


Convention on the Conservation of Migratory Species of Wild Animals

CENTRAL ASIAN MAMMALS MIGRATION AND LINEAR INFRASTRUCTURE (CAMI) ATLAS

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Foreword

Central Asia's diverse landscapes are home to migratory mammals that undertake extensive journeys essential for their survival. From the expansive deserts of Mongolia to the rugged mountains of the Himalaya, wild animals traverse vast and challenging landscapes in search of food, water, and safety. Infrastructure development — including fences, roads, railways, as well as canals and pipelines — poses significant challenges to these animals on their migration routes. As the region experiences rapid economic growth, infrastructure can increasingly fragment habitats and disrupt the ecological connectivity essential for sustaining wildlife populations that have relied on these habitats for millennia.

Since its first publication in 2019, the Central Asian Mammals Migration and Linear Infrastructure Atlas has served as a vital tool for visualizing and understanding these impacts. It provides valuable information for decision-makers and other stakeholders on the locations and ways in which linear infrastructure poses barriers to migratory species.

This Second Edition of the CAMI Atlas builds upon that legacy by incorporating new data, refined analyses, and updated species ranges derived from latest satellite tracking information. It presents the current understanding of linear infrastructure development across eight CAMI Range States, highlights areas of highest concern and provides mitigation strategies for ten terrestrial migratory species, including the iconic Saiga Antelope and Snow Leopard.

This Atlas directly contributes to the achievement of the Convention's objectives to ensure that habitat essential to migratory species is conserved and restored, as well as recent mandates from CMS COP14 including the Samarkand Strategic Plan for Migratory Species. Through careful planning, cross-sector collaboration, and science-driven solutions, we have the opportunity to preserve ecological connectivity while supporting sustainable development.

We express our deepest gratitude to the many experts, institutions, and partners who contributed to the original Atlas and this updated edition. Their knowledge, dedication, and collaboration made this important resource possible. We hope that the Atlas will continue to inform policy, guide sustainable infrastructure development, and inspire collective efforts to safeguard Central Asia's unique migratory species and their habitats.

Amy Fraenkel
Executive Secretary
UNEP/CMS Secretariat

Acronyms

BMU	Ministry of the Environment, Nature Conservation and Nuclear Safety, Germany
BfN	Federal Agency for Nature Conservation, Germany
CAMI	Central Asian Mammals Initiative
CIESIN	Center for International Earth Science Information Network
CMS	Convention on the Conservation of Migratory Species of Wild Animals
GIS	Geographic Information System
INA	International Academy for Nature Conservation
IUCN	International Union for Conservation of Nature
OSM	Open Street Maps
SSC	Species Survival Commission
WCS	Wildlife Conservation Society

Table of Contents

SUMMARY OF KEY FINDINGS **5**

1. INTRODUCTION **7**

1.1 Mandate for the Development and Revision of the Atlas 7
1.2 Scope of the Atlas 8

2. METHODOLOGY **9**

2.1 Methodology of the CAMI Atlas (2019) 9
2.2 Methodology of the Updated Edition of the CAMI Atlas (2025) 9

3. TYPES AND IMPACT OF LINEAR INFRASTRUCTURE **11**

3.1 Effects of Fences on Species 12
3.2 Effects of railroads on species 14
3.3 Effects of Roads on Species 15

4. LINEAR INFRASTRUCTURE MAPS BY SPECIES **17**

Argali Sheep 18
Asiatic Cheetah 23
Asiatic Wild Ass 27
Bukhara Deer 32
Goitered Gazelle 36
Mongolian Gazelle 42
Saiga Antelope 46
Snow Leopard 51
Wild Camel 56
Chinkara 60

5. REFERENCES **64**

Summary of Key Findings

This report provides a comprehensive overview on how and where different types of linear infrastructure affect large mammals in the wider Central Asian region. Wide-ranging large mammals such as the fifteen species covered by the Central Asian Mammals Initiative (CAMI) of the Convention on the Conservation of Migratory Species of Wild Animals (CMS) depend on open and interconnected landscapes for their well-being and ultimately their survival. This report considers nine of those CAMI species, namely Argali Sheep, Asiatic Cheetah, Asiatic Wild Ass, Bukhara Deer, Goitered Gazelle, Mongolian Gazelle, Saiga Antelope, Snow Leopard and Wild Camel, as well as Chinkara, which is not listed under CMS but shares the same range as the CAMI species, across eight countries in Central Asia.

Fences, railroads, and paved roads have a profoundly detrimental impact on those species, fragmenting their habitats, isolating populations, and obstructing their movements to access to vital resources such as forage and water. These barriers directly cause injuries and mortality (see Chapter 3). Additionally, pipelines with embankments reaching heights of up to one meter create significant obstacles, severely disrupting animal movements.

The rapid construction and planning of new infrastructure and transportation systems in the eight CAMI Range States evaluated in this report present an opportunity to consider the protection of threatened and endangered species. This report includes detailed maps that illustrate the distribution ranges of each species in relation to the existing and proposed types of linear infrastructure (see Chapter 4). These maps highlight areas where and what types of conflict exist or can be expected and will assist in identifying locations where proactive measures can be taken to minimize these conflicts.

The eight CAMI Range States, along with certain species ranges in China, showcase an extensive **total of 179,294 km of existing linear infrastructure**. This infrastructure includes 108,763 km of paved roads, 31,489 km of railroads, and 21,253 km of fences. Moreover, with over 5,000 km of planned railroads on the horizon, there is a significant opportunity to further improve connectivity and support sustainable development in these areas.

Fences pose considerable challenges for all species, and their design play a crucial role in determining whether – and which – species can cross them. For instance, while barbed-wire fences along railroads in Mongolia completely block the movement of Asiatic Wild Asses, they create partial barriers to the movements of Goitered and Mongolian Gazelles and lead to direct injuries and mortality. Furthermore, the fences along national borders in Central Asia impede vital transboundary movements for several species, including Saiga Antelopes, Asiatic Wild Asses, Goitered Gazelles, Argali Sheep, and Wild Camels.

Railroads, especially those that are fenced, have double tracks, or operate high-speed trains, significantly hinder ungulate movements and often lead to direct animal mortality. The presence of high and steep embankments further increases the likelihood that these railroads will obstruct ungulate movements, creating a complete barrier. For instance, the fenced railroad between Zhezkazgan and Karaganda in central Kazakhstan cuts through the habitats of the Saiga Antelope, while the fenced railroad between Tavan-Tolgoi and Gashun-Sukhait in the Mongolian Gobi fragments the critical habitat of the Asiatic Wild Ass.

Paved Roads such as highways with medium to high traffic volumes can serve as either partial or complete barriers to wildlife movements, and they can also lead to direct mortality for wildlife. In Iran, while the movements of the Asiatic Cheetah do not appear to be significantly affected by highways, this species often suffers from car accidents, resulting inconsiderable mortalities.

Pipelines and Canals hinder the movement of certain species, such as the Saiga Antelope and the Goitered Gazelle. For example, the high soil embarkment of the gas pipeline in the Aral Sea region in Uzbekistan affects the movement of the Saiga Antelope. Furthermore, canals in Uzbekistan impact the movement of the Goitered Gazelle. More detailed information on this topic is available in the corresponding species-specific infrastructure maps.

Recommendations

1. It is crucial to update the distribution ranges for the Saiga Antelope, Goitered Gazelle, and Wild Camel across their ranges as well as for the Chinkara and Asiatic Cheetah in Iran as the expansion of linear infrastructure is continuously changing and fragmenting the distribution ranges of these species. At the moment, this is not fully reflected in the current IUCN assessments.

2. The conflict areas identified by experts and presented in this atlas require considerable attention and mitigation. Working groups should be set up in the countries concerned, complemented by international cooperation through the framework of CAMI to i) develop a set of targeted remedial actions that leverage existing guidelines and studies, to ii) coordinate the implementation of those actions to ensure a unified approach and to iii) monitor their effectiveness to promote continuous improvement and best practices.

3. To safeguard large mammals and preserve the integrity of their habitats, exploring alternatives to fencing is crucial. If the erection of new fences within a species' range is unavoidable, it is imperative that such structures are designed to facilitate wildlife movement, allowing animals to traverse the barriers. Additionally, the potential for the complete removal of existing fences that disrupt critical habitats and movement corridors should be evaluated as a viable solution.

4. Fences along national borders require special attention due to their negative impacts on transboundary migrations of various species in the CAMI region. Border fences must be carefully designed and maintained. A positive example is the successful adjustment of the border fence between Kazakhstan and Uzbekistan by the Government of Kazakhstan in 2016, which has made it partially permeable for Saiga Antelope. The Convention on Migratory Species (CMS) can play an important role in facilitating dialogue and providing expertise to help countries find solutions that balance national security concerns with the needs of wildlife.

5. Conducting comprehensive monitoring studies in defined conflict areas and movement corridors is essential to better understand the interactions between wildlife and infrastructure such as paved roads and railways. These studies will enable managers to pinpoint specific hotspots where wildlife collisions frequently occur, paving the way for targeted interventions to reduce vehicle speeds and enhance safety for both animals and drivers. Furthermore, it is equally important to conduct detailed monitoring assessments to examine the effects of pipelines and canals on wildlife habitats and their migrations.

6. This Atlas and its online viewer can be used as a resource throughout all phases of the planning process for new infrastructure projects. It is essential that the CMS Guidelines for Addressing the Impact of Linear Infrastructure on Large Migratory Mammals in Central Asia are integrated into both the planning and construction phases, ensuring that wildlife migrations and habitat connectivity are prioritized from the initial stages to project completion.

1. Introduction

Central Asia's expansive steppe, desert, and mountain ecosystems are home to large migratory mammals, including Saiga Antelopes, Mongolian Gazelles, Wild Camels, and many other wide-ranging species, whose well-being and survival depend on open and interconnected landscapes. Recognizing the importance of those landscapes for migratory species, in 2014, the Eleventh Meeting of the Conference of the Parties (COP11) to the Convention on the Conservation of Migratory Species of Wild Animals (CMS) established the Central Asian Mammals Initiative (CAMI) creating a comprehensive framework for the cooperation across fourteen Central Asian countries, nine of which are Party to CMS, to conserve and restore fifteen large mammal species. In 2020, Resolution 11.24 (Rev.13) was revised at CMS COP13 adopting the CAMI Programme of Work (POW) for 2021-2026.

As most of the CAMI countries are of developing economies, they are experiencing a rapid increase of linear infrastructure causing threats to the ecological integrity and connectivity of the landscapes. In addition to its rich biodiversity, Central Asia is also abundant in oil and gas, metals, and coal. With high demand for energy and raw materials in China and other neighboring countries, these resources are being exploited at an unprecedented pace and scale. Numerous long-distance railways and road networks are being built and planned to provide the infrastructure for large-scale natural resource extraction and economic development, stretching all the way to Siberia and the Caspian Sea.

Not only is this level of natural resource extraction and linear infrastructure development creating barriers to the migration for wild animals across the region, but also large ranging animals are losing access to essential feeding and breeding grounds as their habitats are becoming bisected by linear infrastructure. The connectivity of those open landscapes enabling the free movement of many large mammals are at risk of being lost – and with it the species that depend on them.

CMS has been working to address the negative impacts of linear infrastructure and barriers to the movements of migratory species for many years. In 2011 the CMS Scientific Council first discussed a study from WWF Mongolia analyzing the effects of infrastructure on migratory mammals in Mongolia, highlighting the fragmentation of populations and direct mortality of Goitered and Mongolian Gazelles and Asiatic Wild Ass caused by railroads and fences. Since then, several activities have taken place including studies and recommendations for wildlife-friendly fences focusing on Saiga in Kazakhstan, workshops on mining and infrastructure impacts in Mongolia, as well as the development of guidelines and concrete projects such as to remove harmful fences on the ground.

With the adoption of CAMI and the CMS "Guidelines for Addressing the Impact of Linear Infrastructure on Large Migratory Mammals in Central Asia" at COP11, this issue gained further attention. However, while a great deal has already happened and awareness and support for this issue has increased slowly, it is still far from being resolved: for instance, in 2017, more than 5,300 Mongolian gazelles died along the Trans-Mongolian Railway due to harsh weather conditions and their inability to escape from the fence. In contrast, over 2,000 gazelles died along the same railway in 2023, which was a regular year with normal conditions.

1.1 Mandate for the Development and Revision of the Atlas

The original Atlas was commissioned to implement Activity 1.3.1 of the CAMI POW 2014-2020 on making species- and landscape-specific knowledge available, specifically to: a) develop common standards for maps; b) develop maps (layers) per country per species (identify key areas); c) develop and update map layers on existing and planned potential barriers; d) make maps (GIS) available at national, bilateral and regional level; e) develop species-specific factsheets (incl. behavior, ecology, etc.), and f) identify knowledge gaps and initiate targeted applied research.

The updated edition of the Atlas implements the Activities 3.1 (b, c) and (b, c) of the CAMI POW 2021-2026 that instructs the CMS Secretariat to continually update and further develop the CAMI Atlas and to integrate the updated and standardized geographical information about species and landscapes in the CAMI Atlas respectively. In addition, it also contributes to the execution of the CMS COP14 Decisions 14.19 on Atlas on Animal Migration by updating the original CAMI Atlas and improving its usability through its online version; 14.196 on Ecological Connectivity by identifying habitats and ecological corridors of importance for the conservation of migratory species in the context of wider Central Asia; and 14.203 on Infrastructure Development and Migratory Species by improving resolutions of the CAMI Atlas' maps and making them more user-friendly and accessible online; updating range delineation and linear infrastructure information, where necessary.

1.2 Scope of the Atlas

Due to the funding availability, the **range** of the updated edition of the Atlas remains the same, covering the territory of eight CAMI Range States – Afghanistan, the Islamic Republic of Iran, Kazakhstan, Kyrgyzstan, Mongolia, Tajikistan, Turkmenistan and Uzbekistan. The project area covers a 100-km buffer beyond these eight countries, determined through a geographic information system (GIS) analysis, thus, including transboundary areas of neighboring countries such as Russia and China (Study Area Map).

The migration corridors or distribution ranges of the following **species** were mapped for this atlas (the scientific species names applied in the taxonomic reference currently used by CMS, Wilson and Reeder 2005, are indicated in brackets, if different):

Argali Sheep *Ovis ammon*

Asiatic Cheetah *Acinonyx jubatus venaticus*

Asiatic Wild Ass *Equus hemionus*

Bukhara Deer *Cervus hanglu bactrianus (Cervus elaphus yarkandensis*)

Goitered Gazelle *Gazella subgutturosa*

Mongolian Gazelle *Procapra gutturosa*

Saiga Antelope *Saiga tatarica*

Snow Leopard *Panthera uncia (Uncia uncia)*

Wild Camel *Camelus ferus (Camelus bactrianus*)

Chinkara *Gazella bennettii*

1.3 Purpose and Use of the Atlas

To prevent the harmful effect of linear infrastructure on migratory species, it's crucial not only to understand its potential impact but also to know where the animals move and what infrastructure is being built or planned in their habitat to be able to allow timely intervention to influence the placement and design of linear infrastructure objects in a manner that reduces their negative effects.

The aim of the original Atlas (2019) and this updated edition (2025) is to provide expert knowledge to enable decision-makers and other stakeholders to integrate the needs of migratory mammals in the planning of new linear infrastructure or the modification of the existing ones. To facilitate the accessibility of the knowledge in the form of GIS data to stakeholders, this edition of the Atlas has an online viewer, which is available through CMS website.

In addition, beyond the wider mitigation strategies available for the most common effects of infrastructure, this Atlas aims to suggest specific remedial strategies for circumstances that are unique to the eight CAMI species and infrastructure pairings. The user should note that a paired analysis of species and infrastructure type is only included in this document if there was a conflict detected between a given species' distribution and a particular infrastructure type.

This Atlas, especially its online viewer, is intended to function as a living document, subject to ongoing updates. Readers are encouraged to contribute current information should any data become outdated or as new insights and developments emerge.

2. Methodology

2.1 Methodology of the CAMI Atlas (2019)

The majority of the data for the Atlas published in 2019 (UNEP/CMS, 2019a) was collected during a three-day workshop entitled "Atlas of Range-wide Mapping and Priority Setting of CAMI Species (Distribution and Movement Corridors) and Linear Infrastructure Threats across Central Asia" attended by 25 experts on specific species, regions, and/or tools from 27 April to 1 May 2017. This workshop-based methodological approach used for the CAMI Atlas 2019 was based on the International Union for Conservation of Nature (IUCN) Species Survival Commission (SSC) species conservation planning guidelines (IUCN/SSC, 2008).

Prior to the workshop in 2017, the study area of the Atlas was identified and determined through GIS analysis. Experts with knowledge of the distribution and movement patterns of the species under consideration, as well as of linear infrastructure development in the study area, including the CAMI Species Focal Points, attended the workshop. Simultaneously, data were obtained from other sources derived from the IUCN Red List for species ranges and OpenStreetMap, Esri, Center for International Earth Science Information Network (CIESIN), and the experts' local knowledge for linear infrastructure. Pipeline data were obtained from a wider variety of sources, including individual company websites, Harvard WorldMap, Wikipedia, and the United States Energy Information Administration. In addition, data on planned infrastructure were identified on the Center for Strategic and International Studies' "Reconnecting Central Asia" website.

Experts contributed their opinions to weigh the influence on movements associated with the species crossing each of the identified subtypes of linear infrastructure. The questions asked included:

- *To what extent does a linear infrastructure object, e.g., a paved road, constitute a barrier to a species, e.g., Mongolian Gazelle?*
- *Is it a complete barrier, a partial barrier, or not a barrier?*
- *If that road has significant traffic, some traffic, no traffic, how is movement affected?*

The maps and tables in the Atlas published in 2019 represent the collaboration and agreement of the 25 workshop participants.

2.2 Methodology of the Updated Edition of the CAMI Atlas (2025)

The infrastructure and species distribution range data derived from the CAMI Atlas 2019 was used as baseline reference for the CAMI Atlas 2025 (details above). This dataset provided a critical starting point for updating the information regarding linear infrastructure and species distribution ranges.

Further, to facilitate the data compilation process, a comprehensive template containing a series of targeted questions related to additional/new data on linear infrastructure and species-specific distribution across the CAMI region since 2019 was developed, which was grounded in the context of the CAMI Atlas 2019. The country-specific experts were engaged by distributing this template via email, aiming to gather their insights and recent findings. The specific questions included in the template were as follows:

- *Are there any observed changes in species distribution ranges when compared to the distribution range maps provided on the CAMI Atlas 2019?*
- *Is there any GPS tracking data (animal movement data from GPS collars) available that can be used to map conflict areas, corridors and effects of linear infrastructures on movements of species across their range?*
- *Have there been any construction of linear infrastructure including fences, railroads, roads, canals, and pipelines that differ from the maps presented in the CAMI Atlas 2019?*
- *Are there any planned construction of roads, fences, and railways?*
- *Which existing roads, fences, and railways have the most harmful effect on the respective species distribution or their movements? Can you provide specific names of linear features that negatively affect animal movements and distributions?*

To enhance the accuracy of the species range data, a thorough comparison between the range data derived from the CAMI Atlas 2019 and the current species range information available from IUCN Red List assessments was undertaken. Numerous experts contributed most recent, country-specific species range data, which were compared with the ranges provided in the CAMI Atlas 2019 and IUCN assessments. Further, we integrated the data from the previous Atlas with the updated country-specific species ranges while accurately documenting the data sources and compilation years. For species with smaller or shifted ranges compared to the IUCN Red List assessments, a detailed mapping system was developed, including two distinct presence categories following the IUCN assessment:

- *Extant*, which refers to the current range identified by experts;
- *Possibly Extant*, which indicates ranges derived from the IUCN assessment that do not overlap with the current range defined by experts

This comprehensive and systematic approach ensured a thorough understanding of current species distributions and the dynamics of linear infrastructure impacts on the CAMI species since 2019.

In addition to collecting expert feedback based on the questions above, we also obtained updated road and railway data from OpenStreetMap (OSM). The results from the previous Atlas indicated that unpaved local roads or roads with low traffic volume (defined as <=1 car per hour) do not present barrier effects on animals across the study region. Consequently, we concentrated our efforts solely on highways or paved roads that were categorized in OSM as "trunk" and "primary" roads.

Furthermore, more linear infrastructure objects were digitized based on experts' insights and contributed additional data for fences, railroads, and proposed railroads. The estimated total length of known fences, railroads, and paved roads is provided per species range, and conflict areas or key linear threats are highlighted on the maps along with a description.

Given the fact that pipelines are primarily located underground and there are a few canals documented in the study region, along with the absence of overlap with the species ranges indicated in the previous Atlas, any additional pipelines and canals were included not for every species but for those affected by them in this update.

Study Area Map: Eight CAMI Range States – Afghanistan, the Islamic Republic of Iran, Kazakhstan, Kyrgyzstan, Mongolia, Tajikistan, Turkmenistan and Uzbekistan. *Dotted line represents the Line of Control in Jammu and Kashmir agreed upon by India and Pakistan. The final status of Jammu and Kashmir has not yet been agreed upon by the parties.*

3. Types and Impact of Linear Infrastructure

The various types of linear infrastructure can each have a different impact on the movements and mortality of the species concerned. The results from the previous Atlas indicated that unpaved local roads or roads with low traffic volume (defined as <=1 car per hour) do not present barrier effects on animals across the study region. Consequently, the following types of infrastructure were considered for this Atlas and their negative effects are summarized below, starting with infrastructure that has the heaviest impact to those that might be less harmful.

1. **Fences** are clearly the number one threat and a major concern for all CAMI species. For several species fences constitute absolute barriers, which cannot even be mitigated by a change in design. Fences prevent animals from essential movements in search for food and water or to avoid harsh weather. Specifically, fences along national borders across Central Asia impede the transboundary movements of various species across these regions, while fences constructed alongside existing railroads in Mongolia have a severe impact on several iconic wildlife species in the Southern Gobi, which is home to the largest population of notable species, including the Asiatic Wild Ass, Goitered Gazelle, Mongolian Gazelle, and Argali. Additional impacts include entanglement, injuries possibly leading to infection and death, and use by poachers and predators as a tool to entrap.
2. **Railroads**: challenges presented by railroads are the elevated railbed often resulting in a steep embankment and the tracks themselves. Newly constructed Zuunbayan-Khangi railroad in Mongolia is constructed with steep embankments, that impede the movement of the Asiatic Wild Ass. The barrier effect of a railroad *per se* is further enhanced if fenced, resulting in the added risk of wildlife getting trapped in the railway corridor.
3. **Roads**: both paved and unpaved mining roads, significantly impacts wildlife populations. These roads create mortality risks for wildlife due to vehicular traffic and speed, which endangers animals attempting to cross. Increased traffic volumes or high speed can exacerbate this issue, effectively limiting wildlife movement across habitats. Moreover, such roads facilitate poaching activities by providing access to previously remote areas critical for wildlife conservation. The barrier effect of heavily trafficked roads is intensified when they are fenced, increasing the likelihood of wildlife becoming trapped within the road corridor, which can further fragment habitats and hinder population connectivity.
4. **Canals**: a network of irrigation canals exists in many Central Asian countries. The impact of canals on movements of ungulates is not well understood, but they do not seem to have a significant impact or act as a major movement barrier; however, this is mainly due to the fact that there is little overlap with species distribution.
5. **Pipelines**: any sections of pipelines are buried throughout the CAMI range and so are mainly disruptive to CAMI species during construction or in specific places where they remain above ground or where they have steep embankments.

Although the effect of different infrastructure types varies somewhat between species and habitats (see sub-chapters 3.1-3.3), the **following negative impacts** on CAMI species and their habitat arise from the fragmenting effects of linear infrastructure:

i) subdivision of once large and connected populations resulting in smaller subpopulations, which are more vulnerable to demographic stochasticity and reduced genetic variability;
ii) die-offs or decreased fitness when populations are cut off from key resources or refuge areas in emergency situations such as drought or harsh climatic conditions;
iii) reduced movement distances - including the loss of migration movements altogether - resulting in an overall altering of extinction, natural processes, and ecosystem services;
iv) direct changes in wildlife behaviour and distribution with potentially cascading effects on populations fitness and long-term persistence;
v) direct impacts such as injuries and mortality through entanglement and accidents (e.g. collision with roads or railroads).

Assessment of the impacts of fences, railroads and roads (sub-chapters 3.1-3.3) on the species below remains unchanged in this edition. In the original version, they were defined via a collectively produced Data Dictionary, which specifies the attributes for each type of infrastructure necessary to characterize the degree of threat to each species, and a threat matrix, which ranks the threat posed by each type of infrastructure based on those attributes.

In principle, a complete set of fully characterized infrastructure data - such as knowing the exact traffic levels of all roads in Asia - would enable threats to be estimated for all species. In practice, the attributes of

many infrastructure types were not completely filled or are simply not known. As a result, existing (known) linear infrastructure, including fences, railways, paved roads, and also planned railways were estimated per species range and mapped.

More detailed information on the effects of canals and pipelines is available in the corresponding species-specific infrastructure map.

3.1 Effects of Fences on Species

The different species are affected to different degrees by infrastructure – while fences do not stop species such as Asiatic Cheetah and Snow Leopards, they are a complete barrier to Wild Camels and Asiatic Wild Ass (see figures below). The analysis below provides an overview of the extent to which a particular type of infrastructure (focusing on fences, railroads and paved roads) is a barrier to the movements of the animals. **Number codes** are used to show how the different species are affected by the different types of fences: 2=complete barrier effect, 1=moderate barrier effect, 0=low to no barrier effect; 0.5=unknown barrier effect.

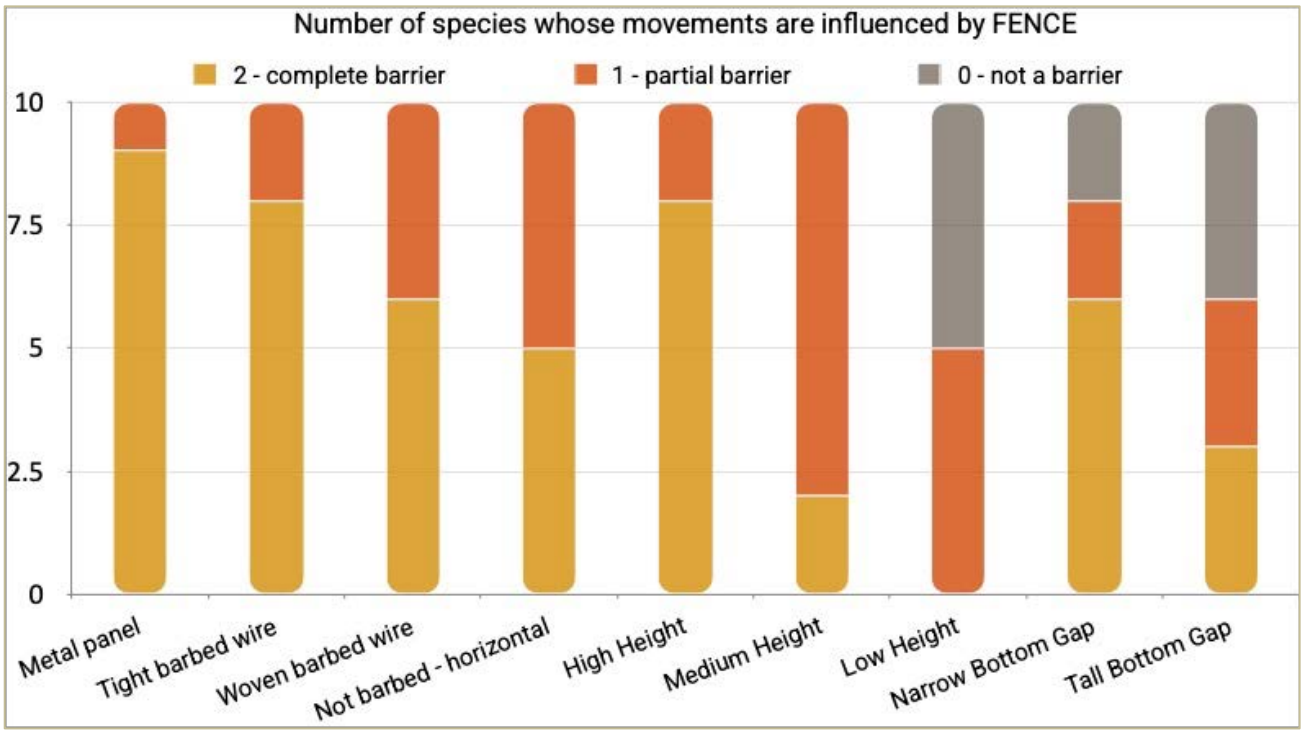
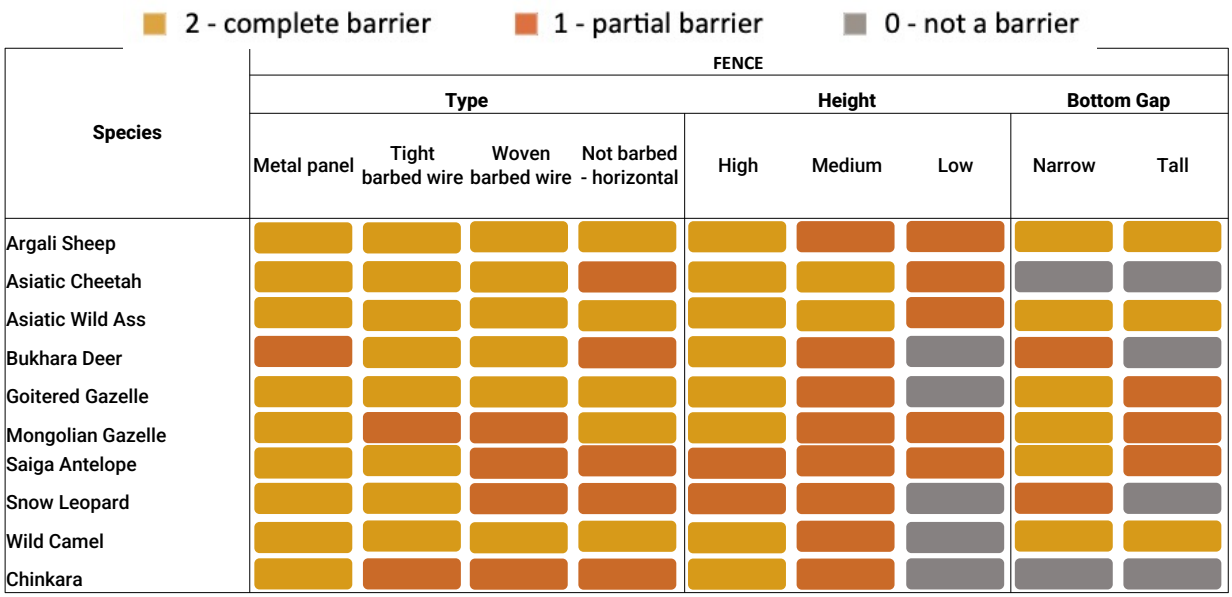


Figure 3.1 Barrier effect of different types of FENCES
Some types of fences are a complete barrier to almost all species such as metal panels (only a partial barrier for Bukhara Deer) and high fences (partial barrier for Snow Leopards). Medium high fences are a partial barrier for most species and the effects of gaps at the bottom of the fence clearly need to be further investigated in order to understand better how this gap needs to be designed in order to allow crossings by certain species.

Table 3.1 Species – Infrastructure Matrix: FENCES



This table shows that fences in all their different forms are a complete barrier to most of the species. Some ungulates, especially the small gazelles such as the Chinkara can cross a fence if there is a gap at the bottom, through which they can crawl. It becomes clear that Asiatic Wild Ass, Argali and Wild Camel cannot cross most types of fences and are significantly affected – all fences are either a complete or at least partial barrier. Asiatic Cheetah, Goitered Gazelle and Mongolian Gazelle are also greatly affected with only a few more fence types forming a partial rather than a complete barrier.

For larger ungulates, all types of fences except those of low height are a complete barrier. Overall, this analysis shows that the existence and construction of new fences are a major problem for all species. Some species might be able to cross a certain type of fence while others cannot – this also illustrates the need to where possible completely remove fences in the species range or design them according to the needs of the concerned species. Further research is urgently needed.

3.2 Effects of railroads on species

The Figure 3.2 below shows the barrier effect of each type of railroads. It becomes clear that there is still a lot of uncertainty regarding to the barrier effect of railroads for many species (shown as unknown). Double-track and high-speed railroads have the largest barrier effect (Saiga Antelope and Wild Camel) with low speed and single track having the least impact.

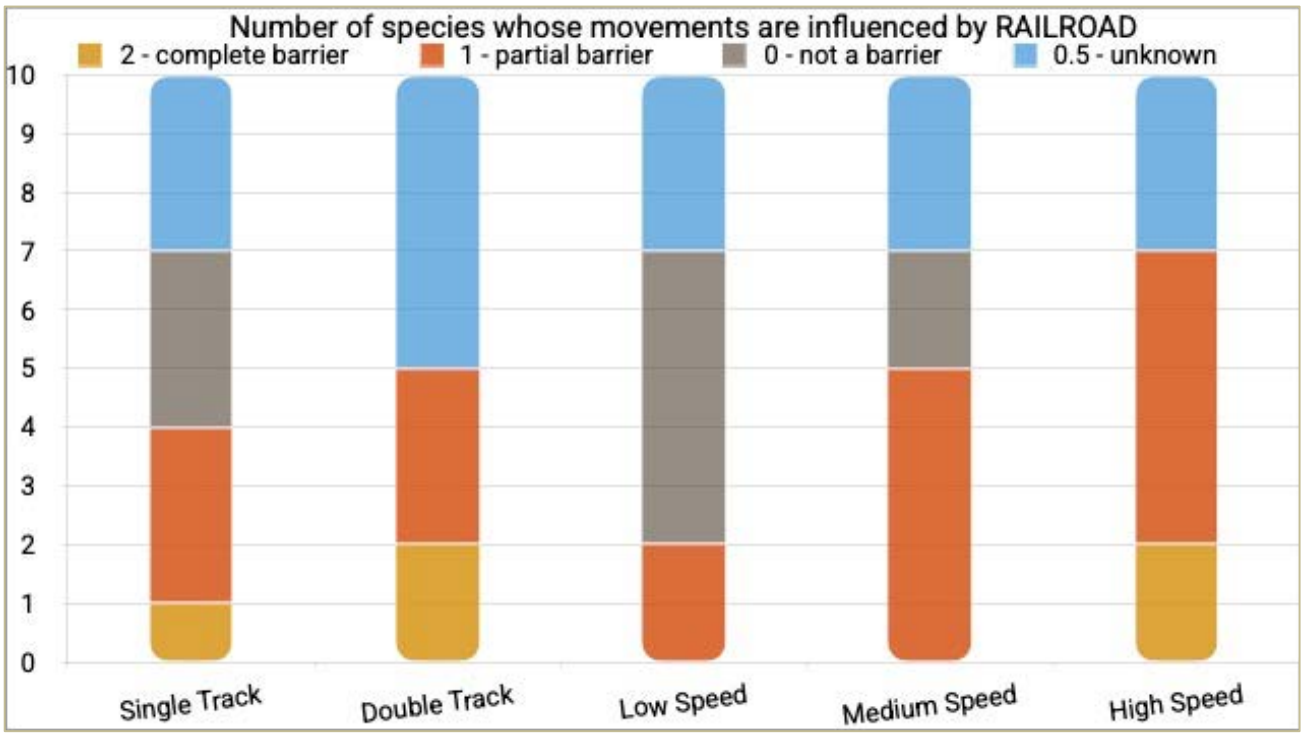


Figure 3.2 Barrier effect of different types of RAILROADS

Saiga and Wild Camel have the biggest problems crossing railroads. For most of the other species, railroads are a partial barrier, with speed and width being the determining factors. It also becomes clear that there is a high degree of “unknown” for many species and further research is therefore needed.

Table 3.2 Species – Infrastructure Matrix: RAILROADS

Species	RAILROAD				
	Track		Speed		
	Single	Double	Low	Medium	High
Argali Sheep					
Asiatic Cheetah					
Asiatic Wild Ass					
Bukhara Deer					
Goitered Gazelle					
Mongolian Gazelle					
Saiga Antelope					
Snow Leopard					
Wild Camel					
Chinkara					

2 - complete barrier
1 - partial barrier
0.5 - unknown
0 - not a barrier

Table 3.2 shows the need for further research to better understand how railroads affect the movements of many species (e.g. Asiatic Cheetah, Chinkara). Double-tracked railroads are a complete barrier for Saiga and Wild Camel, while in general railroads – if not fenced – do not seem to have a strong barrier effect for most species, pending further research.

3.3 Effects of Roads on Species

Figure 3.3 below indicates that unpaved, low traffic and local roads have the least impact on the species. As traffic increases, the barrier effect does too.

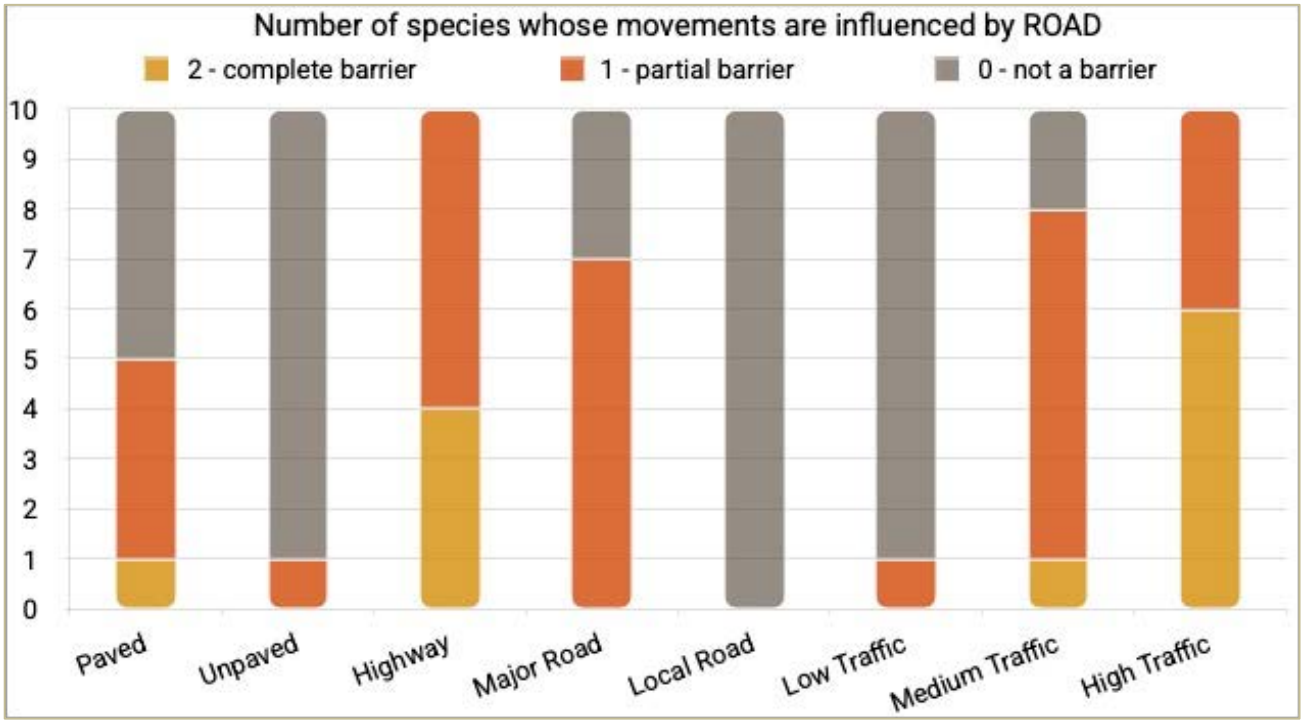


Figure 3.3 Barrier effect of different types of ROADS

Table 3.3 Species – Infrastructure Matrix: ROADS

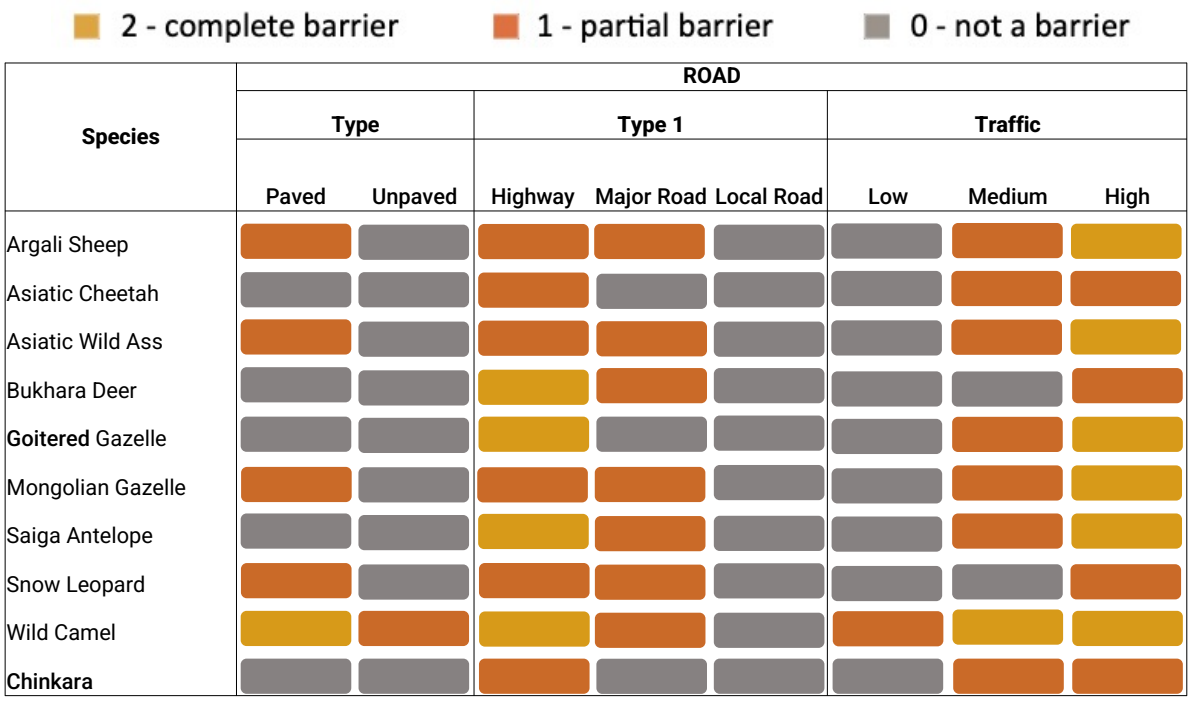


Table 3.3 shows that unpaved and local roads are not having a barrier effect for any of the species (except for local roads that can be a partial barrier for Wild Camel). Wild Camel are clearly having the greatest problems in crossing roads, while none of the road types hinder species such as Chinkara, Asiatic Cheetah (not taking into account the car accidents and resulting mortality) and Snow Leopard completely.

It becomes clear that the higher traffic volume, the bigger the barrier effect. Highways are difficult to cross for most species and a complete barrier for Goitered Gazelles and Bukhara Deer. While Asiatic cheetah can cross roads and highways, they frequently die in car accidents and are therefore also greatly affected by roads.

4. Linear Infrastructure Maps by Species

This section contains sub-chapters dedicated to each species, providing a brief overview of their conservation status and the ways in which they are impacted by infrastructure. For each species, a series of maps illustrate various types of linear infrastructure, indicating their locations within the species' range and identifying areas of conflict. The maps are aligned with the distribution of each species and may cover only a small portion of the study area—if the species has a limited range—or, in the case of wide-ranging species such as the Argali or Snow Leopard, may encompass nearly the entire study area.

Argali Sheep

© Askar Dabletkav, Argali Sheep *Ovis ammon*

SPECIES FACTS

Common Name: Argali Sheep

Scientific Name: *Ovis ammon*

Geographic Range: Afghanistan, China, India, Kazakhstan, Mongolia, Uzbekistan, Kyrgyzstan, Azerbaijan, Pakistan, Tajikistan, Nepal, Russian Federation

Habitat: Shrubland, grassland, rocky areas, desert

Global Population: up to 107,000, possibly substantially lower (UNEP/CMS, 2024)

Conservation Status: Near Threatened (IUCN Red List, 2020), CITES Appendix II, CMS Appendix II

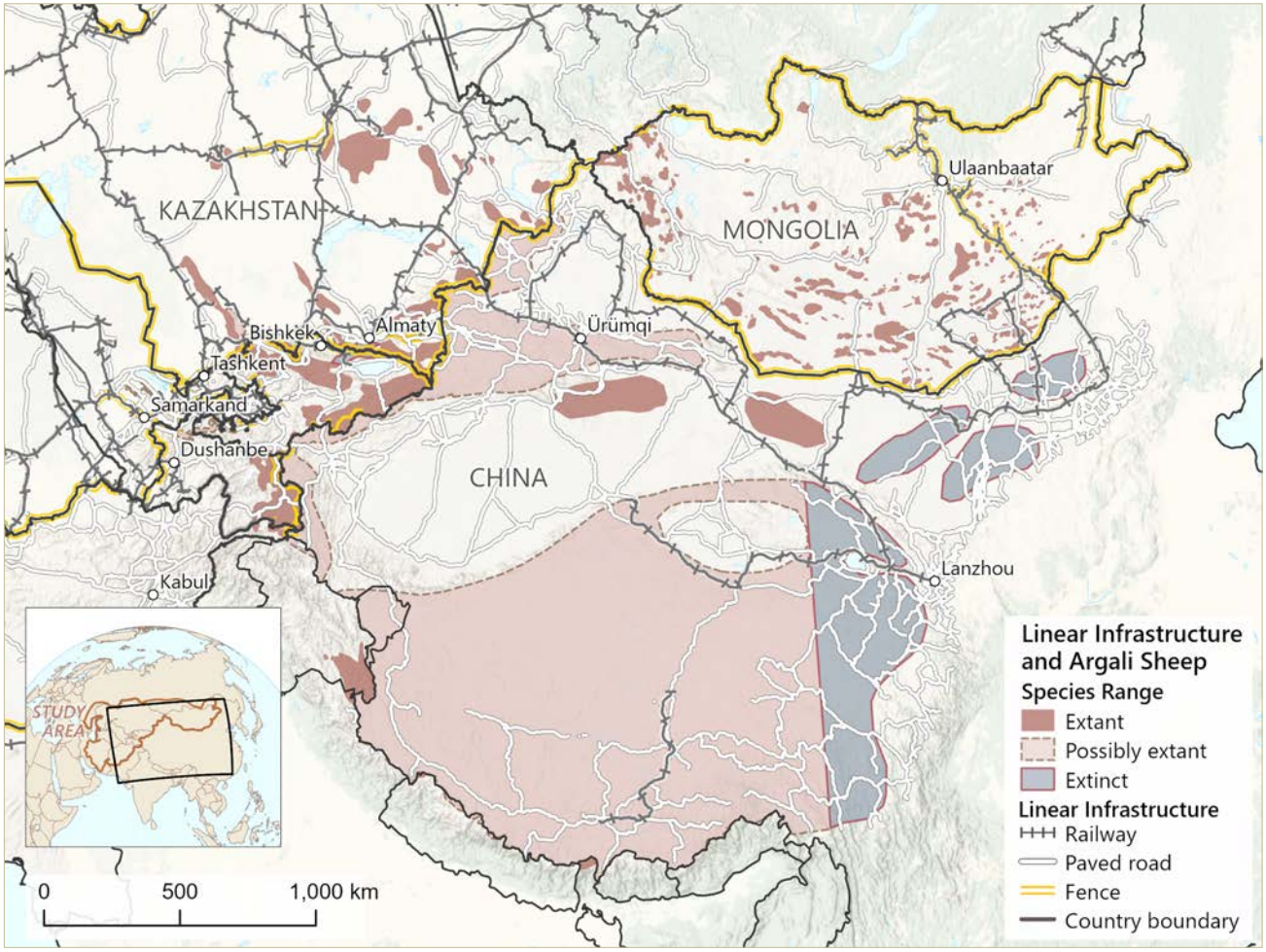
Currently, there are nine recognized subspecies of Argali, seven of which are listed on Appendix II of CMS. These subspecies can be found across 12 countries in Asia and the Russian Federation (Mallon et al., 2014). The IUCN Red List and the Single Species Action Plan (SSAP) for Argali do not provide global estimates for the total population size. However, the Argali Overview Report estimates the total population to be approximately 107,000 Argali (UNEP/CMS, 2024), while the population figures used for the IUCN Red List suggest a substantially lower number.

Eastern Tajikistan, Kyrgyzstan, and China are the strongholds of Argali, with a minimum of 21,000 individuals. Unfortunately, poaching is identified as the major threat to their survival. These sheep tend to avoid areas with humans and livestock, where poaching often occurs and where livestock are protected by dogs. Additionally, overgrazing in their habitats leads to degradation, which is a key factor in habitat destruction and habitat loss. Furthermore, resource extraction activities, such as mining, along with the associated disturbances and infrastructure development, are increasing within parts of the Argali's range, leading to habitat fragmentation and habitat loss.

MOVEMENT BEHAVIOUR

Argali migrate seasonally due to changes in food availability and environmental conditions. During winter, they move to lower altitudes to escape deep snow cover and find better food sources. In summer, they migrate again to higher altitudes in response to drying vegetation and increased disturbances, such as biting insects and livestock grazing. These animals are known for their ability to travel long distances in search of suitable habitats. Their average home range in Mongolia is about 47.5 km², with some up to 75 km² (Reading et al., 2005). Importantly, Argali are transboundary species, which means they are found across multiple countries in Asia and seasonally migrate along border regions in Central Asia (Luikart et al., 2011). Species distribution models show suitable habitats and potential movement corridors extending across national boundaries (Zhuo et al., 2024).

LINEAR INFRASTRUCTURE AND ARGALI SHEEP



Estimated Linear Infrastructure in the Species Range

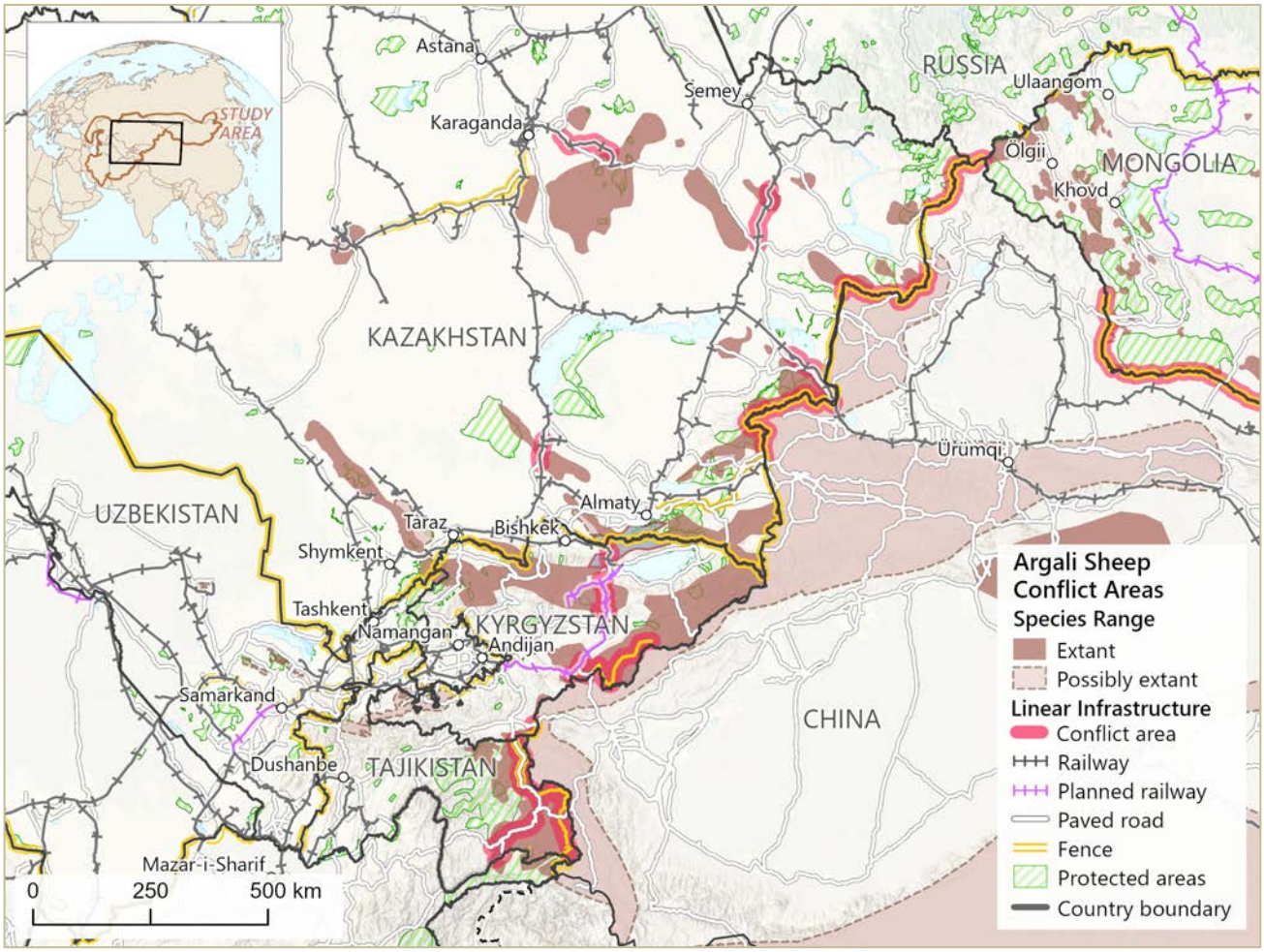
2,351 km	Fence
3,248 km	Railroad
26,991 km	Paved road
32,590 km	**Total existing linear structure**
297 km	**Planned railroad**

Key Linear Threats to Movements and Habitat Fragmentation of Argali Sheep

98% of the total fence in the species range is secure and well-maintained; high fences – built by China along its borders with Afghanistan, Tajikistan, Kyrgyzstan, Kazakhstan, and Mongolia – **present an impassable obstacle to Argali, especially during movements to seasonal pastures.** In addition to these border fences, **fenced railroads in Mongolia also threaten Argali's migration** and fragment their habitats.

Furthermore, there are plans to build **over 297 kilometers of new railroads across the Argali's habitat, primarily in Kyrgyzstan, followed by Mongolia.** This development poses additional challenges for Argali movements, especially if these railroads are fenced. Additionally, roads with high traffic volumes have been identified as partial barriers to Argali movement.

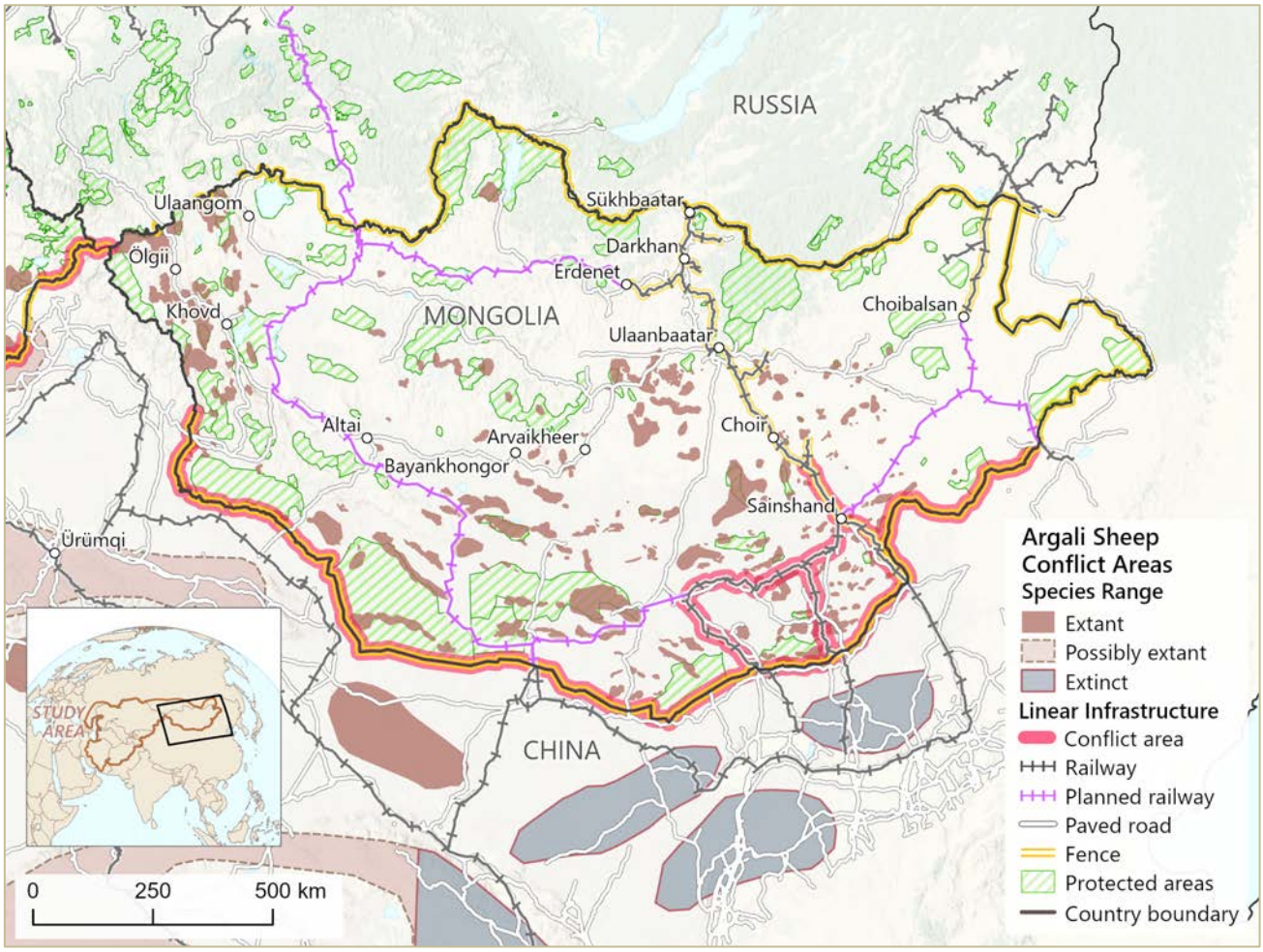
CONFLICT AREA AND ARGALI SHEEP IN CENTRAL ASIA



CONFLICTS WITH LINEAR INFRASTRUCTURE IN CENTRAL ASIA

Border fencing creates a complete barrier for Argali movements in Central Asia. **In Kazakhstan, a 436 km border fence along the Kazakhstan-China border intersects the Argali range, forming impermeable barriers that hinder the transboundary movement of these animals. Additionally, a 660 km railroad in Kazakhstan also intersects the Argali range, identified as conflict areas that further obstruct Argali movements.** A significant portion of the Marco Polo Sheep population (*Ovis ammon polii*), estimated to be in the thousands, migrates seasonally or occasionally between Kyrgyzstan, Tajikistan, China, Afghanistan, and Pakistan. However, **269 km of fencing along the Kyrgyzstan-China border and 368 km of border fencing along the Tajikistan-China border could block these migrations and fragment suitable habitats in the Pamir region.** In 2012, 16 carcasses of Marco Polo Sheep were discovered near a fence along the border between Tajikistan and Afghanistan. Given that eastern Tajikistan is home to the largest population of Argali and provides the most suitable habitat for them, along with large patches of suitable habitats in China, the border fences along the border with China may impact the transboundary movements of this species between suitable habitats. Furthermore, two transboundary ecological corridors between China and Kyrgyzstan have become ineffective due to border fencing. The proposed China-Kyrgyzstan-Uzbekistan railway is expected to cross these habitats.

CONFLICT AREA AND ARGALI SHEEP IN MONGOLIA



CONFLICTS WITH LINEAR INFRASTRUCTURE IN MONGOLIA

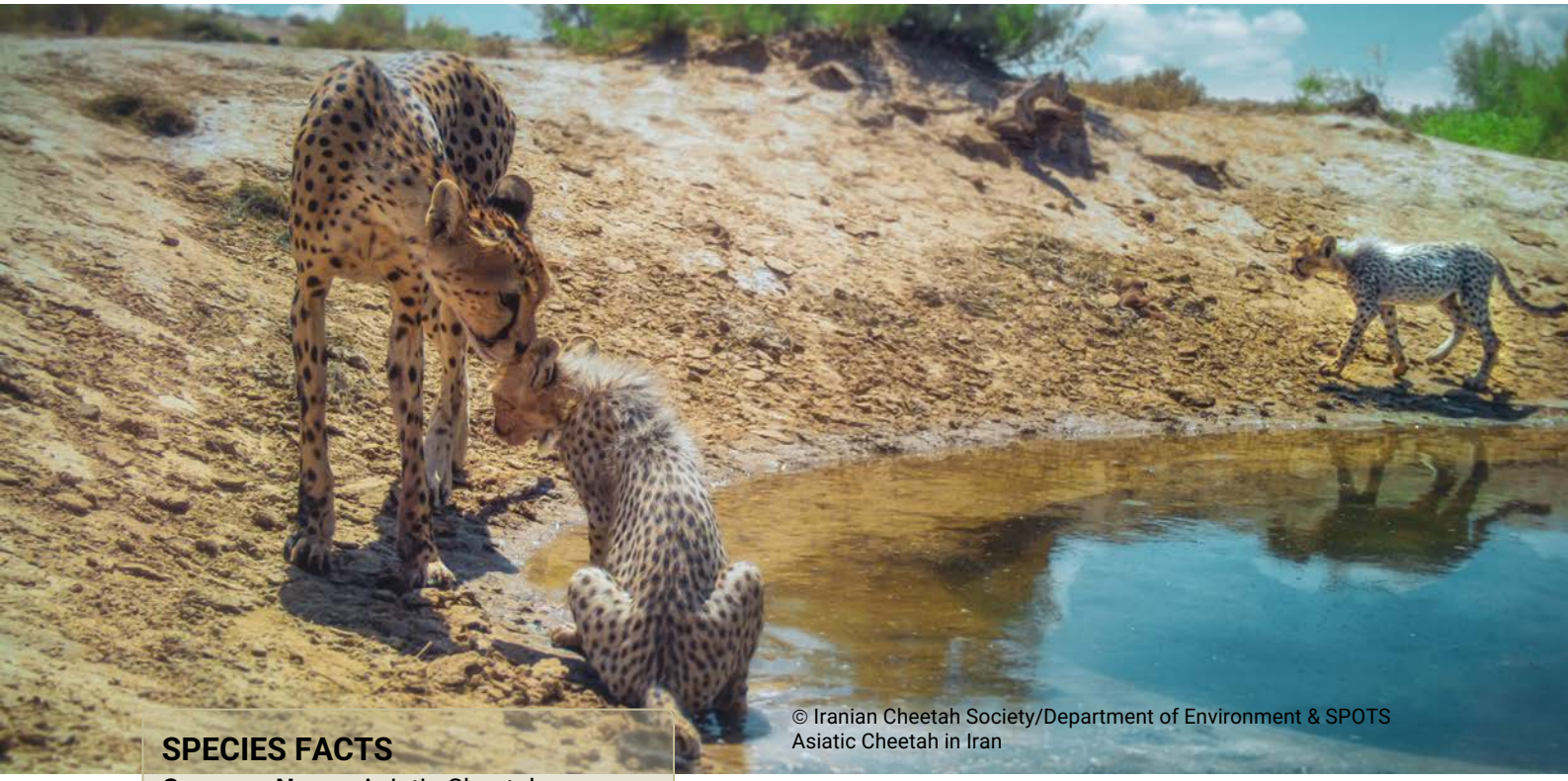
Since the 1960s, the corridor fencing alongside the Trans-Mongolian Ulaanbaatar-Zamyn Uud Railroad in Mongolia has acted as a complete barrier for wildlife, including Argali. Argali can jump over fences if they are wildlife-friendly in height, but they are unable to crawl under them. **The barbed-wire fences along this railroad present a significant barrier for Argali, as they are poorly maintained, loose, and over 1.6 meters high, with no gaps.** This could also lead to entanglement, injuries, and mortality among the Argali population. **The situation has worsened with the recent construction of over 900 kilometers of railroad in the Mongolian Gobi between 2020 and 2023, bringing the total length of railroads within the species' range in Mongolia to 43 km.** Some sections of these new railroads are fenced, while others feature steep embankments, both of which hinder the movement of Argali and fragment their habitat. Although these new railroads include large open-span bridges and box culverts designed for wildlife crossings, their effectiveness for Argali is not well understood. **Additionally, border fences effectively isolate populations between Mongolia and China. There are plans for an additional 67 km of new railroads within the species' range in Mongolia.** This future construction will create even more barriers, leading to further habitat fragmentation and increasing the risk of isolated populations, especially if these new railroads are fenced or built with high embankments.

MITIGATION/REMEDIATION STRATEGY

FENCE	RAILROAD	PAVED ROAD
• Dismantle remaining stretches of unused/decaying fences (e.g. between Tajikistan and Afghanistan); • Remove border fences, where possible; • Create fence openings on a seasonal basis; • Control any illegal hunting along border fence road and openings; • Research whether salt blocks could attract Argali to fence openings.	• Monitor collisions between trains and wildlife to identify high collision zones for Argali. • Build overpasses for Argali; or tunnels for railroads. • Discourage fences alongside railroads.	• Monitor for roadkill and identify zones of frequent collision between Argali and vehicles. • Build overpasses for Argali; or tunnels for roads in identified hotspots. • Prevent poaching facilitated by road access.

More information:
Argali Sheep on the CMS webpage

Asiatic Cheetah



© Iranian Cheetah Society/Department of Environment & SPOTS
Asiatic Cheetah in Iran

SPECIES FACTS

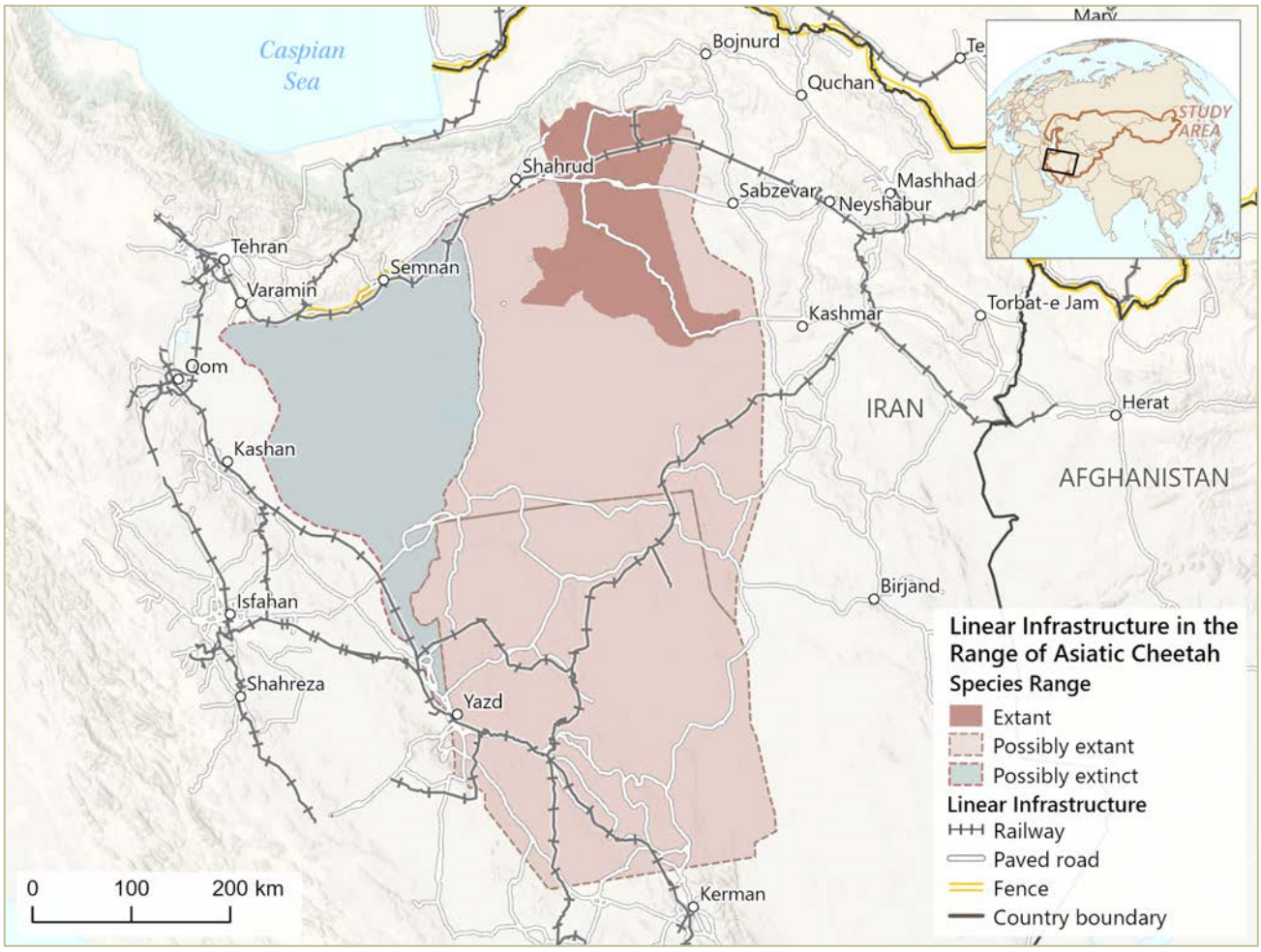
Common Name: Asiatic Cheetah
Scientific Name: *Acinonyx jubatus venaticus*
Geographic Range: Iran (Islamic Republic of Iran)
Habitat: Arid and semi-arid deserts of Iran
Global Population: <40 (Farhadinia et al., 2017)
Conservation Status: Critically Endangered (IUCN Red List, 1996), CITES Appendix I (1975), CMS Appendix I

The Asiatic Cheetah (*Acinonyx jubatus venaticus*), a subspecies of Cheetah, once roaming across a historic range from the Arabian Peninsula to India, now faces critical habitat limitation. Currently, its range is confined to small, isolated areas within Iran. Before World War II, the Iranian population of Cheetah was estimated at almost 400 individuals (Harington, 1971). In recent decades, its population has been estimated as less than 40 individuals (Farhadinia et al., 2017). The main cause of Cheetah mortality is largely attributed to human-induced pressures, including illegal human killing, mainly by herders and their dogs or poachers, as well as vehicle collisions (Durant et al., 2017).

MOVEMENT BEHAVIOUR

The Asiatic Cheetah has been observed as a wide-ranging, nomadic predator, which moves exceptionally long distances to find resources and cope with harsh environments. A multiple year of camera trapping data showed that an adult female moved 150 km multiple times between protected areas in three years, covering an estimated 3,629 km^2 (Farhadinia et al., 2013). A female with 3 cubs covered an area of 3,600 km^2 while a coalition of 3 males moved 4,800 km^2 over 3 years (Farhadinia et al., 2016). In addition, GPS tracking data also showed that over 4.5 months of tracking, a cheetah moved over a range of 1137 km^2 (Cheraghi et al., 2018). On average, cheetahs move 8.87 km/day when they move. An extreme observation showed that the cheetah moved 130 km in over a two-weeks. These wide-ranging behaviors of Asiatic Cheetah in Iran underscore the need for extensive, interconnected habitats to support sustainable populations.

LINEAR INFRASTRUCTURE IN THE RANGE OF ASIATIC CHEETAH



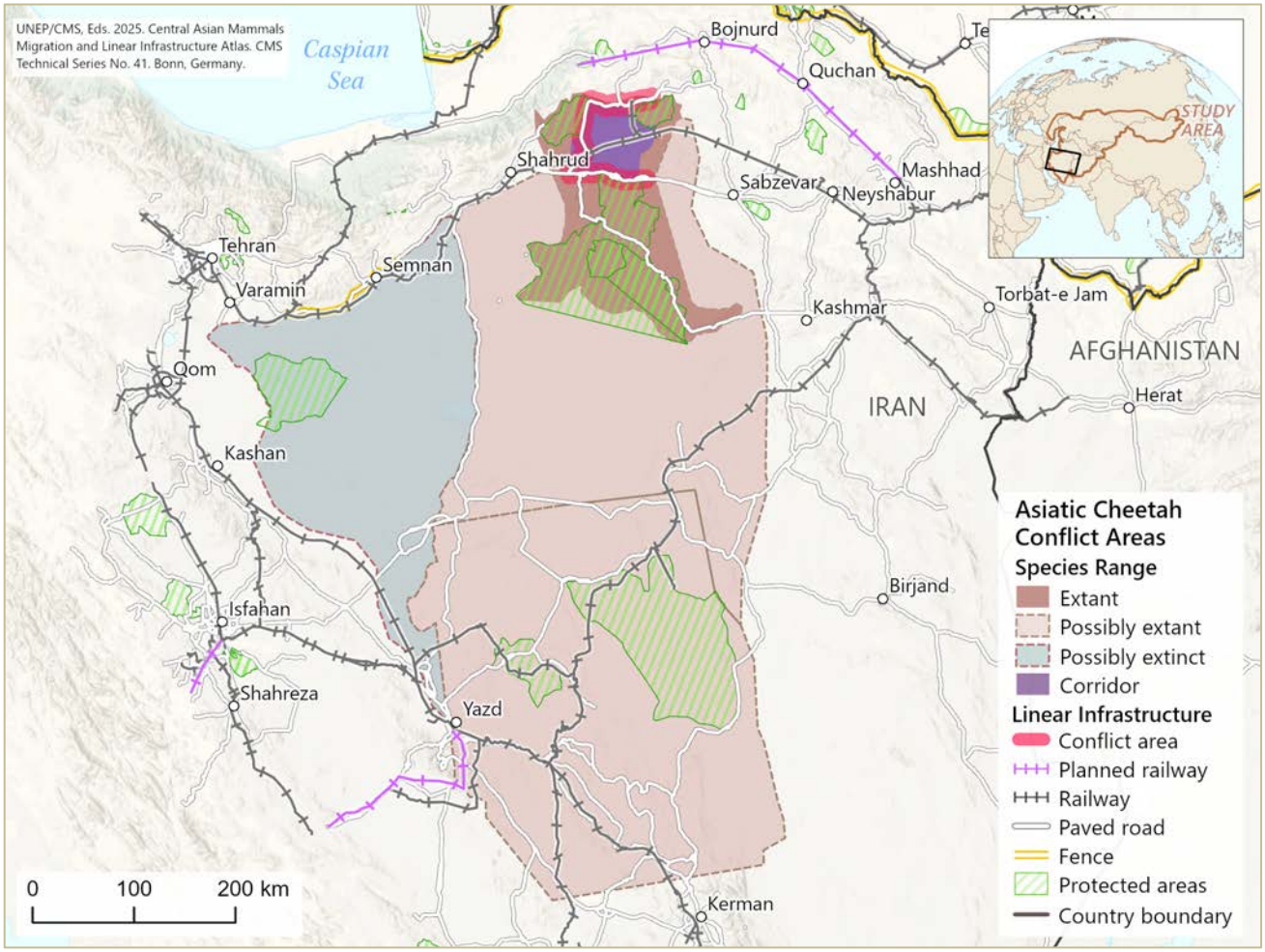
Estimated Linear Infrastructure in the Species Range

6 km	Fence
1,958 km	Railroad
4,303 km	Paved road
6,267 km	**Total existing linear structure**
70 km	**Planned railroad**

Key Linear Threats to Movements and Habitat Fragmentation of Asiatic Cheetah in Iran

The railroad and paved road networks intersect with the species' range, but **highway or paved roads pose a significant barrier to the movement of the Asiatic Cheetah and cause vehicle collisions. Specifically, the highway 44 between Tehran and Mashhad is of particular concern as it transects a key corridor between the core habitats of Touran Biosphere Reserve (1) and Miandasht Wildlife Refuge (2) used by the only known breeding population.** There are no fences within the species' range, and railroads remain unfenced.

CONFLICT AREAS AND CORRIDORS IN THE RANGE OF ASIATIC CHEETAH



CONFLICTS WITH LINEAR INFRASTRUCTURE

As the Asiatic Cheetah requires an extensive home range to thrive, the fragmentation of its habitat has become one of the most pressing threats. **The Asiatic Cheetah is in conflict with the growing network of roads and particularly primary roads transecting its suitable habitat - a threat that markedly increases its risk of extinction** (Mohammadi et al., 2018, Farhadinia et al., 2017). There are several conflict areas within the species range, which overlap with the suitable habitats. **Specifically, the highway 44 between Tehran and Mashhad is of particular concern as it transects a key corridor between the core habitats of Touran Biosphere Reserve (1) and Miandasht Wildlife Refuge (2) used by the only known breeding population.**

At least 14 Asiatic Cheetahs were killed on roads within or between core areas during 2005-2016, making it the major cause of documented mortality for Cheetahs in Iran (Ahmadi et al., 2017, Mohammadi et al., 2018). Among these, **seven Asiatic Cheetahs were killed on Semnan-Mashhad highway. Between 2021 and 2023, three accidents occurred on this highway, resulting in the loss of two cubs and one adult** (Triennial Report 2021-2023)**.**

As a result of the **growing mining industry within Cheetah habitat, the railroad network is projected to grow accordingly and may cause a suite of conservation threats in the future, such as a fragmentation of Cheetah prey populations driving their distribution.**

MITIGATION/REMEDIATION STRATEGY

ROAD

In 2018, Iran took a proactive step by establishing a 3-kilometer fenced area near a wildlife reserve to enhance the safety of Cheetahs by preventing them from accessing the road. This initiative successfully reduced road accidents involving Cheetahs until 2022. However, since the fence only covered a portion of the reserve's border and monitoring was not implemented, the reasons for the temporary decline in roadkill remain unclear.

To build on this progress, Iran has proposed several constructive measures aimed at further reducing collisions. These include plans to extend the fence from 3 kilometers to 36 kilometers on both sides of the road, retrofit culverts beneath the road to function as wildlife corridors, install roadway lighting for better visibility, and deploy speed control cameras to regulate traffic. These efforts could significantly enhance wildlife protection while promoting safer roadways for all.

- Fence dangerous stretches of roads, and create accompanying wildlife passages, to minimize collisions with cars at documented “hotspots.”
- Install effective, reflective signage close to the road.
- Connect existing underpasses in the case of separated highway lines and monitor for effectiveness.
- Investigate efficacy of speed bumps on low-volume roads.

More information:
Asiatic cheetah on the CMS webpage
Asiatic cheetah on the IUCN Red List
Iranian Cheetah Society Triennial Report-2021-2023

Asiatic Wild Ass

© Nandia Dejid
Asiatic Wild Ass *Equus hemionus hemionus*, Dzungarian Gobi, Mongolia

SPECIES FACTS

Common Name: Asiatic Wild Ass

Scientific Name: *Equus hemionus*

Geographic Range: China, India, Iran (Islamic Republic of), Israel, Mongolia, Kazakhstan, Turkmenistan, Uzbekistan

Habitat: Arid and semi-arid deserts

Global Population: 108,300 (Kaczensky et al., 2025)

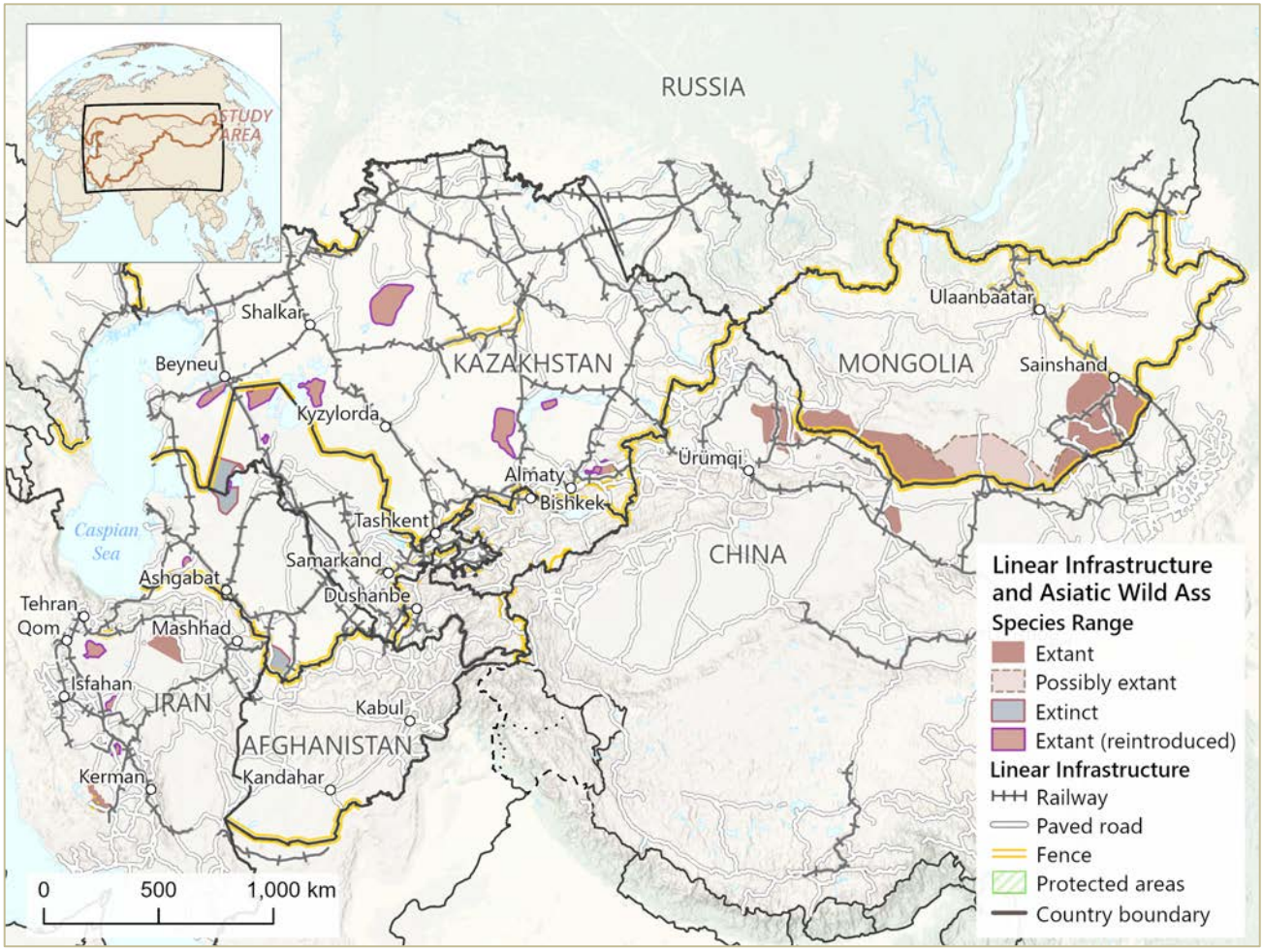
Conservation Status: Near Threatened (IUCN Red List, 2015), CITES Appendix I & II, CMS Appendix II

Historically, large herds of Wild Asses roamed the Eurasian Steppe, from the Mediterranean Sea to the Mongolian-Manchurian Steppe and as far south as Gujarat, India. Today, the global population of Asiatic Wild Ass is estimated at around 108,300 individuals, distributed across 10 populations, of which four have been reintroduced (Kaczensky et al., 2025). About 91,000 Asiatic wild asses (unpublished preliminary estimate)—nearly 85% of the global population—are located in the Mongolian Gobi, which serves as a stronghold for the species. The remaining populations are much smaller and largely isolated from one another. Asiatic wild asses face numerous threats, including competition for forage and water from an increasing number of livestock, pasture degradation, commercial harvesting of wild hay, habitat loss and fragmentation, as well as disturbances caused by human activities, including illegal killings (Kaczensky et al., 2025).

MOVEMENT BEHAVIOUR

The Asiatic Wild Ass is an exceptionally mobile ungulate that exhibits a strong dependence on water sources (Payne et al., 2020). These animals are well-adapted to their arid habitats and undertake wide-ranging nomadic movements to find forage and water, which can be unpredictable due to environmental changes (Nandintsetseg et al., 2016). Their annual home ranges can vary significantly based on ecological factors and individual behavior, with sizes ranging from approximately 6,000 km² in the Dzungarian Gobi Desert to as much as 60,000 km² in the South Gobi region of Mongolia (Kaczensky et al., 2011). Remarkably, one individual has been documented traveling a maximum annual distance of 6,145 km, setting a global record for travel among wide-ranging ungulates (Joly et al., 2019). Water availability is critical for their survival, as Asiatic Wild Asses need to drink every 1 to 2 days. In some regions, they face the challenge of locating scattered water sources, which are often few and far between across their expansive landscapes. Therefore, Asiatic wild Ass are extremely vulnerable to the fragmentation and loss of habitats which is currently on going.

LINEAR INFRASTRUCTURE AND ASIATIC WILD ASS



Estimated Linear Infrastructure in the Species Range

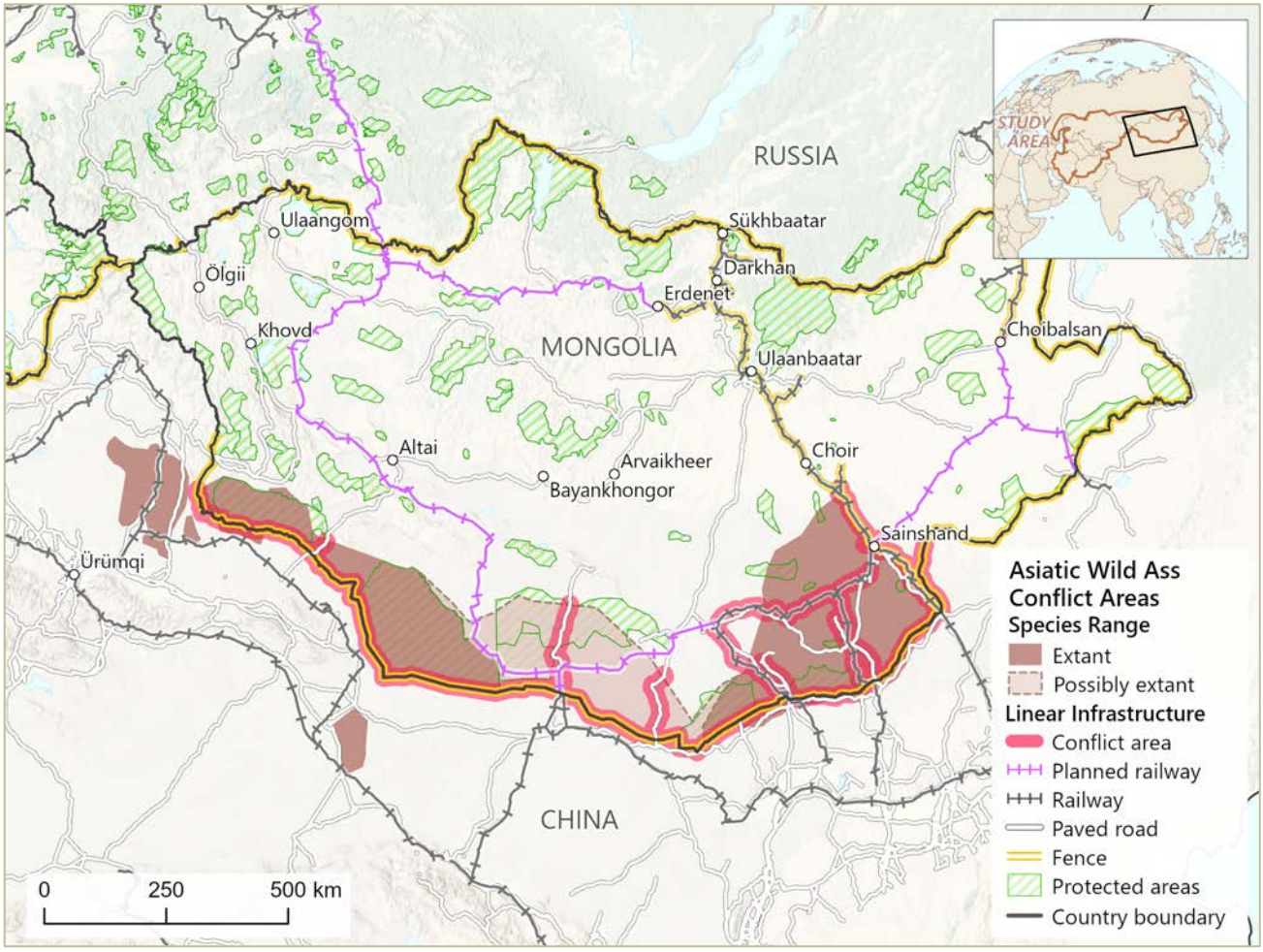
1,755 km	Fence
1,278 km	Railroad
3,168 km	Paved road
6,201 km	**Total existing linear structure**
542 km	**Planned railroad**

Key Linear Threats to Movements and Habitat Fragmentation of Asiatic Wild Ass

Fences along existing railroads and national borders pose a significant threat to the movement of the Asiatic Wild Ass, creating barriers that fragment their habitats. **Currently, there are 892 kilometers of railroads within the range of these wild asses in Mongolia, representing 70% of all railroads across entire species range.** Many of these railroads have fenced sections and steep slopes that severely hinder the species' ability to move freely and access vital resources, such as the sparsely located water sources they depend on. Additionally, border fences effectively isolate populations between Mongolia and China and fragment their range within Turkmenistan and neighboring countries.

The situation is further complicated by **high-traffic roads built for resource extraction**. **An additional 511 kilometers of new railroads are proposed within the species' range in the Mongolian Gobi.** This construction will create even more barriers, resulting in further habitat fragmentation and increasing the risk of isolated populations.

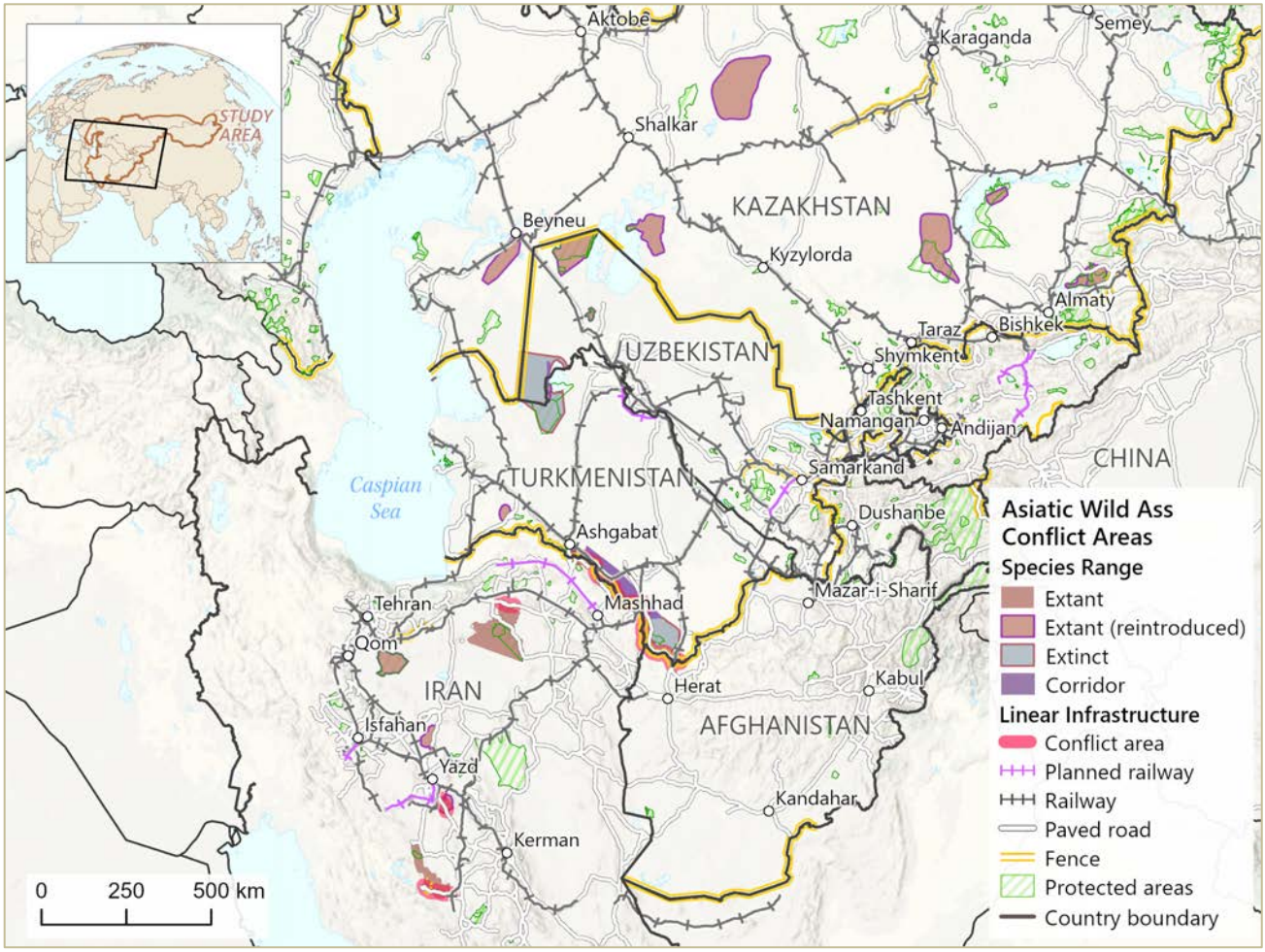
CONFLICT AREAS AND ASIATIC WILD ASS IN MONGOLIA



CONFLICTS WITH LINEAR INFRASTRUCTURE IN MONGOLIA

The corridor fencing alongside the Trans-Mongolian Ulaanbaatar-Zamyn Uud Railroad in Mongolia has been a complete barrier since the 1960s, defining the easternmost limit of the Asiatic Wild Ass species. Although the fence is interrupted by small under- and over-passes for vehicles and livestock, these structures are not designed for wildlife use, and no Asiatic Wild Ass has been observed using these structures in over 70 years. This situation has been compounded by **the recent construction of over 900 km of railroad** between 2020 and 2023 in the Mongolian Gobi, bringing **the total railroad length within the species' range to 891 km (70% of all railroad network within the entire species' range).** One of these newly built railroads is completely fenced, while others feature steep embankments and are planned to have fencing installed in 2025. These developments pose significant obstacles to the movement of Asiatic Wild Ass and fragment their habitat in the Mongolian Gobi. While these new railroads include large open-span bridges and box culverts intended for wildlife crossings, the effectiveness of the structures are not well understood. **Furthermore, border fences effectively isolate populations between Mongolia and China. Moreover, the development of high-traffic roads for resource extraction has emerged as another significant threat. An additional 511 kilometers of new railroads are planned within the species' range in the Mongolian Gobi.** This construction will create even more barriers, resulting in further habitat fragmentation and increasing the risk of isolated populations.

CONFLICT AREAS AND ASIATIC WILD ASS IN CENTRAL ASIA



CONFLICT AREAS AND ASIATIC WILD ASS IN CENTRAL ASIA

In Kazakhstan, the existing populations of Asiatic Wild Ass are confined to reintroduced groups within protected areas. **The reintroduced population in Central Kazakhstan may face obstacles in its southward movement due to the Zhezkazgan-Beyneu railway**, which could hinder its range expansion. Although there is no fence along the railway, the embankment is steep in many sections, and the animals might avoid crossing it. Additionally, if the Central Kazakhstan population expands northward, it would be impacted by roads. **In comparison, the National Park "Altyn Emel" is intersected by a paved road; however, rangers have observed that the animals are able to use habitats on both sides of the road.**

In Turkmenistan, the border fence is placed 5 to 10 km inside the main territory, resulting in a substantial "no man's land" between the fence and the actual border. This arrangement has led to the alarming fragmentation of the small remaining populations of Asiatic Wild Asses, isolating them into groups within the border security zones and along Turkmen territory and Uzbekistan in the north (the Kaplankyr/Lake Sarykamysh region).

In Iran, a fence along the western edge of the Bahram-e Goor protected area was built to reduce vehicle collisions with the Asiatic Wild Ass and protect agricultural land. However, this fence limits the movement and population expansion of the species. Collisions between vehicles and Asiatic Wild Asses have been reported along this road. While the fence aims to mitigate these risks, it also hinders their mobility.

MITIGATION/REMEDIATION STRATEGY

FENCE	RAILROAD	PAVED ROAD
• Ensure that existing standards and guidelines for infrastructure. In Mongolia, the National Standard for Wildlife-Friendly Fencing in Mongolia must be followed. • Remove fences that are not directly serving a purpose within Asiatic Wild Ass range (redesign is not an option) wherever possible. • Develop default policies for segments of new roads and railways that are away from human settlement and other zones requiring greater safety measures to be "unfenced". • All proposed fencing along transport infrastructure or other linear features should undergo an EIA; • Ensure that if fences cannot be avoided, planned fences have 100-metre gaps every 20 kilometres (some uncertainty with gap width and distance); • Explore possibilities of remote surveillance to allow gaps in border security fences which do not compromise national security needs/requirements.	• Ensure that existing standards and guidelines for infrastructure including those described in the CMS Guidelines for Addressing the Impact of Linear Infrastructure on Large Migratory Mammals in Central Asia are followed. • Ensure that the default for new roads and railways is "no fence" and that the use of fences in strategic places needs to be approved by EIAs • Ensure embankment slopes are not too steep (1:4 or 1:5 ratio; field experience is needed to obtain threshold values). • Wherever fences cannot be avoided build over- or underpasses at regular intervals and explore possibilities to guide Asiatic Wild Ass movements to these crossing structures e.g. using strategic fencing to funnel movements or artificial water points to attract animals (field experiments are urgently needed!). • Railway underpasses should be considered.	• On Mongolian mining roads, explore measures to stop traffic when larger aggregations of Asiatic Wild Assess are passing, especially during extreme weather conditions like extreme winter or drought events. This could include education and awareness raising for drivers about wildlife, requiring them to reduce speed when seeing wildlife close to the road, especially large aggregations. • Reduce traffic volume significantly during extreme weather events (e.g droughts) to allow large aggregations of animals to cross high traffic roads in search for forage. • Evaluate options for traffic curfew. The situation should be evaluated annually and an inventory of options should be taken to adjust to changing traffic patterns. • Build over- or underpasses at regular intervals over high-volume traffic axis and explore possibilities to guide Wild Ass movements to these crossing structures e.g. using strategic fencing to funnel movements or artificial water points to attract animals (field experiments are urgently needed!). • Consider installation of speed bumps or rumble strips to slow down trucks. • Build regular gaps into guardrails.

More information:
Asiatic Wild Ass on the CMS wedpage
Asiatic Wild Ass on the IUCN Red List
Asiatic Wild Ass on the GIUM Atlas

Bukhara Deer

© Natalia Marmazinskaya
Bukhara Deer *Cervus hanglu*

SPECIES FACTS

Common Name: Bukhara Deer

Scientific Name: *Cervus hanglu bactrianus*

Geographic Range: Afghanistan, Kazakhstan, Tajikistan, Turkmenistan, Uzbekistan

Habitat: Riparian-forested corridors surrounded by desert and steppe environments.

Global Population: 4,320-4,600 (UNEP/CMS, 2019b)

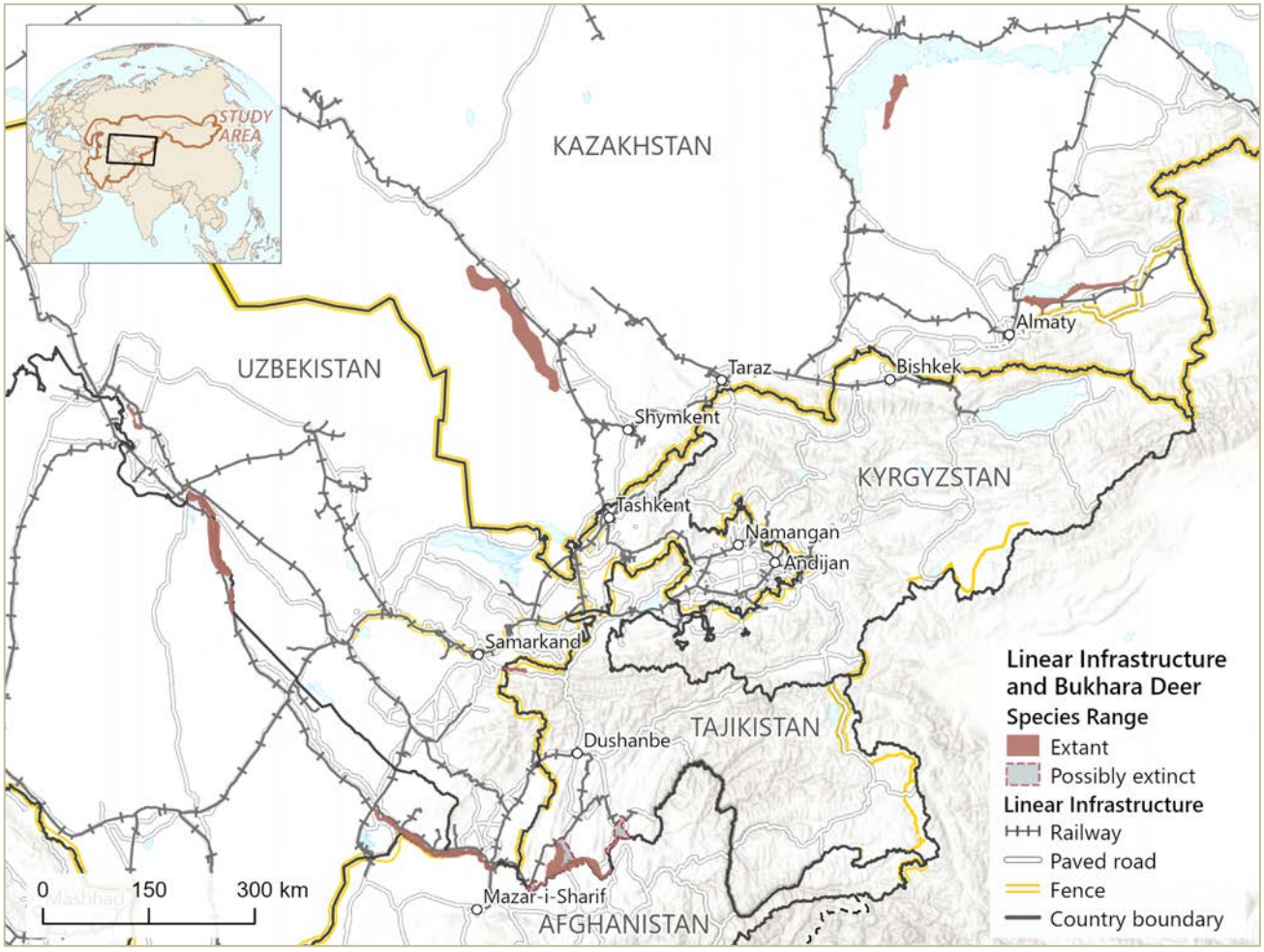
Conservation Status: Least Concern (IUCN Red List, 2017), CITES Appendix II, CMS Appendix II

Historically, Bukhara Deer inhabited across the river valleys of Amu Darya and Syr Darya basin, as well as the valley of several smaller Rivers in Central Asia (Pereladova, 2013). Their range experienced significant contraction during the 19th and 20th centuries due to agricultural expansion and poaching (Brook et al., 2017). Since the 2000s, focused restoration and conservation efforts have successfully increased the Bukhara Deer population to over 4,000 individuals, and this population is now stable and continuing to grow. Currently, Uzbekistan hosts the largest population, estimated at around 2,000 deer, while the Tigrovaya Balka Nature Reserve in Tajikistan supports the largest native population. The limited extent of suitable riparian habitats, habitat fragmentation, poaching and related disturbances may hinder the isolated populations and their dispersal ability (UNEP/CMS, 2019b).

MOVEMENT BEHAVIOUR

The movement behavior of Bukhara Deer is not well understood, but they primarily inhabit riparian areas and tend to have relatively small home ranges of 6 to 8 km² (Baskin and Danell 2013). Although there is no documented evidence of seasonal migration patterns among Bukhara Deer, many populations of Bukhara Deer are transboundary, overlapping with neighboring countries. In Turkmenistan, their populations are contiguous with those in Uzbekistan, and in Tajikistan, their habitat extends across borders into Afghanistan along the Amu Darya River, as well as into Uzbekistan. Notably, significant tugay woodlands cover an area of 11,500 hectares along 66 kilometers across the borders.

LINEAR INFRASTRUCTURE AND BUKHARA DEER



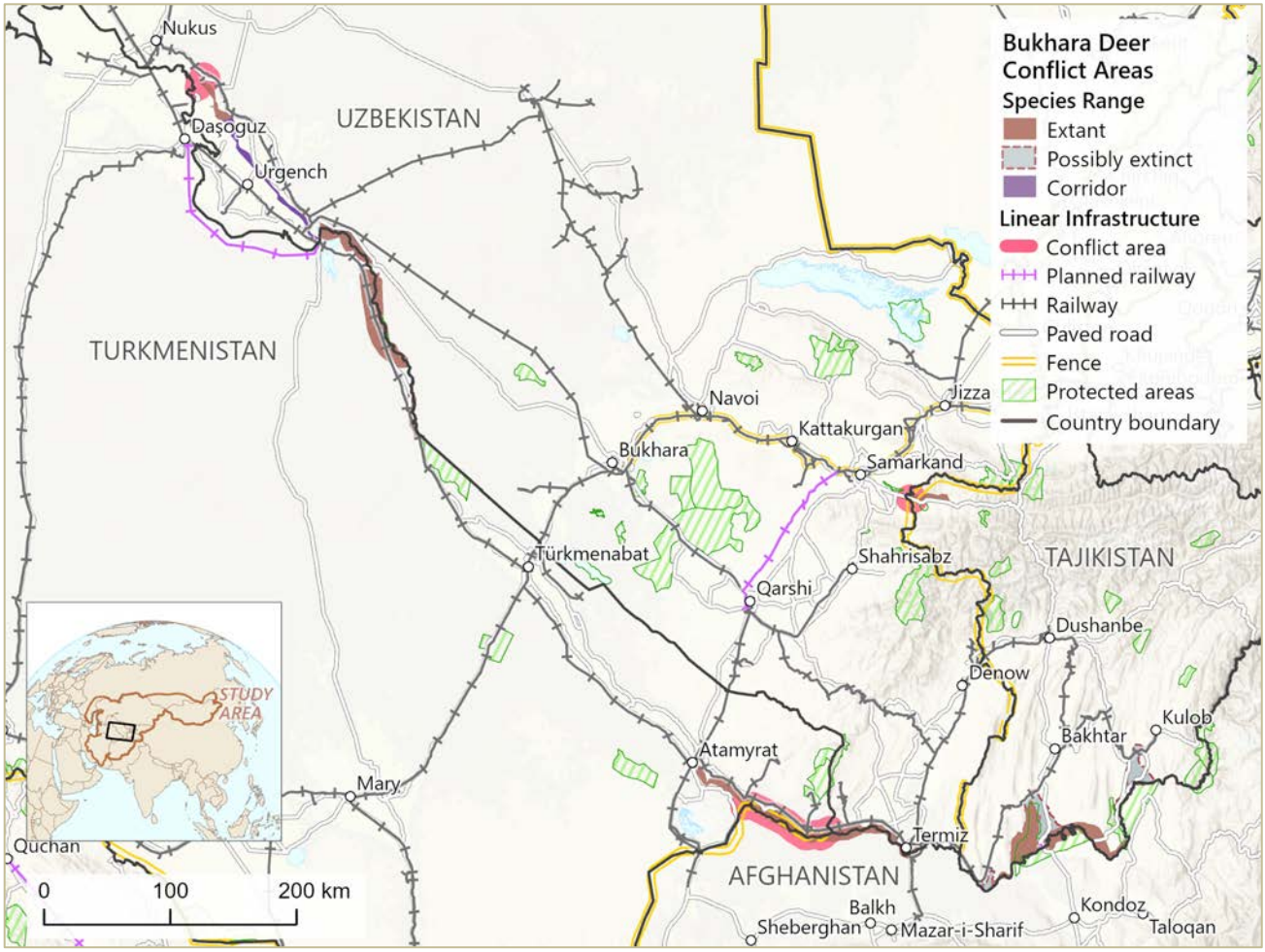
Estimated Linear Infrastructure in the Species Range

139 km	Fence
155 km	Railroad
198 km	Paved road
492 km	**Total existing linear structure**
4 km	**Planned railroad**

Key Linear Threats to Movements and Habitat Fragmentation of Bukhara Deer

A 100-kilometer section of chain link border fences between Turkmenistan and Afghanistan runs through the habitat of the Bukhara Deer in Turkmenistan. This section may disrupt the movements of these deer, hindering their ability to migrate freely between the two countries. Additionally, an 8-kilometer stretch of tight barbed-wire fences along Tajikistan and Uzbekistan intersects the range of Bukhara Deer, which could further impact their movements and lead to habitat fragmentation. Monitoring studies are necessary to verify the potential barrier effects for the fences.

CONFLICT AREAS AND CORRIDORS IN THE BUKHARA DEER



CONFLICTS WITH LINEAR INFRASTRUCTURE

Border fences between Turkmenistan and Afghanistan, as well as between Tajikistan and Uzbekistan, have been identified as potential significant barriers that could obstruct the movement of Bukhara Deer. Additionally, there are the presence of over 120 kilometers of railroads within the habitats of Bukhara Deer in both Uzbekistan and Turkmenistan. While railroads are not recognized as barriers for Bukhara Deer, they may affect the movement of the species due to the increasing population size and the resulting need for greater dispersal in the future. Roads have also not been seen as a major threat to the Bukhara deer to date. However, the ongoing development of road networks, especially within or near their riparian habitats, could elevate the risks associated with poaching. In addition, road traffic may lead to collisions with vehicles in the future.

MITIGATION/REMEDIATION STRATEGY

FENCE	PAVED ROAD
• Field surveys to investigate the effect of border fences on Bukhara Deer are needed. Currently no fence conflicts have been documented, but if they should arise, openings should be made in the fencing and deer/fence interactions should be monitored. • Government, industry and lenders should be informed of the risk of a fence development project in Bukhara Deer habitat, and they should adhere to national legislation and, when relevant, international obligations, including the implementation of strategic environmental assessments and environmental impact assessments.	• Install effective signage that is close to the road and reflective. • Align signage with official policy. • Inform government, industry and lenders of the risk of road development projects in or adjacent to Bukhara Deer habitat, and ensure that projects adhere to national legislation and international obligations, including the implementation of strategic environmental assessments and environmental impact assessments.

More information:

Bukhara Deer on the CMS webpage

Goitered Gazelle

Photo by © Myatav Bodi
Goitered Gazelle *Gazella subgutturosa* in the Mongolian Gobi

SPECIES FACTS

Common Name: Goitered gazelle

Scientific Name: *Gazella subgutturosa*

Geographic Range: China, Iran (Islamic Republic of), Mongolia, Kazakhstan, Turkmenistan, Uzbekistan, Kyrgyzstan, Afghanistan, Azerbaijan, Pakistan, Tajikistan

Habitat: Desert, shrubland, grassland

Global Population: <49,000 (IUCN, 2017)

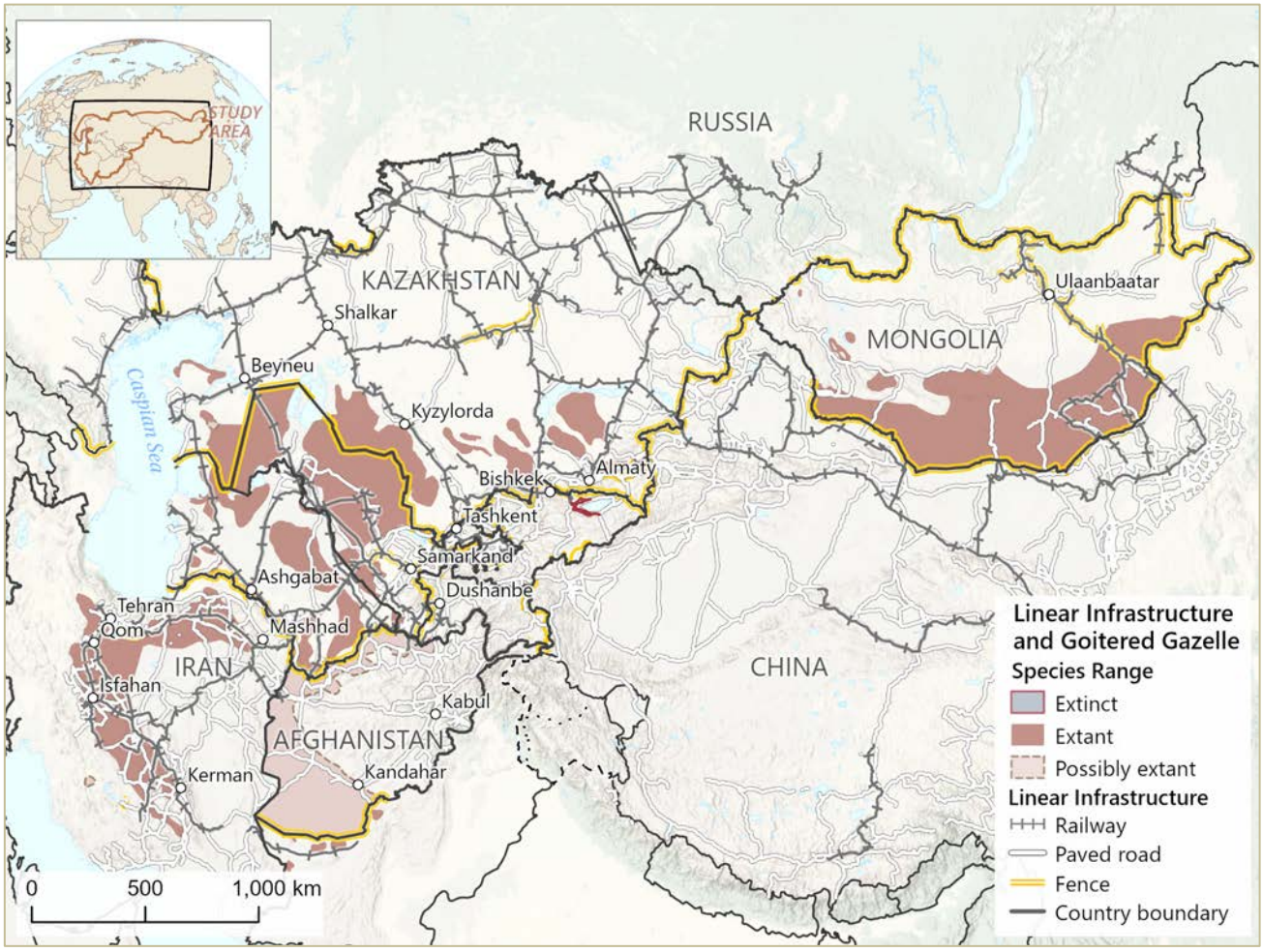
Conservation Status: Vulnerable (IUCN Red List, 2017), CMS Appendix II

The Goitered Gazelle historically occupied extensive regions across Asia. Currently, their range spans the steppes of Central Asia, from southeastern Turkey to northern China and Mongolia. In the late 1990s, their population was estimated at around 140,000 individuals (Mallon and Kingswood, 2001). However, there has been a noticeable decline in their numbers, particularly in Mongolia, where the population decreased from approximately 60,000 in the early 1990s to fewer than 30,000 today—the largest remaining population of the species (IUCN, 2017). Major threats include habitat loss, habitat fragmentation, and poaching, all contributing to this population decline. Today, the distribution range of the Goitered Gazelle is more fragmented in Central Asia than it once was. In 2020, the presence of Goitered Gazelle was recorded in Transbaikalia, Solovievsk in Russia (Kirilyuk, 2021).

MOVEMENT BEHAVIOUR

Historically, the Goitered Gazelle exhibited extensive migratory behavior. Seasonal migrations were undertaken to avoid deep snow in winter and to locate water sources during the dry summer months (Heptner et al., 1961). These migrations covered significant distances, showcasing the species' adaptability to its harsh environment. However, anthropogenic pressures and habitat fragmentation have led to the emergence of sedentary populations, which now inhabit restricted home ranges of just 3 to 8 km² (Martin, 2000; Durmuş, 2010). Seasonal home ranges of Goitered Gazelle in Turkey varied between 2.26 km^2 and 4.55 km^2 (Durmuş, 2010). In Mongolia, Goitered Gazelles have been observed exhibiting both range residency and migratory behavior. During the summer in Mongolia, the average daily movement of the Goitered Gazelle was 2.3 kilometers (Nandintsetseg et al., 2019). Adult males establish individual territories

LINEAR INFRASTRUCTURE AND GOITERED GAZELLE



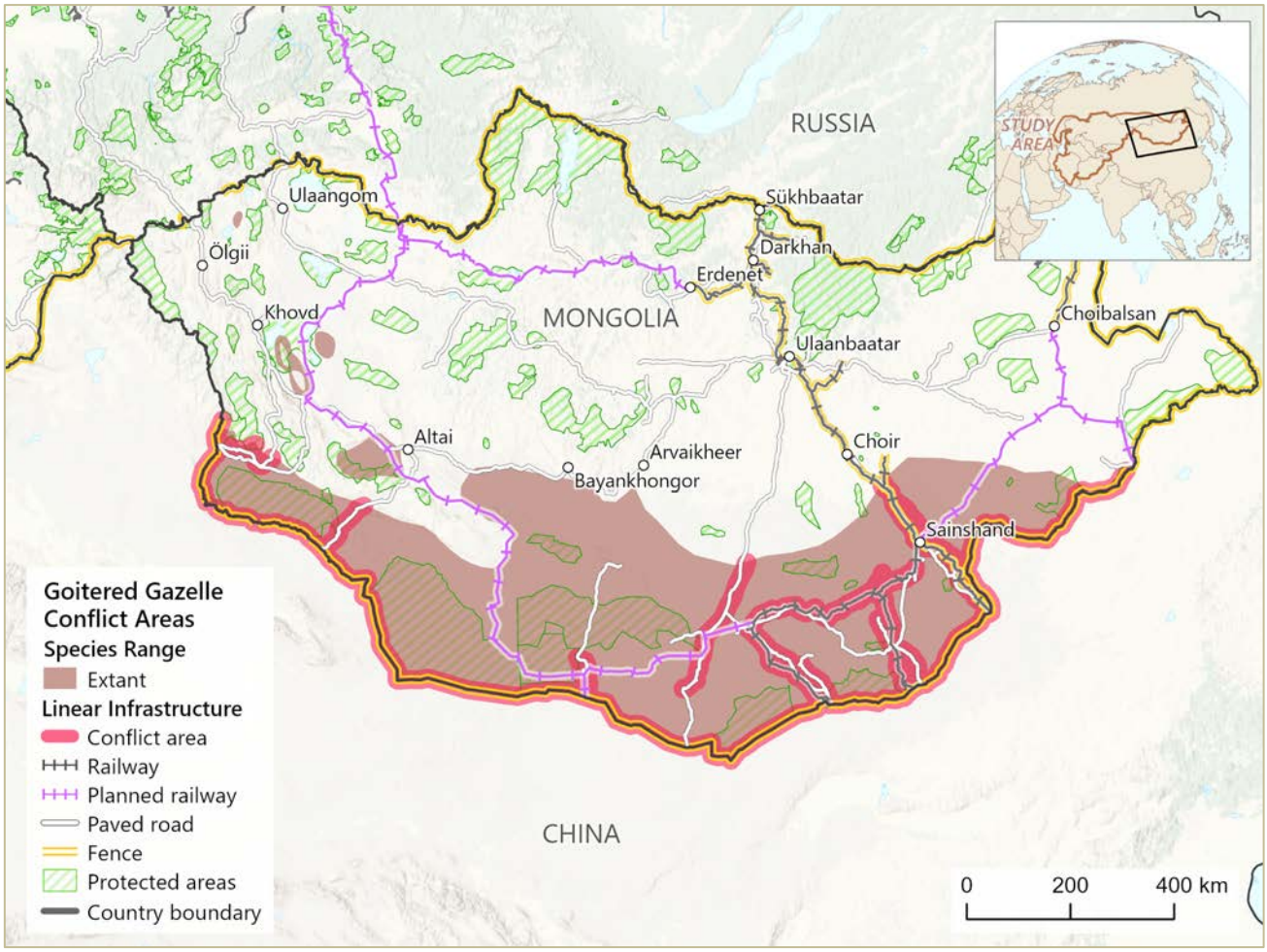
Estimated Linear Infrastructure in the Species Range

6,307 km	Fence
10,564 km	Railroad
19,079 km	Paved road
35,950 km	**Total existing linear structure**
1,724 km	**Planned railroad**

Key Linear Threats to Movements and Habitat Fragmentation of Goitered Gazelle

Various linear features are critical threats to the movement of Goitered Gazelles. **Fences, particularly those alongside borders and railroads, present significant barriers** that disrupt the connectivity of their habitats. The fences along the border between China and Mongolia, as well as those between Turkmenistan and Afghanistan, completely obstruct the transboundary movements of this species. Moreover, fenced railroads in Mongolia stand as absolute barriers that lead to severe habitat fragmentation. Throughout the range of the Goitered Gazelle, **roads with high traffic volume are already causing, or are predicted to cause, severe habitat fragmentation.** 50% (~10,000 km) of the total paved roads intersect the range of the Goitered Gazelle in Iran, followed by Mongolia and Afghanistan. **Railroads are considered partial barriers to the migration of Goitered Gazelles** when they are constructed with underpasses at regular intervals and are not fenced. The most significant railroad conflicts affecting this species are observed in Iran, Mongolia, and Uzbekistan. Additionally, **there are plans for the construction of over 1,200 km of new railroads across the gazelle's habitat in both Mongolia and Iran**, which presents further challenges for their movements.

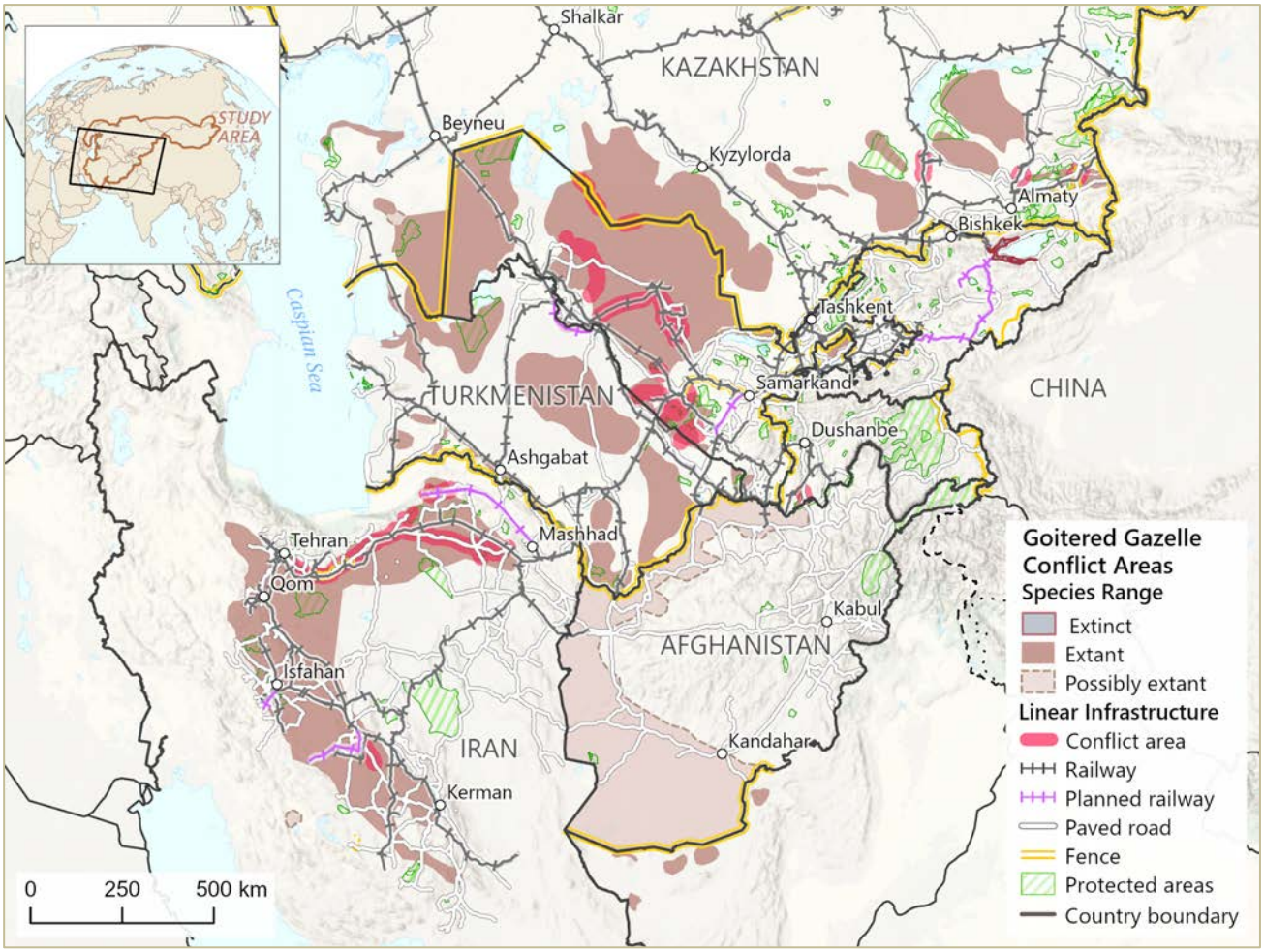
CONFLICT AREA AND GOITERED GAZELLE IN MONGOLIA



CONFLICTS WITH LINEAR INFRASTRUCTURE IN MONGOLIA

The corridor fencing alongside the Trans-Mongolian Ulaanbaatar-Zamyn Uud Railroad in Mongolia has been a complete barrier since the 1960s. Compared to larger ungulates like the Asiatic Wild Ass, Goitered Gazelles, which are medium-sized ungulates, are capable of jumping over or crawling under fences. However, **the barbed-wire fences along this railroad are poorly maintained, loose, and higher than 1.6 meters, with no gaps at the bottom. This condition has led to entanglements, injuries, and mortality, obstructing their movements.** This situation has been compounded by **the recent construction of over 900 km of railroad** between 2020 and 2023 in the Mongolian Gobi, bringing **the total railroad length within the species' range in Mongolia to 1,514 km.** Some sections of these newly built railroads are fenced, while others feature steep embankments, both of which pose the movement of Goitered Gazelle and fragment their habitat in the Mongolian Gobi. While these new railroads include large open-span bridges and box culverts intended for wildlife crossings, the effectiveness of the structures are not well understood. **Furthermore, border fences effectively isolate populations between Mongolia and China. Moreover, the development of high-traffic roads for resource extraction has emerged as another significant threat. An additional 1,268 kilometers of new railroads are planned within the species' range in the Mongolian Gobi.** This construction will create even more barriers, resulting in further habitat fragmentation and increasing the risk of isolated populations.

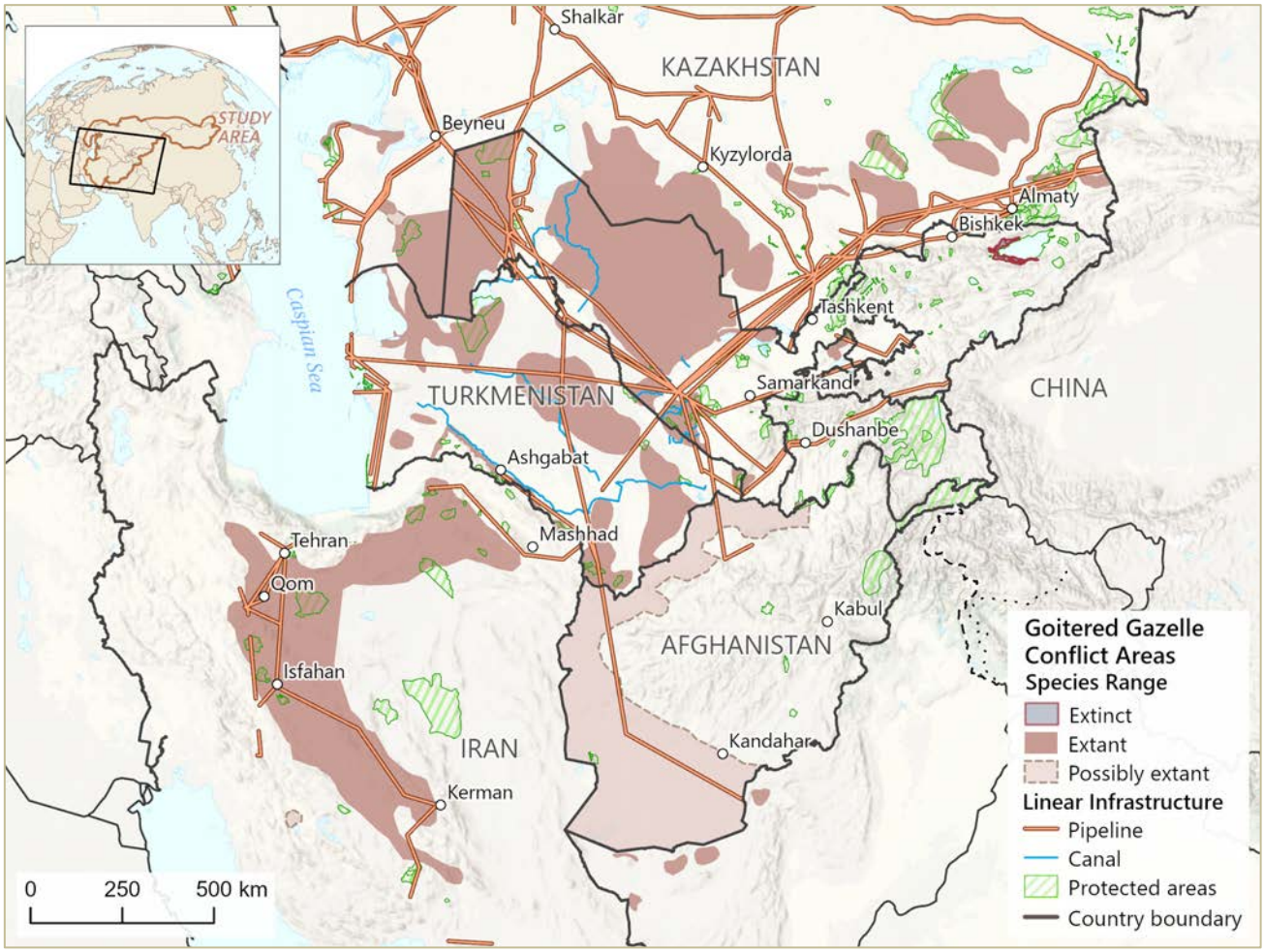
CONFLICT AREA AND GOITERED GAZELLE IN CENTRAL ASIA



CONFLICT AREAS AND GOITERED GAZELLE IN CENTRAL ASIA

In Central Asia, the distribution range of the Goitered Gazelle tends to be more fragmented. **Border fences between Kazakhstan and Uzbekistan, Kazakhstan and Turkmenistan, as well as between Turkmenistan and Afghanistan, may hinder the movement of Goitered Gazelles and could ultimately fragment their habitats.** More studies are needed to understand the effects of these fences on the movement of the gazelles. Additionally, **a 210-km railroad that runs throughout the species range in Kazakhstan is identified as a conflict area.** Furthermore, **paved roads in Iran and Uzbekistan are also considered conflict areas for the Goitered Gazelle.** In particular, the highway connecting Tehran to Mashhad in Iran has been identified as a conflict zone, impacting other species in the region as well. **Plans for the construction of over 340 km railroads in Iran and over 100 km railroads in Turkmenistan will likely lead to additional habitat disruption and obstacles to the movement of Goitered Gazelles.**

CANALS AND PIPELINES IN THE RANGE OF GOITERED GAZELLE



CANALS AND GOITERED GAZELLE IN CENTRAL ASIA

In Central Asia, pipelines are primarily buried, and their impact on animal movements is not well understood. However, there are 1,316 kilometers of canals within the species' range in this region. Of these, 900 kilometers comprise the existing canal system in Uzbekistan, which acts as a barrier that prevents gazelles from moving freely.

MITIGATION/REMEDIATION STRATEGY

FENCE	RAILROAD	PAVED ROAD
• Ensure that existing standards and guidelines for infrastructure. In Mongolia, the National Standard for Wildlife-Friendly Fencing in Mongolia must be followed. • Avoid building any fences (especially important for the planned railroad projects in Mongolia). • Remove fences that no longer serve their intended purpose. • Where fences are present in their range and are necessary, modify them to wildlife friendly fence designs outside of heavily settled areas (see Mongolian Gazelle).	• Raise awareness of habitat fragmentation in Mongolia with significant negative impacts on Goitered Gazelles and other wildlife, caused by existing and planned railroads • Identify conflict areas in Uzbekistan to develop solutions • Determine what partial barriers may be in place in Iran to mitigate conflicts with gazelle movements.	• Remove green vegetation around the roads in order to discourage gazelles from feeding along or near roads (applicable for all herbivores). • Close (mining) roads during times of increased gazelle movement. • Ensure that existing standards and guidelines for infrastructure, including the CMS Guidelines for Addressing the Impact of Linear Infrastructure on Large Migratory Mammals in Central Asia are followed. • Include regular gaps in guardrails.

More information:
Goitered Gazelle on the CMS webpage

Mongolian Gazelle

© Nandia Dejid
Mongolian Gazelle *Procapra gutturosa* in Eastern Mongolia

SPECIES FACTS

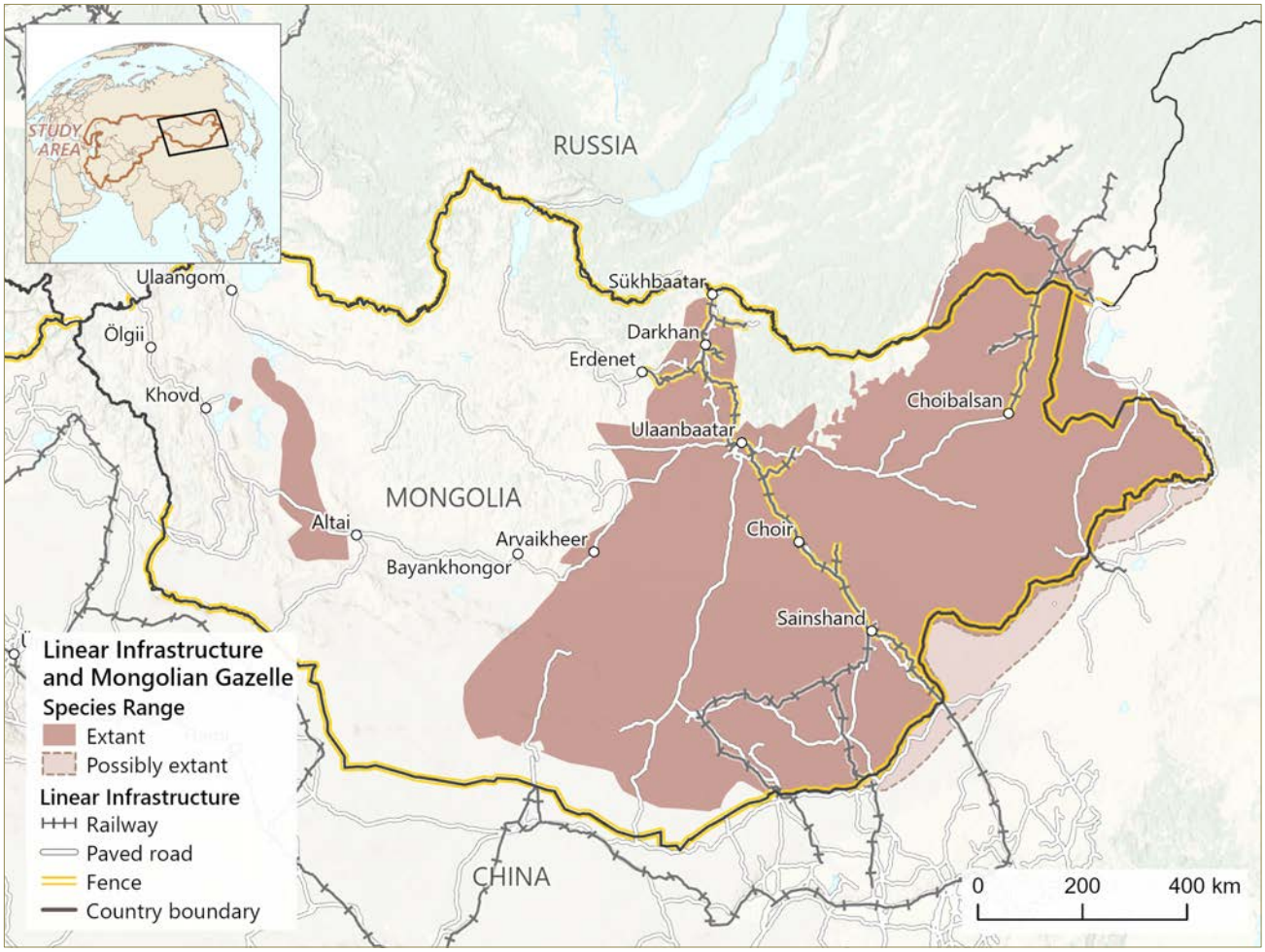
Common Name: Mongolian gazelle
Scientific Name: *Procapra gutturosa*
Geographic Range: Mongolia, Russia, China
Habitat: Plain grasslands
Global Population: 2.17 million (Buuveibaatar et al., 2024).
Conservation Status: Least Concern (IUCN Red List, 2017), CMS Appendix II

Mongolian gazelle is the most abundant ungulate in the open plains across its range and about 2.17 million Mongolian gazelles roam the grasslands of Mongolia and adjacent areas in Russia and China (Buuveibaatar et al., 2024). The estimated global range of the gazelle is 800,731 km^2, of which 92% (750,123 km^2) is in Mongolia, 4% in China (34,718 km^2) and 4% in Russia (29,700 km^2). Mongolia's crucial role as a stronghold for gazelles, hosting approximately 99 percent of the global population. However, amidst Mongolia's rapid development increasing linear infrastructure development, expanding livestock numbers, habitat degradation, and disease spillover pose significant challenges to the species' survival (Mendgen et al., 2023).

MOVEMENT BEHAVIOUR

Mongolian Gazelles are one of few species of large mammals that are known to be nomadic migrants, demonstrating over 100,000 km^2 large life range sizes without site fidelity for their wintering and calving locations (Nandintsetseg et al., 2019). Where and when to move as well as when and where to stop are unpredictable, changing year to year depending on environmental conditions. The movements of Mongolian gazelles do not show any specific movement corridors and protected areas are too small to cover the life range of even a single gazelle. While the annual range is about 19,000 km^2, the lifetime range of an individual gazelle covers an area of 100,000 km^2. The cumulative annual distance moved is on average 3,400 km (Joly et al., 2019). A single gazelle traveled over 18,000 km in five years, with little overlap in ranges between years (Dejid et al., 2022). Gazelles occur in groups from several individuals up to megaherds of 250,000 (Olson et al., 2009). Landscape permeability and large-scale conservation are crucial for sustaining the long-distance, nomadic movements of the Mongolian Gazelle, which are necessary for the species' long-term survival. Today, less than 5 percent of their range has been granted formal protected area status.

LINEAR INFRASTRUCTURE AND MONGOLIAN GAZELLE



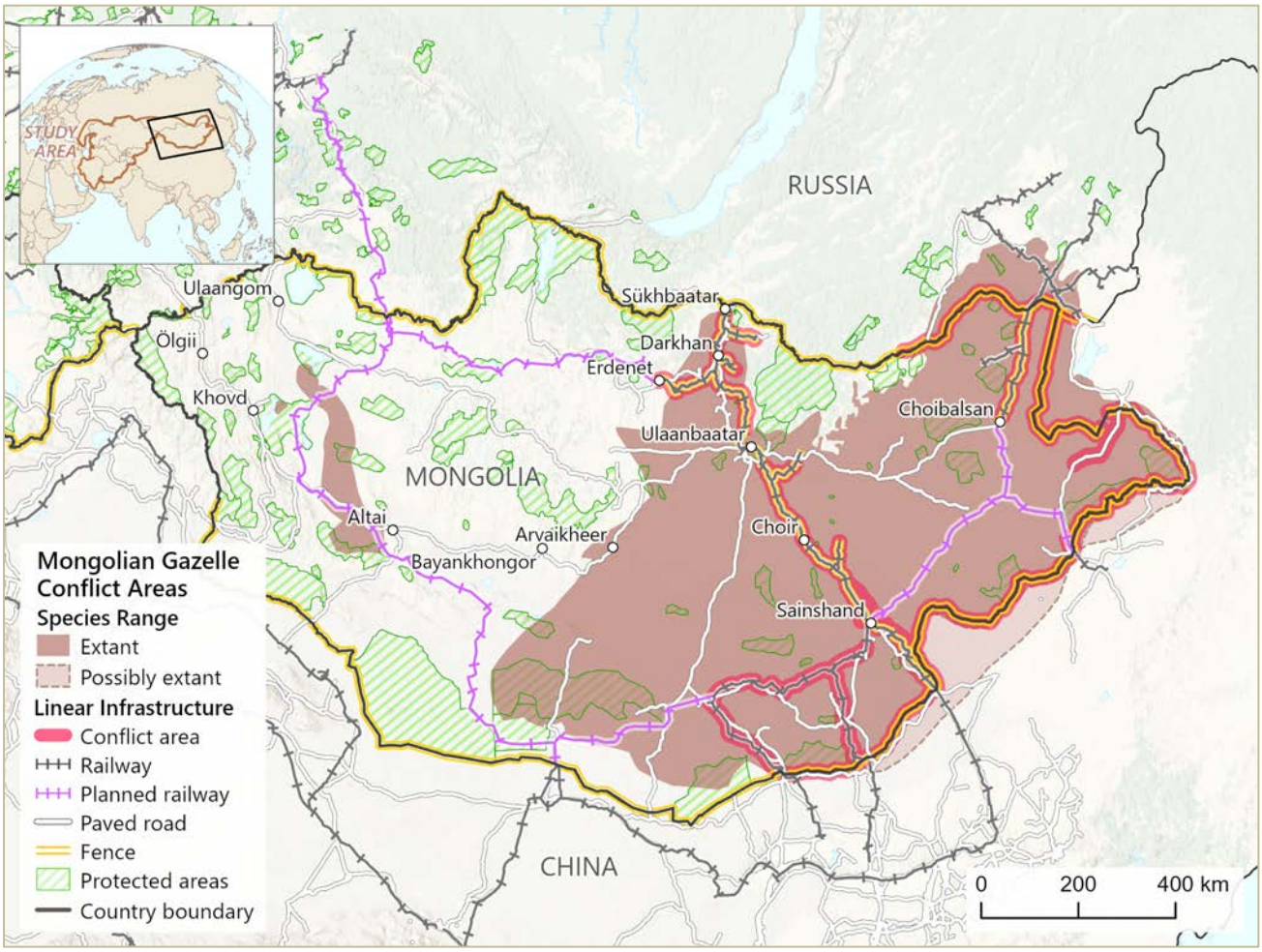
Estimated Linear Infrastructure in the Species Range

3,889 km	Fence
3,280 km	Railroad
7,216 km	Paved road
14,385 km	**Total existing linear structure**
1,374 km	**Planned railroad**

Key Linear Threats to Movements and Habitat Fragmentation of Mongolian Gazelle

A significant threat to the survival of the Mongolian Gazelle is the presence of barbed-wire fences along international borders and railways in Mongolia. Since the 1960s, the corridor fencing of the Trans-Mongolian Railroad has obstructed the movement of gazelles in Mongolia, leading to habitat fragmentation, **resulting in a declining population from Eastern to Western Mongolia.** These fences are too high for the gazelles to jump over and have lack gaps at the bottom for them to crawl under. Each year, thousands of gazelles are injured or killed when herds attempt to cross segments of the fence. Additionally, border fencing with the Russian Federation has been known to entangle large numbers of animals, while the border fence with China is considered nearly impenetrable. Recently, **another 900 km of railroads have been constructed in the southern Gobi region, where the gazelles reside, some of which are also fenced.** This expansion has further fragmented their habitat and created additional obstacles to their movement.

CONFLICT AREAS AND MONGOLIAN GAZELLE



CONFLICTS WITH LINEAR INFRASTRUCTURE

The Mongolian Gazelle face numerous conflict area due to their wide ranging, nomadic movements. **The primary threat is the tight barbed-wire border fence with China, which blocks the transboundary movements of these gazelles and is considered nearly impenetrable barrier.** In contrast, the border fencing with the Russian Federation is more permeable, but it also often entangles a significant number of animals when they cross to the Russian side. The distribution range of Mongolian Gazelle on Russian territory expanded from 260 km^2 in 1998 to 29,700 km^2 in 2020 due to the transboundary seasonal movements and also the increasing number of sedentary groups (Kirilyuk, 2021). During the Dzud winter of 2023-2024 in Mongolia, several thousand gazelles crossed the border between Mongolia and China (public news in China). However, it is important to note that there is currently no monitoring study to track this transboundary movement.

The Mongolian steppe is home to the largest population of Mongolian Gazelles, but this population is under significant threat due to the corridor fencing along the 1,815 km Trans-Mongolian Railroad, which connects Russia and China. Since the 1960s, the railroad has been enclosed on both sides with barbed wire, effectively blocking the movements of Mongolian gazelles and fragmenting their habitats into distinct western and eastern sections. **This situation has had a severe impact on the gazelle population, leading to a decline that spans from east to west.** Additionally, **the construction of a total of 900 kilometers of new railroads in the Southern Gobi region, where these gazelles inhabit, has further hindered their movements and fragmented their habitats.**

Some of these railroads are fenced, while others have high embankments that obstruct the gazelles.

In China, habitat fragmentation from fenced pasture has also affected the ability of Mongolian gazelles to move freely, contributing to their decline in the country.

Furthermore, the increasing number of paved roads with high traffic volume across Mongolia poses another significant threat. Mongolian gazelles are frequently struck by speeding vehicles, especially at night. The volume of car traffic has also rapidly increased, along with a growing extractive energy industry and the paved road construction associated with it. Indirect effects associated with roads, such as increased access for poachers and vehicle collisions, also need to be closely monitored.

With plans to build over 1,375 km of railroad in the gazelle range that will further bisect the gazelle habitat from east to west and north to south, the new barriers could severely alter movement and potentially trigger severe population declines. Fencing these railroads to prevent livestock collisions will create major issues to the gazelle population.

MITIGATION/REMEDIATION STRATEGY

FENCE

- Ensure that existing standards and guidelines for infrastructure. In Mongolia, the National Standard for Wildlife-Friendly Fencing in Mongolia must be followed.
- Avoid constructing fences outside of human-populated areas.
- Design new and existing railroad fences to allow small wildlife to pass through while deterring larger animals such as cows and camels.
- Modify existing fences where necessary to ensure they meet wildlife-friendly standards.
- Remove fences that no longer serve a purpose.
- Whenever possible, eliminate fences from critical wildlife habitats.
- Ensure that new linear barriers include frequent crossing points to maintain landscape permeability and support wildlife population persistence.

RAILROAD

- Avoid constructing railroads through key Mongolian Gazelle habitats and align transport corridors with existing travel routes.
- Ensure all current and planned railroads comply with the CMS Guidelines for Linear Infrastructure.
- For new railroads, avoid long raised-earth embankments and use raised viaduct-style tracks.
- Address indirect effects, such as increased human activity.
- Implement integrated land management that considers wildlife movements, herders, habitat quality, and connectivity between protected areas.
- Place crossing structures every 11 km along the planned railway (Nandintsetseg et al., 2019).

PAVED ROAD

- Avoid building new roads in areas that do not currently have any.
- Adhere to existing standards and guidelines for infrastructure in Mongolia, including the CMS Guidelines for Addressing the Impact of Linear Infrastructure on Large Migratory Mammals in Central Asia.
- Raise awareness among drivers about the dangers of high-speed driving, especially at night, and the risk of collisions with gazelles.

More information:
Mongolian Gazelle on the CMS webpage
Mongolian Gazelle on the IUCN Red List
Mongolian Gazelle on the GIUM Atlas

Saiga Antelope

Photo by © Albert R. Salemgareyev
Saiga Antelope *Saiga tatarica tatarica*, Kazakhstan

SPECIES FACTS

Common Name: Saiga Antelope

Scientific Name: *Saiga tatarica*

Geographic Range: Kazakhstan, Mongolia, Uzbekistan, Turkmenistan, Russian Federation

Habitat: semi-desert and grassland plain steppe

Global Population: 1,344,275 (IUCN, 2023)

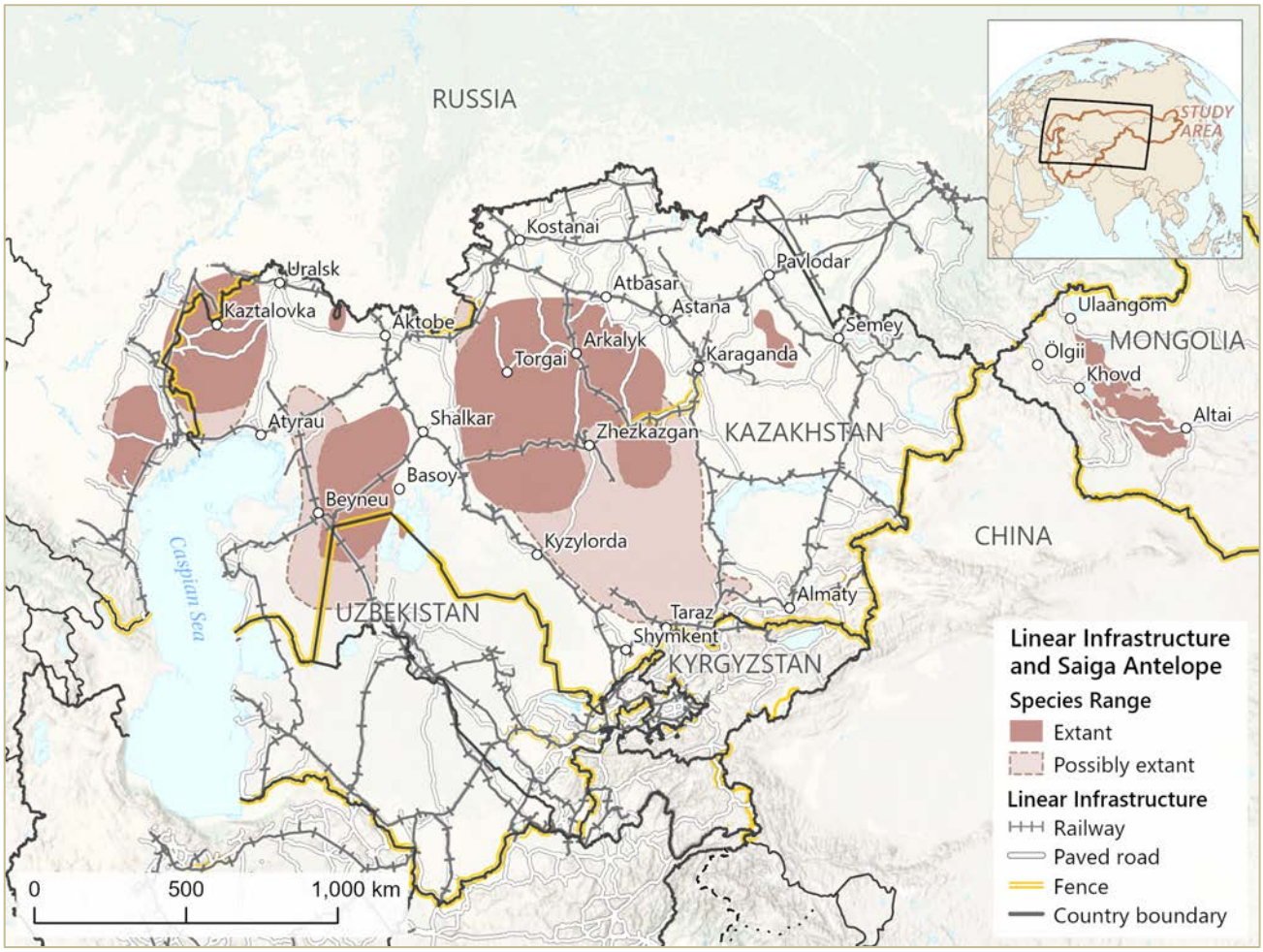
Conservation Status: Near Threatened (IUCN Red List, 2023), CITES Appendix II, CMS Appendix II

The Saiga once inhabited the steppes and semi-desert regions from southeastern Europe, across Central Asia to Mongolia, and northern China. The IUCN recognizes two subspecies: *Saiga tatarica tatarica*, which is found across Central Asia and contains the majority of the global population, and *Saiga tatarica mongolica*, which is endemic to western Mongolia. There are five main Saiga populations: one in Russia, three in Kazakhstan, and one in Mongolia. As of March 2023, the global Saiga population was estimated to be 1,344,275 individuals (IUCN, 2023). However, numbers in all current populations are on the rise, and population surveys conducted in Kazakhstan and Mongolia in 2024 estimated their populations at 2,833,600 and 23,215 individuals, respectively (unpubished data). Saiga populations have been severely impacted by several diseases such as foot-and-mouth disease and brucellosis, and extreme climatic events, which have led to mass mortality events and significant declines (Kock et al., 2018; Chimeddorj et al., 2024a). Additionally, the loss or degradation of steppe habitats due to agricultural conversion and overgrazing, as well as competition with livestock, has affected some areas within their range.

MOVEMENT BEHAVIOUR

The Saiga is recognized as a migratory species inhabiting the semi-arid rangelands of Central Asia (Singh et al., 2010), exhibiting diverse movement patterns among different populations with great individual variability in their movements. In Kazakhstan, some populations engage in long-distance nomadic movements, while others migrate according to a latitudinal gradient in vegetation productivity. For the Ustyurt population, the average annual migration route is 197 km (Salemgareyev et al., 2024). In contrast, the Saiga in Mongolia do not have distinct summer and winter ranges. Instead, their movements are predominantly nomadic and restricted by natural barriers such as mountains, lakes, and sand dunes. During the summer months in Mongolia, the average daily movement of the Saiga was about 4.9 km (Nandintsetseg et al., 2019) with an almost annual range size reaching up to 7,810 km^2 (Saige Resource Centre news).

LINEAR INFRASTRUCTURE AND SAIGA ANTELOPE



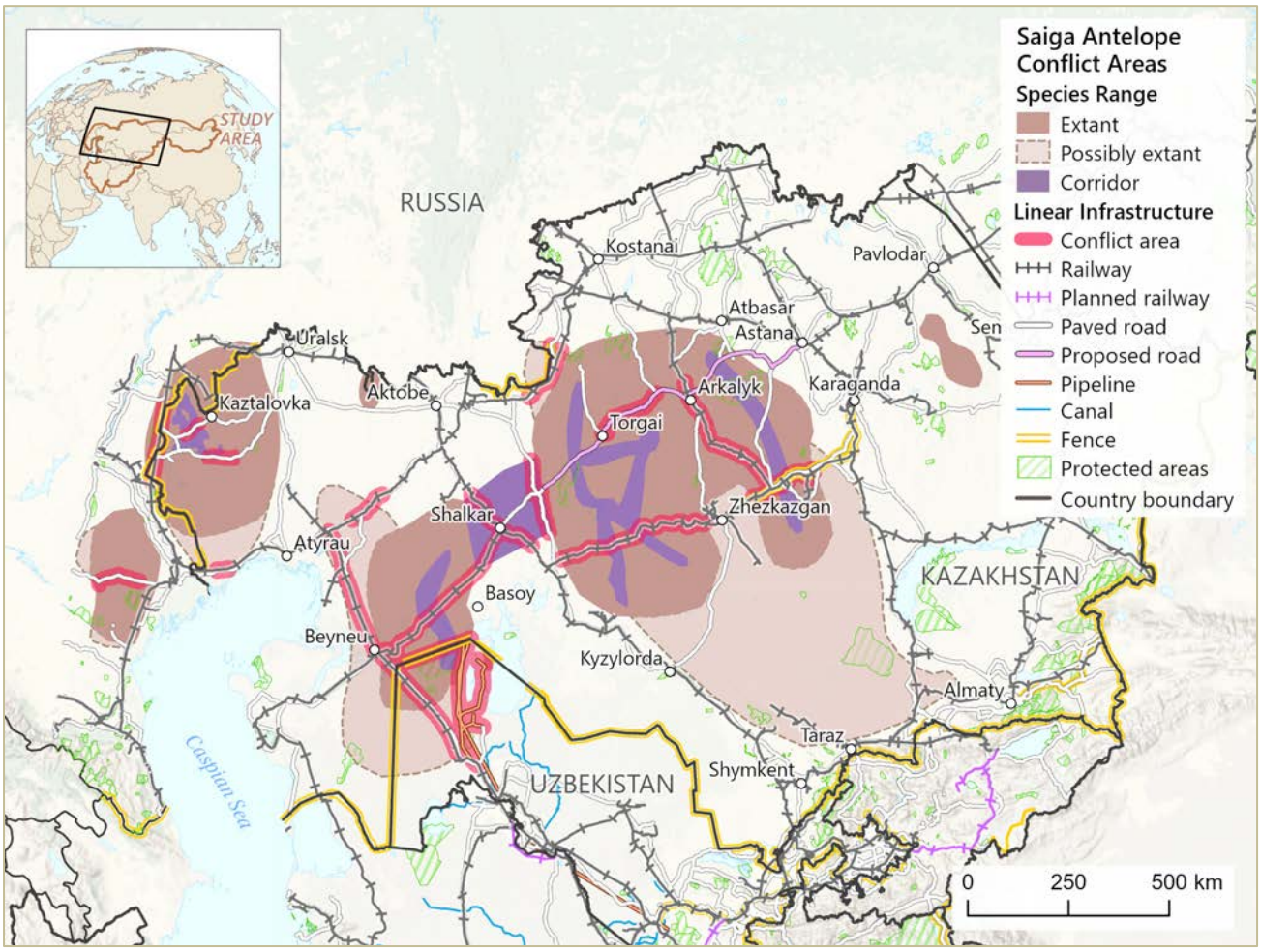
Estimated Linear Infrastructure in the Species Range

1,912 km	Fence
5,460 km	Railroad
6,304 km	Paved road
13,676 km	**Total existing linear structure**
432 km	**Planned railroad**

Key Linear Threats to Movements and Habitat Fragmentation of Saiga Antelope

Railroads that intersect with the habitat of the Saiga Antelope significantly hinder their ability to move freely within their natural ranges. In Kazakhstan, the situation is made even more challenging for populations due to the presence of multiple railroads that isolate them from one another. For example, the railroad that runs between Aktobe and Kyzylorda effectively divides the migration corridor, creating a barrier that separates the Betpak-dala population from the Ustyurt population. Furthermore, GPS tracking data has revealed that another crucial railroad, located between Shalkar and Beyneu, poses a significant obstacle to the Saiga as it prevents them from migrating southward to their wintering grounds in Uzbekistan. In addition to railroads, **border fences also impede Saiga movements.** There are border fences between Uzbekistan and Kazakhstan, as well as partial fences between Kazakhstan and the Russian Federation restrict the movements of Saiga. Lastly, paved roads with high traffic volumes create additional challenges for the Saiga.

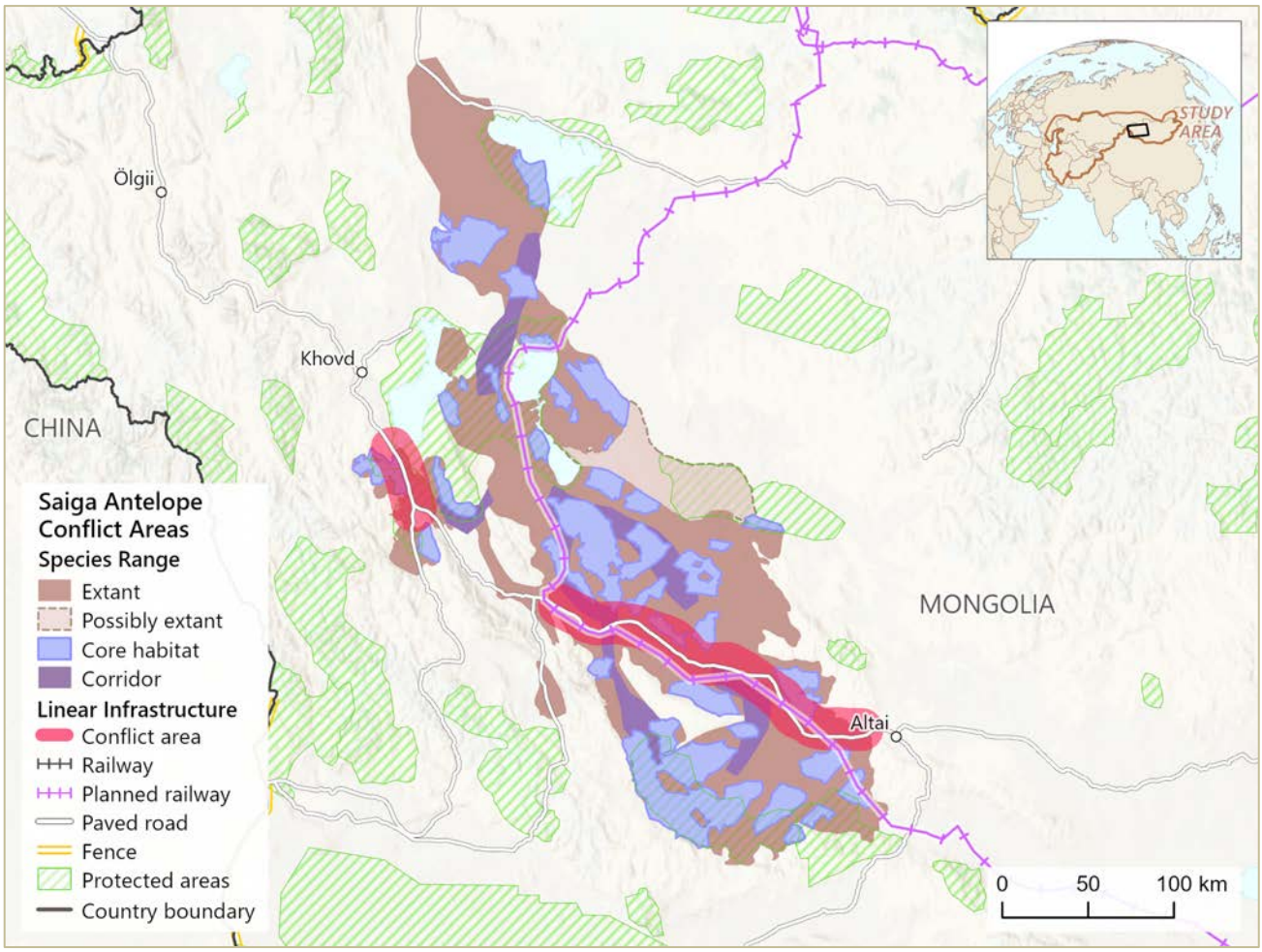
CONFLICT AREA AND SAIGA ANTELOPE IN CENTRAL ASIA



CONFLICTS AND SAIGA ANTELOPE IN CENTRAL ASIA

Unfenced railroads intersecting the Saiga's range in Kazakhstan primarily act as partial barriers to their migration, though in some cases, particularly with two or more tracks, they can become complete barriers. The fenced railroad between Saksaulskiy and Zhezkezgan and extending to Karaganda impedes the migration of the Saiga from the Betpak-dala population, which has the largest contiguous habitats across the species range. Additionally, **the railroad connecting Aktobe and Kyzylorda appears to cut through the migration corridor, separating the Betpak-dala and Ustyurt populations. The railroad between Shalkar and Beyneu currently prevents Saiga from migrating southward to their wintering grounds in Uzbekistan.** In addition, thousands of kilometers of paved roads have been constructed throughout the Saiga's range. Some of these roads pose complete barriers to movement, causing further separation between populations, while others, experiencing lighter traffic, act as partial barriers. **The Ustyurt population is particularly affected by the border fence between Kazakhstan and Uzbekistan.** The Kazakh government has implemented measures to make the fence more permeable. Further modifications to the fence would benefit the vulnerable Ustyurt population. Another fence exists at the border between Kazakhstan and Russia, located at the northwestern edge of the Ural population's range. This fence is a major cause of injuries among the animals, as they often attempt to squeeze through it to reach Russian territory during spring and summer. In Uzbekistan, the gas pipeline in the Aral Sea region, along with highway and railways,

CONFLICT AREA AND SAIGA ANTELOPE IN MONGOLIA



CONFLICTS AND SAIGA ANTELOPE IN MONGOLIA

The Mongolian Saiga Antelope is known to avoid areas with human disturbance. **There is a 438 km paved road that connects the western provinces to the capital of Mongolia and also links to a border port, intersecting the species' range.** Currently, vehicle collisions involving Saiga with this paved road have been reported, and these roads have been identified as conflict areas, acting as partial barriers to their movement. A study on habitat connectivity for the Mongolian Saiga indicated that the existing paved roads may disrupt the connectivity between core habitats located on both sides of the roads (Chimeddorj et al., 2024b). **Additionally, a planned 433 km stretch of railroad will intersect the same part of their range, which will create more pressure on this small population, particularly in the southern part of their habitat.** This becomes a greater concern if the railroads will be fenced off. Considering the current impact of railroads and paved roads on Saiga movements and populations in Kazakhstan, Mongolia should refrain from constructing more paved roads and railways within the range of the Mongolian Saiga.

MITIGATION/REMEDIATION STRATEGY

FENCE	RAILROAD	PAVED ROAD
• Completely remove the border fence between Kazakhstan and Uzbekistan to allow saiga passage; • If not possible to remove, continue redesigning the fence to provide additional openings; • Completely remove border fence between Kazakhstan and the Russian Federation, or, if not possible, consider redesign to allow saiga passage; • Avoid building any fences in open range, outside of settled areas.	• Avoid planning new railroads in currently undeveloped parts of the saiga range. • Construct crossing points for Saiga, including longer parts of elevated railroad with passages underneath (test guiding the animals to these crossing points with strategic fencing). • Evaluate the presence of and options for removing of railroad fencing where the railroad passes between Saiga populations or mapped corridors. • Test temporary traffic stops at nighttime, including turning off all illumination along the railroad. • Avoid fencing the planned railroad in Mongolia. • Monitor effectiveness of any planned or current measures and adjust.	• Follow CMS Guidelines for Addressing the Impact of Linear Infrastructure on Large Migratory Mammals in Central Asia for all existing and planned linear infrastructure projects that exist within Saiga range. • Avoid planning new roads in currently undeveloped areas within Saiga Range. • If roads cannot be avoided, test construction of longer parts of elevated road, to let Saiga cross underneath. • Consider speed limits or road curfews for existing and planned roads.

More information:

Saiga Antelope on the CMS webpage

Saiga Antelope on the GIUM Atlas

Snow Leopard

Frontal Portrait of Snow Leopard in Snow Storm © iStock/abzerit

SPECIES FACTS

Common Name: Snow Leopard

Scientific Name: *Panthera uncia*

Geographic Range: Afghanistan, Bhutan, China, India, Kazakhstan, Kyrgyzstan, Mongolia, Nepal, Pakistan, Russian Federation, Tajikistan, Uzbekistan

Habitat: High mountains

Global Population: 4,731 – 7,465 (McCarthy et al., 2023)

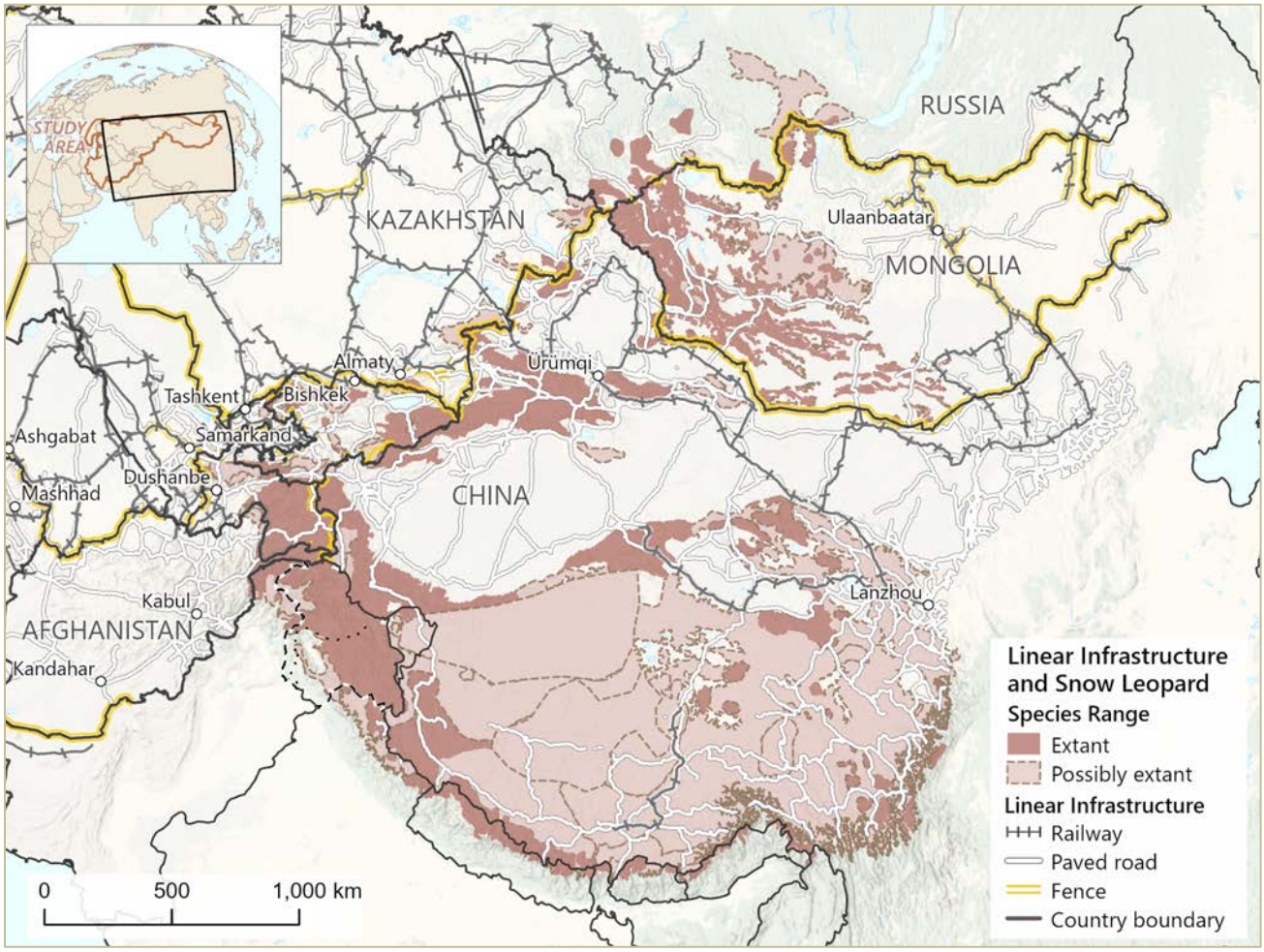
Conservation Status: Vulnerable (IUCN Red List, 2017), CITES Appendix I, CMS Appendix I

Snow Leopards inhabit the mountain regions across southern Siberia in the north, Central Asia, the Tibetan Plateau, and the Himalayas in the south and east. While the Tibetan plateau of China, followed by Mongolia and India, are home to the largest population of snow leopards, the high mountainous regions of Central Asia provide critical habitats for the Snow Leopard (McCarthy et al., 2023). The snow leopard faces several threats that endanger its survival. Key among these are poaching, which occurs for their fur; habitat loss due to human encroachment and development; and declines in natural prey species. Additionally, retaliatory killings often arise from human-wildlife conflict, where local herders may kill snow leopards to protect their livestock. Furthermore, the climate crisis poses another significant risk, as rising temperatures and changing weather patterns can lead to the loss of the snow leopard's high-altitude habitat.

MOVEMENT BEHAVIOUR

Snow leopards are known to be solitary and territorial animals. Young snow leopards may disperse to find a suitable home territory, while both young and adult snow leopards may travel long distances to find food or a mate. Snow leopards inhabit extensive home ranges, averaging 130 km² for females and 220 km² for males in Mongolia (Johansson et al., 2016). Telemetry studies have indicated that their home ranges can be even larger, reaching up to 4500 km² in Mongolia (McCarthy et al., 2005). In comparison, home ranges estimated using a continuous time model were 175 $km^2 \pm 74$ SD for males and 81 $km^2 \pm 23$ SD for females in Kyrgyzstan. On average, adult males in Kyrgyzstan moved 8.5 km daily, while females moved 5 km (S. Kachel, unpublished data). Snow Leopards move periodically cross international borders. These patterns indicate that landscape permeability is essential to the dispersal movements of young animals to establish their home range territory as well as the transboundary movements of the Snow Leopard across their range covering several countries (Mallon et al., 2014).

LINEAR INFRASTRUCTURE AND SNOW LEOPARD



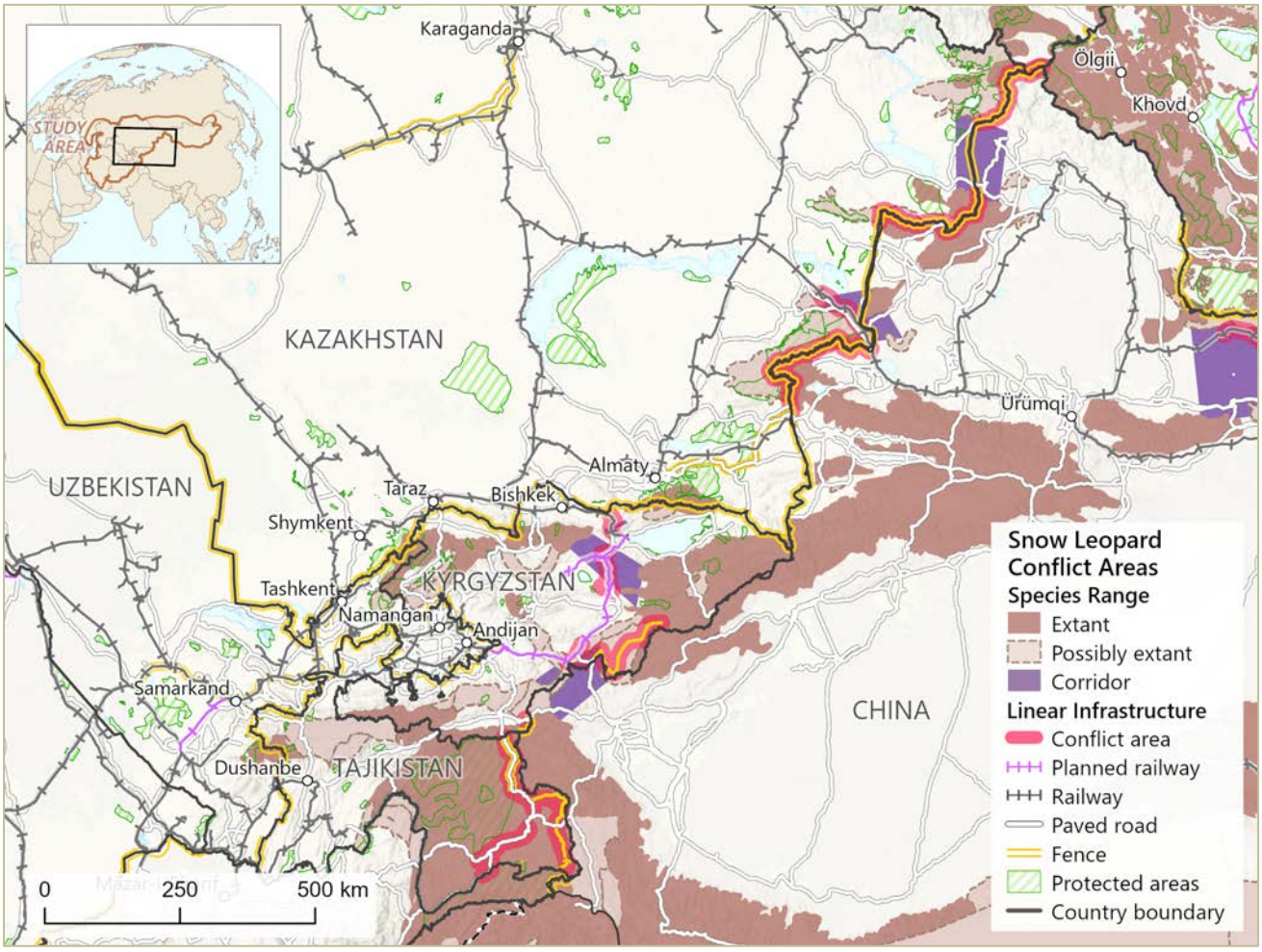
Linear Infrastructure in the Species Range

3,966 km	Fence
1,772 km	Railroad
28,243 km	Paved road
33,981 km	**Total existing linear structure**
266 km	**Planned railroad**

Key Linear Threats to Movements and Habitat Fragmentation of Snow Leopard

All the fences (3,966 km) that currently intersect with the Snow Leopard's range are located along international borders, including China-Kazakhstan, China-Tajikistan, China-Kyrgyzstan, Uzbekistan-Tajikistan, and China-Mongolia. **These border fences are categorized as either complete or partial barriers that may divide home range territories. They may hinder natal dispersal and limit the search for food and mates across large areas.** Additionally, these fences significantly impact the movements of the Snow Leopard's prey ungulates, which can ultimately lead to a decline in the available prey base for Snow Leopards. Moreover, **lowland roads with high traffic volumes, such as highways, can also obstruct the movements of Snow Leopards as they travel from one mountain range to another.** While the overall length of railroads in the Snow Leopard's range is minimal compared to other CAMI species, they are still believed to impede Snow Leopards when crossing lowlands in search of prey and mates.

CONFLICT AREAS AND SNOW LEOPARD IN CENTRAL ASIA

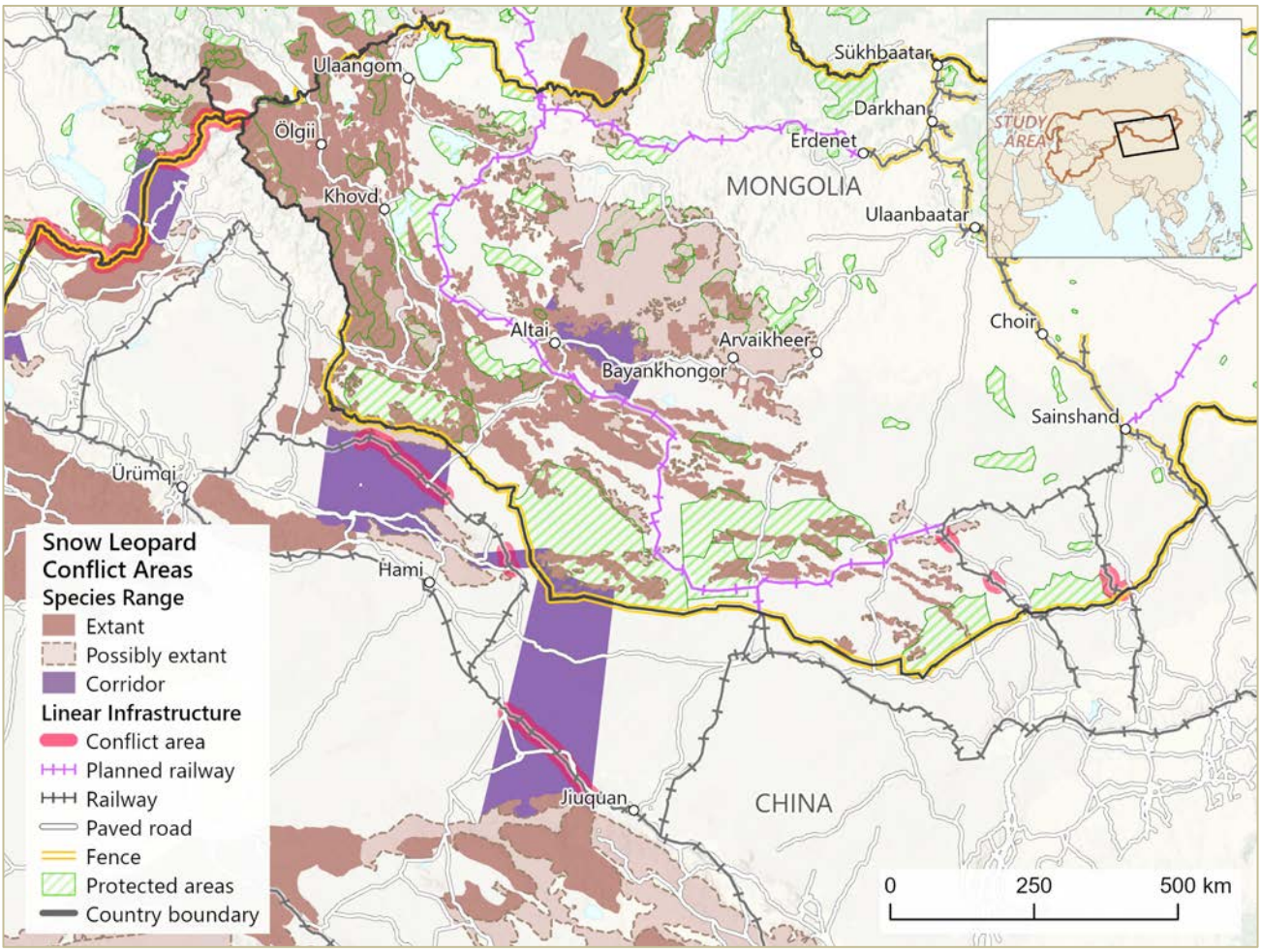


CONFLICTS AND SNOW LEOPARD IN CENTRAL ASIA

Snow leopards inhabit high mountain ridges across Central Asia, with their transboundary habitats spanning multiple countries, including Kazakhstan, Kyrgyzstan, Tajikistan, and Uzbekistan. Fences along the political boundaries of these countries, as well as those with China, pose significant threats to the movement of Snow Leopards and contribute to habitat fragmentation. Regionally, the construction and expansion of mountain villages, mine fields, and the associated road building and electrification are further threats leading to lowland habitat loss and fragmentation for Snow Leopards. In Kyrgyzstan, the planned construction of over 80 kilometers of railroads will intersect the snow leopard's range, potentially hindering their movements. In Uzbekistan, a new challenge arises from the construction of several hydroelectric power plants, some of which are located within or near snow leopard habitats.

Tajikistan, situated at the center of the snow leopard's distribution range, plays a crucial role in connecting populations in the region. Over the next 40 years, the cold and arid mountainous environments of Tajikistan are expected to serve as a refuge for snow leopards in response to climate change, as well as a genetic corridor between northern and southern populations.

CONFLICT AREAS AND SNOW LEOPARD IN MONGOLIA



CONFLICTS AND SAIGA ANTELOPE IN MONGOLIA

In Mongolia, the Snow Leopard's habitat is characterized by relatively small rocky massifs that are separated by open desert. These animals are known to traverse extensive flatlands to connect these rocky areas, highlighting the importance of their ability to move between massifs for finding prey and mates. This movement is vital for their survival in the region. While Snow Leopards are known to avoid areas impacted by human activities, including roads, it is crucial to recognize the potential challenges posed by planned infrastructure projects. In Mongolia, the construction of 188 kilometers of railroads and related potential fencing within their habitat could create barriers that impede their movement and isolate their populations.

To mitigate these risks, it is essential to consider the effects of linear infrastructure—such as fenced railroads and high-traffic roads—on not only the Snow Leopards themselves but also on their prey, such as Argali Sheep. Learning from past experiences, like the vehicle collision incidents involving the Asiatic Cheetah in Iran, can guide future planning.

MITIGATION/REMEDIATION STRATEGY

FENCE	RAILROAD	PAVED ROAD
• Ensure that existing standards and guidelines for infrastructure. In Mongolia, the National Standard for Wildlife-Friendly Fencing in Mongolia must be followed. • Dismantle existing fences whenever possible. • Create gaps in fencing at the bottom (research captive Snow Leopards to determine the required height) at important crossing points (drainages, ridge lines). • Investigate prey species entanglement in fences, and its indirect impact on Snow Leopards • Funnel Snow Leopards toward best available crossing points (avoid blind bends or high traffic areas). • Manage illegal hunting along border fence roads. • Incorporate wildlife passages for prey species in border fences to ensure sufficient prey availability	• Build overpasses over railroads having impenetrable fencing. • Discourage building fences alongside railroads. • Monitor during construction phase to limit illegal hunting.	• Build tunnels under high speed and/or heavily utilized night-time roads. • Prevent poaching of prey species facilitated by road access. • Limit night-time traffic especially if high-volume (frequency)/large transport and mining traffic. • Discourage fences (especially in rugged terrain and on plains between frequently utilized mountain habitat patches, or movement corridors). • Educate mining companies and their staff, especially those operating in remote areas on the importance of protecting wildlife.

More Information:

Snow Leopard on the CMS webpage

Wild Camel

© Anna Jemmett
Wild camel *Camelus ferus* in Mongolia

SPECIES FACTS

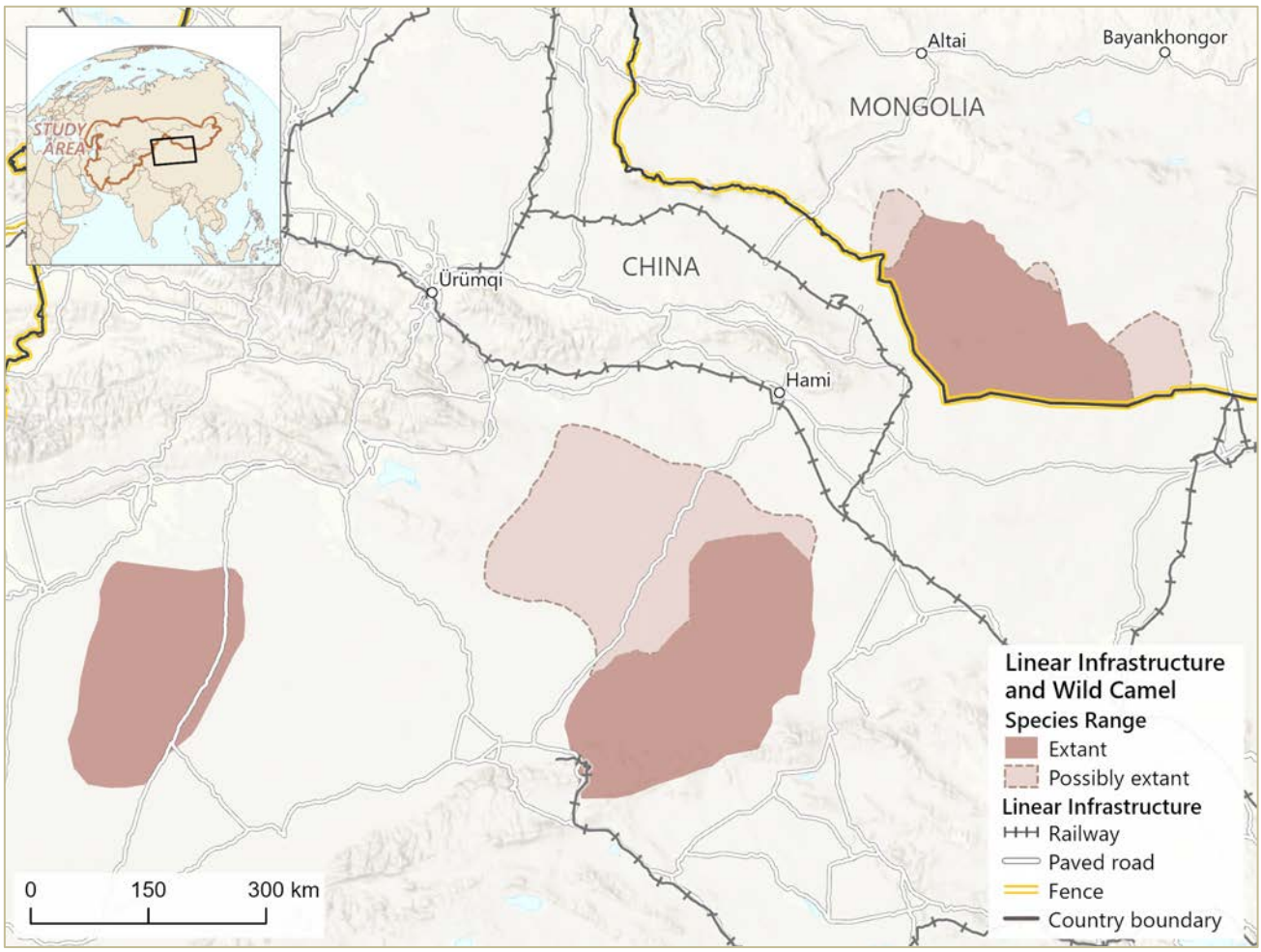
Common Name: Wild Camel
Scientific Name: *Camelus ferus*
Geographic Range: Mongolia and China
Habitat: Arid and semi-arid deserts
Global Population: c. 1,400 (Jemmett, 2023)
Conservation Status: Critically Endangered (IUCN Red List, 2008), CMS Appendix I

The Wild Camel (*Camelus ferus*) is currently found in just four isolated regions: three in northwest China (one in the Taklamakan Desert and two in the Lop Nur Desert) and another in the Transaltai Gobi region of Mongolia (Hare, 2008). While the species once thrived with a population of about 10,000 individuals, conservation efforts are now critical as their population numbers have diminished to an estimated c. 1,400 individuals (640-740 in China and 665 in Mongolia) (Jemmet, 2023). Threats to their survival include increasing human activities, competition from, hybridization with, and disease transmission from, domestic camels, as well as challenges like loss of water sources, habitat loss, and climate change (Yadamsuren et al., 2019).

MOVEMENT BEHAVIOUR

The Wild Camel is a wide-ranging and highly mobile ungulate. These camels can have annual home ranges in the expansive Mongolian Gobi Desert that exceed 12,000 km² (Kaczensky et al., 2014). On a typical day, wild camels travel straight-line distances averaging between 3.0 and 6.4 km. However, they are capable of long-distance travel, with maximum recorded distances reaching up to 74 km in a single day. Moreover, a study conducted in the Kumtag Desert in China further showed the adaptability of these camels (Xue et al., 2021). It found significant variability in the seasonal home ranges of the wild camels, with the largest recorded summer range estimated at 1,256 km² using the Brownian bridge method (Wu et al., 2021). Overall, the wild camels' movements underscore their dependence on expansive habitats to thrive in one of the harshest landscapes on Earth.

LINEAR INFRASTRUCTURE IN THE RANGE OF WILD CAMEL



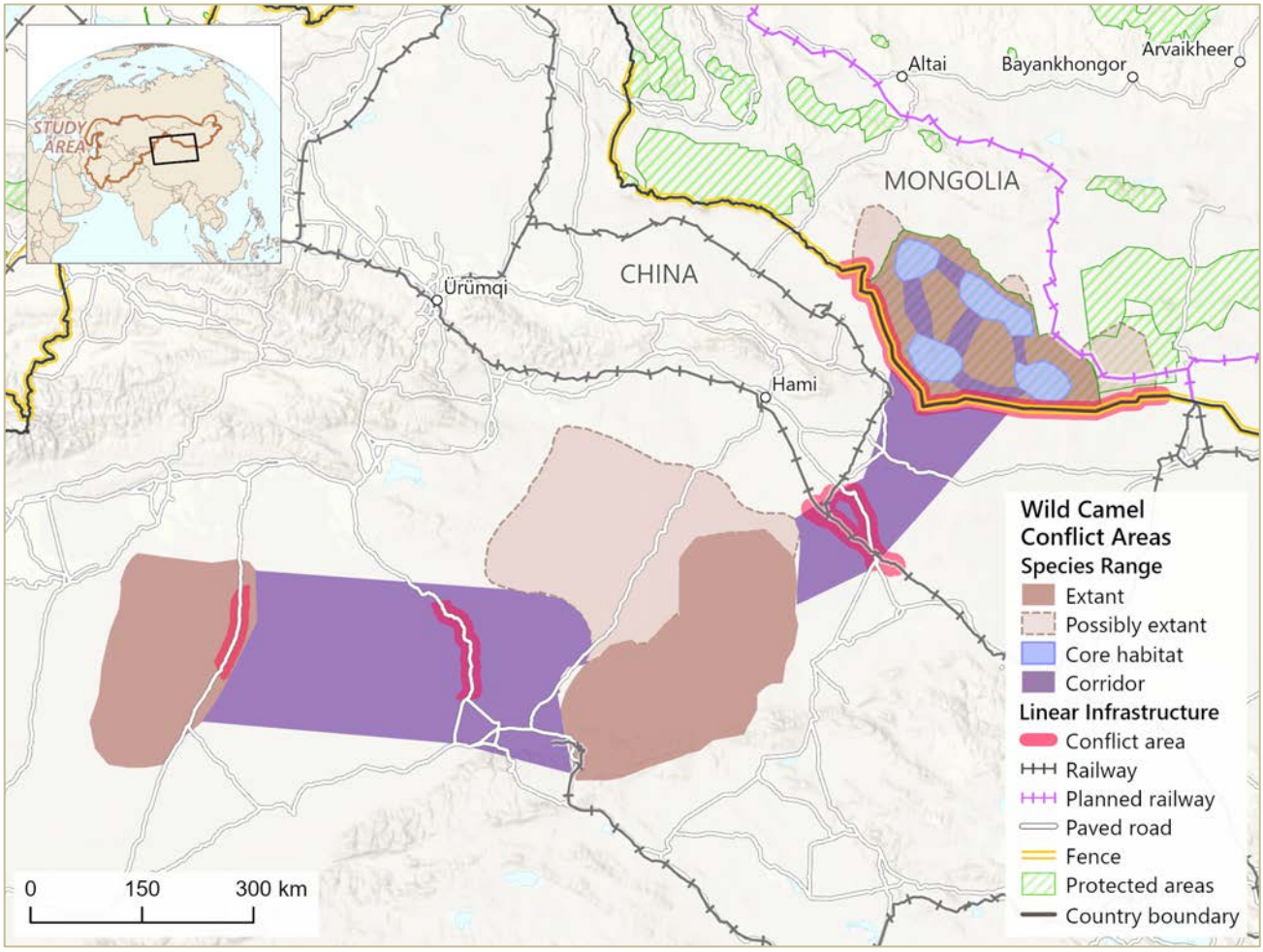
Estimated Linear Infrastructure in the Species Range

378 km	Fence
70 km	Railroad
745 km	Paved road
1,193 km	**Total existing linear structure**
153 km	**Planned railroad**

Key Linear Threats to Movements and Habitat Fragmentation of Wild Camels

The 378 km of barbed-wire fences along the border between Mongolia and China create a significant barrier that completely prevents the transboundary movement of Wild Camels between the two countries. The railroad and paved road network are limited within the species' range, but **the issue is compounded by the presence of highways and railroads that surround the patchy ranges of the isolated populations.** This situation is critical, as the ability of these animals to migrate freely is essential for maintaining their genetic diversity and overall population health.

CONFLICT AREAS AND CORRIDORS IN THE RANGE OF WILD CAMEL



CONFLICTS WITH LINEAR INFRASTRUCTURE

Fences, roads and railroads all seem to constitute a complete barrier for Wild Camels. Specifically, the fences that line the border between Mongolia and China restrict their movements between the two countries. Furthermore, the railroad stretching from Urumqi to Lanzhou in China acts as a barrier, interrupting their migration corridor. In addition to these linear structures, several roads have been constructed, cutting across the key corridors of Wild Camels. These roads not only prevent the camels from migrating but also could cause the risk of vehicle collisions, further threatening their survival.

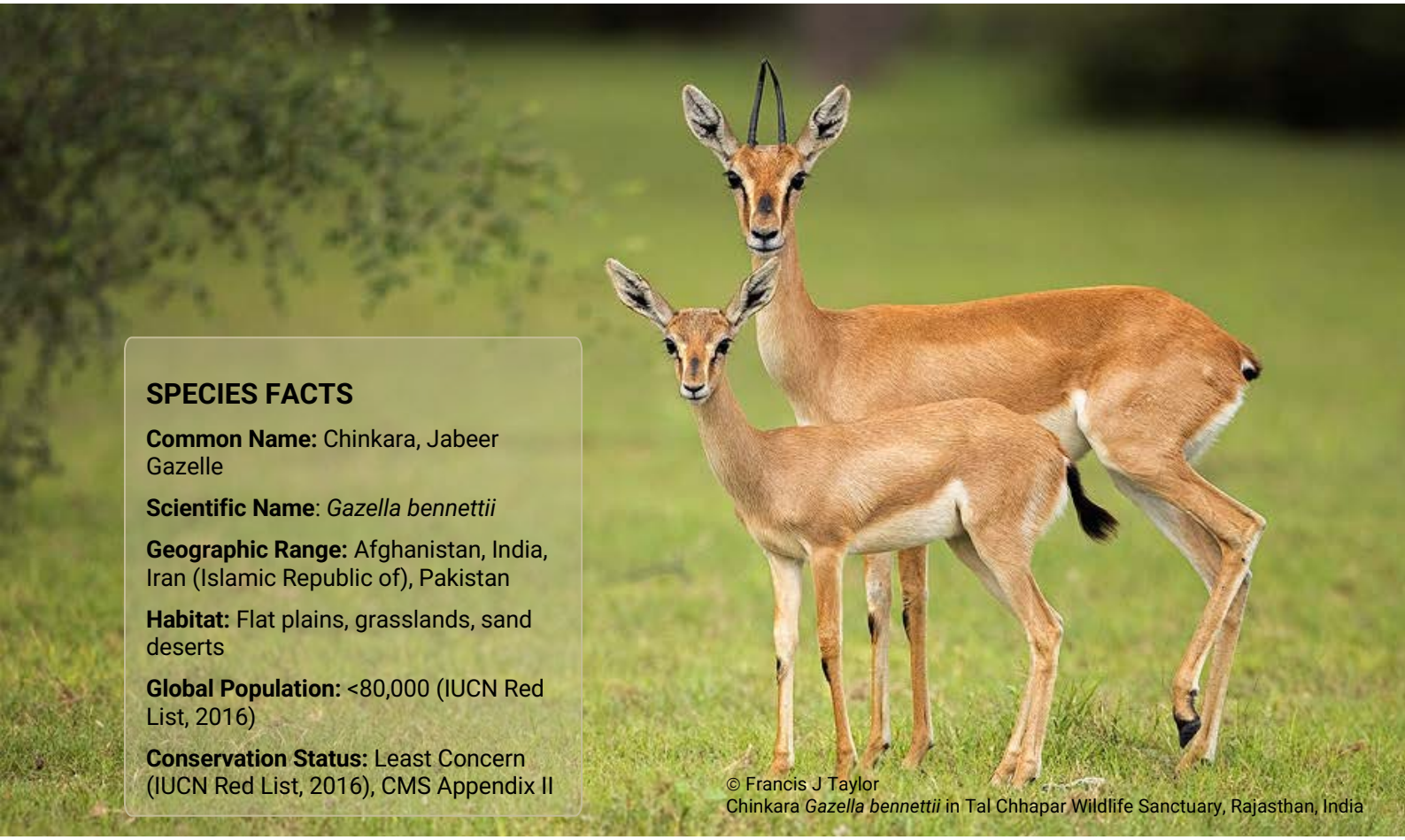
MITIGATION/REMEDIATION STRATEGY

FENCE	RAILROAD	ROAD
• Ensure that existing standards and guidelines for infrastructure. In Mongolia, the National Standard for Wildlife-Friendly Fencing in Mongolia must be followed. • Remove parts of the border fence to have regular 200-metre gaps every 30 kilometres • Facilitate greater bilateral cooperation using several mechanisms, including involving security and border agencies • Increase awareness of cross-boundary issues and improve communication between agency personnel, biologists, and conservationists working on Wild Camel conservation in China and Mongolia • Organize joint meetings on camel conservation to establish trust and cooperation, and initiate joint research projects • Conduct a border fence study on Wild Camel habitat in relevant areas • Establish cooperation between local governmental organization in Gobi-Altai and Bayanhongor province in Mongolia and Xinjian and Gansu provinces in China, including discussion about transboundary protected-corridor areas for Wild Camels • Implement conservation-management actions and strategies, including (i) conducting research and consistent, long-term monitoring along international border; (ii) establishing a trans-boundary park between China and Mongolia and protecting movement corridors for Wild Camels.	• No fencing along the existing railroads; • Consider building overpasses/bridges and monitor for effectiveness.	• Replace existing roads that bisect migration routes with new roads underground, where feasible; • Install effective, reflective signage close to the road; • Consider building overpasses/bridges and monitor for effectiveness.

More information:

Wild Camel on the CMS webpage

Chinkara



SPECIES FACTS

Common Name: Chinkara, Jabeer Gazelle

Scientific Name: *Gazella bennettii*

Geographic Range: Afghanistan, India, Iran (Islamic Republic of), Pakistan

Habitat: Flat plains, grasslands, sand deserts

Global Population: <80,000 (IUCN Red List, 2016)

Conservation Status: Least Concern (IUCN Red List, 2016), CMS Appendix II

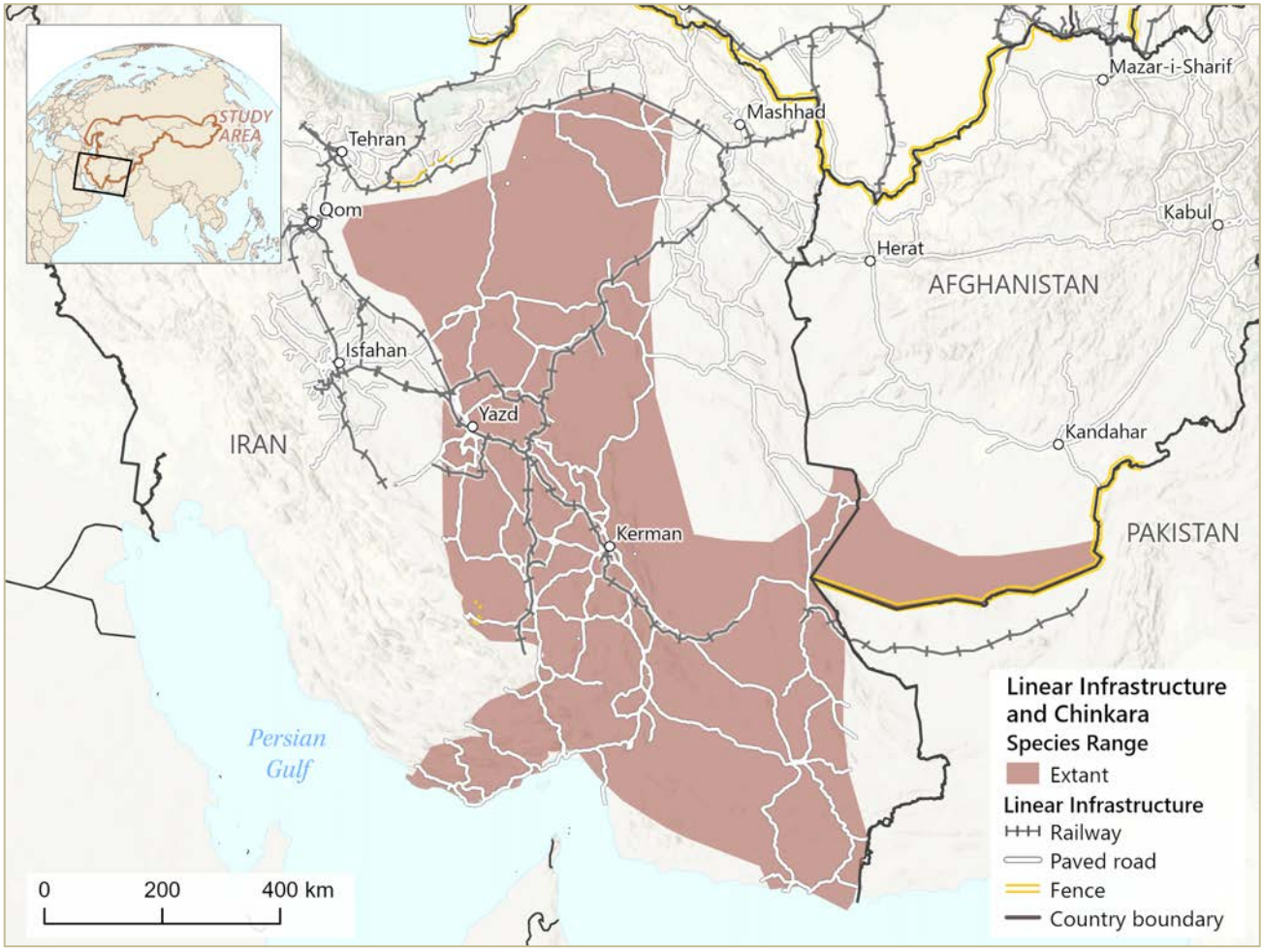
Chinkara *Gazella bennettii* in Tal Chhapar Wildlife Sanctuary, Rajasthan, India

MOVEMENT BEHAVIOUR

The movement and ranging behavior of the Chinkara is not well understood. While male Chinkara are recognized for their territorial nature, studies suggest that their home ranges are relatively small, shaped by factors such as food resource distribution, water availability, and habitat type. In the Thar Desert of Rajasthan, India, herds have been observed to have home range sizes between 2.2 km² and 2.4 km², with the largest range reaching 2.6 km². Chinkara are remarkably adapted to thrive in arid environments, exhibiting lower dependence on water sources. Nevertheless, their reliance on nutrient-rich forage, which also contains sufficient moisture, is crucial for their survival. In arid desert landscapes, this adaptation may lead Chinkara to display nomadic behaviors similar to those of other ungulates in similar conditions with limited forage and water.

The Chinkara predominantly inhabits western and central India, extending across Pakistan, southwestern Afghanistan, and into north-central Iran. India is home to the largest population of this species (Rahmani, 2001), but the Chinkara has seen a drastic decline in numbers in Iran, Pakistan, and Afghanistan over recent decades. Currently, the population status for Chinkara in Afghanistan remains unknown, while Iran has an estimated 2,818 individuals (Akbari et al., 2014) and there are about 6,000 in the Salt Range, Pakistan. The Chinkara faces significant threats, including overhunting, poaching, the expansion of agricultural land, urbanization, predation by feral dogs, overgrazing, and severe habitat destruction from large-scale industrialization. Furthermore, electrical shocks and iron fencing around croplands pose serious risks of injury and mortality to the species. Immediate action is required to address these critical issues and ensure the survival of the Chinkara.

LINEAR INFRASTRUCTURE AND CHINKARA IN IRAN AND AFGHANISTAN



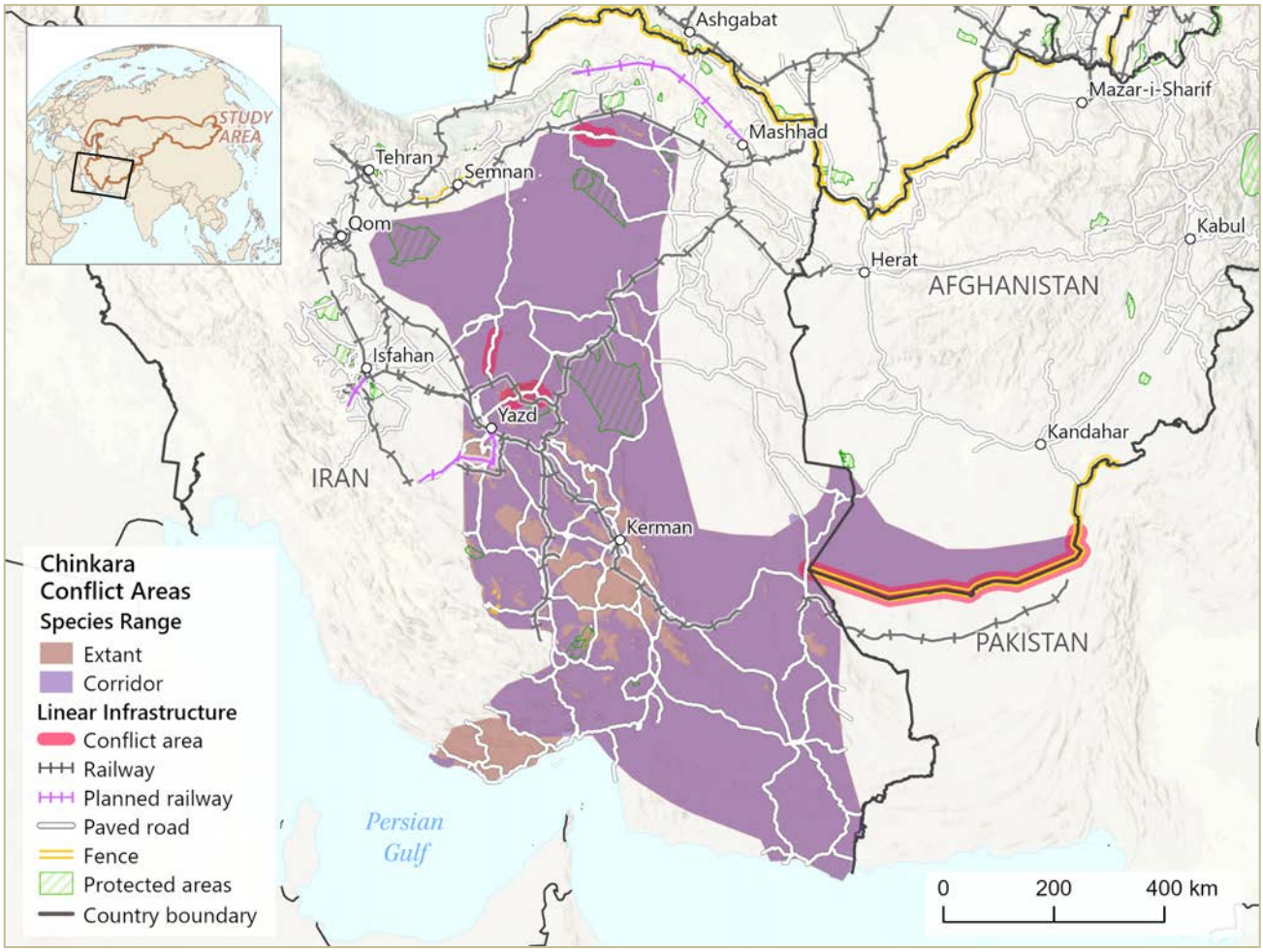
Estimated Linear Infrastructure in the Species Rang (Iran and Afghanistan)

552 km	Fence
3,700 km	Railroad
12,510 km	Paved road
16,762 km	**Total existing linear structure**
119 km	**Planned railroad**

Key Linear Threats to Movements and Habitat Fragmentation of Chinkara

The border fence between Pakistan and Afghanistan intersects part of the Chinkara's distribution range. While the specific effects of this border fence on Chinkara have not been documented, we can infer potential impacts based on research related to the sympatric *Gazella subgutturosa*. During drought conditions, weakened gazelles tend to gather and often die along stretches of the fence that restrict their movement toward areas with better forage (e.g., Zafar-ul Islam et al., 2010). Furthermore, **the expanding network of roads, which experiences heavy traffic, may obstruct Chinkara passage.** The actual frequency of collisions involving Chinkara could be underestimated.

CONFLICT AREAS AND CHINKARA IN IRAN AND AFGHANISTAN



CONFLICT AREAS AND CHINKARA IN IRAN AND AFGHANISTAN

In addition to the existing border fence separating Pakistan and Afghanistan as a conflict area, high-traffic roads may represent a significant barrier to the movement of Chinkara. These roads may not only disrupt the movement of Chinkara but also increase the likelihood of vehicle collisions with these animals. **A notable example is the highway that connects Semnan to Mashhad. This route has been classified as a conflict area, which may impede Chinkara movement.** Although there have not been any documented vehicle collisions involving Chinkara thus far, it is important to highlight that this highway has a notorious reputation for frequent accidents involving the Asiatic Cheetah, emphasizing the dangers posed by high traffic. Furthermore, the effects of railroads on Chinkara movement remain largely unclear. At present, this transportation infrastructure is not a major concern because, in Iran, railroads are typically not enclosed by fences, allowing for some degree of animal movement. **However, the situation may change due to the anticipated expansion of the railroad network in response to the growing mining industry within the habitats where Chinkara reside. Plans are in place to construct approximately 408 kilometers of new railroads within the range of the Chinkara population in Iran.** Such developments could lead to a range of conservation challenges in the future, most notably habitat fragmentation.

MITIGATION/REMEDIATION STRATEGY

FENCE	PAVED ROAD
• Dismantle decaying fences and new fences if possible. • Create fence gaps/openings or promote cable fences that allow gazelles to pass safely through (i.e. no barbed wire). • Control illegal hunting along border fence road and gaps. • Raise awareness in government, industry and lenders of the risk of a fence development project to Chinkaras and ensure adhere to national legislation and international obligations.	• Install small obstacles/bumpers on the road to force drivers to slow down on local roads where Chinkaras occur frequently. • Install more lights along roads and/or reflective signage. • Develop underpasses or bridges for highways. • Improve awareness of government, industry and lenders of the risks and of importance of strategic environmental assessments and environmental impact assessments.

More information:

Chinkara on the CMS webpage

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is an environmental treaty of the United Nations that provides a global platform for the conservation and sustainable use of migratory animals and their habitats. This unique treaty brings governments and wildlife experts together to address the conservation needs of terrestrial, aquatic, and avian migratory species and their habitats around the world.

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