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BIODIVERSITY SAFEGUARDING PROTOCOLS FOR LINEAR INFRASTRUCTURE:

Volume 1 - Wildlife and Connectivity Corridors

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BIODIVERSITY SAFEGUARDING PROTOCOLS FOR LINEAR INFRASTRUCTURE:

Volume 1 - Wildlife and Connectivity Corridors

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INTRODUCTION

Infrastructure development is often associated with direct and indirect consequences on the environment and people, including land erosion and degradation, habitat loss and fragmentation, a potential increase in illegal wildlife trade from access to pristine and previously inaccessible areas and landscapes, and potentially associated zoonotic spillover. Despite facilitating interconnectivity through trade and tourism, these infrastructure developments often overlook environmental and habitat conservation and there is evidence that the development of roads and highways in ecologically sensitive regions accelerates the exploitation of natural resources, generates the displacement of both humans and wildlife and has a substantial, unintended negative impact on the ecosystem.

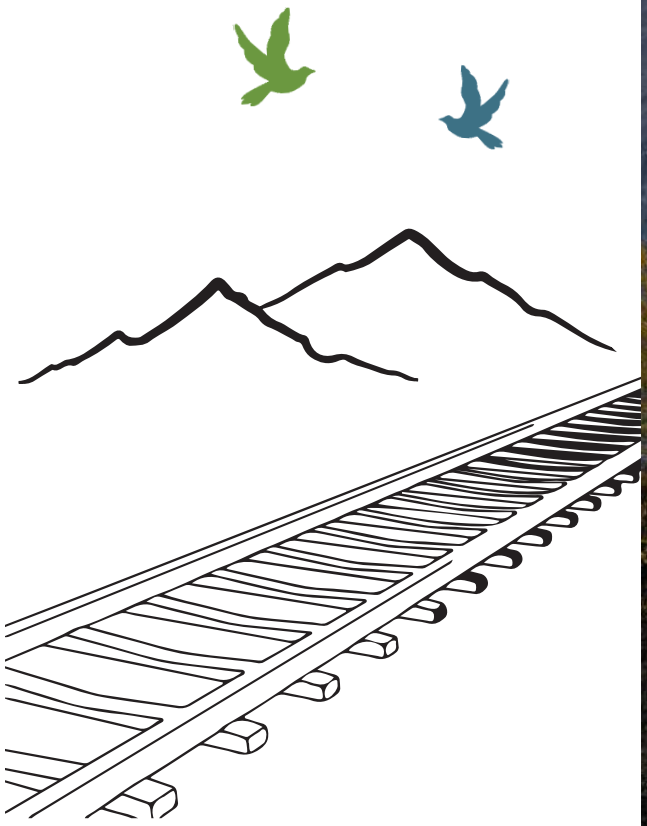
The infrastructure projects under discussion herein are part of the China-Pakistan Economic Corridor (CPEC) under the Belt and Road Initiative (BRI).

When assessing the impacts of CPEC projects in Pakistan, WWF-Pakistan's preliminary research shows that three-quarters of Pakistan's ecologically protected zones and regions that have a high biodiversity and conservation value will be directly and/or indirectly impacted by the current and planned CPEC infrastructure projects such as overlapping with the habitats of **265 threatened species**, other WWF flagship species, and **1,739 Important Bird Areas or Key Biodiversity Areas**. Moreover, the proposed infrastructure development threatens vulnerable wildlife species such as the snow leopard (Panthera uncia), Himalayan ibex (Capra sibirica), Marco Polo sheep (Ovis ammon polii), Markhor (Capra falconeri), and the Indian pangolin (Manis crassicaudata) among others.

Although CPEC is a multifaceted program with extensive development projects in energy (coal and hydropower), maritime development and Special Economic Zones (SEZs), our research is primarily focused on linear infrastructure projects such as roads and railways specialized for the Gilgit Baltistan (GB) region.

These projects include the expansion of the Thakot-Raikot Karakoram Highway (KKH) section (N-35), the under-construction CPEC Link Road: Gilgit-Chitral via Shandur and the Havelian-Khunjerab Railway.

GB is a priority region for WWF-Pakistan due to its potential classification as being one of the most biologically diverse regions in Pakistan. In GB, planned linear infrastructure projects threaten species' home ranges lying in even the most inaccessible landscapes. These developments pose some combination of direct and indirect threats, and could thus reverse conservation gains of multiple priority species and habitats.



CHINA'S GREENING THE BELT AND ROAD INITIATIVE

2016

His Excellency, President Xi Jinping calls for a "green, healthy, intelligent and peaceful" Silk Road.

2017

Guidelines on Promoting Green Belt and Road are issued jointly by the Ministry of Environmental Protection, the Ministry of Foreign Affairs, the National Development and Reform Commission (NDRC), and the Ministry of Commerce.

2019

Green development is further stressed by President Xi Jinping in his keynote speech at the opening ceremony of the Second Belt and Road Forum for International Cooperation held in April and the establishment of the Belt and Road Initiative Green Development Coalition (BRIGC) is announced.

The People's Republic of China is cognizant of the potential detrimental impacts that can be caused on nature and biodiversity as a result of BRI investments in the event where mitigation measures are not in place. In order to streamline and coordinate the delivery of the same, the Belt and Road Initiative International Green Development Coalition (BRIGC) was established soon after the conclusion of the second Belt and Road Forum in April 2019. The main goal of the BRIGC is "to promote international consensus, understanding, cooperation and concerted actions to realize green development on the Belt and Road, to integrate sustainable development into the BRI through joint efforts and to facilitate BRI participating countries to realize SDGs related to environment and development." The BRIGC, supervised by the Chinese Ministry of Ecology and Environment (MEE), publishes a number of policy documents and guidelines for host countries and companies to integrate environmental considerations through a project's life – from planning to construction, management, and deconstruction, as well as in information disclosure.

IMPACTS ON BIODIVERSITY

It is an undisputed fact that the construction and development of BRI investment projects will lead to large detrimental impacts on biodiversity as recognized by the BRIGC themselves:

"The Belt and Road Initiative (BRI), with regional connectivity at its core, runs through a number of biodiversity hotspots, wilderness areas, and other key conservation areas. Infrastructure construction, such as transportation construction, plays an important role in BRI cooperation. Infrastructure projects usually last for a long period of time and have big impacts on the environment. If not properly planned, it will bring huge potential risks to biodiversity protection in the coming decades. Therefore, biodiversity conservation must be taken into serious account in BRI transportation infrastructure projects."[1]
– BRIGC

The BRIGC, in its study titled Key Biodiversity Areas and Impact Assessment in BRI-Covered Areas, acknowledges and recognizes that without proper mitigation planning in place, transportation/linear infrastructure projects will have a severe impact on the population and health of biodiversity that is found in the project areas. These impacts can be divided into two broad categories; however, their impacts are interrelated. These include:

i. **habitat loss, transformation, fragmentation, and degradation** (this also includes the potential risk of increased human-wildlife conflicts as a result of habitat loss and barriers to movement) and;

ii. **wildlife mortality due to wildlife-vehicle collisions**

I. HABITAT LOSS, TRANSFORMATION, FRAGMENTATION AND DEGRADATION AND BARRIERS TO MOVEMENT

Habitat fragmentation is defined as the process during which a large expanse of habitat is transformed into a number of smaller patches of smaller total area isolated from each other by a matrix of habitats unlike the original. As a result, habitat fragmentation leads to habitat loss and habitat disintegration, affecting biodiversity. For many species, populations scattered in space are prone to extinction if the networks of patches are not sufficiently connected by dispersal routes. This connection depends on the availability of dispersing individuals and the ease with which these individuals can move across the landscape. This ease of movement is often termed "landscape connectivity" and is a central concept in conservation biology that is of paramount importance for population persistence, patterns of biodiversity, and functioning of ecosystems across landscapes.[2]

According to our research, the development of linear infrastructure, will cut through pristine regions and natural habitats, thereby fragmenting habitats and/or cutting off the migration routes of a number of species. This may cause loss or isolation of wildlife, possibly making it unsuitable for species to exist and/or thrive in the GB region. The construction of roads will, therefore, effectively replace natural habitats with transport infrastructure, resulting in a net loss of natural habitat; a condition that may be exacerbated by disturbance and isolation effects and lead to a potentially unavoidable change in the distribution of species in GB.[3] Figure 1 provides an illustration of how infrastructure development cuts through landscapes and causes habitat fragmentation.

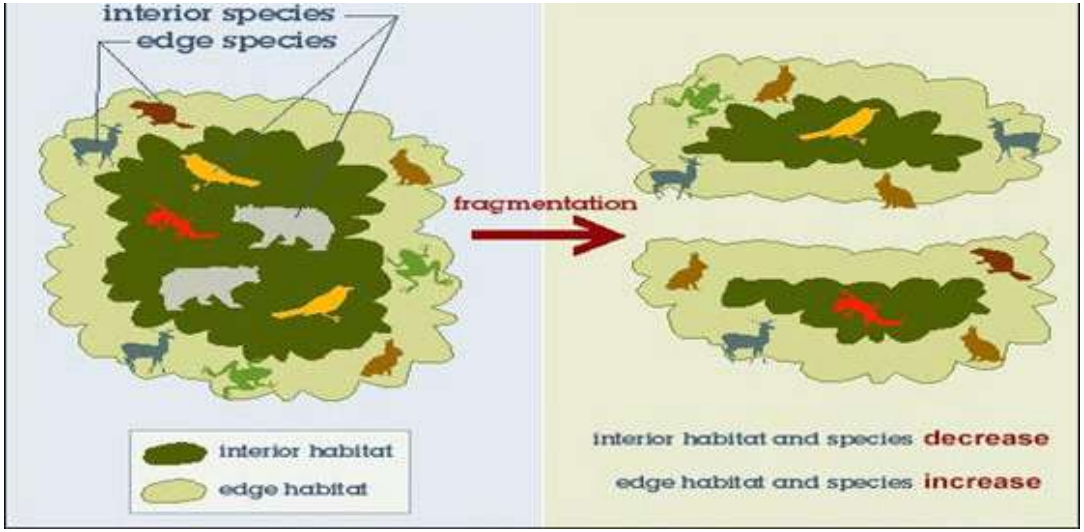


Figure 1: Impact on edge species and habitats

WWF-Malaysia, WWF-Indonesia, and WWF-Nepal have highlighted the impacts of infrastructure development in areas of rich biodiversity and the implication of habitat fragmentation.

One case presented by WWF-Malaysia and WWF-Indonesia on road development in Borneo, an island in Southeast Asia, identified that the construction of road infrastructure will lead to what is called an 'edge effect' in habitat fragmentation, which is a "change in the condition at the edge of a habitat."[4] This results from disrupting habitat areas at the edge along a road corridor, allowing human intervention that may result in human-wildlife conflict.

Similar negative consequences are expected in the CPEC project areas. Furthermore, since fragmentation will result in the splitting up of large groups of population into smaller ones, competition for food, shelter, and water will increase, the migration of animals to other areas will decrease, and the genetic diversity among wildlife species will drop due to a decrease in the number of potential mating partners.[5] Such development efforts have significant direct and indirect ecological impacts that require active intervention.

The BRIGC also provides an example of the impacts of road construction on the Tibetan antelope native to the Qinghai-Tibetan Plateau in China.

> *At the same time, the transportation network will also bring about an ecological island effect. The road network fragments the originally unified ecosystems into individual ecological islands. Among the birds and mammals that have become extinct in modern times, three-quarters are island creatures, and history has shown that species diversity is more fragile in an isolated island ecosystem. As wild animals have a very wide range of activities, their survival and reproduction are at the greatest risk from the ecological island effect. For example, the Tibetan antelope native to the Qinghai-Tibetan Plateau in China usually spends the cold and harsh winter in the Goluo Basin and in the summer migrates in groups to the Zhuonai Lake, Sun Lake, and Hoh Xil Lake, where there are abundant resources and few natural enemies, to reproduce. The fragmentation of their habitat by roads results in inadequate food and the inability to mate, posing a great challenge for them to survive. The impact of roads on wildlife is not only to hinder their migration, but also to increase poaching, deforestation, and threats to endangered species.*[6]
> -BRIGC

While there is extensive literature on habitat fragmentation at landscape levels, and the available body of knowledge on the impact of railway construction contributing to habitat fragmentation has previously been integrated with studies that focus on the impacts of road construction on wildlife habitats, studies and data exclusively focusing on railway-related fragmentation are quite wanting.[7] While it may be possible to extrapolate the impact of the construction of roads to that of railways, it is integral to account for the differences between their respective architecture that will lead them to have varying levels of influence on the GB region. For instance, railways, unlike roads, don't have traffic at the interval between one train and the next, and may even have intervals that are free of traffic at certain hours. Additionally, since railway construction calls for reduced land occupancy when compared to other forms of land transportation, the impact of railways may result in a decreased rate of habitat loss or transformation.[8] This presents unique opportunities to frame effective mitigation measures that are specifically tailored to the operational characteristics of railways to reduce barrier effects, resulting in fragmentation and habitat loss of local and endemic wildlife species.

Concerns regarding habitat transformation influencing biodiversity patterns and ecosystem services need to be addressed. Since the major portion of the planned Havelian-Khunjerab Railway project falls in the Central Karakoram National Park (CKNP) and the Khunjerab National Park (KNP), it is expected to have quite a palpable impact on the migratory movements of wildlife species such as ungulates. A similar situation is expected to be observed in the case of the CPEC Link Road that will pass through the Shandur-Hundarap National Park (SHNP) and the Chitral Gol National Park (CGNP), which house wildlife habitats for key priority species that include the brown bear, Markhor, and the snow leopard. If these projects are implemented without proper planning and in the absence of requisite environmental impact assessments to understand and mitigate their potential adverse effects, the diverse habitats in the GB region could be lost forever.

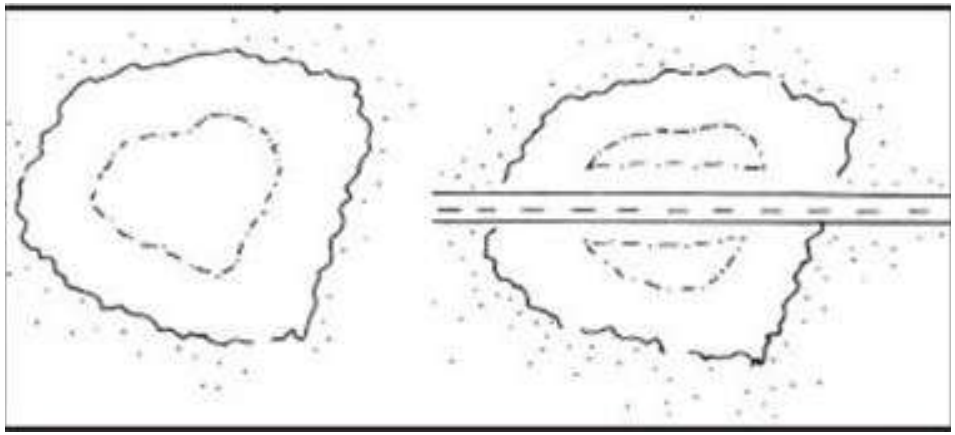


Figure 2: Impact of infrastructure development on the interior core of habitats

II. WILDLIFE MORTALITY DUE TO WILDLIFE-VEHICLE COLLISIONS

The construction of roads and railways is likely to increase wildlife mortality from vehicular accidents and collisions, which are identified as one of the most common negative impacts of linear infrastructure on wildlife. While many of these casualties may not be indicative of imminent peril, in the instance of vulnerable or endangered species, traffic on roads and railway lines may prove harmful to the survival of their already decreasing populations. The indigenous wildlife species of the GB region, particularly the areas falling in the buffer zone of CPEC roads and railways, have a high conservation value and as mentioned herein-above, are included in several published lists by WWF, IUCN, and CITES. Similarly, the ungulate species of the GB region are also at great risk owing to their routine and seasonal migration for breeding, grazing, and finding water.

Furthermore, the northern end of the railway line at the point of Koksil, almost 34 km into the KNP, falls within the core habitat zone of the Himalayan ibex and the snow leopard, and is an area where numerous wildlife sightings have been observed while crossing the existing Karakoram Highway. This would put the already vulnerable wildlife species at a greater risk as the planned roads and rail will disturb their natural habitats and may even lead them to alter their seasonal and routine migration and lifestyle patterns.

There is a dearth of data on wildlife mortality resulting from vehicle collisions in Pakistan, especially in the GB region.

However, by using data from other countries such as Nepal, vehicle-wildlife collisions are observed to have a higher incidence in areas where infrastructure is constructed across ecologically protected areas that serve as wildlife habitats. This was particularly observed in the case of the Narayanghat-Butwal highway that lies adjacent to the buffer zone of the Chitwan National Park (CNP) in Nepal, an area that includes the habitat of the endangered Bengal tiger.[9,10]

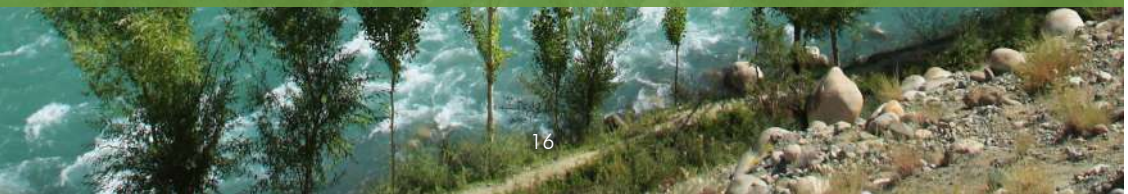


Figure 3: A snow leopard (panthera uncia) killed following a collision with a passing truck in the khovd province of mongolia
Source: wwf website (2017)

It is essential, therefore, to conduct additional research and carry out detailed assessments to develop data-driven mitigation strategies that will help frame effective policy measures for reducing fauna causalities and disturbance from vehicular accidents and collisions following linear infrastructure development. Figure 3 shows a snow leopard killed after a collision with a truck in Western Mongolia, exacerbating the threat to the survival of endangered species.

MITIGATION MEASURES

COUNTERING THE IMPACT ON WILDLIFE

The construction of transportation infrastructure plays a major role in promoting economic development, trade and cultural exchange among the BRI-related countries. However, traffic road networks, as a linear type of network, consist of long-distance and large-scale traffic passages that lead to the fragmentation of habitats, while also exerting a profound and irreversible impact on the ecosystem of the surrounding area. This impact is regarded as one of the most extensive human disturbances to the natural ecosystem of the past century and countries worldwide have attached great importance to it.[11] -BRIGC

As the construction of the CPEC projects under review are expected to negatively impact wildlife populations, mitigation measures such as wildlife corridors, over-passes, underpasses, fences, and signage and warnings can be incorporated in the design, planning, and construction phases.

Wildlife corridors [12], which are linear features that connect at least two significant habitat areas, may help to reduce or moderate some of the adverse effects of habitat fragmentation to ensure against the disruption of migration between habitat patches. These corridors facilitate the movement of species between substantive patches of remaining habitats, allowing both long-term genetic interchanges and for species to re-colonize habitat patches from which populations have been locally extirpated.[13] Many natural areas are critical core habitats and are therefore not suitable for human development. In cases where some development may be acceptable, corridors can be incorporated into the design of a development project by conserving an existing landscape linkage or restoring the habitat to function as a connection between larger habitats and ecosystems.

The roads in GB are expected to pass through the region's ecologically protected areas, the SHNP and the CGNP. This will result in habitat loss, transformation, and fragmentation, which will affect numerous ecological processes across multiple spatial and temporal scales, including changes in abiotic regimes, shifts in habitat use, altered population dynamics, and changes in species compositions. To help minimize the impact on the population and movement of local wildlife, WWF-Pakistan recommends including wildlife corridors, such as continuous corridors[14] and/or stepping-stone corridors[15] as an adaptive measure (Figure 4). These can be built in adjoining native forests and grazing lands to connect the biodiversity of SHNP and CGNP and help facilitate wildlife habitat and migration. This can help keep local wildlife species away from busy roads in the GB region and allow them safe passage despite large-scale human developments in the area, thereby maintaining a considerable degree of cohesion in otherwise fragmented ecosystems.

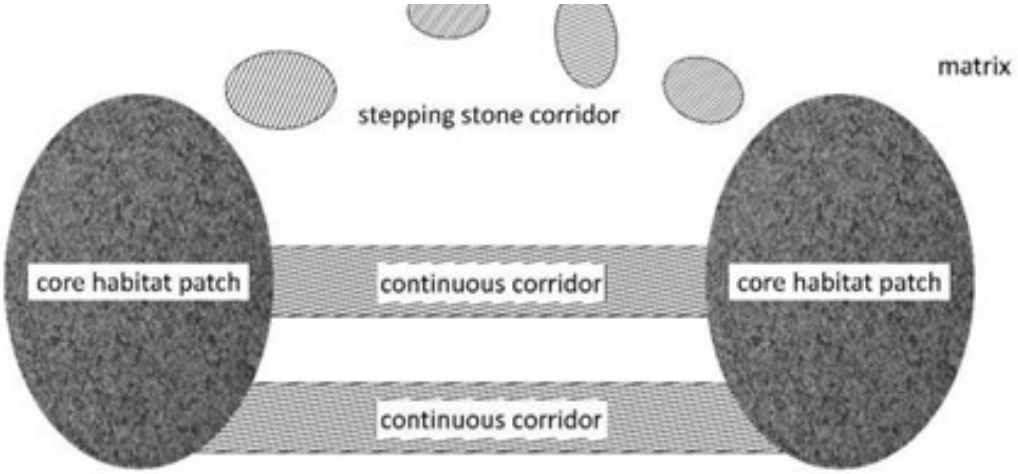


Figure 4: Wildlife corridors as an adaptive measure

Figure 5(a): Wildlife overpass crossing in Banff National Park, Canada Picture copyrights – gloria dickie

Similarly, to mitigate the risk of wildlife mortality from wildlife-vehicle collisions, all road development projects should include fences as part of their design and construction. This will help direct and regulate migration patterns and prevent wildlife from accessing roads, thereby reducing the possibility of wildlife-vehicle collisions and accidents. For mammals with large home ranges, such as the snow leopard, Himalayan ibex, and the Himalayan black bear (Ursus thibetanus laniger), wildlife overpass crossings may be built. A similar model can also be replicated for smaller vertebrates with the construction of underpasses. Examples of wildlife crossings are shown in Figures 5(A) and 5(B).

Figure 5 (b): Wildlife underpass crossing under the trans-canada highway in Banff National Park, Canada Picture copyrights – Parks Canada

It is important to note that there is a dearth of data on wildlife mortality resulting from wildlife-vehicle collisions in Pakistan, especially in the GB region. However, by using data from other countries such as Nepal, wildlife-vehicle collisions are observed to have a higher incidence in areas where infrastructure is constructed across ecologically protected areas that serve as wildlife habitats. This was particularly observed in the case of the Narayanghat-Butwal highway that lies adjacent to the buffer zone of the Chitwan National Park (CNP) in Nepal, an area that includes the habitat of the endangered Bengal Tiger (Panthera tigris tigris).[16]

It is essential, therefore, to conduct additional research and carry out detailed assessments to develop data-driven mitigation strategies that will help frame effective policy measures for reducing fauna causalities and disturbance from vehicular accidents and collisions following linear infrastructure development.

WHAT IS WWF-PAKISTAN DOING?

Under WWF-Pakistan's Sustainable Infrastructure Initiative (SII), WWF-Pakistan is essentially taking steps to identify and provide data-driven solutions to make transport/linear infrastructure biodiversity friendly. The SII is currently being executed through two projects:

i. Greening Linear Infrastructure in Snow Leopard Home Ranges of the Hindukush-Karakoram-Himalaya Landscape in Pakistan – funded by WWF-International (March 2022-ongoing); and

ii. Building Ecological and Sustainable Transport/Linear Infrastructure for Snow Leopard habitats in the Hindukush-Karakoram-Himalaya Landscape in Pakistan (BEAST) (October 2022 - September 2023) – funded by the ShanShui Conservation Center, supported by the Amity Foundation, HUATAI Foundation and Peking University Center for Nature and Society.

Activities currently being undertaken under these projects are as follows:
i. Identifying the potential impacts of linear infrastructure projects on nature and biodiversity in snow leopard habitats;

ii. Improving existing EIA process by reviewing legislation and proposing amendments with a focus on the Federal and Gilgit-Baltistan EPA Acts;

iii. Developing a baseline for snow leopard (and prey species) road kills;

iv. Mapping snow leopard migratory routes to identify hotspots for the construction of wildlife corridors; and

v. Assess infrastructure growth patterns and sprawl of hospitality infrastructure due to the construction of transport infrastructure in the HKH and its impact on snow leopard habitats.

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[10]Jhamak B. Karki, "Biodiversity Baseline Assessment and Mitigation Strategy: Narayanghat-Butwal Road Project, Nepal," (Nepal Department of Roads Project Directorate (Asian Development Bank), 20 April 2020).

[11]'Key Biodiversity Areas and Impact Assessment in BRI Covered Areas', BRIGC, December 2020, pg. 21.

[12]Wildlife corridors, also known as habitat corridors or green corridors, are wildlife areas that have been designed to keep local migratory animal species from encroaching human populations and anthropogenic activities, such as the construction of roads, highways, and railways (Conservation Corridor Planning at the Landscape Level).

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[15]Continuous corridors are a type of wildlife corridor that include long, uninterrupted strips of vegetation, which connect habitats, thus enabling wildlife migration regardless of human activities (Conservation Corridor Planning at the Landscape Level).

[16]Stepping-stone corridors are a type of wildlife corridor that include a series of small patches of non-connected habitats to allow wildlife populations to seek food and shelter (Conservation Corridor Planning at the Landscape Level).

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