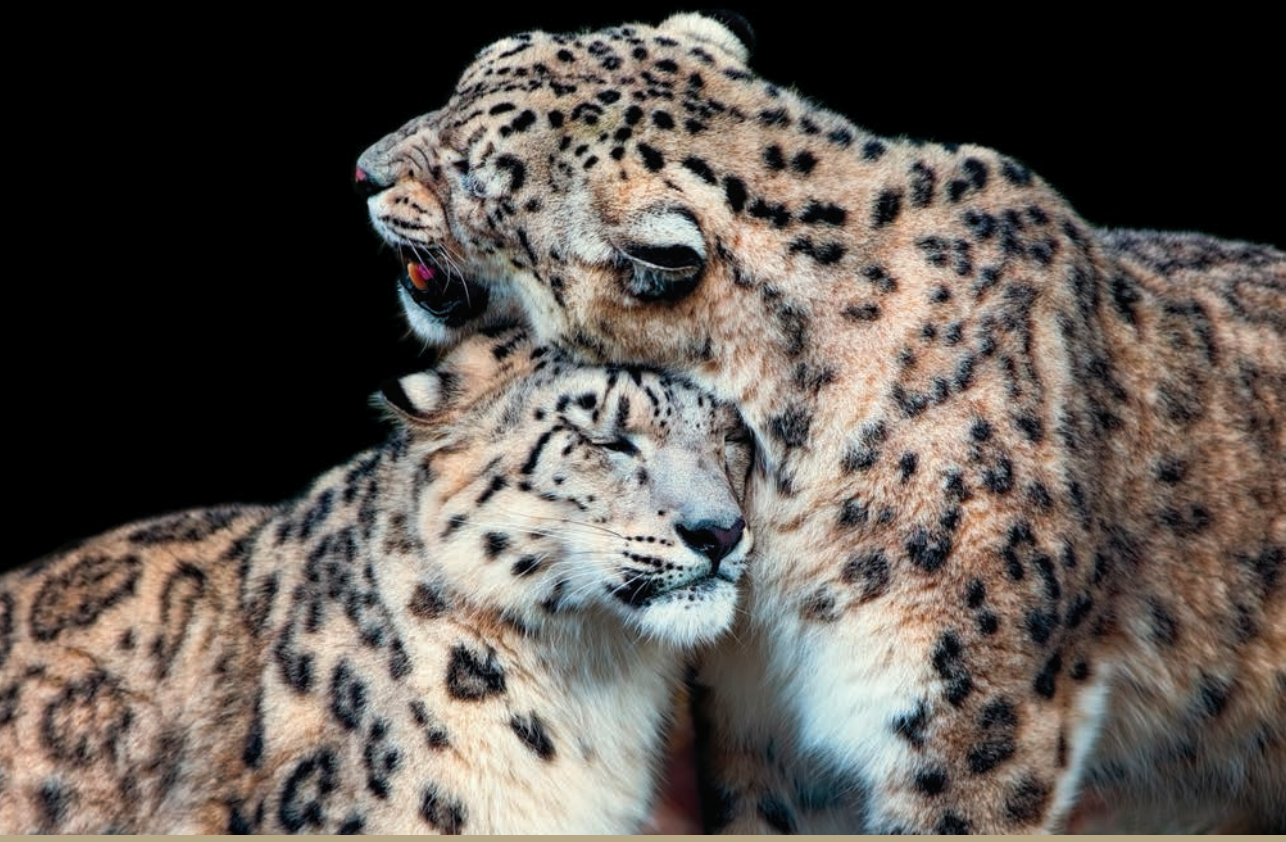
A SPECIES AND CLIMATE CHANGE BRIEF FOR THE VANISHING TREASURES PROGRAMME

## GETTING CLIMATE-SMART WITH THE

# SNOW LEOPARD

## IN CENTRAL ASIA



VANISHING TREASURES

PROTECTING ENDANGERED MOUNTAIN SPECIES

THE GOVERNMENT OF THE GRAND DUCHY OF LUXEMBOURG

UN environment programme

GRID ARENDAL
A UNEP Partner

BOKU

SNOW LEOPARD

ILBIRS FOUNDATION
ИАБИРС ФОНАЙ

SNOW LEOPARD TRUST

ANCOT

HUMBOLDT-UNIVERSITÄT ZU BERLIN

Author:
Laurent Fouinat, GRID-Arendal

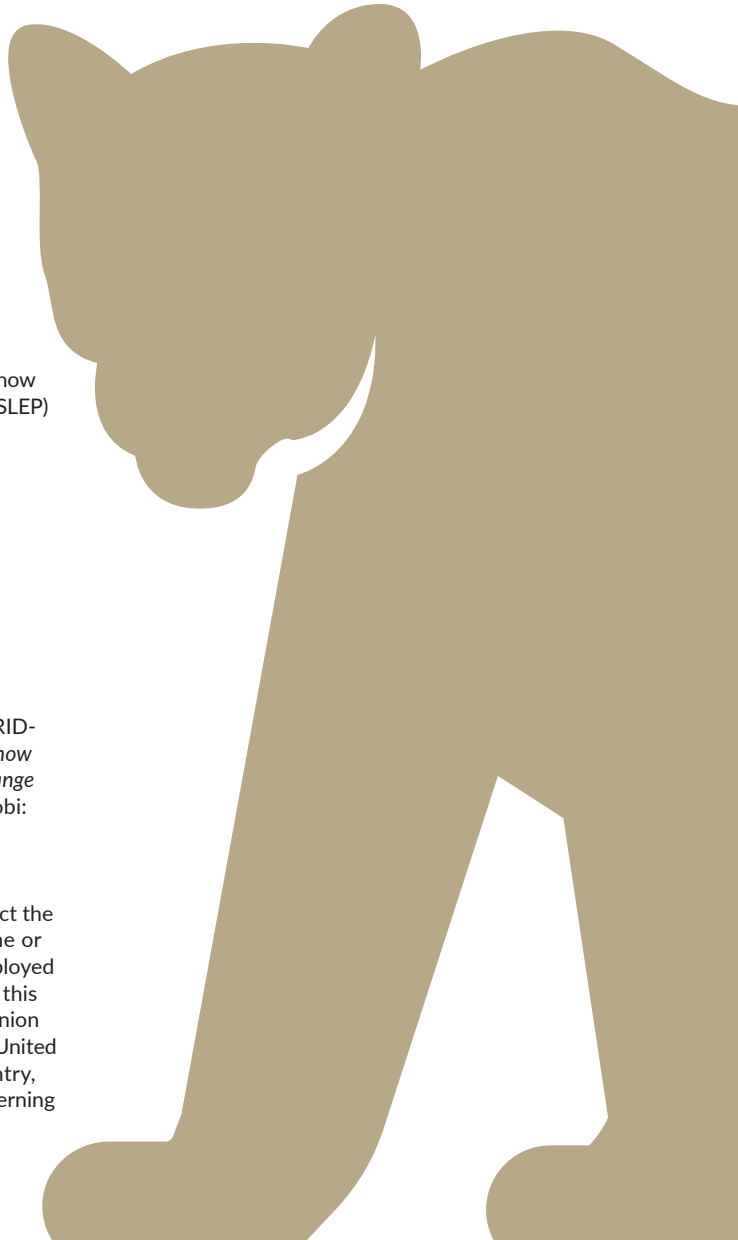
Contributors:
Stefan Michel, UNEP Technical advisor
Tanya Rosen, UNEP Technical advisor
Jessica Bitsch, UNEP
Maarten Hofman, UNEP
Björn Alfthan, GRID-Arendal
Koustubh Sharma, Snow Leopard Trust & Global Snow Leopard and Ecosystem Protection programme (GSLEP)
Justine Shanti Alexander, Snow Leopard Trust
Ranjini Murali, Snow Leopard Trust

Reviewers:
Matthias Jurek, UNEP
Susan Mutebi-Richards, UNEP
Arash Ghoddousi, Humboldt-University Berlin

Cover photo: iStock/RolfSt

Citation:
United Nations Environment Programme and GRID-Arendal (2020). *Getting Climate-Smart with the Snow Leopard in Central Asia: A Species and Climate Change Brief for the Vanishing Treasures Programme*. Nairobi: United Nations Environment Programme.

Disclaimer
The contents of this brief do not necessarily reflect the views or policies of UN Environment Programme or contributory organisations. The designations employed and the presentation of material on any maps in this document do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.



GETTING CLIMATE-SMART WITH THE

# SNOW LEOPARD

IN CENTRAL ASIA

# The goal of this information brief

This brief is one in a series that also includes the mountain gorilla and the Royal Bengal tiger, produced under the Vanishing Treasures programme. Its goal is to highlight how climate change is – and will be – impacting the conservation of the snow leopard in Central Asia, particularly within the countries of Kyrgyzstan and Tajikistan.

The brief examines how climate change has multiple, and often interacting, impacts on the snow leopard – be it on its physiology, on the ecosystems and prey species on which it depends, or on the behaviour of humans living in its surroundings – with important feedback loops that directly affects the conservation of this magnificent animal.

It also includes a series of possible options for policymakers and conservation practitioners in the region. The potential solutions are based on consultations at the local and national level and will be further explored and developed in the course of the Vanishing Treasures programme. They do not, however, refer to the definitive approach being taken by the programme.

The Vanishing Treasures programme is working to:

- integrate climate-smart measures into conservation planning, including ecological connectivity measures, to take into account shifting and changing habitats and other changes as a result of climate change;
- pilot ecosystem-based adaptation and other measures to increase communities' resilience to climate change and to promote livelihood options that reduce or diversify the dependence on natural resources, such as water, that species depend on;
- pilot specific measures to reduce human-wildlife conflict.

*Hidden snow leopard in Kyrgyzstan. Credit: Sebastian Kennerknecht*

*"They call me the 'ghost of the mountains', but I must come out of the shadows and speak up this time. Warmer temperatures mean livestock is coming up higher to graze, encroaching on my favourite wild prey's space and its food. We snow leopards are shy so we prefer seeing locals, their livestock or hikers from a distance. We've no need to haunt or hunt you, but I'm tempted to sneak up on livestock moving in. Healthy habitats would mean more space for my prey to graze and less temptation for me. And as an 'umbrella' species, if we're happy, so are many other species beneath us on these mountains.*

– **Svet** (Russian name for 'Light'), snow leopard, Central Asian mountains

# Introduction

The snow leopard *Panthera uncia* is the smallest and rarest of the so-called "big cats" from the genus *Panthera*. The estimated population of snow leopards remaining in the wild is as few as 3,500 to 7,500 (McCarthy and Mallon 2016; McCarthy et al. 2017). Their elusive behaviour and their expansive habitats, spanning between 200–400 km² for an adult male, has made it difficult to accurately estimate their population size, but experts agree that it is declining. They naturally inhabit high mountain ranges throughout Asia, from the Himalayas in the south, across the Qinghai-Tibet Plateau and the mountains of Siberia in the north, to the mountains of Central Asia in the west. Their natural habitat spans 12 countries: Afghanistan, Bhutan, China, India, Kazakhstan, Kyrgyzstan, Mongolia, Nepal, Pakistan, Russia, Tajikistan and Uzbekistan.

Central Asia is crucial to the conservation of the snow leopard. There are an estimated 470–1,000 of them living in the region. The majority are thought to be in Kyrgyzstan and Tajikistan, home to approximately 150 (Saidov et al. 2016) and 250–280 (Nowell, Paltsyn and Sharma 2016), respectively. These countries mainly consist of relatively high mountainous environments, with 90 per cent of Kyrgyzstan at an elevation of more than 1,500 metres above sea level and 50 per cent of Tajikistan more than 3,000 metres above sea level. The Tian Shan and Pamir mountain ranges are among the highest mountains in the world, with multiple summits at an elevation of more than 7,000 metres above sea level in both countries. These environments are ideal for wild ungulates, the preferred prey of the snow leopard. Apex predators, such as the snow leopard, may act as regulators of prey populations within their habitat and therefore ensuring their well-being should ensure the stability of the whole ecosystem.

*A scar-faced snow leopard captured by camera trap in the mountains of Kyrgyzstan. Credit: Sebastian Kennerknecht*

The agricultural sector is an important driver of livelihoods in the Central Asia region. Agriculture accounts for 35.6 per cent of Kyrgyzstan's gross domestic product (GDP), making it one of the country's main economic sectors. The rest of the economy is supported by the export of metallurgy products, the generation of hydropower, the production of cotton and remittances from migrant labour. Arable land only covers about 6.7 per cent of the country, whereas pasture lands cover 48.3 per cent. The Kyrgyz population has adapted its main activity to this mountainous territory by encouraging their livestock to graze on natural rangelands, an activity which produces large quantities of meat, dairy products and wool. Similarly, in Tajikistan, the total arable land only accounts for 6 per cent of the country, mostly located in the low-altitude areas in the west. Pasture lands cover about 21 per cent of the country. Although livestock remains a key component of the agricultural sector in the country, its management, including grazing regulations, is not fully adequate. Consequently, both corporate and independent farms have insufficient resources to maintain and manage pasture lands, leading to overexploitation of pasture, free-riding behaviour and conflicts between villages (Cavatassi and Mallia 2019). Livestock is also very often owned by people from other parts of a province or the country, as it is considered a safe and stable type of capital or investment.

Snow leopards have been found to attack livestock, either on pasture lands with a relatively low rate of livestock death, or inside livestock barns ("corrals") where they tend to kill many animals at once. Often, such predation results in retaliatory killings of snow leopards, and it therefore remains a severe threat to the species. In Kyrgyzstan, little information about such conflicts is available, but more data is now being gathered. In early 2020, two attacks occurred in villages, but neither resulted in the death of any livestock or snow leopards (Asykulov and Kubanychbekov pers. comm. 2020). In Tajikistan, between 2012 and 2020, 60 attacks by snow leopards were reported, representing a total loss of at least 950 sheep and goats (Association of Nature Conservation Organizations of Tajikistan 2020). Conflict with other carnivores has been reported as well and sometimes leads to erroneous retaliatory killing of snow leopards. Illegal killing of snow leopards is often – but not always – connected with those attacks. For the period 2010–2016, the total

*Tajikistan mountainous landscape. Credit: tajwildlife/ANCOT*

*A herder´s camp in Tajikistan. Credit: ANCOT 2020*

number of seizures, observations and market surveys indicated that at least 259 animals across the entire species range fell victim to this. This number includes the 5–7 adult snow leopards in Kyrgyzstan and 20–25 in Tajikistan assumed to be poached each year (Nowell, Paltsyn and Sharma 2016). In some cases, particularly in Tajikistan, the capture of live animals for further use in staged illegal trophy hunting was reported by local stakeholders. Despite the practice being illegal all over the world, trophy hunting of the snow leopard is still taking place. Proof can be found on social media, where those still engaging in this practice, mainly high-ranking people prepared to pay exorbitant amounts, post photographs taken alongside the dead cats (Rosen 2015).

## Mountains are global biodiversity hotspots

Mountains are hugely important for biodiversity: about half of the world's biodiversity hotspots are located in highland or mountain regions (Myers et al. 2000). There are many reasons for this high biodiversity, including the varied physical terrain across steep altitudinal gradients that has encouraged a high number of endemic species, the historically low human population densities and the convergence of several ecosystem boundaries in one place. Central Asian mountains are currently considered a biodiversity hotspot by Conservation International, due to their rich combination of endemic species of plants, mammals, birds, reptiles, amphibians and freshwater fish.

Many of the same societal forces driving biodiversity loss in lowland areas affect mountains: increasing human populations, the expansion and intensification of agriculture, the exploitation of natural resources, infrastructure development and unsustainable tourism practices have transformed many mountain regions around the world, leading to the fragmentation of natural habitats and replacement by human-dominated landscapes (Peters et al. 2019). Conservation in the twenty-first century needs to fully consider and plan for all the impacts of climate change. Climate change is an important driver of change in ecosystems, in the behaviour of individual species and their prey, and perhaps just as crucially, in human behaviour, which has important feedback loops for ecosystems and individual species.

# Effects of climate change on the snow leopard

## Climate change in Central Asia: key trends

Extensive modelling of future climate change impacts on temperature, precipitation, glacier melt, runoff and vegetation has been conducted for the snow leopard range area in recent years.

### Global trends and predictions

Precipitation patterns in mountain regions are often heterogenous because they are influenced by shifts in large-scale atmospheric circulation. Globally, the trend is towards lower snowfall and reduced accumulation, especially at lower altitudes, due to higher temperatures. Temperature increase in mountainous areas (+0.3°C per decade) has outpaced the global trend (+0.2°C), highlighting just how sensitive the environment is to the warming climate (Hock et al. 2019).

### Central Asia

Temperature observations since 1950 for Central Asia indicate an overall increasing trend in annual and seasonal temperatures with a particular increase in spring and increasingly frequent warmer winters. Overall, these observations showed an increase of 0.4–0.5°C per decade (Haag, Jones and Samimi 2019). Over the last 70 years, there were no significant changes in annual rainfall in the Central Asia region. However, an increase in summer precipitation was recorded in the southern part of the region in mountainous areas of Afghanistan, Pakistan and Tajikistan (ibid.). Temperatures are projected to continue increasing, regardless of the climate scenario, until the mid-twenty-first century (Hock et al. 2019).

### Kyrgyzstan and Tajikistan

The observed trend across the entire Central Asian region is also evident in the two countries of Kyrgyzstan and Tajikistan, which exhibited a trend of increased aridity in the summer alongside greater precipitation in spring and autumn. Mean annual precipitation observations only revealed a slight increase in recent decades (Kyrgyz Republic, State Agency for Environmental Protection and Forestry and United Nations Development Programme 2013; Republic of Tajikistan, State Administration for Hydrometeorology Committee on Environmental Protection 2014; Aalto et al. 2017).

## Direct impacts of the climate on the snow leopard

### Physiological impacts

Snow leopards are adapted to some of the harshest environments on the planet. One way in which the snow leopard has adapted to survive in these environments is through its physiology. Oxygen is scarcer at altitude, and this cat's

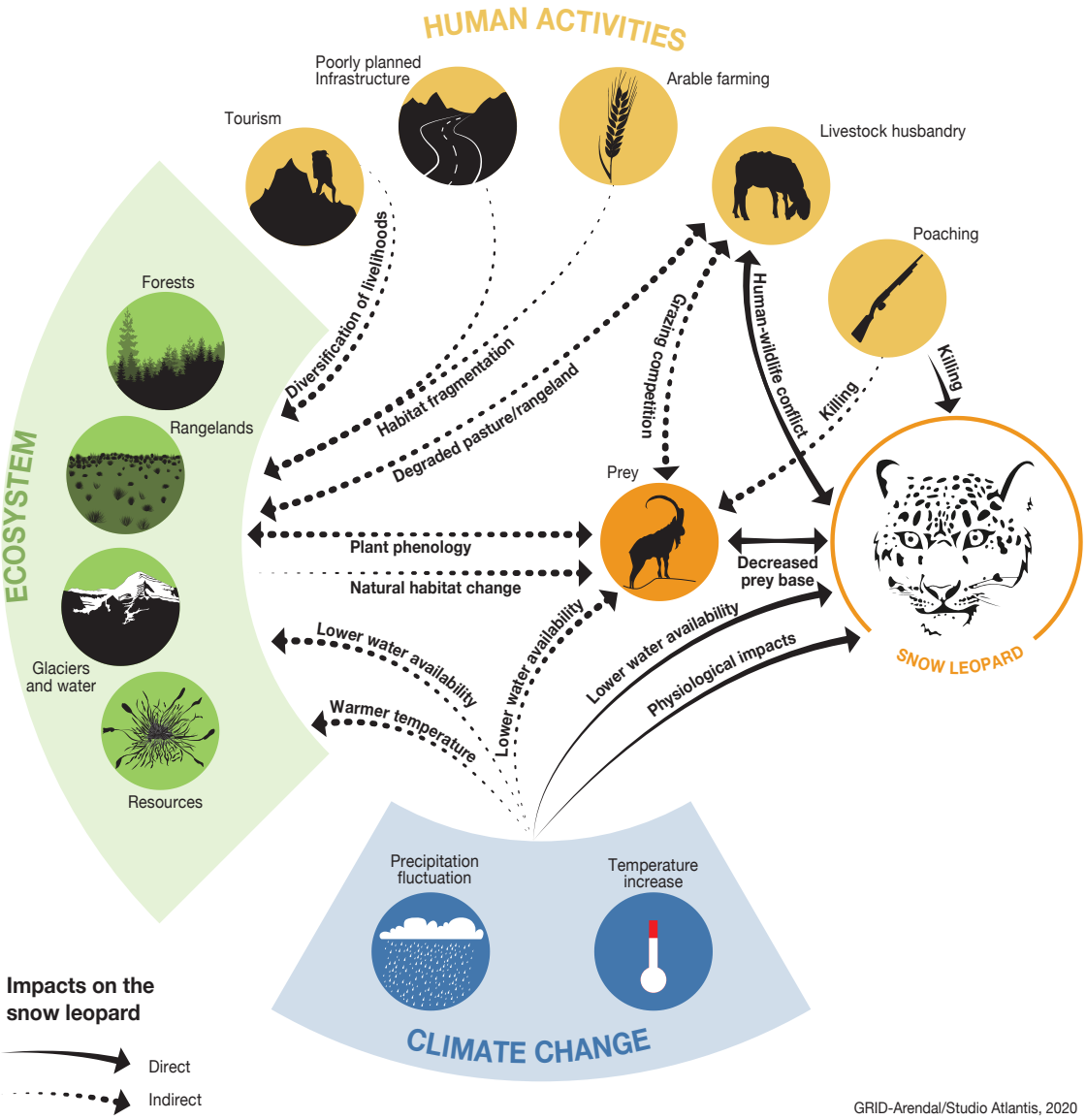
**Table 1:** Climate observations and predictions for Kyrgyzstan and Tajikistan

| Country | Precipitation | | Temperature | |
|---|---|---|---|---|
| | Mean annual observations | Seasonal change observations | Observed trend (1961–1990) | Global mountain modelling |
| Kyrgyzstan | (1961–1990) Slight increase | Higher aridity in the last 20 years | +0.5°C/10 yrs | +0.3°C/10 yrs |
| Tajikistan | (1883–2010) Slight increase | Intensification of droughts in the south | +0.4°C/10 yrs | |

Source(s): Kyrgyz Republic, State Agency for Environmental Protection and Forestry and United Nations Development Programme 2013; Aalto et al. 2017; Hock et al. 2019; Haag, Jones and Samimi 2019

*As the effects of climate change are rapidly descending on the wildlife and the lands upon which local livelihoods depend, I'm glad that thanks to the UNEP Vanishing Treasures programme we have the opportunity to work with communities to identify ways these effects can be buffered. Nature-based tourism holds the greatest promise, despite the current SARS-CoV-2 epidemic, as do forms of agribusiness with a low impact on the environment, such as sustainable bee-keeping and sustainable harvesting of medical plants in the project territory involving female representatives of those communities.*

– **Kenje Sultanbaeva,** Ilbirs Foundation




GRID-Arendal/Studio Atlantis, 2020

**Figure 1:** The impacts of climate change and human activities on the snow leopard in Central Asia

*Corrals like the one shown below could be improved to keep livestock safe from predators at night, for example by adding mesh roofing as shown above. Credits: ANCOT 2020 and T. Rosen*

blood composition features a high number of red blood cells, as well as a large concentration of haemoglobin, which is common among montane mammals (Marma and Yunchis 1968). Additional studies on the snow leopard genome have identified specific genetic determinants probably related to adaptation to high altitudes, but these are still poorly understood (McCarthy and Mallon 2016; Janecka et al. 2020). Further studies need to be conducted to better understand the snow leopard's tolerance to hypoxia, potential regional differences and the ability of snow leopards to track prey or habitat shifts.

Direct effects of climate change on physiology are still largely unknown. A potential direct impact could be an increase in prevalence of disease (Kock et al. 2018). Nonetheless, indirect impacts such as warmer temperatures and fluctuating precipitation over mountain areas is likely to modify the plant distribution in the snow leopard's habitat (Forrest et al. 2012), the effects of which are expected to ripple up the food chain and affect the behaviour and distribution of its prey species, such as wild sheep and goats, as well as marmots and lagomorphs (hares, pikas) (Kitchener, Driscoll and Yamaguchi 2016). Habitat loss associated with climate warming could reduce rangewide snow leopard habitat by 23% from current conditions and increase fragmentation by 30% (Li et al. 2016).

*Fresh snow leopard tracks in a dry lake, Tajikistan. Credit: tajwildlife/ANCOT*

**Lower water availability**

Glaciers play an important role in the Central Asian hydrological cycle. For example, in Kyrgyzstan, 15 per cent of the runoff originates from glaciers. This can reach up to 80 per cent during the melt season (Bolch et. al 2012). Substantial changes in future glacial water runoff from the Central Asian mountains is expected (Luo et al. 2018). In the Tian Shan mountains, long-term cumulative monitoring of glacier volume shows a more pronounced loss beginning in the 1970s. Case studies in the Kyrgyz Trans-Ili Alatau mountain range revealed a decrease of 30 per cent in the glacier surface from 1955 to 1990 (Bolch 2007). The negative balance of glaciers causes a temporary increase in river runoff compared with areas without glaciers. The temporarily higher availability of water for wildlife and land use may give local people the illusion that the impacts of climate change are positive for them and their environment. However, with small glaciers disappearing, reduced snow cover and snowfields melting earlier during the year, streams may disappear from certain areas during the dry season. This will directly affect wildlife through reduced availability of drinking water. The areas showing the most changes are peripheral lower-elevation zones near the densely populated forelands.

## The ecosystem: indirect impacts of the climate on the snow leopard

**Shift in plant phenology**

Shifts in the phenology of plants can lead to mismatches between seasonal patterns of plant growth and the life cycles of herbivores. Across the snow leopard range, there are several studies on the impacts of climate change, specifically warming and

*Snow leopard equiped with a GPS tracker in Kyrgyzstan. Credit: Sebastian Kennerknecht*

precipitation, on rangelands. These studies suggest uncertainty of climate impacts on vegetation and biomass, as they have reported both a decline and increase in vegetation cover and biomass, influenced by site-level environmental differences (Kohli et al. 2020). Studies from other regions such as the European Alps suggested that faster plant growth may also lead to a shorter period of availability of high-quality forage over a large spatial scale, decreasing the opportunities for mountain ungulates such as the Alpine ibex *Capra ibex* to exploit high-quality forage (Pettorelli et al. 2007).

The length of the winter season may also induce a population change in wild ungulates. Long winters with high snow cover reduce the survival of the Alpine ibex (Jacobson et al. 2004). This is also the case for short snow seasons, which can induce a drop in juvenile survival due to poorly studied factors that are likely to be related to parasite infections and interspecific competition (Mignatti et al. 2012).

A progressive shift in the tree line towards higher altitudes is considered a major change for the snow leopard. The alpine zone is expected to shrink at the expense of the forested sub-alpine zone and bring the snow leopard into competition with other predators that are better adapted to forest habitats (Forrest et al. 2012). Changes in seasonal patterns of temperature and humidity can lead to a decline or increase in vegetation productivity. In turn, the latter may cause the displacement of competitively weaker plant species with further effects on the ecosystem, among other effects. On the other hand, productivity decreases in key forage species in areas with already low primary production may make such areas unsuitable for some of the snow leopard's prey species.

### Changes in snow leopard habitats in Kyrgyzstan and Tajikistan

Climate change is expected to impact the snow leopard's suitable habitat, modifying its global range. Modelling based on greenhouse gases

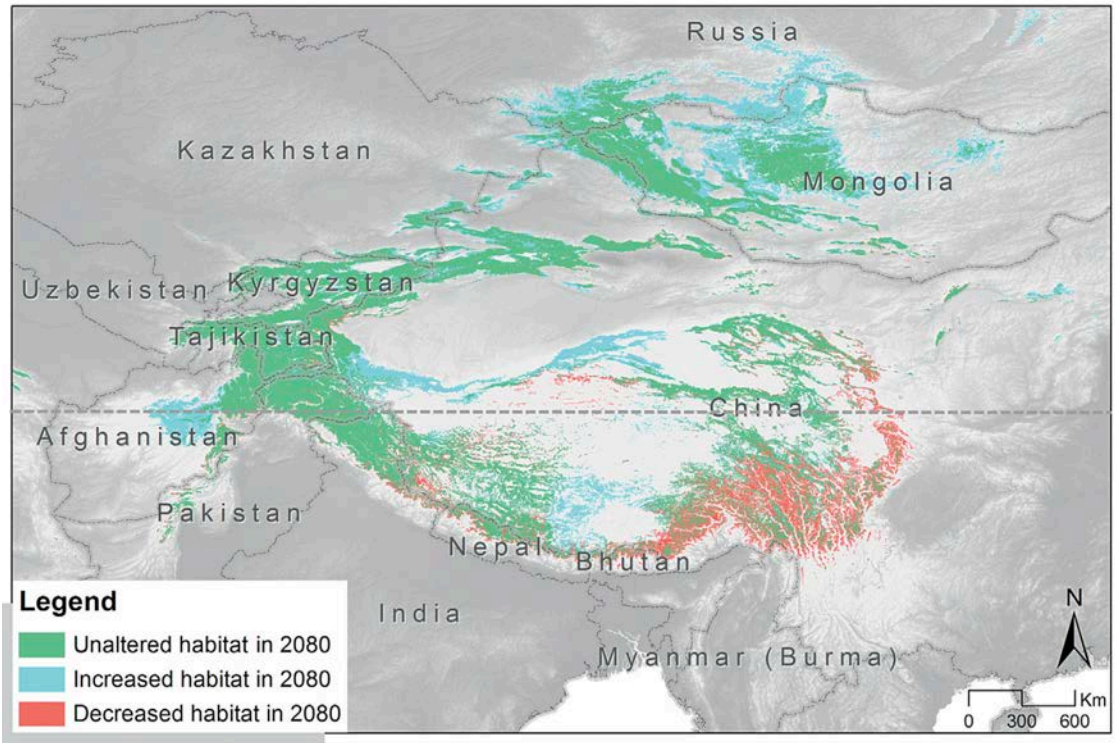



**Figure 2:** Projected changes in distribution of snow leopard habitat by 2080 under the IPCC Scenario A1B. Green, unaltered habitat areas; blue, new habitat areas; red, habitat loss; gray dashed line, boundary between the northern and southern snow leopard range areas (35°N). Source: Farrington and Li (2016). Reproduced with permission from Elsevier.

(GHG), aerosols and other pollutant emissions in a future world of rapid economic growth with a global population increase showed contrasting results on each side of the Himalayas. A shift of suitable habitat northward is expected for the snow leopard, leading to a total range increase of about 60 per cent for the seven northernmost snow leopard range states (Afghanistan, Kazakhstan, Kyrgyzstan, Mongolia, Russia, Tajikistan and Uzbekistan). However, fragmentation of the habitat into smaller and higher altitude ranges, coupled with a higher tree line, can alter prey species' distribution and create new competition with other predators that are better adapted to shrubs and forested land. In this context, snow leopards are predicted to predate on livestock around urban dwellings, which, in turn, could amplify human-wildlife conflicts (Forrest et al. 2012).

Kyrgyzstan and Tajikistan are located north of the Himalayas where the snow leopard habitat is predicted to increase by 9 and 5 per cent, respectively, by 2080. However, the number of patches of habitat is expected to decrease by 36 per cent in Kyrgyzstan, indicating that this habitat will become more fragmented, although it is expected to remain stable in Tajikistan (Farrington and Li, 2016).

*A snow leopard captured on camera during winter. Credit: iStock/through-my-lens*

# Human responses to climate change and their impacts on the snow leopard

## Direct impacts on the snow leopard

### Human-wildlife conflict

Among the major impacts of climate change are the change in plant phenology, the shift of the treeline to higher altitudes, and increased risk for natural disasters. This may change livestock herding patterns and pasture management. Such changes in land use could exert greater pressure on wildlife, including wild prey species and livestock, as they will increase competition for resources. It is uncertain how the interactions between the snow leopard and livestock could change. Potentially, livestock attacks could increase due to decreased wild prey availability or livestock moving into snow leopard habitat. This in turn could have an impact on livelihoods, and result in increased retaliatory killing. An increased frequency of natural disasters impacting livelihoods may further exacerbate the conflict.

### Poaching

At the end of the 1980s, most of the snow leopards in the Soviet Union were found in Kyrgyzstan and Tajikistan. At the end of the Soviet era, people were facing very difficult economic challenges, especially in rural areas, and they turned to opportunistic sources of revenue such as poaching that drastically decreased the number of snow leopards and prey species in the region (Koshkarev and Vyrypaev 2000). More recently, poaching is often done by specialized people who are not necessarily the poorest. It is often related to lack of legal access and ownership of wildlife resources. Poaching has also become a practice of powerful individuals. Trophy hunting of certain prey species is permitted by law in both Kyrgyzstan and Tajikistan and is regulated by quotas. For example, in Kyrgyzstan, the quota includes 80 argali sheep *Ovis ammon* and 350 Siberian ibex *Capra sibirica* per annum and in Tajikistan, it includes 90 argali sheep and a varying number of Siberian ibex. However, there are also cases of illegal trophy hunting, and even if these poachers display their trophies on social media, they and the organizers of these illegal hunts face very little risk of being held to account (Rosen 2015). Cases of human-wildlife conflicts can also lead to the capture of snow leopards for illegal trade.

## Indirect impacts on the snow leopard

### Livestock grazing

One of the major impacts of climate change in Central Asia is an increase in grazing pressure at middle and high altitudes (International Fund for Agricultural Development, Climate Research Foundation and Institute for Hunger Studies 2013). At elevations of less than 1,500 metres above sea level, heat stress will be the major concern, with maximum temperatures above 30°C creating harsher conditions for pastures and livestock. Middle altitudes – between 1,500 and 2,500 metres above sea level – will be less exposed to heat stress, and even milder winters alongside predicted small increases in precipitation in spring and autumn may thus improve the conditions for pasture activity. At

*"During my lifetime, I've already observed that summers are getting longer, starting mid-April and lasting until October, and tend to be hotter and drier because of the effects of climate change. I worry that we won't have enough fodder for livestock, since grass on the pastures is burning faster than before. This means herders keep moving higher, into wildlife habitats. The wildlife is also struggling as we're competing for the same spaces and stealing their food.*

– **Aida Ibraeva**, a representative of Shumkar-Tor Community-based Conservancy, Tar-Suu, Chon Kemin, Kyrgyzstan

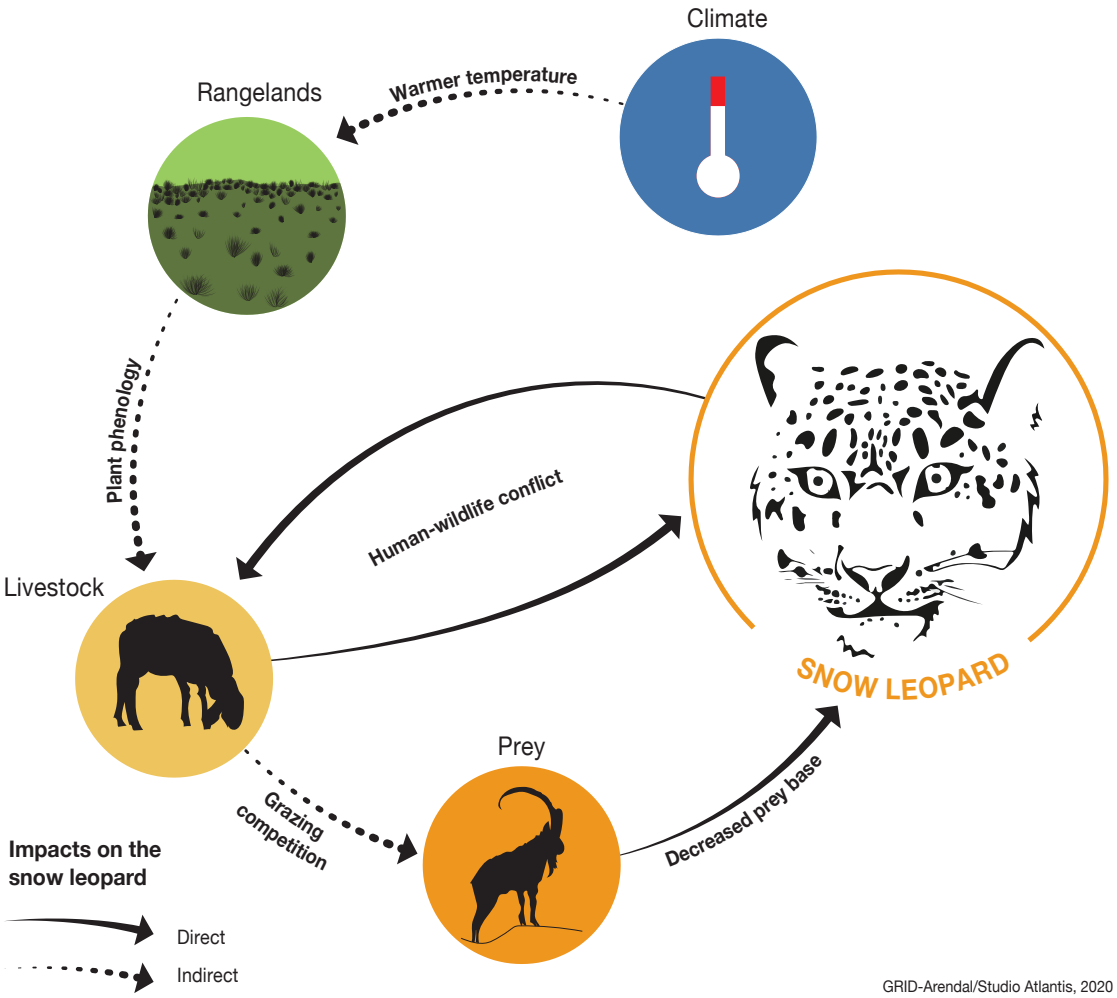



**Figure 3:** Climate change impact on human–wildlife conflicts.

elevations of more than 2,500 metres above sea level, the higher temperature will benefit the pasture land, some parts of which may provide better conditions for livestock.

Climate change will create more favourable conditions for vegetation to grow in pasture lands at middle and high altitudes, with longer pastoral seasons. In Central Asia, livestock is likely to roam at higher altitudes and create competition for resources with local wildlife, as evidenced in other parts of the snow leopard range. In the mountains of China, a similar situation resulted in grassland degradation, negatively impacting the wild prey of the snow leopard (Riordan et al. 2012).

In Nepal, the combination of a higher treeline and increased livestock grazing resulted in increased crop raiding by bharal sheep, followed by snow leopards, thus increasing depredation of livestock. This chain of events negatively impacted the livelihoods of local inhabitants (Aryal, Brunton and Raubenheimer 2013). Johansson et al. (2015) found that in a livestock-dominated landscape in Mongolia, snow leopards mainly prey on wild ungulates and opportunistically kill livestock about 27% of the time. In addition, wild ungulates could potentially find themselves affected by forage competition, disease transmission, and other carnivores such as uncontrolled herding dogs (Ostrowski and Gilbert 2016).

Nonetheless, when livestock graze in vast areas of the snow leopard and ungulates' habitats, the carrying capacity of the environment for wild ungulates is reduced, and their fitness and reproductive success are also impacted. High livestock stocking rates, earlier spring grazing and insufficient rotation of pastures during and between seasons are some of the reasons why the rangelands can become degraded. Livestock may move higher up the mountain valleys and slopes to find forage, which will in turn have a greater impact on wildlife and its habitat.

**Farming practices and other land uses**

Most of the agricultural land in Kyrgyzstan and Tajikistan is semi-arid or arid, and therefore it can only be used for crop cultivation if it is irrigated. Most arable farming is possible at lower elevations because of currently more favourable temperatures and water availability. In rural mountainous areas, crop farming is mostly a family operation. The crops are reserved for their own consumption, as farming in these conditions is considered an extremely difficult practice. Repeated droughts, lack of irrigation and decreasing land productivity are just some of the reasons that people choose not to engage in arable farming (Kerven et al. 2011). In the context of climate change, a longer growing season – if not limited by water availability – may trigger the expansion of arable farming at higher altitudes and the transformation of rangelands into arable fields or support the production of forage for livestock. More winter forage allowing for more livestock may eventually result in higher pressure on pasture lands and increase their degradation.

In the Pamirs the teresken subshrub *Krascheninnikovia ceratoides* have always been collected as fuel for cooking, baking and occasionally for heating, but after the collapse of the Soviet Union and its subsidized energy supply it became a major source of energy (Kraudzun et al. 2014). Under harsh climatic conditions, the plant grows very slowly and the uprooted shrubs are often several decades old. The degradation of teresken

*Herders with their livestock in the mountains of Tajikistan. Credit: ANCOT 2020*

stands in the more easily accessible areas is causing forage shortages in pasture lands, leading to productivity losses for livestock owners and forcing livestock deeper into the habitat of wild ungulates.

**Tourism**

Tourism plays an increasing role in economic activities across Kyrgyzstan and Tajikistan. Skiing, hiking and yurt camping in national parks are becoming more popular. These activities may cause local disturbances and garbage accumulation, potentially impacting wildlife. However, tourism activities that are enrolled in conservation management schemes can also prove beneficial for local livelihoods, creating new streams of income, and can reduce reliance on traditional activities, which may help to mitigate human-wildlife conflicts (Maheshwari and Sathyakumar 2019). Responsible tourism towards snow leopard conservation should focus on four key principles: minimizing the impact, promoting awareness and respect, seeking conservation benefits and providing opportunities for financial benefits at the local level (Alexander et al. 2019). Ensuring that both women and men benefit from alternative livelihood measures is necessary to gain the support of the entire community, as well as the promotion of gender equality in environmental governance.

*Asiatic ibex in Tajikistan. Credit: ANCOT 2020*

## The risk of zoonotic diseases to the snow leopard

Limited information is available on potential zoonotic diseases in wild snow leopards, but this does not discount it as a threat to snow leopard conservation. Of the limited number of studies available, one study in Mongolia detected antibodies to significant zoonotic pathogens in the blood of snow leopards, despite them not showing any clinical signs of disease. The pathogens identified are also known to be present in wild and domestic ungulates as well as scavengers such as raptors and foxes. The cause of transmission is suggested to be indirect – sharing of common contaminated resources such as water bodies or being parasitized by waterborne pathogens (Esson et al. 2019). Greater interactions between human populations and snow leopards may also increase the risk of transmission of zoonotic diseases, including COVID-19, of which no cases were reported in snow leopard at the time of writing. More critical is the risk of transmission of infectious diseases between livestock and wild ungulates. Such potentially problematic diseases include sarcoptic mange, contagious caprine pleuropneumonia (mycoplasmosis), peste des petits ruminants and foot-and-mouth disease (Ostrowski and Gilbert 2016).

*"With COVID-19, nature has sent us a stronger message. To protect ourselves and Earth's precious wildlife for the long term, we must tackle habitat and biodiversity loss. These briefs show the path to the future we all want – one where people's well-being and livelihoods go hand-in-hand with thriving habitats and species.*

– **Bruno Pozzi**, United Nations Environment Programme, Europe Director

# Potential solutions

There are several concerns regarding the future of the snow leopard and the links between climate change and societal development are complex. However, there are solutions that can contribute to mitigation and adaptation strategies. The governments of Kyrgyzstan and Tajikistan have developed policies to support conservation in their respective countries through the creation of specific protected areas for snow leopards and their prey, as well as through penalties to dissuade individuals from harming snow leopards. To achieve this goal, it is essential to build the infrastructure for future research and to sustain and develop communication between communities, local and national policymakers, and researchers.

**Support communities' mitigation and adaptation strategies for climate change**

To mitigate human-wildlife conflict, it is beneficial to create synergies between an ecosystem-based adaptation approach and a community-based approach. The former focuses on rebuilding and protecting ecosystems to provide essential ecosystem services in the face of climate change (Munang et al. 2013), while the latter ensures that the response addresses local vulnerabilities to climate change and builds on local structures.

Planned activities include improving the infrastructure of corrals to protect livestock from snow leopard attacks, finding solutions to improve grazing management in order to limit livestock pressure on wildlife and livestock insurance to compensate for losses from depredation. Vaccination programmes or natural disaster insurance programmes could reduce impacts of livestock loss due to climate risks. Regulated legal hunting of prey species can also offer opportunities and incentives for the local inhabitants who conserve these species and their habitats, provided active participation and equitable benefit sharing are in place. The involvement of local communities is vital to these activities. To gain the support of the community, solutions need to be designed and implemented in partnership with relevant community partners and take into account their needs. A gender-sensitive approach should be used, taking into consideration the participation and contribution of women, including in decision-making roles. Similar consideration should be given to other societal divisions such as ethnicity and class. Knowledge sharing should be focused on climate-risk workshops and development of key adaptation interventions at the local level.

**Adapt the policy and legal framework in Kyrgyzstan and Tajikistan to ensure an even more climate-smart framework**

In order for the above recommendations to be sustainable, long-term and comprehensive, climate-smart thinking needs to be mainstreamed and placed at the heart of government policy, expenditure (budgets) and planning. This means there should be close dialogue and links between science and policy, and adequate support and capacity training on climate change, its impacts and possible mitigation and adaptation responses provided to policymakers at both local and national levels. Coordination between different sectors regarding climate action, which may have an impact on the snow leopard, its habitats and local communities, is also key.

Supporting direct incentives for creating alternative livelihood opportunities would diversify the local economy, which, in turn, would reduce the pressure on the snow leopard and prey species' habitat exerted by livestock grazing activity. Ensuring active participation in and equitable sharing of the benefits arising from these livelihood opportunities across gender, ethnicity, class and other social divisions is key. The collection of sex-disaggregated data further documents and supports gender mainstreaming efforts in sustainable wildlife management.

Conservation schemes need to be adapted to new activities such as ecotourism, which is a growth sector in the region. New revenues from overnight stays and local products would benefit local families, who would rely less on livestock, thereby reducing human-wildlife conflict. However, as the COVID-19 pandemic has shown, over-

> *One of ANCOT's goals is to turn the local perception of snow leopards from a vermin predator into a useful species. To do so, we use a broad spectrum of conservation tools such as sustainable wildlife management, tourism, and donor-sponsored compensation projects. In the last 10 years, we've helped Tajik communities strengthen their livestock husbandry to avoid predator attacks by advising on herding methods and reinforcing more than 100 livestock corrals.*
>
> – **Munavvar Alidodov**, CEO Association of Nature Conservation Organizations of Tajikistan (ANCOT)

reliance on the ecotourism sector can lead to high short- to medium-term risks for communities solely dependent on this activity. This calls for a diversification of approaches. More traditional activities such as sustainable wild ungulate hunting – if carried out under the auspices of conservation management – can help preserve wildlife habitats and benefit the snow leopard in the longer term.

**Target and fund scientific research to better understand the climate change-induced risks for snow leopards and the ecosystems in Kyrgyzstan and Tajikistan**

Scientific research on the impacts of climate change and their possible consequences should be targeted and tailored to understand and assess the likely impacts on the most important ecosystems in Kyrgyzstan and Tajikistan for the snow leopard and its prey species. This requires both baseline data on species distributions, as well as modelling efforts, in order to understand habitat suitability for snow leopards under various climate scenarios and identify and select possible mitigation and adaptation strategies. In addition, research should identify possible scenarios for human behaviour in response to climate change and how this may impact the habitat of the snow leopard and its prey.

Finally, research should be interdisciplinary, involving a diverse and gender-inclusive pool of climate modellers, conservationists, wildlife professionals, social scientists and adaptation practitioners, while also being grounded in local realities, utilizing the best available local and traditional ecological knowledge to gather a holistic and integrated overview of possible impact chains induced by climate change risks, including how they will impact human-wildlife conflict.

## Policies in Kyrgyzstan and Tajikistan related to the snow leopard

The snow leopard is included in the Red Data Book of Tajikistan as "a rare species, decreasing in number" and is regulated under the country's laws on environmental protection (1993), the animal world (2007) and protected areas (2012). Snow leopard poaching is punishable with a penalty of US$1,000 to 50,000. Tajikistan is party to the Convention on the Conservation of Migratory Species of Wild Animals (CMS, ratified in 2000) and to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES, accession 2016), which both provide international legal protection to the snow leopard and some of its prey species. In 2013, the Tajik Government endorsed the National Snow Leopard Ecosystem Protection Priorities (NSLEP) plan (Saidov et al. 2016).

Hunting, possession and trade of snow leopards are prohibited in Kyrgyzstan under the law on the animal world (1999). Moreover, the snow leopard is listed in the country's Red Data Book. Harming a snow leopard is punishable with a penalty of about US$8,400. Kyrgyzstan is party to the CMS (since 2014) and CITES (Accession 2007). Protection of specific areas for the snow leopard was also identified as a national conservation target through the Global Snow Leopard and Ecosystem Protection Program (GSLEP) in 2014 (Davletbakov et al. 2016).

# References


Aalto, J., Kämäräinen, M., Shodmonov, M., Rajabov, N. and Venäläinen, A. (2017). Features of Tajikistan's past and future climate. International Journal of Climatology 37(14), 4949–4961. doi:10.1002/joc.5135.

Alexander, J.S., Murali, R., Bijoor. A., Yuhan, L., Mishra, C. (2019). Principles and recommendations for tourism within snow leopard habitats. Nature Conservation Foundation, Global Snow Leopard and Ecosystem Protection Program and Snow Leopard Trust. 32.

Aryal, A., Brunton, D. and Raubenheimer, D. (2013). Impact of climate change on human-wildlife-ecosystem interactions in the Trans-Himalaya region of Nepal. Theoretical and Applied Climatology 115(3), 517–529. doi:10.1007/s00704-013-0902-4.

Association of Nature Conservation Organizations of Tajikistan (undated). Homepage. https://tajwildlife.com/. Accessed 16 November 2020.

Berger, J., Buuveibaatar, B. and Mishra, C. (2013). Globalization of the cashmere market and the decline of large mammals in Central Asia. Conservation Biology 27, 679–689. doi:10.1111/cobi.12100.

Bolch, T. (2007). Climate change and glacier retreat in northern Tien Shan (Kazakhstan/Kyrgyzstan) using remote sensing data. Global and Planetary Change 56. 1–12. https://doi.org/10.1016/j.gloplacha.2006.07.009.

Bolch, T., Kulkarni, A. Kaab, C. Huggel, F. Paul, J.G. Cogley, H. Frey, J.S. et al. (2012). The state and fate of himalayan glaciers Science 336, 310–314. 10.1126/science.1215828.Cavatassi, R. and Mallia, P. (2019). IFAD Impact Assessment – Livestock and Pasture Development Project (LPDP): Tajikistan. Social Science Research Network (SSRN). http://dx.doi.org/10.2139/ssrn.3389336.

Davletbakov, A., Rosen, T., Anarbaev, M., Kubanychbekov, Z., Samanchina, J. and Sharma, K. (2016). Central Asia: Kyrgyzstan. In Snow Leopards. McCarthy, T. and Mallon, D. (eds.). London, UK: Academic Press. 419–425.

Esson, C., Skerratt, L.F., Berger, L., Malmsten, J., Strand, T., Lundkvist, Å. et al. (2019). Health and zoonotic infections of snow leopards Panthera uncia in the South Gobi Desert of Mongolia. Infection Ecology & Epidemiology 9(1), 1604063.

Farrington, J.D. and Li, J. (2016). Climate change impacts on snow leopard range. In Snow Leopards. McCarthy, T. and Mallon, D. (eds.). London, UK: Academic Press. 85–95.

Forrest, J. L., Wikramanayake, E., Shrestha, R., Areendran, G., Gyeltshen, K., Maheshwari, A. and Thapa, K. (2012). Conservation and climate change: Assessing the vulnerability of snow leopard habitat to treeline shift in the Himalaya. Biological Conservation 150(1), 129–135.

Haag, I., Jones, P.D. and Samimi, C. (2019). Central Asia's changing climate: How temperature and precipitation have changed across time, space, and altitude. Climate 7(10), 123. https://www.mdpi.com/2225-1154/7/10/123/htm#.

Hemmer, H. (1972). Uncia uncia. Mammalian Species 20, 1–5.

Hock, R., Rasul, G., Adler, C., Cáceres, B., Gruber, S., Hirabayashi, Y. et al. (2019). High mountain areas. In IPCC Special Report on the Ocean and Cryosphere in a Changing Climate. Pörtner, H-O., Roberts, D.C., Masson-Delmotte, V, Zhai, P., Tignor, M., Poloczanska, K. et al. (eds.). Intergovernmental Panel on Climate Change. https://www.ipcc.ch/srocc/chapter/chapter-2/.

International Fund for Agricultural Development, Climate Research Foundation and Institute for Hunger Studies (2013). Climate change impact on pastures and livestock systems in Kyrgyzstan. Summary report. https://www.weadapt.org/sites/weadapt.org/files/legacy-new/placemarks/files/5356245f83c58summary-report-kyrgyzstan-final-2013.pdf.

Jacobson, A.R., Provenzale, A., von Hardenberg, A., Bassano, B. and Festa-Bianchet, M. (2004). Climate forcing and density dependence in a mountain ungulate population. Ecology 85(6), 1598–1610.

Janecka J.E., Hacker, C., Broderick, J., Pulugulla, S., Auron, P., Ringling, M., Nelson, B., Munkhtsog, B., Hussain, S., Davis, B. and Jackson, R. (2020) Noninvasive Genetics and Genomics Shed Light on the Status, Phylogeography, and Evolution of the Elusive Snow Leopard. In: Ortega J., Maldonado J. (eds) Conservation Genetics in Mammals. Springer, Cham. https://doi.org/10.1007/978-3-030-33334-8_5

Johansson, Ö., McCarthy; T, Samelius, G., Andrén, H., Tumursukh, L. and Mishra, C. (2015). Snow leopard predation in a livestock dominated landscape in Mongolia. Biological Conservation 184, 251–258. http://dx.doi.org/10.1016/j.biocon.2015.02.003.

Kerven, C., Steimann, B., Ashley, L., Dear, C. and ur Rahim, I. (2011) Pastoralism and farming in Central Asia's Mountains: A research review. Mountain Societies Research Centre. https://www.ucentralasia.org/Content/Downloads/pastoralism_and_farming_in_central_asia_mountains.pdf.

Kitchener, A. C., Driscoll, C. A. and Yamaguchi, N. (2016). What is a snow leopard? Taxonomy, morphology, and phylogeny. In Snow Leopards. McCarthy, T. and Mallon, D. (eds.). London, UK: Academic Press, 3–11.

Kock, R.A., Orynbayev, M., Robinson, S., Zuther, S., Singh, N.J., Beauvais, W., Morgan, E.R., Kerimbayev, A., Khomenko, S., Martineau, H.M. and Rystaeva, R., (2018). Saigas on the brink: Multidisciplinary analysis of the factors influencing mass mortality events. Science advances, 4(1), p.eaao2314.

Kohli, M., Mijiddorj, T.N., Suryawanshi, K.R., Mishra, C., Boldgiv, B., Sankaran, M. (2020). Grazing and climate change have site-dependent interactive effects on vegetation in Asian montane rangelands. Journal of Applied Ecology 00,1– 11. https://doi.

org/10.1111/1365-2664.13781
Koshkarev, E. and Vyrypaev, V. (2000). What has happened to the snow leopard since the break-up of the Soviet Union? Cat News 32, 9–11.
Kraudzun, T., Vanselow, K., Kreutzmann, H. and Samimi; C. (2014). Realities and Myths of the Teresken Syndrome – An evaluation of the exploitation of dwarf shrub resources in the Eastern Pamirs of Tajikistan. Journal of Environmental Management 132, 49–59. http://dx.doi.org/10.1016/j.jenvman.2013.10.019.
Kyrgyz Republic, State Agency for Environmental Protection and Forestry and United Nations Development Programme (2013). Climate profile of the Kyrgyz Republic. https://www.undp.org/content/dam/kyrgyzstan/Publications/env-energy/kgz_Kyrgyzstan%20Climate%20profile_ENG_for%20web-opt.pdf.
Kyrgyz Republic, State Agency for Environment Protection and Forestry (2016). Third National Communication of the Kyrgyz Republic under the UN Framework Convention on Climate Change. https://unfccc.int/sites/default/files/resource/NC3_Kyrgyzstan_English_24Jan2017.pdf.
Li, J., McCarthy, T.M., Wang, H., Weckworth, B.V., Schaller, G.B., Mishra, C., Lu, Z., and Beissinger, S.R. (2016). Climate refugia of snow leopards in High Asia. Biological Conservation 203, 188-196. https://doi.org/10.1016/j.biocon.2016.09.026.
Loginov, O. and Loginova, I. (2017). The snow leopard: the elusive ghost, but not yet lost, cat. A review of its conservation status in Siberia and Central Asia. International Journal of Environmental Studies 74(5), 903–914. doi:10.1080/00207233.2017.1341721.
Luo, Y., Wang, X., Piao, S., Sun, L., Ciais, P., Zhang, Y. et al. (2018). Contrasting streamflow regimes induced by melting glaciers across the Tien Shan – Pamir – North Karakoram. Scientific Reports 8(1). doi:10.1038/s41598-018-34829-2.
Maheshwari, A. and Sathyakumar, S. (2019). Snow leopard stewardship in mitigating human–wildlife conflict in Hemis National Park, Ladakh, India. Human Dimensions of Wildlife 24(4), 395–399.
Marma, B.B. and Yunchis, V.V. (1968). Observations on the breeding, management and physiology of snow leopards Panthera u. uncia at Kaunas Zoo from 1962 to 1967. International Zoo Yearbook 8(1), 66–74.
McCarthy, T. and Mallon, D. (eds.) (2016). Snow Leopards. New York: Elsevier. 23-42.
McCarthy, T., Mallon, D., Jackson, R., Zahler, P. and McCarthy, K. (2017). Panthera uncia, Snow leopard. IUCN Red List of Threatened Species. https://dx.doi.org/10.2305/IUCN.UK.2017-2.RLTS.T22732A50664030.en. Accessed 30 September 2020.
McCarthy, T., Mallon, D., Sanderson, E.W., Zahler, P. and Fisher, K. (2016). What is a snow leopard? Biogeography and status overview. In Snow Leopards. McCarthy, T. and Mallon, D. (eds.). London, UK: Academic Press. 23–42.
Mignatti, A., Casagrandi, R., Provenzale, A., von Hardenberg, A., Gatto, M. (2012). Sex- and age-structured models for Alpine ibex Capra ibex ibex population dynamics. Wildlife Biology 18, 318–332.
Munang, R., Thiaw, I., Alverson, K., Mumba, M., Liu, J. and Rivington, M. (2013). Climate change and ecosystem-based adaptation: a new pragmatic approach to buffering climate change impacts. Current Opinion in Environmental Sustainability 5(1), 67–71.
Myers, N., Mittermeier, R.A., Mittermeier, C.G., da Fonseca, G.A.B. and Kent, J. (2000). Biodiversity hotspots for conservation priorities. Nature 403(6772), 853–858.
Michel, S. and Rosen, T. (2016). Trophy hunting as a conservation tool for snow leopards. Hunting of Prey Species: A Review of Lessons, Successes, and Pitfalls – Experiences from Kyrgyzstan and Tajikistan In Snow Leopards. McCarthy, T. and Mallon, D. (eds.). London, UK: Academic Press, 236–244.
Nowell, K., Li, J., Paltsyn, M. and Sharma, R.K. (2016). An ounce of prevention: snow leopard crime revisited. Cambridge, UK: TRAFFIC.
Ostrowski, S. and Gilbert, M. (2016) Chapter 9: Diseases of free-ranging snow leopards and primary prey species. In Snow Leopards. McCarthy, T. and Mallon, D. (eds.). London, UK: Academic Press, 99–112.
Peters, M.K., Hemp, A., Appelhans, T., Becker, J.N., Behler, C., Classen, A. et al. (2019). Climate–land-use interactions shape tropical mountain biodiversity and ecosystem functions. Nature 568(7750), 88–92.
Pettorelli, N., Pelletier, F., von Hardenberg, A., Festa-Bianchet, M. and Côté, S.D. (2007). Early onset of vegetation growth vs. rapid green-up: impacts on juvenile mountain ungulates. Ecology 88(2), 381–390.
Republic of Tajikistan, State Administration for Hydrometeorology Committee on Environmental Protection (2014). Third National Communication of the Republic of Tajikistan under the UN Framework Convention on Climate Change. https://unfccc.int/resource/docs/natc/tjknc3_eng.pdf.
Riordan, P., Shi, K., Wang, J., Hughes, J. and Wang, W. (2012). Patterns of human land use in mountainous China in response to climate change and the impacts on endangered snow leopard populations. HABIT-CHANGE Project. http://ww.habit-change.eu/index.php?id=200.
Rosen, T (2015). The loss of a moral compass, the loss of snow leopards, 25 April. National Geographic Society Newsroom. https://blog.nationalgeographic.org/2015/04/15/the-loss-of-a-moral-compass-the-loss-of-snow-leopards/. Accessed 11 November 2020.
Saidov, A., Karimov, K., Amirov, Z. and Rosen, T. (2016). Central Asia: Tajikistan. In Snow Leopards. McCarthy, T. and Mallon, D. (eds.). London, UK: Academic Press, 433–437.

This brief is one in a series that also includes the mountain gorilla and the Royal Bengal tiger, produced under the Vanishing Treasures programme. Its goal is to highlight how climate change is – and will be – impacting the conservation of the snow leopard in Central Asia, particularly within the countries of Kyrgyzstan and Tajikistan. The brief examines how climate change has multiple, and often interacting, impacts on the snow leopard – be it on its physiology, on the ecosystems and prey species on which it depends, or on the behaviour of humans living in its surroundings – with important feedback loops that directly affects the conservation of this magnificent animal.

#VANISHINGTREASURES
vanishingtreasures.org