Wildlife Hunting in Eastern Mongolia: Economic and Demographic Factors Influencing Hunting Behavior of Herding Households

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Abstract

Much of Mongolia’s rangelands are under state control and managed via traditional land use practices and are habitat for numerous wildlife species harvested for their meat and fur. Political and economic transformations that have been occurring since the early 1990’s continues to affect all aspects of Mongolian society. To cope during periods of economic hardship, many turned to harvesting wildlife resources for income and subsistence and this resulted in precipitous declines of some populations, marmots for example. Interviews with herding households in Mongolia’s eastern steppe region were conducted to better determine how wildlife resources (Mongolian gazelle, Siberian marmot, red foxes, corsac foxes, and gray wolf) are utilized and valued by herding families. Hunting, carried out by 65% of interviewees, returned an average of $103±172 dollars per household. The number of individuals hunted of any particular species during the previous year ranged widely - 46% of households hunted an average of 8±9 Mongolian gazelles (the equivalent of a small cow), 31% hunted 5±5 corsac foxes, 29% hunted 42±47 marmots, 22% hunted 3±3 red foxes, and 17% hunted 3±2 gray wolves. Differences in mean annual income between hunting and non-hunting households were similar ($1,292±1,132 vs. $1,080±1,196) however the median difference was greater ($1,009 vs $749). However, non-hunting households owned significantly more livestock than hunting households (168±183 vs. 93±92 Livestock Units), and the proportion of hunting households living below the poverty line was higher. Households that were larger or had few numbers of livestock were more likely to engage in hunting than smaller households with more livestock. Household and livestock variables were also significant predictors of a households likelihood of hunting Mongolian gazelle, Siberian marmot, and corsac fox, but not for red fox or gray wolf. Wildlife management policies will likely receive greater acceptance and compliance if subsistence hunting needs were incorporated.

Introduction

Conservation and management of wildlife resources takes place across a range of property rights systems varying from highly restricted and exclusive access on private lands to public land, which is under strictly protected status to complete and open access (Berkes, 2007; Cole & Ostrom, 2012). In landscapes managed according to communal or open access property
use rights, commonly implemented traditional land use practices include pastoralism, shifting agriculture, hunting and gathering. Where hunting is concerned, open-access harvesting of wildlife resources is recognized as a major threat to biodiversity in tropical forest and savanna ecosystems around the world, and harvesting of this nature is especially prevalent in developing nations (Redford, 1992; Milner-Gulland et al., 2003; Norton-Griffiths, 2007). In Mongolia, unoccupied rangeland is owned by the state, and where herders reside, managed through a system of formal and informal property use rights (Mearns, 1993). Wildlife resources are under state protection, but adequate enforcement across vast and empty landscapes is lacking. Recent political and economic changes have raised many questions regarding the future status of biodiversity in Mongolia's grasslands (Reading et al., 2010).

Mongolia retains the conditions that allow a vibrant pastoralist culture to exist and hunting is a part of that (Wingard & Zahler, 2006; Reading et al., 2010; Scharf et al., 2010). The political, economic, and social transformations resulting from Mongolia’s transition to a democratic system and embracement of a free market economy continue to unfold (Reading et al., 2010). The discovery and exploitation of rich oil and mineral deposits have dramatically quickened the pace of these transitions, which in turn is greatly affecting the utilization and management of wildlife resources (Reading et al., 2010; Smith, 2014).

Reported declines in Mongolia’s wildlife populations have been due to a variety of reasons, including armed conflict, the introduction of new technologies, social upheaval, and economic hardship (Hibbert, 1968; Reading et al., 1998; Wingard & Zahler, 2006). The recent surges in wildlife harvesting largely were the result of an increase in rural poverty coupled with ineffective hunting regulations and rejuvenated trade opportunities with China (Pratt et al., 2004). The economic value gained from harvesting of Mongolia’s wildlife resources, at what were most likely unsustainable rates, had been once estimated at ~$100 million annually (more than cashmere) and thus an important contributor to Mongolia’s economy (Wingard & Zahler, 2006).

Overhunting and the consequent reduction of wildlife diversity and abundance can have wide ranging ecological effects and reduce the perceived value of the land, thus increasing its vulnerability to other more intensive and destructive land use practices (Peres, 2000). Improving property use rights, aligning wildlife hunting regulations so they are logical for local people to follow, and improving enforcement capacity conducted by a wildlife management agency are believed to be necessary steps to take in order to ensure a positive future for Mongolia’s wild heritage (Wingard & Zahler, 2006; Reading et al., 2010; Scharf et al., 2010).

Efforts aimed at improving management of Mongolia’s rangeland commons have predominately been centered on pasture management and fostering community based natural resource management models through the formation of herder cooperative groups to increase their resilience to severe weather events, with some attention paid to monitoring of natural resources within designated pasture use areas (Scharf et al., 2010; Fernandez-Gimenez et al., 2015). Conservation and management efforts for Mongolia’s biodiversity have been largely focused on the establishment and management of protected areas, which currently account for slightly over 24% of the country’s territory via a combination of national and local designation (Reading et al., 2010). Grasslands, however, remain poorly represented in these formal protected areas, making up only about 2% of the area while the remaining consists of a patchwork of settlements, livestock pasture, extractive industry activities, transport networks, and open uninhabited rangeland and thus also where most of the region’s wildlife resides (Reading et al., 2010).

Wildlife use for meat and fur has been a part of rural Mongolian life through the ages and managed in piecemeal fashion partly following cultural norms regarding ethical hunting, Soviet-style controlled quota hunting system, and the sale of individual hunting licenses by environmental protection authorities for trophy hunting (Reading et al., 1998; Scharf et al., 2010). Estimating the abundance and distribution of intensively harvested populations across their range is difficult as there are few national level programs with the financial capacity and human resources available to monitor the long-term trends of these species (Reading et al., 1998, 2010).
Given Mongolia’s size, sparsely distributed rural population, and minimal resources available for enforcement of wildlife harvesting regulations, successful wildlife management must include the involvement and support of local people in natural resource conservation (Murray & Yelland, 2005; Berkes, 2007). Thus, knowledge of how wildlife resources are valued and at what scale they are harvested by local people is important information that can be used to develop appropriately targeted conservation interventions and for establishing baselines for which future change can be compared.

The aim of this work is to provide information on the prevalence of wildlife hunting by herding households in eastern Mongolia, what is earned from hunted wildlife, and the motivations for hunting. This information may prove useful in increasing understanding of the value of wildlife resources to local families and thus the potential consequences the disappearance or restriction of access to these resources may have on the lives of rural households in eastern Mongolia.

Methods

Study area. Mongolia is a large (1.57 million km²) and sparsely populated (~3 million people) country with deep ties to the land forged by a long history of nomadic livestock herding, which in turn has fostered a strong ecological and conservation ethos. The eastern steppe of Mongolia, the focal area of this effort, is the easternmost of one of the largest relatively intact grassland ecosystems in the world (Yu et al., 2004; Batsaikhan et al., 2013) (Figure 1). Evidence of hunting by humans in the region goes as far back as the Upper Paleolithic era (Germonpre & Lbova, 1996). Semi-nomadic pastoralists in their current cultural context have been grazing livestock in the region for approximately 3-4,000 years (Sneath, 1998; Gunin et al., 2000). The entire region is highly accessible via a number of roads and dirt paths, and few physical barriers to impede vehicle travel off-tracks.

Commonly hunted wildlife species in eastern Mongolia include: Mongolian gazelle (Procapra gutturosa, IUCN, Least Concern), Siberian marmot (Marmota sibirica, IUCN, Endangered), red fox (Vulpes vulpes, IUCN, Least Concern), corsac fox (Vulpes corsac, IUCN, Least Concern), and grey wolf (Canis lupus, IUCN, Least Concern) (Reading et al., 1998; Wingard & Zahler, 2006). Wild boar (Sus scrofa), moose (Alces alces), red deer (Cervus elaphus), Siberian roe deer (Capreolus pygargus), Siberian hares (Lepus tolai), as well as several species of mustelids, are present and hunted opportunistically, but in the study area they either exist in very low numbers or are only found on the fringes of the steppe (Clark et al., 2006).

Interview protocol. Household interviews were conducted across the study area between late June to the end of August 2004. Households were identified opportunistically by driving along the regions myriad of dirt tracks. In total,
we conducted interviews at 178 households throughout a study area of about 200,000 km², mostly in easternmost Dornod and Sukhbaatar aimags (Figure 1). We estimated from census data that the non-soum center (urban) population of the aimags was approximately 47,000 individuals and thus ~9,400 households (mean household size = ~5). Thus, our interviewed sample constituted approximately 1.9% of all households in the study area. We have no reason to believe that our sample was biased with respect to their representation of pastoral households living in the steppe.

The interview team consisted of three people, a driver, an assistant/interpreter, and a lead interviewer. After following the customary cultural protocols for visitors (sitting down, taking a cup of tea, discussion of local pasture and road conditions, etc...) we explained the nature of our work followed by a brief presentation with illustrations depicting the variety of ways in which wildlife in Mongolia is valued. We then asked the head of the household if they would like to take part in the study by granting an interview. We stressed that the data would remain anonymous and that our interest was to better understand how and why herding households use wildlife in the region. We did not remind the participants of the need to answer truthfully as their volunteering to take part implied they would provide accurate answers. Rather we offered potential scenarios related to future management actions arising from results obtained from under or over reporting by interviewees; e.g., over-reporting may indicate severe and unsustainable exploitation and lead to a call for hunting bans and increased enforcement while under-reporting may indicate wildlife is of minimal value and thus can be exploited by outsiders or lost without concern.

The recall period of interest was from August 2003 to August 2004; recall data obtained at an annual time scale has been shown to be a reliable way to estimate events that are spatiotemporally variable (Golden et al., 2013). During each interview, household demographics (gender and age of each household member), monetary income (sources and amount earned from each), livestock (type and numbers, sheep/goat numbers were aggregated), and hunting practices were discussed in a semi-structured manner. Our discussions were planned to reduce bias from leading questions, ambiguous questions, and cultural differences (Van de Vijver & Tanzer, 2004). To make sure that persons involved in the research were not harmed or that information would be used to harm them after the study, we followed the Principles of Professional Responsibility of the American Anthropological Association (http://ethics.aaanet.org/category/statement/; accessed 15 August 2015), and were guided by the university-authorized online training program (Collaborative Institutional Training Initiative [CITI] Program’s “Group 2 Social Behavioral and Education Research Investigators and Key Personnel”).

Interview questions were asked thru a translator (to insure the question was delivered correctly, the lead interview was not a native speaker although capable of understanding Mongolian) while responses were recorded into a notebook as the respondent answered (translation was requested from time to time). At the end of each interview, answers were reviewed with the interviewee to ensure completeness and accuracy.

Analysis. In total, data was collected from 178 households, 9 were removed from analysis because they were households that were not living year-round in the steppe or that had not been together for at least one year, or were with persons engaged in heavy drinking or who provided contradictory statements that could not be clarified. We were unable to obtain household member ages for all interviews and age was not included in predictive analysis.

Income data were originally reported in Mongolian tugriks and subsequently converted to US dollars using the average exchange rate during the recall period (1 US dollar = 1,165 Mongolian tugriks). Mixed herds are common and for comparative purposes livestock counts were standardized into Livestock Units (LU) calculated as follows: 1 cow = 1, 1 horse = 0.53 cows, 1 sheep/goat = 0.20 cows (Table 3). We calculated the value of a LU based on the animal's value relative to the cash value, as expressed in local livestock markets, of one cow during the period of interest (1 cow = $130; 1 horse = $86; 1 sheep/goat = $26). Households were considered to be hunting households if they hunted and killed at least one of the following wildlife species: Mongolian gazelle, Siberian marmot, corsac fox, red fox, or gray wolf.
Multiple logistic regression was used to test whether household hunting behavior could be determined from the socioeconomic variables for which data were collected and procedures for doing so followed Hosmer and Lemeshow (2000). Dependent variables used in the model were no hunting or hunting, and also hunting for Mongolian gazelles, Siberian marmot, red fox, corsac fox, and gray wolf. For analysis, response variables were pooled into 4 categories: 1) nontraditional income [pension, child support, and miscellaneous work] 2) traditional income [livestock, cashmere, wool, and dairy] 3) livestock wealth [excluding camels] and 4) household size. Traditional income from livestock herding was removed from analyses as the variable was collinear with livestock wealth (Pearson’s product moment correlation $>\pm 5$).

### Results

Hunting is a common activity on the eastern steppes; 65% of households responded that they hunted at least one of the species of interest. Households that hunted wildlife generally were larger (5.4 vs. 4.4, $t$: $P = 0.01$, $t$-value=-2.64), younger (median age: 24 vs. 29 years), and had fewer livestock (93 LUs vs. 168 LUs, $t$: $P = <0.01$, $t$-value=2.57) than households that did not hunt (Table 1 and Figure 2). Median annual household income (excluding income from hunting) was higher in households that declared they had not hunted ($1009) the previous year than households that did report hunting ($749) (Mann-Whitney: significant at $P = 0.15$) (Table 2). As might be expected in pastoral households, the sale of livestock made up the majority of

### Table 1. Demography of hunting ($N = 102$ for size and 93 for age) and non-hunting herding households ($N = 54$ for size and 52 for age) in eastern Mongolia interviewed between July and August 2004.

<table>
<thead>
<tr>
<th></th>
<th>Households that hunted</th>
<th></th>
<th>Households that did not hunt</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
<td>SD</td>
</tr>
<tr>
<td>Number of persons</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All</td>
<td>6</td>
<td>2</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>Males</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Females</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Age of household members</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Males</td>
<td>24</td>
<td>11</td>
<td>29</td>
<td>16</td>
</tr>
<tr>
<td>Females</td>
<td>23</td>
<td>12</td>
<td>32</td>
<td>19</td>
</tr>
</tbody>
</table>

Figure 2. Differences in livestock numbers between hunting and non-hunting households in eastern Mongolia in 2004.
income for both hunting and non-hunting households (54% and 56%). Pensions accounted for 13% of income in households that did not hunt and only 8% in households that did hunt, suggesting younger households hunted more. The total income earned from wildlife products by households that did hunt was around $100/year, but varied greatly between households (Standard Deviation =172/year per household). Herding practices with respect to mobility between summer and winter grazing areas was similar between hunters and non-hunters (19±34km versus 14±19km; pooled median distance travelled was 7 km between winter and summer pasture with a maximum distance of 180 km).

Meat hunting. Among the animals of interest, Mongolian gazelles were sought most frequently, with 46% of all households reported hunting 8±9 gazelles/year (71% of hunting households) (Table 3). The reported sex and age of harvested gazelles was 64% males, 20% females, and 1% calves; while 14% were 'unrecalled'. Households that hunted gazelles believed that an average household takes approximately 12±13 gazelles/year. Only 3% of households that hunted were under the impression that they hunted more gazelles than other households while 36% believed they hunted the same or less compared with other households. The reported price to purchase a gazelle was approximately $6 each.

Furbearers. During the previous 12 months, 29% of surveyed households had hunted 42±47 marmots per year. In 2003, households reported selling marmot skins for $4.32 each, and thus Siberian marmots were also the biggest cash earner, bringing in $181 per household that hunted marmots. Corsac foxes were hunted by 31% of all households, and prices for fox skins averaged $3.46 each. Households hunted an average of 5.2±4.9 corsac foxes/year. In contrast, 22% of households reported hunting 2.6±2.9 red foxes/year and received approximately $12.88 per skin. Gray wolves were hunted the least; only 17% of all households hunted 2.6±2.1 wolves/year the previous 12 months. However, a gray wolf skin had the highest value ($30) among furbearers.

Drivers of hunting. Livestock numbers (expressed as Livestock Units) and family size were effective predictors of household hunting behavior ($\chi^2 = 16.8, P = 0.001$); as the number

<table>
<thead>
<tr>
<th>Income source</th>
<th>Did not hunt (N=43)</th>
<th>Did hunt (N=126)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean ± SD</td>
<td>Median</td>
</tr>
<tr>
<td>Livestock/meat</td>
<td>735 ± 986</td>
<td>343</td>
</tr>
<tr>
<td>Cashmere</td>
<td>341 ± 322</td>
<td>258</td>
</tr>
<tr>
<td>Sheep wool</td>
<td>17 ± 28</td>
<td>0</td>
</tr>
<tr>
<td>Dairy products</td>
<td>1 ± 6</td>
<td>0</td>
</tr>
<tr>
<td>Non herding income</td>
<td>198 ± 209</td>
<td>103</td>
</tr>
<tr>
<td>Total</td>
<td>$1,292±1,132</td>
<td>1,080±1,196</td>
</tr>
<tr>
<td>Wildlife</td>
<td>103 ± 172</td>
<td>34</td>
</tr>
</tbody>
</table>

Table 2. Income sources and the estimated value derived from them by herding households that hunted and those that did not hunt in eastern Mongolia in 2004.

Table 3. Wildlife hunting numbers reported from household interviews carried out in eastern Mongolia and the value* obtained (102 hunted, 1 US$ = 1,165 Mn Tg).

<table>
<thead>
<tr>
<th>Species</th>
<th>Mean ± SD</th>
<th>Median</th>
<th>Max</th>
<th>% that hunted</th>
<th>Value per 1 (US $)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Siberian Marmot</td>
<td>42 ± 47</td>
<td>30</td>
<td>200</td>
<td>29</td>
<td>4.32</td>
</tr>
<tr>
<td>Mongolian gazelle</td>
<td>8 ± 9</td>
<td>5</td>
<td>50</td>
<td>46</td>
<td>6.00</td>
</tr>
<tr>
<td>Corsac fox</td>
<td>5± 5</td>
<td>3</td>
<td>20</td>
<td>31</td>
<td>3.46</td>
</tr>
<tr>
<td>Red fox</td>
<td>3 ± 3</td>
<td>2</td>
<td>15</td>
<td>22</td>
<td>12.88</td>
</tr>
<tr>
<td>Gray wolf</td>
<td>3 ± 2</td>
<td>2</td>
<td>10</td>
<td>17</td>
<td>30.00</td>
</tr>
</tbody>
</table>

*Wildlife value was determined from the reported price that households received for each species.
of livestock owned decreased and family size increased, a household was more likely to hunt (Table 4). Livestock numbers were effective at predicting Mongolian gazelle and Siberian marmot hunting ($\chi^2 = 11.03$, $P = 0.01$; $\chi^2 = 23.4$, $P < 0.001$); as livestock numbers decreased, the likelihood of hunting a gazelle or a marmot increased. Household size was more effective at predicting corsac fox hunting ($\chi^2 = 10.1$, $P = 0.02$), larger households were more likely to hunt corsac foxes. These variables were less effective at predicting household hunting of red fox and grey wolf. Income from non-traditional sources was not an important contributor in predicting hunting behavior in general or for individual species.

**Discussion**

**Household hunting prevalence.** Our data show that hunting is a common (65%) among herding households in eastern Mongolia, especially among herders with the lowest livestock numbers; the proportion of the herding community which hunts is also substantially higher than the national prevalence of 11% for hunting reported by Wingard and Zahler (2006). Scharf et al. (2010) reported hunting prevalence of 47% of the herding population being 'herder-hunters' throughout the eastern steppes and as many as 59% of the herders in some areas. The increase may be evidence that more and more households had turned to hunting as a livelihood necessity or households increasingly took advantage of the effectively open access nature of wildlife resources before they disappear in a tragedy of the commons scenario (Hardin, 1968).

Scharf and Enkhbold (2002) reported that two-thirds of 'herder-hunters' hunted Mongolian gazelles, similar to the 71% of 'herder-hunters' during this study period (2004–2005). The numbers hunted also remain relatively constant; Reading et al. (1998) reported herders hunting an average of 8 gazelles/year, while Wingard and Zahler (2006) reported an average hunter taking 5.2 gazelles/year. Although Wingard and Zahler (2006) found that Mongolian gazelle hunters made up just 5% of the national hunting population, households living in the core of a species range would be expected to hunt that particular species with greater frequency.

Marmot hunting decreased dramatically from 'nearly all' households in 2002 (Townsend & Zahler, 2006) to just 29% of all households and 45% of households that hunted in 2004/2005. The differences in Siberian marmot hunting prevalence observed could be taken as another signal of population decrease which, although occurring steadily over decades, had effectively collapse due to intensive hunting which occurred in the late 1990's and early 2000's (Townsend & Zahler, 2006). During the data collection period, a ban on marmot hunting was in its first season of implementation. This seemed to come with little enforcement as freshly hunted marmot skins were often observed being prepared and fresh marmot meat was commonly offered while conducting interviews. Although it may have had an impact on the percentage of households that hunted marmots, our data suggest that for households that depended on marmots as a resource (i.e. those with less livestock), hunting still continued and households were willing to share that information.

Wolf hunting was not as prevalent (17% of households) as might be expected. Wolf hunting

| Table 4. Importance of nontraditional income, livestock wealth, and household size variables in predicting household hunting behavior using multiple logistic regression. |
|Predictor (Coefficient ± SE) |
| All hunting | 0.593±0.49 | -0.0002±0.01 | 0.7 | -0.06±0.02 | <0.001 | 0.227±0.09 | 0.01 | 16.8 | 0.001 |
| P. gutturosa | 0.009±0.43 | -0.0004±0.0005 | 0.43 | -0.003±0.19 | 0.01 | 0.129±0.075 | 0.077 | 11.03 | 0.01 |
| M. Siberica | -0.414±0.485 | -0.00075±0.0006 | 0.20 | -0.01069±0.003 | <0.0001 | 0.108±0.077 | 0.16 | 23.4 | <0.0001 |
| V. corsac | -1.30±0.45 | -0.0008±0.0006 | 0.16 | -0.00282±0.002 | 0.06 | 0.1818±0.075 | <0.01 | 10.1 | 0.018 |
| V. vulpes | -0.868±0.501 | -0.001054±0.0007 | 0.13 | -0.004±0.002 | 0.03 | 0.044±0.08 | 0.59 | 6.8 | 0.08 |
| C. lupus | -0.453±0.55 | -0.00119±0.0009 | 0.15 | 0.00085±0.0015 | 0.57 | -0.177±0.103 | 0.07 | 6.6 | 0.08 |
tends to be a pastime with a bonus of being profitable carried out by well-equipped hunters from urban regions. Pastoral households are not as well positioned to hunt wolves *en masse* as urban hunters (with 4-wheel-drive vehicles) are, and perhaps have a more conservation-oriented ethos in favor of wolves than their urban compatriots. Only 2 of 26 (8%) households that reported hunting wolves hunted them exclusively, and these households owned 194 LUs each, nearly 3 times that of the average household that hunted (69 LUs). Additionally, herders are less in a position to profit fully from the reported $300-350 dollars a wolf fetches at the market and reported only receiving approximately $30 dollars/wolf (Wingard & Zahler, 2006). Still, 36% of households (35 of 97) reported livestock losses due to wolves. For the 11% of households we interviewed that had lost livestock to wolves, this amounted to 4±3 sheep/goats (29 households), < 1±2 horses (7 households), < 1±1 cows (5 households) (~$139 per year). The loss represented less than 2% of the livestock these families owned. Many respondents noted that loss of livestock to wolves was generally low or was not common because the region had plenty of gazelles for wolves to eat.

Wingard and Zahler (2006) reported higher pelts prices for corsac fox pelts ($28 versus $3.46 in this study) and nearly double the amount harvested (10.2 versus 5.2), but a lower rate of corsac fox hunting (12% versus 31%). The trend is similar for red foxes, with pelt prices less ($18 versus $12.88) and harvest down (4.7 versus 2.6) in our study. The increased rate of fox hunting suggests that, despite low prices and perhaps lower numbers, fox hunting was a worthwhile activity.

**Socioeconomic factors and hunting.** Larger households with less livestock were significantly more likely than smaller households with a large number of livestock to hunt all, but red fox and wolves.

The Minimum Poverty Line (MPL) for Eastern Mongolia during the interview period was $17.50 per person per month ($210/Year) (http://www.nso.mn). Herders, in general, had higher poverty rates than the overall population (36% nationally), and it was highest for households, which hunted in eastern Mongolia; 47% percent of non-hunting households were living below the MPL versus 60% for households that hunted. Wildlife does have a notable contribute to total household income (~9% of total income for hunting households), but wildlife related income does not bump households above the MPL as only 2% of households dropped below the poverty line after excluding wildlife.

However, additional income from wildlife may be important in helping to reduce the severity of their poverty. When examining the income of households that had wildlife income above the overall average for all hunters, thirty-four percent of these households were living below the MPL. Earnings from wildlife made up 41±29% of these households total annual income. For these households, wildlife is likely a very important resource; additionally, the access to Mongolian gazelle as a source of protein and alternative to eating one of their own livestock or purchasing meat.

Why don't all of poor families hunt? It is possible that some of the poorest families have no opportunity to hunt because they do not own a gun or the cost of purchasing traps is too high, and are thus unable to take advantage of this resource. Some poor households are either unskilled at hunting, physically disabled, elderly or simply chose not to hunt. Elderly households with few livestock may be more inclined to purchase gazelles from poachers engaged in small market hunting for sale in village and town centers.

Many households responded that they hunted gazelles for food to reduce the demand on harvesting their own livestock for food, which allows them to increase their herd size and thus wealth. Having a greater number of livestock increases food security and the ability to generate income from livestock sales and livestock products. This would eventually lead to a decrease in hunting as households improve their food and income security.

Socioeconomic variables may not play a role at all in some instances. Mongolian gazelles are a nomadic species and their presence at a particular location during hunting seasons is not predictable (e.g. Olson *et al.*, 2010). Households may not hunt in some years only because of a lack of opportunity. Siberian marmots live in colonies, which are patchily distributed across the steppes and not all households have equal access to marmot colonies. This is reflected
in the overall low percentage of households hunting marmots, but the high harvest levels and income earned for the households that did hunt marmots. Corsac and red foxes, although widely distributed, may also not be present in the areas where some poor households are living.

Authorities in Mongolia often respond to a perceived crisis in wildlife populations by instituting blanket bans on wildlife harvesting until the population is believed to have rebounded. This command and control style of wildlife management is harmful to one of the most vulnerable groups in Mongolia – poor rural households – whom likely continue hunting until they are caught. These bans cannot be effectively enforced as the territory wildlife law enforcement agents have within their jurisdiction is overwhelmingly large and households living far from urban administrative centers have little incentive to comply. In landscapes where hunting wildlife is a part of the local culture, used for subsistence, or as a means of generating income, conservation programs, which discourage hunting and encourage increased law enforcement may be ineffective or counterproductive and result in a lost opportunity to gain the support of local communities. The economic importance of wildlife to rural households need to be realized, and the state must also recognize the value gained in developing sound management policies that enhance the livelihoods of its citizens; without both there will be no incentive to adopt conservation measures (Gibson & Marks, 1995).

A wildlife management program that does not exclude participation by local people and is able to effectively assess wildlife population trends and develop and enforce harvesting regulations is sorely needed.

Acknowledgements

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