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Biodiversity Conservation and Pastoralism in the Tibetan Chang Tang; coexistence or conflict?

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Abstract:

The western Tibetan plateau is currently undergoing the initiation of substantial changes in rangeland management associated with China's drive to develop the western provinces and new land tenure arrangements for pastoralists under the "household responsibility system". However, this same region of high plateau, encompassing parts of western Qinghai, western Tibet Autonomous Region (TAR) and the far south of Xinjiang Autonomous Region, has also seen the recent creation of a number of large nature reserves, covering almost 70% of the high northern Tibetan plateau, called the Chang Tang region. Biodiversity conservation here is focussed on large mammal species such as the Tibetan antelope, wild yak and other herbivores, some of which have seen dramatic reductions in their populations over the past century. Large-scale efforts have been initiated to deter hunting, but the effects of this activity on livelihoods of some of the northernmost pastoralist communities are little-noticed or appreciated. More significant in the long term, however, is that although Tibet's nomadic herders have coexisted with the various wild species for centuries, current development efforts on the plateau to modernize livestock husbandry will lessen the potential for maintenance of current wild populations, and their unique attributes such as the large-scale migratory behaviour of some of these wild species. We focus on an area with pastoralists and abundant wildlife at the northern limit of human habitation in the western Chang Tang Nature Reserve, where the same development interventions as on the rest of the plateau appear to be in conflict with conservation goals. Although some accommodations between human and wildlife interests are possible, as in other pastoral regions of the world, the mixing of wild and domestic large herbivores can be very problematic, and in such instances the maintenance of modern versions of traditional management regimes is often best. How development and nature reserve conservation efforts interact to affect both ecosystem attributes and local livelihoods will constitute formative policy issues in the Chang Tang for the foreseeable future.

Introduction

China has recently placed increased emphasis on development of the far western provinces (Lai 2002), including those regions lying on the high western Tibetan Plateau. Although still small when compared to overall investment in infrastructure and the agricultural sector, funds are becoming available to enhance the living standard and production of the plateau's pastoralist society. And this development is associated with new land tenure contracts,

division of grazing areas and the fenced enclosure of various private or community grazing units. As outlined below, these changes have been gradually introduced to the Tibetan plateau, beginning mostly in the 1990s, and are just now reaching its more remote western parts such as the high Chang Tang region. At the same time, however, and also primarily within the past two decades, a number of large nature reserves have been designated on this same high western plateau, with the goal of conserving biodiversity, and focusing on the community of large wild herbivores and their predators native to the plateau. Traditional pastoralism and high plains wildlife have coexisted in the sparsely inhabited regions of western Tibet for centuries, but current development and conservation policies appear to be on a collision course if the desire is to continue that coexistence in the large designated conservation areas in the west.

Through a review of literature, we place the changes reported here for the Chang Tang within the context of development across the entire Tibetan Plateau. The results presented here are based on interviews with staff and written records obtained from the TAR Forestry Bureau, Gertse County government, and officials and nomad families of Shenchen Township in Gertse County and Dongru Township in Rutok County, both within Ngari Prefecture. It is part of a multidisciplinary research project on wildlife conservation and pastoralism in the Chang Tang Nature Reserve (Fox and Yangzom 2005).

Development of Pastoral Areas on the Tibetan Plateau

Following the commune system, initial changes associated with the new “household responsibility system”, first introduced in the early 1980’s (Oi 1999, Miller 2005), have already been applied throughout western China in the form of reallocation of livestock to household private ownership. New Grassland Law policy directives to also allocate grazing rights on specific parcels of land to pastoral households (with 30-70 year renewable lease contracts) were also initiated in some areas, such as Inner Mongolia, in the mid 1980s, but did not reach the eastern Tibetan plateau rangelands in Qinghai, Gansu and Sichuan until the mid to late 1990’s (Yan et al. 2005). Fencing of communal grazing land had been first introduced during the commune period, but was expanded with the new allocation policies. The primary rationales for these new policies are to counteract the degradation and desertification of rangelands, prevent economic disparity among pastoralist households, and to avoid a “tragedy of the commons”.

The new grassland management policy has been more slowly applied to the drier Tibet Autonomous Region (TAR), where larger grazing areas are required per unit livestock, and fencing is thus more expensive, and it is striking what variety of applications of the policy are being used. After 2000, in many areas of the eastern and central TAR, at least winter grazing parcels started to be allocated to households, with widely varying formulas for allocation (Yan et al. 2005), but grazing contracts were often made with groups of herders (Miller 2005, Richard et al. 2006). The accompanying fencing has primarily been of communal winter pasture, which protects the resource for winter use (Richard et al. 2006). There has been considerable discussion from both Chinese and western rangeland management professionals and academics regarding the efficacy of ongoing rangeland division and enclosure in managing livestock and in reversing the land degradation it is supposed to accomplish, with generally mixed reviews over its entire area of application (Bauer 2005, Miller 2005, Richard et al. 2006, Yan et al. 2005). The group-grazing interpretation of the policy is considered more ecologically sound especially in the drier rangelands of the west (Banks 2003, Banks et al. 2003, Richard et al. 2006) and appears to still be the norm in the TAR, although some of the more productive areas have seen household units fenced. A third stage of household

responsibility system implementation, following the livestock privatisation and grazing land allocation/fencing initiatives, is that the grassland carrying capacity is estimated and thus limits to the number of livestock are set (Yan et al. 2005).

Up until quite recently, the more remote parts of the Tibetan plateau, including much of the far west, had been left to traditional communal grazing arrangements, with no household land allocation or fencing. But the next stages of the household responsibility system have now come to high western plateau, and there are two important differences between the western and eastern plateau that must be noted. One is that the western plateau has much less and more unpredictable precipitation, and thus the setting of rigid carrying capacity figures may not be reasonable. The other is that there are still some areas in the west that have very abundant wildlife populations, that are affected by fencing and that need to be incorporated into carrying capacities estimations to achieve conservation goals. Nevertheless, household grazing land allocations and carrying capacities are being set, and even if the grazing contracts are only to groups or communities, with the funds now becoming available for the fencing of these divisions, the effects on wildlife movement behaviour and populations are likely to be substantial. Furthermore, fencing within the TAR is being highly subsidized by government (Bauer 2005), and is likely to proliferate swiftly.

To date, where grazing allocation and fencing policies have been discussed in terms of their value to livestock production and appropriateness in the western rangelands (Banks et al. 2003, Miller 2005, Richard et al. 2006, Yan et al 2005), this is generally limited to areas where wildlife was not abundant when the fencing was introduced. Effects on wildlife have thus not been discussed, except in the sense that application of the same policies inside and outside reserves need to be different (e.g., Fox and Tsering 2005). The grazing allocation policy application, consequent fencing and application of carrying capacity to determine livestock limits have now come to the areas of abundant wildlife in western Tibet, inside the reserves, and in this paper we focus on one location where this is happening, the Aru Basin, at the northern limit of human habitation in Ngari Prefecture (Fig. 1). But first we review a brief history of human wildlife interaction and conservation initiatives on the western plateau.



Figure 1. Nomad herder's camp at about 5,000 m elevation in the northern Aru Basin, Rutok County, Ngari Prefecture, within the Chang Tang Nature Reserve on the western Tibetan plateau.

Conservation initiatives on the Chang Tang plateau

The large mammals of special conservation interest on the Tibetan plateau include the wild yak *Bos grunniens*, Tibetan wild ass or kiang *Equus kiang*, blue sheep *Pseudois nayaur*, Tibetan argali *Ovis ammon hodgsoni*, Tibetan gazelle *Procapra picticaudata* and Tibetan antelope *Pantholops hodgsoni*, wild species that generally depend on the same kinds of food sources as the domestic livestock herded on the plateau. Populations of some of these species have been eliminated or reduced over much of their former range to the point that they are today considered threatened or endangered species. Province level Forestry or Environmental Protection Bureaus have instigated the formal designation of nature reserves in the Chang Tang region, and several areas now have national level status, the large Chang Tang reserve in the TAR, for example, obtaining national status in 2001. Two large nature reserves in the TAR (Chang Tang and Siling Co) and two small ones cover over 400,000 km², one in Qinghai (Kekexili) is about 50,000 km² and two in Xinjiang (Arjin Shan and Mid-Kunlun) encompass around 80,000 km² (Fig. 2). If additional proposed reserves, one each in Qinghai and Xinjiang, and three in the TAR (Fig. 2) are realized then a total of some 550,000 km² of the high plateau will be included in some type of protected area. This is nearly 70% of what is considered the Chang Tang region, a contiguous area of the western Tibetan plateau averaging over 4,500 m in elevation. Admittedly, these are areas of low productivity, some parts are uninhabited, and most have a very low human population density, but we are still dealing with nearly 150,000 people and over 8,000,000 livestock.

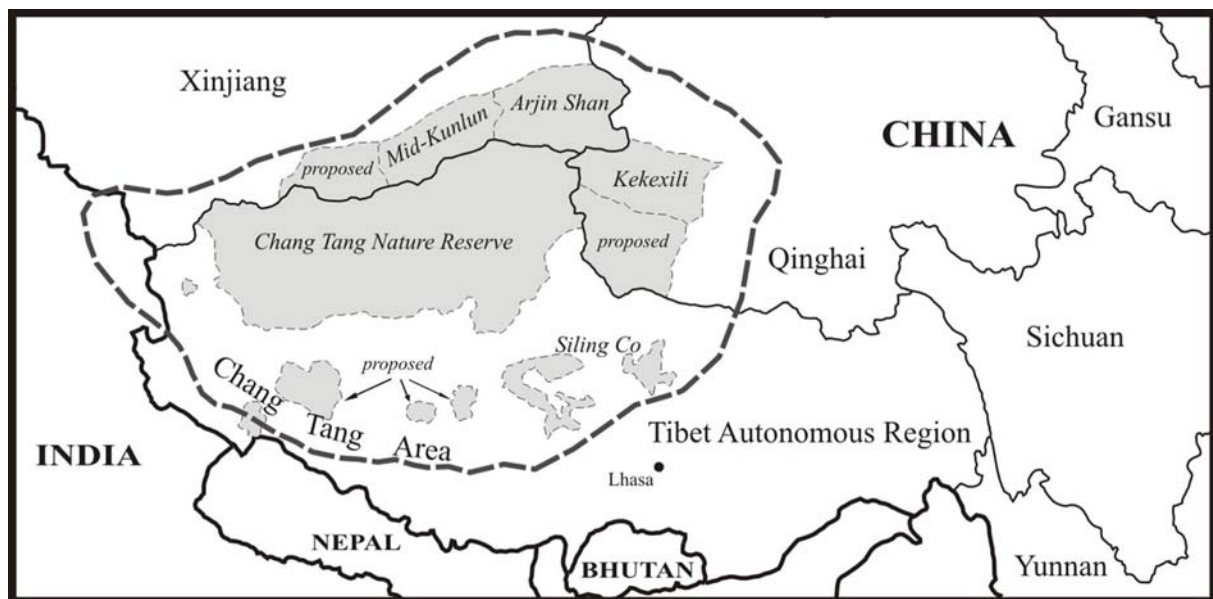


Figure 2. The Chang Tang (thick dashed line), a contiguous area of the western Tibetan plateau averaging over 4,500 m elevation, showing the location of designated and proposed protected areas within this region. Adapted from TARFB (2005) and Ridgeway (2003).

The conservation initiatives are supported by national and international concern regarding the protection a various flagship species such as the Tibetan antelope, wild yak and snow leopard, and involve input from international organizations such as the Wildlife Conservation Society and the World Wildlife Fund. The Tibetan antelope, for example, apparently decreased in number from over a million individuals to less than 100,000 over the past century (Schaller 2000). Much of this decimation has occurred in recent decades as organized hunting aimed at

procuring the animal's valuable underwool (known as "shahtoosh") to feed demand for very fine shawls and other garments (Kumar and Wright 1998). Efforts to stem this trade have had some success, and if the hunting is curtailed, recovery and maintenance of the antelope population will now depend on rangeland development policies that recognize its needs, for livestock grazing exploitation of its habitat is increasing. Wild yaks have suffered a similar fate, with hunting and usurpation of their habitat by livestock having reduced the overall population to less than 10,000 individuals (Schaller and Liu 1996).

An historical perspective - Looking back over the period of human presence in western Tibet, we see differences in the degree of human exploitation in the Chang Tang region, with the far northern areas being the least utilized. In fact the term Chang Tang itself, referring to the empty northern spaces, connotes the remoteness of the northern areas, although the physical area deserving such a name has diminished over time. The existence of a well-developed pre-Buddhist "Zangzong" culture in the central Chang Tang, with remnants described by Bellezza (1997), indicates a long history of exploitation of the large lakes region (see Fig. 2). In contrast, the area well to the north of the current east-west road through Nyima and Gertse (north of 33° N) was apparently only sparsely inhabited by hunter-herders until the 18th century, and then only lightly settled by immigrant groups from Amdo and Kham (Fox and Tsering 2005, Huber 2005). Explorers who travelled through this northern area in the late 1800s and early 1900s wrote about people with livestock, but who depended greatly on hunting (Hedin 1909), but they also described an area with very abundant wildlife (Deasy 1901, Bower 1894).

Thus, whereas over much of the south and central Chang Tang wildlife populations were reduced in the past, presumably in association with human activity, it is only along the northern limits of human habitation where very abundant populations of the plains species of antelope, gazelle, kiang and wild yak still exist. This is a relatively small portion of the Chang Tang, and therefore the concerns discussed in this paper refer to a relatively small segment of the pastoralist population in the Chang Tang. And the Aru Basin area is thus one small area (2,300 km²) representative of this juxtaposition of pastoralism within the realm of abundant wildlife.

Conservation and livestock development: a case study in the western Chang Tang Nature Reserve

Rutok and Gertse counties – These two counties (Fig.3) are the northernmost counties in the western TAR, in Ngari Prefecture. They encompass very large areas, about 130,000 km² and 68,000 km² respectively, with both extending north to the border with Xinjiang. About 70% of Gertse County and 50% of Rutok county are within the Chang Tang Nature Reserve, although the northern half of the reserve (above ca. 34° 30' N) lies within the very high and relatively unproductive Alpine Desert vegetation zone, and remains uninhabited. The northern inhabited areas are known to have experienced substantial increases in settlement and population expansion for the past 50 years, and although the history is somewhat different between Ngari and Nakchu prefectures (Fox and Tsering 2005), we focus here on Ngari. Using Gertse County as an example, the human population has increased from about 8,000 in 1977 to 18,000 in 2005, and livestock from about 450,000 in 1970 to 900,000 by 2005 (source: Gertse County government records). This has meant expanded use of rangelands, including new areas in the north, and beginning in the 1980s the construction of houses, primarily for winter use, for the pastoralists.

Following the commune period when some of the northernmost herders were made to stay closer to administrative centers, once livestock ownership was returned to individual households, there was somewhat greater freedom in the north to return and utilize former grazing areas. Furthermore, there appears to have been recognition by county leaders that human and livestock physical presence could lead to a strengthening of jurisdictional claims, and people were encouraged to move north. During the 1990's a commission was established to revise administrative boundaries in the northern Chang Tang Region, based on human and livestock populations (Dawa Tsering, Dondhup Lhagyal, TASS, pers. comm.), and other political considerations, and new spatial designations were put in place around 1999-2000 (Fig. 3).

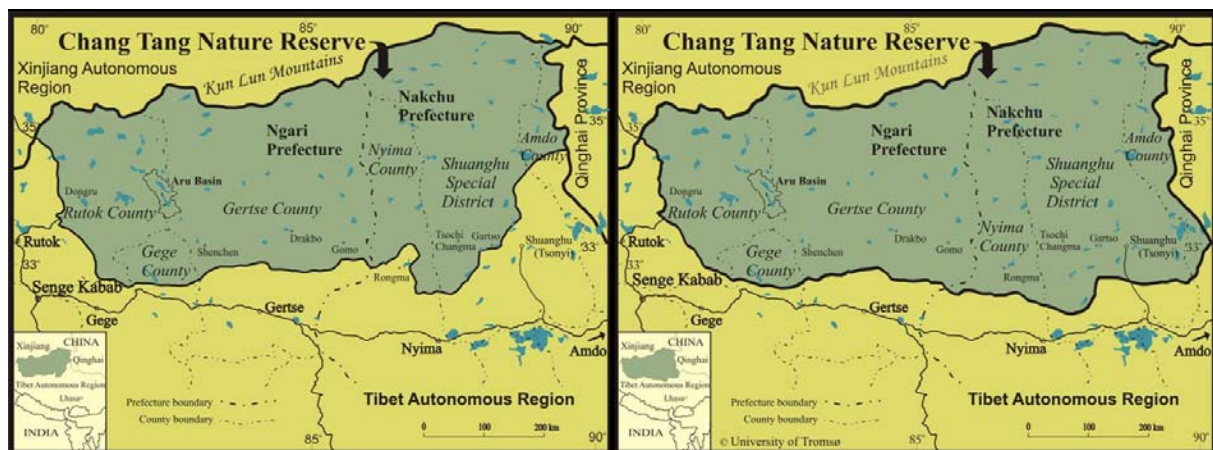


Figure 3. The Chang Tang Nature Reserve and surrounding region, showing county and prefecture boundaries from 2005 maps (left) and earlier boundaries in place during the 1980s and 1990s (right). The changed reserve boundary reflects a recent Forestry Bureau map (TARFB 2005) and the earlier proposed boundary (TARFB 1998). The Aru Basin study area is shown in the west-central portion of the reserve.

The jurisdictional revisions have northern Gertse County increasing dramatically in size, to the loss of Nakchu Prefecture, Nyima County¹ (Fig. 3). In 2002 Nyima county officials also resettled some nomads into the northern areas (Fox and Tsering 2005) bordering Gertse County, possibly to strengthen their remaining boundary claims along that front. Within the Aru Basin itself, the northern half has shifted jurisdiction from Gertse County to Rutok County (Fig. 3), presumably as a consequence of the return of Rutok County residents to that area. Apparently, residents from Rutok County, moved to more southern areas during the commune period in the 1970's associated with cultural revolution imperatives to more easily administer communities, were sent back to an area just west of the Aru Basin and within the northern part of that basin in the late 1980's (Fox and Tsering 2005, Næss et al 2004). Their return was probably related to these boundary issues, and there are still Rutok vs. Gertse county grazing boundary disagreements within the Aru Basin, with re-negotiations continuing into 2006.

¹ But this relates to a long-standing jurisdictional dispute between the present Ngari and Nakchu Prefectures, for in the past Gertse district was much larger and regained some if its influence once Ngari was returned in 1980 to the TAR from its administration under Xinjiang, and boundary negotiations were reinitiated in the 1990's.

Gertse County consists of seven townships; the three northern ones, Shenchen, Drakbo and Gomo, are situated primarily within the nature reserve; their township centers are shown in Fig. 3. Within Rutok County, there is only one township represented within the reserve, Dongru (Fig. 3). In 1999, at the same time as the larger boundary revisions², Gomo Shang was formed from Drokbo, as the areal extent of Gertse County had been greatly increased in this area (Fig 3). At the same time a part of Woma Shang was divided off to create Shenchen Shang, which includes the southern portion of the Aru Basin. A new township headquarters was completed in 2004 for Shenchen Shang (Fig. 4), and in 2005 records show populations here of 1,637 pastoralists and 83,773 livestock.

The Chang Tang Nature Reserve was first designated by the TAR government in 1993 and it received national level status in 2001. Clearly, although nature reserve designation was in place, at least at the TAR level, this had little effect on county and prefecture level manoeuvring to control little-used or potential grazing lands within the reserve. In terms of reserve management activity, the primary consequence for residents has been a hunting ban, which outlaws the traditional subsistence hunting that has long taken place in this area. This is based to a large extent on the desire to deter illegal take of the Tibetan antelope for its skins, but the ban is on all wildlife and some species such as kiang, wolf and brown bear can cause substantial problems for the pastoralists. Evidence of organized hunting and trapping in northern Gertse County indicates that hunting sites (reflecting winter and spring Tibetan antelope concentrations) have moved northward, as human settlement and habitation increased (Fox and Dorji, in press). Furthermore, a traditional reliance on subsistence hunting of chiru during hard times has been made illegal by the hunting ban (Fox and Tsering 2005).



Figure 4. Shenchen Shang center. The township was established in 1999 and the walled administrative center shown here was completed in 2004.

Grazing land allocation finally came to northern Gertse County in 2005, and winter grazing areas were allocated and delineated in the southern part of Shenchen Shang during that year, and continued northward in 2006. During 2005 and 2006, large amounts of fencing material were brought into Shenchen (Fig. 5) and Drakbo shangs, with Shenchen Shang officials, for example, given directives to erect 500 km of fenceline.

² This was all part of the widespread "canceling of chu and creation of shang" administrative changes that had begun in southeastern TAR in the 1980's and reached Ngari in the late 1990's.



Figure 5. Rangeland fencing material stored temporarily in the Shenchen Shang center in 2006.

In these townships the fencing material has been used primarily to delineate township and herding group winter grazing boundaries. This has meant the construction of long fencelines across basins, ending at the mountain margins and leaving openings along roads (Fig. 6). The same degree of new fencing is not being experienced in neighboring Nyima County and Shuanghu district of Nakchu Prefecture, in the eastern part of the reserve. The apparently disparate current approaches to fencing in these northern TAR counties, including areas within the nature reserve, is apparently due to a more aggressive and better-connected Gertse County officialdom that has been able to tap into central government funds for rangeland development³. Thus, some RMB 20,000,000 (US\$ 2,500,000) has been allocated over a 3-year period for livestock development in Gertse County, primarily for house and corral construction, but also for fencing. Various factors influence the desire expressed by many locals (officials or herders) for fencing (Bauer 2005), but one not commonly heard elsewhere was the request to “fence out” the wildlife expressed by a township leader at a reserve management workshop we attended in the town of Gertse in 2002.



Figure 6. Fencing constructed in 2005 to delineate herding group grazing boundaries at ca. 4800 m elevation in the northernmost inhabited areas of Drakbo Shang, Gertse County, Ngari Prefecture, within the Chang Tang Nature Reserve.

³ This is in contrast to more southern counties in Nakchu Province that have been very successful in obtaining government animal husbandry development funds, as opposed to most counties in Ngari.

The grazing land allocations do have the potential and implied consequence of limiting further expansion of grazing into currently unused areas of the nature reserve, and when combined with carrying capacity limits this could theoretically put a cap on livestock numbers. However, the intent of local government is clearly to expand animal husbandry, both in terms of size of area and number of animals. For example, during discussions in 2005 with the leader of Drakbo Shang regarding development plans for his jurisdiction, he informed us that government rangeland carrying capacity figures from the Animal Husbandry Bureau were more than double the current livestock population of his township, and their goal was to reach this capacity (i.e., an increase in livestock from 200,000 to 400,000). The credibility of such carrying capacity figures and their applicability are questionable in this dry and probably non-equilibrium rangeland ecosystem, and need to be re-evaluated. In any case, this perception clearly discounts any role of wild herbivores within the reserve in making use of the grazing resources. In 2005, the leader of Shenchen Shang was more conversant in the reserve's conservation goals elucidated by the Forestry Bureau, but clearly his interest in township development aside from livestock husbandry was predicated on economic advantages associated with eco-tourism or, failing that, direct government aid.

The Aru Basin - This enclosed catchment (Figs. 1 and 3) encompasses a fresh and a salt water lake, which lie at about 4950 m, with surrounding mountains rising to over 6,000 m (Fox et al. 2004). As indicated above, it is an area of some contention regarding grazing rights of pastoralists from both Gertse and Rutok counties, and today the boundary runs through the approximate center of the basin, dividing it into north and south sections. It has been the subject of wildlife investigations since the late 1980s, and has been described as one of the best areas for wildlife in the Chang Tang Nature Reserve (Schaller 1998). A preliminary management plan for the Chang Tang Nature Reserve (TARFB 1998) shows the northeast section of the basin within the core wildlife area of the reserve, presumably devoid of settlements, but currently the location of most of the winter houses and grazing areas for the Rutok people are here. In 2005 there were about 145 people and 8,000 livestock using the basin during autumn/winter. With autumn/winter populations of the large wild herbivores (following the return of antelope from summer migration) estimated at over 15,000 individuals (Fox et al. 2004, unpubl. data), one can understand concerns of the pastoralists about grazing competition when the number of large wild grazing animals was much greater than of their livestock. Furthermore, populations of large predators such as wolf *Canis lupus*, brown bear *Ursus arctos*, and snow leopard *Uncia uncia* also occur within the basin, sometimes preying on livestock and, in the case of bears, occasionally damaging houses.

Around the Aru Basin, the first houses were constructed in the early 1990s, and this has progressed rapidly in recent years. In 2005 there were about 25 houses within the Aru-Memar lakes catchment area. In contrast to areas further south, the construction of corrals has not been prominent in the north, but again this has increased dramatically in recent years. Gertse County has been more forthcoming regarding investment in house and corral construction in the area, but the Rutok area is rapidly catching up in this also. During 2006 grazing land allocations began in and around the Aru Basin and the first fences within the basin went up in late 2006 (Fig. 7). Some of this fencing is associated with on-the-spot renegotiation of Rutok vs. Gertse county grazing rights and boundaries, but plans are also being made for additional fencing to divide grazing lands within township jurisdictions. These fences are beginning to cut across some of the migratory paths of the Tibetan antelope, and as the Rutok-Gertse boundary now goes across the Aru Basin, if this continues there may be serious consequences for this species as well as other wild ungulates.



Figure 7. Fencing constructed in 2006 across parts of the Aru Basin, the left photo showing the division between Gertse and Rutok Counties, and the right photo a livestock enclosure to promote the “return of pasture to grassland” but located within an antelope migration staging area in the southern basin.

Discussion

The northwest Tibetan plateau is still dominated by a large wild mammal grazing community that parallels in its uniqueness the better known Serengeti of East Africa or the migrating caribou populations of arctic North America. But within the past century immigration into the region, government efforts to see increased grazing exploitation of the rangelands, and market-induced hunting has begun to have a significant negative effect on biodiversity values in the region. And as western Tibet’s historically low density population of nomadic pastoralists continues to increase in number and modernize under the influence of international markets and China’s development policies, the development needs of these people must be addressed in association with increasing national and international efforts to conserve the unique biodiversity of the region. While it is clear that wildlife populations are still very abundant in this region, unlike anywhere else in Tibet, the effects of ongoing land use changes outlined here portend an end to the coexistence with these large wild populations.

The wildlife conservation concerns are little understood by most residents of the Chang Tang reserves, especially those who live in areas that have had abundant wildlife for centuries. And unless put strictly in terms of economic advantage, the nature reserve status of their jurisdictions are also difficult for many community leaders to fathom. The livestock development initiatives are, understandably, much better understood and appreciated. However, it must also be said that the new dictates of the “household responsibility system” have added new uncertainties for the resident pastoralists, already reacting to the loss of a legal subsistence hunting alternative, and worries of a changing climate (Yangzong 2006). Grazing allocation duration (primarily 30 to 70-year leases at present) and inheritance rights remain uncertain, but these are issues common to all pastoral and agricultural areas of China (Oi 1999). The clearest signal to the pastoralists of the Chang Tang today apparently is that these reforms come with substantial government aid in the form of investment in fencing. The concept that somehow fencing, in and of itself, will lead to increased livestock productivity for the herders is widespread, but the actual effects of fencing and the rationale for its desirability are confused (Bauer 2005). Introduction of the land tenure aspects of the “household responsibility system” to these nature reserves, which is currently underway, can have profound consequences for their use as conservation areas for the various species mentioned above. The region around our Aru Basin study area lies in a key area for wildlife in the western portion of the Chang Tang Nature Reserve, and the basin represents an important site where the different goals of development and conservation policies are likely to clash.

Both large-scale fencing and carrying capacity assessments that do not address wildlife presence and their behaviour are simply not in tandem with conservation goals.

The fencing of rangelands in western North America, for example, led to problems for native wild herbivores such as the pronghorn antelope *Antilocapra americana*. The long-distance migratory behaviour of both bison *Bison bison* and pronghorn antelope has mostly been lost due to their early population decimation and hindered movements due to fencing (Berger 2004). The long-distance migration of Tibetan antelope is an example of what is known in conservation science as a large-scale biological phenomenon. Such phenomena have disappeared in other areas, and efforts are being made today to restore similar migratory routes for the pronghorn antelope (Berger 2004). In western North America, substantial effort has been made to insure that livestock fences are as amenable as possible to wildlife movement, and the pronghorn is a major beneficiary. Whether or not similar consequences will occur for the Tibetan antelope, wild yak, kiang and other species of the high plains and hills of the Chang Tang remain to be seen, but behavioural similarities to pronghorn, bison and wild horses suggest that effects will be similar.

The areal extent of protected area designation covering nearly 70% of the high Tibetan plateau is daunting and presents clear management challenges. In practical terms, it is not feasible to manage such a large area primarily for wildlife, especially since tens of thousands of pastoralists and their livestock currently live there. Thus, it would seem that the identification and designation of some smaller zones specifically for wildlife protection, with very different policies regarding livestock development in and around such sites, would be a reasonable route to take. This would be especially important for major migratory pathways and wintering sites of the Tibetan antelope, where large-scale fencing is not desirable. Where fencing is deemed essential, making it of a kind amenable to wildlife movement within reserve areas should be a priority.

Development initiatives in the nature reserves of the western Chang Tang that address pastoralist livelihood enhancement while protecting the remaining wildlife are greatly needed. Education and new job skills for residents related to reserve management and tourism, sustainable livestock products, and rangeland management practices such as assigning carrying capacities that include wildlife and fencing that permits essential wildlife movements are some of these. As of 2006 the new livestock development actions have not as yet affected antelope populations in the west, but a cautionary note is hereby raised, and rangeland development initiatives that avoid undue impact on wildlife are needed. The experience of indigenous efforts to protect wildlife among resident communities, seen occasionally in the eastern Tibetan plateau where large wildlife is vanishing, could provide models for similar local conservation efforts in the west. Provision of education regarding conservation values, and means to establish such conservation sites can be of great value.

Recognition of the unique environmental values of the northwest Tibetan Plateau has been the basis for an international campaign to protect the Tibetan antelope, and the Chinese government has established a number of large nature reserves in the region. Development and rangeland management policies in and around these reserves will influence both the livelihoods of the pastoralist residents as well as the prospects for maintaining substantial populations of the major wildlife species, including antelope. Adapting the widespread pastoralist development paradigm to accommodate conservation goals will be a major challenge, and with the large area designated as nature reserves, will be a major management issue for the foreseeable future in this region.

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