SNOW LEOPARD CONSERVATION ACTION PLAN FOR BHUTAN (2018-2023)

A Climate-integrated Landscape Approach to Snow Leopard Conservation

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A Climate-integrated Landscape Approach to Snow Leopard Conservation

NATURE CONSERVATION DIVISION

Department of Forests and Park Services

Ministry of Agriculture and Forests

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Suggested citation:

NCD 2019. Snow Leopard Action Plan for Bhutan (2018-2023): A Climate-integrated Landscape Approach to Snow Leopard Conservation. Nature Conservation Division, Department of Forests and Park Services, Ministry of Agriculture and Forests, Thimphu, Bhutan.

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ISBN - 978-99980-873-1-6

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ROYAL GOVERNMENT OF BHUTAN
Ministry of Agriculture & Forests
Tashichhodzong, Thimphu: Bhutan

MINISTER

FOREWORD

Bhutan's conservation efforts, guided by our visionary monarchs, have been rewarding in the sense that we have propelled into the 21st century as the champion and leader in environmental conservation in the world. Conservation of iconic and keystone species both at species level and landscape level has been our priority for bringing far-reaching impacts to the overall biodiversity conservation. Snow leopard (*Panthera uncia*) is a flagship species for the high mountain ecosystems of Bhutan, the conservation of which supports numerous species and livelihoods for a vast number of highland communities bringing in tremendous socio-ecological role in the mountain landscapes.

Large carnivores like snow leopard have evolved to live in some of the world's highest and harshest environments, yet the magnificent cat is threatened throughout its range due to many anthropogenic threats including the human-induced climate change. With as few as 4,000 snow leopards surviving in the wild, there is an urgent need to intensify current conservation efforts. In Bhutan, the magnificent snow leopard is present in most of the northern protected areas, which was confirmed by the National Snow Leopard Survey of Bhutan 2014-2016 that estimated a population of 96 individuals.

Bhutan's effort towards biodiversity conservation has been driven by the government's strong national will in strengthening the legacy of our beloved monarchs to conserve nature. Such efforts helped us gather the information to prioritize conservation needs. Furthermore, the National Snow Leopard Survey of Bhutan 2014-2016 yielded more concrete results on reliable estimate of Snow leopard population and habitat use status. This gave us clear direction for drafting a snow leopard landscape conservation plan to comprehensively include measures to conserve viable populations of snow leopard and their prey while mitigating negative impacts on people's livelihoods and sustenance. Built on these information, I am delighted to learn that Department of Forests and Park Services have taken the much needed step for framing the first Snow Leopard Conservation Action Plan for Bhutan.

The publication of the first Snow Leopard Conservation Action Plan is aptly suited to our conservation journey as Bhutan has begun the implementation of the "Bhutan for Life", a project geared towards sustainably financing conservation in the beautifully and smartly designed protected area system. I am

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optimistic that this pragmatic action plan with clear goal will secure the future of snow leopard in Bhutan with communities as conservation stewards, thereby significantly contributing our efforts towards global initiative to "Conserve 20 snow leopard landscapes by 2020".

Lastly, I would like to express my sincere gratitude to WWF Bhutan and Global Snow Leopard & Ecosystem Protection Program (GSLEP) secretariat for funding the action planning processes and publication of this important document. I also express my heartfelt appreciation to the Department of Forests and Park Services and all other stakeholders engaged in formulating this plan. I wish them good luck for the successful implementation of this plan.

Tashi Delek!

(Yeshey Penjor)

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PREFACE

Bhutan has put concerted effort towards the conservation of snow leopard and as we completed the first National Snow Leopard Survey in 2016, we are proud to have an estimated population of 96 individuals, thriving in our northern alpine landscapes. Being the flagship species of the mountain landscape, Snow leopard conservation is of paramount importance for maintaining the ecological entity of the fragile mountain landscape and its biological diversity. In its entire range, this marvellous cat species is being threatened by many anthropogenic and natural threats such as habitat degradation, prey depletion, conflict with humans and the human-induced climate change that could/may lead to the decline of its population. Snow leopards in Bhutan are equally vulnerable to these threats.

Taking stock of these vital information, viz. the reliable estimate of thriving population of snow leopard in Bhutan's highland ecosystems and the emerging threats to the snow leopard, its prey and their habitat by both natural and anthropogenic factors, Department of Forests and Park Services has taken the next step for snow leopard conservation by framing the first Snow Leopard Conservation Action Plan for Bhutan. I am delighted to learn that this five year plan will commence as Bhutan begins the implementation of the "Bhutan for Life (BFL)" conservation project. Most of the snow leopard habitats are inside the protected areas and BFL is expected to help implement the action plan. This gives us a huge opportunity in harmonizing the strategies and actions of the plan towards achieving the common goal with limited resources.

The Snow Leopard Conservation Action Plan aims to fulfill three important targets of maintaining a stable or increasing population of snow leopard, securing the snow leopard habitats, and engaging the local communities as willing conservation stewards. This action plan not only intends to address various direct and indirect threats towards fulfilling these targets but is also expected to bring far-reaching conservation benefits unlike in the past where Global Snow Leopard Ecosystem Recovery Program (GSLEP), approved at the Bishkek summit in 2013, was the only guiding document for snow leopard conservation.

I, therefore, express my sincere appreciation and would like to congratulate the Department of Forests and Park Services and others who were involved in preparing this holistic plan.

Tashi Delek!

(Rinzin Dorji)

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DIRECTOR

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Royal Government of Bhutan
Ministry of Agriculture and Forests
Department of Forests and Park Services
Thimphu

ACKNOWLEDGEMENT

This Action Plan is an outcome of the collective efforts and contribution from many institutions and individuals. I would like to acknowledge the support rendered by all field offices under whose jurisdiction the snow leopards are thriving. We are also thankful to all the focal persons from various parks and divisions, who attended the Snow Leopard Action Planning workshop at Punakha from and contributed to this development. The overall work of the action planning is led and coordinated by Nature Conservation Division, therefore, I would like to convey my appreciation for their commendable job and bringing out this first Snow Leopard Action Plan for Bhutan.

At the individual level, I would like acknowledge the contributions of Dr. Phuntsho Thinley, UWICER, Mr.Sonam Wangchuk, CEO-NRDCL (ex-CFO of NCD) and Ms. Dechen Lham, (ex-Forestry Officer of NCD) for their joint effort in putting up the framework and initial development of the draft action plan.

I would also like to acknowledge the effort put in by Mr. Sonam Wangdi, Chief of NCD, Mr. Letro, Mr. Tandin and Ms. Tshering Zam – NCD for their hard work and dedication in giving the final shape to this action plan. I also remain highly indebted to Dr. Eric Wikramnayake (WWF Consultant) for his valuable inputs in developing this plan and Ms. Dechen Yeshi, WWF Bhutan for her contributions.

The action planning and publication has been generously supported by WWF Bhutan, Bhutan Trust Fund for Environmental Conservation (BTFEC), International Center for Integrated Mountain Development (ICIMOD), and Global Snow Leopard & Ecosystem Protection Program (GSLEP) Secretariat for which the Department will remain always grateful. The Department look forward to continued support towards implementing the actions prescribed in this plan, so that future of Snow leopard in Bhutan remains secured through our collective conservation efforts.

Tashi Delek and Best Wishes!

(Lobzang Dorji)

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EXECUTIVE SUMMARY

The snow leopard is an apex predator, an umbrella species, and a flagship species of the alpine ecosystems of the Himalaya. In Bhutan, the snow leopard is considered a 'precious animal' by upland communities, and revered as a mountain deity. Despite its vast range distribution in the Himalaya and central Asia, snow leopards are listed as 'Vulnerable' in the IUCN's Red List, mainly because of their relatively low population density, persecution because of conflict with pastoral communities, and demand for their pelt and body parts in the international wildlife trade. Thus, urgent conservation actions are necessary to ensure the persistence of snow leopards.

Bhutan conducted its first nationwide survey of snow leopards from 2014 to 2016 using grid-based sign surveys and camera traps. The results estimated the total population at 96 animals (*SE* ± 8) with a density of about 1.08 animals/100 km^2. Most animals were in the western alpine regions, especially in Jigme Dorji National Park (JDNP), Wangchuck Centennial National Park (WCNP), and Jigme Khesar Strict Nature Reserve. However, these numbers are much lower than previous surveys conducted in JDNP, where the population was estimated at 192 animals at a density of over 6 animals/100 km^2, and densities of 2 to 3 animals per 100 km^2 in WCNP. This discrepancy reflects the considerable uncertainty about the population status and ecology of snow leopards in Bhutan, and calls for a strategic plan to conserve Bhutan's snow leopards.

The management and action plan requires that the threats to snow leopards—including information gaps—be identified, and strategic actions developed and implemented. Thus, key personnel from snow leopard range agencies and relevant stakeholders gathered together to identify the key threats, which included climate change impacts; habitat degradation, loss, and fragmentation; solid waste pollution; natural disasters; human-snow leopard conflict; and information gaps. Based on the analysis of these threats, several strategic actions were identified to ensure that snow leopard populations will persist and be conserved as a metapopulation by ensuring ecological connectivity across Bhutan's northern landscape, and that local communities will become willing conservation stewards and guardians of snow leopards. The plan will also be grounded on more robust information about snow leopard ecology and population status.

The 5-year targets, objectives, and strategic actions identified to achieve the long term goal are as follows:

Goal: To maintain a viable population of snow leopards in Bhutan with ecological links to snow leopards in the eastern Himalayan mountain landscape.

Target 1. By 2023, Snow leopard populations in Bhutan are stable or increasing.

Objective 1. To ensure harmonious co-existence of snow leopards and local communities and prevent retaliatory killing.

- Output 1.1. Compensation mechanism to address livestock losses re-instated.
- Output 1.2. Mechanisms in place to minimize livestock depredation by snow leopards.
- Output 1.3. Communities aware of conservation significance of snow leopards.

Objective 2. To fill knowledge gaps necessary for snow leopard conservation through research and monitoring, including in response to community activities and climate change.

- Output 2.1. Research on the demography, ecology and habitat use of snow leopard conducted.
- Output 2.2. Studies on blue sheep ecology and demographics vis-à-vis grazing ecology, interactions with livestock conducted.
- Output 2.3. The population of snow leopard and its prey monitored using structured, grid based camera trap surveys.

Objective 3. To prevent the spread of diseases between wildlife and domestic animals.

- Output 3.1. The prevalence of communicable diseases in livestock and wild ungulates monitored.
- Output 3.2. Feral dog population in the snow leopard habitats controlled/ removed.

Objective 4. To stop poaching of snow leopards in Bhutan.

- Output 4.1. Capacity of forestry officials in snow leopard range parks and divisions developed for effective protection.
- Output 4.2. Collaboration with other stakeholders strengthened.

Target 2. By 2023, important snow leopard habitat mapped and secured for conservation to ensure ecological and demographic connectivity of snow leopard population.

Target 3. By 2023, over 80% of the local communities are engaged as willing conservation stewards of snow leopards, prey species, and habitats.

Objective 5: To manage adequate habitat areas with ecological connectivity to maintain a viable snow leopard population in Bhutan.

Output 5.1. Climate change integrated spatial analysis conducted and suitable habitat identified and zoned

Output 5.2. Climate resilient snow leopard habitat secured for conservation with appropriate management plans.

Output 5.3. Alpine meadows monitored and managed to prevent degradation and loss from grazing and NWFP collection.

Output 5.4. Solid waste disposal in alpine areas reduced.

Output 5.5. Policy in place to ensure principles of Smart Green Infrastructure are followed in all development projects in the alpine regions.

Objective 6. To provide sustainable and alternative income sources to local communities linked to snow leopard conservation.

Output 6.1. Community development projects follow principles of sustainable development and resource use, and aligned with SDGs.

Objective 7. To monitor and address climate change-related impacts and natural disasters on snow leopard, habitats and communities.

Output 7.1. Vulnerabilities of local communities living in alpine areas to climate change and consequent natural disasters reduced.

Output 7.2. Monitoring programme to detect impacts of climate change in place and operational.

Cross Cutting Target: Awareness Programmes

Objective 8. To raise awareness on importance of snow leopard conservation at local and national levels.

Output 8.1. Awareness raised on the importance of snow leopard conservation at national and local levels.

The overall outcomes from implementing this action plan are: 1) that the next population estimate would not show a significant decline in the snow leopard population because all major threats to snow leopards, from physical killing and harm to habitat loss and degradation, would be addressed; 2) core snow leopard habitat and dispersal routes or movement pathways will be secured to ensure that adequate habitat is available to conserve at least 100 individuals at densities of ~ >1 individuals/100 km^2; and 3) local communities become willing conservation stewards, protectors, and citizen scientists to monitor snow leopards and their prey.

It is important to note that this is an action plan for snow leopard conservation, and should be considered in that context, and with the presumption of: a) the existence of protected areas and corridor management plans into which the snow leopard actions can be integrated or vice versa; b) that community socio-economic development plans are being prepared, implemented, or funded by other line agencies and/or donors and that they can be influenced to include activities that are compatible with snow leopard conservation; and c) that infrastructure development plans exist or are being prepared and the government custodians of conservation will be able to influence these plans. As such, this plan does not include activities or strategic actions that are aimed purely at socio-economic development or other park management activities. But the conservation agencies will liaise with these agencies and donors to coordinate and design appropriate projects and actions. The plan that stretches for the next five year has an estimated budget of Nu. 255.15 million, and it is expected that our conservation partners will support the Royal Government of Bhutan in meeting the required budget for successfully implementing the plan.

LIST OF ACRONYMS

BAFRA	Bhutan Food and Agriculture Regulatory Authority
BTFEC	Bhutan Trust Fund for Environmental Conservation
BWS	Bumdeling Wildlife Sanctuary, DoFPS
CITES	Convention on International Trade of Endangered Species of Wild Fauna and Flora
CVA	Climate Vulnerability Assessment
DoFPS	Department of Forests and Park Services
DoL	Department of Livestock
FRMD	Forest Resources Management Division, DoFPS
FNCRR	Forests and Nature Conservation Rules and Regulations
GEF	Global Environment Facility
GIGO	Garbage In Garbage Out
IUCN	International Union for Conservation of Nature
JDNP	Jigme Dorji National Park, DoFPS
JKSNR	Jigme Khesar Strict Nature Reserve, DoFPS
MoAF	Ministry of Agriculture and Forests
MoHCA	Ministry of Home and Cultural Affairs
NBC	National Biodiversity Centre
NCD	Nature Conservation Division, DoFPS
NEC	National Environment Commission
NSB	National Statistics Bureau
PFD	Paro Forest Division, DoFPS.
SFED	Social Forestry and Extension Division, DoFPS
SLIMS	Snow Leopard Information Management System
SWS	Sakteng Wildlife Sanctuary, DoFPS
TCB	Tourism Council of Bhutan
TCP	Tiger Conservation Program
UWICER	Ugyen Wangchuck Institute for Conservation and Environmental Research, DoFPS
WCNP	Wangchuck Centennial National Park, DoFPS
WWF	World Wide Fund for Nature.

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1. INTRODUCTION

1.1 Biodiversity conservation in Bhutan

Bhutan straddles the eastern Himalayan mountain range, and lies between China and India (Figure 1). The people's way of life is largely governed by Buddhism and the uniquely Bhutanese tenet of 'Gross National Happiness', which have contributed to conservation of the country's natural heritage, and are now embodied in Bhutan's legal and policy frameworks. Hunting of any animals (except regulated fishing) is strictly prohibited by the Forest and Nature Conservation Act of Bhutan 1995, and the Constitution mandates the government to maintain at least 60% forest cover for all time to come. The extensive system of protected areas and biological corridors (Figure 2), known as the Bhutan Biodiversity Conservation Complex, or B2C2, cover over 50% of the country.

Biogeographically, Bhutan is positioned along the ecotone of the temperate Palearctic and tropical Indo-Malayan Biogeographic Realms; thus, Bhutan's biodiversity is enriched by representations from both. Overall, the known fauna and flora of Bhutan includes over 5,600 vascular plant species, close to 200 species of terrestrial mammals, and 772 birds (NBC 2014). The altitudinal variation and biogeography combine to create three physiographic zones: the southern foothills (200-2,000m), the inner Himalayas (2,000-4,000m), and the Greater Himalayas (above 4,000m), and are represented by six ecoregions based on the distinct vegetation and faunal communities (Wikramanayake et al. 2001, Olson and Dinerstein 2002). The northern, alpine ecoregions, represented by Palearctic species, is where snow leopard and its primary prey, blue sheep, live.

Most (>62%) of Bhutan's population of 735,000 people is rural (NSB 2018) and live below 4,000 m elevation. The few people that live above 4,000 m, in snow leopard habitat, are primarily pastoral, herding yak and horses, and follow a vertical transhumance practice.

Figure 1. Map showing location of Bhutan and neighbouring countries

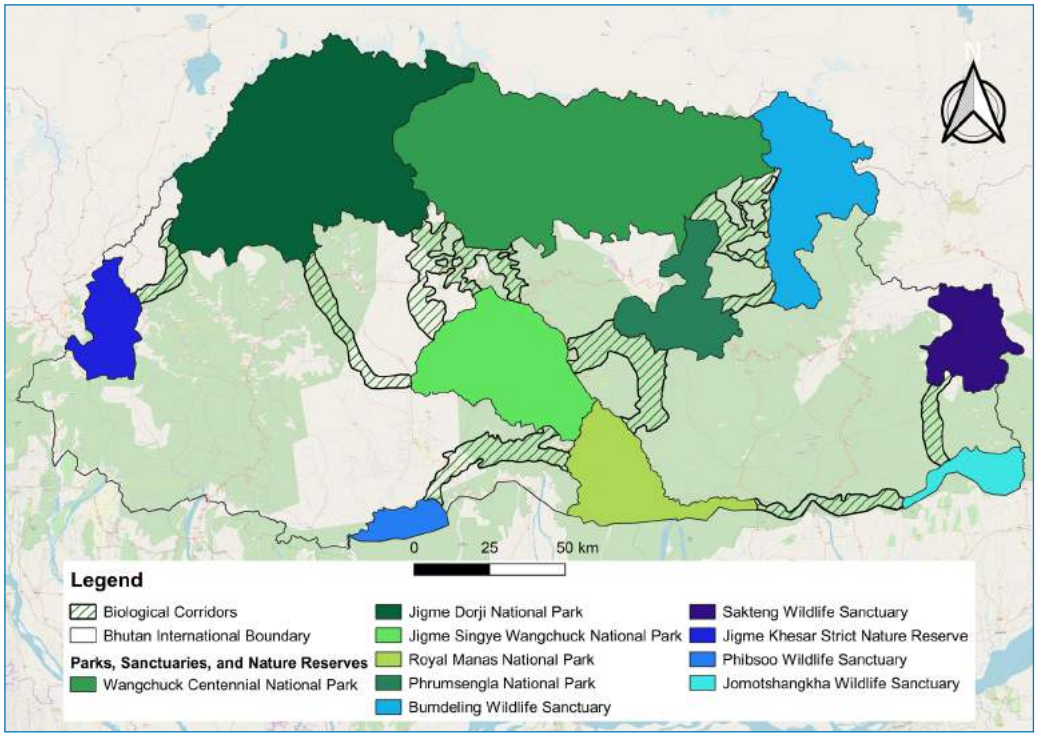

Figure 2. Bhutan's protected areas and corridors.

1.2 Global status and distribution of snow leopards.

The snow leopard range extends across a vast region of over 1.8 million km^2 that covers the Himalayan Mountains and central Asia, and includes 12 countries (McCarthy et al 2017). Because of the magnitude of the spatial area and sparse distribution of snow leopards, there is considerable uncertainty about the global population estimate, and the various numbers put forth range from 3,920 to 7,500 (McCarthy and Chapron 2003, Jackson *et al.* 2010, Snow Leopard Working Secretariat 2013), with 2,710 to 3,386 being mature adults (McCarthy et al. 2017). Recent studies indicate that snow leopards are being detected in new areas, or reappearing in places in the former range from where they have been absent in the recent past. Better field surveys and data derived from other technological advances such as satellite GPS telemetry are now casting doubts on the lower range of population estimates. Thus, it is likely that the global population is in the range of 7,446 to 7,996 individuals (McCarthy et al. 2017). Because the numbers seem higher than previously thought, the snow leopard has been down-listed from Endangered on the IUCN global Red List to Vulnerable (McCarthy et al 2017). But it is still listed in Appendix I of CITES (Hussain 2003).

Despite living in relatively remote regions and inaccessible habitat, snow leopards are now facing increasing anthropogenic threats. These range from local drivers such as habitat degradation that affects both snow leopards and prey; unsustainable natural resource extraction from medicinal plants to mining for minerals; killing by poachers for body parts and by herders in retaliation for livestock depredation; and now, global climate change that is changing the land cover and land use in the alpine regions. Thus, in 2013, the snow leopard range countries convened in Bishkek, Kyrgyzstan, to agree on a global snow leopard conservation plan and strategy. The goal was to commit to actions for a collective and holistic action plan to conserve snow leopards and their habitats, with ecosystem service-related benefits to local communities. This pledge, known as the Bishkek Declaration (Snow Leopard Working Secretariat. 2013), became a shared vision and goal that sought to identify and secure 20 snow leopard landscapes by 2020 across the range, with relevant actionable commitments that would ensure snow leopards remain the living icon of mountains of Asia for generations to come. The snow leopard landscapes are defined as spaces that: 1) contain at least 100 breeding age snow leopards conserved with the involvement of local communities; 2) support adequate and secure prey populations; and 3) have functional connectivity to other snow leopard landscapes, some of which cross international boundaries.

The Bishkek Declaration, or the Global Snow Leopard Ecosystem Protection Program (GSLEP) is comprised of 12 National Snow Leopard and Ecosystem Protection Priorities

(NSLEPs) that represent national priorities and goals. Collectively, the NSLEPs represent the overarching global goal, or the GSLEP. The NSLEPs are also meant to be living documents that will be periodically refined and updated as the program evolves and adaptive management requires changes.

Bhutan has pledged contributions to several of the components of the GSLEP, namely:

a. Engaging local communities and reducing human-wildlife conflict through a community-based snow leopard citizen scientist programme that would engage local communities in snow leopard conservation.

b. Managing habitat and prey by conserving contiguous snow leopard habitat by mapping and protecting key habitats, including habitat linkages, surveys of prey populations, and establishing baselines for both prey and snow leopards. Rangeland management strategies will be developed, based on livestock grazing carrying capacities and impacts on alpine meadows.

c. Strengthening capacity of national and local Institutions to build manpower for effective conservation by establishing a conservation laboratory at UWICER, providing training courses, establishing community participatory structures for each landscape in the northern protected areas, and higher education opportunities for community members.

d. Addressing knowledge gaps through scientific research and monitoring of snow leopards, prey species, and habitats, including climate change impact studies.

e. Strengthening policies and institutions following reviews of the existing Forest and Nature Conservation Act to strengthen law enforcement.

2. SNOW LEOPARD CONSERVATION IN BHUTAN

2.1 Ecological significance

The snow leopard is an apex predator of the alpine ecosystems of the Himalaya, influencing the ecological dynamics of the ecosystems with top-down trophic cascades that help to control the herbivores in the alpine and scree (Devkota et al. 2013). Because of its use of extensive spatial areas, the snow leopard is also an umbrella species for other Himalayan high-elevation biodiversity (Roberge and Angelstam 2004), and conservation of snow leopards and their habitats will also help to protect the water towers by ensuring ecosystem integrity.

In Bhutan, the snow leopard is revered as a mountain deity by most of the yak herders and mountain communities. Its charisma and mystical nature also makes it a flagship species that can attract wide support for wildlife conservation in the highlands of Asia, and play a significant role in developing a tourism-based economy that can bring economic revenue streams to local communities. Snow leopard habitats in Bhutan also offer breath-taking vistas that attract alpine trekkers. Engaging local communities who are most familiar with the snow leopard habitats and habits, and other alpine biodiversity and cultural lore can be guides, naturalists, and home-stay owners. Since the revenue streams from these activities will be based on snow leopard conservation such engagement will encourage them to become snow leopard conservation stewards.

2.2 Conservation status of snow leopards in Bhutan

The Royal Government of Bhutan has granted maximum protection to snow leopards by listing the species as a totally protected species in Schedule I of the Forest and Nature Conservation Act of Bhutan, 1995. The government has also conducted several capacity building programmes, including training provided to JDNP staff on Snow Leopard Information Management System (SLIMS) in 1997 and 2000 (Jackson et al. 2000). In 1996, the Department of Forests (now Department of Forests and Park Services, DoFPS) initiated the Tiger Conservation Programme (TCP), which included a component to compensate livestock kills by both tigers and snow leopards.

In 2012, a camera-trap survey of snow leopard was conducted in JDNP, and between 2012 and 2014 in WCNP with financial assistance from the WWF Bhutan Progam (Thinley et al. 2014, Shrestha and Tenzin 2015). These surveys catalysed the subsequent nationwide survey, which was conducted in two phases: 1) a sign and prey base survey from 2014 to mid-2015 and, 2) the camera trap survey from mid-2015 – 2016.

2.3 Population status of the snow leopard and prey in Bhutan

The first nationwide camera trap survey of the snow leopard in Bhutan was conducted from 2014 to 2016 using grid-based sign surveys and camera traps (DoFPS 2016, Thinley et al. 2016). Snow leopards were confirmed for the first time in JKSNR and PTFD during this survey. Although camera traps were placed in BWS, no snow leopards were confirmed during the survey but images were captured later in 2017 .

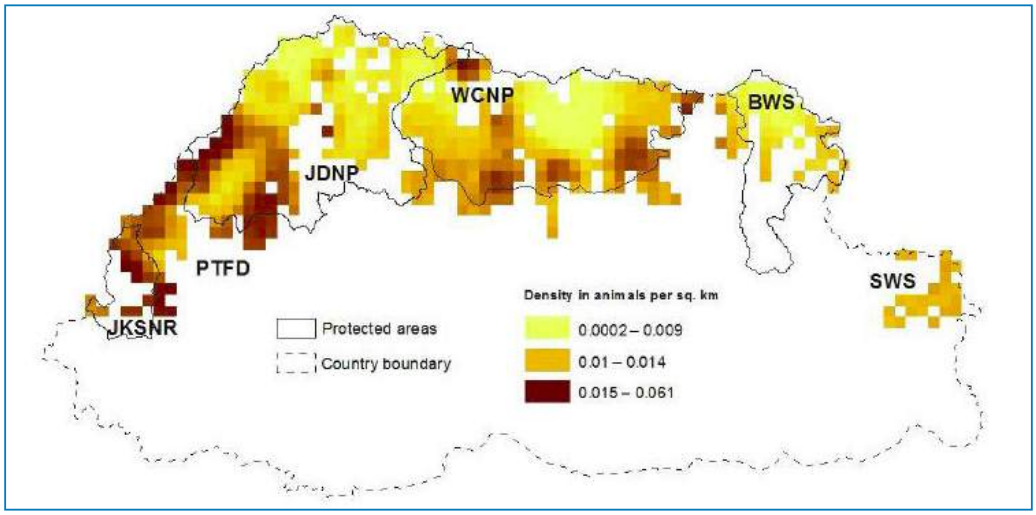

Figure 3. Snow leopard densities (animals/ km^2) estimated from SPACECAP analysis using the camera trap data from the national snow leopard survey.

The results estimated the snow leopard population in Bhutan at 96 animals (*SE* ± 8), with an estimated density of 1.08 (*SE* ± 0.09) animals per 100 km^2 and a declining trend in the probability of occurrence from west to east, with the highest probability of occurrence being in western JDNP, in the 'corridor' between JDNP and JKSNR, and in some central regions of WCNP and JKSNR (Thinley et al. 2016). Camera traps captured 63 distinct individuals, identified from the unique pelage patterns. Of these, 31 were from JDNP, 17 from WCNP, 9 from JKSNR, and 6 from the PTFD. The highest density of snow leopards (6.1 individuals per 100 km^2) was observed in JDNP, in the areas adjoining Soe and Lingzhi Park Range to the southwest (Figure 3; DoFPS 2016).

Camera trap data from JDNP showed that about 48% of snow leopard images were captured from alpine rocky outcrops, about 35% from alpine meadows, and about 17% from scrub forest. However, during the 2014-2015 nationwide sign survey, 56% of the snow leopard signs were observed in alpine meadows, 25% in alpine scree, 12% in scrub forest, 4% in fir forest, and 3% in rocky outcrops. These discrepant statistics likely reflect observer bias especially due to the inaccessibility of the terrain (much of the areas in the alpine areas are difficult to access for surveys and surveyors on foot), snow leopard behaviour, and their cryptic nature. Thus, more research on habitat use is urgently needed using unbiased methodologies such as satellite GPS collars that can track snow leopard movements and locations, and map them on satellite images. Continued use of methodologies that are subject to heavy researcher biases and constraints will only serve to provide more biased information about snow leopard ecology and population status.

A nationwide survey of blue sheep-the snow leopard's primary prey-could not be conducted to derive population estimates because of cadre constraints. But surveys in WCNP estimated the average blue sheep population density in the central and western ranges of the park at 1.8 and 2.4 individuals per km^2, respectively, which is relatively low compared to other adjacent blue sheep range areas (Shrestha et al 2013). A double-observer method of estimating ungulate population (Forsyth and Hickling 1997), adapted for mountain ungulates by Suryawanshi et al. (2012) was tested in Lingzhi Park Range of JDNP by Leki et al. (2017), and can now be used to conduct blue sheep population surveys in all parts of Bhutan.

2.4 Need for a snow leopard conservation action plan

Despite the conservation potential for snow leopards in Bhutan, the threats and challenges are growing. Climate change has now emerged as a very real and pervasive threat to natural ecosystems and human communities in Bhutan, especially in the alpine regions. Projections, based on current trends, suggest that Bhutan will experience a 3.5°C increase

in temperature by 2069, and a steady increase in rainfall to over 500 or 600 mm annually, with rainfall patterns deviating from the predictable, monsoon-driven regime to a more erratic regime (RNR 2016). Other analyses have indicated a northward movement of forests, agriculture, and species into the alpine regions (Lhendup et al. 2011). More favourable living conditions in the alpine areas could encourage anthropogenic land use changes as people seek refuge from warming and crowded conditions in the south (Forrest et al. 2012). All of this can affect persistence of snow leopards in Bhutan. Thus, a holistic approach to snow leopard conservation is timely; one that places Bhutan's snow leopard conservation opportunities and contributions within a regional context, and integrates climate change impacts that will become manifested at scales and ways that will require landscape-scaled approaches, and includes and integrates conservation with human land and resource use patterns. This action plan will be the first that will seek to do this.

3. THREATS AND CHALLENGES TO CONSERVATION OF SNOW LEOPARDS AND PRINCIPAL PREY

3.1 Key threats to snow leopards in Bhutan

Key threats to snow leopards, blue sheep (the primary prey species), and their habitats were discussed and assessed during several consultative meetings with the staff of field offices, NCD, and WWF experts. Miradi software was used to identify the relationships among these threats and their impacts on the conservation targets by mapping out a conceptual model (Figure 3). The threats were then ranked and prioritized based on scope[1], severity[2], and irreversibility[3] (Table 1)

3.1.1 Climate change

Climate change has now emerged as an overarching global threat to ecosystems, human communities, and development targets and aspirations (IPCC 2014, Parmesan 2006). Mountain ecosystems and their biodiversity are especially vulnerable to climate change impacts, and the Himalayas are not exempted (Beaumont et al. 2011, Shrestha et al. 2012). Climate projections indicate there could be shifts in vegetation, species extinctions, and changes to ecosystem service delivery, with cascading consequences along the ecosystems and to human livelihoods and lives (Xu et al. 2009).

Analyses suggest that snow leopards, their prey species and habitats are also vulnerable to the changes brought about by climate change (Forrest et al. 2012, Li et al. 2016). Climate models suggest that the treeline in Bhutan will shift northward and upwards along the mountains, intruding into alpine scrub and meadows (Figure 4; Lhendup et al. 2012). These projections are being verified through field research by a scientist from the Ugyen Wangchuck Institute for Conservation and Environmental Research (UWICER).

As the temperatures and seasonality becomes milder, creating conditions for forest expansion into alpine meadows, it is more likely that the alpine meadows and scrub will be converted to anthropogenic land uses such as horticulture and agricultural lands before forests could grow (Forrest et al. 2012). This change in land use is already happening in Nepal's Trans Himalayan region, where large areas of alpine scrub and

1 The proportion of the target that can reasonably be expected to be affected by the threat within ten years given the continuation of current circumstances and trends. For ecosystems and ecological communities, measured as the proportion of the target's occurrence. For species, measured as the proportion of the target's population.

2 The level of damage to the target that can be expected with continuation of current circumstances and trends. For ecosystems and ecological communities, typically measured as the degree of destruction or degradation of the target within the scope. For species, usually measured as the degree of reduction of the target population within the scope.

3 The degree to which the effects of a threat can be reversed and the target affected by the threat restored.

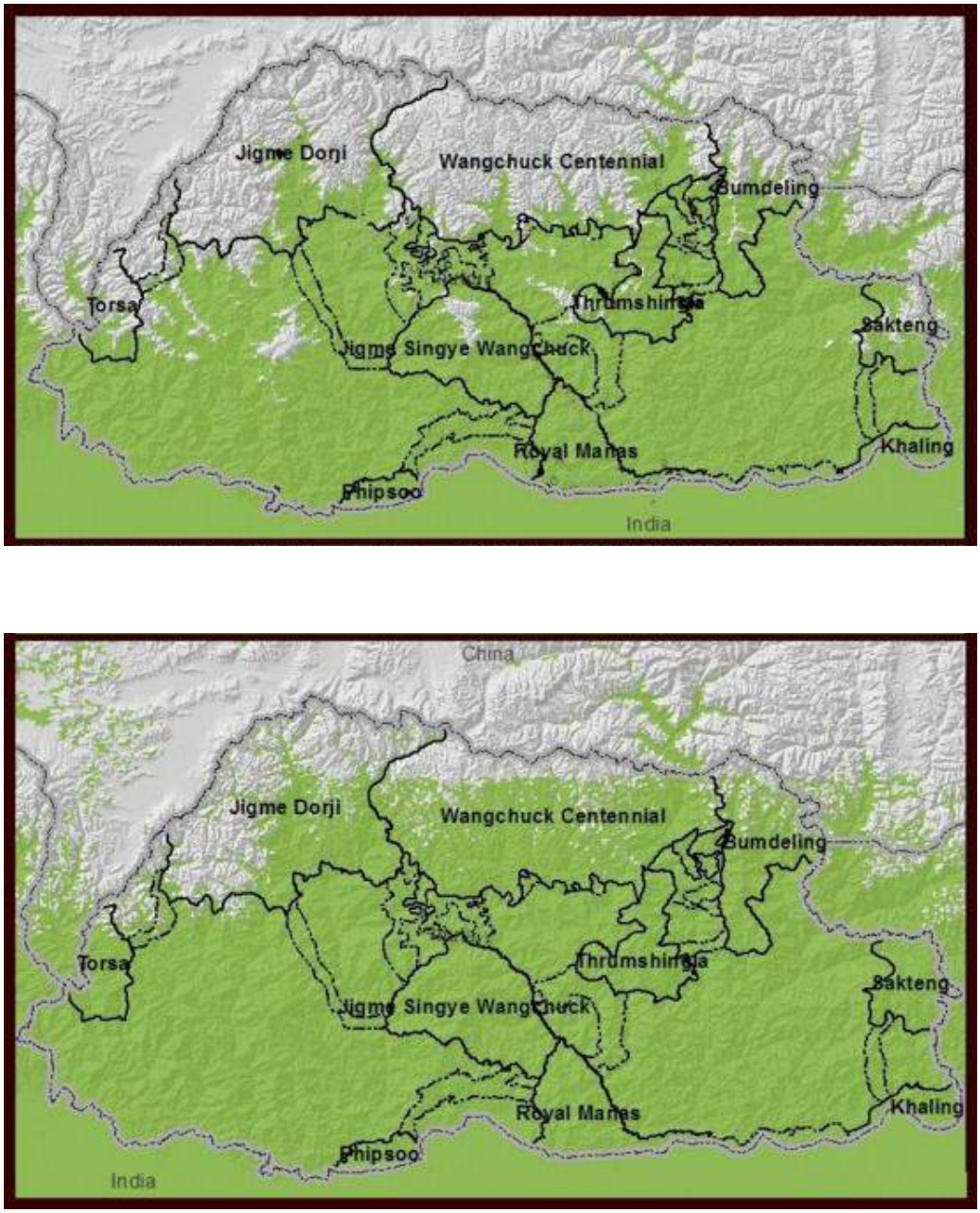

Figure 4. Northward shifts of forests expected in Bhutan based on climate models. Map from Lhendup et al. 2012. Green areas represent forest cover.

scree are being converted to fenced apple orchards. Regardless of the type of change, climate change could reduce the extent of habitat for snow leopards and their prey species, trapping them in a narrower and fragmented space, between a hypoxic zone where occupation will be prevented by oxygen deprivation, and unsuitable habitat in the southern boundary. Janecka et al (2015) have shown that snow leopards do not possess genetically determined physiological adaptation mechanisms for high-altitude, hypoxic conditions. Thus, it is unlikely that snow leopards in the high elevations of the Himalaya could adapt fast enough to live in hypoxic elevations since the impacts of climate change will occur relatively more rapidly than physiological evolution.

As the extent of alpine habitats shrinks, there will be less grazing areas for domestic livestock, potentially increasing competition with wild ungulates. If the ungulate prey populations then decline, the snow leopards will have less wild prey and begin to prey on domestic livestock, thus increasing conflict with local people.

Climate change could also change the ecological community of alpine ecosystems as invasive flora out-compete and exclude alpine species, contributing to an overall change and degradation of the ecosystem community structure and function. Degraded ecosystems are less resilient to climate and environmental change (Thompson et al. 2009). Thus, the combined effects of increased rainfall occurring as intense weather events that can cause landslides, floods, and even GLOFs and ecosystem degradation in the upper and mid-elevation watershed will endanger the lives and livelihoods of people living in downstream and downslope areas.

Overall, then climate change is expected to have wide-ranging, over-arching, and cascading impacts on the biodiversity and human communities in the alpine areas of Bhutan. It is therefore necessary to build resilience against these changes as a proactive measure, following a precautionary principle, by conserving ecosystem integrity through appropriate conservation actions. These will include conserving the ecosystem structure and community composition of the alpine meadows, preventing degradation, and introducing adaptation strategies as safeguards to vulnerable mountain communities.

3.1.2 Degradation of alpine meadows

Degradation of alpine meadows was identified as a direct and important threat to snow leopards and blue sheep. In addition to climate change (described above), there are several other drivers that contribute to habitat degradation. Cordyceps and other alpine medicinal and incense plant collection and the ancillary activities of the collectors are significant contributors to habitat degradation. Since the legalization of Cordyceps collection in 2004, hundreds of collectors converge on the alpine areas to collect this

caterpillar fungus that commands high prices in the commercial market. Monitoring collection levels is difficult in Bhutan's high mountain region, especially since there is very few park staff that can be deployed to cover the vast expanses of difficult terrain. Collectors strew large quantities of trash (mostly plastic wraps, cloth, plastic and glass bottles, and used batteries) in the alpine meadows, and these accumulate throughout the years. This trash kills plants by smothering them and changing the micro-climatic conditions that retard growth. Batteries release toxic chemicals into the sensitive and fragile ecosystems. Some collectors also use unsustainable harvesting methods to collect the Cordyceps by digging and loosening the soil as they search for the caterpillar fungus. These methods impede regeneration of the meadow community, facilitates soil erosion, and continues to degrade the ecology of this alpine ecosystem. The Cordyceps collection period also coincides with the blue sheep birthing period, from May to July (Wegge 1979; Wilson 1981), and the presence of hundreds of collectors can cause stress and disrupt blue sheep birthing that will eventually affect population growth rates.

Trekkers, trekking companies, and even local people also discard garbage, including into water bodies. These irresponsible practices have to be prevented. Visitors and trekking companies have to be educated to ensure that they bring back all solid waste that is taken into the alpine areas, and a strict Garbage In-Garbage Out (GIGO) policy should be adopted, backed by regulation.

Unregulated camping is another driver of habitat degradation, especially in JDNP. Tour guides are reportedly setting camps outside of designated campsites, and in areas that are intrusive to blue sheep and snow leopards. Park management is unable to cope with the rising demands from the tourism sector, and there has to be better collaboration between the Tourism Council of Bhutan (TCB) and the Department of Forests and Park Services' Nature Conservation Division (NCD).

Although there aren't many large infrastructure in the alpine areas, there could be plans to construct highways and other linear infrastructure in the future, especially if market based agriculture and horticulture is introduced in the alpine regions. Such linear infrastructure has been built or are planned in other regions of the Himalaya, and include trans-national highways, and could happen in Bhutan in the future. Any such infrastructure should be planned to ensure they are climate resilient and will not disrupt ecological connectivity. Appropriate safeguards should be included through responsible EIAs, including during the construction phases.

Natural disasters, such as GLOFs and landslides can contribute to localized habitat degradation. Fires can cause more widespread degradation, especially if extended dry periods exacerbated by climate change causes more frequent and severe fires that could drive alpine meadows and scrub beyond the thresholds of resilience, retarding recovery.

3.1.3 Habitat loss and fragmentation

Habitat loss and fragmentation in the alpine region is considered in the context of climate change. As indicated earlier, forest intrusion and anthropogenic land uses can potentially convert and fragment the continuity of alpine meadows and scrub habitats (see ICIMOD 2016), severing ecological connectivity for snow leopards and affecting population persistence. Conversion of alpine meadows will also reduce the extent of habitat available for wild prey species and for domesticated livestock.

3.1.4 Natural disasters

Flash floods, landslides, and unusually dry winters are now occurring more frequently. The rapidly melting glaciers and heavy rainfall are expected to increase the probability of GLOFs that leave downstream communities vulnerable. These changes and trends in natural disasters are attributed to climate change, and will leave mountain communities vulnerable (ICIMOD 2016).

3.1.5 Livestock depredation

Yak rearing is the main source of livelihood of the people living in alpine regions of Bhutan. Although depredation of yak—especially juveniles and calves—is occasionally reported, there seems to be considerable tolerance with little evidence of retaliatory killing. According to records only three cases of retaliatory killing of snow leopard were reported, possibly because of the compensation scheme. However, this livestock compensation scheme has now been discontinued because of inadequate funds to sustain it, and there is a possibility that retaliatory killings could resume. Thus, alternative income sources with links to snow leopard conservation should be made available to prevent killing.

3.1.6 Livestock grazing levels

The levels of livestock grazing and trends are in dispute. According to annual livestock statistics available from the Department of Livestock (DoL), the yak populations in Bhutan are increasing, and so is the demand for grazing areas. An increasing trend in livestock populations could degrade the ecologically sensitive and fragile alpine meadows, resulting in degradation of the ecosystem and sustainability of the practice and livelihoods and associated cultural practices. It can also potentially increase competition for fodder between blue sheep and livestock, with consequent increases in human-wildlife conflicts. A case study on the nature and intensity of fodder competition between blue sheep and domestic ungulates was conducted in Lingzhi Park Range in 2016, and the preliminary report suggests there is dietary overlap (personal communication, Leki, Park Range Officer for Lingzhi Range). Similar overlaps have been reported in other alpine areas of the Himalaya, but under high stocking rates (Shrestha and Wegge 2008).

However, other studies indicate that Yak-based pastoralism is declining in Bhutan (Wanchuk 2017), as younger generations pursue alternate lifestyles and livelihoods, and consider transhumant pastoralism as 'backward' (Namgay et al. 2014). Surveys show that over the past decade, there has been a 31% decrease in the number of yak-herding households (Wanchuk 2017), although it is unclear if this is also associated with a decline in the actual yak population and grazing intensity. There are now recommendations for government policies to encourage, support, and sustain transhumant pastoral lifestyles in the alpine areas (Wangdi 2016).

These opposing views require urgent attention because both, over-grazing and under-grazing of alpine meadows can result in degradation of this ecosystem that is essential habitat for snow leopard conservation. The alpine meadows support the primary prey species (blue sheep) of snow leopards. Overgrazing by domestic livestock could result

in loss of fodder and grazing areas for blue sheep, and declining blue sheep populations can also result in escalating livestock depredation by snow leopards.

On the other hand, under-grazing of alpine meadows because of a decline in livestock numbers could cause the alpine meadows to be encroached by trees and shrubs. However, it is also likely that the decrease in livestock populations will allow blue sheep populations to increase, and maintain alpine grasslands. Such an increase in blue sheep populations will also allow snow leopards to thrive as prey availability increases. Predator-prey dynamics of other large carnivores show that densities and population sizes are closely related to prey availability (Karanth et al. 2004). Thus, research is necessary to determine the ecological dynamics of grazing by livestock, wild ungulates, grassland communities and regeneration capacities of alpine meadows.

Herders also remove alpine shrubs for firewood, which causes soil erosion and landslides in the alpine meadows. Proper monitoring and regulation of such activities are challenging in the large protected areas since the park offices are a considerable distance from the park boundaries.

3.1.7 Disease

Disease transmission from domestic livestock and feral dogs to wild ungulates and snow leopards is an important, but often overlooked threat. Foot and mouth disease has been reported in livestock from some areas and can be transmitted to wild ungulates such as blue sheep, takin (*Budorcas taxicolor whitei*), and musk deer (*Moschus chyrsogaster*). Livestock officials also point to the possibility of the spread of the disease known as 'black quarter', which is caused by a bacterium (*Clostridium chauvoei*), from yaks and horses to the wild ungulates. While livestock can be and are vaccinated, if these diseases spread to wild ungulates they will be harder to control.

Packs of feral dogs in the alpine areas can also spread diseases such as canine distemper and rabies to snow leopards. Apart from that, parasites (external and internal) are also a threat.

3.1.8 Feral dogs

There are increasing numbers of feral dogs in alpine areas. Most of the dogs are brought from the lowlands by local trekkers, pilgrims, tour guides, traders, and yak herders. These dogs are already harassing yaks, and there is concern that the dogs would begin to kill blue sheep and even snow leopard cubs, and the possibility of disease transmission to snow leopards and other wildlife.

3.1.9 Wild prey depletion

Killing of blue sheep happens rarely, but there are a few reports of killings by local people, visitors from the lowlands, and medicinal plant collectors. In some cases, border security forces were alleged to have killed blue sheep when rations were in short supply. Retaliatory killing by herders as perceived competitors with livestock on grazing area do not seem to be a significant threat.

However, wild prey populations could also become depressed because of habitat degradation and consequent loss of nutritious food necessary for the ungulates to survive winters. Large numbers of medicinal plant collectors and herding communities displace blue sheep to smaller and marginal alpine habitats where density-dependent population controls restrict population growth.

3.2 Challenges to conservation of snow leopards and prey in Bhutan

The principal challenges and contributing factors to snow leopard and prey conservation were also exhaustively discussed during the consultative meetings, especially with field staff from the snow leopard areas.

3.2.1 Proximity to the international border

One of the biggest challenges to snow leopard conservation is the proximity to international borders with China and India. The market demand for snow leopard and other wildlife parts and products in international illegal market is high, and monitoring, patrolling, and protection along the long, porous border is extremely difficult, especially with the small protected areas cadre. Thus, monitoring has to be strategic based on intelligence from local communities and engaging them as guardians or stewards.

3.2.2 Rugged terrain

The snow leopard habitats in Bhutan are mostly characterized by steep gorges and valleys with precipitous cliffs that are very difficult for people to traverse. The harsh climatic conditions in the high elevations add to the difficulty of access and patrol.

3.2.3 Poor awareness among local people

There is little awareness among the local communities about the conservation significance of snow leopards and prey, and the roles they play in maintaining ecosystem structure and function. There are also a number of local people who view protected areas and conservation policies as being restrictive and pose threats to their livelihood, instead of seeing them as national and even global assets of which they could become guardians.

Thus, considerable awareness is required to apprise them of the benefits and importance of conserving mountain biodiversity and take pride in their contributions as guardians of Bhutan's natural assets.

3.2.4 Lack of adequate funds

Bhutan is still a donor-dependent country, and most capital expenditures require external fund support. As such, the government cannot set aside a sustainable budget towards conservation activities. Very recently, the government had to stop the livestock compensation scheme, which provided monetary compensation to livestock owners whose livestock have been depredated by wildlife, including by snow leopards. Limited funding also restricts transportation and communication facilities, and general equipment required for effective patrolling and monitoring. Most field offices require permanent structures in strategic locations to enable effective patrolling and anti-poaching operations. Frontline staff cannot be provided with sufficient travel allowances and training opportunities on patrolling and wildlife surveys, monitoring, and management. The Bhutan for Life fund will support most of the activities proposed in this plan.

3.2.5 Dependence of local people on natural resources

The local people living in snow leopard areas are heavily dependent on natural resources for their livelihoods that range from grazing pastures to collection of firewood, medicinal and aromatic plants. This heavy dependence puts a lot of pressure on the natural resources, making management a daunting task due to frequent conflicts arising between the local people and the field staff. The field officers are frequently blamed by the local governments for delays in issuing resource allocation permits.

3.3 Information gaps

There are several information gaps that have to be addressed for better conservation of snow leopards and prey, and to manage the habitat at landscape scales with ecological and demographic connectivity.

3.3.1 Snow leopard ecology, habitat, and ranging behaviour

All information related to habitat use by snow leopards are based on sign surveys and camera trap data. These data are inherently biased since they are collected from areas that are accessible to researchers who conduct the surveys, while snow leopards likely use other rugged, steeper, and higher terrain. Thus, an unbiased habitat assessment will require satellite GPS collaring of snow leopards. These data, when overlaid on satellite images classified for land cover, will provide a better understanding of habitat use

and preferences of snow leopards, including movement pathways. This information is essential to define and protect movement corridors for metapopulation management of snow leopards and to identify core habitat.

Recently, a snow leopard was captured by a camera trap placed in an isolated patch of alpine habitat in the northern parts of JSWNP. Satellite GPS collaring a snow leopard in this patch of habitat will provide information about the movement pathways and habitat used by snow leopards in JSWNP. For instance, if the snow leopard in JSWNP arrived there from the northern regions, it would have used forested habitats, which are not considered to be preferred habitat of snow leopards. This information will be highly useful to manage snow leopard habitat and connectivity under climate change conditions, when forests are expected to intrude into the alpine areas.

3.3.2 Poaching incidences

No information exists on the extent of snow leopard and blue sheep poaching in Bhutan. But the lack of information does not necessarily mean such illegal activities are absent because the large areas and porous borders are hard to monitor. The participants from field offices agreed that this is an important threat that requires investigation and vigilance. Staff from JDNP and PTFD reported the presence of traps set for various animals, including the snow leopard, during anti-poaching patrols. Camps and caves used by poachers were frequently seen in JKSNR, PTFD, and JDNP. The close proximity to the international border allows poachers to transport snow leopard parts with relatively little probability of being detected. Thus, better information must be gathered, including by forming an intelligence network consisting of local communities and border security. This information, together with SMART patrolling reports will help to build a better database with predictive capability to address poaching.

3.3.3 Population status of the blue sheep

There is no information on the population estimates and densities of blue sheep in Bhutan, except in limited areas, such as in WCNP. Consequently, there is no way tracking their population status and to establish a baseline to manage the desired population.

3.3.4 People's attitude towards snow leopards

There is no baseline information to gauge and monitor local people's perceptions and tolerance levels towards snow leopards. Several livestock insurance schemes have been established in the upland communities, but their efficacy towards snow leopard conservation is yet to be assessed.

3.4 Overall threat analysis and priority ranking

Overall, the threat rating for snow leopard conservation was Very High (Table 1), with threats to snow leopard populations and habitat ranked as High. Threats to local communities, that would discourage them from becoming willing conservation stewards of snow leopards was ranked as Medium; which also requires actions to elicit a positive response, attitude, and contributions towards conservation.

Among the individual threats, Cordyceps and other NFWP collection was given the highest threat ranking, being ranked High for its impact on snow leopard population conservation and recovery and Very High for its impact on habitat. Climate change was given a combined rank of Medium, while the impact on snow leopard populations was High, driven by the Very High score for Scope and High scores for Severity and Irreversibility. Degradation of alpine meadows scored High for its impact on snow leopard habitat and Medium for its impact on the snow leopard population. Livestock depredation scored High, mostly because the threat was extensive in Scope and High in Severity.

Thus, the priority actions should be to address the impacts from Cordyceps and other NFWP collections and climate change, which can act in synergy with several other identified threats and challenges. Degradation, loss, and fragmentation of alpine meadows, and containing and preventing natural disasters are the overall threats that have to be addressed, while tackling poaching, retaliatory killing, feral dogs, spread of diseases are important to ensure snow leopard population stability and growth. Livestock grazing was not ranked because it requires further investigation to understand the interactions of livestock grazing, ecosystem community structure and response of wild prey populations.

Table 1. Miradi table of threats for each target ranked by scope, severity, and irreplaceability.

Threats \ Targets	Snow Leopard populations...	Snow leopard habitat ...	Engage local comm...	Summary Threat Rating
Climate change	High	Medium	Medium	Medium
Cordyceps and other NFWP collection	High	Very High	Medium	High
Degradation of alpine meadows	Medium	High	Low	Medium
Disease	Medium			Low
Feral Dogs	Medium		Not Specified	Low
Infrastructure	Low	Medium	Low	Low
Killing Prey	Medium		Not Specified	Low
Livestock depredation	High		Not Specified	Medium
Livestock Grazing Levels	Not Specified	Not Specified	Not Specified	Not Specified
Loss and fragmentation of alpine meadows	Medium	Medium	Medium	Medium
Natural disasters (Fire, landslises, GLOFS)	Low	Medium	Medium	Medium
Poaching snow leopards	Medium			Low
Retaliatory killing of SL	Medium			Low
Solid waste	Low	Medium	Low	Low
wild prey depletion	Medium			Low
Summary Target Ratings:	High	High	Medium	**Overall Project Rating** Very High

4. CONSERVATION OPPORTUNITIES

4.1 National policies and regulations

The Royal Government of Bhutan provides strong administrative and policy support towards conservation of natural resources; Article 5 of the Constitution mandates the government to recognize every Bhutanese as a 'trustee of the Kingdom's natural resources and environment'. The Forest and Nature Conservation Act of Bhutan 1995 accords the highest protection status to the snow leopard by listing it in Schedule I. The Forest and Nature Conservation Rules and Regulations of Bhutan 2017 imposes the maximum penalties for killing or illegal possession of snow leopard parts (DoFPS 2017). Killing a snow leopard is considered a fourth degree felony under the Penal Code of Bhutan.

There are also several other laws and regulations that are relevant to protection of habitat by ensuring obligatory environmental safeguards, such as the Environment Assessment Act of Bhutan, 2007, and Bhutan Water Policy, 2007 that requires EIAs and watershed protection, respectively. The National Forest Policy of Bhutan 2011 (MoAF 2011) strives to 'maintain species persistence and ensure long-term sustainability of Bhutan's biodiversity, ecosystem services, natural habitats through a network of protected areas, biological corridors and management of other parts of the landscape for positive environmental outcomes'. These policies also rationalizes the existence of the protected areas and biological corridors, and zoning within them to ensure persistence of snow leopard and prey species.

4.2 Institutional mechanisms

The Department of Forests and Park Services (DoFPS) within the Ministry of Agriculture and Forests (MoAF), is the institution mandated with implementing the snow leopard conservation plan. Within the DoFPS, the Nature Conservation Division (NCD) is tasked with conservation of plants and animals and nature recreation within and outside the protected areas, the Social Forestry and Extension Division (SFED) has oversight of community-based natural resource management in and outside the protected areas, and the Forest Resources Management Division (FRMD) is responsible for permitting science-based harvesting and allocation. The Ugyen Wangchuck Institute for Conservation and Environmental Research (UWICER) is mandated to conduct forestry and wildlife research and training of forest guards. Thus, all these institutions will have to work collaboratively to implement this plan.

Field offices can span several districts (*Dzongkhag*), and are administratively divided into several range offices or warden posts, each of which is stationed in a Dzongkhag. Each range office will have several sub-range offices that cover a sub-district (*Gewog*). The field offices are headed by a Chief Forestry Officer or a Park Manager. Each sub-range office is manned by at least five forest guards. The biological corridors are managed by the Forest Divisions.

4.3 Land tenure

The Land Act of Bhutan 2007 (Chapter 10, Section 235) has rescinded the pasture ownership rights of the people and reverted all privately registered pasturelands (*Tsamdro*) to Government Reserve Forest. Thus, virtually all snow leopard and blue sheep habitats are now state property. The Act stipulates that a reverted pastureland shall be leased for a period of 30 years (with the possibility of extension) to a lessee who will be a resident of the Dzongkhag where it is situated. The DoL and the DoFPS shall jointly prepare pastureland management plans and the lease agreements will be based on these plans (Section 247). This enables the government to scientifically manage snow leopard and blue sheep habitats. In pursuance of this Act, the respective park management authorities have conducted management zoning of their jurisdictional areas, and in consultation with the local people, the park management can demarcate core areas for snow leopard conservation.

Currently, there are issues with core area designation which have to be addressed to avoid confusion and conflict. Some propose a contiguous core zone while others suggest several core zones in different areas. In some areas, such as in JDNP, the core zone constitutes more than 70% of the park, and will have to be re-zoned to avoid conflicts with the local people. The zoning will have to be informed by the results of the national snow leopard and prey species survey, and ideally, also by satellite GPS tracking research. Section 392 (Chapter 12) of the Forest and Nature Conservation Rules and Regulations of Bhutan 2017 prohibits collection of Non-Wood Forest Products from the core zones, and Section 403 (Chapter 13) prohibits construction of any structure in the core zones. These sections restrict local people's activities, such as collection of medicinal plants, building herder camps, and collection of firewood in the core zone. Thus, park management must conduct careful assessments of local community land and resource uses with conservation priorities and develop appropriate strategies and actions

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4.4 Stakeholders and conservation partners

4.4.1 Government Agencies

- The Tourism Council of Bhutan (TCB) is responsible for regulating tourism and formulating tourism practices. The DoFPS will work with TCB to strategize and implement ecotourism within and outside the protected areas.
- The Department of Traditional Medicine Services (DTMS) of the Ministry of Health collects wild medicinal plants, including from alpine areas, with permission from the DoFPS, and will help in identification and conservation of the high altitude medicinal plants.
- The Department of Hydropower Services (DoHPS) of the Ministry of Economic Affairs will work with the DoFPS for water source protection, including plantation and soil conservation in the water catchments.
- The National Environment Commission (NEC) is the focal agency for environmental acts and policies that support protection.
- The Department of Livestock (DoL) is responsible for livestock development and pastureland management in the alpine areas.
- The Department of Agriculture Marketing and Cooperatives (DAMC) will collaborate with DoFPS in marketing medicinal plants and other Non-Wood Forest Products, and the formation and training of community-based natural resource management groups.
- The Department of Culture (DoC) of the Ministry of Home and Cultural Affairs regulates preservation and maintenance of sacred cultural sites, meditation centres, and retreat sites, most of which are located in snow leopard habitats.
- The Local Governments, particularly the Dzongkhag Administrations and Gewog Administrations of MoHCA are key partners in conservation of natural resources, and responsible for planning and implementing developmental activities within the Dzongkhags and Gewogs. The field offices can incorporate conservation projects into the local development plans in partnership with the local governments to avoid redundancy and conflict of activities.
- The Department of Revenues and Customs are key partner in regulating the export and import of goods including prohibited wildlife products.

4.4.2 Institutes

- The College of Natural Resources in Lobesa, of the Royal University of Bhutan trains forest rangers, and is a key partner in human resource capacity development.

- The Ugyen Wangchuck Institute for Conservation and Environmental Research (UWICER) is the research and training arm of the department.
- The National Institute of Traditional Medicine of the Department of Traditional Medicine Services (DTMS) is the authorized agency to collect medicinal plants from the alpine areas.
- The Dratshang Lhentshog of the Central Monastic Body collaborates with the DoFPS to educate the monks and rural people on wildlife conservation.

4.4.3 Corporations

- The Natural Resources Development Corporation Limited (NRDCL), is a key partner with regard to commercial harvesting of resources from the snow leopard areas.
- The Druk Green Power Corporation (DGPC) looks after management of key hydropower companies in Bhutan, and is thus an important end-user of the ecosystem services provided by the DoFPS. The company collaborates with the DoFPS in conservation and management of the watersheds.

4.4.4 Non-Governmental Organizations (NGOs)

- The Royal Society for Protection of Nature (RSPN) partners with DoFPS in managing critical conservation areas outside the protected areas, and specializes in environmental education.
- The Bhutan Ecological Society (BES) conducts ecological research and mass advocacy, and can lead key ecological research and education.
- The Association of Bhutan Tour Operators (ABTO) works with the DoFPS to construct and maintain tourist campsites, home-stays, and ecotourism trails.
- The Guides Association of Bhutan (GAB) can train national tour guides in responsible nature recreation in accordance with the Forestry Act and Rules.
- The National Commission for Women and Children (NCWC) can help to mainstream gender and improve women's participation in natural resource management in snow leopard conservation areas.
- The Tarayana Foundation, a charitable organization, can support community development projects in the remote areas of Bhutan.

4.4.5 Conservation donors

- The WWF Bhutan Program is a donor and conservation partner in Bhutan since 1997, WWF will remain a key partner for snow leopard conservation in Bhutan.

- The Bhutan Trust Fund for Environmental Conservation (BTFEC), established in 1992, supports conservation projects within and outside the protected areas.
- The UNDP office in Bhutan is currently the implementing agency of the GEF-6 project cycle, including the Small Grant Projects (SGPs) to support area-based community ventures related to nature conservation.
- The Bhutan Foundation supports several conservation projects in JDNP that are relevant to snow leopard conservation.

4.4.6 Armed forces

The Royal Bhutan Police (RBP) is a crucial partner for information networking, apprehending, and detention of suspects and convicts related to wildlife crimes. The Royal Bhutan Army (RBA) can support surveillance, joint patrolling, and apprehending wildlife poachers and smugglers. Both RBA and RBP can be enlisted to help tackle forest fires and natural disasters related to climate change.

Participants of the Snow Leopard Conservation Plan Finalization Workshop held at Punakha, Bhutan

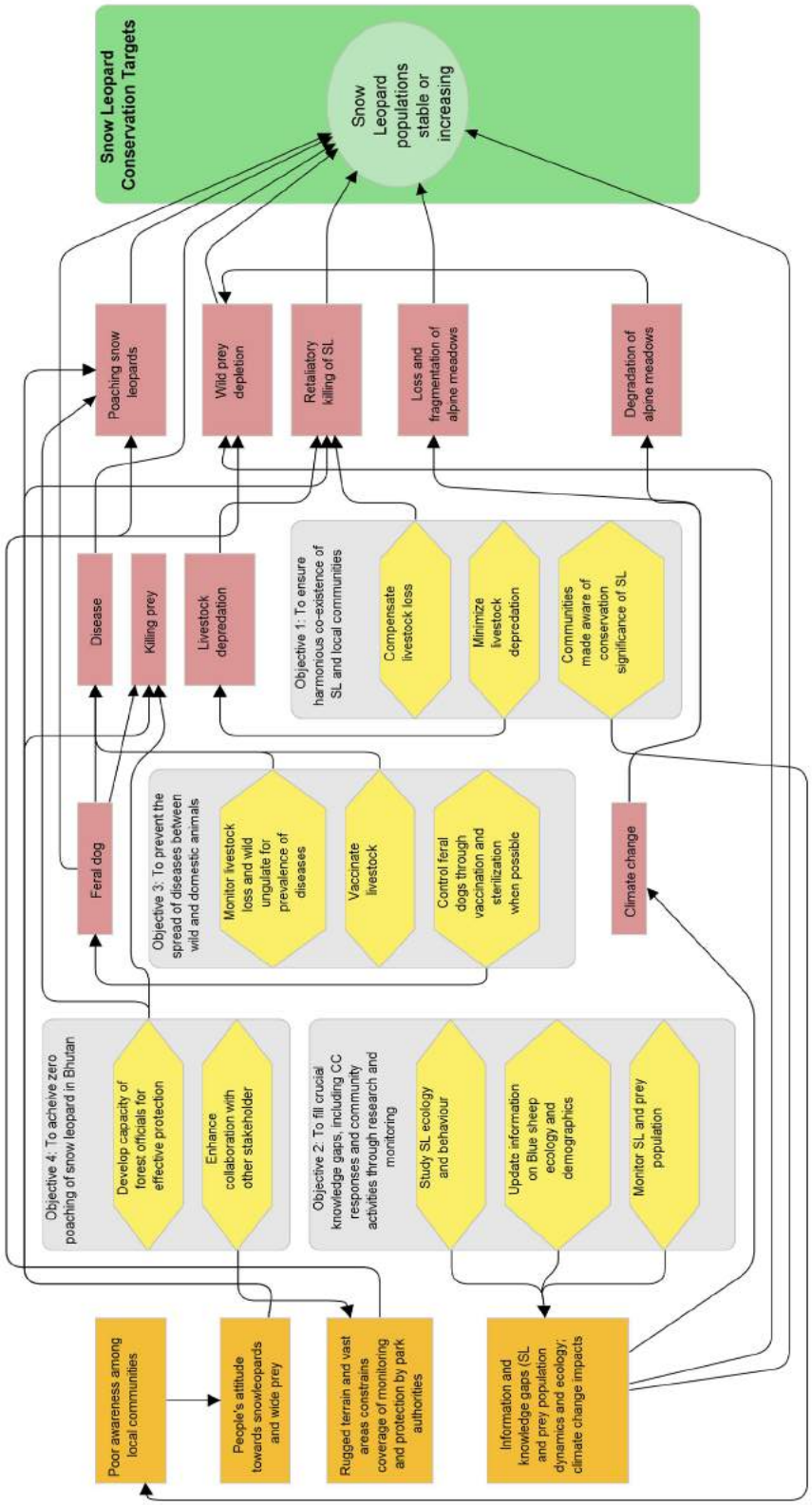

Figure 5. Objectives and Strategic Actions to achieve Target 1.

5. ACTION PLAN

5.1 Vision and Goal

Vision: Snow leopards in Bhutan are thriving, and local communities in the alpine areas are informed stewards contributing to their conservation.

Implicit in this vision is that for snow leopards to thrive and persist, they exist as a metapopulation with ecological, demographic and genetic connectivity across the northern alpine regions of Bhutan, from JKSNR to WCNP. It also assumes that climate change-driven vegetation and other anthropogenic land use changes to snow leopard habitat in the high elevation landscapes in Bhutan can be managed to allow ecological and demographic connectivity.

Goal: To maintain a viable population of snow leopards in Bhutan with ecological links to snow leopards in the eastern Himalayan mountain landscape.

5.2 2023 Targets and Expected Outcomes

Three conservation targets have been identified for the period, 2018-2023 to contribute towards achieving this longer term conservation goal. These will be achieved through strategic actions grouped under 8 objectives, including one cross-cutting objective for awareness-raising.

Target 1. By 2023, Snow leopard populations in Bhutan is stable or increasing.

Target 2. By 2023, important snow leopard habitat mapped and secured for conservation to ensure ecological and demographic connectivity of snow leopard population.

Target 3. By 2023, over 80% of the local communities are engaged as willing conservation stewards of snow leopards, prey species, and habitats.

Target 1 relates to snow leopard populations, whereas Targets 2 and 3 relates to conserving snow leopard habitat at landscape scales, with ecological connectivity for metapopulation management and local communities contributing to conservation as stewards and guardians.

It is important to note that this is an action plan for snow leopard conservation, and should be considered in that context, and with the presumption of: a) the existence of protected areas and corridor management plans into which the snow leopard actions can be integrated or vice versa; b) that community socio-economic development plans are being prepared, implemented, or funded by other line agencies and/or donors and

that they can be influenced to include activities that are compatible with snow leopard conservation; and c) that infrastructure development plans exist or are being prepared and the government custodians of conservation will be able to influence these plans. As such, this plan does not include activities or strategic actions that are aimed purely at socio-economic development or other park management activities. But the conservation agencies will liaise with these agencies and donors to coordinate and design appropriate projects and actions.

5.3 Expected outcomes and Theory of Change

Outcome 1. The outcome expected by implementing the strategic actions to achieve Target 1 is that the next population estimate would not show a significant decline in the snow leopard population because all major threats to snow leopards, from physical killing and harm to habitat loss and degradation, would be addressed.

However, it is important to note that this will be the first data point since the baseline was established, and should be treated as such. This is especially significant because of the large discrepancies in the various population surveys conducted in Bhutan. To some extent this discrepancy in both population estimates and densities likely reflect the difficulties and challenges in conducting unbiased snow leopard population surveys and deriving estimates for high mountain areas with complex topographies. The accumulation curve of new individuals captured by camera traps during the national survey continued to ascend even after 90 days of sampling. Thus, it is likely that the national survey has under-estimated the population. These studies also highlight the fact that without better knowledge of habitat use by snow leopards, extrapolating census data from a few localities to derive national-scale estimates based on habitat availability can provide uncertain results, especially since current knowledge of habitat use is biased.

The national survey was conducted using a grid-based structured methodology, where grids were placed in several locations in the protected areas. Given the issues with deriving a more precise survey, future surveys should use the same locations to place camera traps and conduct the population estimates using similar methodology. However, the population estimates should be derived for areas with grid clusters, and the population trends in each cluster used as an indicator metric to assess population status and trends, rather than to derive a national-scale estimate.

Outcome 2. Core snow leopard habitat and dispersal routes or movement pathways will be secured to ensure that adequate habitat is available to conserve at least 100 individuals at densities of >1 individuals/100 km^2 (based on the current population parametres and assuming the populations are not depressed) as a metapopulation.

Most of Bhutan's northern protected areas are vast and inaccessible to people (inter alia, park staff and researchers). All estimates of habitat suitability, population metrics, and attempts to map ecological connectivity are thus biased. Therefore, satellite GPS collaring of snow leopards is urgently needed to get a better understanding of habitat selection and use, movement patterns, and other ecological attributes of snow leopards in Bhutan. Using the outputs from these studies the habitat can be mapped, and core areas and movement pathways secured for conservation, protection, and management, based on the proposed actions.

Outcome 3. The local communities become willing conservation stewards, protectors, and citizen scientists to monitor snow leopards and their prey. The protected areas staff mandated with patrolling and protecting the northern landscapes have a near impossible task, and the porous border makes it even more difficult. Thus, protecting and managing this landscape for snow leopard conservation will require engaging the local people—the pastoralist community—as partners in this mission. The strategies and actions designed in this plan should engage these communities as willing stewards and citizen scientists, by: a) providing them with appropriate financial benefits from ecotourism linked to snow leopard conservation; b) ensuring they are less vulnerable to climate change; and c) raising their conservation awareness of the importance of snow leopard conservation and its contribution to global biodiversity stewardship.

It is important to note that there are other livelihoods related actions that will be implemented to benefit these communities. However, since the main target for this snow leopard conservation plan is to implement actions that have direct implications to achieve the goal of snow leopard conservation, they will not be included as part of this plan. However, conservation agencies should liaise with other line agencies, donors, inter alia to coordinate and design appropriate projects and actions.

Theory of Change. This strategic plan is intended to conserve Bhutan's snow leopard populations, and ensure that climate resilient habitat is secured and managed with the collaboration of local communities to manage these populations as a metapopulation. The theory of change on which the strategies are predicated are that effective patrolling by well-trained and well-equipped protected areas staff using SMART technology and approaches will improve protection effectiveness and efficiency, especially when coordinated with key law enforcement partners, informed by intelligence networks, and assisted by community stewards. The latter will be engaged and incentivized through economic revenue streams from livelihoods that are linked to the presence of snow leopards and sustainable landscapes linked to snow leopard conservation. These strategies will reduce snow leopard poaching for the commercial wildlife trade, conserve habitat

from unsustainable resource extraction by local communities and seasonal Cordyceps and medicinal plant collectors, and promote good visitation practices by tourists and tour operators. Public awareness of the significance of snow leopards and national pride in conservation of such a global flagship species will be raised, and the existing reverence among mountain communities towards snow leopards will be fostered.

Current knowledge of snow leopards and prey species are sparse and biased. Thus, the proposed research using modern technologies will inform development of robust, climate-integrated landscape-scaled conservation plans for metapopulation management with appropriate zoning of core areas and movement pathways or corridors.

The spread of diseases from domestic animals, including livestock and feral dogs, to wild ungulate prey and to snow leopards are a threat with the potential for devastating consequences. Thus, vaccination of livestock and removal of feral dogs have been proposed to mitigate this threat.

5.4 Objectives and Outputs

Target 1. In 2023, Snow leopard populations in Bhutan stable or increasing.

This target will be achieved through strategic actions (Figure 5) designed to stop all poaching of snow leopards for their parts and products which are in demand in the international illegal wildlife trade. Park staff capacity has to be strengthened, but because forest and park staff cannot effectively patrol the vast areas, engaging other stakeholders, including local communities as guardians is an important strategic action.

The target also requires better understanding of habitat use and requirements of snow leopards. Snow leopards require adequate prey to maintain populations and their distributions; thus, a comprehensive study of prey, especially of blue sheep, will be conducted. Studies of the interactions of blue sheep and livestock and their collective impacts on alpine ecology is also needed for better habitat management and zoning.

The presence of packs of feral or stray dogs in the alpine areas is of concern, especially in terms of the spread of diseases such as canine distemper or rabies. Dogs can also attack snow leopards and their prey species, and even displace snow leopards in some areas. Thus, the feral dog population will have to be controlled and monitored.

The spread of disease from domestic livestock to wild ungulates is also of concern. Thus vaccination programmes for livestock should be facilitated through the relevant departments, especially the Department of Livestock.

Conflict and potential for retaliatory killing due to depredation of livestock has to be prevented through pro-active actions to promote a more harmonious co-existence with local communities and elicit their stewardship.

Objective 1. To ensure harmonious co-existence of snow leopards and local communities and prevent retaliatory killing.

Output 1.1. ***Compensation mechanism to address livestock losses re-instated.***

Activity 1.1.1. Develop and strengthen livestock insurance/compensation schemes to adequately compensate the communities for the loss of livestock to snow leopards.

Output 1.2. ***Mechanisms in place to minimize livestock depredation by snow leopards.***

Activity 1.2.1. Carry out hotspot mapping to highlight spatial-temporal characteristic of the conflict to understand patterns and trends.

Activity 1.2.2. Pilot-test protective mechanisms such as enclosures and corrals to protect juvenile yaks against snow leopards.

Activity 1.2.3. Develop and implement proper livestock herding regulations in discussion with the communities.

Output 1.3. ***Communities aware of conservation significance of snow leopards.***

Activity 1.3.1. Conduct questionnaire surveys to assess people's perception towards the snow leopard and establish baseline for monitoring.

Activity 1.3.2. Conduct awareness and education programmes to the herding communities to make them aware of the significance and importance of snow leopard conservation, and encourage them to become citizen scientists and local conservation leaders.

Activity 1.3.3. Organize exposure visits for local leaders to learn about snow leopard conservation efforts both within and outside Bhutan.

Objective 2. To fill knowledge gaps necessary for snow leopard conservation through research and monitoring, including in response to community activities and climate change.

Output 2.1. ***Research on the demography, ecology and habitat use of snow leopard conducted.***

Activity 2.1.1. Use satellite GPS collars to determine habitat use, movement patterns and pathways of snow leopards.

Activity 2.1.2. Conduct a feasibility study for introduction of snow leopards to SWS and JSWNP.

Output 2.2. ***Studies on blue sheep ecology and demographics vis-à-vis grazing ecology, interactions with livestock conducted.***

Activity 2.2.1. Study the ecological relationships of blue sheep and livestock, and impacts on alpine meadow ecology.

Activity 2.2.2. Study and monitor zoonotic disease transmission from domestic ungulates to blue sheep and other prey species.

Output 2.3. ***The population of snow leopard and its prey monitored using structured, grid based camera trap surveys.***

Activity 2.3.1. Provide the cramera traps necessary for grid-based surveys and conduct refresher courses and training for field staff in handling, installation, and retrieval of camera-traps for snow leopard survey.

Activity 2.3.2. Conduct camera-trap surveys of snow leopards (in protected area and forest divisions) in the period 2020-22 (once every 5 years) to monitor and estimate population abundance, density, and occupancy, using the same grids for the national snow leopard survey of 2014 – 2016.

Activity 2.3.3. Monitor and assess the prey population dynamics of blue sheep and other prey species using SMART patrolling data.

Activity 2.3.4. Develop a database of camera-trap data for snow leopards with networked access in each field office, with the central data repository at the NCD.

Objective 3. To prevent the spread of diseases between wildlife and domestic animals.

Output 3.1. ***The prevalence of communicable diseases in livestock and wild ungulates monitored.***

Activity 3.1.1. Coordinate with the Department of Livestock to monitor the prevalence of diseases in livestock.

Activity 3.1.2. Train patrol teams to monitor wildlife for common disease and submit patrol reports.

Activity 3.1.3. Coordinate with the Department of Livestock to vaccinate livestock for disease.

Output 3.2. ***Feral dog population in the snow leopard habitats controlled.***

Activity 3.3.1. Identify strategic locations where feral dogs have greatest impacts on snow leopards, and capture, sterilize, and vaccinate.

Objective 4. To stop poaching of snow leopards in Bhutan.

Output 4.1. ***Capacity of forestry officials in snow leopard range parks and divisions developed for effective protection.***

Activity 4.1.1: Run SMART patrolling training programmes, provide necessary equipment, and ensure teams are deployed for patrolling.

Activity 4.1.2: Identify and map patrolling routes and surveillance sites in each snow leopard conservation area.

Activity 4.1.3: Develop and install a networked database of snow leopard and prey poaching levels with a baseline in each field office.

Activity 4.1.4: Train field staff and other relevant stakeholders (e.g. police) in proper wildlife forensics.

Output 4.2. ***Collaboration with other stakeholders strengthened.***

Activity 4.2.1. Strengthen collaboration with Royal Bhutan Police and Army, Customs, and BAFRA, inter alia to deal with poachers.

Activity 4.2.2. Develop community-based snow leopard monitoring and intelligence sharing networks with incentives to informants.

Activity 4.2.3. Upscale citizen scientist programme.

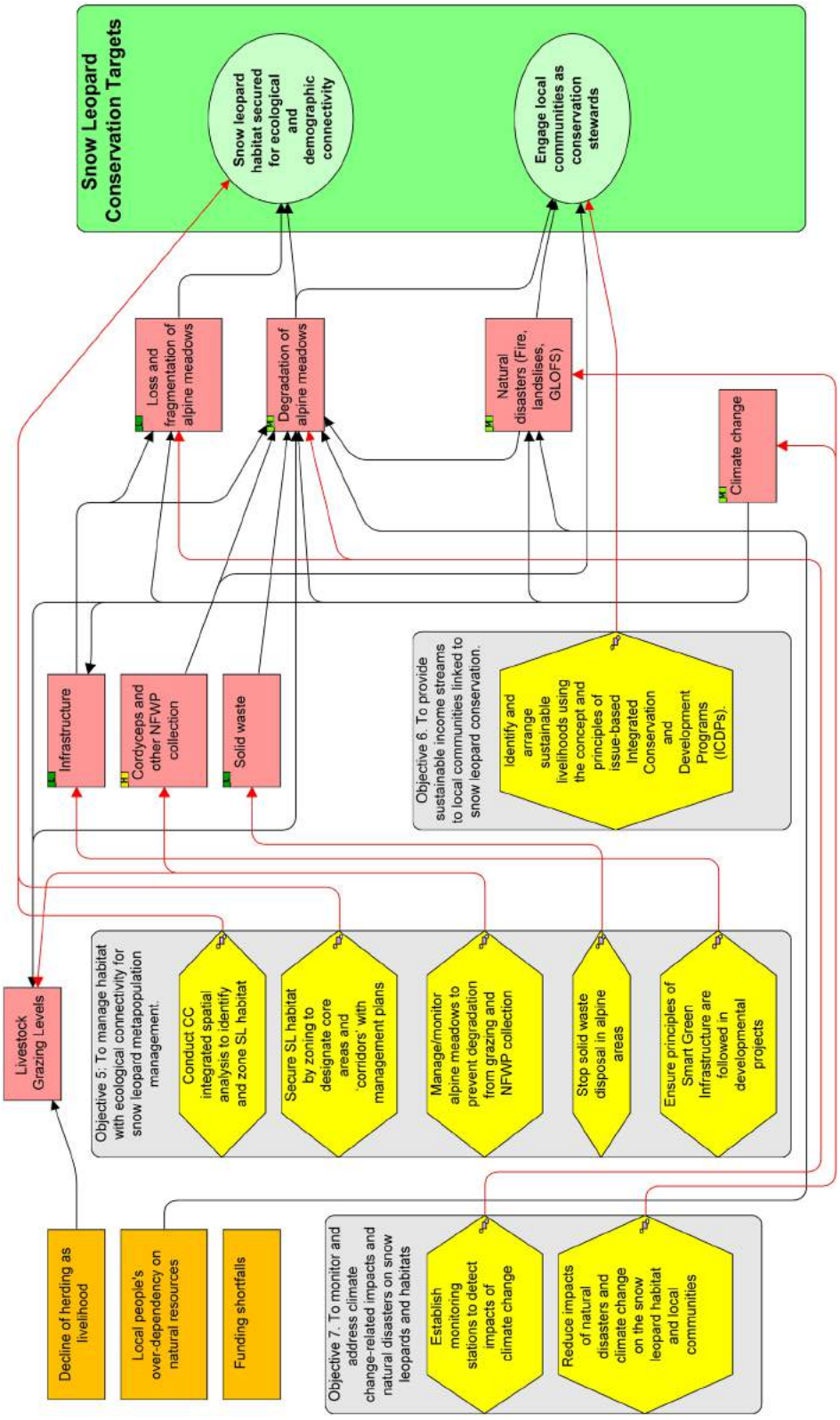

Figure 6. Objectives and Strategic Actions to achieve Targets 2 and 3.

Target 2. By 2023, important snow leopard habitat mapped and secured for conservation to ensure ecological and demographic connectivity for metapopulation management.

Target 3. By 2023, over 80% of the local communities are engaged as willing conservation stewards of snow leopards, prey species, and habitats.

These two targets will be achieved through strategic actions (Figure 6) designed to identify and secure important core habitats that will support breeding populations and dispersal pathways of snow leopards. Climate models will be used to identify climate resilient habitats, including the movement pathways that will be available for snow leopards if vegetation and land use changes driven by climate change occurs, for a 'win-win' conservation strategy. The habitat analyses will be informed by unbiased habitat use and other ecological and ranging behaviour information gathered using satellite GPS collaring and tracking snow leopards (see proposed activity in Target 1). Programmes to monitor snow leopard habitat, especially to check and take management actions on impacts from overuse, pollution, and exploitation of alpine grasslands, impacts from livestock grazing intensities (including the effects from decreasing livestock numbers), and any large infrastructure projects will be implemented.

There will be collaborative efforts with other donors, line agencies, and stakeholders to engage local communities as willing conservation stewards. NCD and other relevant conservation organizations will work with the line agencies to build snow leopard conservation into biodiversity and environmental related projects, and link economic streams to snow leopard presence and other aspects related to habitat conservation; for instance, the herder communities can also participate in ecotourism programmes as guides, providing home stays in the camps, etc. The forestry staff will also provide information and help local communities to monitor for natural disasters that could make the communities vulnerable, and help to identify refugia for people. The local communities will also be engaged as citizen scientists to monitor snow leopards and prey species.

Objective 5: To manage adequate habitat areas with ecological connectivity to maintain a viable snow leopard population in Bhutan.

Output 5.1. ***Climate change integrated spatial analysis conducted and suitable habitat identified and zoned.***

Activity 5.1.1. Conduct a spatial assessment of snow leopard habitats for metapopulation management, including of climate resilient habitats, using models based on empirical habitat use data and develop map for zoning.

Output 5.2. ***Climate resilient snow leopard habitat secured for conservation with appropriate management plans.***

Activity 5.2.1. Identify habitat management strategies and actions to maintain, manage, and protect ecological connectivity and integrate into protected areas and corridor management plans as part of adaptive management.

Activity 5.2.2. Identify areas for inclusion and management of salt licks and water sources.

Output 5.3. ***Alpine meadows monitored and managed to prevent degradation and loss from grazing and NWFP collection.***

Activity 5.3.1. Integrate and prescribe pasture management, as per the Land Act of Bhutan 2007 & Tsamdro lease agreement (FNCRR 2017), and livestock grazing regimes backed by research that provides an understanding of the ecological interactions of wild ungulate prey, livestock, and grassland ecology.

Activity 5.3.2. Work with the Department of Livestock to improve yak gene stock by supplying high yielding breeds to herder communities in strategic areas, where grazing and pasture management plans are being implemented on a priority basis.

Activity 5.3.3. Develop scientific management plans for sustainable NWFP collection and initiate group formation.

Activity 5.3.4. Conduct training and awareness programmes on sustainable management of NWFPs for the community groups.

Activity 5.3.5. Monitor NWFP collection.

Output 5.4. ***Solid waste disposal in alpine areas reduced.***

Activity 5.4.1. Institutionalize waste collection among the highland communities and conduct awareness program on proper waste management to the upland communities.

Activity 5.4.2. Work with TCB to designate proper camping sites and identify local operator to manage the sites.

Activity 5.4.3. Implement and enforce GIGO (Garbage In, Garbage Out).

Activity 5.4.4. Install signage and information boards informing of GIGO policy.

Output 5.5. ***Policy in place to ensure principles of Smart Green Infrastructure are followed in all development projects in the alpine regions.***

Activity 5.5.1. Develop relevant guidelines for Smart Green Infrastructure in alpine areas and integrate into government development policy for alpine regions.

Activity 5.5.2. Organize national and community level sensitization workshops on the necessity for infrastructure to follow 'Smart-Green' principles in alpine areas.

Activity 5.5.3. Organize exposure trips to understand the features of Smart Green infrastructure.

Activity 5.5.4. Monitor infrastructure planning, designing and development to ensure Smart Green features are integrated and safeguards are maintained during building, in collaboration with the Ministry of Works and Human Settlement.

Objective 6. To provide sustainable and alternative income sources to local communities linked to snow leopard conservation.

Output 6.1. ***Community development projects follow principles of sustainable development and resource use, and aligned with SDGs.***

Activity 6.1.1. Coordinate and collaborate with other line agencies and development donors to direct programmes to supply alternative fuel, construction materials, and energy sources to reduce local people's dependence on natural resources (based on a need assessment reflected in each of the park's conservation management plans).

Activity 6.1.2. Coordinate with TCB to develop an ecotourism strategy that directly involves alpine communities and snow leopard viewing and conservation (eco-trail development, homestays in herder camps, guide training, festivals, etc.).

Activity 6.1.3. Coordinate with TCB and monastic bodies to maintain culturally significant areas and monuments in the snow leopard conservation areas.

Objective 7. To monitor and address climate change-related impacts and natural disasters on snow leopard, habitats and communities.

Output 7.1. ***Vulnerabilities of local communities living in alpine areas to climate change and consequent natural disasters reduced.***

Activity 7.1.1. Adopt and implement Sustainable Land Management Program in degraded or affected (e.g., landslide sites) alpine areas (e.g., bio-fencing with native species, restoring degraded riparian areas, etc.).

Activity 7.1.2. Programmes to build awareness on forest and grassland fire prevention and management.

Activity 7.1.3. Conduct climate vulnerability assessment (CVA) of local communities in snow leopard habitats and propose adaptation actions to reduce vulnerabilities in line with protected areas management plans and snow leopard conservation strategies.

Activity 7.1.4. Organize awareness campaigns to sensitize local communities on the impacts of climate change based on CVA findings.

Activity 7.1.5. Organize study tours for local communities to other countries and regions to understand the impacts of climate change on community vulnerabilities.

Output 7.2. ***Monitoring programme to detect impacts of climate change in place and operational.***

Activity 7.2.1. Maintain and revive the climate and weather monitoring stations and flow discharge data loggers in the snow leopard and blue sheep habitats and gather periodic data, and train field staff in installation and maintenance of instruments.

Activity 7.2.2. Establish and monitor permanent vegetation plots to detect upward altitudinal shift in tree-line in the snow leopard and blue sheep habitats.

Cross Cutting Target: Awareness Programmes

Objective 8. To raise awareness on importance of snow leopard conservation at local and national levels.

Output 8.1. ***Awareness raised on the importance of snow leopard conservation at national and local levels.***

Activity 8.1.1. Conduct high-profile education and awareness campaigns on Snow Leopard Day to raise awareness on the conservation significance of snow leopards.

Activity 8.1.2. Organize national and international workshops to discuss and share lessons to mitigate the impact of climate change on snow leopards.

6. IMPLEMENTATION AND MONITORING PLAN

6.1 Manpower requirements

Implementing this snow leopard action plan will require a team of dedicated and well-trained staff. Therefore, MoAF and the DoFPS must retain and deploy trained cadres in field offices within the snow leopard conservation areas. Each field divisions and protected areas should have a minimum of 10 staff at the range office level to conduct regular field patrolling, surveys, monitoring, and other activities. The staff should liaise closely with other line agencies and local governments to facilitate and integrate snow leopard conservation requirements into community development and awareness programs, especially to achieve Target 3. The Chief Forestry Officers of the parks and forest divisions where snow leopard are found must appoint one focal person at the division level and another at the range level to coordinate these activities and submit timely reports to the NCD, which in turn will report to the department.

6.2 Equipment

The snow leopard surveys will require a large number of camera-traps and related survey equipment, satellite GPS collars, and implementation budgets. These funds will have to be sought from donor organizations, including from the Bhutan for Life Project, BTFEC, and WWF. To keep overall costs low, the existing camera-traps and survey equipment at NCD and field offices will be inventoried and defective camera traps repaired if possible.

6.3 Implementation mechanism

The respective protected areas and forest divisions where snow leopard are found will implement field-based activities while the NCD will be tasked with centrally coordinated activities such as major procurement, organizing workshops and seminars, coordinating surveys, and coordinating with the Global Snow Leopard and Ecosystem Protection Program (GSLEP) for international and transboundary coordination. UWICER will organize staff training, and implement all research activities.

6.4 Monitoring and Evaluation

Plan implementation will be monitored by the NCD. Progress will be monitored based on periodic reports submitted by the focal persons from the field offices and presented at the departmental meeting. The logical framework (Table 2) will be used for monitoring and evaluation, using indicators and monitoring frequency provided.

Table 2. Logical framework and implementation plan.

GOAL: To maintain a viable population of snow leopards in Bhutan with ecological links to snow leopards in the eastern Himalayan mountain landscape.										
	Objectively verifiable indicators	**Means of verification**	**Frequency**	**Implementing agency**	**Budget estimate (Nu. in millions)**	**Timeline**				
						Y1	Y2	Y3	Y4	Y5
Target 1. In 2023, Snow leopard populations in Bhutan stable or increasing.										
Objective 1. To ensure harmonious co-existence of snow leopards and local communities and prevent retaliatory killing.										
Output 1.1. Compensation mechanism to address livestock losses re-instated.										
Activity 1.1.1. Develop and strengthen livestock insurance/compensation schemes to adequately compensate the communities for the loss of livestock to snow leopards.	Operational insurance program	Compensation payment receipts.	Quarterly	NCD/ Respective Field Office	10					
Output 1.2. Mechanisms in place to minimize livestock depredation by snow leopards.										
Activity 1.2.1. Carry out hotspot mapping to highlight spatial-temporal characteristic of the conflict to understand patterns and trends	Hotspot mapped	Map, Reports	Once	Respective field offices.	1					
Activity 1.2.2. Pilot-test protective mechanisms, such as enclosures and corrals) to protect juvenile yaks against snow leopards	Fencing installed	Interviews with herders about predation reduction	Annual after Y2 until Y4	Respective field offices.	5					
Activity 1.2.3. Develop and implement proper livestock herding regulations in discussion with the communities.	Guidelines produced	Report on guidelines	Once	Respective field offices.	0.25					

Output 1.3. Communities aware of conservation significance of snow leopards.										
Activity 1.3.1. Conduct questionnaire surveys to assess people's perception towards the snow leopard and establish baseline for monitoring.	Survey conducted	Survey Report	Once (Y1)	Respective field offices.	3					
Activity 1.3.2. Conduct awareness and education programmes to the herding communities to make them aware of the significance and importance of snow leopard conservation, and encourage them to become citizen scientists and local conservation leaders.	No of awareness programmes conducted	Awareness education reports	Bi-annual after Y2	Respective field offices, NCD	2					
Activity 4.3.3. Organize exposure visits for local leaders to learn about snow leopard conservation efforts both within and outside Bhutan.	Exposure visit organized	Tour Report	Once	NCD, Respective field offices.	5					
Objective 2. To fill knowledge gaps necessary for snow leopard conservation through research and monitoring, including in response to community activities and climate change.										
Output 2.1. Research on the demography, ecology and habitat use of snow leopard conducted.										
Activity 2.1.1. Use satellite GPS collars to determine habitat use, movement patterns and pathways of snow leopards.	No of SL collared	Reports and data	Quarterly	NCD, UWICER, Respective field offices.	10					
Activity 2.1.2. Conduct a feasibility study for survival of snow leopards to SWS and JSWNP.	Feasibility study conducted	Reports	End Y5	NCD, UWICER, Respective field offices.	1					

Output 2.2. Studies on blue sheep ecology and demographics vis-à-vis grazing ecology, interactions with livestock conducted.										
Activity 2.2.1. Study the ecological relationships of blue sheep, livestock, and impacts on alpine meadow ecology.	Research projects begun	Progress reports and scientific reports	Annually	DoFPS (Respective field offices.), DoL	3					
Activity 2.2.2. Study and monitor zoonotic disease transmission from domestic ungulates to blue sheep and other prey species.	SMART patrols conducting surveys and monitoring	Patrol reports and database	Monthly	NCD, UWICER, Respective field offices.	1					
Output 2.3. The population of snow leopard and its prey monitored using structured, grid based camera trap surveys.										
Activity 2.3.1. Provide the camera traps and field gears necessary for grid-based surveys and conduct refresher courses and training for field staff in handling, installation, and retrieval of camera-traps for snow leopard survey.	Equipment procured; Number of staff trained	Equipment, Training reports	Once	NCD, UWICER	12					
Activity 2.3.2. Conduct camera-trap surveys of snow leopards (in protected area and forest divisions) in the period 2020-22 (once every 5 years) to monitor and estimate population abundance, density, and occupancy, using the same grids for the national snow leopard survey of 2014 – 2016.	National Snow Leopard Survey Conducted	Progress reports and final report	Annual (Y2 and Y3)	NCD, Respective field offices.	30					
Activity 2.3.3. Monitor and assess the prey population dynamics of blue sheep and other prey species using SMART patrolling data.	Survey of snow leopard prey conducted	Scientific reports	Annual (after Y2)	NCD, UWICER, Respective field offices.	0.5					

Activity 2.3.4. Develop a database of camera-trap data for snow leopards with networked access in each field office, with the central data repository at the NCD.	Database developed and maintained	Database	Bi-annual (after Y2)	NCD	2					
Objective 3. To prevent the spread of diseases between wildlife and domestic animals.										
Output 3.1. The prevalence of communicable diseases in livestock and wild ungulates monitored.										
Activity 3.1.1. Coordinate with the Department of Livestock to monitor livestock for disease.	Livestock Dept conducting monitoring programme	Reports submitted to NCD	Quarterly	NCD, UWICER	1					
Activity 3.1.2. Train patrol teams to monitor wildlife for common disease and submit patrol reports	Number of training programmes	Training and patrol reports	Quarterly after Y2 for monitoring; Training reports in Y2	FPED, NCD, UWICER	0.6					
Activity 3.1.3. Coordinate with the Department of Livestock to vaccinate livestock for disease.	Livestock Dept conducting vaccination programme	Reports with vaccination events and places	Quarterly	NCD, Respective field offices.	0.6					
Output 3.3. Feral dog population in the snow leopard habitats controlled										
Activity 3.3.1. Identify strategic locations where feral dogs have greatest impacts on snow leopards, and capture, sterilize, and vaccinate.	Locations identified and vacinations conducted	Reports	Quarterly	NCD, UWICER, Respective field offices.	6					

Objective 4. To stop poaching of snow leopards in Bhutan.										
Output 4.1. Capacity of forestry officials in snow leopard range parks and divisions developed for effective protection.										
Activity 4.1.1. Conduct SMART patrolling training programmes, provide necessary equipment, and ensure teams are deployed for patrolling.	Number of trained and equipped patrol teams deployed	SMART Patrol Reports	Bi-annual	Respective field offices.	30					
Activity 4.1.2. Identify and map patrolling routes and surveillance sites in each snow leopard conservation area	Patrolling route plans and protocols	Strategic plan	end Y1	Respective field offices.	3.5					
Activity 4.1.3. Develop and install a networked database of snow leopard and prey poaching levels, with a baseline, in each field office for information input and sharing.	Operational Database	Database access/ outputs	Quarterly	Respective field offices.	0.5					
Activity 4.1.4. Train field staff and other relevant stakeholders (e.g. police) in proper wildlife forensics.	No. of staff trained	Training reports	Y2 and Y 3	Respective field offices.	2					
Output 4.2. Collaboration with other stakeholders strengthened.										
Activity 4.2.1. Strengthen collaboration with Royal Bhutan Police, Royal Bhutan Army, Customs, and BAFRA, inter alia to deal with poachers.	Number of meetings	Meeting reports and minutes	Annually	NCD, Respective field offices.	2					
Activity 4.2.2. Develop community-based snow leopard monitoring and intelligence sharing networks with incentives to informants.	Intelligence available from networks	Intelligence reports	Bi-annual after Y 1	Respective field offices and communities	2					

Activity 4.2.3. Upscale citizen scientist programme	Number of citizen scientists trained and providing data	Database and reports	Annual after Y3	NCD	2					
Target 2. By 2023, important snow leopard habitat mapped and secured for conservation to ensure ecological and demographic connectivity for metapopulation management.										
Target 3. By 2023, over 80% of the local communities are engaged as willing conservation stewards of snow leopards, prey species, and habitats.										
Objective 5: To manage adequate habitat areas with ecological connectivity to maintain a viable snow leopard population in Bhutan.										
Output 5.1. A zoning plan for protected areas and corridors based on habitat analyses using satellite GPS telemetry and climate change models.										
Activity 5.1.1. Conduct a spatial assessment of snow leopard habitats for metapopulation management, including of climate resilient habitats, using models based on empirical habitat use data and develop map for zoning.	Analysis conducted (after satellite collaring data are available)	Report and map	End Y4	NCD, Respective field offices.	1.5					
Output 5.2. Climate resilient snow leopard habitat secured for conservation with appropriate management plans.										
Activity 5.2.1. Identify habitat management strategies and actions to maintain, manage, and protect ecological connectivity and integrate into protected areas and corridor management plans as part of adaptive management.	Area of habitat improved in the corridors. Review plan for adaptive management after analysis using GPS collaring data.	Reports	Annual Y2/3 and Y5	NCD, Respective field offices.	5					

Activity 5.2.2. Identify areas for inclusion and management of salt licks and water sources	Number of salt licks and water sources identified and managed	Maps and reports	Annual Y4/5	DoFPS	3					
Output 5.3. Alpine meadows monitored and managed to prevent degradation and loss from grazing and NWFP collection.										
Activity 5.3.1. Integrate and prescribe pasture management, as per the Land Act of Bhutan 2007 & Tsamdro lease agreement (FNCRR 2017), and livestock grazing regimes backed by research that provides an understanding of the ecological interactions of wild ungulate prey, livestock, and grassland ecology.	Area of pasture land managed	Acreage of pasture management, reports	Annual Y1-Y3	DoFPS (Respective field offices.), DoL, NLCS	12					
Activity 5.3.2. Work with the Department of Livestock to improve yak gene stock by supplying high yielding breeds of yaks to herder communities in strategic areas, where grazing and pasture management plans are being implemented on a priority basis.	Number of breeding bulls supplied	Handing taking notes, procurement reports	Annual Y3/ Y4	DoFPS (Respective field offices.), DoL	4.5					
Activity 5.3.3. Develop scientific management plans for sustainable NWFP collection and initiate group formation	Scientific management plans developed for different NWFP species	Management plans	Annual Y3/ Y4	DoFPS (SFED & Respective field offices.), ITMS	7.5					

Activity 5.3.4. Conduct training and awareness programmes on sustainable management of NWFPs for the community groups.	Number of community groups trained	Training reports	Annually Y1 and Y2	DoFPS (SFED & Respective field offices.), ITMS	3					
Activity 5.3.5. Monitor NWFP collection	No of permits issued	Monitoring reports/ Number of permits issued	Annually	DoFPS (Respective field offices.)	7.5					
Output 5.4. Solid waste disposal in alpine areas reduced.										
Activity 5.4.1. Institutionalize waste collection among the highland communities and conduct awareness program on proper waste management to the upland communities.	Number of awareness programs conducted. Waste removal institutionalized	Reports. Assessment of waste removal	Bi-annual Y1 and Y2. Then Annual	DoFPS/LG	8					
Activity 5.4.2. Work with TCB to designate proper camping sites and identify local operator to manage the sites.	Number of camp sites designated and local operators identified	Location of camp sites, status, and operations	Bi-annual Y1 and Y2. Then Annual	DoFPS/ TCB/ LG	1					
Activity 5.4.3. Implement and enforce GIGO (Garbage In, Garbage Out)	Quantity (weight & volume) of waste collected	Report and field surveys	Bi-annual Y1 and Y2. Then Annual	DoFPS/ TCB/ LG	5					

Activity 5.4.4. Install signage and information boards informing of GIGO policy	Waste bins, signs and information boards installed	Field surveys	End Y1. Then based on patrol reports	DoFPS (Respective field offices.)	2					
Output 5.5. Policy in place to ensure principles of Smart Green Infrastructure are followed in all development projects in the alpine regions.										
Activity 5.5.1. Develop relevant guidelines for Smart Green Infrastructure in alpine areas	Guidelines prepared	Final guidelines report	End Y2	NCD	2					
Activity 5.5.2. Organize national and community level sensitization workshops on the necessity for infrastructure to follow 'Smart-Green' principles in alpine areas.	Number of workshops conducted at national and community level	Workshop proceedings	Annual Y2/ Y3	NCD	2					
Activity 5.5.3. Organize exposure trips to understand the features of smart-green infrastructure.	Number of trips and participants	Tour report/ HR award letters	Y2 and Y3	NCD	4					
Activity 5.5.4. Monitor infrastructure planning, designing and development to ensure smart-green features are integrated and safeguards are maintained during building in collaboration with the Ministry of Works and Human Settlement.	Monitoring committee active	Monitoring plans & reports	Y2-Y5	NCD	2					

Objective 6. To provide sustainable and alternative income sources to local communities linked to snow leopard conservation.										
Output 6.1. Community development projects follow principles of sustainable development and resource use, and aligned with SGDs										
Activity 6.1.1. Coordinate and collaborate with other line agencies and development donors to direct programmes to supply alternative fuel, construction materials, and energy sources to reduce local people's dependence on natural resources (based on a need assessment reflected in each of the park's conservation management plans).	Alternative materials supplied	Number of beneficiaries	Annual	LG, DoL, DoA, Respective field offices.	10					
Activity 6.1.2. Coordinate with TCB to develop an ecotourism strategy that directly involves alpine communities and snow leopard viewing and conservation (eco-trail development, homestays in herder camps, guide training, festivals, etc.).	Local people actively involved in ecotourism activities	Field verification; TCB plans	Annual	NCD, Respective field offices.	10					
Activity 6.1.3. Coordinate with TCB and monastic bodies to maintain culturally significant areas and monuments in the snow leopard conservation areas.	Culturally significant sites restored	Field verification.	Annual (Y2-Y4)	NCD, Respective field offices.	3					
Objective 7. To monitor and address climate change-related impacts and natural disasters on snow leopard, habitats and communities.										
Output 7.1. Vulnerabilities of local communities living in alpine areas to climate change and consequent natural disasters reduced.										
Activity 7.1.1. Adopt and implement Sustainable Land Management Program in degraded or affected (e.g., landslide sites) alpine areas (e.g., bio-fencing with native species, restoring degraded riparian areas, etc.)	Area of degraded habitat brought under SLMP	Field verification, reports	Annual	Respective field offices.	7					

Activity 7.1.2. Programmes to build awareness on forest and grassland fire prevention, and management.	Number of awareness programmes	Programme reports	Y1, Y4 end	Respective field offices.	2					
Activity 7.1.3. Conduct climate vulnerability assessment (CVA) of local communities in snow leopard habitats and propose adaptation actions to reduce vulnerabilities in line with protected areas management plans and snow leopard conservation strategies.	Field survey conducted and report published	Technical report on adaptation strategies	Y2	UWICER	3					
Activity 7.1.4. Organize awareness campaigns to sensitize local communities on the impacts of climate change based on CVA findings.	Awareness programmes conducted	Report	Y3	Respective field offices.	1.2					
Activity 7.1.5. Organize study tours for local communities to other countries and regions to understand the impacts of climate change on community vulnerabilities.	Study tour conducted	Tour report	Y4	Respective field offices.	2					
Output 7.2. Monitoring programme to detect impacts of climate change in place and operational.										
Activity 7.2.1. Maintain and revive the climate and weather monitoring stations and flow discharge data loggers in the snow leopard and blue sheep habitats and gather periodic data, and train field staff in installation and maintenance of instruments.	Existing weather stations made functional and data gathered	Weather data and reports	Annually	NCHM, Respective field offices.	4					

Activity7.2.2. Establish and monitor permanent vegetation plots to detect upward altitudinal shift in tree-line in the snow leopard and blue sheep habitats.	Plots established and baseline assessment	Reports and baseline database available	Y3	UWICER, Respective field offices.	3					
Objective 8. To raise awareness of importance of snow leopard conservation at local and national levels.										
Output 8.1. Awareness raised on the importance of snow leopard conservation at national and local levels.										
Activity 8.1.1. Conduct high-profile education and awareness campaigns on Snow Leopard Day to raise awareness on the conservation significance of snow leopards.	Number of events	Press reports; citizens' feedback	Annual	NCD/ Respective field offices.	1.5					
Activity 8.1.2. Organize national and international workshops to discuss and share lessons to mitigate the impact of climate change on snow leopards	Workshops/ Conference conducted	Reports	Y2 and Y5	NCD, UWICER	2.5					
			Grand Total		255.15					

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ISBN 978-99980-873-1-6

Designed and Printed by United Printing Press