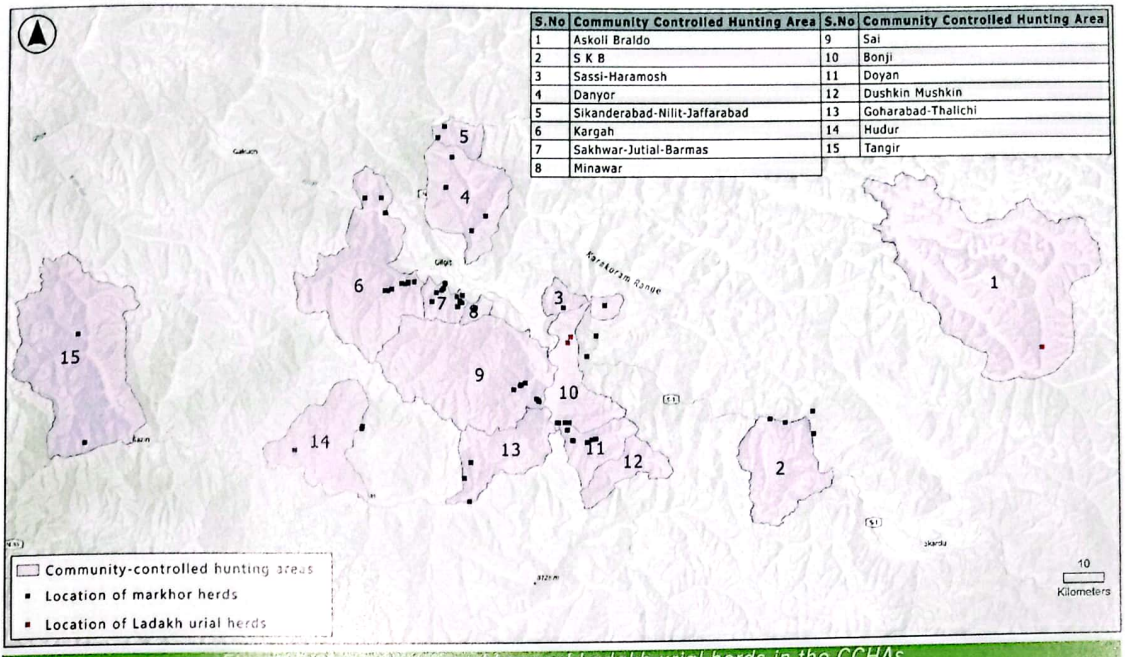

Figure 3: Distribution of markhor and Ladakh urial herds in the CCHAs.

Table 3: Details of markhor in community controlled hunting areas of survey districts.

District	Community Controlled Hunting Area	Female	Young	Yearling	Class1	Class2	Class3	Class4	Total	Trophies
Gilgit	Sakhwar-Jutial-Barmas	119	64	61	6	22	12	26	310	12
	Kargah	66	30	23	0	14	10	18	161	10
	Sai	58	10	10	2	10	6	21	117	7
	Minawar	16	10	9	0	0	16	18	69	4
	Danyour Nallah	24	11	7	2	5	1	1	51	1
	Sassi-Haramosh	12	4	2	0	0	1	2	21	2
	District Gilgit Total	**295**	**129**	**112**	**10**	**51**	**46**	**86**	**729**	**36**
Astore	Bonji	168	60	54	18	41	12	39	392	20
	Doyan	47	10	8	0	3	2	6	76	5
	D M T	29	10	9	1	7	6	13	75	10
	District Astore Total	**244**	**80**	**71**	**19**	**51**	**20**	**58**	**543**	**35**
Skardu	S K B	42	28	22	0	0	8	19	119	10
	District Skardu Total	**42**	**28**	**22**	**0**	**0**	**8**	**19**	**119**	**10**
Diamer	Hudur	4	3	3	0	0	4	2	16	0
	Tangir	4	3	1	0	3	0	0	11	0
	Goherabad-Thalichi	0	0	0	0	0	5	3	8	3
	District Diamer Total	**8**	**6**	**4**	**0**	**3**	**9**	**5**	**35**	**3**
Nagar	Sikanderabad-Nilt-Jaffarabad	9	3	2	2	2	2	0	20	0
	District Nagar Total	**9**	**3**	**2**	**2**	**2**	**2**	**0**	**20**	**0**

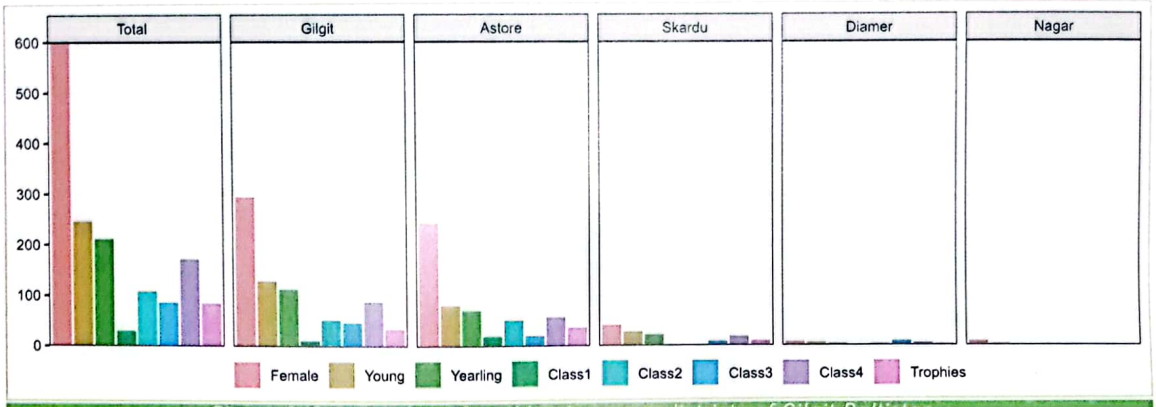

Figure 8: Demography of markhor in survey districts of Gilgit-Baltistan.

Plate 4: Astore markhor herd sighted by the survey team.

Table 4: Details of Ladakh urial population in community-controlled hunting areas of surveyed districts.

District	Valley	Female	Young	Yearling	Class1	Class2	Class3	Class4	Total	Trophies
Astore	Bonji	72	18	13	8	7	7	8	133	2
	District total of Astor	**72**	**18**	**13**	**8**	**7**	**7**	**8**	**133**	2
Shigar	Durumdo	2	0	0	1	0	0	0	3	0
	District total of Shigar	**2**	**0**	**0**	**1**	**0**	**0**	**0**	**3**	0

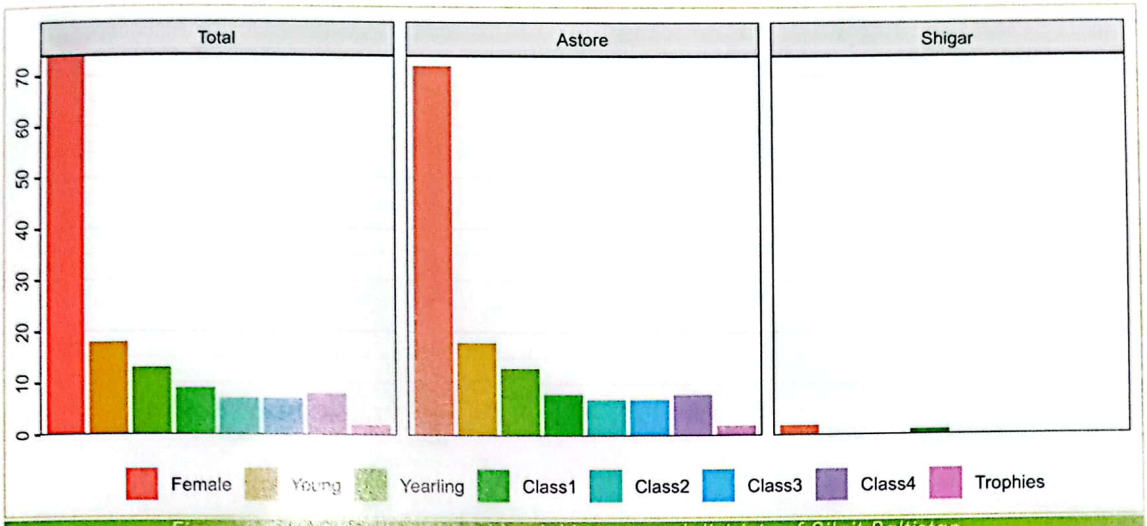

Figure 9: [illegible] of Ladakh urial in surveyed districts of Gilgit-Baltistan.

Plate 5: Ladakh urial herd sighted by survey team in Durumdo Nullah of district Shigar.

3.2 Population Density

The highest per square kilometer (km^{-2}) occupancy of markhor was observed in the CCHA of Sakhwar-Jutial-Barmas i.e., 3.87, followed by Minawar CCHA with 2 animals/km^2 and Bonji CCHA with 1.30 animals km^{-2} (Figure 10). The population density of Ladakh urial was 0.44 animals km^{-2} in Bonji and 0.001 animals km^{-2} in Durumdo Nullah of Shigar district.

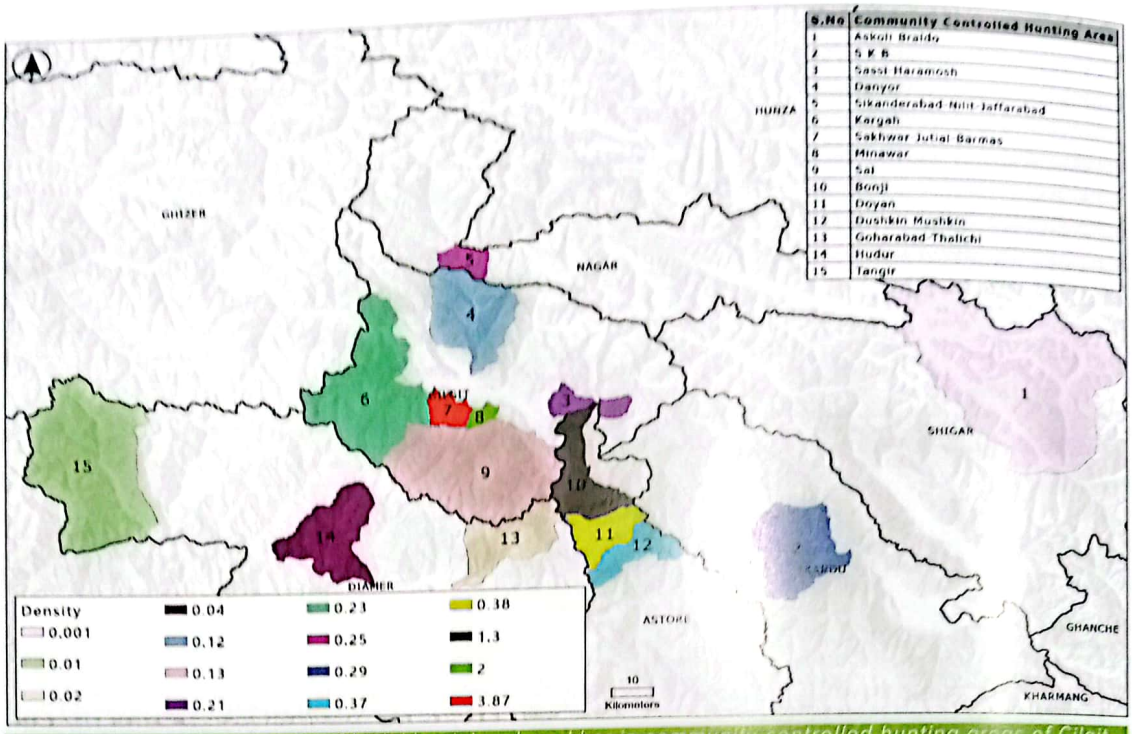

Figure 10: Population density of Ladakh urial and markhor in community-controlled hunting areas of Gilgit-Baltistan.

3.3 Population Trend

In the current survey, more markhors were sighted in the districts of Gilgit and Astore compared to the 2021 surveys, while fewer markhors were sighted in the districts of Diamer, Skardu, and Nagar than in 2021 (Figure 11). Similarly, more Ladakh urial were sighted in the Astore district during this survey than in 2021, while no Ladakh urial were sighted in the Diamer district this year, and fewer Ladakh urial were sighted in the Shigar district this year compared to 2021 (Figure 12).

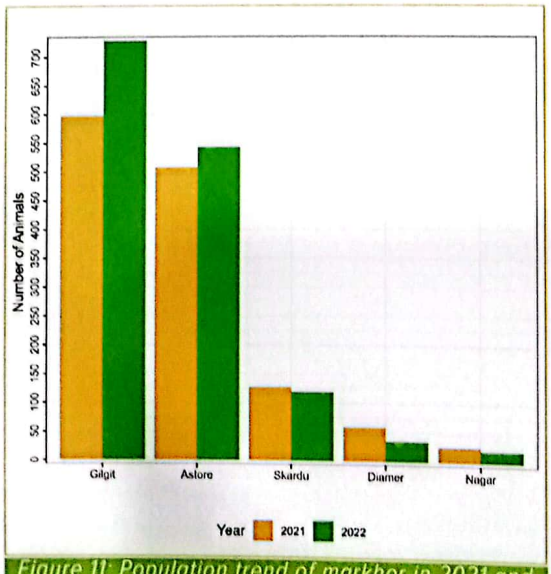

Figure 11: Population trend of markhor in 2021 and 2022 in Gilgit-Baltistan.

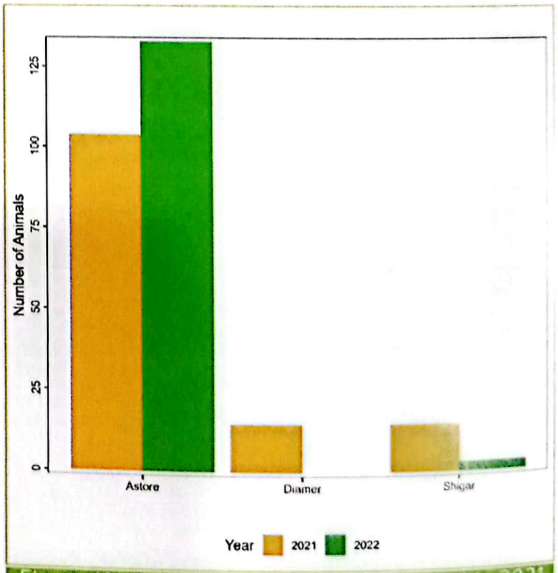

Figure 12: Population trend of Ladakh urial in 2021 and 2022 in Gilgit-Baltistan.

3.4. Number of Harvestable Animals for Year 2024

4. DISCUSSION

Wild ungulates have always been a valuable resource for humans, providing not only a source of protein and pelts for making thermals (Hess et al., 1997), but also playing key roles in ecosystem maintenance. They serve as nitrogen fixers, facilitate seed dispersal, and provide prey for many carnivorous species (Ali et al., 2021).

Plate 6: Snow leopard in its habitat

The rapid increase in human population has put non-resilient pressure on natural resources, including wild ungulates, which are targeted for their derivatives such as hides and horns. At times, poverty drives direct poaching as a source of subsistence food (Ripple et al., 2016). The situation has been further aggravated by advancements in weapons, which make it easier to kill multiple animals instantly (Ripple et al., 2015).

The wild ungulates in Gilgit-Baltistan faced the same dilemma as they did elsewhere (Haider et al., 2021); the markhor and Ladakh urial had reached the verge of extinction (Din et al., 2016). However, when a trophy hunting program was introduced and local communities were involved in the management of wild ungulates (Haider et al., 2021), this tool proved to be effective for the recovery and persistence of the remaining population of markhor (Ahmad et al., 2022). The effectiveness of conservation to people and ecosystem is important to assess (Singh and Milner-Gulland, 2011) and interventions like annual monitoring surveys are recommended to assess the effectiveness.

Plate 7: Astor markhor herd grazing

We counted 1,449 markhors in 15 community-controlled hunting areas, which is consistent with recent studies. For example, Haider et al. (2021) counted 1,087 markhors in Gilgit-Baltistan, and Asif et al. (2022) counted 1,319. The population demography of markhor was as follows: females (598), young (246), yearlings (211), class 1 males (31), class 2 males (107), class 3 males (85), and class 4 males (168), out of which 83 were trophy size males within class 4. The population demography observed in this survey is like that reported by (Asif et al., 2022).

Unlike markhor, there was higher females in Ladakh urial population (74) than males (31), with 18 young and 13 yearlings. Population estimates for Ladakh urial have decreased since (Din et al., 2016) count of 400 in Gilgit-Baltistan but akin to (Asif et al., 2022) count of 158. However, (Asif et al., 2022) reported a higher number of males than females.

The male-to-female ratio of the markhor was 1:1.56. Using other criteria such as the 2% rule of the total population, 29 markhors may be harvested, or using the 25% rule of the total trophy size males, 21 markhors may be harvested (Adhikari et al., 2021; Zaman et al., 2019).

4.1 Recommendations

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To

The Chief Conservator Wildlife
Khyber Pakhtunkhwa
Peshawar

No.__**346**__/WL-K dated Pattan the_**09**_/01/2023

Subject: **ANNUAL SURVEY REPORT FOR THE YEAR 2022**

Reference Your letter No. 5409-34/WL-(S.I) dated 16-12-2022

With reference to above reference letter, it is submitted that during the year 2022 the annual wildlife species surveys is not conducted on scientific methodology and appropriate survey techniques due to financial constraints in the current allocated budget of this office. However, the subject annual survey report is based on the staff feedback, field observations and field visits reports of staff from various areas/valleys in Kohistan Wildlife Division. The data was further extrapolated on the basis of extent and potential of wildlife habitats in major.

S No	District Name	Species Name	Valley/Area	No's Birds/Animal	Total
1	Upper Kohistan	Markhor	Kighah, Kandia,	625	660
	Lower Kohistan		Kayal & Dubair	35	
2	Kolai Palas	Ibex	Ledi Valley, Chor Valley & Neelgah	166	166
3	Kolai Palas	Musk Deer	Kundal	10	10
4	Upper Kohistan,	Goral	Jalkot Kandia	60	200
	Kolai Palas		Gohar Abad, Kundal, Kunshair	120	
	Lower Kohistan		Kayal, Jijal, Dubair Madraza,	20	
5	Upper Kohistan	Black Beer	Kighah,, Jalkot Kandia	20	50
	Lower Kohistan		Kayal, Dubair Madraza,	10	
	Kolai Palas		Gohar Abad, Kundal, Kunshair	20	
6	Upper Kohistan	Brown Beer	Supat Valley	25	25

7	Kolai Palas	Common Leopard	Upper Palas	3	4
	Lower Kohistan		Dubair	1	
8	Kolai Palas	Marmot	Upper Palas	70	135
	Upper Kohistan		Supat Valley	65	
9	Upper Kohistan,	Wolf	Kighah, Supat Valley	30	55
	Lower Kohistan		Kayal, Dubair Madraza, Jalkot Kandia,	10	
	Kolai Palas		Gohar Abad, Kundal, Kunshair	15	
10	Upper Kohistan,	Fox	Kighah, Supat Valley, Jalkot Kandia,	20	85
	Lower Kohistan		Kayal, Dubair Madraza,	30	
	Kolai Palas		Kundal, Gohar Abad, Kunshair	35	
11	Upper Kohistan	Wild Cat	Kighah, Jijal Supat Valley, Jalkot, Kandia,	150	480
	Lower Kohistan		Kayal, Dubair Madraza,	200	
	Kolai Palas		Kundal, Gohar Abad, Kunshair	130	
12	Upper Kohistan	Jackal	Supat Valley, Jalkot Kandia, Kighah	130	350
	Lower Kohistan		Pattan,Galos Banda Jijal Kayal, Dubair Madraza,	100	
	Kolai Palas		Kundal, Gohar Abad, Kunshair	120	
13	Upper Kohistan	Rhesus Monkey	Supat Valley, Jalkot Kandia, Kighah	230	550
	Lower Kohistan		Pattan,Galos Banda Jijal Kayal, Dubair Madraza,	70	
	Kolai Palas		Kundal, Gohar Abad, Kunshair	250	
14	Kolai Palas	Himalayan Langur	Khabkot Valley, Upper Palas	40	40
15	Kolai Palas	Western Tragopan	Khabkot Valley, Upper Palas, Karosair	25	70
	Lower Kohistan		Jalkot Kandia,	45	
16	Upper Kohistan,	Monal	Palas, Karosair,	40	230
	Lower Kohistan		Dubair Kayal, Choa Dara, Madraza,	80	
	Kolai Palas		Dubair, Kayal	110	
17	Upper Kohistan,	Koklas	Jalkot Kandia,	60	250

	Lower Kohistan		Dubair Kayal, Choa Dara, Madraza,	75	
	Kolai Palas		Palas, Karosair,	115	
	Upper Kohistan,	Chakor	Jalkot Kandia,	2500	6000
	Lower Kohistan		Jijal, Chakai, Galose Banda, Madraza, Dubair Kayal, Choa Dara,	2000	
	Kolai Palas		Batera, Kharat, Palas, Karosair	1500	
18	Kolai Palas	Kalij	Karosair	45	45
19	Upper Kohistan,	Rock Pigeon	Jalkot	350	850
	Lower Kohistan		Jijal, Chakai, Kayal, Choa Dara, Madraza, Galose Banda, Dubair	300	
	Kolai Palas		Batera, Kharat Palas, Karosair,	200	
20	Kolai Palas	Snow Cock	Karosair, Khabkot	25	25
21	Upper Kohistan,	Dove	Jalkot Harban, Sew, Shityal	180	420
	Lower Kohistan		Pattan, Chakai, Kiyal	160	
	Kolai Palas		Bataira, Guli Bagh, Palas, Madakhail, Kolai,	80	
22	Upper Kohistan,	Vulture	Jalkot	25	65
	Lower Kohistan		Pattan	20	
	Kolai Palas		Palas, Madakhail, Kolai,	20	
23	Upper Kohistan,	Jungle Crow	Jalkot, Kandia	230	690
	Lower Kohistan		Dubair, Razika	190	
	Kolai Palas		Upper Palas, Barshiryal	270	

Divisional Forest Officer
Kohistan Wildlife Division
At Pattan

No. **347** /WL-K

Copy forwarded to the Conservator Wildlife Hazara Circle Abbottabad for information please.

Divisional Forest Officer
Kohistan Wildlife Division

At Pattan

REPORT ON WILDLIFE SURVEY IN BAHRAIN WILDLIFE RANGE UPPER SWAT WILDLIFE DIVISION MATTA DECEMBER, 2022

Upper Swat Wildlife Division, Matta

Table of Contents

Summary

The primary aim of the survey was to determine the Markhor population and density. The survey was conducted in three valleys i.e Mahodand, Shahoo, and Mankyal of Bahrain Wildlife Range and animals were observed at Nine (09) vantage/observation points. Surveys were conducted from 29th to 31st December 2022 in the rut season of Markhor. The survey aimed to estimate the Markhor population trends and growth rate and to record other wildlife species found in these valleys.

Survey analysis revealed that, fawn accounts for 27.04% of the total population (43/159), female population is (51/159) which is 32.07 % of the total population and male of different classes accounts for 40.88% of the total count (65/159). The survey results further reveled that trophy size markhor were 19 in number. During the survey, 18 Foxes, 67 Rhesus Monkeys, 7 No Wolves, 35 Ram Chukars, 24 No. Koklass Pheasants, 19 No. Snow Partridges, 30 No. Monal Pheasant and 14 No. Vultures, Eagles etc were also observed. Based on daily observations of field staff and informal eveidences, it is derived that Snow leopard is the top predator of Markhor and Ibex. In the absence of Snow leopard predation mostly done by the Himalayan Lynx and wolves.

Introduction

1. General

Upper Swat Wildlife Division lies in the upper northern portion of swat district. Swat occupies a central position geographically in Malakand Division and it is surrounded by District Indus Kohistan and District Shangla in East, District Lower and Upper Dir in West, Lower Swat in South.

Administratively Upper Swat Wildlife Division is divided into one Wildlife Sub Division and two Wildlife Ranges i.e. Bahrain Wildlife Range, Khwazahela Wildlife Range and Matta Wildlife Sub Division. Upper Swat Wildlife Division is providing a habitat to a variety of flora and fauna i.e from Sub Tropical Broad Leaved Evergreen Forests to Moist Temperate and up to the limits of Sub Alpine and Alpine pastures. Each habitat abode from partridges population to the pheasants and also for Markhor, Ibex, Snow Leopard, Mush Deer, Black Bear and Brown Bear etc.

Increase in human and livestock population, Illegal hunting and trade in the area has put the wildlife species in awkward position, and it has to compete intensively with man and livestock and is on high risk due to human wildlife conflict.

2. Survey Sites

2.1 Kalam:

Kalam lies in the extreme north of Swat district at a distance of about 100 Kms from Mingora city and 70 Kms from Matta and between 35^{O} – 26'and 35^{0}- 40' North latitudes and 72^{0}-12' and 72^{0}-45' East longitudes with an area of about 1900.8 Km^{2}. It is bounded on the North by Gilgit and Chitral District, on the East by Indus Kohistan, on the South by Bahrain Kohistan and on the West by Dir District. Kalam consists of six valleys, namely Bhan, Godar, Shahoo, Mahodand, Utror and Gabral.

2.2 Mankyal

Mankyal valley is situated at a distance of 80 km in the north east of Swat on the main Mingora to Kalam road on the left bank of River Swat. It spreads over an area of 20,380 Hectares between 35^{o}-15-18" to 35^{o}-25-17" North Latitudes and 72^{o}-36-11" 72^{o}-47-5" East Latitudes over the globe. It is bounded by Kalam valley in the north, Bahrain valley in the south, Kohistan District in the east, Balakot and Swat River in the west.

3. Biological significance of the area

Bahrain Wildlife Range in particular and Kalam, Mankiyal in general are very rich zones as far as biodiversity is concern. Both these areas are considered as Wildlife conservancies by the fact that they have the capability to support variety of wildlife species. But there is considerable concern for conservation of biodiversity, because many species of plants and animals are on the verge of extinction or endangered due to human activities, such as, excessive exploitation of forests, hunting, pollution, modernization of agriculture, damages due to forest fire, changing local culture and fragmentation of wildlife habitats.

Biodiversity of an area can play a role in local economy through viewing and hunting on sustainable grounds. The local communities depend on the natural resources to meet their requirements of timber, fuel wood, and fodder for livestock. All the flora and fauna have numerous benefits for the people, in the form of food, medicines etc. They collect non-wood products including honey, mushrooms, chilghoza, walnuts, and medicinal plants from forests of the valley having great market values and are one of the major sources of income and support

economy of the poor community of Kalam. Following are major Flora and Fauna found in Kalam and Mankiyal of Behrain Wildlife Range:

S #	Fauna	
	Local/English Name	**Scientific Name**
1	Kashmir Markhor	*Capra Falconeri*
2	Snow Leopard	*Panthera uncia*
3	Black Bear	*Ursus Thibetanus*
4	Indian Wolf	*Canis lupus pallipes*
5	Rhesus Monkey	*Macaca mulatta*
6	Koklass Pheasant	*Pucrasia macrolopha*
7	Monal Pheasant	*Lophophorus impejanus*
8	Himalayan Snow-cock	*Tetraogallus himalayensis*
9	Snow Partridge	*Lerwa lerwa*
10	Chukar	*Alectoris chukar*
11	Flying squirrel	*Sciuridae*
12	Pigeon	*Columbidae*
13	Musk Deer	*Moschus chrysogaster*
14	Yellow Throated Martin	*Martes flavigula*
15	Leopard Cat	*Prionailurus bengalensis*
16	Lynx	*L. Lynx*
17	Fox	*Vulpes vulpes*

S #	Flora	
	Local/English Name	**Scientific Name**
1	Ranzra/Diyar	*Cedrus deodara*
2	Kail	*Pinus wallichiana*
3	Mangazai/Spruse	*Picea smithiana*
4	Achar/ Fir	*Abies pindrow*
5	Ghuz/Walnut	*Juglans regia*
6	Birch	*Betula utilis*
7	Jawaz/Horse-Chestnut	*Aesculus indica*
8	Willow	*Salix tetrasperma*

9	Chilghoza	*Pinus gerardiana*
10	Kwaray/Berberies	*Berberies lyceum*
11	Cranberry bush	*Viburnum nervosum*
12	Barmi	*Taxus baccata*
13	Burash	*Rhododendron arboream*
14	Shah Baloot	*Quercus baloot*
15	Maple	*Acer caesium*
16	Sperdar/Poplar	*Populus ciliate*
17	Tor Amlook	*Diospyrus Lotus*
18	Banj	*Quercus dilatata*
19	Oak	*Quercus semicarpifolia*
20	Ephedra	*Ephedra gerardiana*

4. Objectives of the Survey*:*

Following are the main objectives of the survey:

4.1.To find out population trend of Markhor

4.2. To estimate the current population trend of Markhor and their sex/age analysis.

4.3.To record other birds and animals during the survey.

5. Methodology of Survey

Trend monitoring in wild ungulates populations is required to measure the effectiveness of any conservation programme, monitor the population and decide about the harvest quota for trophy hunting (Cooperridor*et al.,* 1986). In northern Pakistan, it is difficult to conduct survey on precipitous terrain and rugged mountain cliffs, while using standard sampling techniques of strip counts, line transects, stratified sampling. Random block counts are also generally very difficult to be used in these high mountains with rugged and broken terrain (Caughley, 1977; Burnham *et al.,* 1980; Seber, 1982).

It is very difficult in the broken and rocky mountain topography to map productive habitats of mountain ungulates because to calculate areas under steep slopes, barren rocks, and glaciers requires considerable efforts and expertise. Therefore, extrapolation of densities obtained from the sample counts to a larger area may mislead due to over estimation or under estimation of the

population (Virk, 1999; IUCN, 2006). Harris (1994) stated that precisely estimating numbers of Caprinae species especially markhor and Ibex is difficult due to variation in the group size and composition. Jackson and Hunter (1996) investigated that group size and composition may be different for different days because individuals sometimes join or leave a specific group. According to Roberts (1997 and 2005), markhor and ibex are social animals and they usually live in small group shaving females with their kids, yearlings and young males. Mature and old males live alone during spring and summer in inaccessible and high elevation areas. They only join the herds during the winter rut season. Markhor and Ibex are diurnal in habit and graze during day time mostly early in the morning and late in the evening. Rut season is December and continues for one month until January. In the rut season, male markhor, male Ibex possess a strong goat smell. During rut season, the male come down to lower elevations to join herds in search of females (The herd consists of females, kids-young of the year-six months old, yearlings-18 months old and young males) and attach themselves to one particular herd.

Keeping in view this biological behavior of the animals and the problems faced in sampling and extrapolation, winter rut season survey on fixed points (vantage points) for two to three consecutive days were carried out. Winter rut season survey on fixed points was also used by IUCN in 2006. Yash, *et al.* (2009) also used this method by setting up vantage points along some trials at places that offered a vast view during winter. During summer, locating male animals after segregation becomes difficult.

Moreover, survey data from 2019 to 2021 from Swat Wildlife Division, Khyber Pakhtunkhwa Wildlife department, was also used for analysis. The department also used the same method of data collection.

To wander around the difficult and dangerous hill slopes for counting of the animals often becomes very difficult and risky. Markhor and Ibex are diurnal in habit and usually start grazing early in the morning with sunshine and in the late afternoon before sunset. To avoid this difficulty and count the animals, vantage points were selected. Vantage points are those commanding positions on hill slopes from where activities of the animal could be best monitored on a regular basis at the same time of the year with the help of Binoculars/spotting scopes (Khyber Pakhtunkhwa Wildlife Department, 2010;Ali, 2008; IUCN, 2006; Virk, 1999, Ghafoor,

2014). Since these animals start grazing from bottom in the morning and the animal grazes upto the top of the mountain. Keeping in view this behavior the vantage point were selected to monitor the animal along the contours to avoid duplication. Vantage points were selected while keeping in view the geophysical conditions of the ground as well. Virk (1999) considered this method as the best method for wild ungulates survey.

To record male animals of trophy size, surveys were carried out during the months of December and January in winter rut season. Survey in these months was conducted from sun rise to sun set for about nine hours daily. During winter, the ground is mostly covered with snow and the animals usually come down to lower slopes for food. Rut season is best for survey because mature males also come down and join a group having females and juveniles (Ali, 2008).

Wildlife annual Survey was conducted while using vantage point method of direct couting. All the survey parties in the team had to ensure early morning sighting at about 0700 hours and early evening sighting around 1600 hours to confirm the movements, occurrence and number of wild species. survey team members ensured their presence before 7am in the morning and remained till late at least 4pm on their respective vantage points and recorded the data on prescribed data sheet developed for the purpose.

Animals were observed with the help of 10 x 42 mm binoculars and Spotting scope. Herd size and composition of Markhor along with other species were recorded. To avoid duplication in counting, the data was critically examined and the reports of adjoining points were examined with reference to herd size and composition. In this examination the possible duplicate counting was eliminated and the herd composition with reference to time was taken as perameter to reduce the counting error.

The community wildlife experts, who are the experienced hunters, are illiterate, cannot count the annuli in the horns even if they are clearly visible. Even if they are holding the markhor physically, it is very difficult for them to count the annuli. They also do not understand inches and centimeters. Therefore in the survey form three classes were written i.e. young, sub adult and adult, which corresponded to horn size.

In male Markhor young would mean horns between one and two Balishts (Human adult male palm) or horns with more than one twist but less than two twists. This corresponds to horn size upto 15". Sub adult would mean horns of more than two Balishts but less than four Balishts or horn with more than two twists but less than three twists. This corresponds to horn size 15" to 36". The adult mean horns of four Balishts and more or horns of three twists and more. This corresponds to horn size more than 36" (IUCN 2002 to 2006). In trophy hunting, only adult males are harvested and thus animals having more than 36" long horns would be considered as trophy size animals.

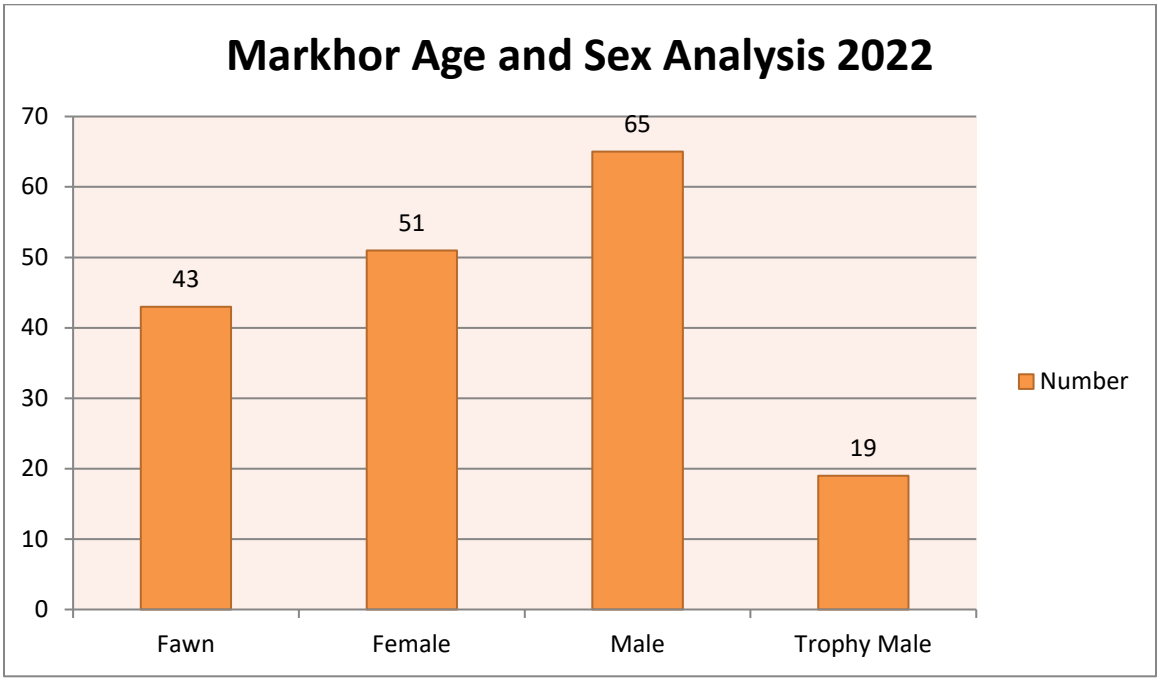
6. Results and Discussions

6.1 Total count of Markhor*:*

Data was collected from 09 vantage points in three valleys of Bahrain Wildlife Range and 159 Nos. of Markhor were sighted during the survey.

6.2 Age and sex wise analysis for Markhor in Bahrain Wildlife Range:

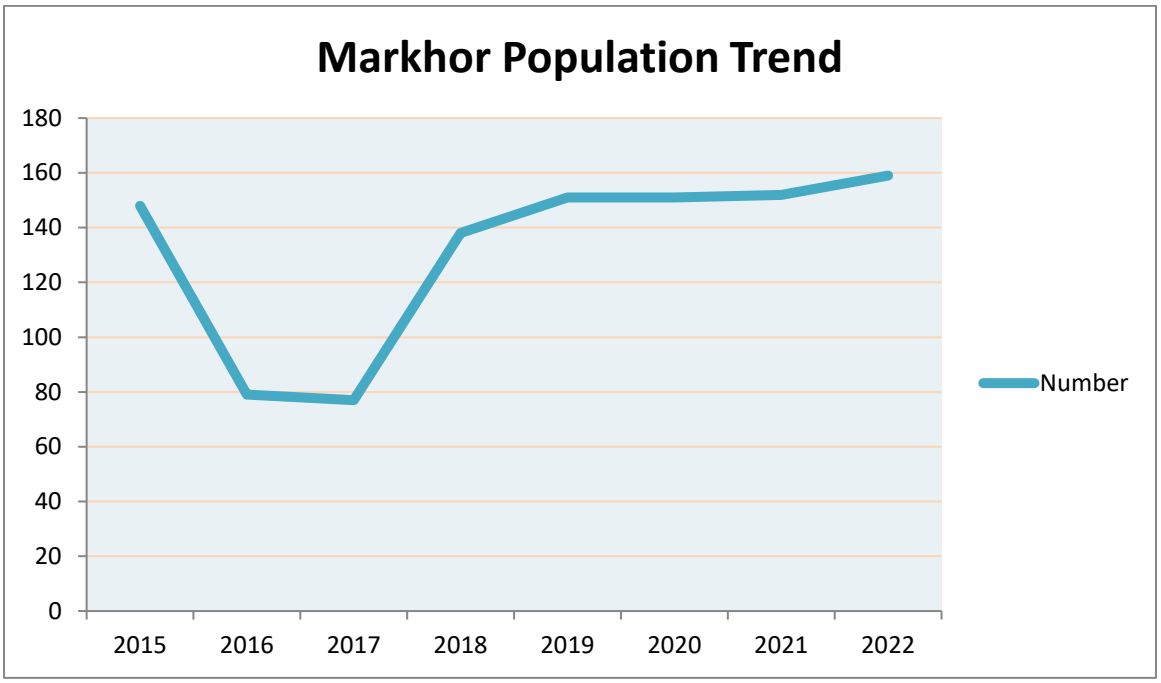
Age wise analysis for Markhor revealed that, fawn accounts for 27.04% of the total population (43/159), while sex wise analysis revealed that the female population is (51/159) which is 32.07% of the total population and male of different classes accounts for 40.88% of the total count (65/159). The survey results further reveled that trophy size markhor were 19 in number.



7. Discussion

Swat Wildlife Division hosts a healthy surviving population of Kashmir Markhor in the wild. Results compiled during winter survey conducted by the wildlife department show the following figures:

7.1 Markhor Population*:*



Over all trend of the markhor population in Bahrain Wildlife Range show an upward trend except for 2016 and 2017, when the there was drought and snowfall delayed till end of January.

Table 1: Survey Results of Markhor in Mahodand Valley December, 2022.

S#	Name of Valley	Vantage Points	Coordinates	Classification			Total
				Male	Female	Fawn	
1	Palogah Dara	Deder Banda	**35.55405N 72.72619E**	**8**	**5**	**7**	**20**
2	Maidan Khwar	Banalot	**35.08895N 71.76690E**	**13**	**8**	**4**	**25**
3	Batin Dara	Och Bandha		**4**	**4**	**3**	**11**
		Total		**25**	**17**	**14**	**56**

Table 2: Survey Results of Markhor in Shahoo Valley Kalam December 2022

S#	Name of Valley	Vantage Point	Coordinates	Classification			Total
				Male	Female	Fawn	
1	Beshai	Chin Banal	**35.47139N 72.69118E**	**7**	**7**	**4**	**18**
2	Kalam Banal	Goom	**35.49967N 72.56560E**	**6**	**3**	**4**	**13**
3	Chamin Banal	Kehlasan	**35.50321N 72.60485E**	**4**	**4**	**3**	**11**
			Total	**17**	**14**	**11**	**42**

Table 3: Survey Results of Markhor in Mankiyal Valley December, 2022.

S#	Name of Valley	Vantage Point	Coordinates	Classification			Total
				Male	Female	Fawn	
1	Kailny (Basharai Dara)	Dhiky	**35.34274N 72.61787E**	**9**	**5**	**6**	**20**
2	Kamar khwa	Char		**6**	**7**	**7**	**20**
3	Kashkat Dara	Kashkat		**8**	**8**	**5**	**21**
			Total	**23**	**20**	**18**	**61**

Table.4: No. of Age /sex group of Markhor in Bahrain Wildlife Range*:*

S. No		No. of animals	Percentage %
1	Fawn	43	27.04
2	Male	65	40.88
3	Female	51	32.07
Total		**159**	**100**

Table 9: Abstract of Wildlife Survey at Bahrain Wildlife Range December 2022.

S.#	Name of Valley	Markhor	Snow Leopard	Lynx	Black Bear	Musk deer	Fox	Rhesus Monkey	Wolf	Ram Chakor	Koklass Pheasant	Snow Partridge	Monal Pheasant	Golden Eagle	Vultures
Mahodand Valley															
1	Palogah Dara	16	-	-	-	-	3	-	1	8	-	4	-	-	-
2	Maidan Nala	26	-	-	-	-	-	-	-	4	2	-	-	-	1
3	Batin Dara	13	-	-	-	-	4	-	2	7	4	7	8	-	3
Total		**55**	**-**	**-**	**-**	**-**	**7**	**-**	**3**	**19**	**6**	**11**	**8**	**-**	**4**
Mankyal Valley															
1	Kailny (Basharai)	**20**	-	-	-	-	-	17	-	-	3	-	4	-	-
2	Kashkat Dara	**21**	-	-	-	-	2	20	-	7	2	3	5	-	3
3	Char(Kamar khwa)	**22**	-	-	-	-	4	24	2	4	6	2	2	-	1
Total		**63**	**-**	**-**		**-**	**6**	**61**	**2**	**11**	**11**	**5**	**11**	**-**	**4**
Shahoo Valley															
1	Chamin Banal	20	-	-	-	-	-	1	-	3	1	1	2	-	3
2	Beshai (Chamin)	10	-	-	-	-	2	3	2	2	2	-	3	-	1
3	Kalam Banal	11	-	-	-	-	3	5	-	-	4	2	6	-	2
Total		**41**	**-**	**-**	**-**	**-**	**5**	**9**	**2**	**5**	**7**	**3**	**11**	**-**	**6**
Sub Total		**159**	**-**	**-**	**-**		**18**	**67**	**7**	**35**	**24**	**19**	**30**	**-**	**14**

During the survey 18 Fox, 67 Rhesus Monkey, 7 No Wolf, 35 Ram Chukar, 24 No. Koklass Pheasant, 19 No. Snow Partridge, 30 No. Monal Pheasant and 14 No. Vultures, Eagles etc.

8. Recommendations

- The survey shall be repeated/ reconducted at the same dates and in the same valleys each year.
- Community mobilization and organization is due required for introducing the future Trophy Hunting programme as in vogue in Chitral and Kaiga valley of Indus Kohistan.
- An exposure visit for the community members shall be arranged to Chitral for widening their vision and learning from ther community members.

Kashmir Markhor & Himalayanlbex
Rut Season Survey Chitral Gol National Park
December, 2022

CHITRAL GOL NATIONAL PARK, THE LIVING MUSEUM OF WILDLIFE

Table of contents

List of Boxes

SUBMITTED BY:

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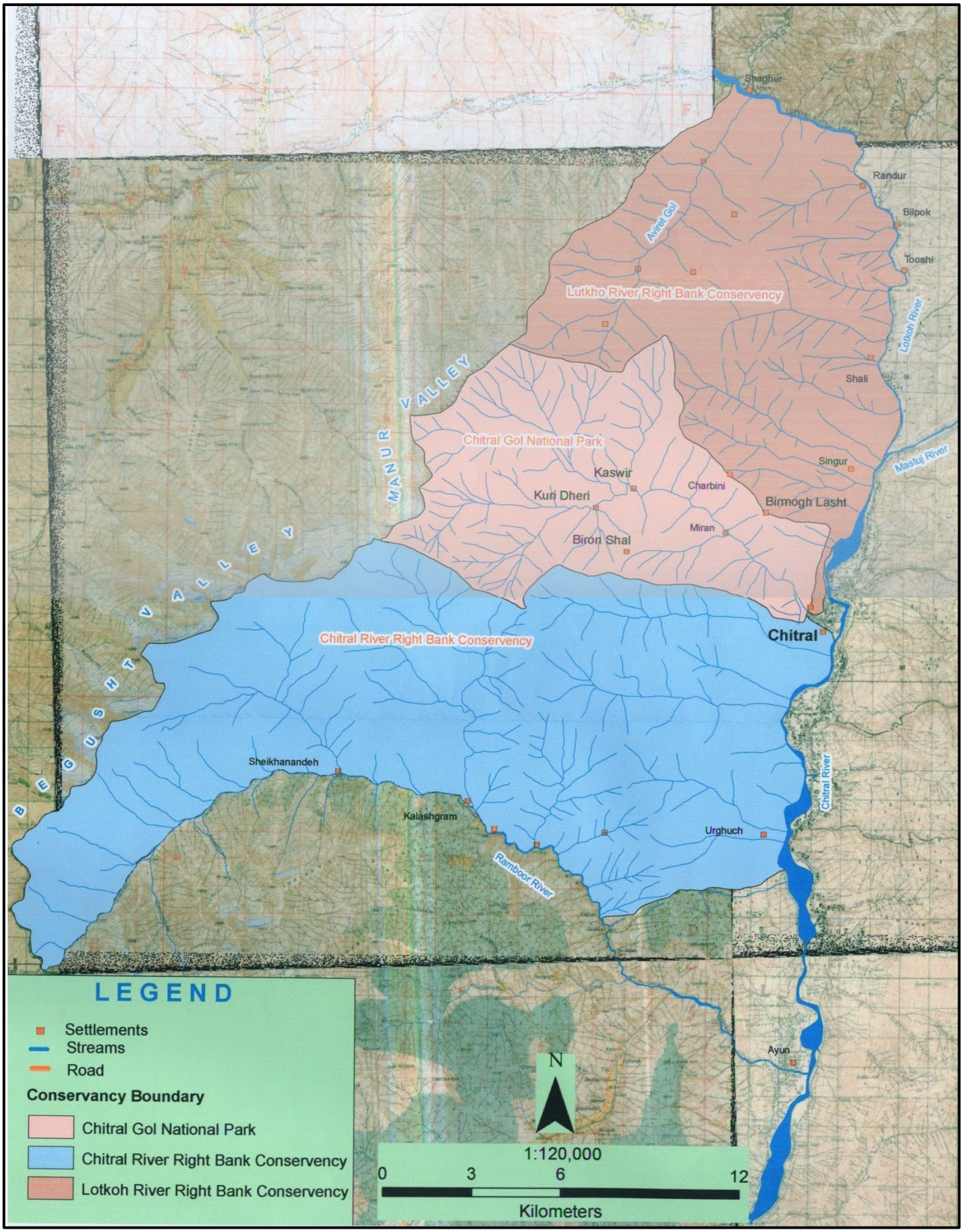
GOL NATIONAL PARK WILDLIFE DIVISION CHITRAL

List of Figures

List of Tables

Map of Chitral Gol National Park



Summary

This report is the outcome offivedays long survey, conducted in December 2022during Markhor Rut season. The survey aimed to estimateMarkhor population trends, estimate the growth rate of the animals, and to determine the predation trends during the year within the CGNP core and buffer zones.

A total of **2375** markhor were counted in Chitral Gol including core and buffer zonesduring the survey.The four vantage points namely Sha dehar, Loho Bangot, Merin dehar and Olowak which were hosting 407,227, 223 and 168 markhors respectively therefore regarded as heavy concentrated areas while the low concentration was observed at Banj shal with 37 markhors only

Age wise analysis of the count shows that Lamb accounts for 20.1%(477) and yearlings accounts for 13.6% (324) of the total count while sex wise analysis revealed that the female population 32.5 %(772), male of different classes is 33.8 % (802) of the total count. The recent count revealed that class IV males were highest in number (215) followed by class III representing 206, class I with 205 animals and class II with 176 animals respectively.

Based on daily observations of field staff and register maintained in Range Office revealed that Snow leopard is the top predator of Markhor in CGNP core and buffer zone but for the last few years Snow leopard visiting the core zone occasionally and in the absence of Snow leopard predation mostly done by the Himalayan Lynx, wolves and stray dogs. No serious viral disease among the Markhor population has been observed yet. 10 yearlings , 6 Lamb, 3 males and 5 females Markhors were killed by stray dogs. 6 Lambs, 1 yearling and 4 females Markhor were killed by wolves while 1 male and 3 yearlings were killed by Himalayan Lynx. Thus total 39 predation were recorded during the year 2022. Beside predation, migration of animals from core zone to other potential habitats like Noristan Afghanistan and Toshi-shasha community managed game reserve is routine activity.

1.Introduction

Chitral Gol National park is famous not only for its panoramic view but also hosts the largest population of Kashmir markhor(National animal of Pakistan) in the wild and providing suitable habitat for Deodar (National tree), Chakur partridge (National bird) and globally endangered Snow leopard.It is located in the Northern most part of the country in district of Chitral (Khyber Pakhtunkhwa province). Every year a number of national and international naturalists and ecologists are attracted to this area because of its scenic beauty and its enigmatic wildlife.

Core area of the park spreads over an area of 7750 ha situated in the north-west of Chitral town and further extends in the west and east as its buffer zone include some of the biological rich habitats of Hindu Raj Mountains, Kalash culture and famous Aviret Gol. The approximate geographical position of the park is 35^{o} 42' to 36^{0} 01' N Latitude and 71^{0} 36' to 71^{0} 49' E Longitude with an elevation ranging from 1450 to 4979 m. It receives 462 mm annual precipitation mainly in form of snow in winter and spring. Monsoon clouds do not reach CGNP.

There are more than 24 peaks extending 3000 m. Most of the northern parts of the park are lined above the tree line and have many high mountain peaks covered with snow. Few springs and glacial streams borne in this area flow down and join Chitral Gol in Gokhshal. In the south-west of Gokhshal, two valleys Chat and Doni divided by a sharp edge mountain ridge lies narrowly side by side in the west opens in the alpine meadows near the snow line at 4000 m.

Year of Establishment:	1984
Total Area:	
Core zone:	7750 hectares
Buffer zone:	34599 hectare
Geographical Location:	
35^{0} 42’ to 36^{0} 01' N	
71^{0} 36’ to 71^{0} 49' E	
Physical location:	North West in the KPK Pakistan in Hindukush

BOX 1

1.1 History of Chitral Gol:

Different tribes ruled over the region before its amalgamation in Pakistan as a settled district in 1969. Kalash were the first rulers of the area who ruled for more than three centuries. During 1320 Raees tribe took over control of the region and ruled until the Katoor family came over to rule. The three ruler tribes have used Chitral Gol according to their needs and traditions. In 1880 for the first time in Chitral Gol history Mr. Aman-ul- Mulk paid attention to its management and his second son SardarNizam-ul-Mulk used Chitral Gol as a hunting ranch. In 1902 Chitral Gol was given the status of ShahiShikargah and in 1907 Sir Shuja-ul-Mulk started its proper management. During 1912 Guest houses and Shikari huts were constructed in-side Chitral Gol. Chitral Gol remained under strict protection during the tenure of ex-Mehtar family till the state was declared as a settled district in 1969.

1.2 Present Status:

During 1957 and 1958 uprisings the local people’s demand of complete merger of the state with Pakistan caused complete deterioration of law and order situation and the young ruler of Chitral became almost ineffective consequently Chitral Gol became no body’s property as a result the localinhabitants’heavily taped natural resources of Chitral Gol.After realizing the deteriorating situation of Chitral Gol the provincial government took control of Chitral Gol and Commissioner Malakand Division issued a notification declaring Chitral Gol as a wildlife sanctuary on 23 December

1971. In order to manage the area on the principles of sustainable use and further enhance the protection efforts for the recovery of wildlife and to provide facilities for recreation and research, Chitral Gol wildlife sanctuary was declared as National Park on October 1984.

1.3 Biological significance of CGNP:

Chitral Gol National park not only supports important bio-diversity of the world but also provide natural habitat for Pakistan's national tree (Deodar), national bird (Chukor), national animal (Markhor) and globally endangered big cat (Snow leopard) is the beauty of the park.

1.4 Objectives of the Markhor Rut Season Survey:

1. Estimate the current population trend of Markhor and Ibex.
2. Estimate the growth rate of the animals during the year.
3. Determine the current predation trends within the park.

2.Literature Review

2.1 Description of Markhor:

In appearanceMale have black beard while female have small chin tuft. Male Markhor have shaggy mane of long hairs extending down the chest and from the fore part of the neck which consist grey and white hairs. There are long hairs extending from shoulder to the croup. Male animals above six years have tufts of long hairs on the elbow of hind legs. In winter coat hairs on body grow longer and very little under wool is developed. While in summer it shed wool and long hairs rubbing its body with rocks and trees and long hairs becomes shorter and thinner. In autumn some well-fed young male's coat becomes as dark that it looks blackish. Male and female yearling are not differentiable but according to local expert hunters and wildlife staff the male yearling have thick horn and the space between horns at basal portion is shorter compare to female and legs of the male looks broader and color is darker while female yearling's body color is comparatively lighter. When the male animal reaches to the age of nine years its body starts shrinking and horns grow longer and the animals becomes weaker and easy target for predators and other natural threats like avalanche, flood and rolling stones etc.

The age of the animal is determined through annual rings develop on horns. It is possible only in captive or observing dead animal; in wild the age of male animal is easily determined through observing curves (vurals) of the horns. After each third year one curve appears and the portion near the tip (which rise during first year of the animal) of the horn is considered one year. It means that if there are three curves in the horn the animal is 10 years old.

Classification of ungulates

Kingdom:	Animalia
Phylum:	Chordata
Sub phylum:	Vertebrata
Class:	Mammalia
Order:	Artiodactyla
Family:	Bovidae
Sub family:	Caprinae
Genus:	Capra
Species:	Capra falconeri

(Website: University of Michigan, museum of Zoology)

BOX 2

2.2. Social behavior:

Kashmir Markhor is diurnal and mainly becomes active in the early morning and late afternoon. During summer months Markhor start feeding very early morning and move upward, when the sun shine get hot they seek shade and lay under trees or rocks chewing the cud for whole day. After sunset their downward movements start again for feed and water. Late evening, they select precipitous area for night stay to protect themselves from predators. While during winter Markhor feed whole day taking short rest and basking. During rut season and in moon light the herds have been observed feeding during night too. Markhor stand on their hind legs to reach *Quercusilex* leaves and seeds. Young males take advantage in rut while older male take part in rutting later and big fights occurs between males to occupy maximum females and during such fights some males lost horns and some lost even their lives falling from rocks. Stronger male occupy larger group. In case of danger one animal in the group make special sound like "tiff"to alert whole group. Markhor are gregarious, females and young makes group mostly 8-11 animals while male lives

in separate herd consisting 4-6 individuals, during rut season male, female and kids make larger herd around 80 individuals. Markhor are good tree climber.

2.3 Breeding:

The mating system in Kashmir Markhor is polygynous and occurs in winter. Rut season start from first week of December. In case of rainy season, the matting starts a little bit earlier while in case of drought conditions it delayed. Birth occurs during last week of May to Mid-Jun. Each pregnancy produces 1-2 off springs, while pregnancy duration is 135-170 days. Young remain with mother till next breeding season. Weaning occurs at the age of 5 to 6 months. Reproductive maturity in female is about 18 to 30 months while in male it is 24-36 months. A few days before giving birth to offspring the female select most difficult and rocky place and remain near the specific location. After delivery the mother dried offspring by her tongue and soon after milking, although the offspring can walk with mother but mother preferred to hide the offspring in caves or in hollows to protect them from predators for a few days and then the offspring start traveling with mother. It is observed that male and female both come to their birth place for rutting and for giving birth offspring. Markhor hardly lives up to 12 years.

Breeding interval:	*Markhor breed annually*
Breeding Season:	*May and June*
Number of offspring:	*1 to 2*
Gestation period:	*135 to 170 days*
Time to weaning:	*5 to 6 months*
Maturity age (female):	*18 to 30 months*
Maturity age (male):	*24 to 36 months*

2.4 Food habit

Markhor are strictly herbivorous. Markhor graze on grasses during spring and summer while it switches over browsing leaves, twigs, shrubs and seeds during autumn and winter.

2.5 Ecosystem roles:

Markhor helps in dispersal of seeds of various shrubs and grasses which compose their diet. Kashmir markhor is food source for predator of the park like snow leopard, lynx and wolves etc.

BOX 3

3.Methodology

3.1 Methodology:

Markhor Rut Season Survey was conducted while using vantage point count method in December 2022. All the survey parties in the team had to ensure early morning sighting at about 7am and early evening sighting around 4pm to confirm the movements, occurrence and number-age-sex data of the Markhor at any vantage point. For this purpose 14 survey parties were assigned the task to cover all the 14vantage points of the core zone, while 02 two parties for Muleen Gol, 03 parties for Rumbor valley and 07 parties for Shoghor Range were assigned to cover the mentioned vantage points of buffer zones of the park and the survey team members ensured their presence before 7am in the morning and remained till late at least 4pm on their respective vantage points and recorded the data on prescribe data sheet developed for the purpose.

Animals were observed with the help of 10 x 42 mm binoculars and Spotting scope. Herd size and composition were recorded. To avoid duplication in counting, the data was critically examined and the reports of adjoining points were examined with reference to herd size and composition. In this examination the possible duplicate counting was eliminated and the herd composition with reference to time was taken as perameter to reduce the counting error. Location, altitude, aspects, habitat type of Markhor observation sites were recorded through GPS.

The following age and sex classification table was followed during the survey.

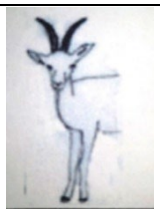
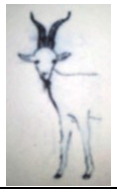
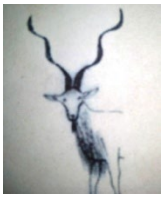
S/#	Age & Sex Classification	Description	Illustration
1	Young ½ years	1. Born in May/June, these are easily recognizable in the field due to their sizes. 2. Base of male horn is wider than female of same age (less space in horns of males as compared to female. 3. Colour of the female legs below knee is white while the male have paler colouration	
2	Yearling 1½ Years	1. Yearling males resembles adult females but still slightly smaller with thirty centimeter long horns which are darker, longer and broader. 2. The males have black line on neck running from head towards back.	
3	Females (all age classes)	1. Yearling combined with adult females can make one group.	
4	Class I males 2 ½ years	1. these are the size of females but horns grow up to 45 cm 2. pelage is dark brown with a grayish neck with no ruff 3. The straight horns of males start showing the first curve.	
5	Class II males 3 ½ years	1. Males in this class resemble to the previous age group but with the addition of a fringe of white hair on fore legs and across the chest, the first intimation of the ruff. 2. The horns may be over 50cm long and complete the first whorl (twist are spiral) at this age.	
6	Class III males 4 ½ to 6 ½ years.	1. Class III males have a prominent black beard and a long ruff of white to grey hair flowing from neck, chest and upper parts of the fore legs. 2. Horns are often 75 cm long.	
7	Class IV	1. They contain all those trades which are already conspicuous in class III males. 2. Their ruff is voluminous in this age class. 3. Their horns strikingly long. 4. Their pelage has more grey than brown, except for the black face and upper parts of the legs.	

Table 1 Age and Sex classification of markhor (*Capra falconerikashmireinsis*)

To asses predation trends during the year, personal observations of field staff and predation register maintained in the Range Office were used.

4.Results and Discussions

4.1 Total count:

Data were collected from 14 vantage points with 47 observation points in core zone of CGNP.Although the core zone of the park comprises of four vegetation types (Scrub, conifer, Sub-alpine and Alpine) but during the survey period maximum portion of the park remained without snow and the animal found scatterd to each corner of the park specially in precipetous difficult rocky terrains which were not accessible due to frozen soil.In the buffer areas i.e. Rumboor valley, Muleen Gol and Shoghor Range 4, 2 and 7 vantage points were surveyed respectively. A total of 2375 markhor were counted during the survey out of which 2082 Markhor were counted in Core zone(For detail see table 2 and 3).

While in buffer zones a total of 40 markhor at Muleen gol, 211 in Shoghor Range and 42 markhor at various vatage points of Rumbor valley were counted. During the survey a total of 38 Ibex were also counted at Rumbor valley. (For detail see table 3 and 4).

4.2 concentrations of Markhor at various vantage points of core zone of CGNP:

The four vantage points namely Sha dehar, Loho Bangot, Merin dehar and Olowak which were hosting 407,227,223 and 168 markhors respectively therefore regarded as heavy concentrated areas while the low concentration was observed at Banj shal with 37 markhors only.

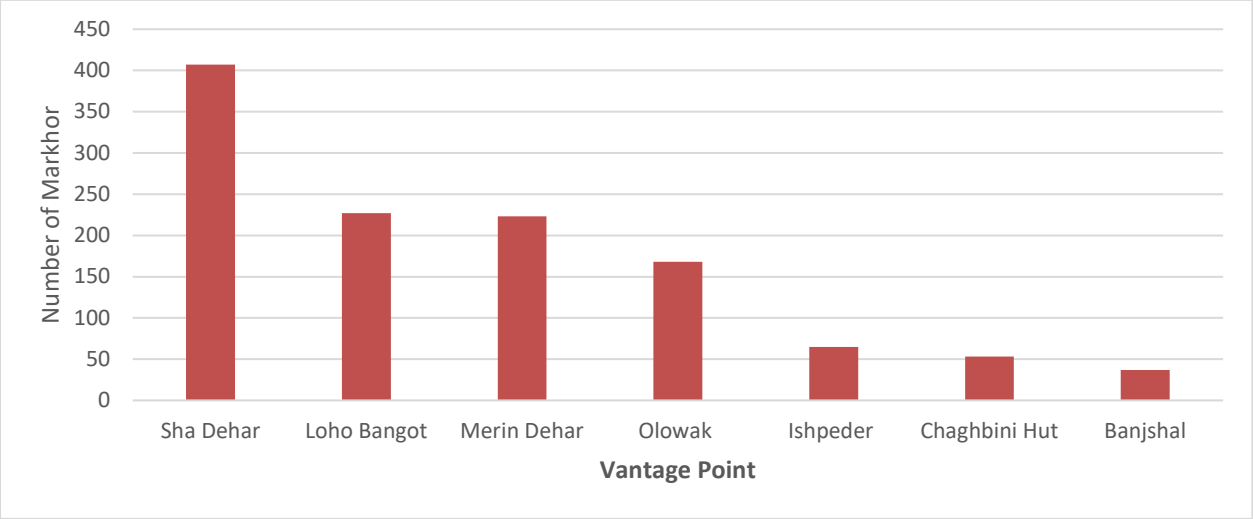


Figure 1 Markhor population concentration at various vantage points in core zone CGNP

The data revealed that concentration of male markhor were high at sha dehar vantage point 134 and lowest at Banj shal having 14 animals respectively. Concentrations of female were high at Sha dehar while low at Banj Shal 173 and 12 animals. Similarly highest population of 41yearlingat Sha dehar andLowest number of yearling 5 at Banj shal were recorded while highest number of Lamb were observed at Malosh vantage pointhaving 77 and Lowest number of lamb 5 individual were reccorded at Banj shal respectively.

4.3 Age and sex wise analysis:

Age wise analysis of the count shows thatLamb accounts for 20.1 % (477) of the total count while sex wise analysis revealed that the female population 23.5%,(772) male of different classes is 33.7 % (882) and yearling 13.6 % (324) of the total count. The recent count revealed that class IV males were

highest in number followed by class 1II representing 215(9.1 %) and 206 (8.7 %) animals respectively. Class I and class II males were 205 (8.6 %) and 176 (7.4 %) in order.

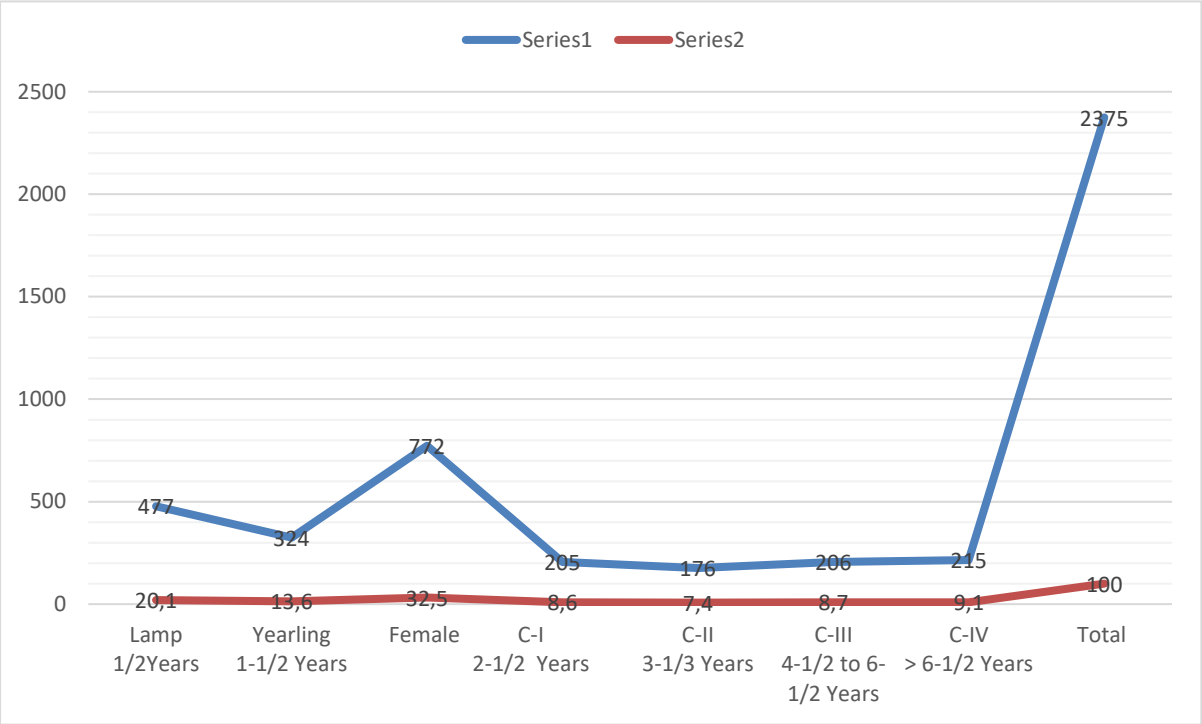


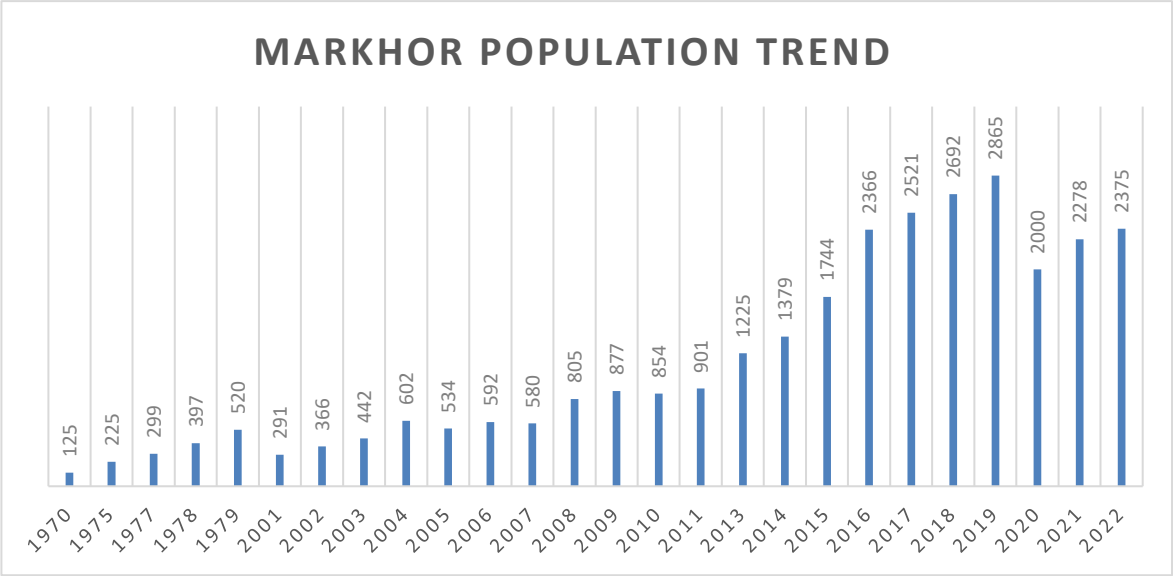
Figure 2 Age and sex wise analysis

4.4 Predation trends during the year:

Sonwleoaprd was considred top predator of Markhor in CGNP Core & Buffer Zones but based on daily observations of field staff and register maintained in Range Office revealed that the last few years Snow leopard visiting the core zone occasionally and in the absence of Snow leopard predation mostly done by the Himalayan Lynx, wolves and stray dogs. No serious viral disease among the Markhor population has been observed yet. 10 yearlings , 6 Lamb, 3 males and 5 females Markhors were killed by stray dogs. 6 Lambs, 1 yearling and 4 females Markhor were killed by wolves while 1 male and 3 yearlings were killed by Himalayan Lynx. Thus total 39 predation were recorded during the year 2022. Beside predation, migration of animals from core zone to other potential habitats like the are of Nooristan (Afghanistan) and Toshi-shasha community managed game reserve is routine activity.

4.5 *Discussion:*

Chitral Gol National Park hosts the largest surviving population of Kashmir Markhor in the wild.



Results compiled during winter surveys conducted by the wildlife department and third party validation teames show the following figures for the heads of animals;

Figure 3 Trend of Markhor population

Survey reports for the last twenty five years revealed a gradual upward trend in markhor population. The period 1975 to 1984 was crucial one for survival of markhor and other wildlife species of chitral Gol which led to the establishment of National park. During 2002 after launching protected areas management project and the involvement of local communities in the management of Chitral Gol further supported to enhance watch and ward system of the park and thus markhor population progressively increased. During 2005, 2007 and 2010 a little fluctuation in population was noticed which was due to increase of wolves' population and intrusion of stray dogs inside core zone but over all trends remained satisfactory. While during 2019 Snow Leopard Foundation (SLF) team took the responsibility to conduct Markhor Rut season Survey as third party and during the process the survey team adopted new methodology (Double Observer counting which is very costy and need high human resource) instead vantage point counting method through which the number of Markhor were recorded a little bit high. When the wildlfie department conducted survey very next year during 2020, through vantage point counting method which is less costy and need less labours, the total number of Markhor decreased. The local communities shown their concern on decrease of Markhor number. Basically there were reasons for this fluctuation. Firstly the same year there were high military movement on boundary which restricted movement of migrated Markhor from Chitral Gol to adjacent area of Afgahnistan. Secondly, due to drought season there was no snow fall in the area and most of the animals were scattered in inaccessible areas and remained un counted. Thirdly high predation of the animals by predators specially stray dogs. Any how during 2021the same survey was conducted through IUCN, Zoological Survey department, WWF, PFI etc and they recorded 2278 Markhor. Which show upward movement of the graph. There are many factors responsible to determin

fluctuation in numbers of animals in insitu conservation like predation, seasonal migration, climatic conditions, experties of survey team members etc.

4.6 Threats

- In past a few field staff were performing watch and ward duties and it was very difficult for them to keep check on each corner of the vast area of the park and constant threat of illegal hunt was existed. For the time being the said problem was dealt through the recruitement of Wildlife field chowkidars and other field staff.
- During winter season stake holder communities are collecting dry fuel woods from the areas where Markhor are rutting and breeding which hindered the Survey activity as well as the breeding process of Markhor.
- Increas in number of predators

4.7 Recommendations:

- Trainings in latest wildlife Survey techniques should be arranged for park field staff.
- The culling of feral dogs in scientific manner is needed to reduce the damages to the overall biodiversity.

Table 2 No. of Markhor observed from different vantage points of Core zone CGNP

Vantage Point	Coordinates	Lamp 1/2Years	Yearling 1-1/2 Years	Female	C-I 2-1/2 Years	C-II 3-1/3 Years	C-III 4-1/2 to 6-1/2 Years	C-IV > 6-1/2 Years	Total
Olowak	35° 51' 48.30"N 71o 45' 58.85"E Alt:2020 m	22	21	49	20	16	22	18	168
NarkokoBokht	35° 51' 49.12"N 71° 46' 23.29"E Alt: 1719 m	10	10	23	9	7	8	13	80
LohoBangot	35° 53' 30.45"N 71° 45' 10.12"E Alt: 2485 m	56	40	57	21	17	17	19	227
Chagbini Hut	35° 53' 56.98"N 71° 45' 01.35"E Alt: 2926 m	18	7	15	3	3	3	4	53
TongoghoPakhtori	35° 54' 17.55"N 71° 43' 59.68"E Alt: 2857 m	15	14	60	6	9	15	22	141
Ishpedar	35° 54' 37.73"N 71° 43' 52.07"E Alt: 3048 m	11	9	22	4	7	12	0	65
Baghotek	35° 54' 04.88"N 71° 43' 07.13"E Alt: 2525 m	15	9	26	4	3	7	5	69
Kroideri	35° 53' 25.85"N 71° 42' 02.48"E Alt: 2485 m	11	7	35	8	6	3	7	77
DaleemDehar	35° 53' 32.19"N 71° 44' 30.33"E Alt: 2241 m	36	33	32	17	12	10	17	157
DoktonoTek	35° 53' 15.88"N 71° 43' 45.61"E Alt: 2575 m	27	41	29	17	23	13	14	164
Merin Dehar	35° 52' 50.44"N 71° 44' 53.00"E Alt: 2068 m	68	24	87	10	7	18	9	223
Banjshall	35° 52' 25.65"N 71° 44' 32.27"E Alt: 2393 m	6	5	12	3	3	3	5	37
Malosh	35° 52' 31.70"N 71° 45' 12.78"E Alt: 2079 m	48	41	58	28	15	11	13	214
ShaDehar	35° 52' 17.26"N 71° 46' 02.44"E Alt: 2122 m	77	23	173	36	23	39	36	407
Total		420	284	678	186	151	181	182	2082

Table 3 No. of Markhor observed from different vantage points Buffer Zones CGNP

Vantage Point	Coordinate	Lamp 1/2Years	Yearling 1-1/2 Years	Femal	C-I 2-1/2 Years	C-II 3-1/3 Years	C-III 4-1/2 to 6-1/2 Years	C-IV > 6-1/2 Years	Total
Moleen Gol Buffer Zone									
ParpatoDehar	35° 51' 02.19"N 71° 45' 22.83"E Alt: 2019	8	6	12	3	5	3	3	40
ShelioMokhoDehar	35° 50' 56.09"N 71° 44' 19.74"E Alta: 2748 m	-	-	-	-	-	-	-	-
Total		**8**	**6**	**12**	**3**	**5**	**3**	**3**	**40**
Rumbor Buffer Zone									
GoranisakBethani	35°48' 51.90" N 71 38' 58.91" E Alt: 2614 m	4	3	7	0	1	0	2	17
Rawalic	35° 47' 25.07"N 71° 39' 14.03"E Alt: 2355 m	0	0	0	0	0	0	0	0
Palarodehar	35° 47' 27.95" N 71° 41' 22.18" E Alt: 2613 m	6	4	9	0	2	0	4	25
Total		**10**	**7**	**16**	**0**	**3**	**0**	**6**	**42**
Shoghor Wildlife Range									
Avaxon	35° 58' 45.62"N 71° 47' 22.94"E Alt: 2425 m	5	3	9	1	1	1	3	23
Ogdar Der Tower	35° 59' 46.28"N 71° 48' 39.35"E Alt: 2046 m	7	5	13	6	7	8	4	50
Angarghon	36° 00' 08.84"N 71° 47' 45.67"E Alt: 1818 m	8	4	9	2	3	4	2	32
DokoTek	36° 00' 27.74"N 71° 46' 32.29"E Alt: 1773 m	7	6	8	1	1	0	4	27
PanjioTek	35° 59' 59.16"N 71° 45' 04.59"E Alt: 2104 m	5	5	13	3	3	4	5	38
Kishmanja	35° 58' 31.24"N 71° 43' 59.19"E Alt: 2627 m	5	3	9	3	0	5	2	27
RuniDehar	36° 01 11.68"N 71° 44' 27.84"E Alt: 1946 m	2	1	5	0	2	0	4	14
Total		**39**	**27**	**66**	**16**	**17**	**22**	**24**	**211**
G.Total		**477**	**324**	**772**	**205**	**176**	**206**	**215**	**2375**

Table 4 No. of Ibex observed from different vantage points Rumbor (Buffer Zones)

Vantage point	coordinat	Age and Sex classification							Total
					Male				
		Young ½ yrs	Yearling 1½ yrs	Female	C-I 2 ½ yrs	C-II 3 ½ yrs	C-III 4½ to 6½ yrs	C-IV Above 6½ yrs	
Ustoide har	**35° 49' 42.43" N 71° 35' 32.10" E Alt: 3147 m**	13	3	9	4	2	3	4	38
Total		**13**	**3**	**9**	**4**	**2**	**3**	**4**	**38**

Table 5 No. of Age /sex group of Markhor and their respective percentage:

S. No	Sex and Age Group	No. of animals	Percentage
1	Lamp 1/2Years	477	20.1
2	Yearling 1-1/2 Years	324	13.6
3	Females	772	32.5
4	Male class I	205	8.6
5	Male class ii	176	7.4
6	Male class iii	206	8.7
7	Male class iv	215	9.1
Total		2375	100

Table 6 Abstract of Survey Report for the year 2022

Area	Markhor	Ibex	Snow leopard	Fox	jackal	Marten	Monal	Snow cock	Wood Pigon	chukor	Golden Eagle	Griffon vulture	Chough
Chitral Gol (core zone)	2082	0	0	11	7	3	27	6	11	78	6	1	0
Muleen Gol	40	0	0	16	3	0	0	7	0	22	0	3	0
Shoghor Range	211	0	0	12	9	0	0	12	9	43	1	2	0
Rumbor Valley	42	38	0	9	13	0	0	53	22	70	5	3	41
Total:	**2375**	38	0	48	32	3	27	78	42	213	12	09	41

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Kashmir Markhor & Himalayanlbex
Rut Season Survey Chitral Gol National Park
December, 2022

CHITRAL GOL NATIONAL PARK, THE LIVING MUSEUM OF WILDLIFE

Table of contents

List of Boxes

SUBMITTED BY:

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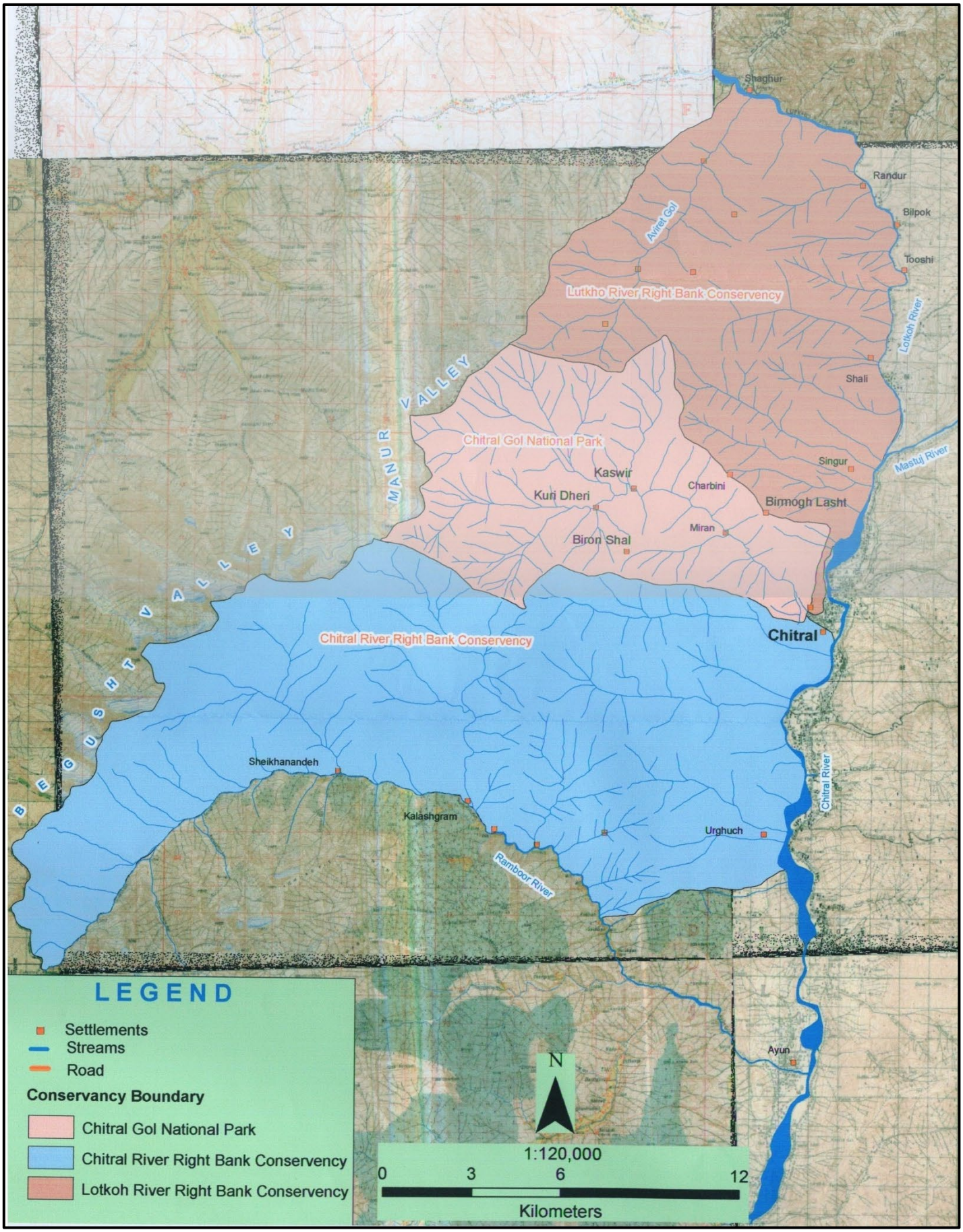
List of Figures

List of Tables

Map of Chitral Gol National Park



Summary

This report is the outcome offivedays long survey, conducted in December 2022during Markhor Rut season. The survey aimed to estimateMarkhor population trends, estimate the growth rate of the animals, and to determine the predation trends during the year within the CGNP core and buffer zones.

A total of **2375** markhor were counted in Chitral Gol including core and buffer zonesduring the survey.The four vantage points namely Sha dehar, Loho Bangot, Merin dehar and Olowak which were hosting 407,227, 223 and 168 markhors respectively therefore regarded as heavy concentrated areas while the low concentration was observed at Banj shal with 37 markhors only

Age wise analysis of the count shows that Lamb accounts for 20.1%(477) and yearlings accounts for 13.6% (324) of the total count while sex wise analysis revealed that the female population 32.5 %(772), male of different classes is 33.8 % (802) of the total count. The recent count revealed that class IV males were highest in number (215) followed by class III representing 206, class I with 205 animals and class II with 176 animals respectively.

Based on daily observations of field staff and register maintained in Range Office revealed that Snow leopard is the top predator of Markhor in CGNP core and buffer zone but for the last few years Snow leopard visiting the core zone occasionally and in the absence of Snow leopard predation mostly done by the Himalayan Lynx, wolves and stray dogs. No serious viral disease among the Markhor population has been observed yet. 10 yearlings , 6 Lamb, 3 males and 5 females Markhors were killed by stray dogs. 6 Lambs, 1 yearling and 4 females Markhor were killed by wolves while 1 male and 3 yearlings were killed by Himalayan Lynx. Thus total 39 predation were recorded during the year 2022. Beside predation, migration of animals from core zone to other potential habitats like Noristan Afghanistan and Toshi-shasha community managed game reserve is routine activity.

1.Introduction

Chitral Gol National park is famous not only for its panoramic view but also hosts the largest population of Kashmir markhor(National animal of Pakistan) in the wild and providing suitable habitat for Deodar (National tree), Chakur partridge (National bird) and globally endangered Snow leopard.It is located in the Northern most part of the country in district of Chitral (Khyber Pakhtunkhwa province). Every year a number of national and international naturalists and ecologists are attracted to this area because of its scenic beauty and its enigmatic wildlife.

Core area of the park spreads over an area of 7750 ha situated in the north-west of Chitral town and further extends in the west and east as its buffer zone include some of the biological rich habitats of Hindu Raj Mountains, Kalash culture and famous Aviret Gol. The approximate geographical position of the park is 35^{o} 42' to 36^{0} 01' N Latitude and 71^{0} 36' to 71^{0} 49' E Longitude with an elevation ranging from 1450 to 4979 m. It receives 462 mm annual precipitation mainly in form of snow in winter and spring. Monsoon clouds do not reach CGNP.

There are more than 24 peaks extending 3000 m. Most of the northern parts of the park are lined above the tree line and have many high mountain peaks covered with snow. Few springs and glacial streams borne in this area flow down and join Chitral Gol in Gokhshal. In the south-west of Gokhshal, two valleys Chat and Doni divided by a sharp edge mountain ridge lies narrowly side by side in the west opens in the alpine meadows near the snow line at 4000 m.

Year of Establishment:	1984
Total Area:	
Core zone:	7750 hectares
Buffer zone:	34599 hectare
Geographical Location:	
35^{0} 42’ to 36^{0} 01' N	
71^{0} 36’ to 71^{0} 49' E	
Physical location:	North West in the KPK Pakistan in Hindukush

BOX 1

1.1 History of Chitral Gol:

Different tribes ruled over the region before its amalgamation in Pakistan as a settled district in 1969. Kalash were the first rulers of the area who ruled for more than three centuries. During 1320 Raees tribe took over control of the region and ruled until the Katoor family came over to rule. The three ruler tribes have used Chitral Gol according to their needs and traditions. In 1880 for the first time in Chitral Gol history Mr. Aman-ul- Mulk paid attention to its management and his second son SardarNizam-ul-Mulk used Chitral Gol as a hunting ranch. In 1902 Chitral Gol was given the status of ShahiShikargah and in 1907 Sir Shuja-ul-Mulk started its proper management. During 1912 Guest houses and Shikari huts were constructed in-side Chitral Gol. Chitral Gol remained under strict protection during the tenure of ex-Mehtar family till the state was declared as a settled district in 1969.

1.2 Present Status:

During 1957 and 1958 uprisings the local people’s demand of complete merger of the state with Pakistan caused complete deterioration of law and order situation and the young ruler of Chitral became almost ineffective consequently Chitral Gol became no body’s property as a result the localinhabitants’heavily taped natural resources of Chitral Gol.After realizing the deteriorating situation of Chitral Gol the provincial government took control of Chitral Gol and Commissioner Malakand Division issued a notification declaring Chitral Gol as a wildlife sanctuary on 23 December

1971. In order to manage the area on the principles of sustainable use and further enhance the protection efforts for the recovery of wildlife and to provide facilities for recreation and research, Chitral Gol wildlife sanctuary was declared as National Park on October 1984.

1.3 Biological significance of CGNP:

Chitral Gol National park not only supports important bio-diversity of the world but also provide natural habitat for Pakistan's national tree (Deodar), national bird (Chukor), national animal (Markhor) and globally endangered big cat (Snow leopard) is the beauty of the park.

1.4 Objectives of the Markhor Rut Season Survey:

1. Estimate the current population trend of Markhor and Ibex.
2. Estimate the growth rate of the animals during the year.
3. Determine the current predation trends within the park.

2.Literature Review

2.1 Description of Markhor:

In appearanceMale have black beard while female have small chin tuft. Male Markhor have shaggy mane of long hairs extending down the chest and from the fore part of the neck which consist grey and white hairs. There are long hairs extending from shoulder to the croup. Male animals above six years have tufts of long hairs on the elbow of hind legs. In winter coat hairs on body grow longer and very little under wool is developed. While in summer it shed wool and long hairs rubbing its body with rocks and trees and long hairs becomes shorter and thinner. In autumn some well-fed young male's coat becomes as dark that it looks blackish. Male and female yearling are not differentiable but according to local expert hunters and wildlife staff the male yearling have thick horn and the space between horns at basal portion is shorter compare to female and legs of the male looks broader and color is darker while female yearling's body color is comparatively lighter. When the male animal reaches to the age of nine years its body starts shrinking and horns grow longer and the animals becomes weaker and easy target for predators and other natural threats like avalanche, flood and rolling stones etc.

The age of the animal is determined through annual rings develop on horns. It is possible only in captive or observing dead animal; in wild the age of male animal is easily determined through observing curves (vurals) of the horns. After each third year one curve appears and the portion near the tip (which rise during first year of the animal) of the horn is considered one year. It means that if there are three curves in the horn the animal is 10 years old.

Classification of ungulates

Kingdom:	Animalia
Phylum:	Chordata
Sub phylum:	Vertebrata
Class:	Mammalia
Order:	Artiodactyla
Family:	Bovidae
Sub family:	Caprinae
Genus:	Capra
Species:	Capra falconeri

(Website: University of Michigan, museum of Zoology)

BOX 2

2.2. Social behavior:

Kashmir Markhor is diurnal and mainly becomes active in the early morning and late afternoon. During summer months Markhor start feeding very early morning and move upward, when the sun shine get hot they seek shade and lay under trees or rocks chewing the cud for whole day. After sunset their downward movements start again for feed and water. Late evening, they select precipitous area for night stay to protect themselves from predators. While during winter Markhor feed whole day taking short rest and basking. During rut season and in moon light the herds have been observed feeding during night too. Markhor stand on their hind legs to reach *Quercusilex* leaves and seeds. Young males take advantage in rut while older male take part in rutting later and big fights occurs between males to occupy maximum females and during such fights some males lost horns and some lost even their lives falling from rocks. Stronger male occupy larger group. In case of danger one animal in the group make special sound like "tiff"to alert whole group. Markhor are gregarious, females and young makes group mostly 8-11 animals while male lives

in separate herd consisting 4-6 individuals, during rut season male, female and kids make larger herd around 80 individuals. Markhor are good tree climber.

2.3 Breeding:

The mating system in Kashmir Markhor is polygynous and occurs in winter. Rut season start from first week of December. In case of rainy season, the matting starts a little bit earlier while in case of drought conditions it delayed. Birth occurs during last week of May to Mid-Jun. Each pregnancy produces 1-2 off springs, while pregnancy duration is 135-170 days. Young remain with mother till next breeding season. Weaning occurs at the age of 5 to 6 months. Reproductive maturity in female is about 18 to 30 months while in male it is 24-36 months. A few days before giving birth to offspring the female select most difficult and rocky place and remain near the specific location. After delivery the mother dried offspring by her tongue and soon after milking, although the offspring can walk with mother but mother preferred to hide the offspring in caves or in hollows to protect them from predators for a few days and then the offspring start traveling with mother. It is observed that male and female both come to their birth place for rutting and for giving birth offspring. Markhor hardly lives up to 12 years.

Breeding interval:	*Markhor breed annually*
Breeding Season:	*May and June*
Number of offspring:	*1 to 2*
Gestation period:	*135 to 170 days*
Time to weaning:	*5 to 6 months*
Maturity age (female):	*18 to 30 months*
Maturity age (male):	*24 to 36 months*

2.4 Food habit

Markhor are strictly herbivorous. Markhor graze on grasses during spring and summer while it switches over browsing leaves, twigs, shrubs and seeds during autumn and winter.

2.5 Ecosystem roles:

Markhor helps in dispersal of seeds of various shrubs and grasses which compose their diet. Kashmir markhor is food source for predator of the park like snow leopard, lynx and wolves etc.

BOX 3

3.Methodology

3.1 Methodology:

Markhor Rut Season Survey was conducted while using vantage point count method in December 2022. All the survey parties in the team had to ensure early morning sighting at about 7am and early evening sighting around 4pm to confirm the movements, occurrence and number-age-sex data of the Markhor at any vantage point. For this purpose 14 survey parties were assigned the task to cover all the 14vantage points of the core zone, while 02 two parties for Muleen Gol, 03 parties for Rumbor valley and 07 parties for Shoghor Range were assigned to cover the mentioned vantage points of buffer zones of the park and the survey team members ensured their presence before 7am in the morning and remained till late at least 4pm on their respective vantage points and recorded the data on prescribe data sheet developed for the purpose.

Animals were observed with the help of 10 x 42 mm binoculars and Spotting scope. Herd size and composition were recorded. To avoid duplication in counting, the data was critically examined and the reports of adjoining points were examined with reference to herd size and composition. In this examination the possible duplicate counting was eliminated and the herd composition with reference to time was taken as perameter to reduce the counting error. Location, altitude, aspects, habitat type of Markhor observation sites were recorded through GPS.

The following age and sex classification table was followed during the survey.

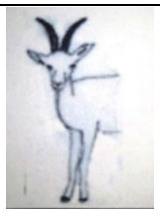
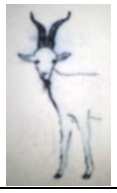
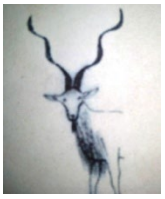
S/#	Age & Sex Classification	Description	Illustration
1	Young ½ years	1. Born in May/June, these are easily recognizable in the field due to their sizes. 2. Base of male horn is wider than female of same age (less space in horns of males as compared to female. 3. Colour of the female legs below knee is white while the male have paler colouration	
2	Yearling 1½ Years	1. Yearling males resembles adult females but still slightly smaller with thirty centimeter long horns which are darker, longer and broader. 2. The males have black line on neck running from head towards back.	
3	Females (all age classes)	1. Yearling combined with adult females can make one group.	
4	Class I males 2 ½ years	1. these are the size of females but horns grow up to 45 cm 2. pelage is dark brown with a grayish neck with no ruff 3. The straight horns of males start showing the first curve.	
5	Class II males 3 ½ years	1. Males in this class resemble to the previous age group but with the addition of a fringe of white hair on fore legs and across the chest, the first intimation of the ruff. 2. The horns may be over 50cm long and complete the first whorl (twist are spiral) at this age.	
6	Class III males 4 ½ to 6 ½ years.	1. Class III males have a prominent black beard and a long ruff of white to grey hair flowing from neck, chest and upper parts of the fore legs. 2. Horns are often 75 cm long.	
7	Class IV	1. They contain all those trades which are already conspicuous in class III males. 2. Their ruff is voluminous in this age class. 3. Their horns strikingly long. 4. Their pelage has more grey than brown, except for the black face and upper parts of the legs.	

Table 1 Age and Sex classification of markhor (*Capra falconerikashmireinsis*)

To asses predation trends during the year, personal observations of field staff and predation register maintained in the Range Office were used.

4.Results and Discussions

4.1 Total count:

Data were collected from 14 vantage points with 47 observation points in core zone of CGNP.Although the core zone of the park comprises of four vegetation types (Scrub, conifer, Sub-alpine and Alpine) but during the survey period maximum portion of the park remained without snow and the animal found scatterd to each corner of the park specially in precipetous difficult rocky terrains which were not accessible due to frozen soil.In the buffer areas i.e. Rumboor valley, Muleen Gol and Shoghor Range 4, 2 and 7 vantage points were surveyed respectively. A total of 2375 markhor were counted during the survey out of which 2082 Markhor were counted in Core zone(For detail see table 2 and 3).

While in buffer zones a total of 40 markhor at Muleen gol, 211 in Shoghor Range and 42 markhor at various vatage points of Rumbor valley were counted. During the survey a total of 38 Ibex were also counted at Rumbor valley. (For detail see table 3 and 4).

4.2 concentrations of Markhor at various vantage points of core zone of CGNP:

The four vantage points namely Sha dehar, Loho Bangot, Merin dehar and Olowak which were hosting 407,227,223 and 168 markhors respectively therefore regarded as heavy concentrated areas while the low concentration was observed at Banj shal with 37 markhors only.

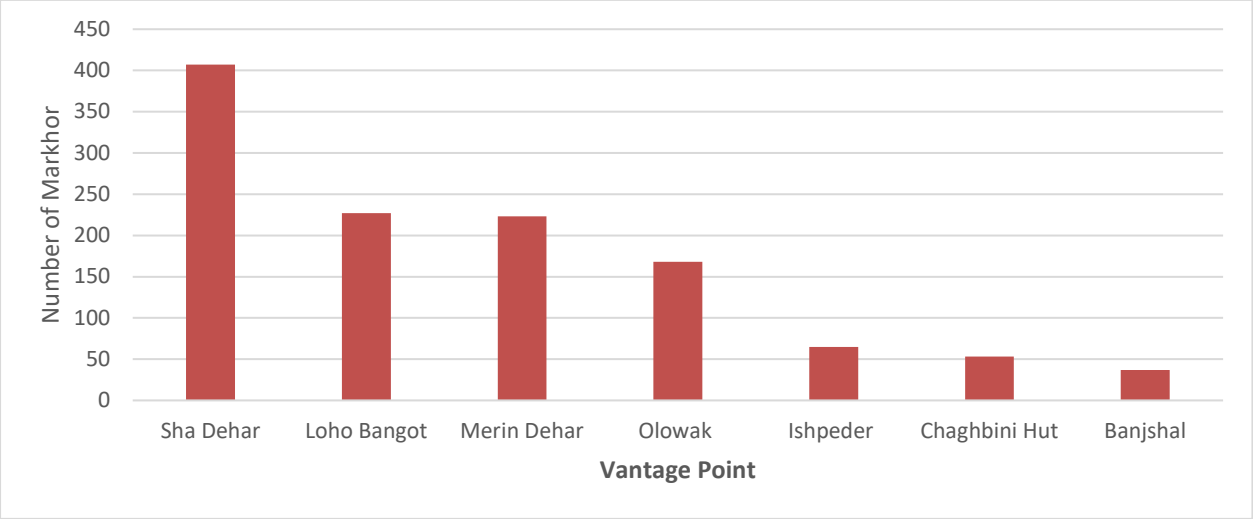


Figure 1 Markhor population concentration at various vantage points in core zone CGNP

The data revealed that concentration of male markhor were high at sha dehar vantage point 134 and lowest at Banj shal having 14 animals respectively. Concentrations of female were high at Sha dehar while low at Banj Shal 173 and 12 animals. Similarly highest population of 41yearlingat Sha dehar andLowest number of yearling 5 at Banj shal were recorded while highest number of Lamb were observed at Malosh vantage pointhaving 77 and Lowest number of lamb 5 individual were reccorded at Banj shal respectively.

4.3 Age and sex wise analysis:

Age wise analysis of the count shows thatLamb accounts for 20.1 % (477) of the total count while sex wise analysis revealed that the female population 23.5%,(772) male of different classes is 33.7 % (882) and yearling 13.6 % (324) of the total count. The recent count revealed that class IV males were

highest in number followed by class 1II representing 215(9.1 %) and 206 (8.7 %) animals respectively. Class I and class II males were 205 (8.6 %) and 176 (7.4 %) in order.

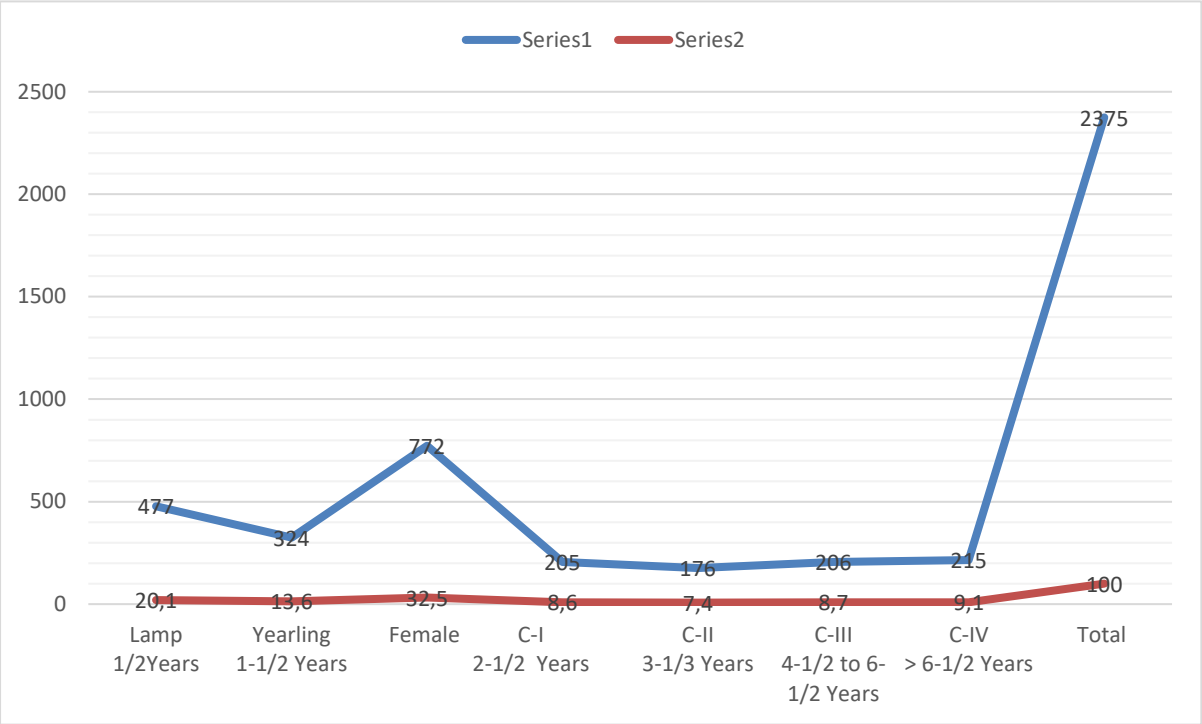


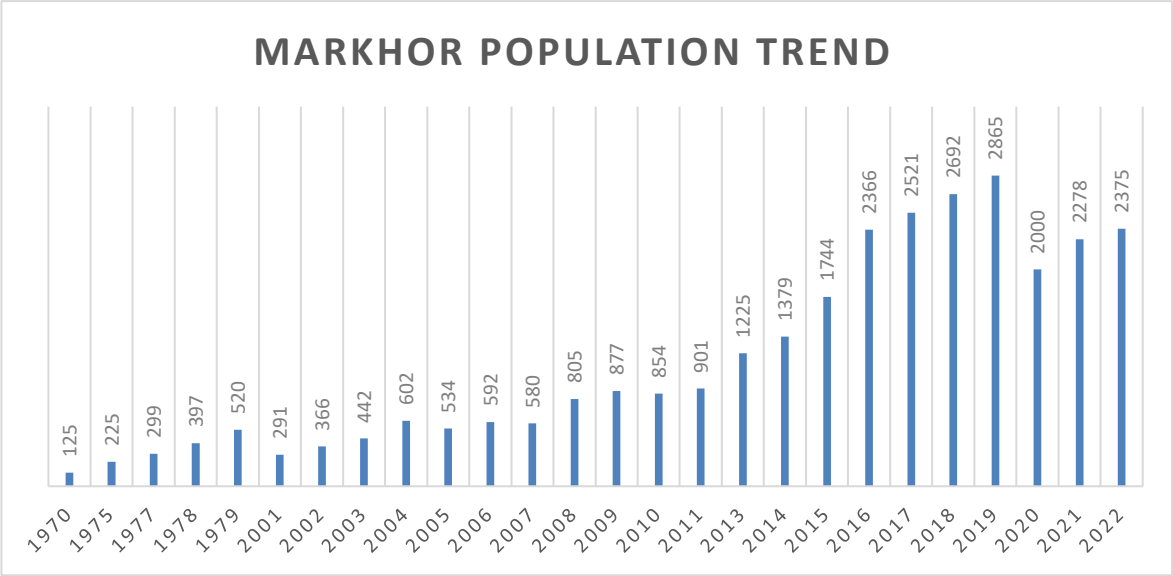
Figure 2 Age and sex wise analysis

4.4 Predation trends during the year:

Sonwleoaprd was considred top predator of Markhor in CGNP Core & Buffer Zones but based on daily observations of field staff and register maintained in Range Office revealed that the last few years Snow leopard visiting the core zone occasionally and in the absence of Snow leopard predation mostly done by the Himalayan Lynx, wolves and stray dogs. No serious viral disease among the Markhor population has been observed yet. 10 yearlings , 6 Lamb, 3 males and 5 females Markhors were killed by stray dogs. 6 Lambs, 1 yearling and 4 females Markhor were killed by wolves while 1 male and 3 yearlings were killed by Himalayan Lynx. Thus total 39 predation were recorded during the year 2022. Beside predation, migration of animals from core zone to other potential habitats like the are of Nooristan (Afghanistan) and Toshi-shasha community managed game reserve is routine activity.

4.5 *Discussion:*

Chitral Gol National Park hosts the largest surviving population of Kashmir Markhor in the wild.



Results compiled during winter surveys conducted by the wildlife department and third party validation teames show the following figures for the heads of animals;

Figure 3 Trend of Markhor population

Survey reports for the last twenty five years revealed a gradual upward trend in markhor population. The period 1975 to 1984 was crucial one for survival of markhor and other wildlife species of chitral Gol which led to the establishment of National park. During 2002 after launching protected areas management project and the involvement of local communities in the management of Chitral Gol further supported to enhance watch and ward system of the park and thus markhor population progressively increased. During 2005, 2007 and 2010 a little fluctuation in population was noticed which was due to increase of wolves' population and intrusion of stray dogs inside core zone but over all trends remained satisfactory. While during 2019 Snow Leopard Foundation (SLF) team took the responsibility to conduct Markhor Rut season Survey as third party and during the process the survey team adopted new methodology (Double Observer counting which is very costy and need high human resource) instead vantage point counting method through which the number of Markhor were recorded a little bit high. When the wildlfie department conducted survey very next year during 2020, through vantage point counting method which is less costy and need less labours, the total number of Markhor decreased. The local communities shown their concern on decrease of Markhor number. Basically there were reasons for this fluctuation. Firstly the same year there were high military movement on boundary which restricted movement of migrated Markhor from Chitral Gol to adjacent area of Afgahnistan. Secondly, due to drought season there was no snow fall in the area and most of the animals were scattered in inaccessible areas and remained un counted. Thirdly high predation of the animals by predators specially stray dogs. Any how during 2021the same survey was conducted through IUCN, Zoological Survey department, WWF, PFI etc and they recorded 2278 Markhor. Which show upward movement of the graph. There are many factors responsible to determin

fluctuation in numbers of animals in insitu conservation like predation, seasonal migration, climatic conditions, experties of survey team members etc.

4.6 Threats

- In past a few field staff were performing watch and ward duties and it was very difficult for them to keep check on each corner of the vast area of the park and constant threat of illegal hunt was existed. For the time being the said problem was dealt through the recruitement of Wildlife field chowkidars and other field staff.
- During winter season stake holder communities are collecting dry fuel woods from the areas where Markhor are rutting and breeding which hindered the Survey activity as well as the breeding process of Markhor.
- Increas in number of predators

4.7 Recommendations:

- Trainings in latest wildlife Survey techniques should be arranged for park field staff.
- The culling of feral dogs in scientific manner is needed to reduce the damages to the overall biodiversity.

Table 2 No. of Markhor observed from different vantage points of Core zone CGNP

Vantage Point	Coordinates	Lamp 1/2Years	Yearling 1-1/2 Years	Female	C-I 2-1/2 Years	C-II 3-1/3 Years	C-III 4-1/2 to 6-1/2 Years	C-IV > 6-1/2 Years	Total
Olowak	35° 51' 48.30"N 71o 45' 58.85"E Alt:2020 m	22	21	49	20	16	22	18	168
NarkokoBokht	35° 51' 49.12"N 71° 46' 23.29"E Alt: 1719 m	10	10	23	9	7	8	13	80
LohoBangot	35° 53' 30.45"N 71° 45' 10.12"E Alt: 2485 m	56	40	57	21	17	17	19	227
Chagbini Hut	35° 53' 56.98"N 71° 45' 01.35"E Alt: 2926 m	18	7	15	3	3	3	4	53
TongoghoPakhtori	35° 54' 17.55"N 71° 43' 59.68"E Alt: 2857 m	15	14	60	6	9	15	22	141
Ishpedar	35° 54' 37.73"N 71° 43' 52.07"E Alt: 3048 m	11	9	22	4	7	12	0	65
Baghotek	35° 54' 04.88"N 71° 43' 07.13"E Alt: 2525 m	15	9	26	4	3	7	5	69
Kroideri	35° 53' 25.85"N 71° 42' 02.48"E Alt: 2485 m	11	7	35	8	6	3	7	77
DaleemDehar	35° 53' 32.19"N 71° 44' 30.33"E Alt: 2241 m	36	33	32	17	12	10	17	157
DoktonoTek	35° 53' 15.88"N 71° 43' 45.61"E Alt: 2575 m	27	41	29	17	23	13	14	164
Merin Dehar	35° 52' 50.44"N 71° 44' 53.00"E Alt: 2068 m	68	24	87	10	7	18	9	223
Banjshall	35° 52' 25.65"N 71° 44' 32.27"E Alt: 2393 m	6	5	12	3	3	3	5	37
Malosh	35° 52' 31.70"N 71° 45' 12.78"E Alt: 2079 m	48	41	58	28	15	11	13	214
ShaDehar	35° 52' 17.26"N 71° 46' 02.44"E Alt: 2122 m	77	23	173	36	23	39	36	407
Total		420	284	678	186	151	181	182	2082

Table 3 No. of Markhor observed from different vantage points Buffer Zones CGNP

Vantage Point	Coordinate	Lamp 1/2Years	Yearling 1-1/2 Years	Femal	C-I 2-1/2 Years	C-II 3-1/3 Years	C-III 4-1/2 to 6-1/2 Years	C-IV > 6-1/2 Years	Total
Moleen Gol Buffer Zone									
ParpatoDehar	35° 51' 02.19"N 71° 45' 22.83"E Alt: 2019	8	6	12	3	5	3	3	40
ShelioMokhoDehar	35° 50' 56.09"N 71° 44' 19.74"E Alta: 2748 m	-	-	-	-	-	-	-	-
Total		**8**	**6**	**12**	**3**	**5**	**3**	**3**	**40**
Rumbor Buffer Zone									
GoranisakBethani	35°48' 51.90" N 71 38' 58.91" E Alt: 2614 m	4	3	7	0	1	0	2	17
Rawalic	35° 47' 25.07"N 71° 39' 14.03"E Alt: 2355 m	0	0	0	0	0	0	0	0
Palarodehar	35° 47' 27.95" N 71° 41' 22.18" E Alt: 2613 m	6	4	9	0	2	0	4	25
Total		**10**	**7**	**16**	**0**	**3**	**0**	**6**	**42**
Shoghor Wildlife Range									
Avaxon	35° 58' 45.62"N 71° 47' 22.94"E Alt: 2425 m	5	3	9	1	1	1	3	23
Ogdar Der Tower	35° 59' 46.28"N 71° 48' 39.35"E Alt: 2046 m	7	5	13	6	7	8	4	50
Angarghon	36° 00' 08.84"N 71° 47' 45.67"E Alt: 1818 m	8	4	9	2	3	4	2	32
DokoTek	36° 00' 27.74"N 71° 46' 32.29"E Alt: 1773 m	7	6	8	1	1	0	4	27
PanjioTek	35° 59' 59.16"N 71° 45' 04.59"E Alt: 2104 m	5	5	13	3	3	4	5	38
Kishmanja	35° 58' 31.24"N 71° 43' 59.19"E Alt: 2627 m	5	3	9	3	0	5	2	27
RuniDehar	36° 01 11.68"N 71° 44' 27.84"E Alt: 1946 m	2	1	5	0	2	0	4	14
Total		**39**	**27**	**66**	**16**	**17**	**22**	**24**	**211**
G.Total		**477**	**324**	**772**	**205**	**176**	**206**	**215**	**2375**

Table 4 No. of Ibex observed from different vantage points Rumbor (Buffer Zones)

Vantage point	coordinat	Age and Sex classification							Total
					Male				
		Young ½ yrs	Yearling 1½ yrs	Female	C-I 2 ½ yrs	C-II 3 ½ yrs	C-III 4½ to 6½ yrs	C-IV Above 6½ yrs	
Ustoide har	**35° 49' 42.43" N 71° 35' 32.10" E Alt: 3147 m**	13	3	9	4	2	3	4	38
Total		**13**	**3**	**9**	**4**	**2**	**3**	**4**	**38**

Table 5 No. of Age /sex group of Markhor and their respective percentage:

S. No	Sex and Age Group	No. of animals	Percentage
1	Lamp 1/2Years	477	20.1
2	Yearling 1-1/2 Years	324	13.6
3	Females	772	32.5
4	Male class I	205	8.6
5	Male class ii	176	7.4
6	Male class iii	206	8.7
7	Male class iv	215	9.1
Total		2375	100

Table 6 Abstract of Survey Report for the year 2022

Area	Markhor	Ibex	Snow leopard	Fox	jackal	Marten	Monal	Snow cock	Wood Pigon	chukor	Golden Eagle	Griffon vulture	Chough
Chitral Gol (core zone)	2082	0	0	11	7	3	27	6	11	78	6	1	0
Muleen Gol	40	0	0	16	3	0	0	7	0	22	0	3	0
Shoghor Range	211	0	0	12	9	0	0	12	9	43	1	2	0
Rumbor Valley	42	38	0	9	13	0	0	53	22	70	5	3	41
Total:	**2375**	38	0	48	32	3	27	78	42	213	12	09	41

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Markhor & Ibex Rut Season Survey
December, 2022- January, 2023

CHITRAL WILDLIFE DIVISION CHITRAL

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Table of Contents

TABLE INDEX

FIGURE INDEX

Executive Summary

This report is the outcome of a fourteen (14) days-long survey, conducted during December 2022 during the Markhor and Ibex Rut season. For this purpose thirteen (13) vantage points were selected in Toshi Shasha Community Managed Game Reserve and animals were observed in thirty-nine (39) different observation points. While tweleve (12) vantage points were selected in Gahirat-Goleen Community Managed Game and Markhor were counted in thirty-nine (39) different observation points. For the Ibex survey thirty (30) vantage points were selected and Ibex were observed in thirty nine (39) observation points in Chitral Wildlife Range. Age-wise analysis for Markhor, the count within Toshi shasha and Gahirat Goleen Community Managed Game Reserves of Chitral Wildlife Range shows that young accounts for 24 % and yearling 12% of the total count while sex-wise analysis revealed that the female population 35%, male of different classes is 29 % of the total count. The recent count revealed that Class I males were 11% followed by class II, 8%, class III and class IV were 7% and 2%, respectively. Likewise, age-wise analysis for Ibex in various core its core habitats of Chitral Wildlife Range, young remained 20%, Yearling 18% and female made up 32% and male of different classes is 29% of the total count. The various male classes were composed of Class I making up 9%, Class II constuiting 9%, while Class III were 7% and trophy size males of Class IV were 5% of the population.

While in Booni Wildlife Wildlife Sub-Division total of 39 vantage points were selected and Ibex were counted in 45 observation points. The composition of Ibex population observed in Booni Wildlife Sub-Division consisted of females (38%), young (22%), and yearling (10%) while males of different age groups included class I (9%), class II (8%) followed by class III and class IV (7%) and (8%) respectively.

In Mastuj Wildlife Sub-Division, there were 28 vantage points selected in different Nullahs, and Ibex were counted in equal observation points. The survey aimed to estimate the current population trend, to understand population dynamics and age/sex wise classification. The population reckoned in Mastuj Wildlife Sub-Division was composed of young (9%) , yearling (10%), females (54%)while male population age-wise were made up of Class I (12%), Class II (9%), Class III (6%).

Similarly, there were 12 sightings of ibex in similar number of observation points in Broghil National Park. In Broghil National Park the observed population consisted of young (11%), yearling (11%), and female (35%). The male demographic constituted 43% of various classes.

In Kaslash Wildlife Range, no herds of ibex were sighted but a diverse array of wildlife species were documented during this survey as a baseline information. It was revaeled that this area being a forest habiat harbors a diverse array of avian species specially native game birds.

Based on daily observations of field staff and register maintained in RFO, Range office Chitral revealed that Himalayan lynx is the top predator of Markhor in Toshi game reserve as well as at Gahirat game reserve. A few years ago snow leopards permanently resided in the said areas but for the last few years, snow leopards visiting Toshi and Gahirat is occasionally and in the absence of Snow leopard predation mostly done by the Himalayan Lynx and wolves who are staying in the area of Toshi and reportedly disturbing markhor population and continously killing offsprings of markhor. No serious viral disease among the Markhor population has been observed yet.

1. Introduction

1.1 Introduction:

District Chitral, located in the gigantic mountain range of Hindu Kush, harbors rich biodiversity and host to incredible wildlife resources. It provides a sanctuary to valuable species like Markhor (National animal of Pakistan), Deodar (National tree), Chukar (National bird) snow leopard and many more fascinating wild species of the area. Considering captivating land escape of the area and its charismatic wildlife, the Govt: of Khyber Pakhtunkhwa set aside Toshi Shasha and Gahirat Goleen as Community Managed Game Reserves for better management of Markhor and other wildlife species and used for the purpose of trophy hunt which is consequently playing a vital role to reduce poverty of the inhabitants and improve their socio-economic uplift of the local community of the areas. Furthermost the said conservancy areas provide opportunities to students and scientists for research and tourists to view the spectacular wildlife of the area.

Chitral Wildlife division is divided into three Wildlife sub-divisions and two Wildlife Range for management purposes. Every year a number of national and international naturalists and ecologists are attracted to these world-famed areas, because of their scenic beauty and their enigmatic wildlife.

Chitral Wildlife Division receives a 462 mm annual rate of precipitation mainly in form of snow in winter and spring.

1.2 Biological significance of Chitral Wildlife Division:

Chitral Wildlife Division spread over two administrative Districts vise Chitral upper and Lower which not only supports important bio-diversity of the world but also provide a natural habitat for Pakistan's national tree (*Cedrus deodara*), national bird (*Alectoris Chukar*), and national animal Markhor (*Capra falconeri cashmireinsis*) and globally vulnerable big cat Snow leopard (*Panthera Uncia*) is the beauty of the area.

1.3 Objectives:

The objective of the survey is based on the following;

- Estimate the total population of Markhor and Ibex during Rut season.
- Age and sex analysis of Markhor and Ibex.
- Understanding population dynamics of Markhor and Ibex.

2. Description of Markhor

2.1 Description of Markhor

In appearance Male have black beards while females have small chin tuft. Male Markhor have a shaggy mane of long hairs extending down the chest and from the forepart of the neck which consists of grey and white hairs. There are long hairs extending from the shoulder to the croup. Male animals above six years have tufts of long hairs on the elbow of hind legs. In winter coat hairs on body grow longer and very little under wool is developed. While in summer it shed wool and long hairs rubbing its body with rocks and trees and long hairs becomes shorter and thinner. In autumn some well-fed young male's coat becomes as dark that it looks blackish. Male and female yearling is not differentiable but according to local expert hunters and wildlife staff the male yearling have a thick horn and the space between horns at basal portion is shorter compared to female and legs of the male looks broader and color is darker while female yearling's body color is comparatively lighter. When the male animal reaches to the age of nine years its body starts shrinking and horns grow longer and the animals become weaker and easy target for predators and other natural threats like avalanche, flood and rolling stones etc.

Classification of ungulates	
Kingdom:	Animalia
Phylum:	Chordata
Sub phylum:	Vertebrata
Class:	Mammalia
Order:	Artiodactyla
Family:	Bovidae
Sub family:	Caprinae
Genus:	Capra
Species:	Capra falconeri

(Website: University of Michigan, museum of Zoology)

The age of the animal is determined through annual rings develop on horns. It is possible only in captive or observing dead animal; in wild the age of male animal is easily determined through observing curves (vurals) of the horns. After each third year one curve appears and the portion near the tip (which rise during first year of the animal) of the horn is considered one year. It means that if there are three curves in the horn the animal is 10 years old.

2.2 Social behavior:

Kashmir Markhor is diurnal and mainly becomes active in the early morning and late afternoon. During summer months Markhor start feeding very early morning and move upward, when the sun shine get hot they seek shade and lay under trees or rocks chewing the cud for whole day. After sunset their downward movements start again for feed and water. Late evening, they select precipitous area for night stay to protect themselves from predators. While during winter markhor feed whole day taking short rest and basking. During rut season and in moon light the herds have been observed

feeding during night too. Markhor stand on their hind legs to reach *Quercus ilex* leaves and seeds. Young males take advantage in rut while older male take part in rutting later and big fights occurs between males to occupy maximum females and during such fights some males lost horns and some lost even their lives falling from rocks. Stronger male occupy larger group. In case of danger one animal in the group make special sound like "tiff "to alert whole group. Markhor are gergerious, females and young makes group mostly 8-11 animals while male lives in separate herd consisting 4-6 individuals, during rut season male, female and kids make larger herd around 80 individuals. Markhor are good tree climber.

2.3 Breeding:

The mating system in Kashmir Markhor is polygynous and occurs in winter. Rut season start from first week of December. In case of rainy season, the matting starts a little bit earlier while in case of drought conditions it delayed. Birth occurs during last week of May to Mid-June. Each pregnancy produces 1-2 off springs, while pregnancy duration is 135-170 days. Young remain with mother till next breeding season. Weaning occurs at the age of 5 to 6 months. Reproductive maturity in female is about 18 to 30 months while in male it is 24-36 months. A few days before giving birth to offspring the female select most difficult and rocky place and remain near the specific location. After delivery the mother dried offspring by her tongue and soon after milking, although the offspring can walk with mother but mother preferred to hide the offspring in caves or in hollows to protect them from predators for a few days and then the offspring start traveling with mother. It is observed that male and female both come to their birth place for rutting and for giving birth offspring. Markhor hardly lives up to 12 years.

2.4 Food habit

Markhor are strictly herbivorous. Markhor graze on grasses during spring and summer while it switches over browsing leaves, twigs, shrubs and seeds during autumn and winter.

2.5 Ecosystem roles:

Markhor helps in dispersal of seeds of various shrubs and grasses which compose their diet. Kashmir Markhor is food source for predator of the park like snow leopard, lynx and wolves etc.

2.6 Description of Himalayan ibex

Himalayan Ibex (*Capra ibex sibirica*) is symbol of arid and rocky mountain of Karakoram, Hindukush and

Classification of ungulates

Kingdom:	Animalia
Phylum:	Chordata
Sub phylum:	Vertebrata
Class:	Mammalia
Order:	Artiodactyla
Family:	Bovidae
Sub family:	Caprinae
Genus:	Capra
Species:	Capra siberica

ibex

(Source: WWF-Pakistan)

Himalayas. Siberian ibexes are large and heavily built goats, although individual sizes vary greatly. Males are between 88 and 110 cm (35 and 43 in) in shoulder height, and weigh between 60 and 130 kg. Females are noticeably smaller, with heights between 67 and 92 cm (26 and 36 in), and weights between 34 and 56 kg. The nose is straight in profile, the neck short, and the back straight. The neck is also particularly thick and muscular in males, but much less so in females. Both sexes have beards, although the male's beard is more pronounced, and those of females are sometimes absent altogether. the female's horns are relatively small, and grey-brown in color, measuring an average of 27 cm (11 in) long. Those of fully-grown males are black and typically measure about 115 cm (45 in), although in extreme cases they can grow to 148 cm (58 in). Both sexes have circular rings around their horns that represent annual growth, but males also have large transverse ridges along the front surface. The exact shape of the horns varies considerably between individuals.

The coloration is also variable, from dark brown to light tan, with some reddish individuals. There is usually a stripe of darker hair down the center of the back and onto the tail, and some males have saddle-like patches on the back in the winter. The undersides are paler, and, in the winter, mature males becoming much darker with white patches. Females and infants are generally blander in color than the adult males, and do not always have the stripe down the back. Siberian ibexes typically change color between April and July, developing their paler summer coat, which continues to grow and become darker as the year progresses, reaching the full winter condition around December.

The age-wise classification can be carried out based on the small buds appearing semi-circular at specific intervals on the surface of each horn. The new production of each buds indicated years and one of the basic sources of their classification during annual population census.

2.7 Social behavior:

Himalayan ibex are active at early dawn and dusk for foraging and stay sedentary at night as they are modified to diurnal mode. Habitually living at high elevations, sometimes at the vegetation line and well above tree line, Siberian ibexes seek out lower slopes during the winter in search of food. They have also been known to seek out tree lines on hot days, but they do not enter forested areas, preferring to return to their alpine habitat when the weather has cooled. When snow is heavy, they have to paw away snow to reach the vegetation below.

Their diet primarily consists of alpine grasses and herbs. During spring and summer, grasses and sedges form the bulk of their diet, while during winter they eat more tall herbs, and the twigs and needles of trees such as willow and salix. During the summer, they often visit salt licks. Herds vary in size depending on the local population; about 5-30 is most common, although they can become much larger during the rut. Outside of the rut, most herds are single-sex, although some mixed-sex herds

persist throughout the year. Herds spend much of the day grazing, spending an hour or more at each location before moving on.

2.8 Breeding:

The breeding season, known as Rut season, takes place from late October to early January. During the rut, the males spend considerable effort courting females, and they are often emaciated from lack of grazing by the time it ends. Courtship lasts for over 30 minutes, and consists of licking, ritualized postures. Males compete for dominance during the rut, rearing up on their hind legs and clashing their horns together.

Maturation lasts 170 to 180 days, and usually results in the birth of a single kid, although twins occur in up to 14% of births, and triplets are born on rare occasions depending upon the availability of sufficient food. Newborn kids weigh about 3 kg, and grow rapidly during their first year. The horns are visible after about three to four weeks. They begin to eat grass as little as eight days after birth, but do not do so regularly until they are about one month old, and are not fully weaned until six months.

Males are sexually mature at eighteen months, but do not reach their full adult size for nine years. Females first breed in their second year. Males typically live for ten years in the wild, and females for up to seventeen years. They have been reported to live for up to 22 years in captivity.

2.9 Food habit

Himalayan ibex is adopted to feed on various types of grasses and shrubs grown in highland pastures. These grasses include Artemisia spp., ephedra, etc while twigs of Rosa webbiana, birch, are consumed as well.

2.10 Ecosystem roles:

Himalayan ibex is important player in maintaining the ecological balance in this fragile ecosystem. They keep o check on certain spread of dominant flora while also involve in dispersal of seeds of various shrubs and grasses. Besides, they are major source for predator like snow leopard, lynx and wolves in the food web.

3. Methodology

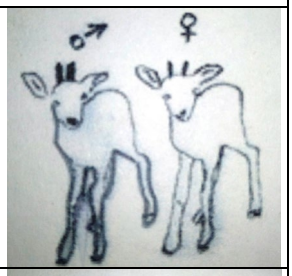
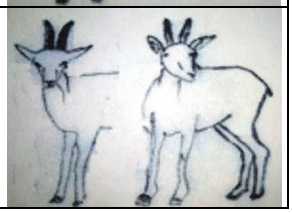
3.1 Methodology:

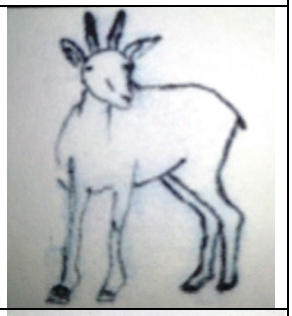
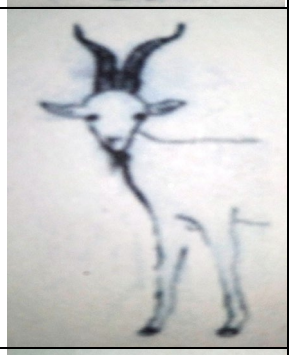
Markhor and Ibex Rut Season Survey was conducted while using vantage point count method in 30th December 2020 to 5th January, 2022 for Markhor while 5th January to 15th January, 2022 for Himalayan ibex. All the survey parties in the team had to ensure early morning sighting at about 7am and early evening sighting around 4pm to confirm the movements, occurrence and number-age-sex data of the Markhor & Ibex at any vantage point. survey team members ensured their presence before 7am in the morning and remained till late at least 4pm on their respective vantage points and recorded the data on prescribed data sheet developed for the purpose. Survey parties also recorded other animals and birds from the vantagepionts as well on way traveling.

Animals were observed with the help of 10 x 42 mm binoculars and Spotting scope. Herd size and composition were recorded. To avoid duplication in counting, the data was critically examined and the reports of adjoining points were examined with reference to herd size and composition. In this examination the possible duplicate counting was eliminated and the herd composition with reference to time was taken as perameter to reduce the counting error. Location, altitude, aspects, habitat type of Markhor observation sites were recorded through GPS.

The following age and sex classification table was followed for Markhor as well as for Ibex during the survey.

Table 1: Age & Sex Classification of Markhor (*Capra falconeri cashmiriensis*)

S/#	Age and Sex Classification	Description	Illustration
1	Lamb	1. Born in May/June, these are easily recognizable in the field due to their sizes. 2. Base of male horn is wider than female of same age (less space in horns of males as compared to female. 3. Colour of the female legs below knee is white while the male have paler colouration	
2	Yearling 1 Years	1. Yearling males resembles adult females but still slightly smaller with thirty centimeter long horns which are darker, longer and broader. 2. The males have black line on neck running from head towards back.	

S/#	Age and Sex Classification	Description	Illustration
3	Females (all age classes)	1. Yearling combined with adult females can make one group.	
4	Class I males 2 years	1. these are the size of females but horns grow up to 45 cm 2. pelage is dark brown with a grayish neck with no ruff 3. The straight horns of males start showing the first curve.	
5	Class II males 3 years	1. Males in this class resemble to the previous age group but with the addition of a fringe of white hair on fore legs and across the chest, the first intimation of the ruff. 2. The horns may be over 50cm long and complete the first whorl (twist are spiral) at this age.	
6	Class III males 4 to 6 years.	1. Class III males have a prominent black beard and a long ruff of white to grey hair flowing from neck, chest and upper parts of the fore legs. 2. Horns are often 75 cm long.	
7	Class IV	1. They contain all those trades which are already conspicuous in class III males. 2. Their ruff is voluminous in this age class. 3. Their horns strikingly long. 4. Their pelage has more grey than brown, except for the black face and upper parts of the legs.	

4. Results and Discussions

4.1 Result:

The data was collected from 25 vantage points i.e., 13 vantage points from Toshi-Shasha Community Managed Game Reserves and 12 vantage points from Gahirat-Goleen Community Managed Game Reserve. Current counts revealed about 2427 Markhor of different age groups distributed within two Community Managed Game Reserves of Chitral Wildlife Division. 1470 animals were recorded from Toshi Shasha while 957 animals were recorded from Ghairat Gol Community Managed Game Reserves.

The population of markhors has seen a gradual and steady increase as 2349 animals were documented during 2020 which observed a slight uptick upto 2405 during 2021 in both Protected areas which indicates improvemt in the management and success of community-participatory approach in conservation.

3.1 Toshi-Shasha Community Managed Game Reserve:

A total of 1470 markhors were sighted in Toshi-Shasha Community Managed Game Reserve. The composition included abundance of female markhor population (484) followed by youngs (312), Yearling 1 and half years were 174. The male population constituted C-1, 2 to 1 and half years (193 Markhor), C-II, 3+1 and years (143 Markhor), C-III, 4 to 6 years (120 Markhor) and C-IV above six years trophy size male (44 Markhor) as shown in (Figure-1) while population observed at each vantage is given in Table-3.

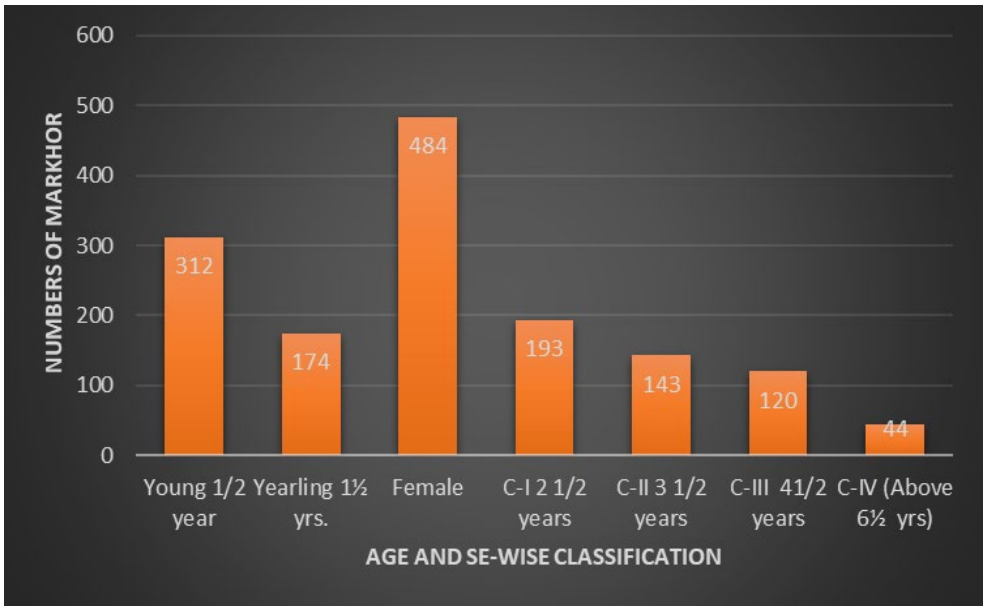


Figure 1: Population estimation of Kashmir Markhor with categorized age group in Toshi-Shasha Community Managed Game Reserve.

Table 2: No. of Markhor observed from different vantage points of Toshi Shasha Community Managed Game Reserve.

S.No	Vantage point	Coordinates	Observation Point	Age and Sex classification							Total
				Young 1/2 year	Yearling 1½ yrs.	Female	Male				
							C-I 2 1/2 years	C-II 3 1/2 years	C-III 41/2 years	C-IV (Above 6½ yrs)	
1	Bemish Gol	35.54'26. N 71.49'10. E	Bemish Gol	7	0	5	2	1	1	0	**16**
2	Sorum	35.56'.32 N 71.49'30 E	SarrumSor	5	6	6	5	10	3	1	**36**
	-do-		Shogorio tek	4	5	10	6	5	4	0	**34**
	-do-		Palogho Ouch	5	4	10	8	5	2	1	**35**
3	Bokht Pasin	35.56'17 N	Maghzer Male	3	3	10	6	0	0	0	**22**
	-do-		ChokolWakht	0	4	5	4	0	0	0	**13**
	-do-		Shallok	0	10	9	8	0	0	1	**28**
	-do-		Khoralasht	3	1	4	0	1	1	0	**10**
	-do-		MagzerMalee	0	0	0	0	0	0	2	**2**
4	BangaloTek	35.56'53.1 N	Charmolan	6	4	10	5	2	3	0	**30**
	-do-		BangaloKlup	4	3	6	5	6	3	2	**29**
	-do-		Banjo tek	10	4	10	5	4	2	1	**36**
	-do-		Thok	15	15	40	10	10	10	2	**102**
	-do-		Sotshakho bichan	10	15	45	15	10	10	2	**107**
5	Aleheni	35.95'440 N	Pakhtori Mokh	4	3	15	2	2	1	0	**27**
	-do-		Buliogh Gol	8	6	21	5	5	6	1	**52**
	-do-		Machi Mali	4	5	10	2	3	4	0	**28**
6	Majat Gol	35.58'16.74 N	Ghoro Gol	8	0	10	2	0	2	8	**30**
	-do-		Beshowo Dahar	9	6	20	4	6	10	1	**56**
	-do-		Ghoro Guch	10	5	10	3	5	7	2	**42**
	-do-		Tushi Koch	12	8	20	6	2	1	0	**49**
7	Boliough	35.96564 N	Thokxal	4	3	8	3	2	6	3	**29**
	-do-		Kandoxhal	2	2	3	2	1	2	1	**13**
	-do-		ShiyakoTek	8	5	15	5	4	3	2	**42**
	-do-		Kharashom	5	4	9	3	3	2	1	**27**
	-do-		Taran Payeen	6	3	12	5	4	3	2	**35**
8	SewakhtJunali	36.12'86 N	Kandujal	5	3	10	5	3	3	1	**30**
	-do-		Ucho Gol	7	4	10	6	3	4	1	**35**
	-do-		Jalasho Gol	10	4	13	8	4	5	1	**45**
9	Shoghore	36.054'.338 N 71.45' 51.44 E	Pashkudar	30	8	26	10	8	3	0	**85**
	-do-		Gandowass	31	7	21	11	5	4	0	**79**

10	Shasha	36.00'298 N 71.45' 51.44 E	DesuGol	3	2	5	4	3	2	1	**20**
	-do-		MolirKhatan	4	2	4	3	2	2	1	**18**
11	Sewakht Pol	36.250.96 N 71.45' 51.44 E	Daro Junali	30	6	25	7	6	3	3	**80**
	-do-		Dashura	25	5	23	8	6	2	1	**70**
12	Terin	36.05'1.4 N 71.45' 51.44 E	Motaro Khatan	3	2	5	3	3	2	0	**18**
	-do-		Terin Der	2	1	2	2	4	1	0	**12**
	-do-		Terin Gol	2	1	2	1	2	0	0	**8**
13	Kharshum	36.02'94 N 71. 81'85 E	Kandu Der	8	5	15	4	3	3	2	**40**
		Total		**312**	**174**	**484**	**193**	**143**	**120**	**44**	**1470**

3.1 Gahirat-Goleen Community Managed Game Reserve:

A total of 957 markhors were observed in Gahirat-Goleen Community Managed Game Reserve. The composition of herds were consisted of predominatly female Markhor population i.e., 370 animals followed by youngs (272), Yearling years (116) respectively. The male population was as follows; C-1, 2 to 1 and half years (79 Markhor), C-II, 3+1 and years (62 Markhor), C-III, 4 to 6 years (43 Markhor) and C-IV above six years trophy size male (15 Markhor) respectively as shown in Figure. 2.

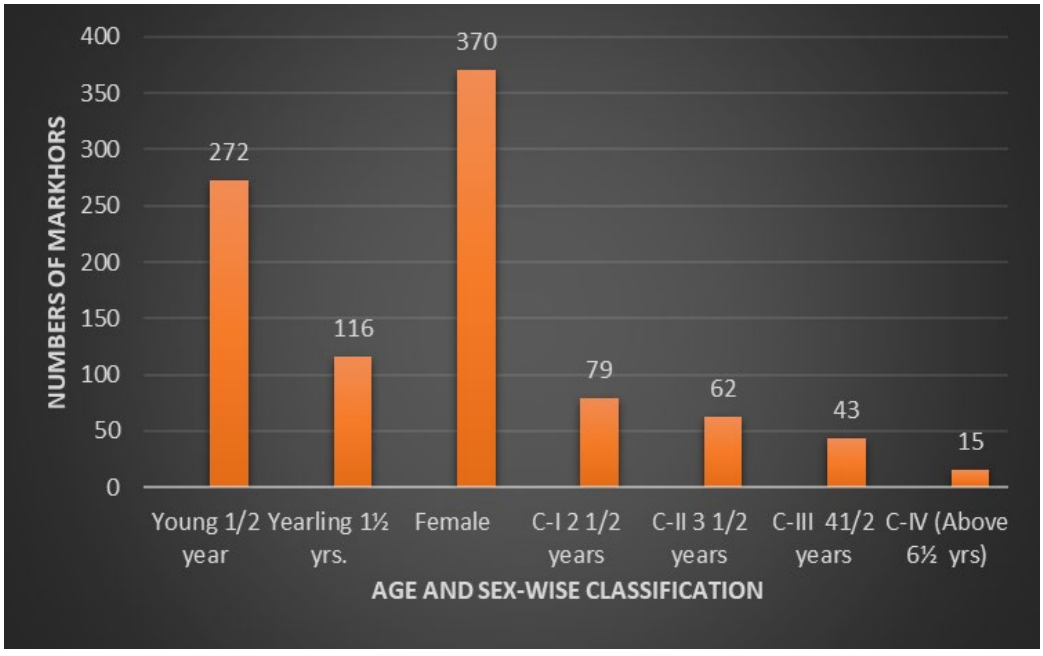


Fig. 2: Population estimation of Kashmir Markhor with categorized age group in Gahirat-Goleen Community Managed Game Reserve.

In Gahirat-Goleen Community Managed Game Reserve, total of 12 vantage points were surveyed. The population observed at the vantage points are given in details in Table. 4.

Table 3: No. of Markhor observed from different vantage points at Gahirat-Goleen Community Managed Game Reserve

S.No	Vantage point	Coordinates	Observation Point	Age & Sex Classification							
				Young (½ yr)	Yearling (1½ yrs)	Female	Male				Total
							C-I (2½ yrs)	C-II (3 ½ yrs)	C-III (4½ to 6½ yrs)	C-IV above (6½ yrs)	
1	Kesssu Gol	35.40'.270 N 71.50'132 E	Shaal	3	1	6	2	2	0	0	14
			Gochar	4	1	8	1	1	0	0	15
			Shah Keli	3	1	7	2	3	1	0	17
2	Kessu Gol Parraly	35.40'.897N 71.50'609 E	Ucha-Uchey	4	1	10	3	1	0	0	19
			Romain	2	1	6	2	1	0	0	12
			Uchuu Gol	8	1	12	3	0	1	0	25
3	BakrabaGeeri	35.39'.714 N 71.47'884 E	Sarzoz	6	4	6	3	5	1	1	26
			Kash golugh	7	5	5	2	1	1	0	21
			Nechagh	5	6	7	3	2	3	1	27
4	Koru Gol	35.40'.721 N 71.47'.495 E	Kuru Gol	8	4	25	0	2	0	0	39
5	LawarTek	35.69'219 N 71.80'457 E	LawarTek	8	6	26	3	6	3	1	53
6	Gehirat	75.40'.418 N 71.47'.272 E	Marble	18	8	35	4	4	2	1	72
			Tracho Gol	44	12	60	6	7	2	1	132
			Panji	30	9	55	5	6	2	1	108
7	Koghuzi Gol	35.94544 N 71.96374 E	Acho Gol	7	3	5	2	0	1	0	18
			Nichagh	9	2	7	3	0	2	0	23
			Sero tek	3	1	3	0	1	0	0	8
			Gwano tak	2	0	1	1	0	0	0	2
			Dabi	8	3	6	2	0	1	1	21
			-do-	12	4	9	5	2	1	1	34
			-do-	3	5	5	3	2	1	0	19
8	Don Gol	35.934693 N 71.942953 E	Bashwan Tek	11	5	9	3	2	2	0	32
			Sharishto Gol	5	1	3	1	1	0	0	11
			ChochoGol	6	4	3	1	1	0	1	16
			Char	18	9	11	5	2	1	2	48
9	Kuryo Tek	35.917406 N 71.924888 E	Pasto Kuch	5	2	4	1	0	1	0	13
			Xhango Koch	2	1	3	2	1	0	0	9
10	NerdithGol	35.902207 N 71.816448 E	Seeno Ouch	3	2	4	1	1	0	0	11

			Mardano Tek	2	1	2	2	1	0	0	8
			Langah	3	2	2	0	1	0	0	8
			Sabanjal	1	0	4	0	1	3	1	10
11	Broze Gol	35.745233 N 71.803231 E	Gochan Gol	2	2	2	0	1	0	0	7
			Sheradak	1	1	1	1	0	0		4
12	Goleen Gol	35.915968 N 72.010041 E	Nichagh	6	3	5	2	1	5	2	24
			Beshum Tek	4	2	2	1	0	1	0	10
			Lohbit	2	1	2	0	1	1	0	7
			Margholi	4	0	3	2	0	1	0	10
			Pindorpol	2	0	4	0	2	5	1	14
			Darbanduk	3	2	2	2	0	1	0	10
Total				**272**	**116**	**370**	**79**	**62**	**43**	**15**	**957**
Grand total				**584**	**290**	**854**	**272**	**205**	**163**	**59**	**2427**

The population of both species of ungulate including Kashmir markhor and Himalayan ibex was observed across their potential habitats of various types in all ecologically significant watersheds of the Chitral Wildlife Division. The population of markhor was mostly restricted to the dry temperate zone and a stable population resided inside two protected areas viz. Toshi Sasha and Gehraite Goleen Community Managed Game Reserves while the stable population of Himalayan ibex is found in alpine and sub-alpine meadows in the upper parts of Chitral Wildlife Division. The population reckoned during rut season survey of 2022 is given in tabulated form.

Table 4 : Age /sex group of Markhor in Chitral Wildlife Range

S. No	Sex and Age Group	No. of animals	Percentage %
1	Young	584	24%
2	Yearling	290	12%
3	Females	854	35%
4	Male class I	272	11%
5	Male class ii	205	8%
6	Male class iii	163	7%
7	Male class iv	59	2%
Total		**2427**	**100**

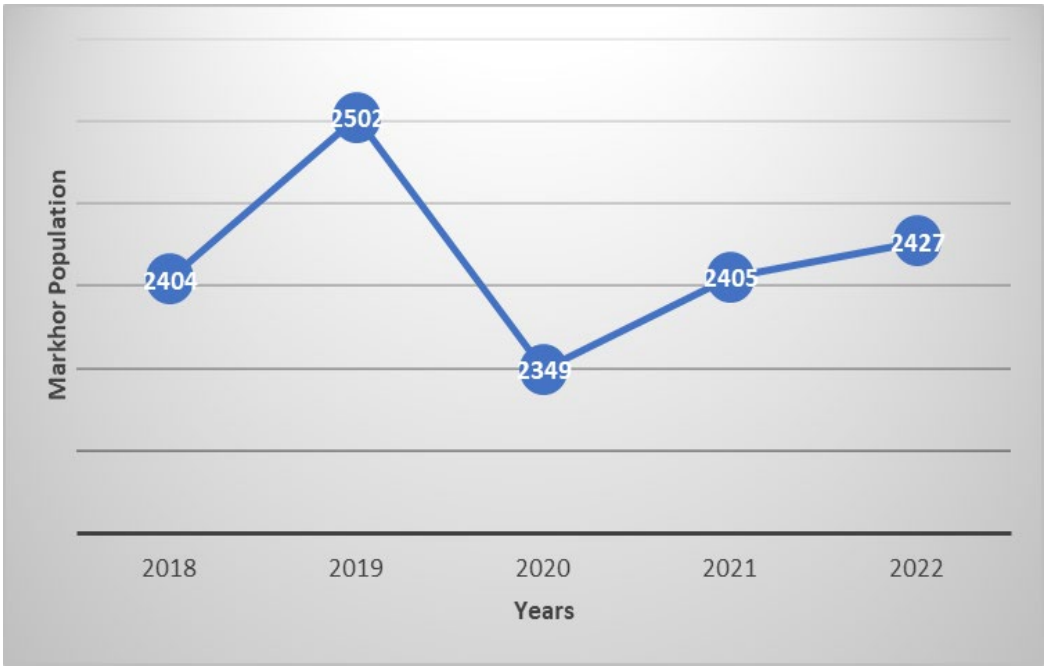


Figure 3: Population trend of Markhor in Chitral Wildlife Range

Table 5: No of Ibex observed from different vantage points at Chitral Wildlife Range

S.No	Vantage point	Observation Point	Age and Sex classification							Total
			Young ½ yr.	Yearling 1½ yrs	Female	Male				
						C-I 2½ yrs.	C-II 3 ½ yrs.	C-III 4½ to 6½ yrs.	C-IV Above 06 Years	
Arkari valley										
A	**Mizigram Gol Arkari**									
1	Ghari	Thok xal	9	7	11	4	3	2	1	37
	-do-	Reshtoon	2	3	7	-	-	-	-	12
	-do-	Meruxi	4	2	7	1	-	-	-	14
	-do-	Nizdir	3	4	6	3	5	2	3	26
B	**Besti Arkari**									
2	Lashkar gaz Khoyeen Gol	Metrek	4	3	7	1	2	1	1	19
	-do-	Gherum Gol	7	5	13	5	4	3	2	39
	-do-	Nakhghon	6	5	11	3	5	4	2	36
	-do-	Tori hongiak	17	12	29	5	7	7	5	82
3	Koro	Pusdam jal	7	3	13	10	7	9	6	55
4	Borbor	Ottor	6	9	16	11	6	5	2	55
5	Warwara	Rapoti	5	4	7	1	1	1	2	21
C.	**Rabat Gol Arkari**									
6	Trachin Gol	Khatobarma	5	4	9	3	4	2	2	29
	-do-	Pakhtori	9	6	14	7	5	4	3	48

		side								
7	Sakal	Sha gologh	5	4	8	1	2	1	1	22
D.	**Ano Gol Arkari**									
8	Bat khana	Raw xal	11	8	15	7	9	8	5	63
	-do-	Bishin mali	5	3	7	2	1	1	0	19
9	Koro baz	Chap kutal	17	13	21	5	3	2	0	61
10	Chat	Jaro der	10	9	12	2	1	1	3	38
11	Gazikistan	Zowmar gor	9	10	18	3	5	2	1	48
E.	**Agram Gol OvirArkari**									
12	Agram Kuro	Bakat	11	29	21	6	6	4	9	86
	-do-	Papno Gol	15	15	22	6	5	3	7	73
13	Nawasing/Dijar	Tor Gol/Sur Dok	9	11	26	1	1	0	0	48
14	-do-	Nichagh	6	12	14	2	1	0	0	35
15	Akram Kuro	Kenewesh	12	13	21	1	1	1	3	52
F.	**Momi Arkari**									
16	Ghezeen Gol	Thagh Zal	6	5	7	1	2	1	0	22
	-do-	Ranga Ghor	3	2	4	1	1	0	0	11
	-do-	Reshthun	4	4	5	1	1	1	0	16
	-do-	Isi gol	9	7	9	2	1	1	0	29
Total No. of Ibex at Arkari valley										**1096**
Garam Chashma valley (Gobor)										
17	Shah saleem deh	Mukhamukh Prash	6	4	9	3	2	1	1	26
	-do-	Ustugam Gol	5	2	10	2	4	1	1	25
18	Beghusht	Chingico Gol	2	1	4	0	2	3	0	12
19	Dinsk	Merith	5	4	7	4	3	1	2	26
20	Zidik Gol	Zidiki Gol	7	5	9	3	1	2	1	28
21	Irjiak	Toghono Gol	5	4	4	5	2	1	2	23
	-do-	Ralawo	8	5	9	2	2	1	1	28
	-do-	Chocho Ralawo	13	9	7	4	3	3	2	41
	-do-	Uni gol	3	2	7	4	3	1	2	22
22	Istanik Birzeen	Mushen Gol	3	2	5	3	2	1	1	17
	-do-	Spoghtgol	4	3	9	3	3	2	1	25
Total No. of Ibex at Garam chashma valley										**273**
Goleen valley										
	Roghili gol	Khondar gol	9	2	19	1	3	5	2	41
23	-do-	Nechagh	6	1	5	2	2	2	1	19
	-do-	Nechagh	4	3	13	3	1	7	1	32
	-do-	Shabakho sor	3	4	5	2	5	4	1	24
	Saroz xhaal	Moshain xha	4	3	5	2	0	2	2	18
24	-do-	Dok gol	3	2	4	0	1	2	0	12
	do-	Chakas gol	0	1	3	1	1	2	0	8
	do-	Bermogh	3	4	6	1	2	0	1	17
	-do-	Doman dok	1	1	1	1	0	0	0	4

	Jungal (Xoghxaal)	Chato dok	9	7	7	2	4	3	2	34
25	-do-	Darkhatan	12	9	8	0	3	4	1	37
	-do-	Betabeti	13	7	9	0	2	4	0	35
Total No. of Ibex at Goleen valley										**281**
Istan Gol Koh Block										
26	Muz dehar	Chat	2	1	4	2	0	0	0	9
Total No. of Ibex at Istan Gol										**9**
Chumuruk Gol Koh Block										
27	Pai thudahar	Palardu	0	1	5	1	1	0	0	8
Total No. of Ibex at Chumuruk Gol										**8**
Mroi Gol Koh Block										
28	Mroi Gol	Ken	3	7	8	2	2	1	2	23
Total No. of Ibex at Mroi Gol and Daleem Gol Koh Block										**23**
Baranis Gol Koh Block										
	Hamajano kham Baranis gol	Maramar	2	8	3	0	1	1	2	17
29	-do-	Yoz angini	2	1	4	0	1	0	1	9
	Nisako dehar	Jamshili Gol	1	2	3	2	3	2	2	15
30	Girm Shalo Kham	Donk Saroz	0	3	5	2	1	1	3	15
Total No. of Ibex at Baranis										**56**
Grand total			**354**	**320**	**557**	**152**	**149**	**123**	**91**	**1746**

Table 6: Age /sex group of Ibex in Chitral Wildlife Range

S. No	Sex and Age Group	No. of animals	Percentage %
1	Young	354	20 %
2	Yearling	320	18%
3	Females	557	32%
4	Male class I	152	9%
5	Male class ii	149	9%
6	Male class iii	123	7%
7	Male class iv	91	5%
Total		**1746**	**100**

Table 7: Abstract of wildlife survey of Chitral Wildlife Range Chitral

S.No	Area	Markhor	Ibex	Snow Leopard	Bearded Vulture	Wolf	Golden Eagle	Lynx	Fox	Jackal	Hare	Monal pheasant	Ram Chukar	Chukar	Pigeon
1	Tooshi-Shasha Conservancy	1470	-	-	6	2	11	5	6	10	18	-	-	232	-
2	Gehret-Goleen Conservancy	957	281	-	4	2	7	3	5	6	-	19	190	154	286
3	Arkari	-	1096	3	6	28	15	9	37	-	18	-	438	138	358
4	Goboor & Gramchashma	-	281	-	5	19	4	-	21	-	2	-	245	695	348
5	Baranis	-	56	-	2	9	2	-	22	-	11	-	33	167	172
6	Istan gol & Chumuruk	-	9	-	1	-	2	-	6	13	21	-	53	96	136
7	Mroi Gol/Dalum Gol/	-	23	-	1	2	2	-	13	25	19	-	46	109	132
Total		**2427**	**1746**	**03**	**25**	**62**	**43**	**17**	**110**	**54**	**89**	**19**	**1005**	**1591**	**1432**

Table 8: No of Ibex observed from different vantage points at Booni Wildlife Sub-Division.

Sr.No	Vantage Point	Observation Point	Age and sex classification							
			Female	Yearling 1 ½ Yrs 1Yrs	Young ½ Yrs	Male				
						C-i 2 ½ Yrs	C-ii 3 ½ Yrs	C-iii 4 ½ Yrs to 6 ½ Yrs	C-iv above 6 ½ Yrs	Total
1. **Udrun**										
1.1	Kootor Dok	Kootor Dok	8	3	12	2	3	2	1	31
1.2	Shano Sor	Shaa Dok	9	5	11	2	4	3	3	37
1.3	Band	Gashto Sor	8	9	9	1	1	1	2	31
		Total	**25**	**17**	**32**	**5**	**8**	**6**	**6**	**99**
2. Athak										
2.1	Shakotal	Dok	6	-	8	-	2	2	2	20
2.2	Betony dardu	Shaa Dok	5	2	9	1	2	2	1	22
2.3	Bandok	Gashto Sor	2	3	12	3	4	2	2	28
		Total	**13**	**5**	**29**	**4**	**8**	**6**	**5**	**70**
3. Rosh gol										
3.1	Isparu Gol	Pareecho sor	5	2	9	4	3	4	5	32
3.2	-do-	Ishpando sor	6	1	7	1	2	2	3	22
3.3	Ishpand	Rushuno sor	4	2	6	3	1	1	2	19
		Total	**15**	**5**	**22**	**8**	**6**	**7**	**10**	**73**
4. Lon Gol										
4.1	Dok Ghari	Dok	7	3	14	3	1	1	2	31
4.2	Samichan lasht	Ghari	2	2	3	2	3	1	1	14

4.3	-do-	Pakhturi	2	1	4	2	1	2	1	13
		Total	**11**	**6**	**21**	**7**	**5**	**4**	**4**	**58**
5. Zewar Gol										
5.1	Beroghun Gol	Xokho Sor	6	2	8	2	-	2	-	20
5.2	Mekina	Lumass	2	1	5	-	2	-	-	10
5.3	Ouch	Noghor zom	3	2	7	-	3	1	3	19
5.4	Ghalang	Ghalango Sor	5	-	9	1	-	-	2	17
5.5	Gram	Gram Ghari	7	2	8	1	-	1	2	21
		Total	**23**	**7**	**37**	**4**	**5**	**4**	**7**	**87**
6. Ujnu gol										
6.1	Doutrakh	Ghocharn Sor	4	-	5	-	2	-	1	12
6.2	Sara rach	Saruxaa	5	4	9	3	2	1	2	26
6.3	Undruask	Roi tuta	2	1	5	1	1	1	1	12
6.4	Hawara	Ponghut	1	2	3	1	-	2	-	9
6.5	Palut	Band	2	2	3	2	1	1	1	12
		Total	**14**	**9**	**25**	**7**	**6**	**5**	**5**	**71**
7. Rech gol										
7.1	moriloleni	Shah Dhar	9	4	14	2	2	2	5	38
7.2	Kort Sarux	Saruxaa	6	2	9	2	1	-	4	24
7.3	Shah junali	Ouchle	5	1	7	3	2	2	0	20
		Total	**20**	**7**	**30**	**7**	**5**	**4**	**9**	**82**
8. Reshun gol										
8.1	Bend	Lot Bend	5	3	12	1	1	1	1	24
8.2	Chuchu gal	Murder kham	4	-	5	2	1	-	2	14

8.3	Mirghiz	Lot Shal	6	-	5	3	-	2	-	16
8.4	Thaghghile	Isparu boht	2	3	5	1	3	1	2	17
8.4	Jangaluti	Lashto bron	2	1	3	-	2	-	3	11
		Total	**19**	**7**	**30**	**7**	**7**	**4**	**8**	**82**
9. Booni gol										
9.1	Hut	Hut o tak	5	3	12	1	1	2	1	25
9.2	Gol	Shaman ach	4	2	8	3	2	2	3	24
		Total	**9**	**5**	**20**	**4**	**3**	**4**	**4**	**49**
10. Awi gol										
10.1	Band	Saruxa	3	2	6	3	2	1	1	18
10.2	Shan gahli	Shano Sor	4	2	4	1	1	1	-	13
		Total	**7**	**4**	**10**	**4**	**3**	**2**	**1**	**31**
11. Mam gol										
11.1	Torrjal	Risht	3	-	5	1	1	-	1	11
11.2	-do-	Saruxaa	2	1	6	2	-	1	-	12
		Total	**5**	**1**	**11**	**3**	**1**	**1**	**1**	**23**
12. Miragram gol										
12.1	Xangh xoi	Saruxja	2	-	5	2	1	-	1	11
12.2	-do-	Dolup o tak	2	1	3	-	-	2	-	8
		Total	**4**	**1**	**8**	**2**	**1**	**2**	**1**	**19**
13. Sonoghor gol										
13.1	Sonoghur Gol	Karkast	2	1	5	3	2	2	1	16
		Total	**2**	**1**	**5**	**3**	**2**	**2**	**1**	**16**
14. Charun Ovir										
14.1	Over lasht	Chaurn Gol	3	-	4	2	-	-	2	11

14.2	Over	Over Gol	4	-	7	2	-	1	-	14
14.3	Pawasum	Kuragh gol	2	3	6	-	1	1	-	13
		Total	**9**	**3**	**17**	**4**	**1**	**2**	**2**	**38**
15. Barum Ovir										
15.1	Brum Go	Saruzo Dok	5	2	8	1	1	1	1	19
15.2	-do-	Sheyaqh	3	1	9	1	2	1	-	17
15.3	-do-	Dok Gaz	4	1	7	2	1	1	-	16
		Total	**12**	**4**	**24**	**4**	**4**	**3**	**1**	**52**
Grand Total			**188**	**82**	**321**	**73**	**65**	**56**	**65**	**850**

Table 9 : Sex Analysis for Ibex Population of Booni Wildlife Sub-Division

S.No	Sex & Age Group	Number of Animals	Percentage
1	Females	321	38%
2	Young < 1	82	10%
3	Yearling (>1<2 years)	188	22%
4	Male Class- i (>3years)	73	9%
5	Male Class-II (>4years)	65	8%
6	Male Class-III (>5 years)	56	7%
7	Male Class-Iv (>6years)	65	8%
	Total	**850**	**100%**

Table 10: Abstract of Wild Life Survey of Booni Wildlife Sub-Division

S.No	Area	Ibex	Snow Leopard	Lynx	Wolf	Jackal	Fox	Hare	Ram Chakur	Chakor	Golden eagle	Pigeon	Chough	Vultures	Brown Bear
1	Reshun Gol	82	-	1	3	8		12	40	112	-	-	55	2	-
2	Booni Gol	49	-	1	3	16	5	7	17	65	-	-	45	1	-
3	Awi Gol	31	-	2	2	18	8	8	14	40	-	-	18	-	-
4	Mem Gol	23	-	1	2	6	5	10	11	21	-	-	-	-	-
5	Miragram Gol	19	-	-	3	9	4	5	16	43	-	-	-	-	-
6	Lon Gol	58	-	2	1	2	4	3	12	45	-	-	7	2	-

7	Rosh Gol	73	-	1	2	9	5	7	36	74	-	-	12	-	-
8	Udrn Gol	99	-	2	3	-	3	7	13	60	-	-	-	-	-
9	Attakh	70	-	1	4	8	2	4	13	30	-	-	9	-	-
10	Zewar Gol	87	-	2	3	2	3	4	16	30	-	-	21	2	-
11	Ujnu Gol	71	-	5	4	14	3	3	17	116	-	-	30	-	-
12	Reech	82	-	2	3	6	2	2	12	40	-	-	30	-	-
13	Sonoghour Gol	16	-	1	1	7	1	8	12	50			17	-	-
14	Charun Gol	38	-	1	1	5	2	6	19	60	-	-	15	-	-
15	Barum Gol	52	-	2	2	-	5	6	25	90	-	-	31	-	-
	Total	**850**	**0**	**24**	**37**	**110**	**52**	**92**	**273**	**876**	**0**	**0**	**290**	**7**	**0**

Table 11: No of Ibex observed from different vantage points at Mastuj Wildlife Sub-Division

S.No.	Ibex Area	Age and sex classification						
		Young	Yearling	Female	Male			
					<18"	18",36"	>36"	Total
1	Parkusap Gol	2	3	15	2	3	2	27
2	Pasum Gol	4	3	10	5	2	1	25
3	Kirkiz Gol	3	3	13	4	0	3	26
4	Chumurkan Gol	3	4	19	7	2	1	36
5	Chapchiragh	2	3	17	3	0	2	27
6	Kargin Gol	3	4	18	4	2	1	32
7	Ishperzomi	3	3	10	2	3	0	21
8	Shano Gol	3	2	11	3	0	1	20
9	Brep Gol	2	3	16	2	3	2	28
10	Dewan Gol	5	4	17	4	2	2	34
11	Kuxh Gol	2	3	15	4	4	3	31
12	Murkuzh	2	3	18	5	2	2	32
13	Grove Gol	7	6	45	12	6	5	81
14	Shich Gol	4	5	10	2	2	2	25
15	Darkhut Gol	2	0	12	3	2	3	22
16	Wasum Gol	3	4	22	5	4	2	40

17	Power Gol	3	3	26	4	4	3	43
18	Bang Goal	4	7	27	2	3	0	43
19	Sardar Gol	3	4	13	2	1	2	25
20	Khoshraw Gol	2	3	16	2	2	0	25
21	Seru Gol	4	5	14	2	1	0	26
22	Dubargar Gol	3	3	11	2	2	2	23
23	Rexun Gol	4	6	20	4	4	4	42
24	Phargram Gol	6	7	23	5	4	3	48
25	Shacho Gol	4	4	21	4	3	2	38
26	Baha Gol	2	2	23	3	4	1	35
27	Bashqar Gol	17	18	111	33	24	10	213
28	Shandur	6	6	51	11	10	9	93
Grand Total		**108**	**121**	**624**	**141**	**99**	**68**	**1161**

Table 12 : Sex analysis for Ibex population of Mastuj Sub-Division

S.NO	SEX AND AGE GROUP	NUMBER OF ANIMALS	PERCENTAGE
1	Young (1/2 Years)	108	9%
2	Yearling (1 ½ Years)	121	10%
3	Female	624	54%
4	Male Class-1(<18”)	141	12%
5	Male class-2(18”,36”)	99	9%
6	Male Class -3(>36”)	68	6%
	Total	**1161**	**100%**

Table 13: Abstract of Wildlife Survey of Mastuj Sub-Division

Sr.No	AREA	IBEX	SNOW LEOPARD	WOLF	FOX	HARE	RAM CHAKUR	CHUKAR	BROWN BEAR
1	Parkusap Gol	27		3	3	8	31	5	0
2	Pasum Gol	25		1	2	6	17	35	0
3	Kirkiz Gol	26		3	3	0	15	7	0
4	Chumurkan Gol	36	1	3	6	14	41	0	0
5	Chapchiragh	27	1	4	4	2	14	9	0
6	Kargin Gol	32		3	2	5	24	22	0
7	Ishperzomi	21		2	3	4	16	20	0
8	Shano Gol	20		2	2	0	0	0	0
9	Brep Gol	28		2	4	6	26	20	0
10	Dewan Gol	34	1	3	3	5	20	33	0
11	Kuxh Gol	31		4	2	0	13	0	0
12	Murkuzh	32		0	2	6	5	16	0
13	Grove Gol	81	1	7	8	16	22	26	0
14	Shich Gol	25		0	2	3	12	36	0
15	Darkhut Gol	22	1	0	4	7	8	0	0
16	Wasum Gol	40	1	5	7	14	23	0	0
17	Power Gol	43	1	5	4	5	14	30	0
18	Bang Goal	43		4	3	9	20	41	0
19	Sardar Gol	25		5	4	3	13	12	0
20	Khoshraw Gol	25		3	1	2	11	20	0
21	Seru Gol	26	1	4	4	6	12	30	0
22	Dubargar Gol	23		3	1	5	14	14	0
23	Rexun Gol	42		5	7	6	20	6	0

24	Phargram Gol	48		4	5	11	11	12	0
25	Shacho Gol	38		1	2	2	0	11	0
26	Baha Gol	35		3	3	3	2	0	0
27	Bashqar Gol	213	3	9	11	17	41	43	2
28	Shandur	93		4	2	5	22	8	1
Grand Total		**1161**	**11**	**92**	**104**	**170**	**467**	**456**	**3**

Table 14: No of Ibex observed from different vantage points at Broghil National Park Wildlife Sub-Division

S.No.	Ibex Area	Age and sex classification						
		Young	Yearling	Female	Male			
					<18"	18",36"	>36"	Total
1	Yarkhon	4	6	18	8	5	7	48
2	Khotan Lasht	2	4	9	3	4	3	25
3	Kash Kon	6	3	14	5	2	1	31
4	Badin Khot	2	1	4	1	3	5	16
5	Khoshraw Gol	7	3	15	5	6	4	40
6	Kand Gol	1	2	4	1	3	2	13
7	Moarail	4	1	6	1	4	2	18
8	Eshar Dok	0	1	2	1	2	3	9
9	Chikar Gol	2	0	5	3	4	3	17
10	Koraspor Gol	0	0	2	2	2	4	10
11	Chianter Gol	3	5	12	4	7	6	37
12	Irshad Gol	5	9	24	10	6	9	63
	Grand Total	**36**	**35**	**115**	**44**	**48**	**49**	**327**

Table 15: Sex analysis for Ibex population of Broghil National Park Wildlife Sub-Division

S.NO	SEX AND AGE GROUP	NUMBER OF ANIMALS	PERCENTAGE
1	Young (1/2 Years)	36	11%
2	Yearling (1 ½ Years)	35	11%
3	Female	115	35%
4	Male Class-1(<18")	44	13%
5	Male class-2(18",36")	48	15%
6	Male Class -3(>36")	49	15%
	Total	**327**	**100%**

Table 16: Abstract of Wildlife Survey of Broghil National Park Wildlife Sub-Division

Sr. No	AREA	IBEX	SNOW LEOPARD	WOLF	FOX	HARE	RAM CHAKUR	CHUKAR	LYNX
1	Yarkhon	48	0	02	03	11	30	40	04
2	Khotan Lasht	25	01	01	02		15	13	02
3	Kash Kon	31	0	0	04	02	10	18	0
4	Badin Khot	16	0	03	01	06	08	10	01
5	Khoshraw Gol	40	0	0	02		0	05	03
6	Kand Gol	13	01	0	03	06	04	0	01
7	Moarail	18	0	01	01	02	0	10	01
8	Eshar Dok	9	0	02	04	04	0	0	0
9	Chikar Gol	17	0	01	01	03	0	06	0
10	Koraspor Gol	10	01	01	0	02	0	02	03
11	Chianter Gol	37	02	02	0	01	0	01	01
12	Irshad Gol	63	04	13	23	02	68	105	6
Grand Total		**327**	**06**	**26**	**44**	**39**	**135**	**210**	**22**

Table 17: Abstract of Wildlife Survey of Kaslash Wildlife Range

Sr.No	AREA	IBEX	SNOW LEOPARD	LYNX	WOLF	FOX	HARE	RAM CHAKUR	CHUKAR	PIGEON
1	Grambad Gol	0	2	2	8	7	6	11	33	6
2	Pishpo Nala Birir	0	1	1	7	7	5	22	33	15
3	Lot Gol Bamborat	0	1	2	15	14	21	7	51	23
4	Ayun Dok	0	1	5	15	18	35	52	83	44
5	Acholga	0	2	7	11	21	23	26	46	47
6	Seikhan Deh Rumbor	0	2	5	18	29	29	23	46	48

4.2 Discussion:

This survey revealed an increase in the overall population of Wildlife species across the whole Chitral Wildlife Division. The population dynamics of ecologically significant species such as wildlife ungulate species i.e. Kashmir markhor and Himalayn ibex are stable and indicate an upward trend which is a positive indication. The effective conservation and management of wildlife resources through ehnaced watch and ward, efficient community participation as co-management partner and the employment of some successful conservation tool such as trophy hunting is proving a success in a big deal while ecologically contributing to the resotoration of the fragile ecosystem.

Table 18: Abstract of wildlife survey of Chitral Wildlife Division Chitral

Sr.No	Area	Markhor	Ibex	Snow Leopard	Vulture	Wolf	Golden Eagle	Lynx	Fox	Jackal	Hare	Monal pheasant	Ram Chukar	Chukar	Pigeon	Brown Bear
1	Mastuj Wildlife Sub-Division	-	1161	11	-	92	-	-	104	-	170	-	467	456	-	03
2	Booni Wildlife Sub-Division	-	850	-	7	37	-	24	52	110	92	-	273	876	-	-
3	Chitral Wildlife Range	2427	1746	03	25	62	43	17	110	54	89	19	1005	1591	1432	-
4	Broghil National Park	-	327	06	-	-	26	22	44	-	39	-	135	210	-	-
5	Kalash Wildlife Range	-	-	3	5	74	25	22	96	102	119	22	142	292	183	-
6	G-Total	2427	4084	23	37	265	94	85	456	266	509	41	2022	3425	1615	3

6. Recommendations

- Proper latest scientific survey training for Wildlife field staff is needed.
- Provision of proper field gear for field staff
- Provision of adequate funds for specific wildlife surveys
- Proper research is recommended to find out the drastic fluctuation in population patterns.
- Engagement of indpendent orgazniations and entities for transparent third party validation of the population across the whole Division.

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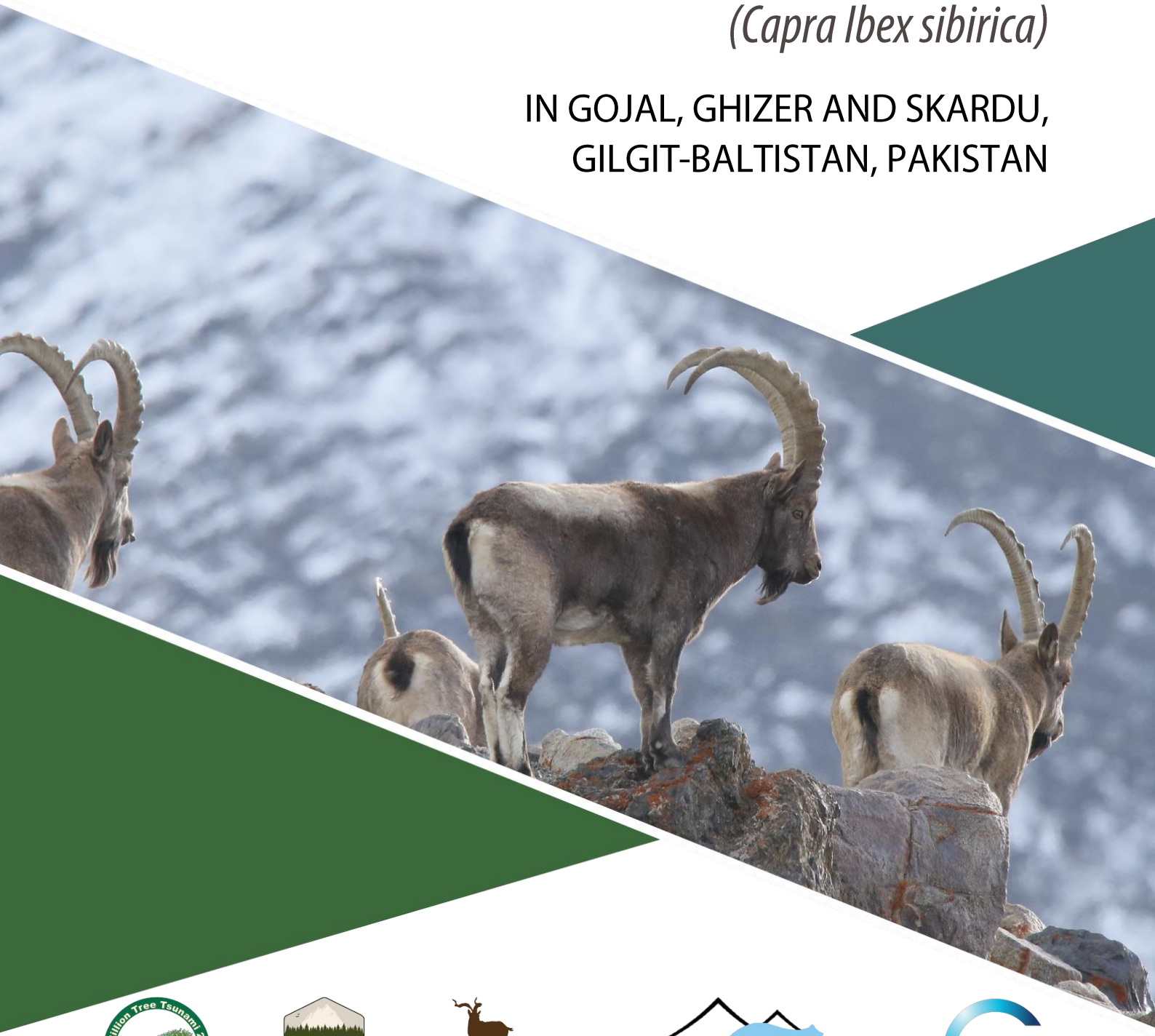
FOREST, WILDLIFE AND PARKS DEPARTMENT
GOVERNMENT OF GILGIT-BALTISTAN

RUT SEASON SURVEY REPORT 2020-21

HIMALAYAN IBEX

(Capra Ibex sibirica)

IN GOJAL, GHIZER AND SKARDU, GILGIT-BALTISTAN, PAKISTAN



10 Billion Tree Tsunami 2020
10 Billion Tree Tsunami 2018
FOREST DEPARTMENT Gilgit Baltistan
PARKS & WILDLIFE Gilgit Baltistan
SNOW LEOPARD FOUNDATION
IUCN

RUT SEASON SURVEY REPORT 2020-21

HIMALAYAN IBEX (*Capra ibex sibirica*)

IN GOJAL, GHIZER AND SKARDU, GILGIT-BALTISTAN, PAKISTAN

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This report on "The Current Status of Himalayan Ibex (*Capra ibex sibirica*) in Gojal, Ghizer and Skardu, Gilgit Baltistan (2020-2021)" has been developed for Gilgit-Baltistan Forest, Wildlife and Parks Department, with the support of Ministry of Climate Change, IUCN Pakistan, Snow Leopard Foundation and divisional offices of Forest, Wildlife and Parks Department.

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Table of Contents

Executive Summary

Mountain areas provide suitable habitat for a number of wildlife species including threatened species. The Himalayan ibex is distributed in neighbouring countries of Pakistan, including China, India, Afghanistan, and in north-eastern Uzbekistan, Tajikistan and Kyrgyzstan Mountains. In Pakistan, it is found in Karakoram, Himalaya and Trans-Himalayan regions of Jammu Kashmir especially in upper Neelam valley. In Gilgit-Baltistan, the species is abundant in district Ghizer, Hunza and Skardu. Himalayan Ibex (*Capra ibex sibirica*) is symbol of an arid and rocky mountain of Karakoram, Hindukush and Himalayas of Gilgit-Baltistan. Globally it is categorized as near threatened species according to IUCN red list criteria. The main threats to Ibex are resident Livestock and migratory livestock which may be the cause of disease spread in Ibex.

The detection probability of both observers is quite low, possibly due to topography and rough terrain of the survey area, while in comparison the detection probability of observer one was higher than observer two. However the current recorded biomass of ibex was insufficient for the predators (snow leopard (*Uncia unicia*) and wolf (*Canis lupus*) population in the area. We used capture Mark Recapture method as a tool for estimating viable population status of Himalayan Ibex in the study area. It is vital to ensure a sustainable trophy hunting programs in addition to developing and adopting comprehensive hunting rules. The basic purpose of study was to estimate the current population of Himalayan Ibex in the area. Based on which suggest a hunting quota of Himalayan ibex for the area. To ensure sustainability of the population only 2 % of the total population or 25% of the trophy animals could be harvested, while keeping the male to female ratio at minimum of 1:6. As per our records, 2 % of the total population becomes 29.74≅30 trophy animals, while 25% of the total trophy animals become 22 trophy animals and male to female ratio is 1:4, which can be considered as a viable ratio, therefore, we suggest 25 hunts in the area.

This report contains results of the 2 surveys conducted during 2020 and 2021. The first section of the results deals with findings in Gojal area in upper Hunza. Efforts were made to estimate population of Himalayan ibex in Community managed Conservation areas (CMCAs) and Conservancies of Gojal area in upper Hunza with a special focus on age and sex structure. Double observer method which is based on Capture-Mark-Recapture (CMR) was used to assess a significant and precise estimate of the

Himalayan ibex population. The survey was carried out in January between 7th to and 15th January, 2020. The overall observed population of ibex in the area was (n=1487) individuals (95%CI ± 997.45). Overall 75 groups/herds were sighted with mean size of (19.83) ibex/herd. Sex ratios of female to young was (1: 0.39) and female to male (1:0.57) while Female to Yearling is (1: 0.24) respectively. However, the population is represented by (45.05 %) Adult female, while male Class I represents (4.24%), male Class II (4.30%), male Class III (5.64%), male Class IV (11.83%), young (17.75%) and yearling constitutes (11.16%) of the overall population.

Second part of the result section elaborates findings of the survey in Ghizer and Skardu Districts during winter of 2020-21. A total of 269 animals including 85 males, 111 adult females, 30 yearlings and 43 young were counted from different valleys during the survey in district Ghizer. In SKB area, a total of 67 animals were sighted which include 25 males, 26 adult females and 16 yearlings. Population of Ibex on the basis of sex (female = 41.3 %, Young = 16 %, Male=31.6 % and Yearling were 11.2 %) in district Ghizer and for SKB it was 37%, 39% and 24% male, female and yearling respectively.

1. INTRODUCTION

Pakistan is home to a great variety of habitats and one of unique landscape starting with few 100 meters a.s.l in the extreme south and reaches upto 8,611 meters on the top of K2 in the extreme North, the area of Gilgit-Baltistan. It hosts a number of ungulate species spread across the country' diverse landscape and are well-adopted to environmental conditions of the area they belong to. Gilgit-Baltistan is famous for its unique mountain and associated ecosystems and rich diversity of wild fauna. Many important and threatened large mammals both carnivores and herbivores are thriving in the mountains of Himalaya, Karakorum, Pamir and Hindu Kush.

Mountain areas provide suitable habitat for a number of wildlife species including threatened species (Viña et al., 2010). The Gilgit Baltistan in Pakistan are famous for having diverse habitat and being rich in wildlife diversity. It includes good population of six species of wild sheep and goat including Astor Markhor (*Capra falconeri falconeri*), Ladakh urial (*Ovis vignei*), Himalayan ibex (*Capra sibirica*), Blue sheep (*Pseudios nayaur*), Marco polo sheep (*Ovis ammon polii*), and Musk deer (*Moschus chrysogaster*). The carnivore's species include Himalayan brown bear (*Ursus arctos isabelinus*), snow leopard (*Panthera uncia*), black bear (*Ursus thibetanus*), grey wolf (*Canis lupus*) Himalayan lynx (*Lynx lynx isabelinus*) and Indian wolf (Zafar et al., 2014). Among wildlife, winter ungulates play an important role as drivers of ecosystem functions and as prey of large carnivores (Bagchi & Mishra, 2006).

Ungulates play important role in Conservation of flora structure, ecosystem and nutrient cycling in their habitats (McNaughton, 1979; Bagchi and Ritchie, 2010). (Johansson et al., 2015; Suryawanshi et al., 2017) have documented that the wild ungulates such as blue sheep (*Pseudois nayaur*), Himalayan ibex and Marco polo sheep (*Ovis ammon polii*) provide more than 50% of the biomass consumed by large carnivores, such as the Snow leopard (*Uncia uncia*), Wolf (*Canis lupus*), Brown bear (*Ursus arctos*) and Red fox (*Vulpes vulpes*).

According to (Roberts, 2005), the Himalayan ibex is a subspecies of ibex occur in the rough mountain of Pakistan and Central Asia. It belongs to caprine and most common in the region of Northern Area of Pakistan (Schaller, 1977; Anonymous, 1997; Hess et al., 1997). Ibex is closely resembled with wild goat, found in the high altitude mountains (Khan, et al., 2008). Likewise, several other species, Himalayan Ibex is one of the important wildlife species in study area.

1.1 Himalayan Ibex

Himalayan Ibex (*Capra ibex sibirica*) is symbol of arid and rocky mountain of Karakoram, Hindukush and Himalayas of Gilgit-Baltistan. (B. Khan et al., 2016). The males have heavy body, large horns, long bears and females are small body and small horns. Its presence in its natural habitat is essential to maintain healthy ecosystem. Himalayan ibex (*Capra ibex*) is one of the ungulates inhabiting these areas. Despite competition with livestock for forage as well as continuous hunting pressure, it is categorized as a near threatened species internationally according to IUCN red list (IUCN, 2020).

The Himalayan ibex is distributed in neighbouring countries of Pakistan, including China (Reading & Shank, 2008), India (Bagchi, Mishra, & Bhatnagar, 2004; Fox, Sinha, & Chundawat, 1992), Afghanistan (Fedosenko & Blank, 2001) and in north-eastern Uzbekistan, Tajikistan, Kyrgyzstan mountains and in northern Pakistan (ALI, NAWAZ, & ANWAR, 2015; M. Z. Khan et al., 2020; Raza et al., 2015; Usman, Ahmed, Awan, Basher, & Awan, 2007) and found in Karakoram, Himalaya and Trans-Himalayan regions of Jammu Kashmir especially in upper Neelam valley (Usman et al., 2007). In Gilgit-Baltistan, it is found in Ishkoman, Yasin and Hunza valley.

1.2 General Characteristics

Ibex is a 'sturdy, thick-set goat. The face is short and broad with a long beard in males and a shorter one in females. It lives in precipitous terrain where it requires not speed but power. Hence, they have stocky legs with healthy fore limbs to climb and leap among rocks (Schaller, 1977).

Ibex are sexually dimorphic and their pelage colour varies round the year. In winter adult males are a prominent, dark brown with a white saddle and in some males whitish areas are also present on shoulders, abdomen, legs and thighs. A dark flank stripe is present in some animals. The whitish rump patch is surrounded by light coloured hair that extends down the back of the legs. In contrast, females have grey brown coats with less conspicuous whites on their bodies (Fox et al., 1992; Schaller, 1977).

Ibex develop a dense under-fur of fine wool (pashm) during winter that enables them to withstand extremely low temperatures. Molting occurs during spring and early summer (May - July) in most parts of it's range, after which ibex acquire a paler coat (Fox et al., 1992; Schaller, 1977).

Ibex males have scimitar shaped horns with a relatively flat anterior surface, broken by prominent transverse ridges. Horns grow throughout their life, the annual horn increment declining with increasing age (Nievergelt, 1981; Schaller, 1977). Horns grow during spring and summer, and cease growth at the initiation of the rut. Each of the thus formed segments can be identified by a furrow

which is most clear on all sides of the horn except the anterior. Usually, 2 ridges or knobs are added each year on male horns between 2 and 9 years.

The weighs of an adult ibex male roughly 1.5 to 2 times more than an adult female which weighs 50 to 60 kg. An adult male stand about 100 cm at the shoulder while an adult female has a shoulder height of about 70 cm (Heptner, Nasimovich, & Bannikov, 1966; Schaller, 1977). The weight of an ibex male head with horns may constitute approx. 6 to 8 % of its body weight and the horn length is usually about 1.25 to 1.58 times longer than its shoulder height (Schaller, 1977).

Yearling males roughly equal adult females in body size and horn length but differ in having a thicker horn and a darker body. Yearling females are a little over half the size of adult females and have thin, short horns measuring approx. 10 to 15 cm (Heptner et al., 1966).

1.3 Population Structure and Group Size

Females more than two years old were considered as adults. Ibex less than two years old were classed as young. Kids were individuals in their first year and had stubby horns while Yearlings were individuals in their second year with females having horn length usually < 5 cm and body size about 3/4th smaller than adult females. Yearling male horn length was usually < 20 cm, were laterally wide with one or two frontal knobs and body size was close to, but smaller than that of an adult female. They were relatively darker than adult females and yearling females. Kids and yearling males were clearly identifiable, but yearling females and young females were sometimes misclassified. Hence, there is a chance of a slight underestimation of females. Males were recognised into following four categories;

Class	Description
A. Class I (third year):	Horn length approx. 35 cm. Horns short with little curvature. Animal usually did not develop dark brown markings on body during rut and winter
B. Class II (fourth & fifth year):	Horn length approx. 50 to 60 cm. Horns curved slightly backwards and dark brown markings with a distinct silvery 'saddle' that appeared during rut and winter
C. Class III (sixth and seventh year):	Horn length 60 to 70 cm. Horns curve back in a semi-circle and dark black coloration with silvery saddle appeared during rut and winters.
D. Class IV (> seventh year):	Horn length more than 70 cm. Horns shape and body coloration similar to Class III which also curve outward.

1.4 Status and Distribution

Geographical Distribution

Five Capra ibex subspecies are unevenly distributed from the European Alps to the north-western Himalayas. These occur in the Alps (*C.i. ibex*), the highlands of Ethiopia (*C.i. walia*), North Sudan, portions of Egypt, Syria and Israel (*C.i. nubiana*), the Caucasus (*C.i. caucasica*), and the northwestern Himalaya (*C.i. sibirica*) of Central Asia (Schaller, 1977). Globally *C. sibirica* is distributed in Afghanistan, China, India and Mongolia and also found in the mountains of Central Asia, Tien Shan and Koh Altai (Rovero et al., 2020; Usman et al., 2007).

Ecological Distribution

As documented by (Schaller, 1977 & Prater 1980), the Himalayan ibex mostly live on rugged mountains of cold areas, range between (2500 to 3000m) tree line and sometime upper limit of vegetation (5000m) above sea level. Although its range as per (Heptner et al., 1966) in northerly of the Tien Shan and Altai ranges, as low as altitude 500m above sea level and frequently live between 1000m to 2000 m.

Mostly ibex is found in the territory of alpine scrub (Champion and Seth, 1968) or dry high steppe vegetation (Schweinfurth, 1957; Puri et al. 1989). These areas are described by scattered and open bushland mostly with shrub and herbaceous species i.e. Artemisia spp., Lonicera spp and caragana spp. Such areas having low relatively annual production of biomass with high vegetation pulse during summer when ibex recapture body condition. They venture into sparsely forested slopes in lower areas of the region seasonally in Gilgit-Baltistan (GB) Pakistan (Schaller, 1977) and Central Asia (Heptner et al., 1966).

Pakistan is home to a rich population of Himalayan ibex likely found in dry highlands of Himalaya Karakoram, Hindu Kush and Pamir areas in Gilgit Baltistan. It is spread relatively in the dry mountains and rocky areas of GB with hotspots in District Hunza, Nagar, Gilgit, Ghizar Skardu, Shiger, Ghanche and Kharmang while it is also occur in some areas of Khyber Pakhtunkhwa (Chitral, Dir, Swat, Kohistan and Mansehra districts and in Azad Jammu Kashmir and Kashmir(Roberts, 1997; Ali et al., 2007; Anwar 2011).

Sympatric Species and Predation

In the lower areas of Gilgit-Baltistan, ibex share its habitat range with other Mountain Ungulates like Markhor (*Capra falconeri*) and Urial (*Ovis orientalis*). In the Karakoram and Pamirs range Ibex found with Marco polo sheep (*Ovis ammon polii*) (Roberts 1977; Schaller, 1977; Petocz, 1978). Ibex share their range with other mountain ungulates. In the lower parts of their western distribution, their range overlaps with markhor (*Capra falconeri*) and urial (*Ovis orientalis*). In the Pamirs and Karakorum Range, they occur along with Marco polo sheep (*Ovis ammon polii*) (Roberts 1977, Schaller 1977, Petocz 1978). Alongside the south-west, west and northern marginal of the Tibetan plateau their series overlays with diverse argali subspecies (*Ovis ammon*), and bharal (*Pseudois nayaur*) (Schaller 1977, Schaller et al., 1987; Mallon 1991; Fox et al., 1992). Snow leopard (*Panthera uncia*) and the Tibetan wolf (*Canis lupus chanko*) are the primary predators of Ibex (Schaller 1977).

1.5 Habitat Use

The Himalayan Ibex occupied a distinct seasonality range, which reflects in the habitat use trends by ibex. Ibex are usually limited to rugged and steep terrain. Their life is closely associated with cliffs. In order to escape from predators, they use cliffs as an advantage (Fox et al., 1992; Schaller, 1977).

Ibex changes its habitat according to different season and select different altitudes. Throughout the year, they mostly occur on upper slopes. In peak summer, they go to highest altitudes and descending lowest during spring to take advantage of the new plant growth (Fox et al., 1992; Schaller, 1977).

The winter in the regions which is used by ibex is usually long and severe. During this season, forage is of low quality and is not easy to access through the snow cover and thus makes the period very

critical. Ibex cannot move efficiently on snow, thus feeding in deep snow conditions at a considerable cost. Hence, they mainly confine to steep precipices on southern slopes which have less or no snow in this season. The day range length of ibex is approximately 300 m and they may occasionally travel 3 to 5 km or more in a day. Most ibex use the same general area all year round (Fox et al., 1992; Schaller, 1977).

1.6 Feeding Ecology

The ibex is a gregarious species, which chooses living in rugged regions, avoiding vast flat areas without cliffs or rocks. The diet of ibex contains mainly grasses and forbs, as well as sprouts, flowers, and fruits of many herb and shrub species are willingly eaten (Johnsingh, Stuwe, Rawat, Manjrekar, & Bhatnagar, 1999). Schaller (1977) reported 14 such plant species that were eaten by Ibex.

Studies have confirmed that group size and composition have a strong relationship with habitat structure, distribution of food (spatially and temporally), and reproductive characteristics (Barrette, 1991; Raman, 1997).

1.7 Behaviour

Courtship

During the rut season, all females are passive and courting males have to test for oestrus females. Usually, mating is the privilege of the dominant male in a group. A male usually approaches the female in the low stretch from behind, often twisting its head and kicking with its forefoot. The female ignores this gesture initially and may eventually comply to the persistent pursuits by urinating. The male then tests for oestrus by smelling and twisting its lip. A male repeatedly mounts a receptive female, a few seconds each time (Schaller, 1977).

Play

Young often involve in play behaviour which seem to be mostly exaggerated aggressive or sexual behavioural forms. On occasions it also involves running with huge bounds, often with hind legs thrown up in the air and head waving from side to side. Sometimes even adults involve in such behaviour (Schaller, 1977).

Escape Behaviour

Ibex have evolved in the rugged mountainous tracts where they require strength in the forelimbs to climb and jump on steep slopes and cliffs. Cliffs are one place where they can outsmart any land predator and ibex use this to their benefit in escaping predators. Being saltatorial animals, ibex cannot run fast over long distances but can climb steep slopes with ease (Schaller, 1977). Cliffs are hence referred in literature as escape terrain (Fox et al., 1992). Ibex respond to danger, especially large predators by issuing a high-pitched whistle or chirp like a bird before bounding off into escape terrain (Schaller, 1977).

Activity Pattern and Feeding Habits

Ibex mostly feed during early morning and evening but activity patterns vary seasonally. During the month of November and December ibex had a bimodal pattern with a major activity peak around

sunrise and a minor one around sunset. During mid-day, most ibex rested and after sunset they started bedding for the night. After heavy snow fall and drop in temperatures, limited observations by Fox et al. (1992) suggested that ibex had switched to a single mid-day activity peak, often remaining bedded till mid-morning, followed by feeding and bedding again just before sunset (Fox et al., 1992).

1.8 Reproduction and Population Dynamics

Reproduction

Mating and calving period of Ibex last for two to three weeks each (Heptner et al., 1966). (Heptner et al., 1966) stated that in the Russian Pamirs, Ibex mate in December-January and after a gestation period of 170 to 180 days, usually one and rarely two young are born in June-July. According to (Schaller, 1977) also got similar information from villagers in Pakistan but (Zahid et al., 2018) reports the rut to start in October.

Ibex females have their Youngs usually only after they are 3 years old. It give birth about a month after the snow melts and green forage becomes available in the short plant growth season that follows (Heptner et al., 1966). This enables the lactating females to replenish their reserves lost during the lean winter season and rear their young more efficiently (Schaller, 1977).

Ibex females having around 50 kgs weight were reported to have young of 3.5 to 4.0 kgs (Heptner et al., 1966). Ibex females may cache their young for 2 to 3 days, after which the young follow their mother. A strong mother-young bond exists for about an year and may temporarily (in female yearlings) or permanently (in male yearlings) break during birth giving (Savinov, 1962; Schaller, 1977).

Longevity

Ibex is the most long lived Caprine as some animals had lived up to 15 years, based on its horn characteristics. However, during their prime years (4 to 10 years), most deaths in (male) ibex occurred with a mean of 8 years. This paradoxical situation is difficult to explain and is probably due to stressful conditions following a period of high activity, i.e., the rut, when males successful in mating have a higher chance of facing malnutrition in the following lean season i.e., winter (Schaller, 1977). Due to ambiguous annual rings, it is difficult to estimate the Longevity in females.

Herding Activities

Ibex live in the form of groups and may occur in groups of adult females with young, all male groups and groups with both sexes (Heptner et al., 1966). During the year, adult males and females associate with each other. In summer season, the proportion of males increases in all males' groups. As month of October approaches, males re-join female groups, coinciding with the onset of the rut and stay with or close to the females until early summer (Bagchi et al., 2004; Bhatnagar, 1997; Zahid et al., 2018).

Population Structure

According to various authors, group size and composition of Ibex differs significantly with season, forage availability and population density. Group size ranged from 3 to 50 reported in different studies (Bhatnagar, 1997; Heptner et al., 1966; Schaller, 1977).

1.9 Conservation and Status

Ibex is categorised as a near threatened species according to IUCN red list. It is pouched/hunted for trophy, meat or high-quality wool (Bhatnagar, 1997; Schaller, 1977).

Ibex is one of the common ungulate along with bharal in its range (Schaller, 1977 & Fox et al., 1991). Random records on absence – presence and abundance from studies exist for its range and it is very difficult to compare the available studies due to difference in use of methods and the season or time of the study. As per studies conducted by (Schaller, 1977 & Fox et al., 1991), the ibex founds in low to average densities (0.5 to 2.8 ibex per sq. km.) in its range.

Threats such as fragmentation, competition with domestic livestock and illegal hunting and especially diseases have been the main factors responsible for demographic changes in the recent history of this species (Acevedo & Cassinello, 2009).

According to Schaller (1977), much of the ibex range in his study area in Northern Pakistan was overgrazed by livestock, and only 1 to 3 % of the plant species were eaten by ibex. Areas above 4,000 m were relatively free from human disturbance but the forage available there was very sparse due to the dry and harsh climatic conditions. In addition to these threats, mega infrastructural development projects right in the core zones of protected areas, illegal hunting and poaching and human encroachment into its habitat for various reasons are posing a great threat to the population of ibex in the study area.

1.10 Potential Threats to Ibex

Resident Livestock

Resident livestock may pose a threat to ibex through transmission of contagious diseases. Pastures with Verity of grasses species is preferred for stall feeding livestock in winter and feeding yaks used for ploughing during May-June. Traditional local law has allocated pastures to households whose members collect numerous back-loads of grass in September. Ibex often foraged in these pastures during winter. This may be a significant threat to ibex using northern slopes.

Migratory Livestock

Migratory livestock intensive grazing causes degradation of the pastures, which have direct impacts on the food availability for Ibex. Another significant threat by migratory livestock is the transmission of diseases to the Ibex (Bhatnagar, 1997).

(Bhatnagar, 1997) reported another significant threat posed by the migratory livestock is the accompanying dogs. Ibex got alarmed when dogs barked, even from considerable distances. Its sometime chases ibex and attack on them.

1.11 Trophy Hunting Programme of Gilgit-Baltistan

Trophy hunting is one of the conservation tools, widely use across the world for managing the wildlife, where the selected past prime, old male animals are harvested to generate revenues. Trophy hunting of Markhor, Ibex and Blue sheep in several valleys was initiated by Forest, Parks and Wildlife Department of Gilgit-Baltistan in collaboration with IUCN and WWF-Pakistan in early nineties to promote community based conservation of the dwindling ungulate species in Gilgit-Baltistan. From the revenue generated, Eighty (80) percent goes to the communities who spent this money on rural uplift and conservation related projects. It has been admired at both national and international level.

Pakistan is actively promoting community based wild resources management as a conservation tool to ensure that the financial benefits derived from trophy hunting go directly to local communities. In some cases trophy hunting of less threatened species has contributed to the recovery and conservation threatened and endangered species (Lindsey et al., 2007a).

Trophy Hunting of Himalayan Ibex

(Nawaz et al., 2016) report that some 261 ibex were hunted between 2000 and 2014.in Gilgit-Baltistan and are of the view that the trophy hunting programme has a positive effect on ibex and other wild ungulates in northern Pakistan., However, there are many concerns from the conservationists and

animal right groups about the available information on current ibex population sizes and the trophy hunting programme.. Thus viability of the population of the target species needs to be determined for streamlining the trophy hunting programme of GB.

1.12 Aim and Objectives of the Current Study

The current study was aimed at assessing the current status of Himalayan ibex in Gojal community conservation areas of Gilgit-Baltistan using a double observer based Capture-Mark Recapture (CMR) method with the goal of determining, if the H. ibex numbers are viable enough to support and continue the trophy hunting programme in the area.

Key parameters examined, included estimation of population size as well as ratios of females to young, females to yearling and females to males and young proportion in the population with the following set of objectives:

i. To briefly describe mountain ungulates in general and Himalayan ibex in particular;
ii. To estimate population size of Himalayan ibex in Gojal, Ghizer and Skardu community conservation areas;
iii. To identify the population structure of Himalayan ibex; and
iv. To assess, if the extant population of Himalayan ibex is viable enough for the continuation of trophy hunting programme in the study area.

2. MATERIAL AND METHOD

2.1 Location and Topography

The Survey area was located in the Gilgit-Baltistan in the Districts of Hunza (Tehsil Gojal), Ghizer and Skardu. Gilgit-Baltistan, previously known as Northern areas of Pakistan, has unique climate and topography. It lies between latitudes 34–45°N and longitudes 75–77°E and is bordered to the north by western China and northern Afghanistan (Joshi et al., 2013). The Karakorum, Hindu Kush and Himalaya ranges knot in the centre of GB and diverge in different directions. The Karakorum and Hindu Kush have north-western and southwestern orientations, respectively. The east-west oriented Himalayas occupy southern parts of GB. The Himalayas receive more abundant precipitation during the summer and winter monsoon. They are therefore greener, supporting Himalayan dry temperate mountain forest, sub-alpine and alpine forest (Champion, Seth, & Khattak, 1965). The Karakoram and the western Himalayas are the main mountain ranges; the Pamir Mountains lie to the north and the Hindu Kush to the west. Excluding the polar area, the region has three of the world's longest glaciers, the Biafo, Baltoro, and Batura glaciers, and five of the world's 14 peaks above 8,000 ml.

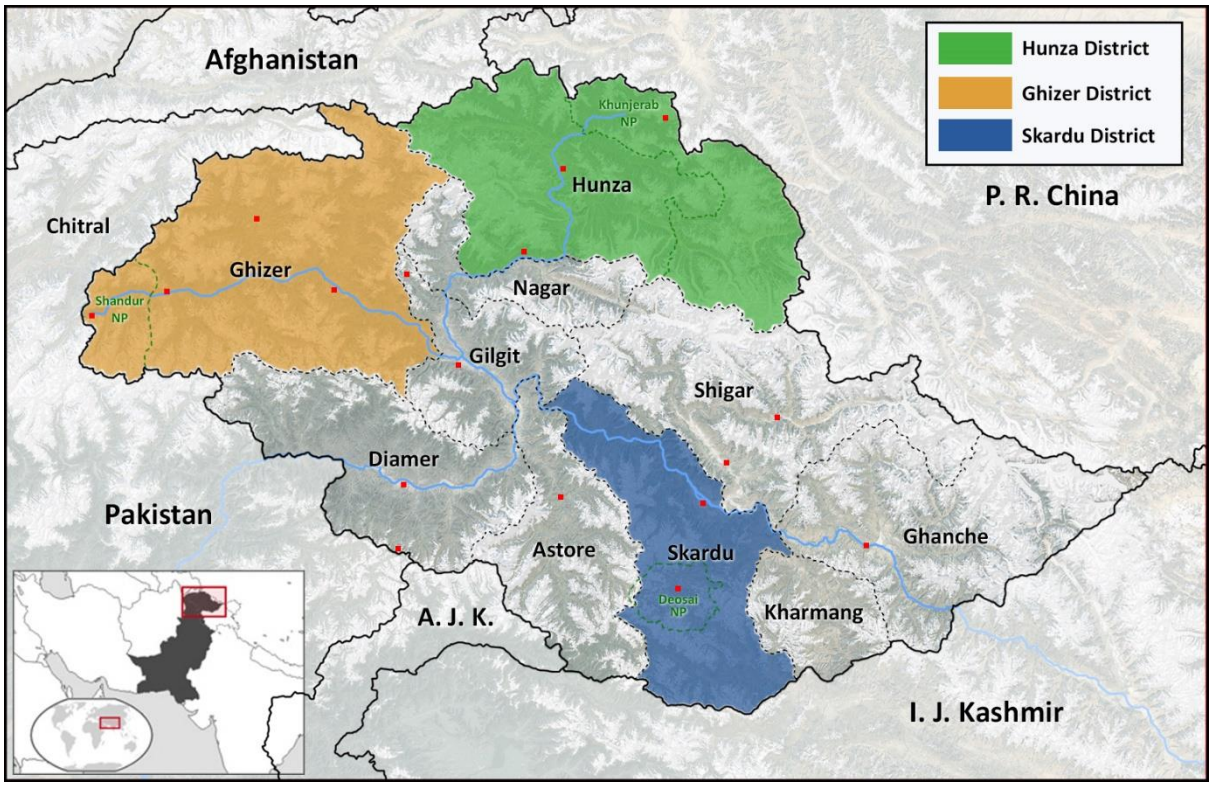

Figure 1: Location Map of Survey Areas

Yak and goats are the main animals grazing in the area. Local herders supplement their life in the lowland areas by subsistence farming and migrate their yaks seasonally between low altitude winter pastures and summer pastures in the alpine region.

The human population of Gilgit Baltistan according to 2017 census by AKRSP was 883,799 (AKRSP). The human population is surveyed districts, i.e., districts Hunza, Ghizer and Skardu were 68,589, 131,278 and 139,564 respectively.

Climate and Seasons:

The Gilgit climatic condition varies from region to region; surrounding mountains ranges creates sharp variation in weather. The eastern part has the moist zone of the western Himalayas, but going towards Karakoram and Hindu Kush the climate dries considerably.

With the high elevation (above 2,000 masl) and rugged terrain, the climate is quite harsh and characterized by a long and cold winter, high solar radiation, and low precipitation. The maximum and minimum mean daily temperatures fluctuate between +42 and -20 °C at many locations.

Gilgit is hot during the day in summer yet cold at night and valleys like Astore, Khalpu, Yasin, Hunza and Nagar where the temperature is cold even during the summer. At an altitude of 1,500 meters Gilgit has a desert climate with warm summers and cold winters. Precipitation figures are low all year round. During the winter precipitation often falls in the form of snow or hail. Overall, the climate is semi-arid in most parts of the Karakorum Range (Joshi et al., 2013).

2.2 Methodology

Double Observer Method

The double-observer survey method was initially developed for the estimation of the detection probabilities of the aerial surveys of the different wildlife species (Cook and Jacobson, 1979) and later on modified by (Magnusson et al., 1978) to allow for observer difference in the ability to detect the targeted species. Caughley (1974) is based It is based on the principles of capture mark-recapture theory (Forsyth and Hickling, 1997). This method generally involves two observers scanning for and counting animals simultaneously, while ensuring that they do not signal or cue each other about the sighting of animals groups. The two observers are conducting the survey as independent surveyors. Hence, an individual group of ungulates becomes the unit that is being “marked” and “recaptured” in

double-observer technique. (Suryawanshi et al., 2012; Tumursukh et al., 2016; Ahmad et al., 2020) used this method for estimating the Himalayan ibex and other mountain ungulates population in the mountain areas of the Asia.

The current survey was conducted in the month of January 2020 in 7 valleys of the Gojal Conservancies. The survey areas were divided into small blocks assuming the occupied area of one block is less than the daily movement of the Himalayan ibex. The survey blocks with either a temporal or spatial separation between them were scanned by the two independent observers (OB-1 and OB-2). Whereas the survey in Ghizer and Skardu Districts was carried out during winter of 2020-21 (26 Dec 2020 -14 January 2021).

For temporal separation, both observers adopted the same route along the survey block, but observer OB-2 began, scanning the block 20 min after observer OB-1. For spatial separation, both observers began trekking the block at the same time, but took different routes within the survey block as previously did by (Tumursukh et al., 2016).

As documented by (Roberts, 2005), the scans were carried out during the dawn (6:00 a.m. - 10:00 a.m.) and dusk (3:00 p.m. - 5:00 p.m.) to coincide with the crepuscular activity of the species. Ibex were observed using binoculars and spotting scopes and coordinates were taken using the GPS.

Groups of ibex were classified on the basis of age and sex, when there were more than one animal in each group. Further, habitat, time, and coordinates were used to differentiate among the groups seen in two adjacent areas. Upon sighting of an ibex herd, they were first counted and demographically classified on the basis of their horns and body size as previously documented by (Schaller, 1977) into the following categories: Young (<1year), Yearling (>1 < 2 years), and Adult Female (>2), Males: Class I (>3years), Class II (>4years), Class III (>5year), and Class IV (>6years).

At the end of the day both observers matched their data and similar groups were identified on the basis of herd size, demographic categories, habitat types and location. Groups that were deemed identical and groups that were deemed different were then classified. Any occurrences of double counts were removed from the dataset as did by (Masood, 2011).

2.3 Analytical Approach

The estimated population, detection probabilities, mean group size and variance in the group size were calculated by using formulas following (Forsyth and Hickling, 1997).

Estimated Number of Groups

$$G=(B+S1+1)(B+S2+1)/B+1-1 \quad (1)$$

Where,

S1 = number of group sighted by observer 1

S2 = number of group sighted by observer 2

B = number of animal group sighted by both observers

N = population estimated (rather than the number of individual)

Estimated Population Size

Population size estimated as the number of group in the population multiplied by the mean group size (Choquenot, 1990)

$$\check{N}=\hat{G}\hat{u} \quad (2)$$

Where,

$\check{N}$ = estimated population as the product of estimated number of group $\hat{G}$ and mean group size

The variance of estimated population, Var ($\check{N}$) is the variance of the product of independent random variables (Goodman, 1960).

Variance in Estimated Population

$$Var(\check{N})=\hat{G}^2Var(\hat{u})+\hat{u}^2var(\hat{G})-Var(\hat{G})Var(\hat{u}) \quad (3)$$

Where,

$$Var(\hat{G})=S1S2(S1+B1+1)(S2+B+1)/(B+1)2(B+2) \quad (4)$$

S1 = number of group sighted by observer 1

S2 = number of group sighted by observer 2

B = number of animal group sighted by both observers

Confidence Interval

Confidence intervals were calculated for each population estimated in each conservancy using the following formula (Forsyth and Hickling, 1997):

$$\check{N}\pm z\ \alpha/2^{se}\ (\check{N}) \quad (5)$$

Estimating Density

The density was estimated by divided total number animals by the surveyed area (Suryawanshi et al., 2012)

$$D=(\text{Total number of animals sighted})/(\text{surveyed area}) \quad (6)$$

Detection Probability

We used multinomial regression to determine the detection probability of observers with three possibilities for each herd in the study area:

i. herd sighted by observer OB-1 only,
ii. herd sighted by OB-2 only and/or
iii. Sighted by both observers (Unique sighting).

On the basis of "Walt test" (Yan and Su, 2009), the significance variable was selected for our model and according to p-value criteria removed the insignificant variables from the model.

3. RESULT

3.1 Status of Himalayan Ibex in Gojal Conservancy

During winter survey, a total of 1487 ibex were counted across all Gojal conservancy (Ainabad, Shishkat, Gulmit, Passu, Ghulkin, Hussaini, Khyber and KVO). The estimated population of Himalayan ibex using Capture-Mark and Recapture in the study area is (N=2716: Mean 19.83 ± SE 2.38, Var(Ñ)= 252448.30, Variance in mean group 2.72, Variance in estimated number of groups is 534.75, 95% Confidence is 997.45) (Table 1).

Table 1: Statistical Test Results

Statistic test	Group size	Male				Adult Female	Young	Yearling
		Class I	Class II	Class III	Class IV			
	1487	63	64	84	176	670	264	166
Mean	19.83	0.84	0.85	1.15	2.37	8.93	3.56	2.21
S.D	20.59	1.83	1.46	1.71	3.28	10.83	3.97	3.18
SE	2.37	0.21	0.16	0.20	0.38	1.25	0.46	0.36

The detection probability of reported for both observers is quite low and there isn't any significant variation in the detection probability of Oberver-1 and Observer-2. The detection probability recorded for Observer-1 is Obs=0.311 while for Observer-2 is Obs=0.318. Observer-1, sighted a total of (S1=30) groups/herds while Observor-2 sighted (S2=31) groups/herds and groups/herds sighted by both Observers are (B=14), while estimated mean group size is calculated to be (Ĝ=137). The density calculated on the basis of current survey is (D=1.55) ibex/km2 (Table 2).

Table 2: Double observer based CMR results of Himalayan ibex in entire study area

Estimates parameters	
# groups sighted by both observers	14
# groups sighted by observer one only	30
# groups sighted by observer two only	31
Estimated number of groups	137.00
Mean Group size	19.83
Estimated population	**2716**
Variance in mean group size	2.32
Variance in estimated number of Groups	534.75
Variance in estimated population	252448.30
95% Confidence interval	**997.45**
Detection probability Observer 1	0.311
Detection probability Observer 2	0.318

The total counted or observed individuals of H. ibex in the study area are (n= 1487). Out of the total counted individuals, females constitutes (45.05 %), male Class I represents (4.24%), male Class II (4.30%), male Class III (5.64%), male Class IV (11.83%), young (17.75%) and yearling represents about (11.16%) (Table 3).

Table 3: Total Counts of Himalayan ibex in Gojal Conservancy

Total count	
Overall total	1487
Observer one total	1074
Observer two total	959

Distribution of Himalayan ibex in CCHAs of Gojal Conservancy is shown in (Figure 2), which shows female population is dominated while male and young population is almost the same.

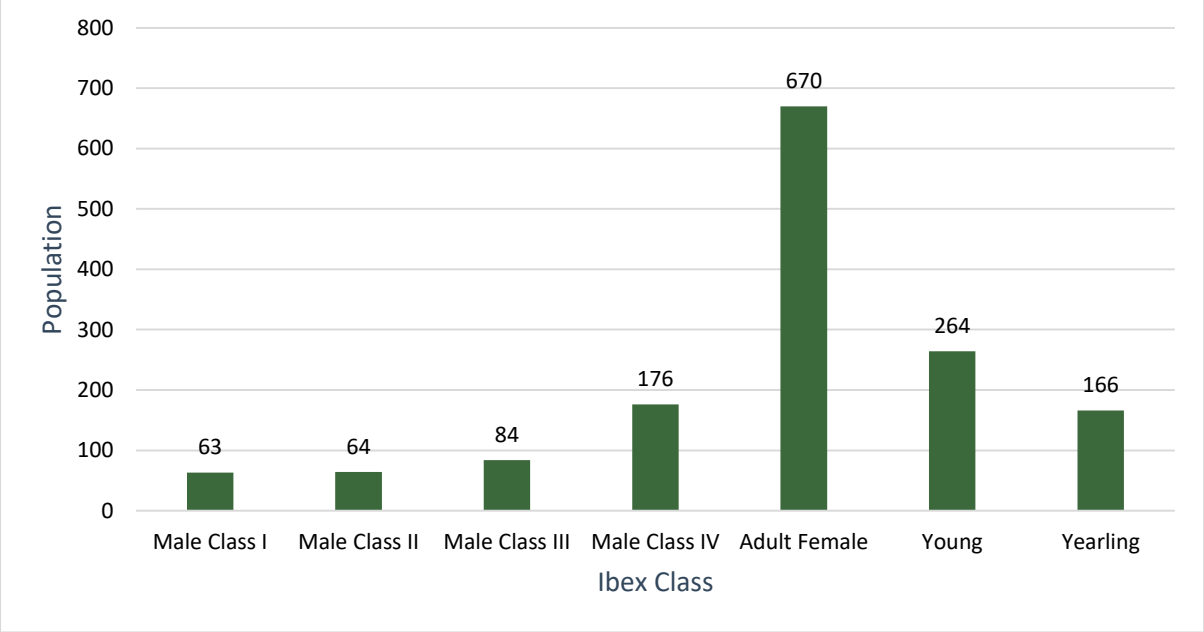

Figure 2: Class-Wise Population of Ibex in Gojal Conservancy

Table 4: Sex Ratio: Female to Male, Female to Yearling and Female to Young

Overall Ratio	Female: Male	Female: Yearling	Female: Young
Gojal CCHAs (Hussani, Shishkat, Ghulmit, Ghulkin, Khaybar Passu and KVOs consist of (Murkhun, Glapan, Jamalabad, Nazimabad, Sost, Sartiz and Gircha)	1:0.57	1: 0.24	1:0.39

Khyber Village

In Khyber, overall (n=292 animals), out of which, male individuals were 56 (19.18%), females were 135 (46.22%), young were 49 (16.8%) and Yearlings were 52 (17.80%). The mean herd size calculated for Khyber is (24.33 ± 7.85).

Passu

In Passu Valley a total of (n=198), out of which males constitutes 53 (26.77%), females were 94 (47.47%), young were 36 (18.18%) and yearlings were 15 (7.58), with the mean herd population size (12.37 ± 2.36).

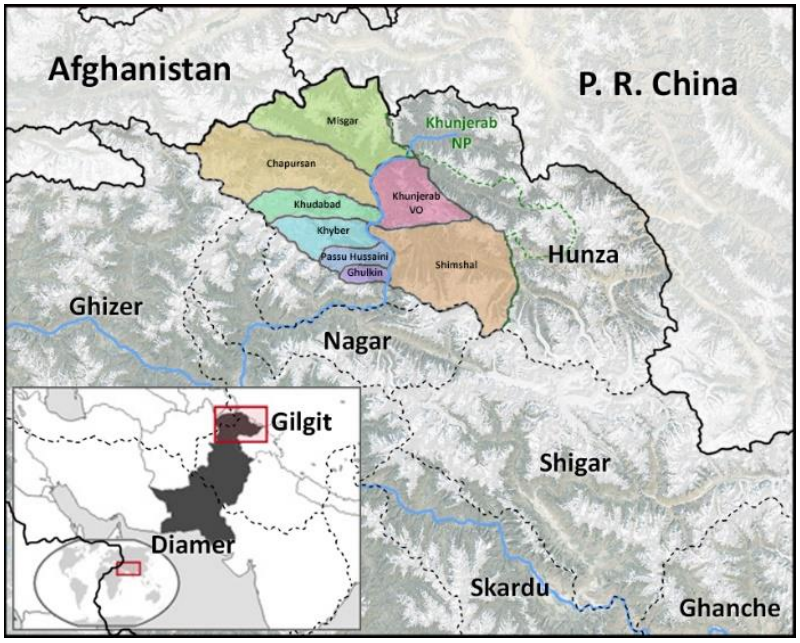

Figure 3: Map of Study Area in Gojal

Khunjerab Villagers Organisation (KVO)

In KV, a total of (n=182 animals) were sighted. Out of the total, males were 37 (20.33), females were 92 (50.55%), young were 37 (20.33), yearlings were 16 (8.79). The mean herd size is (13 ± 3.46).

Ghulkin

In Ghulkin a total of (n=275 animals) were sighted, out of which males were 105 (38.18%), females were 89 (32.36), young were 49 (17.82), yearlings were 32 (11.64). Mean herd size recorded for Ghulkin was (19.64 ± 4.56).

Ghulmit, Shishkat and Ainabad

In Ghulmit, Shishkat and Ainabad a total of (n=131 animals), out of which males were 40 (30.53%), females were 51 (38.94%), young were 19 (14.50%) and yearlings were 21 (16.03%). Mean herd size recorded in these villages is (16.37 ± 7.82).

Hussaini

In Hussaini village, a total (n=409 animals) were sighted. Out of the total counts, males were 96 (23.47%), females were 209 (51.11%), young were 72 (17.60) and yearling were 32 (7.82). Mean herd size recorded for Hussaini villages is (37.18 ± 8.15).

3.2 Status of Himalayan Ibex in Ghizer and Skardu

The survey was carried out during winter (26 Dec 2020 - 14 January 2021). A total of 269 animals including 85 males, 111 adult females, 30 yearlings and 43 Youngs were counted from different valleys during the survey in district Ghizer. In Skardu area, a total of 67 animals were sighted which include 25 males, 26 adult females and 16 yearlings. The classes and its number are illustrated in figure 5 for Ghizer and figure 6 for Skardu.

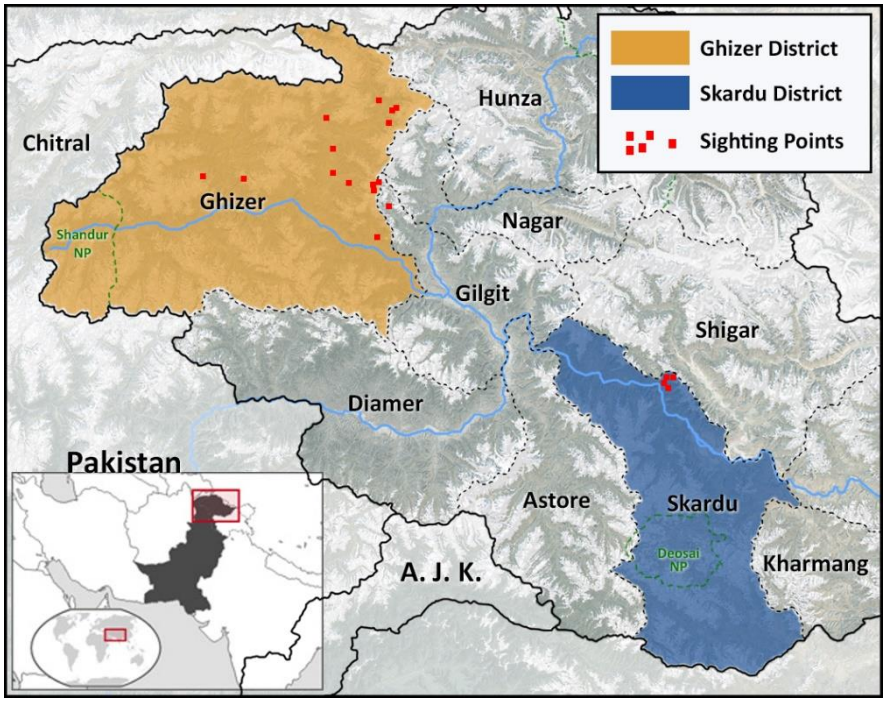

Figure 4: Map of Ibex Sighting Points in Ghizer and Skardu

Table 5: Survey Results for Ghizer District

	Group size	Male				Adult Female	Young	Yearling
		Class I	Class II	Class III	Class IV			
Count	269	18	13	19	35	111	43	30
Percentage	100.00	6.69	4.83	7.06	13.01	41.26	15.99	11.15

Table 6: Survey Results for Skardu District

	Group size	Male				Adult Female	Young	Yearling
		Class I	Class II	Class III	Class IV			
Count	67	1	3	12	9	26		16
Percentage	100.00	1.49	4.48	17.91	13.43	38.81	0.00	23.88

Figure 5: Class-Wise Population of Ibex in District Ghizer

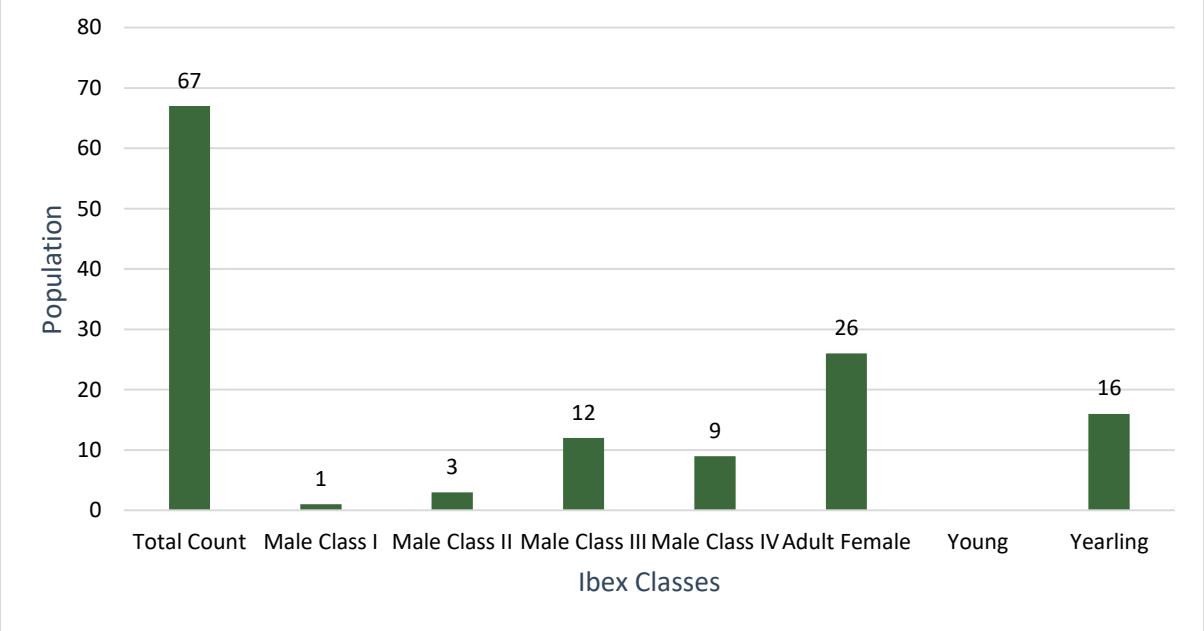

Figure 6: Class-Wise Population of Ibex in District Skardu

Population of Ibex on the basis of sex (female = 41.3 %, Young = 16 %, Male=31.6 % and Yearling were 11.2 %) in district Ghizer and for Skardu it was 37%, 39% and 24% male, female and yearling respectively.

4. DISCUSSION

Population estimation of wild ungulates is difficult because of the rough terrains they inhabit in the high altitude mountainous environments, which require a considerable logistical and financial constraint (Singh and Milner-Gulland, 2011). Hence, a robust monitoring which requires a low costs like a double observer based Capture Mark Recapture technique developed by (Suryawanshi et al., 2012). CMR one of is an appropriate method to meet the challenges in monitoring species in rugged mountains like that of Gilgit-Baltistan, and has been successfully used in the Himalayas in the Indian side by (Suryawanshi et al., 2012), in Mongolia by (Tumursukh et al., 2016). Therefore, during current study, we deployed this statistically robust and recently developed method in Gojal area of Gilgit-Baltistan, Pakistan. Himalayan ibex is the most abundant wild ungulate species (Hess, 1990) in the mountains of Asia including Pakistan.

The current efforts for documenting population of Himalayan ibex in Gojal area indicates that the Hussaini valley has the highest number of individuals (n=409 individuals) followed by (n= 292 individuals) in Khyber, (n=275 ibex) in Ghulkin, (n=192 Individuals) in Passu, (n=182 individuals) in KVO and (n=131 individuals) in Ghulmit, Shishkat and Ainabad respectively.

The detection probability of both the observers recorded in the study area is quite low (Obs1=0.311 & Obs2=0.318) possibly due to the ruggedness of the study area. The detection probability in the previous studies conducted by (Ahmed et al., 2020 & Khan et al., 2020) was quite high with detection probabilities for Obs1 in KNP, Gojal watershed, Socterabad conservancies were recorded to be 0.944, 0.538 and 0.333 respectively and for Obs2 the detection probabilities were 0.607, 0.12, and 0.038 respectively. Lower detection probability for Obs2 versus Obs1 was noted by (Tumursukh et al., 2016) for Mongolia due to behavior of ibex, as the species is sensitive to human presence (Suryawanshi et al., 2012). The estimated population of the current study (N=2716), which is relatively high as compared to (N=2020 individuals) recorded by (Ahmed et al., 2020) in the same study area.

The density (D=1.55 ibex/km2) of ibex estimated in the current study is quite similar to that calculated for Gojal (D=1.4 ibex/km^2) by (Ahmed et al., 2020). While the density recorded by. Khan (2012) was quite low (D= 0.4–0.7 ibex/km2) in Khunjerab and in Central Karakoram National Park (CKNP). The sex ratios of Ibex recorded in the current study, i.e., Female to Male (1: 0.57), Female- Yearling (1: 0.24) and Female - Young (1: 0.39) is slightly different to that observed by Zafar et al. (2014) in CKNP area where the ratio of female to male was 1:1, female to yearling 1:0.52, and female to young 1:0.7 in 2011 and in 2012 the ratios were recorded as 1:0.87, 1:0.58, and 1:0.77, while in 2013 they recorded ratios of 1:1.3, 1:0.47, and 1:0.84 respectively.

These slight differences in the sex ratio between different studies in similar and different area may be due to factors such as food quality and availability, climatic conditions, habitat and human interference. The mean herd size during the current study (19.83 ± 2.37 (range1-93) is quite similar to that recorded (19.3 ± 3 (range3– 88) by (Ahmed et al., 2020) in Gojal watershed. The findings of our current study are somewhat resembled in all aspects of the study.

The findings of the current study shows that the population of Himalayan ibex is stable in Gojal conservancy and the trophy hunting programme can be continued with regular monitoring of the species and implementation of the guidelines developed by IUCN Pakistan in collaboration with Parks and Wildlife Circle to streamline the "Trophy Hunting Programme of Gilgit-Baltistan".. On the basis of current study findings, we suggest 25 hunts in the area (Ainabad, Shishkat, Gulmit, Passu, Ghulkin, Hussaini, Khyber and KVO) in which we have considered the sustainability of the ibex population, which means the suggested quota constitutes, less than 2 % of the total population or 25% of the trophy animals and male to female ratio is also higher than the minimum ratio required to ensure sustainability of the species, i.e., male to female ration should be 1:6 at minimum. As per our records, 2 % of the total population becomes 29.74≡30 trophy animals, while 25% of the total trophy animals become 22 trophy animals and male to female ratio is 1:4, which can be considered as a viable ratio thus supports our recommendations.

A total of 35 catchments and sub catchment were surveyed for Himalayan Ibex in two districts of Gilgit Baltistan, i.e., District Ghizer and District Skardu. A total of 336 animals were sighted from 35 points at different location. A maximum Ibex were sighted in Qurambar area with a number of 25 individuals from one sighting point followed by Broth and Immit area with a maximum number of 20 and 17 Ibex respectively in district Ghizer.

Their distribution was confined in this range during winter season due to acute shortage of food as a result of snow accumulation in their habitat, hence compelled to move from the upper areas to nearby human settlements. The statement also supports findings of (Fedosenko & Blank, 2001) that ibex shifts to lower elevations up to 2000 m during winter season in mountainous regions and prefer to move in less snow covered areas into a larger group (Grignolio, Rossi, Bassano, Parrini, & Apollonio, 2004). The extent of occurrence of ibex population in winter season was more prominent at mid altitude (3400-3600 masl) due to availability of food and less interference of human beings. In the distribution of ibex, depth of snow cover is an important factor and sometimes it is the only reason of their absence in some surrounding areas and mountains. The movement of ibex have strong influence by snow cover in alpine areas (Grignolio et al., 2004; Raza et al., 2015). The trophy ibex was more confined to the higher altitude (>3600 m) as compared to other age groups of the population. This might be due to their adaptability having larger body size to access food by digging with their hooves and horns than that of smaller ibex even in heavy snow by foraging up to 30-40 cm depth of snow (Raza et al., 2015).

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LAMBING & RUT SEASON
SURVEY REPORT 2020-21

ASTORE MARKHOR & LADAKH URIAL

IN GILGIT-BALTISTAN, PAKISTAN

LAMBING & RUT SEASON SURVEY REPORT 2020-21

Astore Markhor (*Capra falconeri*) & Ladakh Urial (*Ovis vignei*)

IN GILGIT-BALTISTAN, PAKISTAN

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Table of Contents

List of Tables

List of Figures

1. INTRODUCTION

Astore markhor (*Capra falconeri falconeri*) belongs to the sub-family Caprinae of the Bovidae family (Schaller, 1977; Roberts, 1977). The word "Markhor" apparently derived from Persian language meaning "snake eater". However, it is mostly considered that it is derived from Pashto language word "Mar Akhkar" in which "Mar" means snake and "Akhkar" means horn. The markhor has horns twisting like a snake; therefore it got its name as "Mar Akhkar". With the passage of time, it changed to markhor (Roberts, 1977).

There are four sub-species of markhor reported to occur in Pakistan; Astor markhor (*Capra falconeri falconeri*), Kashmir or Pir Panjal markhor (*Capra falconeri cashmiriensis*), Kabul markhor (*Capra falconeri megaceros*), Suleiman markhor (*Capra falconeri jerdoni*) (Roberts, 1997). Hunting pressure and habitat loss has pushed this species to live in patchy populations, (Shackleton, 1997), consequently this species is placed on Appendix I of CITES, listed as Near Threatened globally (IUCN, 2015) and "Endangered" in Pakistan (Sheikh & Molur, 2004).

Markhor usually avoids deep snow and are adapted to regions of low rainfall. They are well tailored to steep slopes of moderately low altitudes as compared to other wild goats ranging from 700 meters to 1000 meters arid hot hills in southern part to maximum 4000 meters in Himalayas of Pakistan in scrubs with birch and juniper (Schaller, 1977; Roberts, 1997).

1.1 Distribution of Markhor

The majority of the total world population of markhor is found in Pakistan and is estimated to comprised of about 3,200–3,700 animals, with numbers generally decreasing (Shackleton, 1997; Weinberg et al., 1997). However, certain conservation measures, such as community-based conservation have been implemented in recent years and that appeared to have a positive effect on at least some markhor populations (Virk, 2000)

In Pakistan, two sub species are distinctly recognized i.e., flared horned markhor *Capra falconeri falconeri* and straight horned markhor *Capara falconeri megaceros* (Schaller and Khan, 1975; Hess et al., 1997).

In Pakistan, the Markhor is completely protected by federal law (Rao 1986). In 1991, the federal government imposed 3-year ban on all big game hunting. This ban officially lapsed in 1993 but practically remained in effect, although it was reviewed in the case of community-based trophy hunting programs (Shackleton, 2001).

Astor markhor, recognized as the flare-horned Markhor, is confined to upper catchments of Indus River and its tributaries in Gilgit-Baltistan (GB) (Hess et al., 1997). Like other subspecies of Caprinae, Astor markhor is still threatened for its genetic isolation, specialized habitat requirements, low reproductivity, habitat fragmentation, food competition and excessive hunting (Shackleton, 1997).

1.2 Distribution of Ladakh Urial

Ladakh urial (*Ovis vignei vignei*) belongs to Bovidae Family, Kingdom: Amimalia, Genus: Ovis and Species: Vignei. It is a wild species of sheep native to the Central Asia and Middle East. It is listed as Vulnerable on the IUCN Red List. Urial is lives on montane areas in the Pamir Mountains, Hindu Kush and Himalayas up to an elevation of 4,500 m (14,800 ft), it is distributed from northeastern Iran, Afghanistan, Turkmenistan, Tajikistan, Uzbekistan and southwestern Kazakhstan to northern Pakistan and Ladakh in northwestern India. It prefers grassland, open woodland and gentle slopes, but also inhabits cold arid zones with little vegetation Michel, S. & Ghoddousi, A. (2020).

The current and past distribution of Ladakh urial in Gilgit Baltistan is shown below figure 1.

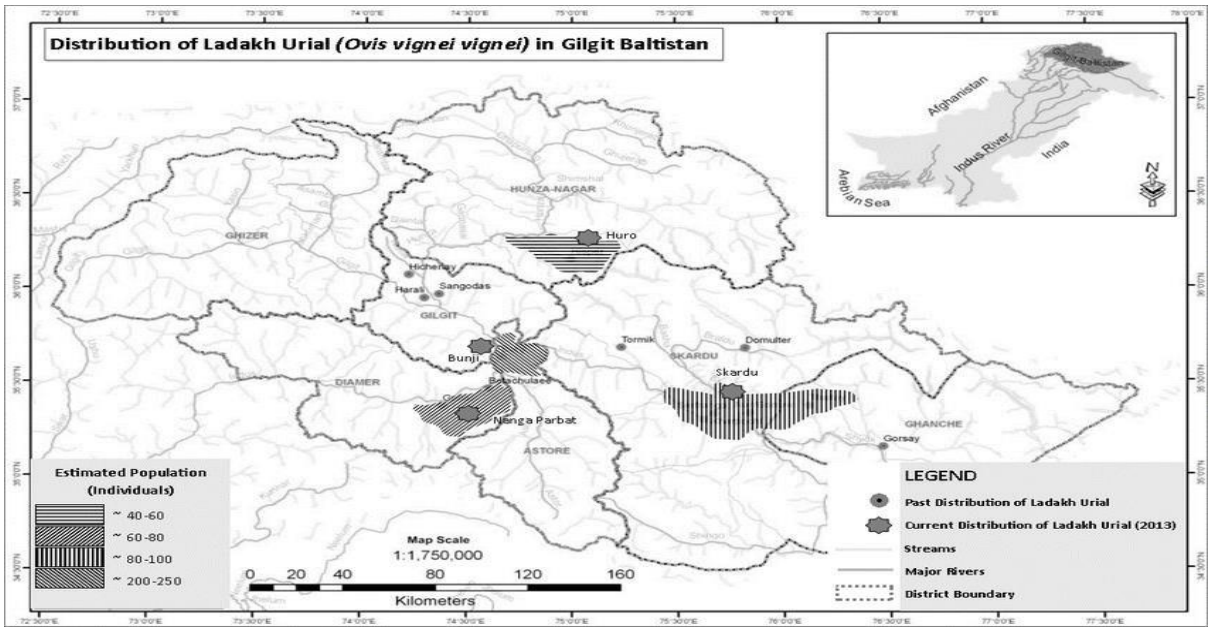

Figure 1: Distribution of Ladakh Urial in the Study Area

1.3 Threats to Ungulates

Shackleton (1997) pointed out that most Caprinae species face threats of extinction due to genetic isolation, specialized habitat requirements, and low reproductive rates besides anthropogenic cuases. The CITES placed a ban on all forms of export of a species which are endangered.

Mountain ungulates around the world have been threatened by illegal hunting, habitat modification, increased livestock grazing, disease and development (Kulbhushansingh et al., 2012). Frisina et al., (2002) stated that various diseases are transmitted to markhor through domestic goats and sheep.

The Khyber Pakhtunkhwa Wildlife Department reported that thirty to fifty individuals of markhor were died of the 19 disease transmitted from livestock that was brought from Afghanistan (Malik, 2002b; Shackleton, 2001; Anonymous, 2000). However, when threats such as excessive poaching and/or habitat loss contribute to a decline in the population of the species within a country, the CITES ban on export becomes less effective for the conservation of the species (Caughley et al., 1990).

Hess et al. (1997) noticed that Pakistan is a unique country in the world which has rich diversity of Caprinae and is famous for conservation of wild sheep and goats. Out of the twelve sub species of wild goats and sheep, only markhor is a coveted trophy for game hunters.

Population of markhor outside the protected areas, especially community managed conservation areas (CMCA) are still negatively influenced by poaching, habitat degradation, slow reproductively and genetic isolation (Hess et al., 1997; Schakleton, 1997).

1.4 Rutting Season and Reproduction

Markhor are social animal and live in small herds. The herds consist of females, their kids, yearlings and young males. Mature males live alone outside the herds and only join the herds during the winter rut season in late December (Roberts, 1977). Markhor are diurnal crepuscular animals but they can be seen feeding irregularly during winter throughout the day (Roberts, 1977).

It can seldom be seen climbing into oak trees for eating of its leaves, especially during winter, when the ground is either covered with snow or herbaceous flora is dried due to severe cold (Schaller, 1977). Food preferences are dependent on season and its availability (Aleem, 1976).

The females in straight-horned markhor reproduce at about three years (Roberts, 1977), while for the female of flare-horned markhor, it is two years (Aleem and Malik, 1977). December is the rut season, and it continues for one month. According to Roberts (1977) gestation period is approximately six months. .

In Gilgit-Baltistan the young are born at the end of May to early June, which indicates a gestation period of about 160 days. Similarly, in Baluchistan the young are born in early April. Other authors have reported varying gestation period as from 147 to 180 days (H. Vass, 1961; Walker et al,. 1964).

1.5 Trophy Hunting as a Tool for Conservation

According to Shackleton (2001) trophy hunting has a significant role in conservation as compared to other uses of wildlife. Likewise, trophy hunting can be used as a tool for the conservation of endangered species even when excessive exploitation might be the original cause of the conservation problem. For a hunting Programme to be sustainable, population of the species must be monitored, managed and conserved on sound basis.

Sustainable use of natural resources through community involvement is acceptable if the overall management process is economically and socially attractive to local people as a long-term livelihood strategy (Ahmad and Sattar, 2001). Due to its economic value, sustainable management of wildlife can be used as a development tool for rural communities (Lamarque, 1995).

Trophy hunting is a significant wildlife management strategy in many countries of Asia, Africa, and Europe (Lechuga, 2001) that has resulted in a positive change in attitudes of local people towards wildlife, the active involvement of communities in natural resource projects, and the achievement of conservation goals (Lewis and Alpert 1997, Baker 1997a).

Shackleton (2001) investigated that trophy hunting is advocated by the conservationists on the basis of assumption that trophy animals are mostly older males which spent maximum of their life-span, , which seems rationally wrong.

Trophy males are always in their major reproduction years. It is sometimes difficult to find older males in ungulates populations because once a male reaches the end of his active life, its health condition weakens quickly and the individual gave up to natural predators or starvation or could not stand severe weather conditions.

Trophy hunting discourages poaching and, if funds generated from trophy hunting were used for the activities related to conservation, the impact of well managed trophy hunting programme could be positive (Shackeleton, 2001; Harris et al., 2002). In the study area, trophy hunting of four adult male Markhors is being carried out annually and 80% share of the revenue from a trophy hunting license goes to the local communities for their socio-economic wellbeing (Shackleton, 2001).

1.6 Survey Objectives

The basic objective of survey is to assess the distribution and population status of Astore Markhor, to allocate Trophy Hunting Quota in Gilgit Baltistan based on these scientific surveys.

2. MATERIAL AND METHOD

2.1 Study Area

Gilgit-Baltistan, lies between 34° to 37° N and 72° to 75° E, with about land area of 72,971 km²) consists of towering snow-covered mountains, deep gorges and narrow valleys. The fast running streams ultimately drain into the River Indus (Figure 1). The Karakorum, Hindu Kush and Himalaya ranges knot in the center of GB and diverge in different directions. The Karakorum and Hindu Kush have northwestern and southwestern orientations, respectively. The east-west oriented Himalayas occupy southern parts of GB. The Himalayas receive more liberal precipitation during the summer and winter monsoon (mean annual precipitation = 180 cm). They are therefore greener, supporting Himalayan dry temperate mountain forest, sub-alpine and alpine forest (Champion et al., 1965). Northern parts (Karakorum and Hindu Kush) have scanty summer rains, thinner vegetation and greater wind and water erosion. Climatically, GB falls in temperate zone. Winter temperatures remain below freezing for most of the year. The human population (0.7 million) is concentrated in major towns along streams. Small human settlements, groups of family houses and nomadic camps are scattered throughout GB (Abbas et al., 2015).

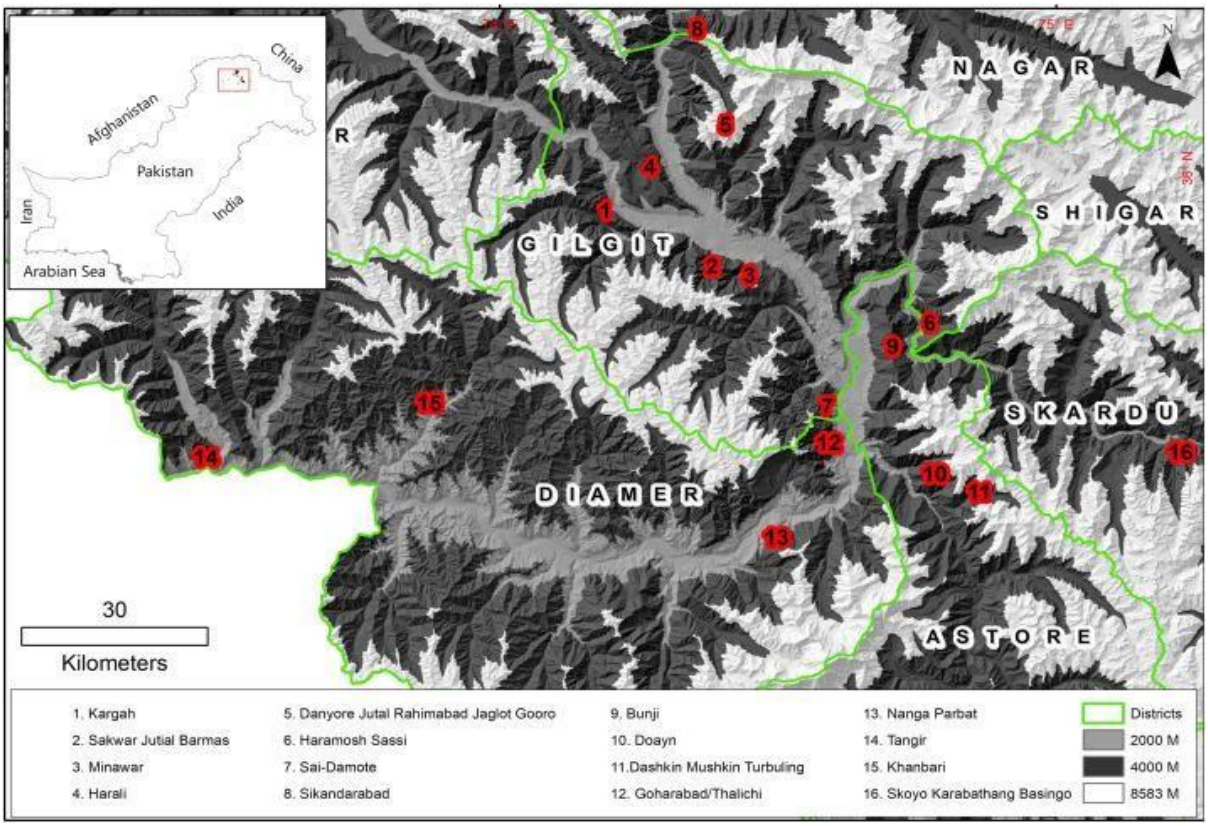

Figure 2: Study Area Map (Haider et al., 2021)

Historically markhor are distributed in many areas of Gilgit Baltistan including Astore, Gilgit, Ghizer, Skardu Diamer and Nagar (Figure 2). This survey were conducted in four Districts of Gilgit Baltistan, namely; Astore, Gilgit, Diamer and Nagar).

2.2 Methodology

Double Observer Method

The double-observer survey method was initially developed for the estimation of the detection probabilities of the aerial surveys of the different wildlife species (Cook and Jacobson, 1979) and later on modified by (Magnusson et al., 1978) to allow for observer difference in the ability to detect the targeted species. Caughley (1974) iIt is based on the principles of capture mark-recapture theory (Forsyth and Hickling, 1997). This method generally involves two observers scanning for and counting animals simultaneously, while ensuring that they do not signal or cue each other about the sighting of animals groups. The two observers are conducting the survey as independent surveyors. Hence, an individual group of ungulates becomes the unit that is being “marked” and “recaptured” in double-observer technique. (Suryawanshi et al., 2012; Tumursukh et al., 2016; Ahmad et al., 2020; Ali et al., 2019; Khattak et al., 2019) used this method for estimating the Astore Markhor and other mountain ungulates population in the mountain areas of the Asia.

For temporal separation, both observers adopted the same route along the survey block, but observer OB-2 began, scanning the block 20 min after observer OB-1. For spatial separation, both observers began trekking the block at the same time, but took different routes within the survey block as previously did by (Tumursukh et al., 2016).

As documented by (Roberts, 1997), the scans were carried out during the dawn (6:00 a.m. - 10:00 a.m.) and dusk (3:00 p.m. - 5:00 p.m.) to coincide with the crepuscular activity of the species. Markhor and urial were observed using binoculars and spotting scopes and coordinates were taken using the GPS.

Groups of Markhors and Urials were classified on the basis of age and sex, when there were more than one animal in each group. Further, habitat, time, and coordinates were used to differentiate among the groups seen in two adjacent areas. Upon sighting of an Markhor and urial herd, they were first counted and demographically classified on the basis of their horns and body size as previously documented by (Schaller, 1977) into the following categories: Young (<1year), Yearling (>1 < 2 years), and Adult Female (>2), Males: Class I (>3years), Class II (>4years), Class III (>5year), and Class IV (>6years).

At the end of the day both observers matched their data and similar groups were identified on the basis of herd size, demographic categories, habitat types and location. Groups that were deemed identical and groups that were deemed different were then classified. Any occurrences of double counts were removed from the dataset as did by (Masood, 2011).

2.3 Analytical Approach

The estimated population, detection probabilities, mean group size and variance in the group size were calculated by using formulas following (Forsyth and Hickling, 1997).

Estimated Number of Groups

$$G=(B+S1+1)(B+S2+1)/B+1-1 \quad (1)$$

Where,

S1 = number of group sighted by observer 1

S2 = number of group sighted by observer 2

B = number of animal group sighted by both observers

N = population estimated (rather than the number of individual)

Estimated Population Size

Population size estimated as the number of group in the population multiplied by the mean group size (Choquenot, 1990)

$$\check{N}=\hat{G}\hat{u} \quad (2)$$

Where,

$\check{N}$ = estimated population as the product of estimated number of group $\hat{G}$ and mean group size

The variance of estimated population, Var ($\check{N}$) is the variance of the product of independent random variables (Goodman, 1960).

Variance in Estimated Population

$$Var(\check{N})=\hat{G}^2Var(\hat{u})+\hat{u}^2var(\hat{G})-Var(\hat{G})Var(\hat{u}) \quad (3)$$

Where,

$$Var(\hat{G})=S1S2(S1+B1+1)(S2+B+1)/(B+1)2(B+2) \quad (4)$$

S1 = number of group sighted by observer 1

S2 = number of group sighted by observer 2

B = number of animal group sighted by both observers

Confidence Interval

Confidence intervals were calculated for each population estimated in each conservancy using the following formula (Forsyth and Hickling, 1997):

$$\check{N}\pm z\ \alpha/2^{se}\ (\check{N}) \quad (5)$$

Estimating Density

The density was estimated by divided total number animals by the surveyed area (Suryawanshi et al., 2012)

D=(Total number of animals sighted)/(surveyed area) (6)

Detection Probability

We used multinomial regression to determine the detection probability of observers with three possibilities for each herd in the study area:

i. herd sighted by observer OB-1 only,
ii. herd sighted by OB-2 only and/or
iii. Sighted by both observers (Unique sighting).

On the basis of "Walt test" (Yan and Su, 2009), the significance variable was selected for our model and according to p-value criteria removed the insignificant variables from the model.

3. RESULT

3.1 Astore Markhor Population Status during Lambing

The survey was carried out during summer (August-September 2020). There were total 312 markhor individuals observed in Eleven Conservancies, while the estimated population was 308 ; in Jutilal-Sakwar conservancy 88 individuals were sighted, Kargah 58, Danyor-Jaglot guru 26, DMT 25, Skandarabad 25, Bunji 20, Talichi- Hudur 15, Tangir 19, Sai Jaglot 18 Doyan 9 and in Sassi-Haramosh conservancy only 5 individuals were observed. In eleven conservancies the overall mean Group size was (6.55 ± 0.57). The standard deviation value was 3.92. Population of Markhor on the basis of sex (female=44 %, kids=41%, Male=8% and Yearling were 7%) while the sex ratios were (Female-Kids= 1:0.94, Female- male= 1:0.19 and Female-Yearling = 1:0.15 respectively. Total population and Classes are shown in below (figure 3).

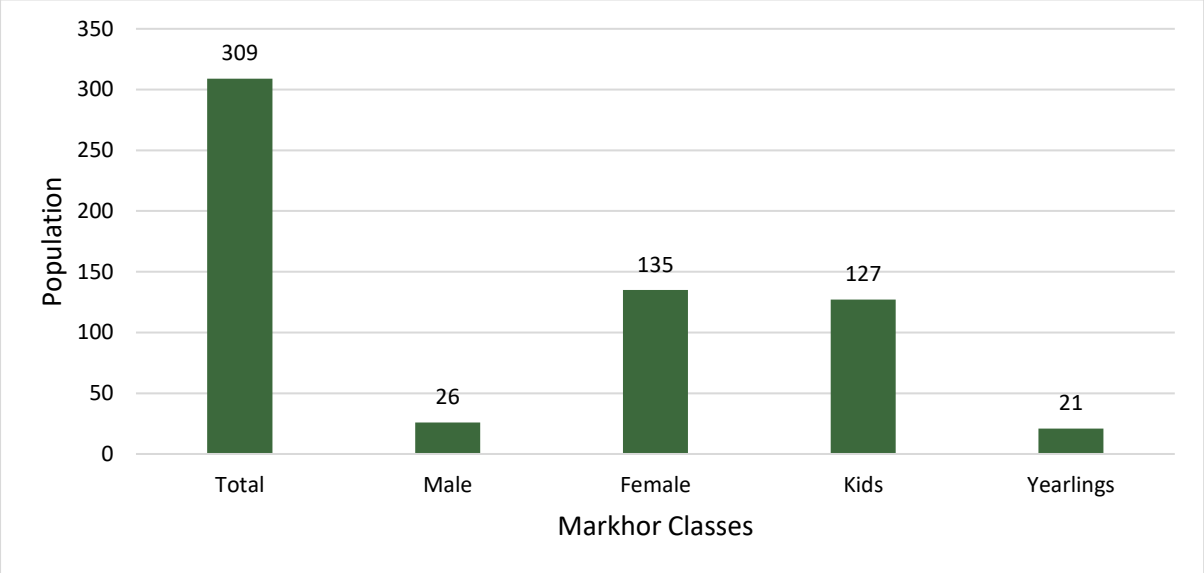

Figure 3: The Overall Population in Eleven Conservancy's of Gilgit-Baltistan

Population status in Jutial-Sakwar Conservancy

The Jutial-Sakar conservancy provided good habitat for Markhor. There were observed 88 total markhor. The mean value was (6.77±1.23) and their range between (2 to 16). The population was composed of Female=47%, Kids=35%, Male=10% and Yearling were 8% respectively. In Jutial Nallah team observed total 48 individual, Minawar 22, Barmass 11 and minimum individuals were observed in Sakwar Nallah which consist of only 7, individuals. The ration among different class were (Female-Male 1: 0.22; Female Kids 1:0.7, Female-Yearling 1:0.17).

Table 1: The Population of Markhor in Jutial-Sakwar Conservancy

	Group size	Male	Female	Kids	Yearlings
Sub Total	88	9	41	31	7
S.D	4.44				
S.E	1.23				
Mean	6.77				
Percentage	100	10	47	35	8

Population status in Kargah Conservancy

In Kargah conservancy 58 Markhor individuals were observed. The herd size range from 3 to 17 individuals, with mean group size of (8.29± 2.02). The standard deviation was 5.35. Shanigah area provide well habitat in summer where 40 individuals recorded, while in Hanzal Haltar therewere 18 Markhor individual recorded. The distribution among different age and classes were Kids = 45%, Female = 41%, Male = 9% and yearling = 5 %. While ratio among classes were Female to Male = 1: 0.20, Female to Kids = 1:1.08 and Female to Yearling were = 1: 0.12).

Table 2: The Population of Markhor in Kargah Conservancy

	Group size	Male	Female	Kids	Yearlings
Sub Total	58	5	24	26	3
S.D	5.35				
S.E	2.02				
Mean	8.29				
Percentage	100	9	41	45	5

Population status in Danyore to Jaglote Guro Conservancy

In Danyor Jutal Rahimabad and Jaglote Guro Conservancy there were total 26 Markhor individual. The groups mean size was (5.2 ±0.37), the herd size range from 4 to 6. The standard deviation was 0.84. The recorded individual in different location of the conservancy were Jutal 11 markhor sighted, Danyore = 6, Rahimabad = 5 and the minimum individual sighted in Jaglote guru which consist of 4 individual. The distribution of age classes in the conservancy were following; Kids= 46%, Female = 38% Yearling = 12 % and Male individual were 4 %. The ratio among age group was (Female to Male 1: 0.1, Female to Kids 1: 1.2, Female to Yearling 1: 0.3). Kids ratio was high which indicate that the females in the area are giving birth to more kids, that could resulted in to population increased in future if conservation practices will be adopted in the Conservancy.

Table 3: Total population of Markhor in Danyore to Jaglote guru Conservancy

	Group size	Male	Female	Kids	Yearlings
Sub Total	26	1	10	12	3
S.D	0.84				
S.E	0.37				
Mean	5.2				
Percentage	100	4	38	46	12

Population status in Sassi-Haramosh Conservancy

In Sassi-Haramosh conservancy there were only 5 markhor individuals observed, consist of 2 Female and 3 kids, which shows alarming indication. The distribution among classes was female 40% and Kids 60% respectively. The local people said due to road construction activates the population of markhor move toward higher elevations.

Table 4: The population of Markhor in Sassi-Haramosh Conservancy

	Group size	Male	Female	Kids	Yearlings
Sub Total	5		2	3	
Mean	5				
Percentage	100		40	60	

Population status in Doyan Conservancy District Astore

In Doyan conservancy there were only 9 individuals observed, consist of 3 Female and 6 kids, the mean group value was (3±0). The distribution among classes was female 33% and Kids 67% respectively. The ratio among Female to Kids was (1:2).

Table 5: The population of Markhor in Doyan Conservancy District Astore

	Group size	Male	Female	Kids	Yearlings
Sub Total	9		3	6	
S.D	0				
S.E	0				
Mean	3				
Percentage	100		33	67	

Population status in DMT Conservancy District Astore

In DMT conservancy there were 25 markhor observed, consist of Female 13 and kids 10, Yearling 1 and Male 1, the mean group size was (5±1.18) The value of standard deviation was 2.65 and the range was 2 to 9. The distribution among classes was (female 52%, Kids 40%, Male 4 % and Yearling 4 %) respectively.. The ratio among Classes was (female to Kids 1:0.76, Female to Male 1: 0.3 and Female to Yearling 1: 0.3).

Table 6: The population of Markhor in DMT Conservancy

	Group size	Male	Female	Kids	Yearlings
Sub Total	25	1	13	10	1
S.D	2.65				
S.E	1.18				
Mean	5				
Percentage	100	4	52	40	4

Population status in Thalichi, Darang and Hudur Conservancy District Diamer

In Thalichi 4 markhor individuals were observed, in Darang Batchulai 4 markhor and in Hudur only 7 Markhors observed. In this conservancy there were 15 Markhor sighted, consist of 06 Female and 02 number of kids and 07 Yearling only. The mean herd size was (5±1.0). The value of standard deviation was 1.73 and the range group was 4 to 7. The distribution among classes were (female 40%, Kids 13%,

and Yearling 47 %) respectively. The sex ratios among Classes were (female to Kids 1:0.3, and Female to Yearling 1: 1.2).

Table 7: The Population of Markhor in Thalichi to Hudur Conservancy District Diamer

	Group size	Male	Female	Kids	Yearlings
Sub Total	15	0	6	2	7
S.D	1.73				
S.E	1.00				
Mean	5.00				
Percentage	100	0	40	13	47

Population status in Tangir Conservancy District Diamer

In Tangir conservancy there were only 19 Markhor sighted, consisting of Female 7, Male 2, and kids 11. The mean group value was (9.5± 2.5), The value of standard deviation was 3.54 and the range group was 7 to 12. The distribution among classes was (female 37%, Kids 58%, and Male 11 %) respectively. The sex ratio among Classes were (female to Kids 1:1.5, and Female to male 1: 0.28).

Table 8: The Population of Markhor in Tangir Conservancy Distirct Diamer

	Group size	Male	Female	Kids	Yearlings
Sub Total	19	2	7	11	0
S.D	3.54				
S.E	2.5				
Mean	9.5				
Percentage	100	11	37	58	0

Population status in Sai-Jaglote Conservancy

In Sai Jaglote conservancy 18 Markhors were sighted, consisting of Female 9, Male 1, and kids 8. The mean group value was (6 ± 2.65). The value of standard deviation was 4.58 and the range group was 2 to 11. The distribution among classes was (female 50%, Kids 44%, and Male 6 %) respectively. The ratio among Classes was (female to Kids 1:0.8, and Female to male 1: 0.1).

Table 9: The Population of Markhor in Sai-Jaglote Conservancy

	Group size	Male	Female	Kids	Yearlings
Sub Total	18	1	9	8	0
S.D	4.58				
S.E	2.65				
Mean	6				
Percentage	100	6	50	44	0

Population status in Skandarabad Conservancy District Nagar

In Skandarabad conservancy there were 25 Markhor sighted, consist of Female 12, Male 7, and kids 6. The mean group value was (12.5 ± 0.5). The value of standard deviation was 0.71 and the range group was 12 to 13. The distribution among classes was (female 48%, Kids 24%, and Male 28%) respectively. The ratio among Classes was (female to Kids 1:0.5, and Female to male 1: 0.6).

Table 10: The population of Markhor in Skandarabad Conservancy District Nagar

	Group size	Male	Female	Kids	Yearlings
	13	3	7	3	
	12	4	5	3	
Sub Total	25	7	12	6	0
S.D	0.71				
S.E	0.5				
Mean	12.5				
Percentage	100	28	48	24	0

3.2 Astore Markhor Status during Rut Season

The survey was carried out during rut season 2020-21. The overall population of Markhor in the study area was 933 individuals. The mean group size was (±11.24) recorded, the variance in estimated number of groups were 0.007, variance in estimated population were 3534.60, while 95% Confidence interval was 121.01 recorded. Bunji conservancy has high potential habitat for Markhor, 278 individuals of markhor were recorded; the overall populations of Markhor in different areas of Gilgit Baltistan is shown in below figure 4.

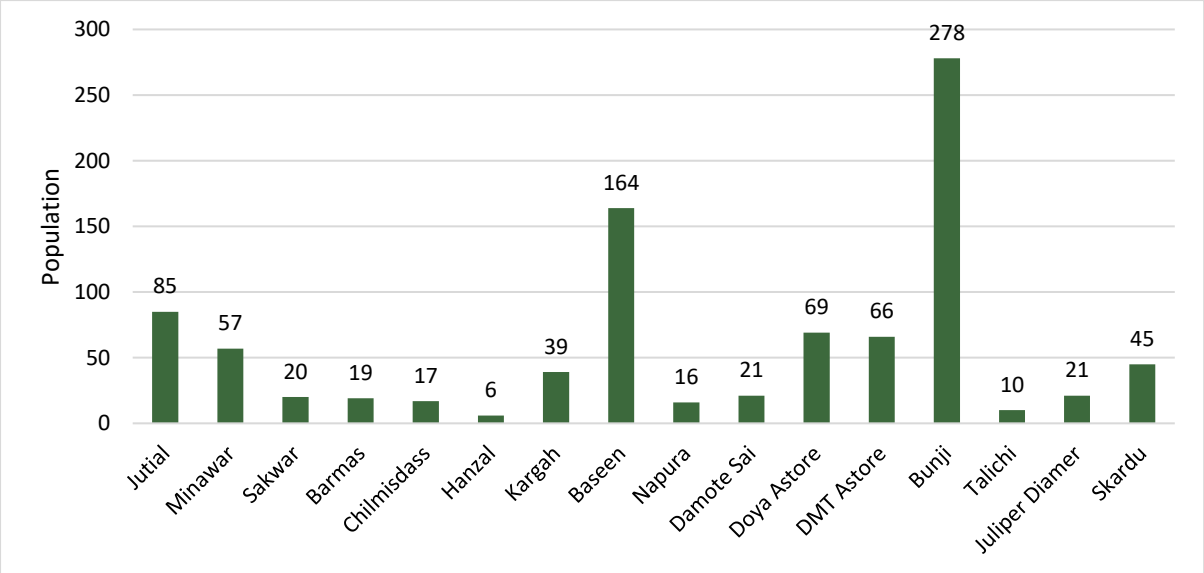

Figure 4: Overall Population of Markhor in Gilgit Baltistan

During Rut season survey we observed 31 Trophy size animals in the different areas of Gilgit Baltistan the results were shown in below figure no 5.

Total 83 groups/herds were sighted in study area, Majority of Herds were sighted in the Bunji, Jutial-Sakwar, Kargah, Doyan, DMT and SKB Conservancy Skardu. The herds/groups results were shown in below (figure no 6.)

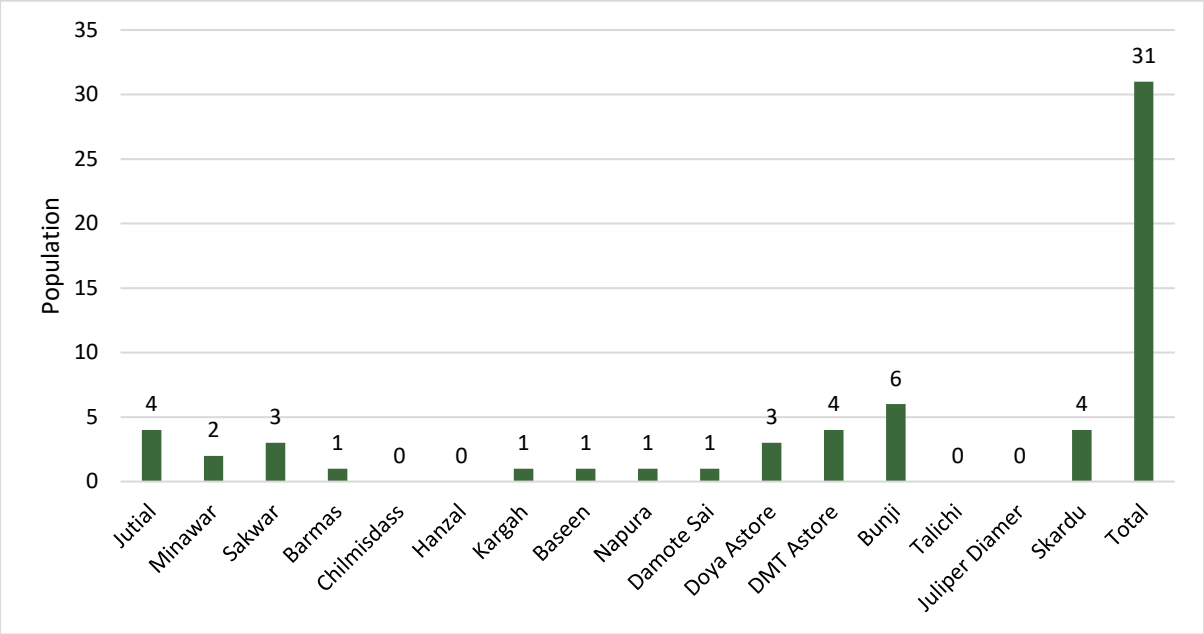

Figure 5: Trophy Animals in the Study Area

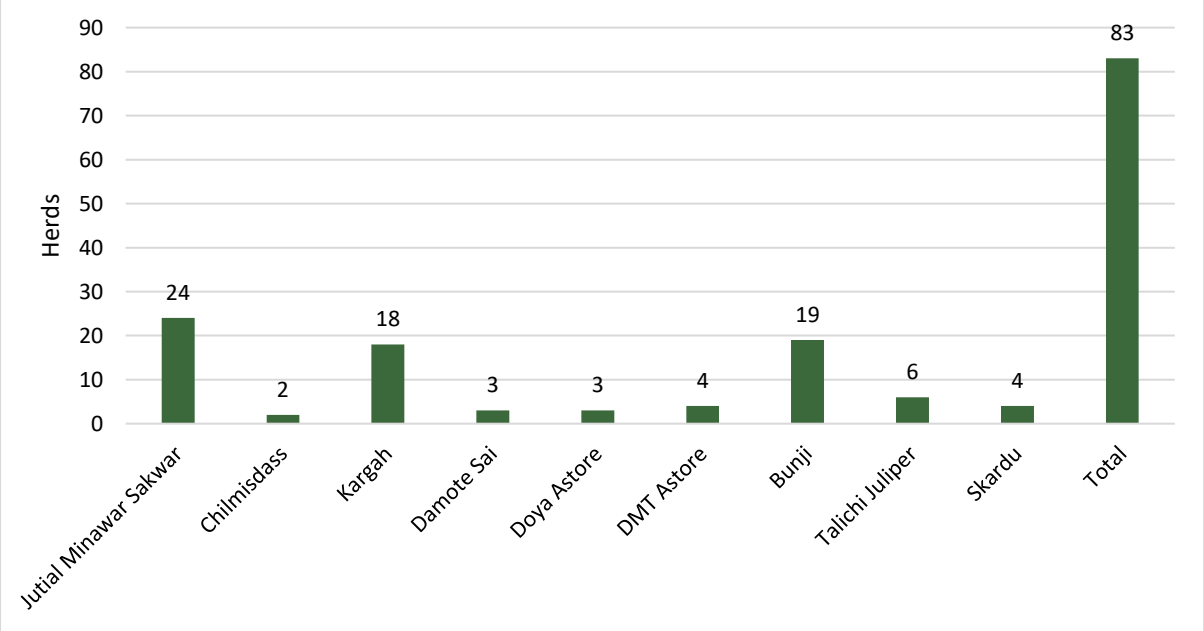

Figure 6: Total Groups/Herds in Study Area

Figure 7: Overall Group Composition Markhor in the Study Area

Population of Astore Markhor in District Gilgit

Kargah conservancy provide good habitat for Markhor almost overall 225 individuals were recorded in Kargah Conservancy with group mean Value of (12.5 ± 1.49) Range between (5-30) in whole conservancy. From 225 individual 164 individuals were sighted in Baseen area, 39 individual in Kargah Nallah, Napura 16 and just 6 individuals found in Hanzal area. The results were shown below (Figure 8)

In Jutial-Sakwar conservancy total 181 Markhor Individuals were recorded, with mean group value (7.54±4.80) range between (2-18), majority of individuals were sighted in Jutial which were 85 individual, respectively 20 individuals were sighted in Minawar and 19 markhor individuals were observed in Barmass Nallah. The results were shown in below figure 9.

In Damote sai 21 Markhor individuals were sighted, while 17 Markhor individuals were observed in Chilmissdass (Figure 10), while 57 markhor individual were observed in Minawar Conservancy. The Group composition results were shown in below figure 10.

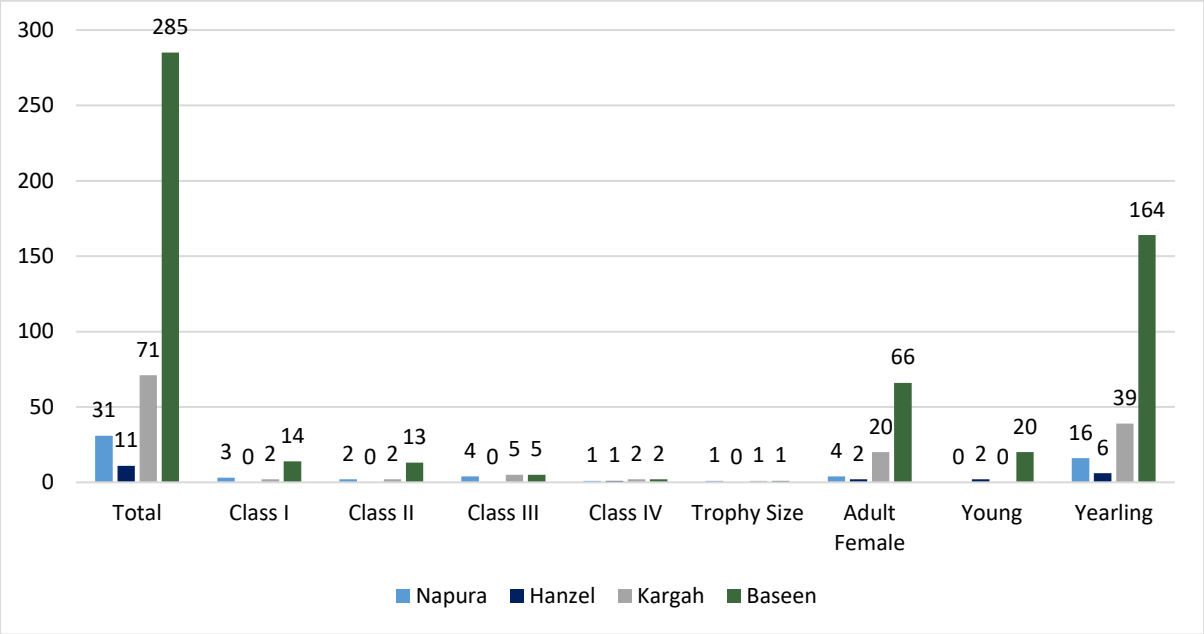

Figure 8: Kargah Conservancy Markhor Population

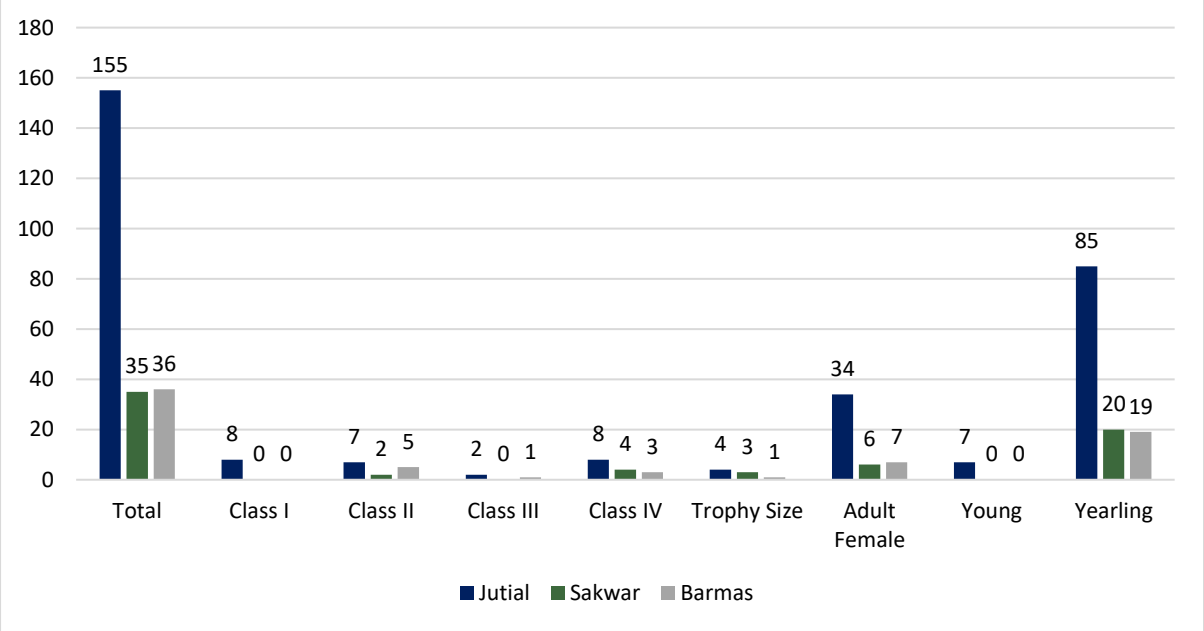

Figure 9: Jutial - Sakwar Conservancy Markhor Population

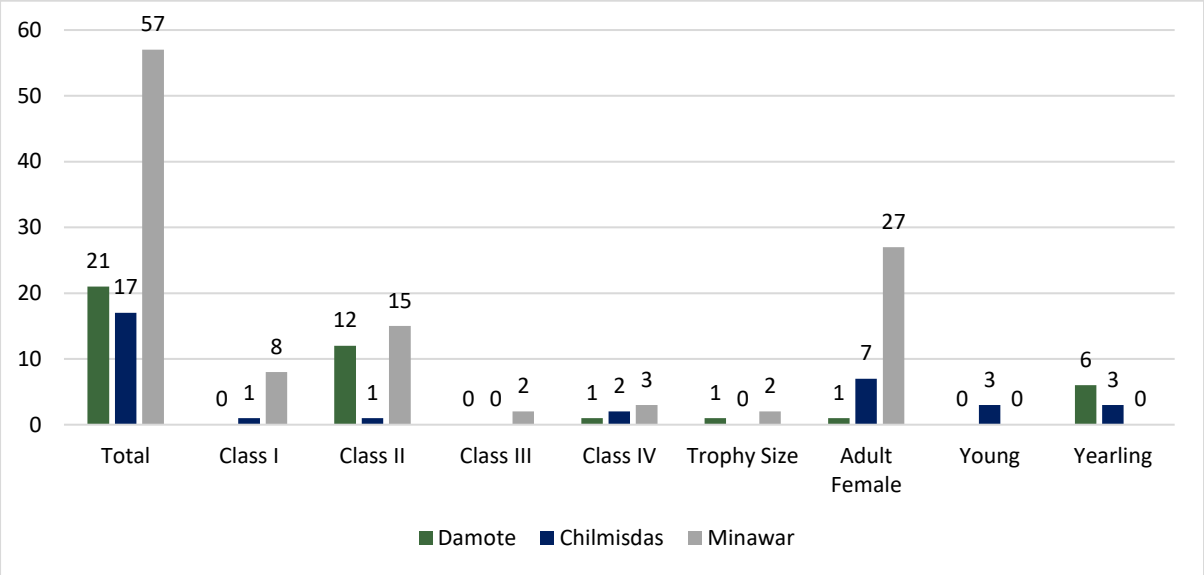

Figure 10: Damote sai, Chilmisdass & Minawar Conservancy Markhor Population

Population of Astore Markhor in District Astore

In Astore the survey was carried out in Doyan Conservancy, total 69 Markhor individual were observed with mean value (23±7.0) range between (18-30), 3 trophy size animals were also observed, results are shown in below figure .11)

Total 66 individual of markhor were observed in DMT conservancy with mean value of 16.5± 2.02) the SD were 4.04, the overall group composition of DMT conservancy results were shown in below figure 11.

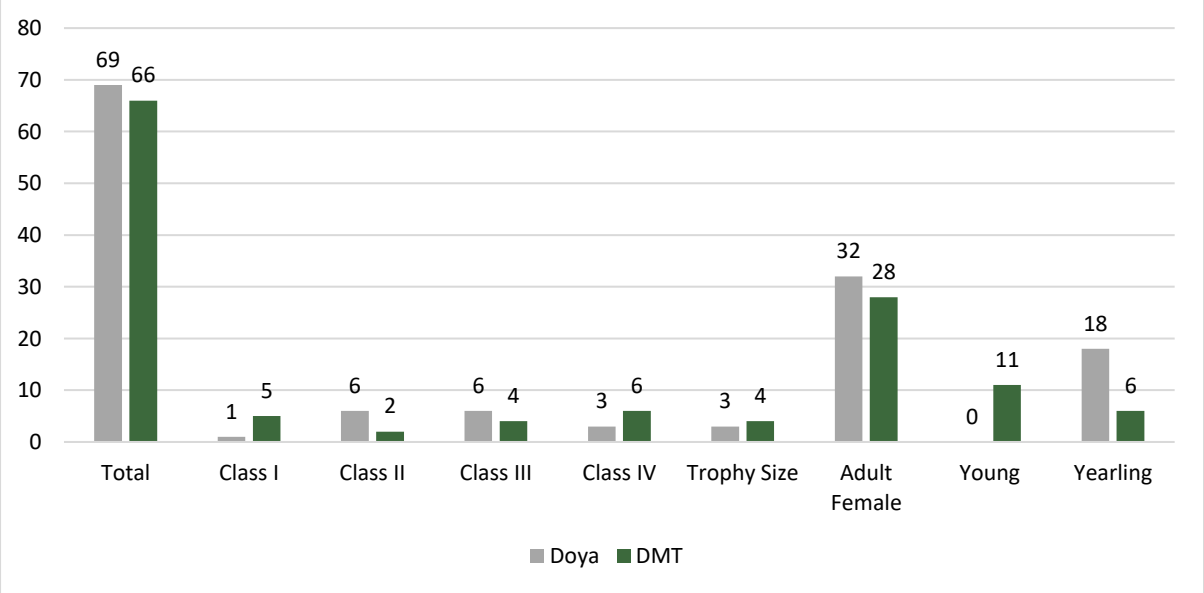

Figure 11: Markhor Population in Doyan and DMT Conservancy, Astore District

Population of Astore Markhor in District Diamer

In Diamer surveys was carried out in Juliper and Talichi where total 31 number of Markhor sighted from their 21 Individuals observed in Juliper while 10 number of individuals in Thalichi with mean value of (5.17±1.05) Range from (2-9), the results shown in below figure 12.

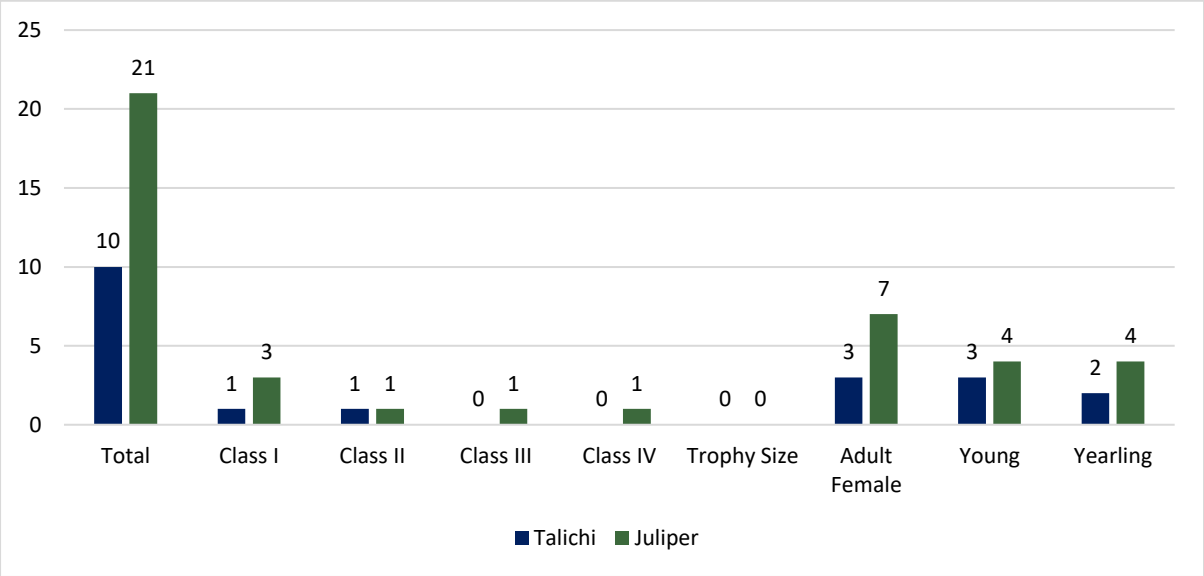

Figure 12: Markhor Population in Juliper/Chilas & Thalichi

Population of Astore Markhor in District Skardu

In Skardu district the population and distribution of Markhor in Sokoyo-Kharbatan and Basingu (SKB conservancy) which is located along with Indus basin. A total of 45 Markhor individuals were sighted, with mean value of (11.25±3.25) range (8-21). There were 4 Trophy size markhor in the herd. The group composition results were shown below figure no. 13.

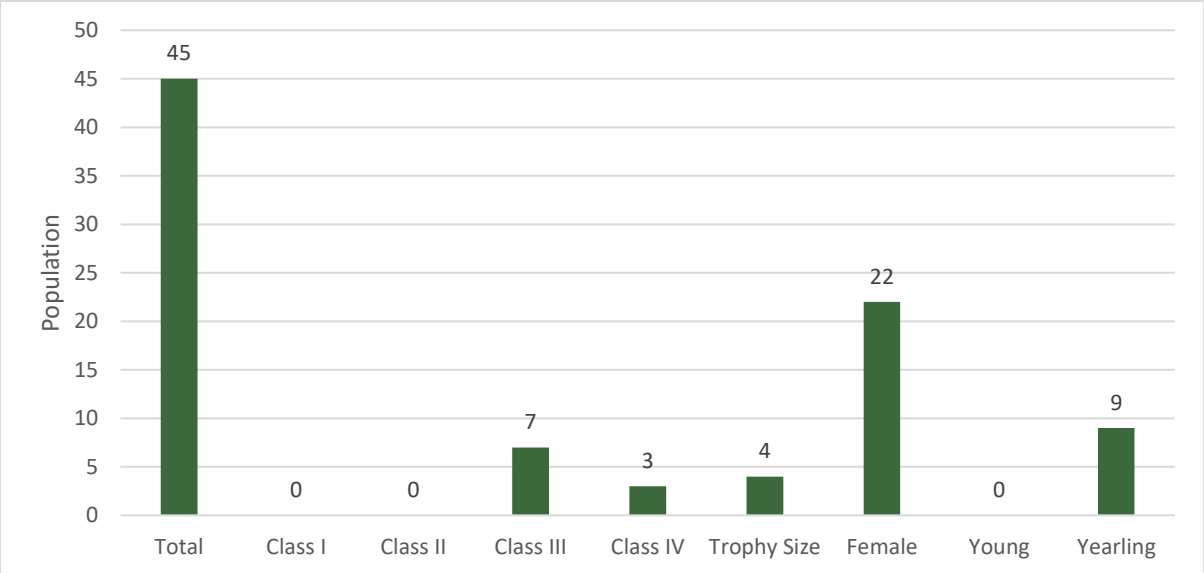

Figure 13: Markhor Population in SKB Conservancy District Skardu

3.3 Ladakh Urial Results in Study Area

In study area total 24 ladakh urial individuals were observed In Bunji area and Batchulay areas. With mean (±4.80). Bunji and Batchulay are main habitat for Ladakh Urial. Total 5 herds/Groups were observed, Variance in Group size were 2.34. The overall group composition and Population results were shown in below figure 14.

Table 11: Ladakh Urial Population during Rut Season Survey

Ladakh Urial population in Survey Area	
# groups sighted by both observers	5
# groups sighted by observer one only	0
# groups sighted by observer two only	0
Estimated number of groups	5.00
Mean Group size	4.80
Estimated population	24
Variance in mean group size	2.34
Variance in estimated number of Groups	0.00
Variance in estimated population	58.50
95% Confidence interval	15.18
Detection probability Observer 1	1.000
Detection probability Observer 2	1.000

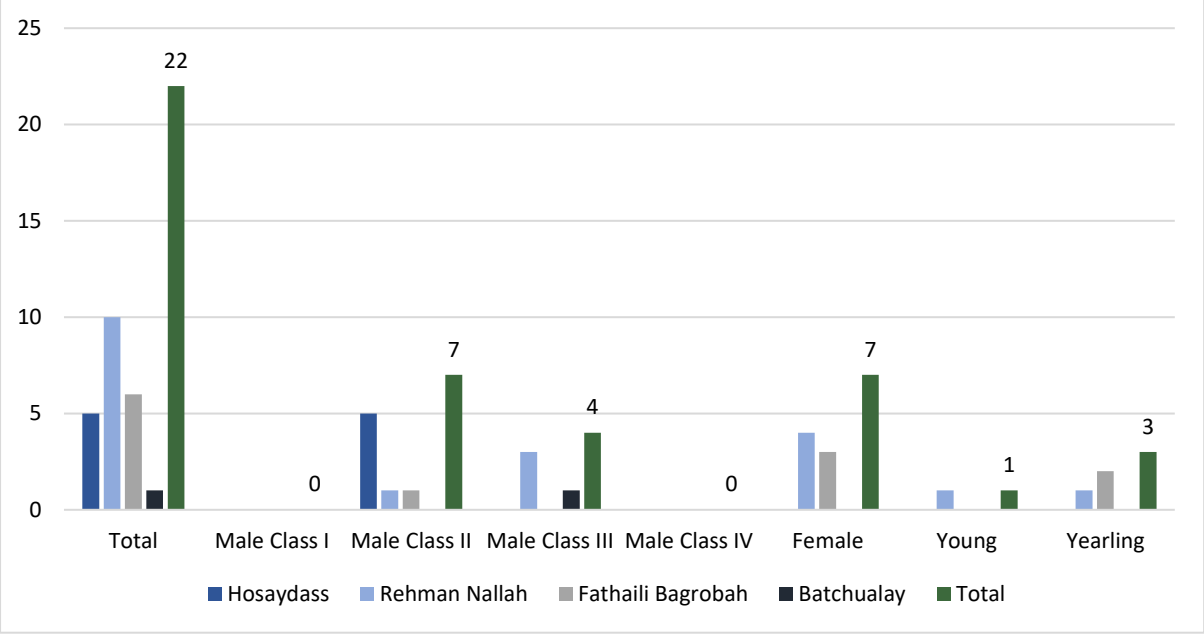

Figure 14: Ladakh Urial Population in Bunji and Batchulay

4. DISCUSSION

During Rut season survey, a total of (N=934) Markhor individuals were observed through double observer method in Gilgit Baltistan by scanning almost all the potential habitats. Based on current results and assuming human error in detecting the total number of individuals in the surveyed area, it can be concluded that, as estimated population of Astore Markhor could be between 1200-1400 individuals. The estimated population of Markhor is quite similar to that of (Khan et al., 2014), in which a total of (N=1071) individual were observed in the potential habitat Markhor in Gilgit Baltistan.

The population trend is slightly increasing in the areas where, trophy hunting taking place, However, the field team also observed various means of poaching like used of ammunition, poisoning evidence, suspected poachers during the surveys, which if not addressed can lead to decline of this important species population.

It is further recommended to conduct regular monitoring of Markhor including other key wildlife species across Gilgit-Baltistan to enable site and time specific conservation and management.

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ANNEXURES

Annexure 1: Population of Markhor in Doyan Conservancy

	Group size	Male	Female	Kids	Yearling	Location (Herd)	Time and remarks
	3	0	1	2		Doyan/ Dungai gero	6:10am
	3	0	1	2		Doyan/ Sidqayharai	7:42am
	3	0	1	2		Doyan/Baral Side	9:15am
Sub Total	9	0	3	6	0		
S.D	0						
S.E	0						
Mean	3						
Percentage	100	0	33	67	0		

Annexure 2: Population of Markhor in DMT Conservancy

	Group size	Male	Female	Kids	Yearling	Location (Herd)	Time and remarks
	6	1	3	2		Shurba	8:03am
	2	0	1	1		Shurba	9:08am
	9	0	4	4	1	Astore Shulter/ Kasnarat	7:00
	4	0	2	2		Shulter/ Chili thalap	7:20
	4	0	3	1		Shulter/ Bakhat	10:05
Sub Total	25	1	13	10	1		
S.D	2.65						
S.E	1.18						
Mean	5						
Percentage	100	4	52	40	4		

Annexure 3: Population of Markhor in Bunji Conservancy

	Group size	Male	Female	Kids	Yearling	Location (Herd)	Time and remarks
	5	0	2	3		Bunji /Rehman/ Chjacha	8:13am
	11	0	4	7		Bunji Nele Jegha	8:10am
	4	0	2	2		Bunji Nele/ Chaja	8:50am
Sub Total	20	0	8	12	0		
S.D	3.79						
S.E	2.19						
Mean	6.67						
Percentage	100	0	40	60	0		

Annexure 4: Population of Markhor in Diamer (Thalichi, Darang and Hudur) Conservancy

	Group size	Male	Female	Kids	Yearling	Location (Herd)	Time and remarks
	4	0	1		3	Diamer Thalichi/ Sanpebax	6:40am
	4	0	2	2		Diamer Darang/ Batchulai	9:12am
	7	0	3		4	Diamer Hudur/ Phakhat	7:20am
Sub Total	15	0	6	2	7		
S.D	1.73						
S.E	1.00						
Mean	5.00						
Percentage	100	0	40	13	47		

Annexure 5: Population of Markhor in Tangir Conservancy

	Group size	Male	Female	Kids	Yearling	Location (Herd)	Time and remarks
	12	2	5	6		Tangir/ Ukurga	7:30am
	7	0	2	5		Tangir/ Shukga	6:12am

	Group size	Male	Female	Kids	Yearling	Location (Herd)	Time and remarks
Sub Toatal	19	2	7	11	0		
S.D	3.54						
S.E	2.5						
Mean	9.5						
Percentage	100	11	37	58	0		

Annexure 6: Population of Markhor in Sai-Jaglote Conservancy

	Group size	Male	Female	Kids	Yearling	Location (Herd)	Time and remarks
	5	0	2	3		Juglote sai/ Dudu kuii	7:08am
	11	1	5	5		Jaglote sai/ Kaloyo khor	10:15am
	2	0	2			Jaglote sai/ Birbish shong	12:55pm
Sub Total	18	1	9	8	0		
S.D	4.58						
S.E	2.65						
Mean	6						
Percentage	100	6	50	44	0		

Annexure 7: Population of Markhor in Kargah Conservancy

	Group size	Male	Female	Kids	Yearling	Location (Herd)	Time and remarks
	4	0	3	1	0	Hanzal/ Haltar Nallah	10:05am
	14	1	7	5	1	Hanzal Chalarung	1:30pm
	3	0	2	1		Shanigah/ Lashobah Kor	10:00am
	6	0	2	4		Shanigah/ Biglot Khor	2:48pm
	9	0	3	5	1	Shanigah/ Naydar	4:00pm
	17	4	5	7	1	Shinigah/ Tingai khor	9:00am

	Group size	Male	Female	Kids	Yearling	Location (Herd)	Time and remarks
	5	0	2	3		Shinigah/ Padha Area	10:00am
Sub Total	58	5	24	26	3		
S.D	5.35						
S.E	2.02						
Mean	8.29						
Percentage	100	9	41	45	5		

Annexure 8: Population of Markhor in Jutial-Sakwar Conservancy

	Group size	Male	Female	Kids	Yearling	Location (Herd)	Time and remarks
	11	0	6	4	1	Barmas/ Iskalee	5:31pm
	3	0	1	2		Jutial/ chancher	5:30pm
	9	0	8	1		Jutial/ Nar nerial	9:00am
	14	1	6	7		Jutial/ Bawany khor	5:00pm
	16	1	7	3	5	Jutial/ Shikari khor	5:00pm
	6	0	3	2	1	Jutial/ Munbari	5:45pm
	3	0	1	2		Sakwar/ waloo	6:01pm
	4	0	2	2		Sakwar/ Ashpo	5:14pm
	4	0	2	2		Minawar/ Mowarchi	5:40am
	2	2				Minawar/ Dadoshurt	6:00am
	6	3	1	2		Minawar/ Bakourgo	6:00am
	4	2	2			Minawr/ Barachi	6:50am
	6	0	2	4		Minawar/ Danoidar	7:20am
Sub Total	88	9	41	31	7		
S.D	4.44						
S.E	1.23						
Mean	6.77						
Percentage	100	10	47	35	8		

Annexure 9: Population of Markhor In Danyore-Jaglote Guru Conservancy

	Group size	Male	Female	Kids	Yearling	Location (Herd)	Time and remarks
	5	1	2	2		Jutal/ Loye	5;00pm
	6	0	2	3	1	Jutal/ Yarofow	8:00am
	6	0	3	3		Danyore/ Hurashy	7:50am
	4	0	2	2		Juglot gah/ Sargachi doko	7:00am
	5	0	1	2	2	Rahimabad/ Kaand	6:00am
Sub Total	26	1	10	12	3		
S.D	0.84						
S.E	0.37						
Mean	5.2						
Percentage	100	4	38	46	12		

Annexure 10: Population of Markhor in Sassi-Haramosh Conservancy

	Group size	Male	Female	Kids	Yearling	Location (Herd)	Time and remarks
	5	0	2	3		Haramosh/ Shatoot Dar	5:30pm
Sub Total	5		2	3			
Mean	5						
Percentage	100		40	60			

Annexure 11: Population of Markhor in Skandarabad Conservancy District Nagar

	Group size	Male	Female	Kids	Yearling	Location (Herd)	Time and remarks
	13	3	7	3		Skandarabad/ Chanes	6:30am
	12	4	5	3		Skandarabad/ Shatho Khur	7:12am
Sub Total	25	7	12	6	0		

	Group size	Male	Female	Kids	Yearling	Location (Herd)	Time and remarks
S.D	0.71						
S.E	0.5						
Mean	12.5						
Percentage	100	28	48	24	0		

FOREST, WILDLIFE AND PARKS DEPARTMENT
GOVERNMENT OF GILGIT-BALTISTAN

Wildlife & Parks Circle,
Forest Complex, Jutial, Gilgit,
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Website: http://parksandwildlife.gog.pk

FEE SCHEDULE FOR IMPORT / EXPORT OF WILDLIFE

S.#	CITES Appendix	Import/Export	Number/ Heads	Fee (PKR)
1.	Non-CITES	Commercial	1-1000	5,000
2.	Non-CITES	Non-Commercial	Only 10 Heads Allowed	500
3.	Appendix-II	Commercial	1-100	10,000
4.	Appendix-II	Non-Commercial	1	1,000
5.	Appendix-III	Commercial	1-500	5,000
6.	Appendix-III	Non Commercial	Only 10 Heads allowed	1,000
7.	Appendix-I	Commercial / Non-Commercial	1	4,000
8.	Appendix-I Trophy	Commercial / Non-Commercial	1	5,000
9.	Appendix-II, III & Non-CITES Trophy	Commercial / Non-Commercial	1	5,000
10	*Dalbergia* species (Shisham) Appendix-II	Commercial / Non-Commercial	1 Consignment	2,000

Registration Fee (per calendar year)

Existing
Rs. 10,000