



Conserving the World's Finest Grassland Amidst Ambitious National Development

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Animal migration, one of the most fascinating of all behaviors, links ecosystems and has profound ecological consequences over very large scales. Ungulate migrations are among the most imperiled ecological phenomena in the world (Harris et al. 2009). Substantial populations

of migratory ungulates are found in Mongolia's Gobi-Steppe Ecosystem (GSE), which is the largest area of intact steppe in the world and hence is of global importance (Fig. 1). The region hosts as many as one million Mongolian gazelles (*Procapra gutturosa*); the largest

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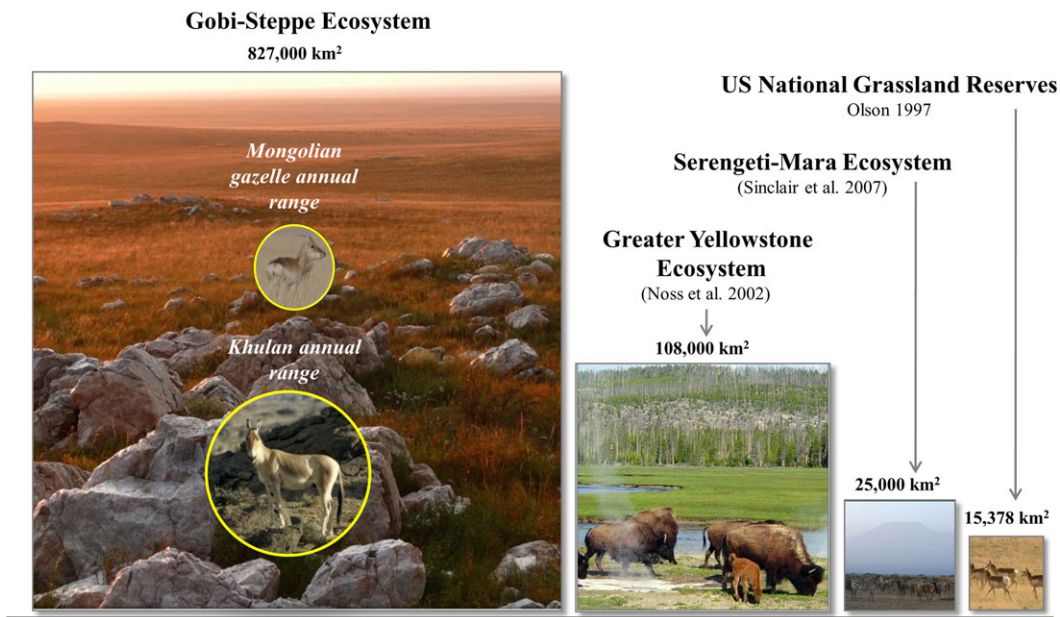


Figure 1. Mongolia's Gobi-Steppe Ecosystem with maximum observed annual range sizes of GPS collared Mongolian gazelle and khulan compared to select globally renowned grazing systems and grassland reserves. See references Olson 1997, Noss et al. 2002, and Sinclair et al. 2007.

populations of Asiatic wild ass (*Equus hemionus*—*khulan* in Mongolian); perhaps half the world's remaining wild bactrian camels (*Camelus ferus*); and what might be the largest population of goitered gazelles (*Gazella subgutturosa*) anywhere (Reading et al. 2001; Olson et al. 2011).

Mongolia has begun an economic transformation fueled by rich mineral and fossil fuel deposits and is at a crossroad. If the country's rapid growth can be managed in a way that can maintain the integrity and resilience of the GSE then the impressive ungulate assemblage and unique migratory dynamics may be maintained. Numerous infrastructure projects are underway or planned; the largest is a railroad designed to link major coal deposits in the south with northeastern Mongolia. This railroad will span some of the most undisturbed regions of the GSE and divide the largest tracts of habitat used by Mongolian gazelle, khulan, and goitered gazelle (Fig. 2). To improve living standards of rural communities by facilitating access to markets, education, and health care, Mongolia is extending its network of paved roads. These roads will connect population centers and border crossings by upgrading existing tracks, but others will traverse open rangelands, where they are likely to disrupt wildlife movements (Harris et al. 2009; Holdo et al. 2011; Laurance & Balmford 2013).

The GSE is characterized by constant fluctuations in precipitation patterns resulting in a constant change in availability of quality forage (von Wehrden et al. 2012). Mongolian gazelles and khulan are well adapted to this unpredictability because of their ability to travel extremely long distances (Kaczensky et al. 2011; Fleming et al.

2014). Animal movements in the GSE are distinct from other migrations in that gazelles and khulan do not necessarily demonstrate return movements between seasons; instead, they move in a more nomadic pattern. In just 1 year, an individual Mongolian gazelle can range over a 32,000 km² area and an individual khulan can range up to 70,000 km² (Kaczensky et al. 2011; Fleming et al. 2014).

Ungulates in the GSE have already been adversely affected by existing barriers constructed since the 1950s, namely a fenced border with both Russia and China and the Trans Mongolian Railroad corridor (TMR) (Hibbert 1968). Mongolian gazelles frequently get entangled, trapped, or turned away by railroad and border fences (Ito et al. 2013). Khulan appear unwilling to jump over and are too big to crawl under fences, so the railroad now constitutes the absolute eastern border of their range (Kaczensky et al. 2011).

The continued survival of Mongolia's large ungulate populations will depend on whether Mongolia's economic development proceeds at the expense of its natural heritage or whether development will be successfully integrated with biodiversity and ecosystem conservation goals. We suggest the following practical steps to enable effective conservation of highly mobile ungulate populations in Mongolia's GSE.

Regional-Scale Science-Led Planning

Maintaining the integrity of the GSE requires planning and constructing railroads and highways in ways that do not substantially impede critical, long-distance movements of

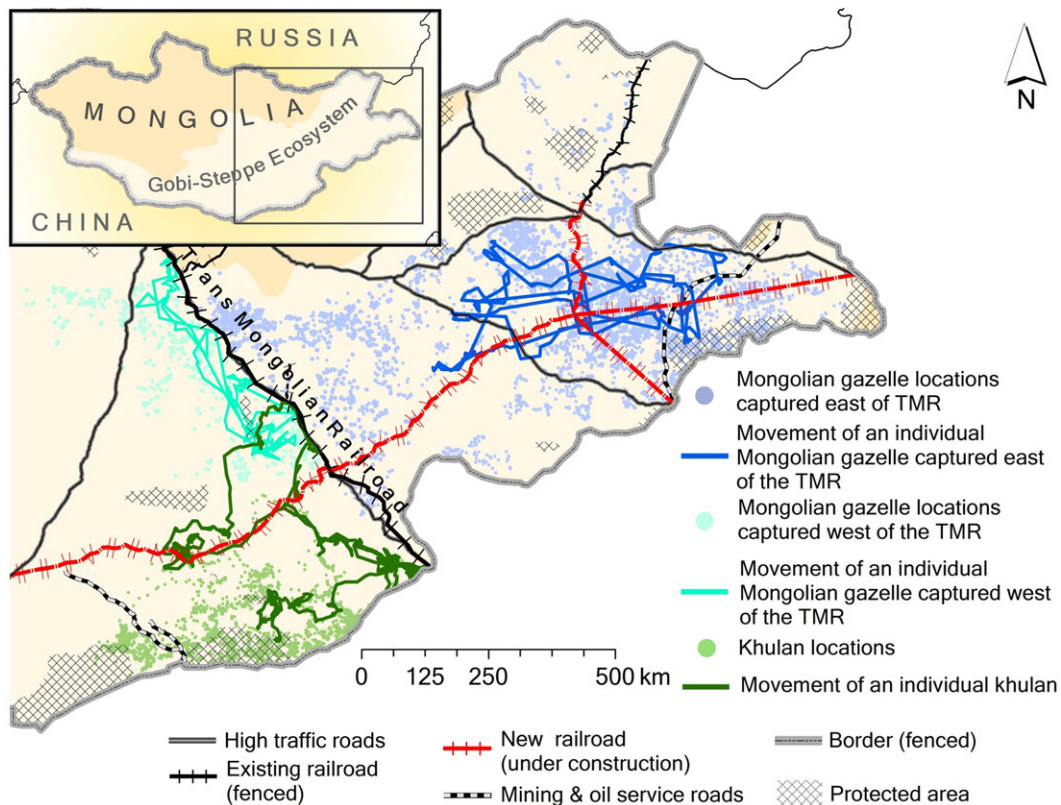


Figure 2. Locations of 61 Mongolian gazelles and 7 khulan (Kaczensky et al. 2011; Ito et al. 2013; Fleming et al. 2014) and movement pathways of 2 Mongolian gazelle and one khulan in the Gobi-Steppe Ecosystem.

ungulates. This requires research into the movement and habitat requirements of Mongolia's plains ungulates be intensified. Such efforts will aid in identification of areas of potential development-conservation conflict and locations where mitigation of development effects may be feasible. Expanding protected areas will create important, but temporary, refuges for migratory wildlife. Ultimately, however, only regional planning on the scale of the migrations themselves can preserve the ecological process of migration.

Mitigation of Existing and Future Infrastructure

Options for mitigating adverse effects of linear barriers include rerouting railways to maintain large roadless tracts. Railways and high volume roads can incorporate wildlife overpasses or underpasses at ecologically appropriate intervals. Railways far from settlements do not need to be fenced. Unnecessary decades-old barriers should be removed. For example, there are extensive fence segments bordering the TMR where there are no herders; thus, the fences do not serve their original purpose of preventing livestock collisions. Fence removal would allow khulan access to large parts of their former range, enabling restoration of this globally endangered species.

Where fences are necessary, structural modifications are possible, such as increasing the distance from the ground of the lowest fence strand and using barbless strands to encourage gazelles to crawl underneath while ensuring that large domestic stock are protected. Such fence removal and modifications have resulted in successful restoration of ungulate migrations in other grasslands (Hartlam-Brooks et al. 2011).

Financial and Technical Support from International Partners

Development planning and implementation of linear infrastructure should follow a mitigation hierarchy of avoid, minimize, restore, and offset. Mongolia is already embracing biodiversity offsetting for some of its static industrial developments, and there is potential to use offsetting as an approach to conserving moving targets such as migratory species (Bull et al. 2013).

Mongolia can be a global model for demonstrating that major economic development projects can proceed without degrading ungulate migrations. Thousands of herding families depend on the GSE and its rich and abundant wildlife for subsistence, and any major alterations to its functions and services would not only affect their natural

and cultural heritage, but also reduce their options to further develop alternative livelihoods.

Grasslands harbor extraordinary diversity, and the presence of migratory ungulates within them is increasingly threatened by anthropogenic factors. Mongolia can improve the livelihoods of its people without losing its irreplaceable natural heritage and by doing so forge a reputation as one of the world's leading stewards of wildlife and wild lands.

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