CHAPTER 4: NORTH TIEN SHAN CASE STUDY

4.1 Introduction

In the absence of a pre-existing dataset against which to test the generic bioeconomic model, a case study is developed concerning the hunting of Asiatic Ibex, *Capra sibirica*, in the North Tien Shan (NTS) mountain range along the Kazakh-Kyrgyz border. The aim in doing so is to test not only whether the model is able to predict the outcome of hunting, but whether its use as such is likely to be practicable under conditions typical for developing world conservation scenarios.

Whilst data were available to parameterise the bioeconomic model, testing dynamic outcomes against real events would necessitate many years of data from the system. The approach adopted was therefore to develop a complex simulation model for the NTS case study, and to test the predictions of the simple generic model, henceforth referred to as the Supply-and-Demand (S&D) model, against this. Hence the model is not tested against actual events in the NTS, but rather against a complex set of dynamic processes which are considered to be appropriate and credible for the hunting of ibex in the NTS, if not necessarily accurate for it.

The current chapter gives context to the case study, introducing the study region, describing why it is an appropriate choice, and detailing what is understood about the conditions and causes of hunting. Chapter 5 details the development of the simulation model. Chapter 6 covers the implementation of a stochastic form of the generic bioeconomic model for the NTS, and compares the behaviour of this S&D model to that of the simulation under assumptions of differing amounts of knowledge of the system. It also examines the effects of variation in some of the parameters which are assumed identical in both the simulation and S&D models. Chapter 7 broadens the bioeconomic approach by using it to explore a general incentive-based framework for developing and analysing conservation management options, and attempts a simple case study based on circumstances in the NTS.

4.2 Background to conservation and hunting in Central Asia

Ex-Soviet Central Asia comprises 5 states – Kazakhstan, Kyrgyzstan, Tadjikistan, Turkmenistan and Uzbekistan – and covers an area of around 3.9 million km^2, sandwiched between Russia, the Middle East, the Indian subcontinent and China. The human population is somewhat over 50 million, giving a relatively low average population density, especially in comparison to many other parts of Asia. Naturally, the population is not evenly distributed; fertile areas along river plains, are densely populated, but large areas of high mountains, steppe and desert are very sparsely so. The relative size of these uncultivated areas varies between the republics, such that average national population densities vary by an order of magnitude, between 5.89 people km^{-2} in Kazakhstan and 52.4 in Uzbekistan, according to 1998 figures (UN 1998). Largely due to the extreme continental climate, Central Asian

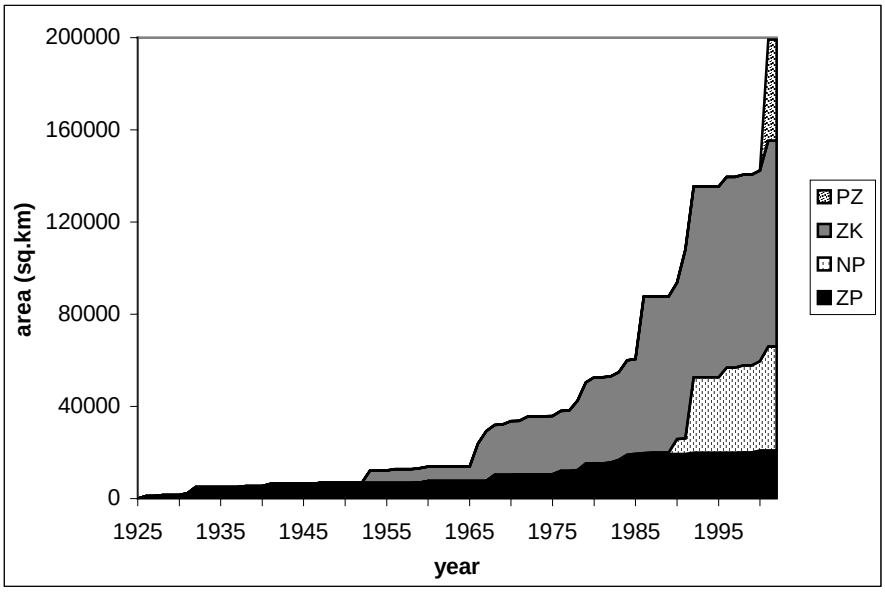
ecosystems are not particularly biodiverse by global standards, although the combination of a confluence of biogeographical regions and numerous mountain ranges do provide considerable diversity by temperate standards. The bird lists for the republics, which total from around 350 to 500 species, are roughly half the size of those that could be expected from tropical Asian countries of a similar size. The republics have retained most of their megafauna, however, and due to their biogeographical setting and large areas of open habitat, they contain important populations of several gregarious species of the Bovidae.

From the start of the soviet period, an emphasis was placed on harnessing nature for maximum productive effect, in line with communist ideology; 'Nature taken abstractly, for itself, and fixedly isolated from man, is nothing for man.' (Marx, quoted in Ponting 1991). Soviet agricultural programs led to ploughing of large areas of steppe from the 60s onwards, and devastation of many rivers and water bodies through irrigation, most famously the Aral Sea. Industrial and military developments brought numerous examples of severe local environmental degradation. Low rainfall over much of the region inhibits forest growth and limits natural cover mostly to those areas that also have high agricultural value. Following the intensification of agriculture and the settlement of previous nomadic tribes, deforestation has been pronounced, and pressure has been particularly intense on the tugai gallery forests of low altitude river plains (e.g. Kyrgyz Republic 1998; Republic of Kazakhstan 1999; Savvataev 2000). But the fact that the human population remained low over vast regions allowed the persistence of large areas of essentially natural habitat. Few of these areas were pristine; typically grass- and scrublands were intensively used by graziers, and the steppe was dissected by wildlife barriers such as fencing, roads and pipelines, but outright habitat loss has been less of a problem in Central Asia than in many other parts of the continent.

Moreover, the soviet ideal of controlling nature was not entirely negative, resulting over time in an extensive system of protected areas. The first reserves in Central Asia were local *zakazniks*, which were established as hunting territories, but the origins of the state PA systems were in 1926 with the establishment of the first *zapovedniks* – strict nature reserves, set aside for the conservation of ecosystems and to provide opportunities for scientific research. State-level *zakazniks* did not emerge until later. These were created with more of an emphasis on conservation than local *zakazniks*, but they retained extractive resource use as an integral component (Bykov and Kovshar 1982).

The area under state protection grew steadily until the late 1980s. The greatest period of growth came between the late 80s and early 90s, when an expansion in the Kazakh system of PAs was followed closely by the dissolution of the Soviet Union (fig 4-1a). Independence brought vast expansions in the PA systems of Uzbekistan and Tajikistan, as the newly independent states required their own systems of PAs. Political changes were also reflected in the nature of the protected areas; national parks were established, incorporating new considerations of recreation and environmental education, and representing both a move towards international norms and a democratization of PAs.

a.



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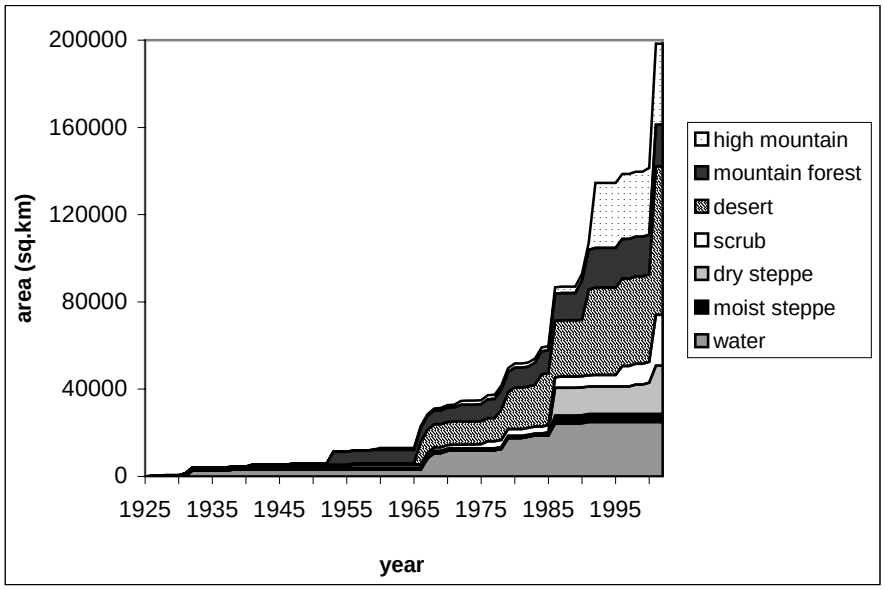


Fig 4-1. Growth in area (km^2) of the Central Asian Protected Areas system over time; by type of area (a), and predominant habitat type (b). PA class codes: PZ – Prohibited Zone, ZK – Zakaznik, NP – National Park, ZP – Zapovednik. 'Water' refers not only to aquatic habitats themselves, but also to associated dependant terrestrial habitats, such as gallery forest. Plots are based on the year of establishment and current area of nationally gazetted PAs, except for a small number of cases for which the specifics of post-establishment changes in area were known, and hence represent the growth of the current system rather than the size of the system at any point in time. Figures are taken from data collected under INTAS project no. 99-1493, 'Correlates of Extinction Risk for Central Asian Biodiversity', and supplemented by data from Myrzabekov (2000) for Kazakhstan. No data were available from Kyrgyzstan. Classification of PAs by ecosystem type was based on point locations and ecosystem types in the INTAS GIS. For large PAs, likely to encompass several ecosystem types, a subjective judgement had to be made as to the predominant type, usually assisted by descriptions of the primary habitat type the PA was established to protect. The two largest Prohibited Zones are 1-2 orders of magnitude larger than the next biggest PAs, and their areas were divided between the two predominant ecosystem types in the regions where they occurred.

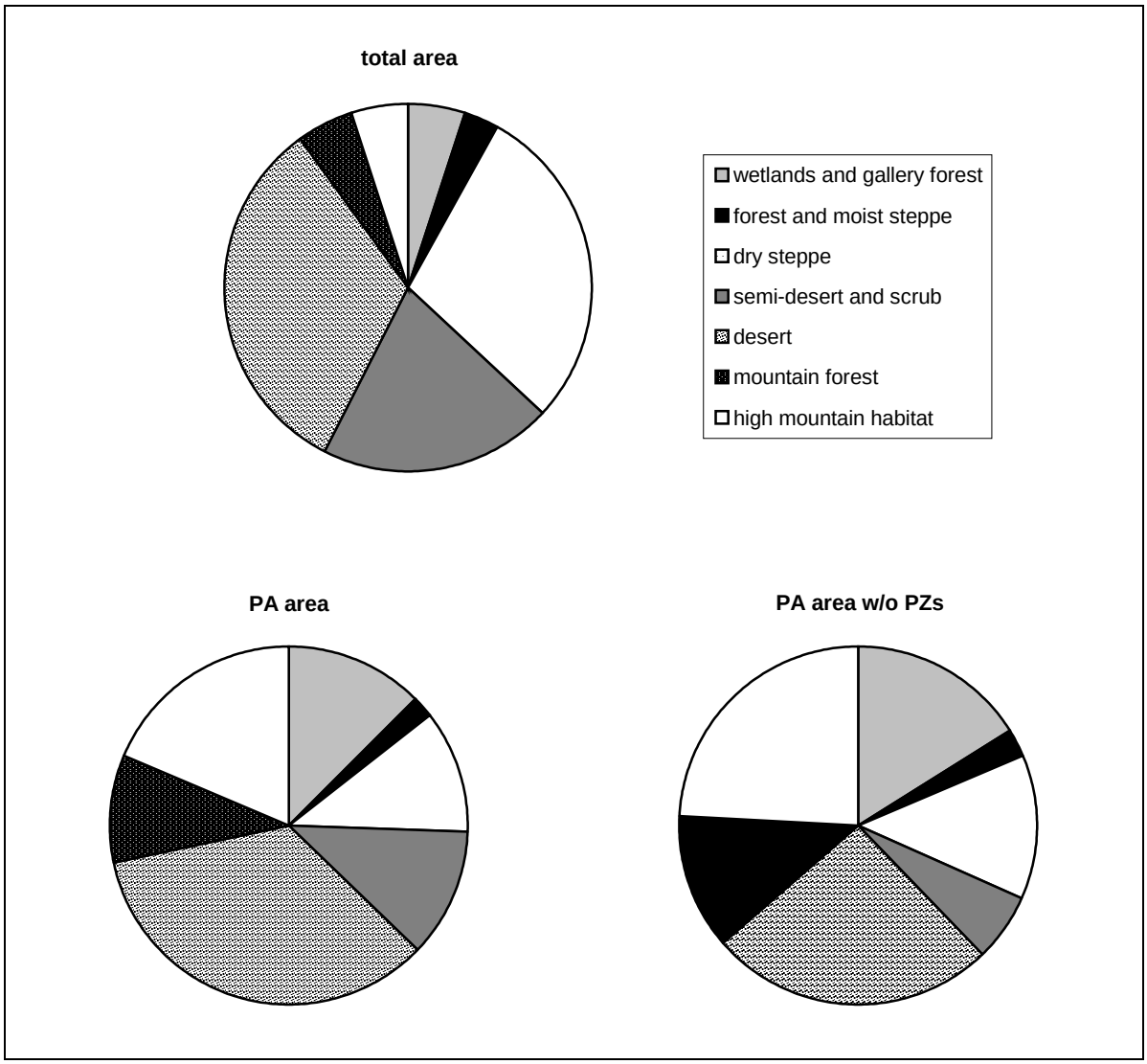


Fig 4-2. Pie charts showing the composition by ecosystem type of all Central Asian territories, of land within the PA system, and of the PA system excluding Prohibited Zones, based on data from the INTAS project GIS. High mountains, mountain forest and water-linked habitats make up only about a sixth of the land area of the region, but account for well over a third of the area of the PA system. This figure increases to more than a half if the new Kazakh Protected Zones are excluded, and inclusion of data from Kyrgyzstan would make the bias even more apparent as the Kyrgyz republic is almost entirely mountainous and has several protected areas based around mountain lakes.

A further jump in the size of the regional PA system in 2001, mostly represented the introduction of a new class of Kazakh PA; *Zapovednie Zoni* or Prohibited Zones. Although only three such zones were gazetted and it is yet unclear what their management objectives are (U. Grachev pers. comm.), they cover a huge area, and now represent roughly a quarter of the entire CA PA system. Figure 4-1b shows a fairly even coverage of different ecosystem types within the present regional system. Growth in the coverage of different habitat types has not been even, however, and coverage as a proportion of habitat area throughout Central Asia as a whole is not particularly representative (fig 4-2).

Comparison of the occurrence of 85 vertebrate species within regional PAs suggests taxonomic coverage is also biased towards more prominent groups, mammals and especially birds (fig 4-3a, table 4-1a). If species are reclassified according to whether or not they are commonly considered quarry for hunters, then the contrast is even more stark (fig 4-3b, table 4-1b). The 'hunted' category comprises all large mammals and smaller species which are commonly targeted, such as hares, and game birds such as waterfowl and galliforms. The better coverage of birds in comparison to mammals is probably explined by the fact that virtually all the birds included in the sample were large waterbirds. Hence the PA system grew out of the desire to manage game species, and an association with hunting is still evident in the coverage of the system, both in terms of species, and to a lesser extent habitats, mountain and wetland habitats being particularly important to hunters. An ethos of game management is also evident in the fact that winter feed provision, introductions and predator control are still common practice within Central Asian PAs.

The prominence of hunting within the ethos of the PA system reflects a wider cultural presence: a recent article in Kazakhstan's most analytical news magazine took for granted that, 'the fundamental passions of real men are long and well known. One of these is the love of weapons and hunting' (Semykina 2002). Trophy hunting by foreigners can be an important source of foreign currency, with extremely high trophy fees being paid for the rarest species. The Kazakh government trophy fee for killing a single argali, *Ovis ammon*, is 900 000 Tenge, c. $6 000 (State Decree no. 429, 15/04/2002), and although the all-in price for hunting a single argali in Kyrgyzstan is c. $20 000, this is only about half the price that was previously charged (Koshkarev 2002), and the figure is considerably higher in Tadjikistan (S. Robinson pers. comm.). Local hunting licences are far more modestly priced, but exclude the rarest species such as argali and goitered gazelle. The quality of management of sport hunting undoubtedly varies between localities, and the overall situation is somewhat opaque. There are widespread suspicions that hunters take more than their permits allow, and numerous personal contacts suggested that hunting argali is a something of a status symbol amongst the Kyrgyz elite, even though it is only permitted for foreigners. Cunha (1995) suggests a general absence of hunting controls in Central Asia, whereas Koshkarev (2002) decries the corruption, bribery and mismanagement surrounding argali hunting in Kyrgyzstan more specifically. Harris (2001) conversely emphasizes that the hunting estates in eastern Kyrgyzstan still support large population densities of argali, although it is debatable whether this represents the fruits of good management, or a disappearing inheritance from the soviet era, when the border regions were deserted.

There is widespread poaching for more material purposes. In Kyrgyzstan, at the high value end of the market, rare wildlife products such as live falcons and bear pelts attract substantial sums, and more than $10000 can be demanded for oddities such as live snow leopard cubs. In areas with high densities of large ungulates, commercial hunting primarily for meat also occurs and may be carried out by large groups of men with vehicles and automatic weapons (T. Harder pers. comm.). It is unclear, however, whether organised commercial poaching is widespread. Commercial hunting for meat is only confirmed from a few locations in Kyrgyzstan, and high-value, rare species may be mostly taken

opportunistically and then sold to traffickers. In Kazakhstan, organised meat poaching is widespread for Saiga, or at least was before recent population collapses (Milner-Gulland *et al.* 2002), and there are indications of highly organised commercial poaching effecting other species (Cunha 1995; Koshkarev 2002).

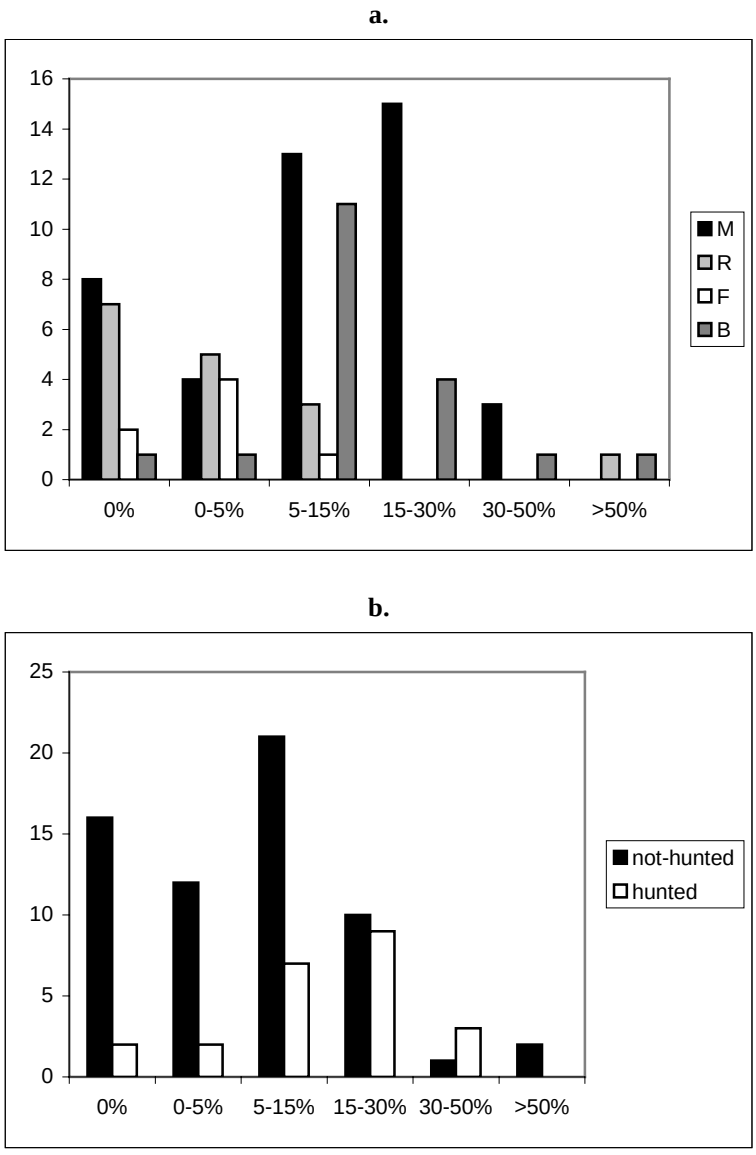


Fig 4-3. Number of species known to occur in different proportions of Central Asian PAs; by taxonomic group (a), M-mammals, R-reptiles, F-fish, B-birds, and classified according to whether or not they are commonly hunted. Figures are based on a sample of 85 species upon which data was collected for the INTAS project. The sample is both subjective and, as the project focussed on Red-listing, biased towards species recognized as being at risk, but was chosen to include a broad taxonomic range within the limits of the data that were available. Absences from PAs represent a lack of positive records, rather than proof of absence *per se*. Hence the frequencies of occurrence resented are highly sensitive to differences in the amount of knowledge available for individual species.

1a.

	M	R	F	B
in PA	33	6	5	18
not in PA	10	10	2	1

[Overall χ^2, M vs. R vs. F vs. B: 15.08**]
Mammals and fish combined, M&F vs. R vs. B: 14.99***
Sub-table, M&F vs. R: 6.64**
Sub-table, M&F&R vs. B: 5.89*

1b.

	non-hunted	hunted
in PA	41	21
not in PA	21	2

Overall χ^2: 4.19*

Table 4-1. Contingency tables of numbers of species by taxon (a) and by hunting category (b) confirmed to occur in at least one protected area or not confirmed as such. Contingency-corrected or Fisher Exact chi-square test statistics and their significance levels are given below the tables, as appropriate: *-significant at 5%, **-significant at 1%, *-significant at 0.1%. Overall results for table 4-1a narrowly failed to meet strict criteria for the application of a chi-square test, as two expected values (i.e. > 20% of observations) were <5, although one of these was only marginally so. Combining mammals and fish allowed strict criteria to be met, and degrees of freedom of the resulting 3x2 table were partitioned between statistically independent sub-tables to determine where the differences lay (see Siegel & Castellan 1988). Data are from the same source as those in figure 4-3.**

Of academic interest to the linkage between socio-economic conditions and the environment, and of concern for conservationists, are the changes that have occurred since the end of the Soviet Union. The economies of the former Soviet Socialist Republics of Central Asia were no more independent than their political leadership. They relied on Moscow for direct fiscal subsidies, various production subsidies, raw materials, and markets for their products. The shock from the rapid disintegration of this common economy was inevitably devastating, regardless of any debate over soviet efficiency. In Kyrgyzstan for example, between 1990 and 1994 industrial output fell by 60% and agricultural output by 30%. Between 1993 and 1996, the proportion of the population living below the poverty line had risen from 43 to 63%, and by this time unemployment had reached 20% nationally. In both Kyrgyzstan and Kazakhstan, the trend was for an increase in per capita GDP during the second half of the 90s, but in 1998 Kyrgyz GDP was still only 65% of the 1990 value (UNDP 1998, 2000a). Economic shocks have been compounded by social and political changes. Not only have national incomes fallen, but disparities of wealth unimaginable during soviet times have also appeared. Pensions and other benefits have fallen well below subsistence levels, and the direct costs of education and healthcare have risen dramatically. At the same time, mass emigrations of certain ethnic groups (over 8% of the population of Kyrgyzstan) have left many people bereft of family support. Crime and alcohol abuse have become chronic problems, increasing social inertia. Certainly a shift in mentality has been required in order to adapt from a largely paternalistic system in which roles were assigned, to a competitive one in which opportunities have to be identified, and this adjustment appears to have been especially hard for men, who commonly consider many forms of work below them (A. Orozobaeva, pers. comm.). But even

amongst those who show a more entrepreneurial spirit, there are complaints over access to affordable credit, and nepotism.

The Newly Independent States have generally orientated themselves to the market economy, with a certain degree of macro-economic success in recent years, notably in Kazakhstan due to the incipient exploitation of its substantial oil deposits. It is likely that recent gains have been concentrated on a small urban elite, however, and although the worst period of privation for vulnerable urbanites, such as pensioners left without family, may have passed, there is little indication that rural livelihoods are improving. The end of the collective farms brought drastic changes to the rural sector, most dramatically and seemingly irrevocably in the decimation of livestock herds, which once formed the backbone of the Kazakh and Kyrgyz rural economies (Robinson 2000). The dominant reason for this is debatable; the removal of soviet subsidies certainly made some forms of herding non-viable (Robinson and Milner-Gulland 2003), but shepherds interviewed in Kyrgyzstan were of the opinion that livestock-raising was profitable, and the loss of herds could have been due to a drawing down of capital at a time of wider crisis (Leroux and Omuraliev 2001; Robinson and Milner-Gulland 2003). Possibly the slaughter of livestock can simply be seen as part of the general frenzy of asset stripping that occurred at the end of the Soviet Union in response to insecurity over ownership (see e.g. Stiglitz 2002).

It is appropriate to study the impact of hunting within Central Asia due to its widespread practice, relatively modest habitat loss in comparison to other regions, and the importance of the large ungulate populations. Also Central Asia has experienced precisely the kind of socio-economic turmoil to which traditional protectionist approaches to conservation are most vulnerable according to their critics. Political and economic changes of the last 10 years have drastically reduced civil obedience in general, and have led to a marked increase in rural poverty and income inequality. Downsizing of the State has greatly reduced spending on nature protection, even as the area of designated reserves has increased (fig 4-1). This combination of factors has certainly been disastrous for some hunted ungulates, e.g. saiga antelope (Milner-Gulland *et al.* 2002), but it is not clear if this is universally the case. In less accessible regions, the reduction in domestic ungulate populations, and therefore grazing competition, may have been beneficial to wild populations. There is disagreement amongst sources as to how well official hunting is managed and the impact of poaching, but those who work most closely with hunting agree that it is a major threat to ungulate populations (B. Dyakin, T. Harder, pers. comm.).

4.3 Background to North Tien Shan

4.3.1 Suitability as a case study

It was decided not to focus on recreational hunting in applying the bioeconomic model, although not because it is insignificant as a threat to wildlife populations in Central Asia. It was avoided due to the intrinsic difficulties of measuring an esoteric benefit such as the enjoyment of hunting, and of trying to

determine the factors influencing enjoyment. The North Tien Shan is an area that is sufficiently removed from large population centres to avoid much attention from wealthy urban recreational hunters. In addition, local informants suggested that hunting in the area was predominantly or exclusively for personal consumption, and such small-scale exploitation seemed likely to be more accessible to investigation than organised poaching. Ibex is the largest commonly hunted species in the area, and the only wild ungulate which occurs in significant numbers in open mountain habitats. Due to the preference of ibex for high and especially steep slopes, the confounding issues of disturbance unrelated to hunting and grazing competition are likely to be far less significant than for other wild ungulates. Finally, workers from a snow leopard project, funded by the German NGO NABU, were already carrying out some anti-poaching patrols and field surveys of ibex populations in the area, which offered a potential source of insight, data and assistance with biological fieldwork.

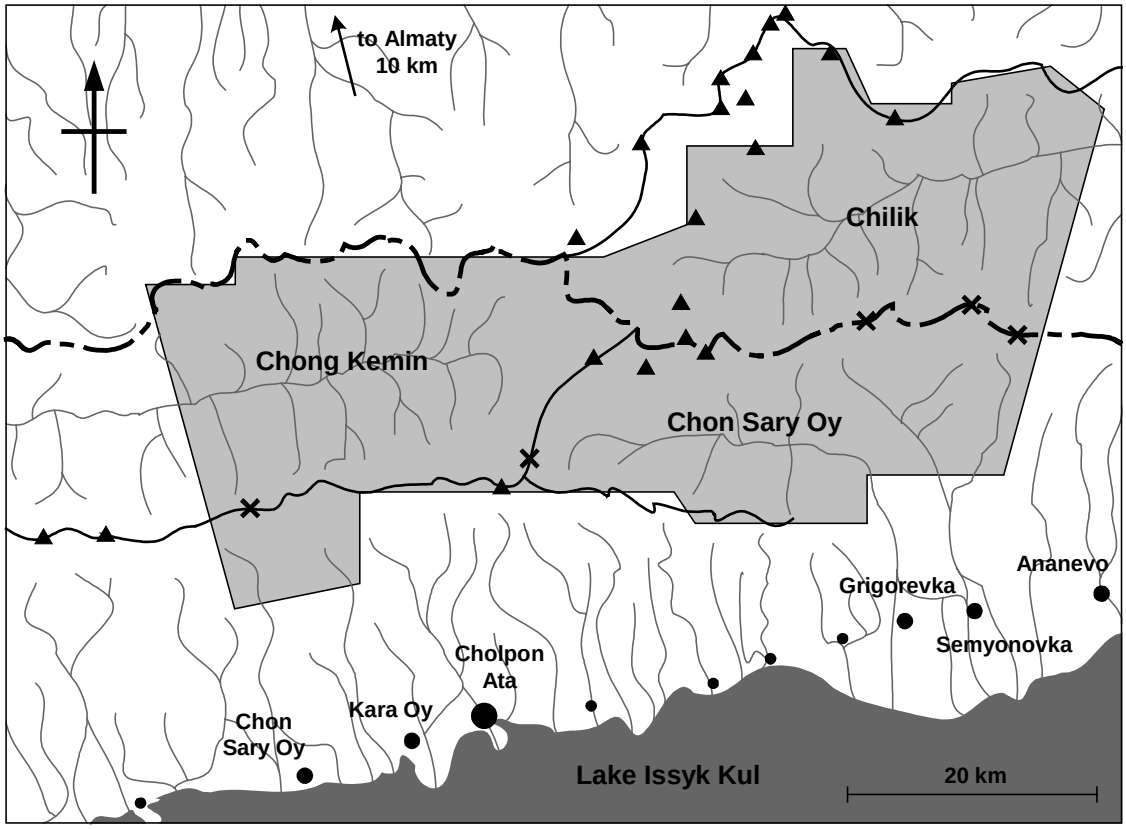


Fig 4-4. NTS study area. The approximate area of the landscape modelled in subsequent chapters is shaded light grey. The heavy black lines give the positions of the ridgelines defining the three major valleys, and the heaviest and broken line also denotes the location of the Kazakh (N) – Kyrgyz (S) border. Peaks at 4500 masl and above are shown as black triangles (the shore of Issyk Kul is at roughly 1700 masl), and passes as black crosses on the ridgelines. Streams, rivers and lake Issyl Kul are shown in dark grey. Villages are represented as black dots, with the size of the dot roughly relating to population size. The names of villages mentioned in the text are shown alongside.

Geographically, the North Tien Shan also offers the advantage of being an insular mountain range, surrounded on all sides by settled, low-lying areas and roads, and hence its mountain species are largely isolated from surrounding populations. The range runs for roughly 200 km west to east along the Kazakh-Kyrgyz border, and at its feet lie Kazakhstan's largest city, Almaty, to the north and

Kyrgyzstan's largest lake, Issyk Kul, to the south (fig 4-4). Three large valleys meet at the centre of the range, Chong Kemin, Chilik and Chong Ak Suu. Whilst the floors of these valleys reach little over 3000 masl, the peaks which separate their heads rise to over 4500 masl. The 1697 km^2 area used as the landscape for the models encompasses the upper halves of Chong Kemin and Chilik, and all of Chong Ak Suu (fig 4-4). Although this area does not include all ibex habitat within the NTS, it does include a large proportion of it, and the bulk of the best habitat according to altitude, relief and remoteness, and of the ibex population. It is extremely unlikely that there is any net immigration from the far sparser ibex population of the surrounding area.

4.3.2 Stakeholder population

Whilst Chilik falls within Kazakh territory, the whole of the study area was traditionally used by Kyrgyz herders and exclusive Kyrgyz use currently remains the case. The herders and hunters who access the valleys come from villages strung along the narrow alluvial plain that forms the north shore of *Issyk Kul.* This group of villages comprise the 9 *Aiyl Kenesh* (local councils) from Chong Sary Oy to Ananevo, running west to east, and a human population of roughly 57200 or 81% of the population of Issyk Kul Rayon (district). This is the most densely populated group of *Aiyl Kenesh* within Issyk Kul *Oblast* (region) outside of Karakol, the only sizable urban centre, which lies to the east of lake Issyk Kul. Chong Ak Suu is accessed via the Grigorevka Canyon, which opens out at the shore of Issyk Kul. Chilik and Chong Kemin must be accessed via passes a little below 4000 masl at the foot of Chong Ak Suu and roughly 50 km to the west, respectively. Access to Chong Kemin from the foot of the valley is blocked by the presence of the Chong Kemin National Park, which also prevents livestock herding in the valley, other than for the Kyrgyz President's own herd of yaks. The bottoms of the Chong Ak Suu and Chilik valleys are used as summer pasture, mainly for sheep, although much less intensively than during soviet times, and a couple of families keep small herds of cattle year-round in the latter.

There are therefore only two access points to the inner NTS valleys, and there is a cluster of villages directly opposite each. At the base of the pass to Chong Kemin lie Chong Sary Oy and Kara Oy Aiyl Kenesh, and to the east, at the foot of Chong Ak Su are Grigorevka and Semyonevka Aiyl Kenesh. These have combined populations of 8898 and 10536 respectively, according to 1999 census data (NatStatKom 2001). Socio-economic research was carried out in the largest (and eponymous) village of each of these 4 aiyl kenesh; Chong Sary Oy (1958 persons in roughly 420 households), Kara Oy (2946 persons in 713 households), Grigorevka (5648 persons in 1688 households) and Semyonevka (2884 persons in roughly 840 households).

According to the 1999 census, Issyk Kul Rayon has 62050 rural inhabitants, and 9020 urban, representing the population of Cholpon Ata, the only sizeable town in the area, lying just to the east of Kara Oy. Europeans (Russians, Ukrainians, Germans) comprise 20% of the population of identified ethnicity; the remainder being Asiatic (Kyrgyz, Kazakhs, Tatars, Uzbeks, Uighurs, Balkars, Kalmucks,

Dungans). The ethnic groups are not evenly distributed, however; typically villages are either a fairly even mix of Europeans and Asiatics, or almost exclusively Asiatic. Of the four villages in which research was conducted, Chong Sary Oy is 98.5% Kyrgyz, Kara Oy 73.6% Kyrgyz, 24.0% Russian, Grigorevka 47.3% Kyrgyz, 44.0% Russian, and Semyonevka 45.5% Kyrgyz, 49.4% Russian according to census data. Issyk Kul Rayon is also the centre of the Issyk Kul tourist industry.

4.3.3 Economic overview and trends

Official national statistics published in the annual UN Human Development Reports (UNDP 1998, 1999, 2000b, 2001) suggest that following the macroeconomic chaos of the early nineties, there has been a steady improvement in Kyrgyz living standards. PPP per capita GDP has risen steadily in both absolute and relative terms since the mid-90s, as has the Human Development Index more generally, and there has been a slight fall in the percentage of household income spent on food, which is generally viewed as an indicator of a reduction in poverty. After a period of hyperinflation following the dissolution of the Soviet Union, inflation has stabilised at moderate figures in the range of 10-40% (UN 2001).

Independent village surveys in rural areas of Issyk-Kul Oblast paint a somewhat less rosy picture, however, which has encouraged scepticism towards some of the official figures (N. Omuraliev, pers. comm.). Villagers view the late 1990s as having been the worst period, and although there may have been a slight upturn in the last couple of years, they are still vulnerable to specific economic shocks, such as a recent sharp rise in fuel prices (InterBilim 2001; Leroux and Omuraliev 2001). Although average incomes may have risen over the past half decade, there has also been a dramatic increase in income disparity since the Soviet times, and in dollar terms, GDP fell during the late 1990s. The 2001 Kyrgyz Common Country Assessment (UN 2001) estimated that in 2000, the poorest 20% of the population received around 7% of national income, which would equate to an annual per capita income of about US$ 94.

The possibility that specific sectors of the economy are driving the overall figures, but not reflecting the experiences of the majority is suggested by growing regional disparities. Figures on the creation of new businesses suggest that a rapid increase in entrepreneurialism in Bishkek has not been reflected elsewhere (UN 2001). In Issyk-Kul the signs are even starker; the region went from being amongst the lowest ranked in terms of GDP and HDI, to being second behind the capital within the space of a couple of years in the late 90s (UNDP 1998, 1999, 2000b, 2001). This gain is due to the opening in 1997 of the Kumtour goldmine, however, which alone accounts for half the current Kyrgyz industrial output, and which absorbed around 80% of national foreign investment in 1995 and 1996. It is far from clear that economic gains from the mine have impacted typical rural villages in Issyk-Kul, or even that they will result in any lasting changes after its forecast closure in around 5 years.

Previously, Issyk-Kul was the second most popular tourist area within the Soviet Union. After independence, the industry collapsed, but numbers of Russian and Kazakh visitors have started to recover in recent years (GTZ 1998). The economic importance of tourism has recently grown in Issyk-Kul (UNDP 1998, 1999, 2000b, 2001), which is of relevance to the villages on the north shore of the lake that lie within the study area. Again, it is unclear, however, to what extent gains from tourism have penetrated local village economies beyond the small number of people who are directly employed in the sector. Of a total employed population of 21897 in Issyk Kul Rayon, 13489 were employed in 'agriculture, hunting and related services', and most of the rest were public sector workers (NatStatKom 2001). Only 114 were employed in 'hotels and restaurants', suggesting that the direct impact of tourism is low, despite its prominence in the region. These figures are difficult to interpret, however, both because clear definitions of the categories are missing, and because salaried employment often represents only a fraction of subsistence needs.

The health of the agricultural economy is of overwhelming importance to the largest number of people in the region. Of 34771 respondents reporting an independent income, 11270 reported salaried employment as their major source of income, of which 2787 were employed on farms, 10571 reported non-salaried employment, of which 8876 were from personal small holdings, 9525 reported state benefits, of which 9050 were pensioners, and 34771 reported property and other sources. Hence at least 33.5% rely directly on agriculture for their principle income, even ignoring the unknown numbers of non-salaried workers employed on larger agricultural enterprises, the role of agriculture in deriving income from property, the numbers employed in agricultural support services, and supplementary incomes from small-scale cultivation or livestock-rearing. Within the agricultural sector there has also been a national recovery after the initial chaos of independence. By 1999, crop production had roughly risen back to 1992 levels, but the meat production was still decidedly lower, wool production remained around a third, and numbers of sheep, goats and chickens were still a fraction of their former levels (UN 2001). Issyk Kul was not spared the general shock to the Central Asian agricultural economy; the number of sheep in the oblast fell by 2/3 between 1993 and 1997 (GTZ 1998). The probability of a recovery in livestock numbers depends greatly on the relative contributions of the reasons for the initial decline. Whilst it is unlikely that the peak numbers of the Soviet era will be seen again, shepherds spoken to in the NTS expressed eagerness to increase their herds of sheep and cattle, and considered it a lucrative investment. It is therefore possible that numbers may be temporarily depressed at present due to a lack of access to capital.

Despite modest gains in the national economy, it remains difficult to forecast economic trends in the villages of relevance to the case study. It is at least a possibility that, whilst recourse to a subsistence economy buffered rural communities from the worst shocks of the first years of independence, they will be the ones left behind in the rise of the new economy. It does seem to be the case, however, that the initial wave of emigration has passed, and the population in Issyk-Kul is currently growing at 2.04% pa.

4.4 Village-based research

4.4.1 Information needed for model and existing sources

Aside from the biological dimension, in order to fit bioeconomic models, information is required in two areas; the costs associated with hunting, and the demand for the resulting products. Costs involve the time taken to catch animals as well as any material and capital costs involved. The cost of time is an opportunity cost, so it is necessary to identify available alternate activities are available, and estimate the net incomes they generate. In order to develop a simulation model for the system, it was also necessary to know how hunters hunt, so that the dynamics of their search and capture strategies could be simulated. To characterise demand, it is necessary to know which goods are derived from hunting and their demand functions.

Little information relevant to these questions was already available. Government statistics made available through UN publications (e.g. UN 2001), give estimates of per capita GDP, which have some relevance to expected incomes, but can hardly be used directly. Village surveys commissioned by NGOs give a more human perspective on incomes in the *oblast*. Inhabitants of three villages on the southern shore of Issyk Kul reported that around a third of the population was 'very poor', owning at most a house and a little land (Leroux and Omuraliev 2001). An additional 40-50% of villagers were considered 'poor', owning a small number of livestock and some land, but with limited means to work it. These proportions correlate with the results of similar exercises carried out elsewhere in Kyrgyzstan by UNDP (Candelise 2000). The Helvetas Rural Advisory Service found that a majority of workers received an annual income of less than 4000 som (c. US$ 80) in two Issyk Kul villages in 1999, previous to the period of project intervention (InterBilim 2001). Throughout, infrastructure is dilapidated and services such as basic education and healthcare are becoming unaffordable. The existence of a number of such broad, consultative studies, and the general agreement between their results, obviated the need to repeat a similar PRA exercise in the focal case study villages.

Instead the approach taken to collecting human data for the model was essentially twofold. As many known hunters as could be identified, and were willing, were interviewed about the reasons for hunting, the techniques used and the costs involved. Where possible information on their household economies was also collected by use of a structured household survey. The difficultly here was in identifying hunters willing to talk, as the aim was to contact unlicensed, illegal hunters. Only 10 hunters were interviewed formally, one of whom may hunt legally. Additional opportunities were taken to casually interview knowledgeable informants wherever possible, particularly hunting inspectors, rangers, shepherds and on one occasion individuals directly observed hunting in the mountains. Household surveys were also carried out for a cross-section of the community as a whole. These focussed on incomes and demand for meat, in order to supplement the small sample of opportunity cost and demand estimates from hunters, and to place the group of hunters within a wider social context.

4.4.2 Methods

4.4.2.1 Hunter interviews

Hunters were identified as such by other villagers, both in the course of collecting other information, and by specifically asking appropriate village contacts, such as rangers, shepherds and previously identified hunters. Although a few people in the area were fully aware of the nature of the work, during the collection of general socio-economic data it was simply stated that the links between household economies and the environment in general were being researched, and hunters were told that we were interested in local hunting traditions and practices. Hunters were never asked directly if they hunted illegally, but this could typically be established through questions on the prices of licences for hunting ibex and the locations in which they hunted. Legal hunters must have a weapon licence, a personal hunting licence, and pay a fee for each animal killed during supervised hunts in designated hunting territories. A degree of opacity regarding the research aims was deemed necessary because illegal hunting does carry substantial penalties, and two recent events, concerning the imprisonment of a group trafficking snow leopard cubs and the shooting of a ranger, had increased the level of nervousness locally.

Interviews were semi-structured, according to the list of questions in appendix 4-1, and observing standard considerations (Russell Bernard 2002). These usually took place in hunters' homes. Interviews were conducted primarily in Russian, but a Kyrgyz-speaking research assistant was available if translation was required. Maps were used to locate hunting sites. After the interview, if respondents were willing, a household survey form was completed as described below. This proved possible in 6 of 10 cases. Typically, respondents waited until this business was completed before offering tea, which allowed an opportunity to further probe any unresolved areas in a more relaxed setting.

4.4.2.2 Household survey

Target households were identified through *Aiyl Okmotu* (AO – village council) registers. These list family members, employment, number of rooms in house, land, livestock and certain other possessions for tax purposes. For each village, 200 households were selected uniformly, i.e. if there were 1000 households, then every 5^{th} household was selected. As households were listed by street order, uniform selection was used to provide an even distribution of locations and avoid biases due to aggregation of poorer or wealthier households. Given early indications that meat was consumed by hunters themselves, rather than sold (see section 4.4.3 below), only households containing at least one male of

hunting age (17-65) were selected. In the absence of a suitable male member, the household was replaced by the next in the register.

For each of the 200 households, the numbers of members, employed members, male members of hunting age, employed male members of hunting age, rooms in the house, motor vehicles, head of cattle, sheep, goats, pigs, horses and domestic fowl, and area of land were recorded from the AO registers. From the 200, a sample of 30 households were selected at random for each of the 4 villages, and it was in these that household surveys were carried out. Ethnicity was not taken into account when selecting households; the ethnic composition of the households surveyed is given in table 4-2). Although only 2-7% of households in each village were therefore surveyed, it was hoped that correlations between wealth indicators recorded from the AO and survey results with respect to incomes and meat consumption, would allow appropriate scaling up to the larger sample of 200, representing roughly 12-48% of the households in each village.

Village	**No. households by ethnicity**	
	Asiatic	**European**
Semyonovka	15	15
Grigorevka	8	22
Chon Sary Oy	30	0
Kara Oy	7	23
Hunters	6	0

Table 4-2. Number of households surveyed by ethnicity, in each village and amongst hunters interviewed. The proportions of interviewees from each grouping reflect the underlying ethnic composition of each village, except that more Europeans were interviewed in Grigorevka than would be expected given that official figures suggest that Asiatics form a slight majority there (see 4.3.2).

The survey form drew upon examples used in socio-economic research on bushmeat consumption in Gabon and Equatorial Guinea (made available by D. Wilkie and N. Kümpel respectively), and focussed on incomes, opportunity costs for male members of hunting age, and meat consumption and preferences (see appendix 4-2). Respondents were asked to list household members, possessions and value estimates, occupations of male members of hunting age, annual agricultural production and value, cash incomes from salaries, state benefits, etc., and workers and services employed in agricultural production or any other capacity.

Given that there is no established market for ibex meat, its value could not be measured directly. Interviewees were asked which meats were consumed in the household and to order these by preference. Frequency and volume of consumption were directly estimated for each meat, and its value relative to mutton was estimated by asking whether respondents would choose a gift of 10kg mutton or 10kg of the alternate meat, given the proviso that they could not sell it on. If they took the mutton, they were then offered 10kg mutton versus 11kg of the alternative, and this was continued until an equivalence point was reached at which the choice switched, i.e. a bidding process was used to establish an equivalence value, as in many contingent valuations (Mitchell and Carson 1989). Mutton

was chosen for this exercise as it is consumed in greater volume than any other meat, and because it is the most similar to ibex meat of all the commonly consumed meats.

4.4.2.3 Analysis

Assets, such as land and livestock were assigned values according to modal responses from surveys. As most assets are traded fairly frequently, there was generally good agreement between the values quoted. Obviously some individual plots and animals are of higher value than others, but this could not be taken into account in estimating overall wealth, because in the absence of an independent valuation, it was impossible to separate this from estimation error. Consumer durables were more difficult to value as they depreciate with age. Current values of durables were based on the purchase price and an assumption of 10% depreciation per year, with a 20% depreciation in the first year if they had been bought new. A floor in value was set by the modal price paid for old (c. 10+ years) second-hand items.

Household incomes were calculated as the sum of all cash incomes (salaries, benefits, business profits) and the value of agricultural output (regardless of whether it was sold or consumed directly), minus the cost of agricultural inputs. Some agricultural products, such as hay, were themselves used as inputs, and these only contributed directly to household income where they were sold.

Opportunity cost was calculated as the minimum daily earnings of any male of hunting age in each household. Agricultural earnings were included as the net annual household production multiplied by the proportion of agricultural work contributed by the individual male, and divided by the number of working days. The number of working days was estimated as 120, i.e. 6 months of agricultural work with 20 working days per month. Where there was only one adult male in the household, and no specific information was given about the contribution of other household members to agricultural production, it was assumed that the male was responsible for all production. The group of hunters was also compared to the rest of the survey population in terms of the number of male household members who were unemployed or self-employed, as flexibility in working arrangements may be more important to the opportunity to hunt than average income.

The overall consumption of meat in general and of wild-caught meat in particular were compared for different groups. Costs of domestic meats were available from estimates of the values of livestock products, and directly from local market prices. Along with the preferences recorded for various meats, these were used to try to deduce the effects of costs on consumption choices. To this end, household consumption of common meat types relative to mutton were plotted against mutton equivalence values for the meat in that household. If consumption choices are based on market prices, then equivalence values for each meat should have been stereotypical, and there should be no relationship between preference and consumption. If, however, choices are more influenced by what individual households

themselves produce, or what they are perhaps given by others, then there should be a negative relationship between relative preference and consumption (see fig. 4-5).

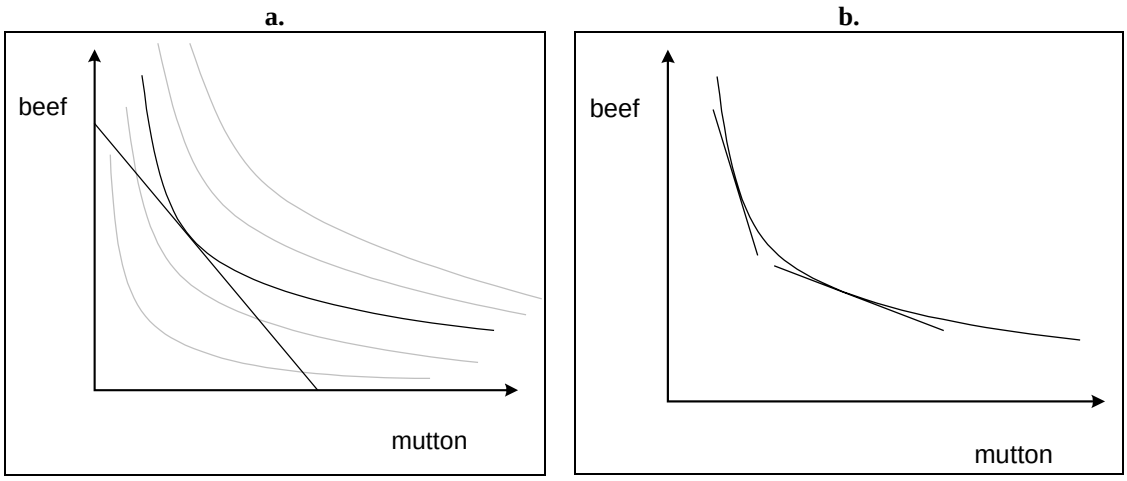


Fig 4-5. Schematic consumptions curves. Figure 4-5a shows a standard consumption-preference curve for two meats, mutton and beef. The quantity of each meat consumed is measured along its respective axis. The budget line (straight line) represents the set of possible consumption points for a given budget, and the preference curves represents sets of potential consumption points at a given utility. Preference curves further from the axes represent higher utility isoclines. The actual point of consumption will occur where the budget line intercepts the furthest possible preference curve, i.e. at the point where the budget line is tangential to a preference curve. The quantity of beef that an individual is willing to exchange for a set quantity of mutton should be determined by the negative gradient of the preference curve at the point of consumption. As the point of consumption occurs where the budget line is tangential, this gradient must be equal to the gradient of the budget line. In the presence of a perfect market with free exchange of goods, the gradient of the budget line is simply set by the market prices of the two meats, so everyone must have a budget line with the same gradient. Hence everyone should be willing to exchange the same amount of beef for mutton, irrespective of where their individual budget lines lie and the shape of their preference curves. If the market is not perfectly costless, however, then individuals will have somewhat different budget lines (b); for instance mutton may be relatively cheaper for those who have many sheep. In this case, stated equivalences should still reflect underlying costs, and on average, those for whom beef is cheaper will eat relatively more beef. In general, therefore, those who eat more of a given meat should assign it a lower mutton equivalence value, than those who eat less of it.

Furthermore, if choices are based on market prices, then we can test whether intrinsic preferences play a role in the volumes of meat consumed, as if this is not the case then the order of consumption should simply be the reverse of the price order (fig. 4-6).

Due to skewed distributions of many metrics, non-parametric comparisons, Kruskal-Wallis, Mann-Whitney U, Spearman rank correlation tests, were used routinely. Linear regression was used in cases where a regression gradient was required, however.

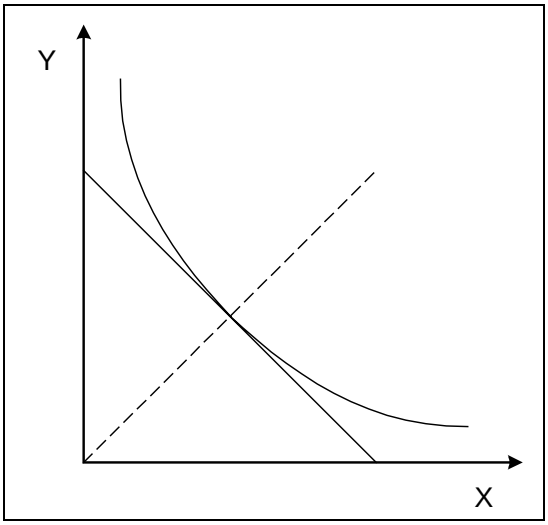


Fig 4-6. If there is no intrinsic preference between meats X and Y, then the XY preference curve must be symmetrical in the line Y=X (and the substitutability of the two meats is given by the curvature of the curve). Therefore the meats will only be eaten in equal quantity if their costs are exactly equal, i.e. if the gradient of the budget line is –1. If Y becomes more expensive than X, the gradient of the budget line will become less negative and less Y will be eaten for each unit of X. Hence the order of consumption should always be the inverse of the price order.

4.4.3 Information from interviews

All hunters identified meat as the predominant product from ibex. A couple mentioned that the hide was also of good quality, but this did not appear to be of much importance. There was no indication of ibex being killed for *yangir* fibres (fine wool, similar to *shatoosh*, made from ibex neck hair; see Tonin *et al.* 2002), as has been suggested (M. Festa-Bianchet, pers. comm.). During interviews roughly half the hunters stated that meat was the primary reason for hunting, whilst others stressed more esoteric values such as a general interest in hunting. None of the hunters interviewed reported selling meat, and a couple mentioned that a powerful rifle was necessary to make commercial hunting viable. Of all local informants, only one said he had sold ibex meat; a shepherd working in Chilik who claimed to hunt opportunistically. Other local informants stressed the link between poverty and hunting for food. One ranger reported that the fish in Issyk Kul had already almost gone and that the ibex would be next. He added that if the economic situation did not improve he would turn to commercial hunting himself.

It is difficult to gauge the relative importance of material benefits and enjoyment of the activity, not least because the presumed attitude of the questioner preconditions the answer (Russell Bernard 2002). Hence informants who knew that the questioner's primary concern was conservation invariably stressed economic desperation and the need to provide meat, whilst hunters who thought that the interest lay in hunting traditions themselves were as likely to wax lyrical about their spiritual connection to the mountains, or at least their enjoyment of the sport. Hunters were asked for the maximum they would pay to hunt if payment were absolutely unavoidable, to which an answer of around 500 som per animal arose with surprising consistency. This is not entirely dissimilar to the net

value of a kill to a single hunter based on expected yield of meat and hunting costs (expected to be in the order of 1000 som, depending on hunting time – see parameters in later models).

Although most hunters did not exclusively hunt ibex, there was uniform agreement that when on an ibex hunt, this was almost always the only species taken. Large carnivores are also available in ibex habitat, but have to be hunted at night, and marmots were only considered worthwhile quarry if a large number could be caught using specialised techniques.

All hunters interviewed had been shepherds at some point, and had obtained a shotgun and binoculars through herding; in most cases they were supplied by the collective farms during the soviet era. Several hunters stressed the physical hardship and danger of hunting ibex, and the need to know the mountains well, implying that the younger generation did not have the dedication for this (8 of 10 hunters interviewed were over 40). Hunters reported that only a handful of people in each village hunted ibex. The only other group implicated in hunting by other informants were rangers, and on one occasion this was confirmed by direct observations in Chong Ak Suu.

There was no agreement between hunters themselves as to whether the number of hunters was now greater or less than previously, although a decrease in opportunistic hunting by shepherds was linked to the drop in shepherd numbers. Neither was there consensus on recent changes in the numbers of ibex; some reported an increase, some a decrease, and others talked only in terms of changes in the distribution of ibex in response to patterns of human activity in specific locations.

Seven of the 10 hunters interviewed owned shotguns, two no longer owned their own weapons, but had to borrow from others, and one owned a .22 rifle. None reported using high-powered hunting rifles. Ammunition was the only significant material cost; food taken on hunting trips was similar to that which would have been eaten at home in any case.

All hunters claimed to only hunt in the autumn when animals are fat. They typically reported making 2 or 3 trips per year. One hunter claimed to kill around 10 ibex per year, but this contradicted later statements about average success.

All hunters considered being caught by hunting inspectors a possibility, but none reported having been stopped by officials for illegal hunting, and only two could give estimates of what the fine would be; 10000 som and 3/4000 som plus confiscation of weapon, respectively (cf. 28000 som in reality, V. Radchenko pers. comm.). None considered they would be caught for hunting illegally whilst in the mountains, but only if they were stopped on the road from the village, or if someone reported them.

With regard to hunting techniques, hunters sequentially check areas that they know ibex to frequent. Once ibex are sighted, the accessibility or ease of approach of the herd was the factor most frequently cited in deciding whether to approach it. The presence of large males, distance and wind direction were

also mentioned. In approaching a herd, hunters try to get above it, sometimes climbing before dawn when the animals are still feeding at lower levels. The most common firing range reported was around 30m, with no hunters reporting shooting from more than about 100m. Respondents suggested that success was highly variable, but their estimates averaged to a rate of about one in every three approaches. Some individuals claimed to have killed up to half a dozen animals in a single trip, but further questioning revealed that one or possibly two animals was a much more typical figure, and some hunts were not successful. All agreed that a single animal was enough, suggesting that they would return home after this unless easy opportunities presented to make another kill. Typical lengths of trips were 2-4 days.

4.4.4 Results of household survey

4.4.4.1 Use of *Aiyl Okmotu* records

Scatter plots of household statistics from *Aiyl Okmotu* tax records and corresponding measures reported during the survey showed discrepancies in the majority of cases and were vastly different in some cases. The number of household members provided the best correlation between the two datasets (fig 4-7), but the proportion of variation explained by a regression of AO records on survey data was still less than 50%. Although all but one of the regressions of other metrics showed a statistically significant positive correlation, in the majority of cases they explained no more than a fifth of the variation, and in no cases more than about a third (table 4-3).

Property	Survey mean	Aiyl Okmotu mean	Intercept	Gradient	R^2	p-value
Household members	4.61	4.68	1.44	0.70	0.465	0.000
Working members	0.71	0.87	0.95	-0.11	0.006	0.396
Men	1.33	1.48	0.82	0.50	0.251	0.000
Working men	0.4	0.53	0.45	0.20	0.022	0.105
Rooms	3.33	1.81	0.63	0.36	0.056	0.010
Land	1.25	1.03	0.67	0.29	0.118	0.000
Cattle	1.53	1.79	1.20	0.39	0.145	0.000
Sheep	4.26	4.78	2.05	0.64	0.355	0.000
Goats	0.75	0.82	0.39	0.58	0.172	0.000
Pigs	0.98	0.53	0.26	0.27	0.343	0.000
Horses	0.59	0.51	0.26	0.44	0.278	0.000
Fowl	12.66	6.69	3.59	0.25	0.154	0.000
Motor vehicles	0.53	0.26	0.08	0.34	0.201	0.000

Table 4-3. Relationship between household characteristics recorded during survey and Aiyl Okmotu records; means for the two datasets and results of linear regression. Although with a sample size of 120, linear regressions were significant in most cases, the amount of variation explained by the regression was lower than 50% in all cases.

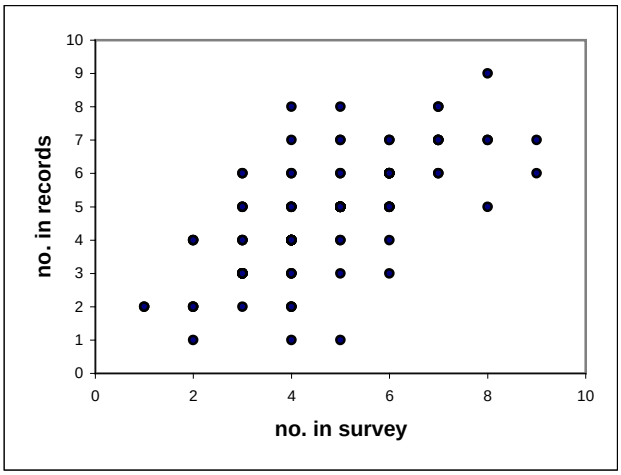


Fig 4-7. Number of household members in Aiyl Okmotu records versus number reported during household survey.

There were also differences in the comparisons between villages. Simply by inspection during the data collection, it was clear that the quality of tax records varied between AOs, with records for the two eastern villages, Semyonovka and Grigorevka noticeably superior in terms of inclusiveness and consistency. The consistency of land records split into three clear groups: highly consistent households; those listed by AO as holding land, but not reporting any during the survey; and those listed as holding only small plots (i.e. peri-domestic garden plots) but reporting much larger areas (fig 4-8). This variation could largely be explained by inter-village differences. In Grigorevka and Kara Oy, only small land parcels were recorded in AO records irrespective of survey holdings; in Chon Sary Oy and Semyonovka, AO records are mostly accurate, but about a quarter to a third of surveyed households in the latter reported no land in the survey, despite being listed as having holdings. There were differences between villages in the prominence of the remaining collective farms, and some of the differences in land reporting may emanate from different perceptions of ownership of land still within the collective system, but there also appear to be major inconsistencies between AO record-keeping in general.

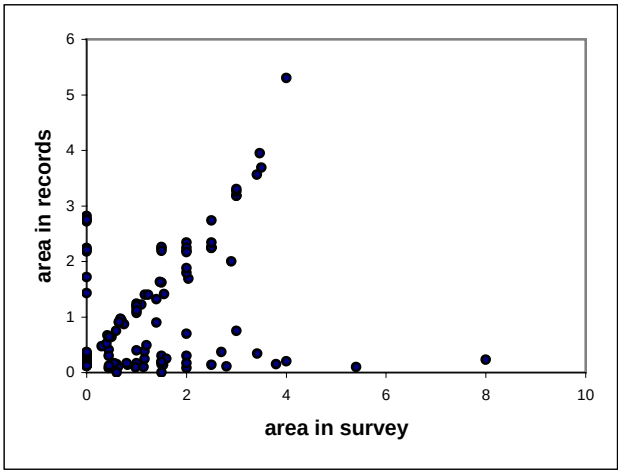


Fig 4-8. Area of land owned (ha) according to Aiyl Okmotu records versus that reported during household survey.

As a results of the lack of consistency in AO records between villages and in comparison with survey results, the idea of using the larger AO sample to scale-up survey results was abandoned. Doubtless there were inaccuracies and biases in the data collected during the survey, and some discrepancies may be for *bona fide* reasons such as changes in possessions or ownership since the tax records were last collected. It is likely that the primary reason for differences is due to misreporting of property to the AO for tax purposes, rather than during the household survey. The regression lines in table 4-3 all have gradients less than 1, suggesting systematic under-representation of possessions in AO records. The intercepts are all positive, presumably as an artefact of the fact that it is impossible to under-report something that you do not possess.

4.4.4.2 Wealth and income

Estimates of the values of various possessions are shown in table 4-4. Naturally those items most commonly traded showed the greatest consistency in reported values, and were therefore the simplest for which to derive estimates. Houses were the hardest to value. The modal value reported by occupants was around $4000, but this is highly unlikely to be accurate as it is about twice the value of similar properties in the Kyrgyz capital, Bishkek, and reportedly, some new holiday cottages built near to Semyonovka were being offered at around $1000. Houses are very rarely bought and sold in the villages, so respondents were probably unaware of true market values, especially given the fact that Kyrgyz property prices fell sharply in the late 90s. Although reported house price was significantly correlated with reported room number, this only explained 15% of the variation. Hence there was no reliable basis for differentiating between the values of individual properties other than on the basis of the individual and highly suspect valuations of the occupants. In these circumstances, houses were omitted form estimates of overall wealth. In any event, only 2 of 120 families owned more than one property, and only one family did not own their own property, living instead in a relative's house.

Informal conversations with people living along the north shore of Issyk Kul before the start of the formal socio-economic research produced a common message; prices of staple goods were much lower during the Soviet period. Now it is impossible to live and support a family on a normal salary, so subsistence farming has become the norm.

Survey results made clear the economic importance of agriculture, even to those households receiving other forms of income such as salaries, and the degree to which production is dominated by subsistence needs. More than two thirds of total reported incomes were from agricultural produce produced directly by the household, and these formed the primary income source for more than two thirds of households (table 4-5). Only a sixth of total income came from sources other than direct agricultural incomes and state benefits, and only a single household did not report any agricultural production. Despite the prominence of the local tourism industry, only 6 households reported incomes directly from the tourism sector.

Possession	Households (of 126)	Value (som)	Unit
Land	91	7500	ha
Sheep	50	1700	head
Goat	25	1000	head
Cattle	90	12000	head
Calf	5	5000	head
Pig	33	4000	head
Piglet	2	1500	head
Horse	46	15000	head
Foal	1	5000	head
Chicken	88	70	head
Duck	11	100	head
Goose	5	250	head
Turkey	16	250	head
Cereals	57	3	kg
Hay	4	2	kg
Clover	39	1	kg
Potatoes	108	3	kg
Other veg	9	3	kg
Fruit	115	5	kg
Meat	83	70	kg
Milk	26	4.5	l
Egg	4	2	item
Cart	22	4000	item
Fridge	89	1000	item
Car	52	10000	item
Motorbike	7	3000	item
Radio/stereo	27	1000	item
Gun	7	2000	item
Tractor	7	25000	item
Truck	4	50000	item
TV	115	500	item

Table 4-4. Number of households owning or producing and estimated values of various items, for all 126 households surveyed (120 randomly selected and 6 hunters). For consumer durables, values are basal values of old, second-hand items. Land only includes land set apart from the house; 123 respondents had a garden around the house, but the value of this is indistinguishable from that of the property.

Fruit was the only widely produced agricultural good for which a clear majority of total production was sold and a majority of producer households marketed some part of their production (table 4-6). Most products in most households, and a narrow majority of total gross agricultural production are consumed within the household. Not a single household reported production of a cash crop purely for export from the local area. Although it was not possible to distinguish the precise proportion, much agricultural production is peri-domestic; fowl, one or two cattle or pigs, and small orchards and vegetable plots are commonly found within the immediate environs of the house.

Income sector	% hh reporting income	% total income	% hh for which major income	Mean annual income of major income hh (som yr^{-1})
Agricultural production	99.2	68.4	69.0	34300
Other agricultural	7.9	3.7	1.6	21000
Salaried	24.6	9.9	12.7	24200
Business	9.5	6.5	5.6	51600
Benefits	42.1	11.5	11.1	16800

Table 4-5. The percentage of households reporting incomes from each economic sector, the contribution of that sector to the sum of all incomes reported in the sample, the percentage of households for which each sector represented the major source of income, and the average income of households deriving their major source of income from each sector. Agricultural production refers to products produced directly by the household. Other agricultural incomes include salaries for agricultural work, rents from land cultivated by others, and profits from the provision of agricultural services, such as tractor hire. Business refers to any self-employment outside of the direct agricultural sector. Benefits were overwhelmingly in the form of pensions, although some disability allowances are also received. The differences in incomes between households deriving major incomes from different sectors were insignificant according to the results of a Kruskal-Wallis test, primarily due to the small numbers of households with non-agricultural major incomes, although when all agricultural incomes were combined, they were only marginally insignificant at a 10% level. Data are based on all 126 households; i.e. including hunters.

Product	Value (som)	% sold	No. hh producing	% hh selling
Meat	1 231 650	50.4	83	41.0
Cereals	610 050	16.6	52	17.3
Vegetables	487 690	31.5	108	18.5
Fruit	471 190	73.4	115	77.4
Milk	207 450	50.4	26	50
Fodder	165 000	12.9	43	14.0
Honey	105 000	90	1	100
Eggs	9 200	30.4	4	75

Table 4-6. Value of the total reported production of each agricultural product, percentage of the production that is sold, the number of households (of 126) reporting the product, and the percentage of those households which sell some part of their production. Note that the total production figures do not sum to the total net agricultural income for the survey sample because they do not take inputs into account. Cereals are mostly wheat, vegetables are predominantly potatoes, and fodder is predominantly clover, which has low fodder value, but as a legume is grown in rotation to enrich soil. The fact that the number of households selling some of their produce is typically in line with the proportion of total production sold, and in the case of meat and vegetables is actually lower, reflects the skew in production. A small number of households often account for a large proportion of total production and sell more of it than other households.

Unsurprisingly, wealth and income were correlated, and both were highly skewed (fig 4-9). Wealth and incomes were higher within the two eastern villages and amongst Europeans households (fig 4-10 & 4-11). Village and ethnicity are highly confounded, however. Within the one village with an ethnically even mix of sampled households, Europeans still reported significantly higher incomes than Asiatics ($p<0.001$; Mann-Whitney U test), but cultural differences in the reporting of income cannot be ruled

out. Due to the extremely low number of confirmed hunters with whom it was possible to complete a household survey form, there is no statistical wealth or income comparison. Hunters are included as a separate group in figure 4-11, however, and clearly fall in the middle of the distribution for both measures.

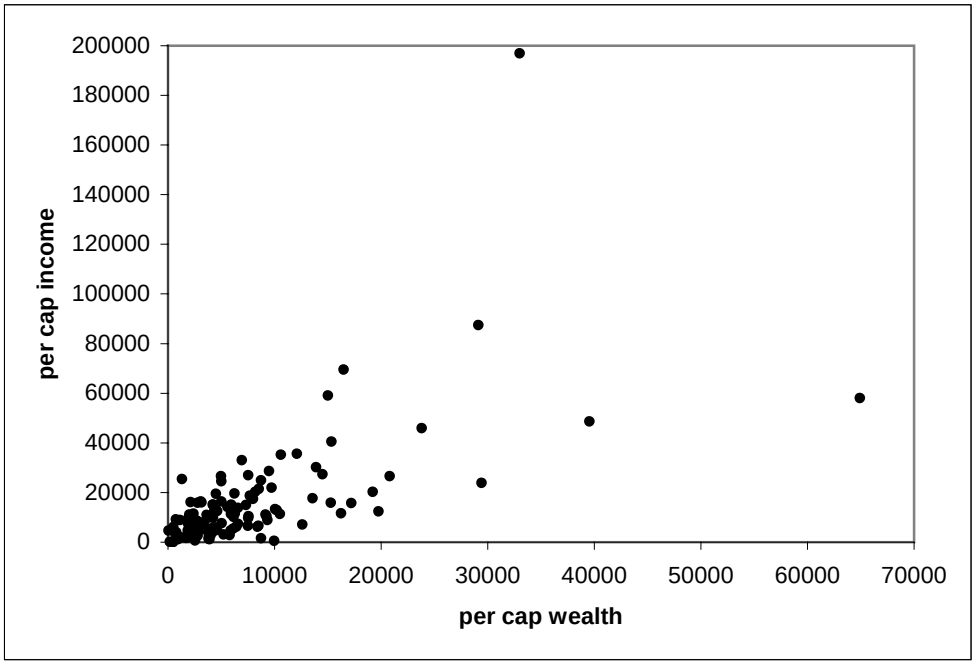
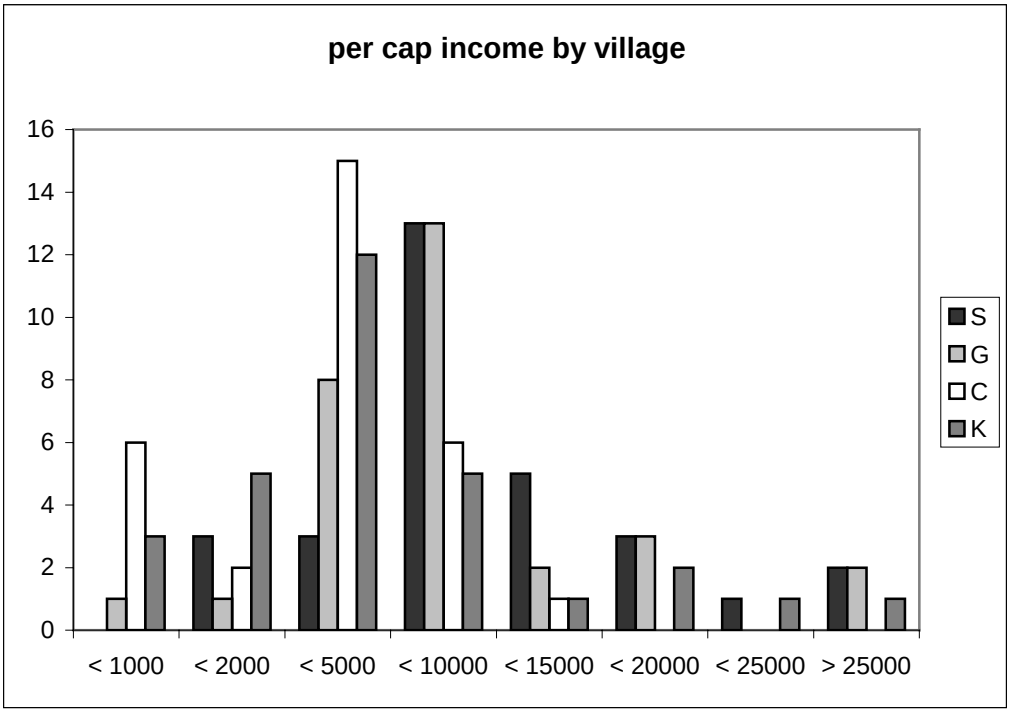


Fig 4-9. Per capita wealth versus per capita annual income (som) of households surveyed. The correlation is significant at the 0.1% level (Spearman's 2-tailed test).

a.



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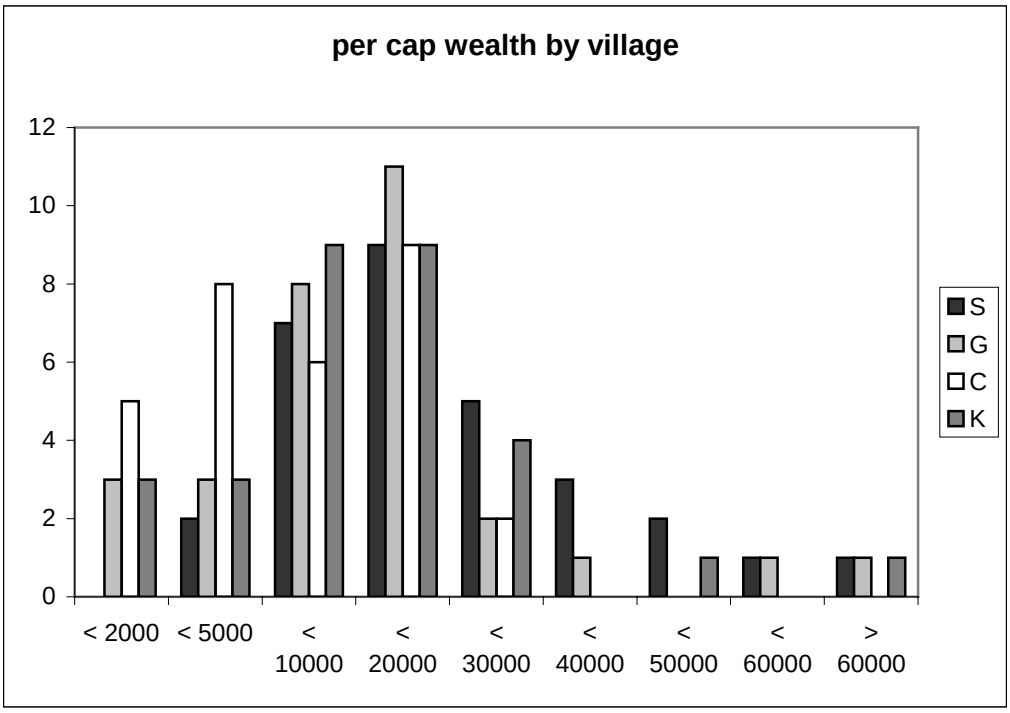
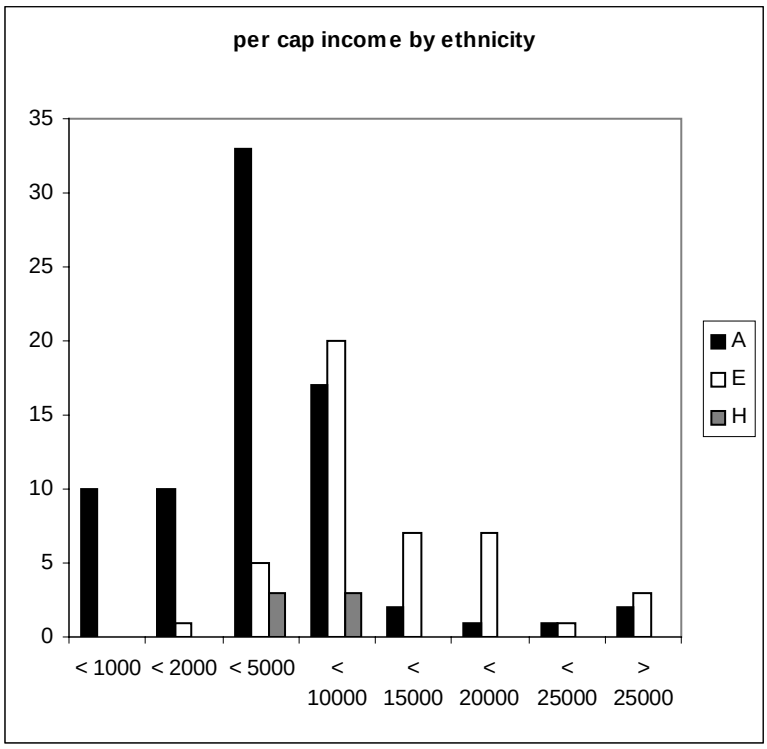


Fig 4-10. Distribution of reported per capita income and wealth by village; S – Semyonovka, G – Grigorevka, C – Chon Sary Oy, K – Kara Oy. In Kruskal-Wallace tests, differences in income were significant at the 0.1% level, and in wealth at the 5% level.

a.



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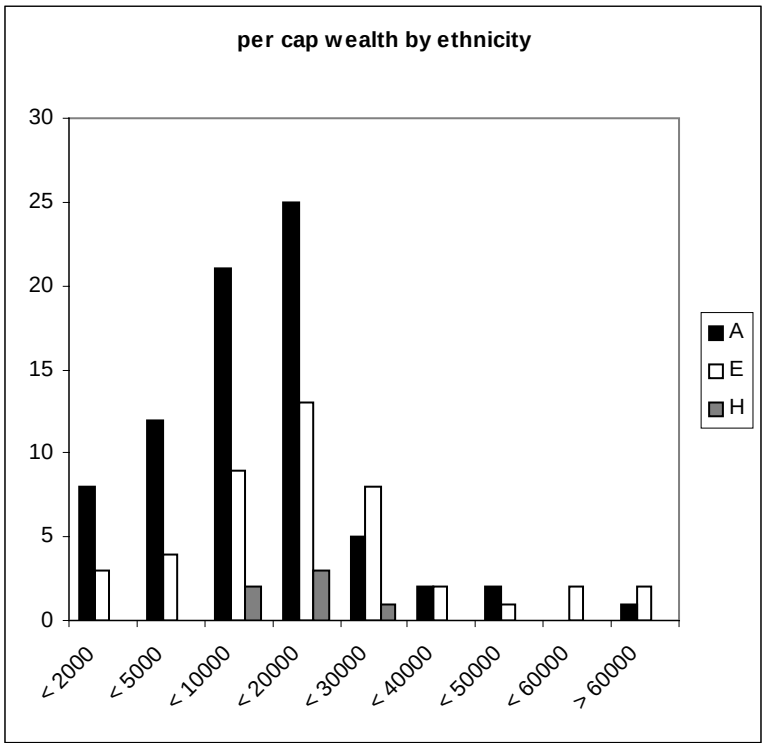


Fig 4-11. Distribution of reported per capita income and wealth by ethnicity, with hunters included for comparison; A – Asiatic, E – European, H - hunter. In Mann-Whitney U tests, differences in income were significant at the 0.1% level, and in wealth at the 5% level. All hunters were Asiatic, but were not included in the statistical comparison.

4.4.4.3 Opportunity cost

Minimum household opportunity costs were unsurprisingly related to household incomes, on which they were based, and showed a similar skewed distribution (fig 4-12). Hunters again fell in the middle of the distribution (fig 4-13), and neither was there an obvious difference in the availability of hunters as measured by the number of male household members self- or unemployed (fig 4-14). Noticeably, 2 of 6 hunters had salaried jobs, suggesting that even in this case, it is not impossible to find time to hunt.

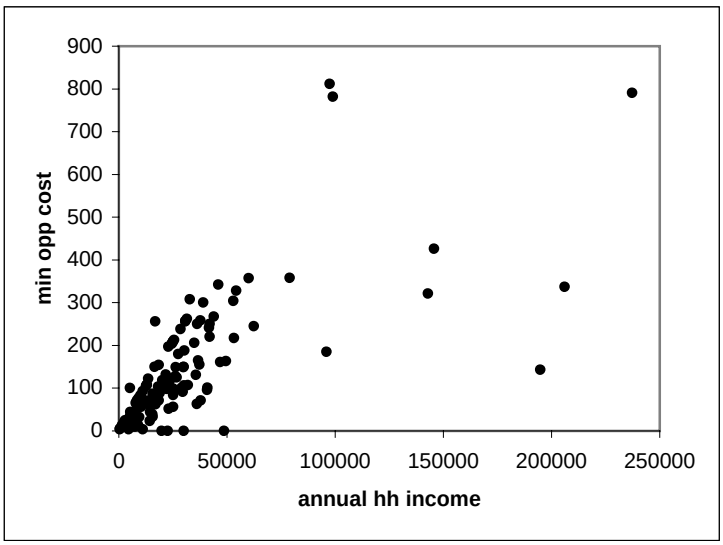


Fig 4-12. Minimum daily opportunity cost versus annual household income (som). Unsurprisingly, there is a strong correlation between the two (Spearman rank correlation; $p<0.001$), but also an asymmetry in the relationship in that minimum opportunity cost may be low when income is high if an individual member does not contribute much to household income, but opportunity cost cannot be high when income is low.

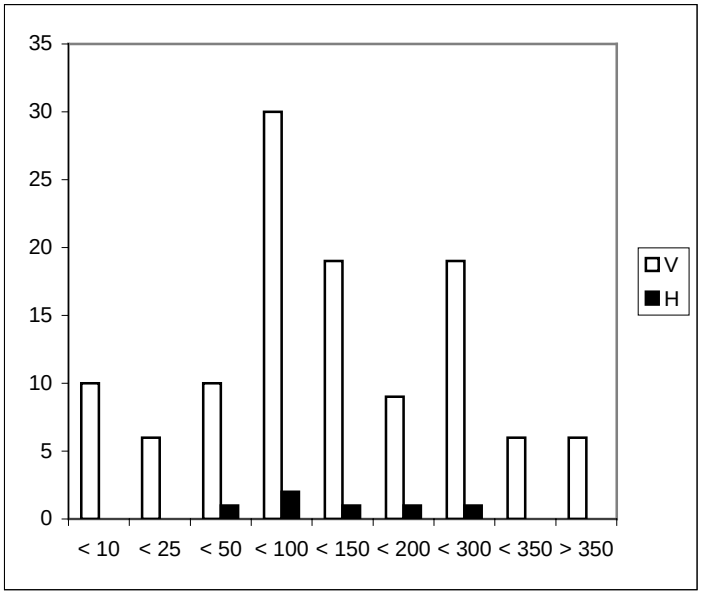


Fig 4-13. Distribution of minimum opportunity costs for villagers selected for the survey at random(V) and hunters (H).

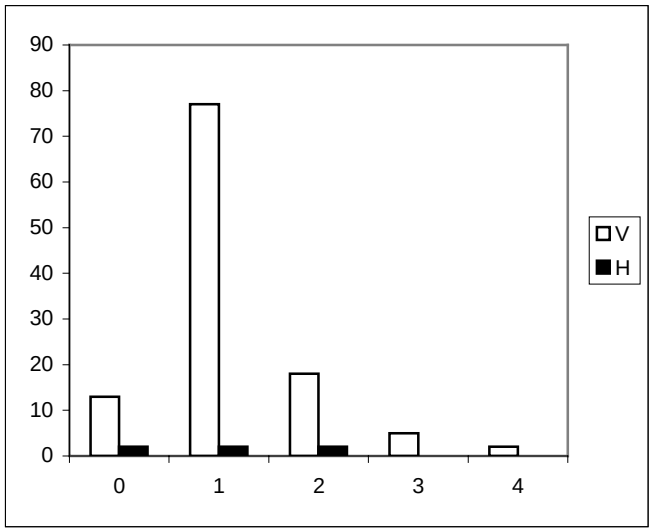


Fig 4-14. Distribution of number of unemployed or self-employed males of hunting age amongst randomly selected villagers (V) and hunters (H).

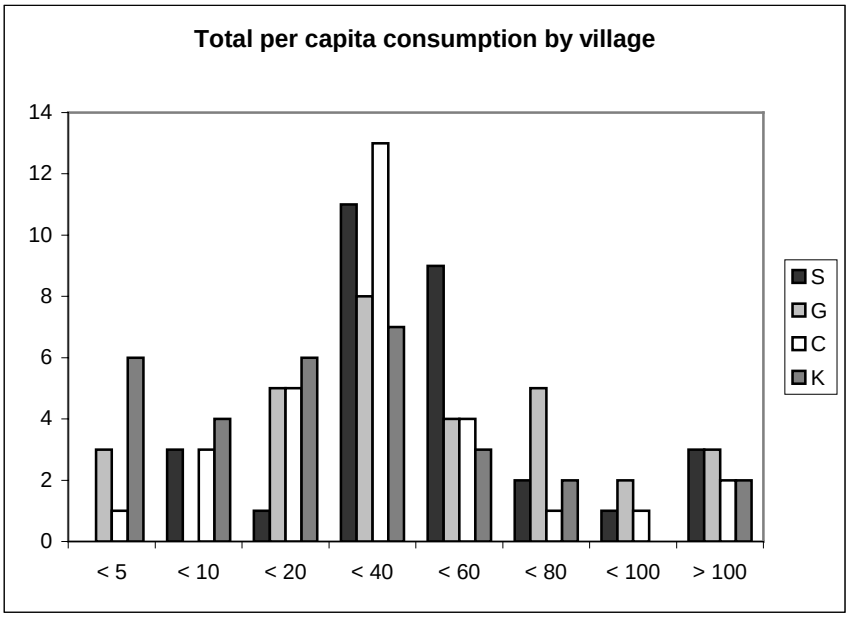
4.4.4.4 Meat consumption and demand

There were significant differences between reports of total per capita meat consumption for different villages and ethnic groups, and a significant correlation between meat consumption and income, but none of the effects was particularly profound (fig 4-15 & 4-16). Hunters averaged towards the upper end of the meat consumption distribution (fig 4-15b), but again, given the small sample size, there was no clear difference.

Five meats, mutton, beef, chicken, pork and fish, made up the bulk of that reportedly consumed, with mutton the most popular, accounting for just over a quarter of the total. There were clear differences in the consumption of different meats by different ethnic groups. Europeans eat relatively less mutton, more chicken, and a large quantity of pork, which is virtually absent from Asiatic diets (fig 4-17). Again cultural differences in reporting cannot be ruled out; it is probable that traditionally Muslim Asiatics would be much less likely to report any pork they do eat and perhaps Europeans to report eating horse. But this reflects existing cultural embargoes and is unlikely to alter the overall picture. Hunters reported eating ibex and other game with much higher frequency than the population as a whole, but even amongst this group, mutton and beef are still the dominant sources of protein.

Median reported equivalence values and consumption relative to mutton are given for each type of meat in table 4-7. The distributions of equivalence values for the most common meats show that preferences were hardly stereotypical, but data suggested that, if anything, equivalence ratios decreased with increasing consumption ratio (fig 4-18). Hence results do not accord with the simple predictions based on either free market or private cost choices.

a.



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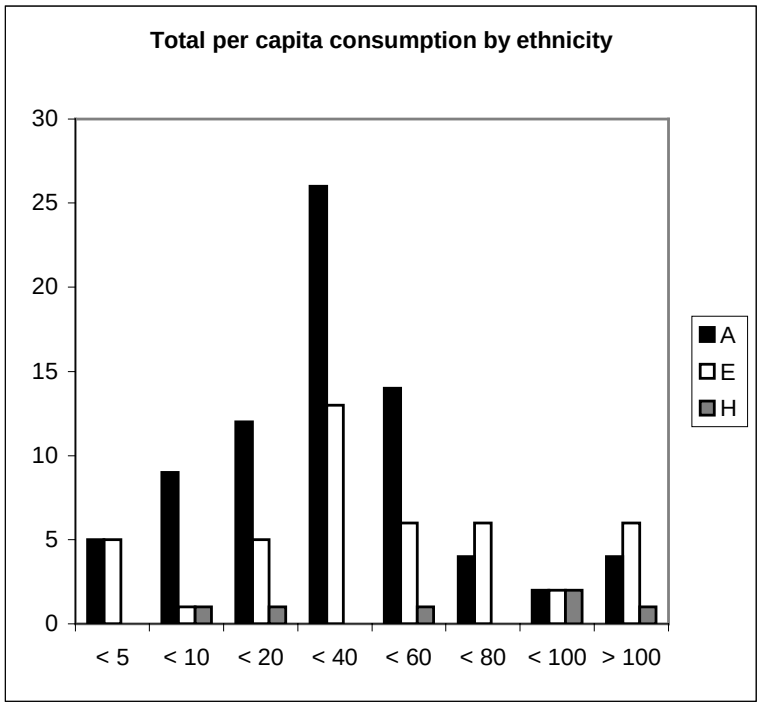


Fig 4-15. Reported total per capita annual consumption of meat (kg) by village and ethnicity with hunters included for comparison. The difference between villages is significant at the 1% level (Kruskal-Wallis test) and that between ethnic groups at the 5% level (Mann-Whitney U test).

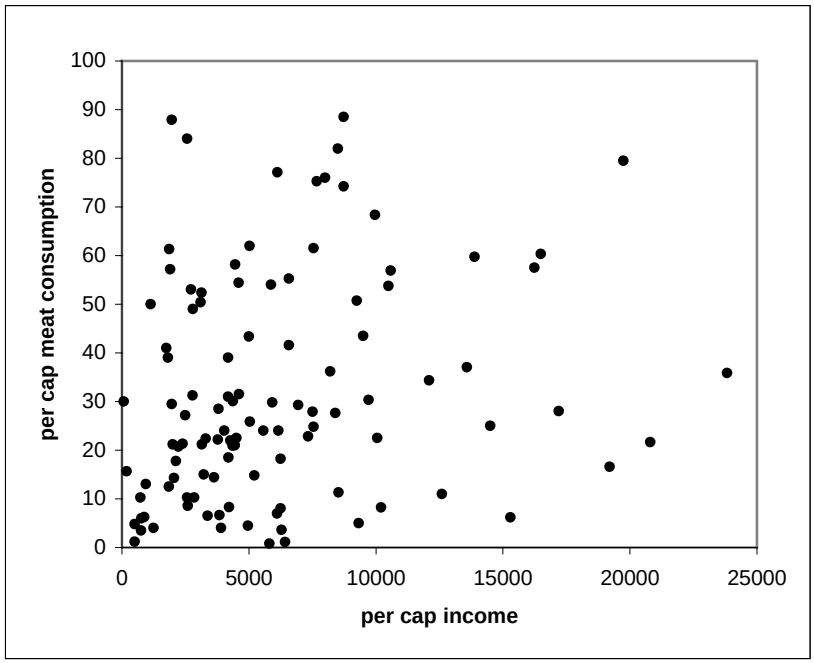


Fig 4-16. Reported total per capita annual meat consumption (kg) versus per capita annual income (som). Although meat consumption is high in Kyrgyzstan, some of the figures reported by individual households were not realistic, reaching up to almost 1kg per person per day. Ten observations above 100 kg yr^{-1} are therefore omitted from the graph and the analysis. Despite the spread of the data, the correlation was significant at the 0.1% level (Spearman's rank correlation).

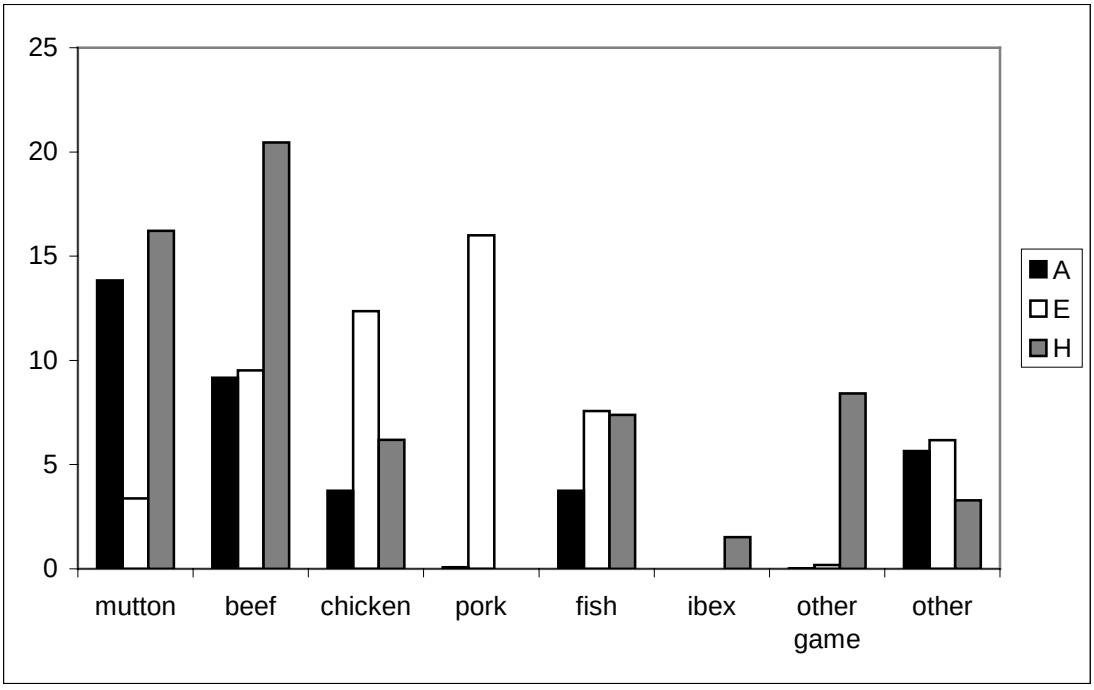


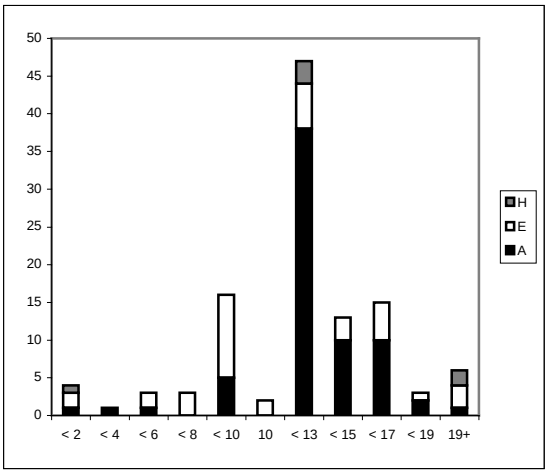
Fig 4-17. Mean per capita annual consumption (kg) of different types of meat amongst Asiatics (n=76), Europeans (n=44) and hunters (n=6).

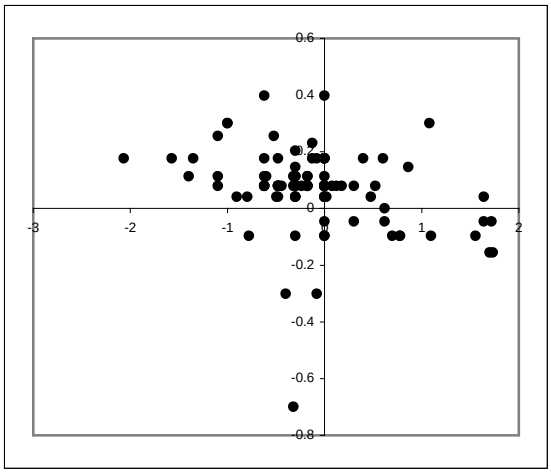
Given that equivalence ratios vary little across consumption ratios, a market scenario seems to be the most appropriate. Under the assumption of a perfect market, the results suggest intrinsic preferences for individual meats are important as price order does not entirely predict consumption order. For instance, beef is eaten in lower quantities that mutton, despite the fact that it is cheaper (table 4-7).

Meat	No. of hh.	Median equiv. ratio	Price (som)	Median cons. ratio	Notes
Mutton	112	NA	70 kg^{-1}	NA	Highest mean consumption overall, and 38% of total meat consumption amongst Asiatics. Generally considered most similar to ibex.
Beef	118	1.2	55 kg^{-1}	1	Marginally preferred by Europeans and marginally disliked by Asiatics.
Chicken	103	1.5	110 whole	0.65	Weight for weight, generally considered inferior to mutton, largely because of the bones.
Pork	43	0.9	100 kg^{-1}	7.2	Eaten almost exclusively by Europeans, amongst whom it is considered slightly superior and is eaten in greatest quantity of any meat.
Fish	80	1.5		0.96	Bimodal distribution of equivalences; some consider it strongly superior, most strongly inferior.
Horse	46	1.5		0.093	Considered inferior and generally consumed by Asiatics in small quantities. It is often given out at funerals and other family events to bulk out higher quality meats.
Yak	8	0.8	65 kg^{-1}	0.12	Half of respondents had a strong preference for yak; considered a more gamy version of beef.
Goat	2	1.9		1.2	Inferior to mutton, but only 2 respondents.
Duck	15	1.3	160 whole	2	Preferences similar to chicken, largely eaten by Europeans.
Turkey	13	1.1	300 whole	0.16	Similar to chicken
Rabbit	11	1.5	250 whole	2	Considered inferior in 8 of 9 preferences expressed.
Ibex	8	1.2		0.025	3 of 8 had a strong preference for it, the remaining 5 had a weak preference for mutton.
Marmot	2	0.6		0.081	Only one respondent gave an equivalence estimate.
Pheasant	8	1.3		0.13	Broad spread of preferences amongst respondents.
Boar	1	1.8		4	Only one hunter reported eating boar.

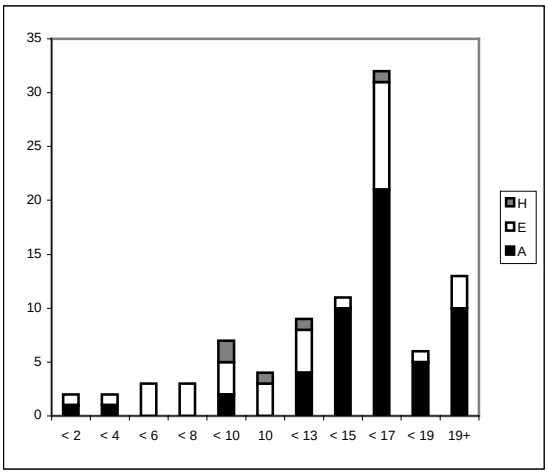
Table 4-7. The number of households (of 126) reporting consumption of each meat type, the median equivalence ration (i.e. equivalent weight of meat / 10 kg mutton), market price and median consumption ratio (wrt mutton). Note that consumption ratios are only for those who consume the meat, so minority meats, eaten in very small quantities in the population as a whole may still have high consumption ratios for the few households where they are consumed. For minority meats, expressed preferences are also likely to be biased, because those who prefer the meat are more likely to eat it.

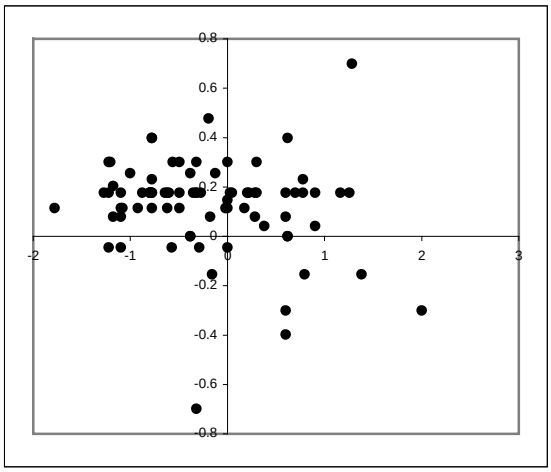
a. Beef



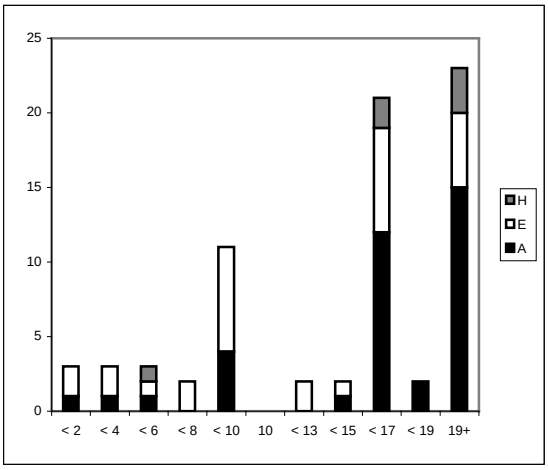


b. Chicken





c. Fish



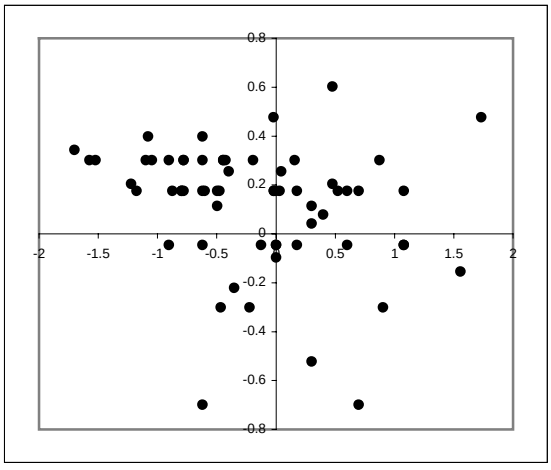


Fig 4-18. The distributions of equivalence estimates (i.e. weight of meat equivalent to 10 kg mutton) by ethnic/hunter group, and log equivalence ratios versus log consumption ratios for beef, chicken and fish. Linear regression lines are shown for the equivalence / consumption ratio plots; the regressions were significant at the 5% level for beef, at the 10% level for fish and non-significant for chicken.

4.5 Conclusions

Methodological weaknesses were apparent in the survey. For instance, it is almost certain that there was under-reporting of occasional or seasonal incomes, and of minor agricultural products, such as eggs, milk and vegetables. Fourteen households reported hiring casual labour (not including the hire of specific equipment or services, such as tractors) during peak agricultural periods, but no household gave an estimated income from casual labour. Estimates of agricultural production were probably influenced by the current year's crop (the survey was carried out in October/November), which is also likely to have biased estimates of total income downwards, as 2002 was a bad year, especially for fruit production. Nevertheless, the income figures produced from the survey are roughly in line with those of similar exercises carried out elsewhere in Kyrgyzstan (InterBilim 2001), and with national per capita GDP ($ 252 or roughly 1200 som, in 2000; UN 2001).

It is known that the accuracy of responses falls off with the length of the period of recall (Wade 02). Estimates of meat consumption were allowed to be open-ended, however, i.e. it was up to respondents whether to give the amount of a meat eaten per week, month, quarter, etc. A more precise method would have been to ask respondents to list the quantities of all the meats eaten within the last day, for example, but this would have missed meats that are eaten only rarely or seasonally, and it was hoped that the relative values given would be meaningful in any event. If respondents had been asked to keep diaries of their meat consumption, then both the sample size and period would have had to be extensive in order to encompass the rarely eaten wild meats that were of most interest.

Similarly, only very approximate estimates of hunting cost can be derived from direct questions to hunters about how long they take on average to make a kill. Similar studies have collected information from individual hunts to make direct estimates (e.g. Alvard 1993; Eves and Ruggiero 2000). In the context of the present study, however, given the number of hunters who could be identified and the typical frequency with which they hunt, it would not have been feasible to obtain statistically meaningful data from this type of study. The effects of the intensity of data collection on the accuracy of the model predictions are explored in chapter 6.

Although there were undoubtedly inaccuracies in estimates of individual incomes, meat consumption, etc., the general economic picture produced is still credible. At a more fundamental and problematic level, however, the socio-economic research illustrates the difficulty of trying to assign specific values where there is no market in operation. Thinking hypothetically is often unfamiliar to subjects without a high level of formal education (Pinker 1998), making it difficult to explore events outside of the immediate sphere. Hence it is difficult to draw many conclusions over patterns of demand for meats because it was not even clear what the metric of preference, equivalent meat weight, was actually measuring. The only firm conclusion seems to be that specific preferences for individual meats, be they due to taste, tradition, religious sentiment, etc., are important to consumption decisions. But economic

analysis tells us nothing about what those preferences should be, so the only way to infer a demand for ibex meat is to make the most plausible assumption about the meat whose demand pattern it is most likely to mirror.

It is also not clear that estimates of daily incomes from labour are a good substitute for the daily opportunity cost of hunting, because there may be hidden constraints to decisions. If, for example, an individual will lose his job if he misses a day's work through hunting, then the opportunity cost may be much higher than his daily wage. If conversely an individual has a flexible work schedule and is limited by the total amount of work on offer, then his opportunity cost may be very low. How should the value added by an individual's input into family agricultural production be assessed? His role might be only one in a chain of steps carried out by other family members, but the other steps may not occur if he does not do his work. In any event, it may be more appropriate to consider not the income derived from an activity, but rather the cost of hiring someone else to carry it out. The share of labour involved in producing an income stream is not the same as the substitutability of that labour.

In the absence of market prices, even more opaque are the preferences involved. If the hardships involved in hunting are genuinely disliked by an individual, then his effective time cost will be much higher than the opportunity cost of other incomes foregone, and vice versa if he genuinely enjoys it. To determine the response in hunting effort from the community as a whole, it is necessary to know not just the preferences of active hunters themselves, but also the distribution of preferences within the entire pool of potential hunters.

Most socio-economic studies of the incentives for subsistence hunting focus on areas where a large proportion of the population (or at least of the adult male population) hunts. Although the number of local active hunters in the NTS is not known, it was clear from the start that it could not be more than a small fraction of the population of nearly 60000. This sets two challenges. Firstly, it suggests that those involved in hunting are somehow different from the bulk of the population, and it is therefore necessary to understand the basis of that difference. Secondly, it implies that in estimating the preferences and opportunity costs that shape hunter behaviour, we may need to estimate the tails of the overall distribution within the population, rather then the hump, which is statistically far more challenging. I.e. it may well be individual preferences and opportunity costs which define the groups of potential hunters in the first place.

It appears that the ibex hunting in the NTS is predominantly or exclusively carried out for meat for private consumption on a casual basis; i.e. hunters do not make a living from hunting ibex, and the meat obtained constitutes only a small fraction of their total meat consumption. When hunting for ibex, hunters do not normally take other prey, so it is appropriate to model the ibex hunting as a single species system (see 4.4.3).

There is no suggestion from the data that hunters are a distinct group in terms of their general economic circumstances or even their consumption preferences, but hunting ibex is physically arduous, and requires knowledge of the mountains and a firearm at least. At present, the pool of potential hunters appears to be restricted to those individuals who already have the experience and equipment to meet these requirements; essentially those who work or used to work as shepherds. Informants suggest that the number of active hunters is not high, but this does not convey information on the potential number of hunters. As a first approximation, this was estimated at 500, according to shepherds' reports of the total number of shepherds who used to work in the area during the soviet period. This cannot be more than a ballpark estimate, but it is also in line with the percentage of the population reporting possession of a firearm during the general household survey; i.e. 4 of 120 households in the general sample reported owning a gun, which would scale up to 500 of an estimated 15000 adult male households for the whole area if the rate were representative of the population in general. The frequentist 95% CI on this estimate is 0-1000, which clearly doesn't make sense as we know there are at least 4 households with guns in the area. Using Bayesian inference with a uniform prior from 0 to 1 on the proportion of households owning guns, p, the posterior probability is approximated by,

$$\Pr\{p = x\} = \frac{x^4 (1-x)^{116}}{\sum_0^1 p^4 (1-p)^{116}} \qquad \textbf{Eqn 4-1.}$$

for whatever interval Δp we might choose (Hilborn & Mangel 1997).

Using *Δp=0.0002*, gives a 95% CI of 202-1237 households (fig 4-19).

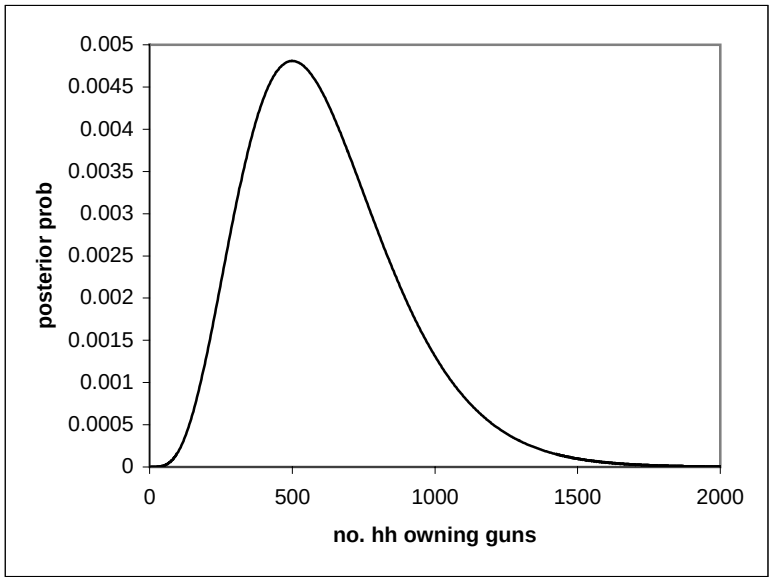


Fig 4-19. Posterior probabilities of the number of households in the study region owning guns, based on Bayesian inference and a uniform prior.

Hunters do not have markedly different incomes from the population at large, but for the reasons discussed, incomes may not translate directly into opportunity cost. Potential hunters may have a

preference for being in the mountains or for hunting itself, or at least a weaker aversion to it, but there is no strong evidence either way. One variable for which survey results were consistent was the rate of pay for casual labour, which in all cases was reported as being at or around 50 som per day. Lacking a much more detailed knowledge of hunter time decisions, it seems most reasonable to take this as a first estimate of opportunity cost. It is likely that there is a surplus of labour in the area as a whole, hence the rate of pay for casual work should reflect the income that necessary to induce someone to work, rather than just spend the day at leisure. For casual hunting, fit around other types of employment, this is likely to be a fair reflection of opportunity cost, but the more time spent hunting the greater the conflict with other activities will be, and so opportunity cost will increase with personal hunting effort. I.e. a lower opportunity cost is appropriate to occasional hunting, than would be for a more regular activity.

The only significant material cost appears to be ammunition. For the population of potential hunters there are no capital or start-up costs, i.e. the assumption that potential participants are limited to those with pre-existing experience and equipment is equivalent to assuming that capital costs for others are prohibitively high.

Strong preferences for ibex meat were not expressed amongst those who consume it, and although there may be a slight preference for wild meat, this does not appear to carry any great significance. Given that ibex meat is generally considered similar to mutton and that most people are net consumers of meat even within rural areas (Leroux and Omuraliev 2001), the most plausible assumption is that ibex meat has equivalent value to the market price of mutton, i.e. 70 som per kg. In those areas where poached ibex meat is sold, it is sold at slightly below the price of mutton because this ensures a quick sale (T. Harder, Chilik shepherd, pers. comm.). As the consumption of ibex meat only accounts for a small proportion of total meat consumption for occasional hunters, it is reasonable to assume that demand is perfectly elastic at the value of 70 som per kg; i.e. hunters' households are not consuming sufficient ibex meat to affect their preferences for it.

Hunters' responses during interviews informed the structure of the simulation model in particular in many general ways, which are discussed in the following chapters. Specific parameter values, used in later models, that were derived from the interviews and household surveys are listed in table 4-8.

Quantity / parameter	Value	Notes
Demand, D	70 som kg^{-1}	Assumed perfectly elastic at the local market price of mutton given that it is considered most similar to mutton and that strong preferences were not expressed. Elastic demand is assumed reasonable given that many substitutes are available and the quantities consumed are small (see above).
Expected hunting time per kill	2.5 days	Hunters' answers indicated several hours of searching to find animals and up to half a day to approach a herd depending on it position. Estimates of success rate varied from about 1 in 2 to 1 in 5 approaches, with a mode at about 1 in 3. The value was therefore calculated assuming roughly 1 in 3 three approaches are successful and that typically one approach per day is made, occasionally two.
Opportunity cost of time, c^o	50 som day^{-1}	Assumed equal to the rate of pay for casual labour in the absence of a better guide (see above). It is assumed that there are 10 hours of activity in the day whilst hunting.
Fixed cost per kill, c^f	18.5 som	Fixed cost per kill is equal to the material cost of consumables and the time cost of the handling time for dressing a carcass, i.e. $c^m + th.c^o$. The only material cost is ammunition. Shells cost about 4.5 som each according to hunters' reports, and three shots per kill are assumed on average, allowing for misses and practice shots. Handling time is assumed to be one hour. Hunters are assumed to already have a reasonable level of competence and suitable equipment, hence there are no capital or start-up costs.
Maximum bag per trip	1	Multiple kills from a single herd are unlikely for hunters armed with shotguns, and seeing as meat is for personal consumption the value of additional kills would be limited as well as causing storage problems. All hunters said that one animal was enough and they would typically return home after this. Several hunters did report making multiple kills during a single trip, but on further questioning admitted that this was a rare occurrence. In any event, multiple kills would only be likely at high prey population density, which is not the circumstance of most interest.
No. of hunters in each group, v	2	Although it is not a fixed property in reality, this was the model reported value (range 1-4), and all hunters reported it as the optimal number. Hunting alone is unsafe, whereas more people create more disturbance.
Maximum number of hunter groups, E_{max}	500	Inferred from gun ownership rate reported during household surveys and the estimated number of current and past shepherds (see above). Only one member of each hunting pair needs suitable equipment and experience, so the number of potentially capable individuals sets the maximum number of groups, not the overall number of group members.
Maximum time for a single hunting trip, T	5 days	No hunter reported trips longer than a week. The consensus was that by the third day of actual hunting, hunters are already tried and ready to return if not successful. One day for travel each way was added to this to give and maximum of 5. Longer trips would present significantly greater logistical complexity. It was also considered that a long weekend would be the maximum time which hunters with other regular employment could spend away from home.
Time spent hunting per year by a single group, t_a	10 days	Reports of the number of trips per year ranged from 1 to 4, with the most common responses being 2 or 3. The Expected time was therefore set to the length of two long hunts. It was also considered that more time spent hunting than this would be likely to interfere with other employment for casual hunters.

Table 4-8. Specific parameter used in later models derived directly from household survey and hunter interview information.