Alternatives to Conservation Fences for the Protection of Tibetan Antelopes in the Tibetan Plateau

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Part 1

Introduction

The Tibetan antelope (*Pantholops hodgsonii*), or chiru, is one of the most famous animal species that is always associated with the mysterious Western China border and "spiritual creatures that survive in the harshest environment on earth". They usually inhabit at elevations of 4000-5000 m only in the Tibetan Plaetau region. Remote and high, the chiru's range has seldom been penetrated by biologists. Knowledge concerning the species is largely confined to accounts by explorers, hunters, and expeditions collecting museum specimens (Schaller et. al.).

However, chiru has been through significant population declines during the last century. From minimal early explorer records, there used to be 500,000~1000,000 chiru in the early 1900s. However, poaching and habitat exploitation have significantly reduced Chiru's population starting the 1950s. From a study in 2015, there are only a total of 10,000~15,000 chiru existed (Xia et. al.).

Historically, people on the Plateau lived a nomadic life. However, due to the dramatic increase in population and deterioration of soil due to over-grazing, nomadic life was prohibited and local residents were allocated permitted grazing land by the central government. Starting 2004, conservation fences became even more widely used for excluding seasonal grazing and protecting the ecosystem. However, in the following years, issues resulting from fencing gradually emerged, including poachers using wire fences to trap chiru, fences blocking migration tracks, etc.

Therefore, this paper will primarily investigate finding better alternatives to fencing for the conservation of Tibetan antelopes (chiru) in the North-west Tibetan Plateau, China. The

structure of this paper will be focusing on two aspects: first, evaluating the state and negative impacts of exclusion fencing on wildlife; second, identifying potential alternatives.

Background Pt. 1 (General Global Application of Exclusion Fences)

Fences are usually described as free-standing structures aimed at restricting or preventing movement across boundaries. (Hayward and Kerley) For hundreds of years, exclusion fences have been a significant role in protecting people's property and agriculture. They are used to separate wildlife from humans, agriculture from pest species, at-risk wildlife from threatening processes, and vectors of disease from livestock. (Smith et. al.)

The unmanaged overuse of publicly-owned resources by an uncontrolled, burgeoning populace is described as the *tragedy of the commons*. To alleviate this problem, the enclosure of common resources, along with privatization and regulation, is usually recognized as the most effective. (Hardin) Due to the increasing need to protect endangered species and habitats in recent decades, exclusion fences have been gaining more attention as an effective conservation strategy. Globally, conservation fences are most often used to alleviate human-animal conflict, reduce human persecution of threatened species, and reduce the impact of introduced species. In addition, there also appears to be a geographical bias in the use of fences for conservation. Australia, New Zealand, and southern Africa have embraced the use of fencing to separate biodiversity from its threats. In Australasia, the threats are largely introduced predators, whereas in Africa they are largely human–animal conflicts. (Hayward and Kerley)

Despite the conservation benefits that fences provide, more and more studies also demonstrate the potential negative environmental consequences they create. Poor fence alignment, often resulting from ignoring environmental assessments, has created serious consequences. An extreme case is the mass-mortality events of ungulates along Botswana's veterinary fences. Those fences blocked wild ungulates from accessing critical water sources

during dry-season migrations, leaving these animals to die along the fence lines in their thousands. (Beal) Fence design, as well as alignment, can also impact biodiversity. Collisions with barbed wire and game fences surrounding hunting estates are a major source of mortality for birds and volant mammals. (Hayward et. al.) For example, fences along roads are often designed to minimize mortality through collisions with vehicles and thereby assist biodiversity conservation, yet 0.25 ungulates/km were killed in roadside wire fences in Colorado and Utah, USA, between 2004 and 2005. (Harrington and Conover).

Aside from the direct individual impacts that fences create, fences may also pose negative impacts on the population scale. Fences that block the immigration of individuals into a population will lead to a collapse in gene flow between populations, which may risk the genetic diversity of the population and species' evolution. Particularly, species with large area requirements are likely to be more negatively impacted as the enclosed populations may often be smaller than that required for long-term sustainability. (Hayward)

Luckily, articles related to exclusion fencing effects are well represented in the literature, particularly in the last 20 years, covering all continents. However, a large proportion of the literature addresses Australia, South Africa, and North America. There is much less spotlight on exclusion fences in Asia, with only 5% among the academia. (Smith et. al.) The insufficiency of impact studies in Asia could be a result of rapid population growth in recent decades and a dramatic increase in land use and therefore demand for fences. However, this gap should be treated with great attention and more fence regulations should be evaluated on ecological impacts.

Background Pt. 2 (Fences in Tibet, and their impacts on Tibetan antelopes)

The Tibetan antelope or chiru (*Pantholops hodgsoni*) is confined to the Tibetan Plateau, usually at elevations of 4000-5000 m. Chiru prefers flat to rolling terrain, although they may cross hills and penetrate mountains by following broad valleys. (Schaller et. al.) Chiru is a capstone species in the Tibetan Plateau ecosystem. They are grazers that can even survive on the grass with very low nutrient levels. With other grazer species in Tibetan Plateau such as Tibetan gazelle *Procapra picticaudata* and kiang *Equus kiang*, they contribute to the diet of predators such as lynxes, brown bears, and wolves.

Poaching is the biggest contributor to the drastic decrease in the chiru population historically. Chiru's wool is known to be the "king of cashmere wool", and can be used to make "Shahtoosh" clothing that each piece is worth more than $10,000. Between the 1980s and 1990s, even though the chiru wool trade had been banned globally, it still remained popular in the black market, and tragically, around 20,000 chirus were hunted down every year during this decade. By 1995, chiru's population declined to around 50,000~75,000 individuals. An increase in human activities is another significant trigger to the chirus population decline. Tibetan Plateau faced an increasing level of mining activities, and the construction of the Qinghai-Tibet Highway also has limited their migration range. For the above reasons, chiru is categorized as Endangered on the IUCN Red List (IUCN, 2008). (Xia and Yang)

At Tibetan Plateau, exclusion fences are primarily installed to explicitly distribute grazing and farming unit to individual residents. In early Communist China society, most herding practices are regulated in the Pastoral Mutual Aid Group (牧业互助组) and/or People's Commune(人民公社). Though those political structures gradually disappeared with the

modernization of the production process, modern pastoral practices are still heavily impacted by them. In the 1990s, two major regulations were promulgated: 1. “Livestock by Household, Privately Owned and Raised, Independently Operate, Permanent Ownership” (“牲畜归户、私有私养、自主经营、长期不变”); 2. “Grassland Owned by the State, Allocate to Households, Independently Operate, Permanent Ownership” (“草场公有、承包到户、自主经营、长期不变”). The government actively encouraged the “privatization” of herding units and in 2005, over 60% of the region has been allocated to household units. (Dawa)

Even though land allocation and fencing practices were originally intended to encourage residents to protect the grazing land, they not only failed to remain effective with the increase in population and demand but also directly cut off the grazing resources that used to be shared between herders and local wildlife. Historically, Tibetan herders will adopt a nomadic lifestyle by traveling to different regions during different seasons for the best grasslands and other natural resources. This cultural practice provided opportunities for natural grassland restoration and resources for local wildlife. Due to the land allocation system, more people immigrated to claim land in the region, bringing in modern farming technology that diluted the traditional practices, Households also started to raise significantly more livestock than at the sustainable level. Specifically, in Chang Tang Nature Reserve (羌塘自然保护区), the biggest nature reserve in China, total livestock is overloaded with more than 200,000~400,000 sheep units. In Gertse County, the biggest county in Chang Tang, the human and livestock population tripled over the past 35 years. (Xu et. al.) This drastic increase in herding activities contributed to the irreversible gradual deterioration of grassland in the reserve areas.

Moreover, land allocation and fences for major conservation purposes that appeared in many post-2005 regulations are also considered to have dubious benefits. In other dry

rangelands, enclosures and fencing have been proven to relate to the reduction of land capacity to support large herbivores, both domestic and wild. (Reid et al.). Furthermore, while the regional pastoral regulations are based on static carrying capacity measurements, this standard's credibility and applicability to an arid and high-elevation rangeland that has low but highly variable annual precipitation is doubtful. (Fox et al.)

Last but not least, the extensive application of fences with almost zero regulation on fence types promoted by post-2005 regulations has caused direct detrimental effects on chiru's population. Before the 2000s, land allocations were not strictly regulated and fences were not heavily relied on for land ownership. However, starting in 2004, fences were widely introduced throughout the area for grazing exclusion purposes. Many specific protected areas in nature reserves were fenced to prevent grazing. This was further promoted by "*Opinions on Further Strengthening the Implementation and Management of Returning Herding Land to Reservation*" (or "Opinions",《关于进一步加强退牧还草工程实施管理的意见》) issued by the National Agricultural Department. This policy was met with great popularity. In fact, a 2007 survey in two towns in Chang Tang Nature Reserve showed that over 80% of households had fenced in their property in one town and 56% in the other. Moreover, the fences constructed by only two towns and 69 households took over 500 km^2 of land. (Dawa) In the towns of Gertse County that lie wholly within the Reserve, fences have been constructed within traditional antelope wintering areas and for many km across their migratory routes. This caused many casualties of chiru during migration season due to entanglement as shown in the pictures below. The fences also pose obvious benefits for hunting. Herds of wild ungulates can be easily tired by chasing motorcycles, and the new fences are being used to block their escape and make killing easier. Even though the chiru wool trade was strictly prohibited, residents' complaints of the loss of their traditional

subsistence hunting and the lucrative black market for shahtoosh greatly complicate this issue. Chirus are still hunted for their wool and, although some traditional trapping is still involved, modern rifles are available, sometimes supplied by illicit traders or local officials, and recently motorcycles have been used to chase down groups of animals.

Images of Deaths of Chirus Caused by Entanglement (Fox et. al.)

For the above reasons, it is clear that the application of fences and land allocation for conservation purposes fails to be the most ideal practice. Therefore, for the second half of this paper, the author will analyze some existing alternative global practices in this context and propose potential solutions for future chiru conservation.

Part 2

Analysis and Result Pt. 1 (Existed Solutions to Fences in the Tibetan Plateau)

Due to the inaccessibility of the region for more detailed study and close supervision, generally the negative impact of fences in the Tibetan Plateau is not well studied in China. The existing political actions that focus on protecting the local ecosystem predominantly were made due to the fact that the Tibetan Plateau is the source of three major rivers in China so maintaining the local soil structure is crucial economically. As a result, strict grazing exclusion using fences was enforced in political order such as “Opinions” mentioned in Part 1, which lead to fast-spreading fence construction across the entire region, directly impacting long-distance migrating species like chirus. There is also very limited policy alternatives to building fences.

One existing political intervention is "One Area, One Law" (“一区一法”) which is first mentioned in “*Notice on Further Strengthening the Management of Nature Reserves*” (“关于进一步加强自然保护区管理工作的通知”) in 1999 and then was emphasized in 2005. “One Area, One Law” urges regions with nature reserves to build their independent regulation system, due to the uniqueness of the biome preserved in each reserve. This idea could motivate independent regulation of nature reserves based on a unique environment, yet in reality, this idea is not proven to be politically achievable due to the top-down governmental structure. As pointed out by Shipeng Yan and Ying Luo from China’s Northeast Forestry University, the standing committees of large cities do have the political power to propose regulations to target individual nature reserves, yet city standing committees are usually unquantified to propose regulations on nation-level projects, such as national parks, and those provincial regulation proposals will always be rejected if they explicitly or implicitly contradict the general regulations on national

nature reserve post by national agencies. (Yan et. al.) In this case for chiru, since fences are a key aspect of the national regulations on the Tibetan Plateau region for soil conservation, any regional modification of the law might be impossible in the near future.

Therefore, even though the emphasis on "One Area, One Law" can be a good start for regions to make more detailed regulations based on unique biomes, more practices to harmonize this order with the actual legal structure of nature reserve regulations are crucial for further studies.

Analysis and Result Pt. 2 (Existed Alternatives and Mitigation Strategies)

Enhance Chiru Migration Tracking Data for Building Migration Corridors

Wildlife movement corridors are linear features whose primary wildlife function is to connect at least two significant habitat areas. (Beier and Loe) However, despite the great ecological benefits of wildlife corridors, constructing one could be very costly, both economically and socially. Therefore, detailed scientific studies that determine the most concentrated locations where many migration routes intersect with human landscapes will be crucial for building a corridor. Modern geospatial information science (GIS) enables GPS tracking of individual animals and also mapping of migration routes. When migration paths are overlaid on landscapes on GIS, barriers and other threats can be identified, pointing toward effective conservation solutions. GIS and the new Barrier Behaviour Analysis were used by Wenjing Xu et. al. from the University of California, Berkeley to assess the individual differences in movements when encountering fences of pronghorn and mule deer in Wyoming, USA. Their research was able to determine that for mule deer, fence density determined the

correlation between barrier behaviors and space use and was negatively associated with individuals' survival especially. (Xu et. al.)

Given the poor spotlight on chiru research due to inaccessible geography, more scientific research and data tracking of each individual status will be significant for the study and conservation of the species. Moreover, since the total population of chirus has already been seriously endangered, tracking only a few individuals could potentially generate great information on the migration status of the species majority.

Conservation Easements

Conservation easement is the regulation strategy in which landowners agree to limits on the future development of their property in exchange for a tax advantage or payment. As a voluntary, incentive-based approach to conservation, easements are a more effective approach for private land conservation in some areas than regulatory-based approaches.(Langpap) This strategy is widely used in many developed countries such as the United States and is proven to be successful. For example, regarding The Nature Conservancy, the largest land trust in the world, the ratio of easement deal count and total investment began to see widespread uptake around 1976, when the Tax Reform Act granted conservation easements a reduction from federal income tax. (Fishburn et. al.)

Conservation easements could be a powerful strategy for incentivizing reduced grazing and utilization of land, yet this may not cause an effective and direct cut in fences. Moreover, due to the socialist top-down regulation structure in China, requesting this level of government subsidy may require much effort in advocacy and lobbying. Therefore, despite being a very powerful conservation tool, it is necessary to proceed with great caution.

Analysis and Result Pt. 3 (Other Recommendations and Summary)

Summarizing the above alternative analysis, here are some recommendations for future regulations and conservation strategies.

First, control the population in the protected area. As long as there is an increasing population in the region, the conflict for natural resources between wildlife and livestock will never be solved. There are three actions that could be taken: 1. Limit the immigration into the region or the movement of residents to areas reserved for wildlife; 2. Create more birth control and sex education resources so that they are accessible to local residents; 3. Generate more education opportunities to advocate emigration from this region to nearby urban areas for jobs.

Second, elaborate on the application of "One Region, One Law" and help individual nature reserves to create independent conservation plans. As evaluated in Analysis and Result Pt. 1, even though this order has been emphasized by the government, due to China's political structure, this regulation may be hard to apply in the real world. Therefore, much effort in social advocacy is needed to request the high-level provincial committee to elaborate on this law and urge them to develop an extensive application plan. It is also important to raise awareness of wildlife protection within small regional governments, such as by adding environmental protection to the political achievement of the committee.

Third, enforce strict regulations on fencing practices and fence types. Currently, there is almost no regulation on the type of fencing or the location to be fenced. The exploitation of these resources not only lead to waste, but also the casualty of many wildlife animals. For example, in sites with low or seasonal livestock use, smooth wire fences could be used instead of five-strand barbed wire fences or woven-wire fences. For example, at the Blue-eyed Nellie WMA near Anaconda, the Anaconda Gun Club, local landowner Wayne Ternes, and FWP partnered to

install a bighorn-sheep-friendly fence. Replacing old four- and five-strand barbed wire, the new fences are three-strand smooth wire that allows Bighorn sheep to hop over and duck under the fences. (Paige et. al.)

Fourth, provide more incentives for research and tracking of chiru using high-level geospatial and other digital tools. More media coverage and social advocacy could be used so that the general public can pay attention to this endangered species living on the margin of the country. With more general public awareness, there might be increasing research interest in this area and maybe one day, we can know more about chiru and understand the best practices to protect them.

Conclusion

Conservation fences can be a very effective tool to protect wildlife in anthropocentric landscapes. They have been used globally in a variety of different ways. However, without an in-depth understanding of the local ecosystem, they may create more harm than benefit in many cases.

Tibetan antelopes are a sacred species in the Tibetan Plateau region that resembles the mysterious Tibetan nomadic culture and beliefs. Due to its cultural and ecological significance as well as the fact that they migrate long distances throughout the year, we need to remain cautious when implementing conservation fencing. Many alternatives to fences used globally could be used to look for the best strategy given the uniqueness of chiru's case. Due to China's political structure, inaccessibility of the region, and lack of research interest, many approaches from the Western countries will not be able to directly apply to this case. Yet there are still four strategies that could potentially be valuable to refer to 1. Population control in protected areas; 2. Enforce and elaborate "One Region, One Law"; 3. Enforce strict regulations on fencing practices and types; 4. provide more incentives for research and tracking of chiru using high-level geospatial and other digital tools. It is our hope that many generations later, we can still hear the mythical stories of chiru roaming on the bare Tibetan Plateau.

Bibliography

Schaller, George B., Ren Junrang, and Qiu Mingjiang. "Observations on the Tibetan antelope (Pantholops hodgsoni)." Applied Animal Behaviour Science 29.1-4 (1991): 361-378.

夏霖(Xia Lin), 杨奇森(Yang Qisen). "藏羚的迁移与保护." 生物学通报 50.1 (2015): 12-15.

Hayward, Matt W., and Graham I. H. Kerley. “Fencing for Conservation: Restriction of Evolutionary Potential or a Riposte to Threatening Processes?” Biological Conservation, vol. 142, no. 1, Jan. 2009, pp. 1–13. DOI.org (Crossref), https://doi.org/10.1016/j.biocon.2008.09.022.

Schaller, George B., et al. “Observations on the Tibetan Antelope (Pantholops Hodgsoni).” Applied Animal Behaviour Science, vol. 29, no. 1–4, Feb. 1991, pp. 361–78. DOI.org (Crossref), https://doi.org/10.1016/0168-1591(91)90261-U.

Smith, Deane, et al. “Impacts of Exclusion Fencing on Target and Non‐target Fauna: A Global Review.” Biological Reviews, vol. 95, no. 6, Dec. 2020, pp. 1590–606. DOI.org (Crossref), https://doi.org/10.1111/brv.12631.

Hardin, Garrett. "The tragedy of the commons." Thinking About the Environment. Routledge, 2015. 173-178.

Beal, Diana J. "Tourism or livestock–a policy dilemma for environmental management and poverty amelioration in Botswana." Tourism and Economic Development. Routledge, 2017. 150-159.

Harrington, Justin L., and Michael R. Conover. "Characteristics of ungulate behavior and mortality associated with wire fences." Wildlife Society Bulletin 34.5 (2006): 1295-1305.

达瓦次仁(Dawa Ciren). 西藏羌塘地区草场管理模式与围栏建设对野生动物和自然保护区的影响. Diss. 2009

徐志高(Xu Zhigao), et al. "西藏羌塘自然保护区野生动物保护与牧业生产的冲突及对策." 中南林业调查规划 1 (2010): 33-37

Reid, Robin S., Philip K. Thornton, and Russell L. Kruska. "Loss and fragmentation of habitat for pastoral people and wildlife in East Africa: concepts and issues." African Journal of Range and Forage Science 21.3 (2004): 171-181.

Fox, Joseph L., Kelsang Dhondup, and Tsechoe Dorji. "Tibetan antelope Pantholops hodgsonii conservation and new rangeland management policies in the western Chang Tang Nature Reserve, Tibet: is fencing creating an impasse?." Oryx 43.2 (2009): 183-190.

颜士鹏(Yan Shipeng), 骆颖(Luo Ying). "国家级自然保护区 “一区一法” 立法模式的理论分析." 世界林业研究 20.5 (2007): 68-72.

Beier, Paul, and Steve Loe. "In my experience: a checklist for evaluating impacts to wildlife movement corridors." Wildlife Society Bulletin (1973-2006) 20.4 (1992): 434-440.

Xu, Wenjing, et al. "Fencing amplifies individual differences in movement with implications on survival for two migratory ungulates." Journal of Animal Ecology (2023).

Langpap, Christian. "Conservation of endangered species: Can incentives work for private landowners?." Ecological economics 57.4 (2006): 558-572.

Fishburn, Isla S., et al. "The growth of easements as a conservation tool." PloS one 4.3 (2009): e4996.

Paige, Christine, and M. T. Stevensville. "A landowner’s guide to wildlife friendly fences." Landowner/Wildlife Resource Program, Montana Fish, Wildlife and Parks, Helena, MT (2008).