Snow leopards and sustainability: livelihoods, governance and coexistence in the Nepal Himalayas

Image courtesy of Jorien Schuurmanns

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Jonathan H. Hanson

Hughes Hall College

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This thesis seeks to understand the coexistence that occurs between people and snow leopards on the roof of the world. Within a political ecology framework, it aims to show how various social and economic factors can influence this coexistence and promote the conservation of Himalayan species and ecosystems. In particular, the thesis addresses the twin assumptions that access to assets, via more diverse livelihoods, and access to influence, via decentralised conservation governance, will improve coexistence. The study opens with an assessment of household livelihoods and then compares them between two iconic but contrasting Protected Areas. The thesis then assesses: (i) knowledge of and attitudes to snow leopards; (ii) attitudes to their conservation; (iii) household livestock losses to snow leopards; and (iv) conflicts between people and snow leopard conservation. Additionally, perceptions of several proposed mitigation methods are also examined.

The political ecology framework employs access theory, the Sustainable Livelihoods model and a mixed-methods approach. Using systematic sampling, a quantitative questionnaire was administered to 705 households at two sites in the Nepal Himalayas: Sagarmatha National Park, with a centralised governance model, and Annapurna Conservation Area, with a decentralised one. Seventy qualitative interviews were also collected for cross-methods triangulation. Multiple and logistic regression models were the main form of statistical analyses.

Access to tourism income, and larger household size, best explained livelihoods scores. Attitudes to snow leopards were best explained by attitudes to their conservation and numbers of livestock owned per household. Attitudes to snow leopard conservation depended on perceptions of snow leopards and household livelihoods. Perceptions of conflict with snow leopards and their conservation was related to the number of livestock lost by any source of mortality. A number of variables explained attitudes to the proposed mitigation measures, including gender, livelihood strategies, livestock numbers and support for snow leopard conservation.

In conclusion, access to assets and access to influence do shape human coexistence with snow leopards and their conservation, albeit in more nuanced ways than anticipated.

In a hundred ages of the gods

I could not tell thee of all the glories of Himal.

The Skanda Purana

The snow leopard will lie down with the lamb,

and the lynx shall lie down with the young goat,

and the calf and the wolf and the fattened calf together;

and a little Sherpa child shall lead them.

The cow and the bear shall graze;

their young shall lie down together;

and the snow leopard shall eat straw like an ox.

The Gurung child shall play over the hole of the cobra,

and the Ladakhi child shall put his hand on the adder's den.

They shall not hurt or destroy in all my holy mountains;

for the Himalayas shall be full of the knowledge of the Lord

as the waters cover the sea.

Adapted from the Book of Isaiah

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ACRONYMS

ACA	Annapurna Conservation Area
ACAP	Annapurna Conservation Area Project
CAMC	Conservation Area Management Committee
CBC	Community-Based Conservation
CBNRM	Community-Based Natural Resource Management
CBO	Community-Based Organisation
DDC	District Development Committee
DNPWC	Department of National Parks and Wildlife Conservation
FDI	Foreign Direct Investment
FUG	Forest User Groups
GHG	Greenhouse Gas
HCC	Human-Conservation Conflicts
HHC	Human-Human conflict
HWC	Human-Wildlife Coexistence
HWI	Human-Wildlife Impacts
ICDP	Integrated Conservation and Development Project
KCA	Kanchenjunga Conservation Area
MAP	Medicinal and Aromatic Plant
MBNP	Makalu-Barun National Park
NGO	Non-Governmental Organisation
NP	National Park
NTFP	Non-Timber Forest Product
NTNC	National Trust for Nature Conservation
ODA	Overseas Development Assistance
PA	Protected Area
PEC	Payments to Encourage Coexistence
PES	Payments for Ecosystem Services
SNP	Sagarmatha National Park
SLCAP	Snow Leopard Conservation Action Plan
SLI	Sustainable Livelihoods Index
SLN	Snow Leopard Network
THED	Theory of Himalayan Environmental Degradation
VDC	Village Development Committee

1. Introduction

The community experiencing greater levels of livestock losses was comparatively more tolerant of the snow leopard...[it] is more dependent on cash crops as a source of income while the...[other]...is more dependent on livestock, and thereby less tolerant of the snow leopard.

Bagchi and Mishra 2006

1.1 Thesis context

This thesis is about snow leopards and sustainability. To be precise, it is about how livelihoods, or access to assets, and governance, or access to influence, shape coexistence between people and snow leopards in the Himalayas of Nepal. Its findings suggest that ownership of, damage to and compensation for livestock; the positive and negative contributions of tourism, including revenue sharing; and attitudes to snow leopard conservation, all play nuanced but particularly significant roles in mediating and explaining these relationships.

The snow leopard *Panthera uncia* is an endangered wild felid inhabiting mountainous areas of twelve South and Central Asian states. With overall numbers estimated at between 4080 – 6590, snow leopards are listed as Endangered on the IUCN Red List (Jackson et al., 2008). They face numerous anthropogenic threats, primarily associated with competition with people for habitat, prey and livestock (Jackson et al., 2010, 2013; McCarthy and Chapron, 2003; Mishra et al., 2016; Mohammed et al., 2016), but also from climate change (Farrington and Li, 2016; Forrest et al., 2012), economic developments such as infrastructure and mining (GSLEP, 2013; Zahler et al., 2016), and poaching (Maheshwari and Meibom, 2016; Nowell et al., 2016).

Poverty and pastoralism are prevalent among the human populations living across the snow leopard's range (Jackson et al, 2010). Livestock predation by snow leopards is both a threat to their livelihoods, via human-wildlife impacts (HWI), and a source of conflict between these communities and those who seek to conserve the species, via human-conservation conflicts (HCC). In the recent Snow Leopard Network (SLN) threat analysis (Snow Leopard Network, 2013), for example, growing livestock populations and intensifying 'human-wildlife conflict' were identified as the most severe threats to the species. The importance of research on these human dimensions of snow leopard conservation was highlighted in the various versions of the Snow Leopard Survival Strategy (Jackson et al., 2013; Kumar, 2011; McCarthy and Chapron, 2003). Here, socio-economic profiling of herder communities and human attitudes to snow leopards were outlined as key research needs, particularly in the Himalayan region.

Many existing studies make the assumption that more sustainable livelihoods are available for local communities. Such livelihoods would result in better attitudes to, and improved coexistence, with snow leopards, as found in Spiti, India (Bagchi and Mishra, 2006; Suryawanshi et al., 2014). These Indian studies, however, used proxy variables for, rather than a more comprehensive and holistic measure of, livelihood diversification, such as the Sustainable Livelihoods framework (Scoones, 1998).

There have also been limited examinations of local peoples' conflict with, and attitudes to, snow leopard conservation, both actors – such as protected area (PA) and non-governmental organisations (NGOs) staff - and interventions. This has been highlighted as an important information gap (Rosen et al., 2012), but it has remained largely unfulfilled until now. Finally, a decentralised model of conservation governance has often been promoted as the best option for conserving the species (Jackson et al., 2010; Jackson, 2012; Johansson et al., 2016). However, its effects on human-snow leopard coexistence have not been examined to date, nor has it been compared with more centralised models.

1.2 Thesis aim and research questions

The overall aim of this thesis was to understand how access to assets and access to influence, in relation to other factors, shape coexistence between humans, snow leopards and snow leopard conservation. This aim is supported by five research questions:

- **Livelihoods**: What do household livelihoods involve, in terms of access to various asset classes, and which factors best explain them?
- **Governance**: How do household livelihoods vary between Sagarmatha National Park (SNP) and Annapurna Conservation Area (ACA), and to what extent does governance explain this variation, among other factors?
- **Knowledge and attitudes**: What are individuals' knowledge of snow leopards, attitudes to snow leopards and attitudes to snow leopard conservation, and which factors best explain all of these?

- **Impacts and conflicts**: What impacts from snow leopards, and conflicts with snow leopard conservation, do households face, and which factors best explain both of these?
- **Mitigation**: What are individuals' attitudes to two proposed mitigation methods, namely the translocation of blue sheep to SNP and a conservation incentive scheme in ACA, and which factors best explain both of these?

1.3 Thesis outline

To address the aim and research questions, the study draws upon a political ecology perspective (Adams, 2013; Blaikie and Brookfield, 1987; Robbins, 2011), access theory (Ribot, 2014; Ribot and Peluso, 2003) and the Sustainable Livelihoods framework (Carswell and Jones, 2004; Chambers and Conway, 1992; Scoones, 2009). This theoretical approach is reviewed in more detail in Chapter Two, along with the literature on livelihoods; governance; knowledge of and attitudes to wildlife and conservation; wildlife impacts and conservation conflicts; and mitigation methods.

Chapter Three reviews the relevant literature on Nepal specifically. Sections on the conservation context in both Royalist and Republican Nepal are followed by reviews of the study sites. This includes geography, history, livelihood strategies, and governance arrangements, as well as a review of human-snow leopard coexistence in both SNP and ACA.

The methodology of the thesis is considered in Chapter Four. This section includes reviews of research theory, research design and research logistics. In summary, the approach taken was as follows. Using systematic sampling, a quantitative questionnaire was administered to 705 households at two sites in the Nepal Himalayas: Sagarmatha National Park, with a centralised governance model, and Annapurna Conservation Area, with a decentralised model. This data was analysed quantitatively using descriptive, bivariate inferential and multivariate inferential statistics. Seventy qualitative interviews were also undertaken for concurrent cross-methods triangulation and were analysed both quantitatively and qualitatively.

Chapter Five considers livelihoods. Based on a combined sample from both SNP and ACA it profiles household access to the five asset classes included in the Sustainable

Livelihoods framework - natural, social, financial, human and physical – and also aggregates this data to form a composite index: the Sustainable Livelihoods Index (SLI). The section also analyses relationships between household SLI scores and various explanatory variables, in both bivariate and multivariate terms.

Chapter Six then compares household access to the same assets considered in Chapter Five between ACA and SNP. It does so on a case-by-case basis and for overall household SLI scores, and also develops separate multiple regression models for livelihoods in each PA. Qualitative data provides more nuanced perspectives on this numerical data, particularly on how governance relates to livelihoods.

The first empirical chapter to relate livelihoods and governance to human-snow leopard coexistence is Chapter Seven. Here, individual knowledge of the species, local attitudes to the species and attitudes to its conservation are considered, as well as the various factors that shape these perceptions, including access to assets and influence. For each of the three results sections in the chapter, descriptive and inferential analyses are considered in turn.

The next chapter of the thesis considers more tangible aspects of the relationship between people and snow leopards. In both SNP and ACA over the previous 12 months, Chapter Eight profiles human-wildlife impacts (HWI), via self-reported household livestock losses, and human-conservation conflicts (HCC), via self-reported household incidents of conflict with snow leopard conservation. The chapter also considers the inferential relationships between this data and a range of variables.

Chapter Nine is the final empirical chapter and analyses attitudes to two proposed methods for mitigating HWI and HCC, one at each study site. In SNP, individual attitudes to the proposed translocation of blue sheep to the area are presented and discussed. In ACA, individual attitudes to a proposed snow leopard conservation incentive scheme are dissected. Chapter Nine is followed by a summary and conclusion; the bibliography; and the appendices.

2. The geography of human-snow leopard coexistence

2.1 Introduction

The previous section gave an introduction to and overview of the study. This chapter will review the literature that has shaped its theory, context and methodology. Theoretical approaches are outlined, followed by a review of publications on livelihoods. The concept of governance is closely linked and is considered next. Three succeeding sections will then deal with the varied aspects of HWC considered in this thesis, namely: (i) knowledge and attitudes; (ii) wildlife impacts and conservation conflicts; and (iii) conflict mitigation. Throughout, the evidence in the literature for this study's central theoretical argument, that access to assets and access to influence shapes coexistence between people and snow leopards, is collated and critiqued.

2.2 Theoretical approaches

Most conservationists are trained to know about biology, not capitalism.

Adams 2013

2.2.1 Political ecology

Political ecology marries the approach of ecological science with political economy, identifying structural, 'power-laden' and normative dimensions of nature, natural resources and their conservation (Robbins, 2011). Its five dominant narratives have been categorised as: 'degradation and marginalisation'; 'conservation and control'; environmental conflict and exclusion'; environmental subjects and identity'; and 'political objects and actors' (Robbins, 2011). Political ecology grew out of attempts, in the latter half of the 20th century, to understand the integration of the natural and social components of land degradation, notably with soil erosion in Nepal (Blaikie and Brookfield, 1987). This in turn had drawn upon developments in other disciplines as diverse as systems theory, ecological anthropology and disaster research (Watts and Peet, 2004). The 'new' approach of political ecology took as its starting point for comprehending environmental destruction the varied forms and phases of capitalism (Peet et al., 2011), an argument particularly pertinent to conservation given its legacy of colonialism (Adams and Mulligan, 2003).

Emanating from this historical context, more authoritarian aspects of contemporary conservation – known variously as 'fortress' or 'fences-and-fines' conservation – have been negatively critiqued by political ecology (Brockington et al., 2006). So too have recent trends towards the renewed commodification and financialisation of nature by neoliberal biodiversity conservation (Büscher et al., 2012; Scales, 2015). Political ecology has both scrutinised and criticised this growing tendency to 'save' nature *through* free-market capitalism, rather than *from* free-market capitalism.

This has been assisted by broadening of the scope of conservation, away from a limited focus on localised threats to 'pristine' landscapes (Robbins, 2011), towards a global synthesis of drivers of biodiversity loss, including governance failures (Dickman et al., 2015; Kelman, 2013), consumer lifestyles and fashions (Baland et al., 2007; Berger et al., 2013), and climate change (Forrest et al., 2012). In addition to these developments, the pluralist nature of political ecology has also contributed to a diverse assemblage of conservation movements and practitioners (McShane et al., 2011; Sandbrook, 2015), as well as increasing engagement with non-traditional environmental movements, such as religion (Mikusiński et al., 2014).

2.2.2 Access theory

Although distinct from political ecology, access theory has a similar critical function. Developed by Ribot and Peluso (2003), it defines access as 'the *ability* to derive benefits from things' as 'a bundle of powers', in direct contrast to property's more formalised '*right* to derive benefits' as a 'bundle of rights'. By broadening the range of social relations that contribute to or constrain benefits from resources, beyond property relations as well as beyond rigid Marxist notions of class, access theory allows processes and relationships of access to be analysed (Ribot and Peluso, 2003). Crucially, it also considers how access to influence or power, and the shaping of the political-economic context that may result, is a key component of the theory (Ribot, 2014). Ribot and Peluso (2003) list the potential access mechanisms as technology, capital, markets, labour, knowledge, authority, social identity or other social relations, as well as via legal or illegal rights-based approaches. Crucially, they also consider how responses to stressors, such as climate change, can affect or be affected by access to assets. In this study, the potential stressor is snow leopard predation on livestock.

By its focus on power, access theory links clearly to political ecology. In their classic political ecology text, Blaikie and Brookfield (1987) comment that, among other factors, the denial of access to common property resources can increase the pressure of households to produce, which in turn can intensify the degradation of land as an asset. Others have noted the potential contributions of inequality to access to environmental assets (Baland et al., 2007). Furthermore, as direct access to natural capital becomes less important, the importance of access to other assets to maintain livelihood strategies by individuals, households and communities increases (Angelsen et al., 2014; Bebbington and Perreault, 1999).

2.2.3 Sustainable Livelihoods framework

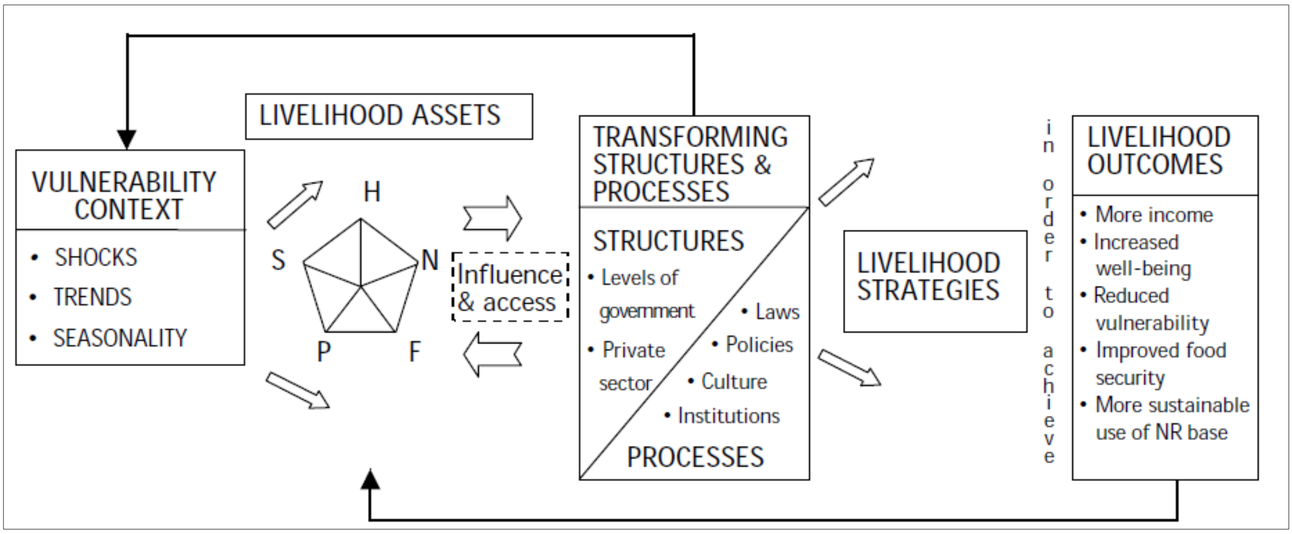
The Sustainable Livelihoods framework provides a practical mechanism for integrating livelihood analysis with a political ecology perspective, as well as with access theory. Emanating from the 1987 World Commission on Environment and Development and other similar integrated approaches (Rigby et al., 2000; Scoones, 2009; Woodhouse et al., 2000), as well as from concerns with the absence of multiple dimensions from conventional poverty analysis (Chambers and Conway, 1992), the concept of Sustainable Livelihoods was proposed. This took an asset-based approach, focusing primarily on the means people had to improve and secure their livelihoods (Carswell and Jones, 2004; Chambers and Conway, 1992; DFID, 1999; Scoones, 2009; Steimann, 2005).

In their seminal working paper Chambers and Conway (1992) proposed this definition for livelihoods which comprise:

> The capabilities, assets (including both materials and social resources) and activities for a means of living. A livelihood is sustainable when it can cope with and recover from stresses and shocks, maintain or enhance its capabilities and assets, while not undermining the natural resource base.

This approach showed how households utilised a repertoire of capabilities and activities to transform a portfolio of tangible and intangible assets into a livelihood (Chambers and Conway, 1992; Dorward, 2009). Furthermore, the framework integrates productive work, poverty reduction, wellbeing and capabilities with resilience and environmental sustainability (Bebbington, 1999; Scoones, 1998). It does so by combining different types of capital: natural, financial, physical, human and social (Figure 2.1). Influence and access, that affect how assets can be controlled or utilised, are also important (DFID, 1999). The inclusion of vulnerability contexts in the framework (Figure 2.1) typically assesses resilience to stressors, such as climate change. However, in this study, as mentioned previously, the main stressor is livestock losses to snow leopards, which can be low-level and continuous, or occasional and stochastic (Jackson et al., 2010).

Figure 2.1 Sustainable Livelihoods framework



Source: DFID, 1999. Key: H = Human Capital; N = Natural Capital; F = Financial Capital; S = Social Capital; P = Physical Capital.

The Sustainable Livelihoods framework provides a more holistic measure of household assets and capabilities than econometric indices (Appleton and Booth, 2005; Chambers and Conway, 1992), and, crucially, identifies the trade-offs between the different elements of the model (Carswell and Jones, 2004). It has been widely used for both development- (Carswell and Jones, 2004) and conservation-related social assessments (Schreckenberg tet al., 2010), including as part of quantitative household surveys (Steimann, 2005). On the other hand, the approach has been criticised for being overly complex, and the framework for paying insufficient attention to power and environmental sustainability (Carswell and Jones, 2004; Dorward, 2009; Kay, 2006; Scoones, 2009). Yet, if both environmental and governance issues are to be adequately examined, complexity is both necessary and expected.

It is through the medium of power that the Sustainable Livelihoods framework fits best with a political ecology perspective and with access theory in this study. Firstly, via practical application of the framework, political ecology can become both 'critical *and* developmentalist, radical *and* relevant' (Bebbington and Perreault, 1999). Secondly, particular attention is paid by both approaches to social capital as a means by which households can access influence, as well as other assets (Bebbington, 1999; Ribot and Peluso, 2003). Thirdly, some analyses of the Sustainable Livelihoods framework include intangible assets as well as tangible assets, and this is a clear fit with the idea of influence as a critical, yet intangible, component of livelihoods and their governance (Chambers and Conway, 1992). Figure 2.1 for instance, includes ‘access and influence’ as a mediator between the various asset classes and ‘transforming structures and processes’.

2.2.4 Mixed-methods

Given the combination of qualitative and quantitative concepts dealt with by a political ecology perspective, access theory and the Sustainable Livelihoods framework, it follows that a mixed-methods approach is the best means to pursue research in these areas. However, conservation, with its basis in natural science has often had an historic tendency towards a positivist ontology, corresponding to dualist analyses and interventions (Ghosal et al., 2013). One the one hand, some assume that conservation research is automatically ecological in nature (Chan et al., 2007). On the other hand, others recognise that social science is as inherently necessary to conservation research as natural science is (Macdonald et al., 2010; Mascia et al., 2003; Redford, 2011). Recent qualitative research on human-carnivore coexistence in Namibia, for instance, has shown its potential for explicating the nuanced and diverse *causes* of conflicts between people over wildlife, as well as potential solutions (Rust, 2016; Rust et al., 2016).

The ongoing debate about the precise definition of conservation mirrors this tension about the nature of conservation research. While some make the case for a sharply-defined process focused on the intrinsic value of wild biodiversity only (Soulé, 2013), others recognise that conservation is, rather, a polyglot and pluralist movement valuing wild *and* agricultural biodiversity for, often overlapping, intrinsic *and* instrumental reasons (Kaimowitz and Sheil, 2007; Sandbrook, 2015). As a social process, conservation needs to accommodate the quantitative and the qualitative, as well as the diverse and sometimes contradictory, nature of its human practitioners, in both its definitions and its research.

Accordingly, a mixed-methods perspective, despite its complexity (Raymond et al., 2010), is a natural fit with the theoretical approach outlined in this section. While Chapter Four outlines the study’s methodology in greater detail, the conceptual focus on power and practicality, access and assets, detailed here, leads to a participatory (Rawat et al., 2010) and applied (Raymond, 2010) conservation study that combines different knowledge-types (Rawat et al., 2010; Raymond et al., 2010; Robbins, 2003). It is with numbers *and* words that we make sense of the world, and it is with numbers *and* words that we must make sense of conservation.

2.3 Livelihoods

[Conservationists] see their job as saving nature in its last fastness, and not as considering the wider picture of the world economy.

Adams 2013

2.3.1 Global development

The global economy has a powerful effect on people and nature. Numerous authors have described the environmental and social impacts of mainstream development (Blaikie and Brookfield, 1987; Nygren, 2000; Swiderska et al., 2008). As discussed in Section 2.2.1, a political ecology/economy perspective allows a more critical analysis of these workings and effects, particularly the inclusion or exclusion of particular groups and places (Ribot, 2014). This is an issue with which conservation has struggled to adequately engage (Adams, 2013). Yet growing evidence of a series of global environmental limits – such as atmospheric Greenhouse Gas (GHG) levels – and of a finite resource-base, make addressing the inter-linked challenges of biodiversity conservation and poverty alleviation more important than ever (Evans, 2011). There are a number of dimensions to this debate on livelihoods and global development.

Firstly, there is the issue of inequality. At the international level, one study found that 30% of global species threats were directly related to international trade in commodities, with countries in the Global South as net exporters of biodiversity and nations in the Global North as net importers (Lenzen et al., 2012). Inequalities of power and wealth have also been associated with environmental degradation within states and communities, especially with resources held in common, although this is often dependent on the institutional settings that structure such relationships (Baland et al., 2007; Blaikie and Brookfield, 1987; Boyce, 1994).

Secondly, there is the issue of consumption. Poverty can contribute to a limited 'aspirations window', as the size of the wealth gap can discourage attempts to close it

(Ray, 2006). Development can, inevitably and understandably, narrow this gap, contributing to aspirations, by both poor *and* rich alike, of ever increasing but, nevertheless, unsustainable levels of consumption (Fischer et al., 2012; Jorgenson, 2003; Walpole, 2006). Trying to shape poor peoples' livelihood aspirations is a complex moral quandary, while still attempting to achieve a balance between economic development and its ecological impacts (Adams, 2013).

The necessary conservation response is therefore twofold. Firstly, conservation needs to recognise more comprehensively the world economy as a driver of biodiversity loss, rather than employ a limited focus on rural poverty in biodiversity hotspots (Adams, 2013; Kelman, 2013; Scales, 2015). In particular, it needs to critique and, where necessary challenge, the various iterations of development - whether relatively new efforts to develop a green economy (Rasmussen, 2012), or market environmentalism (Adams, 2009). These can hand too much power to the market. The optimum size and critical role of the state also needs to be defined (Kay, 2006). Secondly, conservation needs to better communicate and lobby for the mainstreaming of biodiversity issues into development policies at the global level, whether related to foreign direct investment (FDI) or overseas development assistance (ODA) (Swiderska et al., 2008).

2.3.2 Rural development

Nevertheless, despite the critical need for considering the workings of the global economy, the issue of livelihoods in rural areas remains a key concern for conservation. Many rural communities are dependent on significant income from environmental goods, often with a negative correlation between household income and wild biodiversity-dependence (Angelsen et al., 2014; López-Feldman, 2014; Roe et al., 2013; agricultural dependence is considered in the following section). Out of a sample of 8,000 households in 24 developing countries, environmental income accounted for 28% of total household income, of which 77% came from natural forests (Angelsen et al., 2014). Both timber (Förster et al., 2011; Gichuki, 1999) and NTFPs (Larsen and Smith, 2004; Saxena et al., 2002) are important in this regard, with total household income of 19% to 32% from the latter in north-eastern India (Saha and Sundriyal, 2012). Biodiversity also has a particularly important role as a livelihoods safety-net (Roe et al., 2013a).

As a component of the world economy, rural development is shaped by similar forces to those that affect global development. For rural areas in general these can include urbanisation (Beyene, 2012), land abandonment (Wakeel et al., 2005) and population pressures (Gichuki, 1999), all of which can shape livelihoods and change dependencies on environmental income. Mountainous regions, with their disproportionate share of global poverty (ICIMOD, 2011), often have livelihood systems that are particularly vulnerable (Alexander et al., 2016), due to their inherent fragility, inaccessibility and marginality (Ellis-Jones, 1999; Hurni et al., 2012; Magnani, 2012).

Yet, whether montane or otherwise, rural development has the potential to simultaneously increase household income and reduce direct reliance on wild biodiversity. Strategies that can contribute to this outcome include access to fair markets (Rasmussen, 2012), appropriate technology (Butler and Mazur, 2007) and the development of grassroots institutions and networks (Kristjanson et al., 2007). However, 'residual' perspectives on rural development that define poverty in terms of market access alone should be treated cautiously and a more critical 'relational' approach be promoted that involves the restructuring of social relations on more equitable terms (Borras, 2009). As with global development, power-relations are a critical influence on rural livelihoods and development.

2.3.3 Agriculture in the 21st century

Rural development is inextricably linked to agricultural development. Farming is the world's most extensive form of anthropgenic land-use and is associated with a range of negative environmental impacts, including water pollution, excessive Greenhouse Gas (GHG) emissions and biodiversity loss (Balmford et al., 2012; Foley et al., 2011). Exacerbated by globalisation, there are also concerns about the loss of agricultural bio- and cultural diversity, and about the increasing dominance of powerful multinational companies in the food system (Bardsley, 2003). Added to this is the strategic imperative of feeding the world's growing population (Foley et al., 2011), a debate which often ignores the specific challenges and contributions of high mountain areas (Dame and Nusser, 2011).

This globalisation has forced conservation to engage more with farming and other land-use forms (Zimmerer, 2006), although there is a need for even greater recognition (Balmford et al., 2012). Much of the problem for conservation lies with the market's inability to value and maintain diversity (Bardsley, 2003), as well as with the shifting power dynamics of agricultural political economy (Borras, 2009; Kay, 2006). Solutions proposed to balancing these various and competing socio and environmental demands of agriculture in the 21st century range from the top-down and techno-scientific (Godfray et al., 2010) to bottom-up agroecology approaches (Bardsley, 2003), with many advocating a combination of both (Foley et al., 2011). Maximising short-term productivity, for example, needs to be tempered with longer-term integrated socio-ecological considerations, including the maintenance of wildlife (Foley et al., 2011).

2.3.4 Peasant agriculture

This balancing of objectives is crucial for smallholder or peasant farming, particularly in the Global South. Mixed, poly-cultural agriculture have traditionally been associated with high levels of agricultural biodiversity (Bardsley, 2003; Negi et al., 2009), as well as a reliance on wild biodiversity and ecosystems (Nautiyal and Kaechele, 2009). Forest-agriculture ecotones in the Indian sub-continent are a good example of these diverse and integrated farming systems (Bawa et al., 2007; Semwal et al., 2004). Given the strong inverse relationship between the proportion of a country's population employed in agriculture and its per capita income (FAO, 2008), smallholder farming remains a key source of rural livelihoods despite agrarian change.

Recent globalisation trends have brought with them both positive and negative changes for peasant farming, from cash-cropping and mechanisation on one hand, to land degradation and labour shortages on the other (Mertz et al., 2005). The process can exacerbate existing risks and vulnerabilities in farming communities (Bardsley, 2003; Nygren, 2000) and appropriate policy support is necessary to ensure equity, especially through the development of social capital through grassroots institutions and networks (Bawa et al., 2007; Semwal et al., 2004). In terms of impacts on biodiversity, cash cropping at the expense of mixed, traditional farming (Negi et al., 2009), and agricultural expansion into marginal areas (Partap, 1999) can both have detrimental effects.

It is important, though, not to caricature smallholders as hapless victims of change, or rural communities as static (Nygren, 2000; Rigg, 1998; Schneider and Niederle, 2010). A study of two Himalayan communities found that small-scale farmers can and do innovate in response to changing circumstances (Aase et al., 2013). While they found no single determinant, innovation was encouraged by larger farm size, water availability and the presence of an active NGO. This third factor is particularly important for mountain farming, with its already delicate agro-ecosystems and therefore limited capacity for conventional intensification (Fang et al., 2012; Partap, 1999; Paudel and Thapa, 2001).

In fact, given the increasing privatisation of public agricultural extension services under neoliberal development, NGO-led approaches are increasingly important for sustainable peasant agriculture (Jansen et al., 2006). Such education and training programs – effectively, access to influence – can play a key role in helping farmers adapt to changing socio-economic or ecological conditions, whether through ecological intensification (Kristjanson et al., 2007), agricultural diversification (Maikhuri et al., 2011) or value-chain capture (ICIMOD, 2011; Rawat et al., 2010; Saha and Sundriyal, 2012). This access to influence can in turn lead to access to a more and/or better assets.

2.3.5 Pastoralism

Rangelands occupy 40% of the global land surface and 69% of all agricultural land (Niamir-Fuller et al., 2012), rising to 86% in the Hindu-Kush Himalaya region (Partap, 1999). They are characterised by pastoral or semi-pastoral agriculture, with its low human and livestock densities and low inputs, often representing the optimum land-use form for these dry grasslands (Bhasin, 2011; Butt et al., 2009). In them, human uses of livestock can include meat, milk, traction and clothing, among others (Nyariki et al., 2009).

Pastoralism is a system that often allows the co-existence of wildlife with livestock, even in the absence of formal protection. For this reason pastoralism is very important for biodiversity conservation (Foggin, 2012; Niamir-Fuller et al., 2012; Retzer and Reudenbach, 2005). Agro-pastoral and pastoral systems like these predominate throughout the snow leopard's range (Jackson et al., 2010). Given this overlap, the *Snow Leopard Survival Strategy* suggests that good quality data on pastoral socio-economic conditions and trends are essential for designing effective conservation interventions (Jackson et al., 2013; McCarthy and Chapron, 2003). On the other hand, the globalisation of the cashmere industry has been linked to steep declines in Central Asia's large mammals (Berger et al., 2013). Given its importance for livelihoods, pastoralism is also a system that has significant potential for contributing to poverty alleviation, especially given the right policy framework (Berzborn, 2007; Devendra, 2012; Devendra and Chantalakhana, 2002; FAO, 2008).

Pastoralism, however, is under threat from numerous changes. In the Himalayan region alone these have included border closures after the 1962 Indo-Chinese War; an increase in Protected Areas (PAs); land privatisation; the growth of tourism; political marginalisation; sedentarisation; labour shortages in some cases; and increases in human and/or livestock populations in others (Kreutzmann, 2012; Nautiyal et al., 2003; Yamaguchi, 2011). In the Nanda Devi Biosphere Reserve, India, for example, the proportion of the population engaged in animal husbandry fell from 40% to 19% over a 30 year period (Nautiyal and Kaechele, 2009). Other mountain regions face similar challenges (Förster et al., 2011; Jackson, 2012; Kerven et al., 2012; Ludi, 2003). Pastoralists have traditionally managed risk and reduced vulnerability by using the principles of agrodiversity, including temporal and spatial grazing mobility, and the maintenance of different livestock species (Brookfield and Padoch, 1994; Devendra, 2012; Kreutzmann, 2012; Yamaguchi, 2011). However, in response to the changing conditions outlined above, external agencies, including governments and NGOs, have suggested alternative agronomic strategies and sedentarisation (Mearns, 2004).

These have tended to focus on livelihood intensification and commercialisation (Kristjanson et al., 2007; Nautiyal et al., 2003; Ribeiro Palacios et al., 2013), urther livelihood extensification (Oumer and de Neergaard, 2011), livelihood diversification (Beyene, 2012; Ludi, 2003; Wren and Speranza, 2010) and permanent migration (Mearns, 2004). The issue of non-farm diversification will be discussed in the following section. For the other three issues, care needs to be taken not to impose short-term top-down and simplistic analyses and solutions to these problems, such as privatisation (Fraser et al., 2006; Ludi, 2003) or 'modernisation' (Gilbert, 2013), that will disrupt the delicate socio-ecological balance of rangelands should be avoided (Kerven et al., 2012). By contrast, the development of social capital, often through appropriate extension services (Butler and Mazur, 2007; Jansen et al., 2006), is, once again, key. Access to assets is as important for pastoral livelihoods as it in the wider context of smallholder, agricultural, rural and global development.

2.3.6 Livelihood diversification

In all of these arenas, and whether the sustainable livelihoods framework is applied in name or in principle, much development, in the Global South especially, focuses on diversifying assets and increasing resilience in order to reduce risk and vulnerability. Apart from agricultural intensification and extensification, discussed in the previous sections, and migration, the main livelihood strategy employed in this respect is diversification (Scoones, 1998). While this commonly includes changes to farming practices, such as growing cash crops (Section 2.3.4), the main focus here is on the, often complementary, growth of non-farm income (Oumer and de Neergaard, 2011; Sinclair and Ham, 2000).

There are many positive examples of a positive link between livelihood diversification and poverty alleviation. These include studies in Mexico (López-Feldman, 2014), South Africa (Berzborn, 2007), Ethiopia (Beyene, 2012; Block and Webb, 2001), Uganda (Butler and Mazur, 2007), and Africa more generally (Barrett et al., 2001). Their basic principle – that a broader asset base reduces risk – is widely accepted (Berzborn, 2007). However, what is less widely considered is that pre-existing household preferences for risk can shape decisions on diversification, particularly if the household is poor (Block and Webb, 2001; Rasmussen, 2012)

Similarly, diversification amongst three ethnic groups in Ethiopia was affected by pre-existing levels of wealth and power. Thus, the wealthier Afar tended to have fewer but higher value livelihood options in their portfolio than their poorer neighbours (Beyene, 2012). A parallel trend was found in a similar study, also in Ethiopia (Block and Webb, 2001). This challenges the prevailing idea that this diversification-poverty alleviation relationship is automatic and positive. In fact, Kay (2006), while acknowledging the potential of diversification, warns against considering it as a panacea for poverty.

Development interventions may therefore need to specifically target the most vulnerable groups who lack the resources or power to attain sustainable livelihoods on their own (Block and Webb, 2001; Kreutzmann, 2001; Ribot and Peluso, 2003). Research from development interventions has consistently shown that the development of social capital – such as grassroots organisations and networks – is often one of the most beneficial outputs of diversification (Bebbington et al., 2006; Bebbington and Perreault, 1999; Walpole, 2008), a theme repeated often in this section on livelihoods.

Tourism is often proposed as an important livelihood diversification option (Bhattacharya and Sathyakumar, 2011), including for snow leopard conservation (Jackson et al., 2010). There are, however, a number of qualifications to this. Concerns have been raised about how evenly benefits are distributed, given limited numbers of direct employment opportunities in tourism and the disproportionate allocation of costs to farmers and those directly dependent on natural resources for their livelihoods (Munanura et al., 2016; Sandbrook and Adams, 2012). The negative cultural impacts of tourism – including in changing livelihood aspirations – has been noted (Adams, 2013; Funnell and Price, 2003). Environmental stresses, especially in fragile mountain ecosystems and in developing countries, can also be considerable (Geneletti, 2009; Nepal, 2002).

Other diversification options often involve the sustainable use of natural resources in both PAs and the wider landscape, sometimes with a processing and marketing element to capture more of the value-chain (Hutton and Leader-Williams, 2003). These have included, for example, the sustainable extraction of non-timber forest products (NTFPs) and medicinal and aromatic plants (MAPs) in the Himalayas, which, in some cases, have contributed to poverty alleviation (Larsen and Smith, 2004; Nautiyal, 2011; Nautiyal and Kaechele, 2009; Rasul et al., 2012). In mountains generally, suggested opportunities for livelihood diversification have focused on agriculture, water, conservation and tourism, rangelands and forests, mountain industry and services, and ecosystem services (Huddleston et al., 2003; ICIMOD, 2011).

2.4 Governance

Governance was the most common factor limiting [felid] conservation likelihood...As conservation likelihood decreases, it will be increasingly important to identify relevant geopolitical limitations and tailor conservation strategies accordingly.

Dickman et al., 2015

2.4.1 Global governance

Just as livelihoods are significant for conservation and development at the global, rural, agricultural, smallholder and pastoral scales, so too is governance. Governance has been defined as 'structures and processes that are designed to ensure accountability, transparency, responsiveness, rule of law, stability, equity and inclusiveness, empowerment, and broad-based participation' (UNESCO, 2018). Consistent with access theory (Ribot, 2014; Ribot and Peluso, 2003), what matters in constructing and maintaining a livelihood is not only access to *assets*, but access to *influence* in the context that the assets are utilised. As previously discussed, it is this power-laden dimension that constitutes both biodiversity conservation *and* poverty alleviation as inherently political processes (Adams, 2013; Kay, 2006; Roe et al., 2013a).

At the global level, governance was marked in the middle part of the twentieth century by the ongoing process of de-colonialisation (Adams and Mulligan, 2003), with a corresponding shift in power from colonial Northern nations to independent Southern ones. Nevertheless, from the 1980s until the present, the defining feature of global governance has been neoliberalism. This has resulted in power becoming increasingly concentrated in the hands of a financial elite rather than a geographical elite, such as large landowners (Borras, 2009; Clapp, 2014). Neoliberalism has also resulted in governance, including of environmental issues, increasingly being devolved to the market rather than states or multilateral bodies (Adams, 2009).

2.4.2 Conservation governance

The governance of conservation involves numerous competing themes. Particularly significant has been the legacy of colonialism, to which conservation – by advocating Western ideas, and yet attempting to maintain local biodiversity in the face of some of these – was both an accessory and an opponent (Adams and Mulligan, 2003). The critique of Western utilitarian values in the latter part of the twentieth century has contributed to a renewed interest in indigenous approaches to conservation (Adams and Mulligan, 2003), such as sacred groves in South Asia (Nautiyal and Kaechele, 2007; Negi, 2010; Rai, 2007). Yet conservation should be careful of excluding non-indigenous communities, especially poor ones, from conservation governance on the grounds of a, sometimes arbitrary, indigenous label (Brockington et al., 2006).

One of the most enduring and influential strands in conservation governance has been an obsession with wilderness and pristine nature. This has shaped PA governance particularly (Section 2.4.3), often through the exclusion of traditional users (Adams and Mulligan, 2003; Chhatre and Saberwal, 2006; Robbins, 2011). Furthermore, these users – whether peasant farmers or pastoralists – have often been deemed to be both socio-economically backward and ecologically destructive (Gilbert, 2013; Kreutzmann, 2012). This is often despite evidence to the contrary that communities have persistently and sustainably used, transformed and resided amongst nature at specific sites for long periods of time (Cloke, 2006; Kaimowitz and Sheil, 2007; Nygren, 2000).

Tension between preservationist and sustainable use approaches have also divided opinion on environmental management strategies. For example, the strong preservationist tendency in Indian conservation since 1947, itself inherited from colonial conservation approaches (Ghosal et al., 2013), has led to an increasing polarisation there between it and a sustainable use approach (Madhusudan and Raman, 2003). This is also a trend evident elsewhere (Hutton and Leader-Williams, 2003). Given the strengths and weaknesses of each strategy, a combination of both may be ideal (Madhusudan and Raman, 2003). This can be species- and context-specific, whether with communities residing in PAs (Bedunah and Schmidt, 2004), or the broader landscape (Hutton and Leader-Williams, 2003). Nevertheless, win-win solutions can be elusive and trade-offs between different approaches to this dimension of conservation governance may still ensue (Leader-Williams et al., 2010; McShane et al., 2011).

The retreat of the state from environmental management in some cases, has resulted in two contrasting governance systems filling the void. These are community-based conservation (CBC) and market-based conservation. Both are based on the assumptions that they are more efficient and effective than state management because they alter influence over assets (Adams, 2009; Adams and Mulligan, 2003; Roth and Dressler, 2012), although in many cases these differing approaches do not have to be mutually exclusive. CBC usually involves localised management of natural resources, often through the creation of grassroots institutions (Bajracharya et al., 2005, 2006; Nautiyal and Kaechele, 2007). Alternatively, market-based conservation can include various payments for ecosystem services (PES) (Ellison and Daily, 2003), land privatisation (Fraser et al., 2006; Lamprey and Reid, 2004), conservation enterprises (Elliott and Sumba, 2011) and eco-certification (Treves and Jones, 2010).

A final key trend in the conservation governance debate, as with livelihoods (Bebbington and Perreault, 1999), is the importance of institutions. Institutions, and the social capital they develop and represent, are recognised by numerous authors as essential for effective environmental management (Bawa et al., 2007; Saha and Sundriyal, 2012; Wilfred et al., 2007). These can include local and regional, community and NGO organisations, as well as the opportunities for co-management with other stakeholders (Foggin, 2012; Olsson et al., 2004; Torri and Herrmann, 2010). Additionally, at the international level, the importance of 'systematic collaboration' between conservation NGOs to conserve biodiversity has been stressed (Redford et al., 2003), while others have recommended a broad alliance of public and private stakeholders partnering on this goal, particularly its links to livelihoods and poverty alleviation (Roe, 2013).

Large cat conservation is proving a useful microcosm of these varying trends, with governance issues increasingly recognised as important for felids generally (Dickman et al., 2015) and snow leopards particularly (Rosen et al., 2012). Given the altitude and remoteness of snow leopard habitat, and the ubiquity of pastoralism throughout, CBC is generally suggested as the most suitable approach (Jackson et al., 2010; Jackson, 2012; Jackson and Lama, 2016; Mishra et al., 2017). It has been suggested that this approach could be improved upon by linking snow leopard conservation more explicitly to the contemporaneous overlap of Tibetan Buddhist monasteries (Li et al., 2014), while integrating CBC with a conservation enterprise approach has also been recommended (Hussain, 2003). The importance of international collaborations across the species' range has also been noted (Jackson et al., 2013; Riordan et al., 2015; WWF, 2006, 2015).

This is all also true of tiger *Panthera tigris* conservation (Walston, 2010). While there have been some successes with a CBC model in this context (Dinerstein et al., 1999), challenges exist, notably the species' ability to kill humans and India's tendency towards an exclusionary governance model (Rastogi et al., 2012). Elsewhere, an eco-certification scheme for beef from Namibian ranches has been pioneered as an incentive for farmers to coexist with cheetahs *Acinonyx jubatus* (Marker et al., 2010).

In an effort to improve 'systematic collaboration', snow leopard conservation has replicated the Global Tiger Initiative's approach of international and multi-stakeholder cooperation. The resulting initiative has been called the Global Snow Leopard and Ecosystem Protection Programme (GSLEP, 2013). Like with the rest of the sector, various competing themes, and struggles for influence, in big cat conservation, result in mixed-models of conservation governance.

2.4.3 Protected area governance

Protected areas (PAs) are one of the most widely implemented forms of conservation governance (Adams, 2012). Over 155,000 nationally designated PAs cover c. 12% of the world's land surface area (Soutullo, 2010; Watson et al., 2014), and are often recommended as the primary way of preserving species and ecosystems (Xu et al., 2008). Increasingly, a range of socio-economic benefits are also expected from them (Watson et al., 2014), making them inherently political constructs, especially in terms of how these benefits, and any costs, are shared (Adams and Hutton, 2007). Networks of PAs have had some success in stemming biodiversity loss (Green et al., 2013; McKinney, 2002); yet a lack of management resources (Watson et al., 2014) and uneven distributions of costs and benefits, locally and globally (Adams and Hutton, 2007; Chan et al., 2007; Jackson and Hunter, 1996), constrain their potential.

PAs have often been gazetted and governed with a centralised or 'top-down' approach, so called 'fences and fines' or 'fortress' conservation (West et al., 2006). This has been the case particularly where local opposition has been weak (Adams and Hutton, 2007). It has also often been the case with potentially destructive and/or commercially valuable species, such as tigers or other large carnivores (Pettigrew et al., 2012; Walston, 2010).

This approach, however, has been criticised for its lack of attention to human rights and livelihoods (Brockington et al., 2006; Chhatre and Saberwal, 2006), such as community relocations with insufficient compensation (Lam and Paul, 2013; West et al., 2006) or restrictions on resource extraction (Bedunah and Schmidt, 2004; Silori, 2004). Indian tiger conservation in particular has a legacy of conflict with local communities on both these counts (Rastogi et al., 2012). Increasingly, PAs are recognised as social constructs that will have social impacts, and these need to be recognised, understood and mitigated (Heinen, 2010; Mehta and Heinen, 2001; West et al., 2006; Wilder and Walpole, 2008).

Connected with this realisation has been the growth of CBC or community-based natural resource management (CBNRM) in and around PAs (Baral et al., 2007). As discussed previously,these decentralised approaches extend the governance of biodiversity to include local people and their institutions, with varying degrees of involvement and influence in PA governance (Foggin, 2012; Wells and McShane, 2004). They have gained support within such multi-stakeholder forums as the Convention on Biological Diversity and the World Park's Congress (Swiderska et al., 2008), and have been recommended as the optimum governance option for various species, including snow leopards (Jackson et al., 2010; Jackson, 2012; Mishra et al., 2017) and tigers (Gurung et al., 2008).

Part of the logic behind a CBC approach is that biodiversity also needs to be conserved in the c. 88% of the world's land area not covered by PAs (Adams, 2013). Here, various stakeholder groups often have a greater degree of access to and influence over biodiversity than conservation institutions. A landscape model that integrates networks of PAs with stakeholder involvement in conservation governance using a variety of management methods is increasingly seen as essential for the maintenance of viable populations of wild biodiversity, both inside and outside of core PAs (Ripple et al., 2014). This is especially true for wide-ranging and transitory species of large cats, such as snow leopards (Ale and Karky, 2002; Johansson et al., 2016; McCarthy et al., 2005; Riordan et al., 2015), jaguars (Rabinowitz and Zeller, 2010) and tigers (Walston, 2010).

Both bottom-up and top-down governance approaches can elicit mixed responses from people who live in and around PAs (Karanth and Nepal, 2012; Khan and Bhagwat, 2010). Opposition to conservation institutions and authorities can become especially vociferous where land is scarce and over conflict with large, destructive animals (Carter et al., 2012; Ikeda, 2004; Ripple et al., 2014). But regardless of the management model, a key observation from the debate on PA governance is the importance of developing participation, social capital and effective institutions (Dougill et al., 2006; Kaswamila and Songorwa, 2009; Kelman, 2013; Sessin-Dilascio et al., 2015; Wells and McShane, 2004). This is particularly significant as it relates to livelihoods and the alleviation of poverty in and around PAs.

2.4.4 Protected area governance and poverty alleviation

The debate about conservation governance is especially significant in relation to the critical issue of global poverty. Biodiversity conservation and poverty alleviation are both highly political processes that require changes to the existing status quo to be ultimately successful (Roe et al., 2013a). Both relate to the governance and use of natural resources, and the relationships between them – from none to negative to positive - have been outlined by Adams et al. (2004) and, building on their typology, by Roe et al. (2013b).

Other authors have commented on the complexity of these linkages (McShane et al., 2011; Roe et al., 2013a; Walpole, 2008).

Yet such is the overlap between biodiversity and poverty that inaction, because of fears of complexity, is not an option. On one hand, it is argued that, given the small proportion (0.25%) of the world's population resident in wild or extremely wild places, conservation organisations have a role in alleviating povert in these areas (Redford et al., 2008). This approach ignores the quantity and quality of biodiversity that persists, and must continue to persist, in less wild and human-dominated landscapes, often alongside extreme poverty (Fisher and Christopher, 2007). Mountainous areas in particular are bastions of biodiversity *and* under-development in the Global South (Rodriguez-Rodriguez and Bomhard, 2012), and are often poorer than neighbouring lowlands (Hunzai et al., 2011; Kreutzmann, 2001). In fact, the Himalayas are one of the world's biologically significant areas most affected by poverty (Fisher and Christopher, 2007).

The debate is particularly acute in the context of PAs and their governance. The poor are often extremely dependent on natural resources (Angelsen et al., 2014; DeClerck et al., 2006; Larsen and Smith, 2004; Parker and Thapa, 2012; Roe et al., 2013a; Samal et al., 2003), and the creation and management of PAs, especially under centralised conditions, can impose critical restraints on livelihood needs (Adams and Hutton, 2007; Deng et al., 2010). As will be discussed in Sections 2.5 and 2.6, this can lead to conflict with PA authorities, particularly where PAs act as sources for wildlife populations.

This situation is compounded by the vulnerability of the poor, notably those with few assets, insecure and uniform livelihoods and a lack of influence over the processes that shape these (Dickman, 2010, 2013). Others have noted that, where livelihoods need are met, the poor are not necessarily hostile to conservation (Shrestha and Alavalapati, 2006). In short, the relationships between conservation, PA governance and poverty alleviation are varied, context-specific, contested and often involve trade-offs (Adams and Hutton, 2007; McShane et al., 2011; Roe et al., 2012, 2013a; Sanderson and Redford, 2003). Some stress that taking account of human need in conservation is not necessarily the same as tackling poverty (Walpole, 2008). Others argue that PES schemes represent the key to alleviating poverty amongst communities living in conservation priority areas (Turner et al., 2012).

Since the last quarter of the 20th century, Integrated Conservation and Development Projects (ICDPs) have attempted to reconcile ecological and socio-economic goals in and around PAs (Wells and McShane, 2004). Disappointing results have resulted in a newer phase of ICDPs that are more participatory in their governance and more explicit and realistic about the links and trade-offs between their conservation and development objectives (Kelman, 2013; Martin et al., 2011; Wells and McShane, 2004). In a comparison of two Sumatran ICDPs, the more successful of the two focused on a more participatory approach to governance at various levels, and recognised the need to consider socio-economic trajectories beyond the proximate ones of neighbouring villages (Kelman, 2013).

Three other themes emerge from this debate on conservation, PA governance and poverty alleviation. First, the paradox inherent in the potential for the increased consumption levels of households in and around PAs freed from poverty, and their increased demand on natural resources *overall* (Adams, 2013; Jorgenson, 2003). Secondly, the need for more and better research on the intricacies of these relationships, and the potential scope for win-win outcomes (DeClerck et al., 2006; Roe et al., 2013a). Thirdly, the importance of developing social capital – in terms of institutions and networks – that allow communities living in or near PAs to genuinely participate in this very debate, and suggest their own solutions (Elliott and Sumba, 2011; Foggin, 2012; Kelman, 2013). The last of these reappears continually as a central component of good *governance* and sustainable livelihoods at the local, regional, national and international levels. All of these matter for biodiversity conservation, including co-existence between people and snow leopards.

2.5 Knowledge of and attitudes to wildlife and conservation

[Studying attitudes to snow leopard conservation as well as to snow leopards] would highlight the dissonance between the meaning and significance of wildness to local societies and to outside conservationists.

Rosen et al., 2012

2.5.1 Knowledge of wildlife

Knowledge of wildlife is influenced by many factors. Education is cited in numerous studies as having a positive relationship with knowledge of nature (Keane et al., 2011; Kellert, 1980; Nyhus and Tilson, 2003; Williams et al., 2002). Yet the relationship is not always straightforward, as found with knowledge of European bison *Bison bonasus* in Lithuania, where higher education levels correlated with lower levels of awareness (Balčiauskas and Kazlauskas, 2014). Folklore and cultural traditions can also be associated with wildlife knowledge, such as with sacred groves in India (Anthwal et al., 2010) or snow leopards in Central Asia (Li et al., 2014). Other influential variables can include gender and age (Kellert, 1980; Nyhus and Tilson, 2003).

The media can also play a role in shaping awareness. Newspapers were found to be influential in shaping knowledge of black bears *Ursus thibetanus* in Japan, especially through negative stories (Sakurai et al., 2013). In an era of increasingly neoliberal conservation, the media play a significant role in transmitting environmental knowledge as a ‘product’, sold to increasingly urbanised population disconnected from nature (Büscher et al., 2012). Yet knowledge, from varying sources, is noted as playing an influential role in shaping positive attitudes to wildlife (Barthwal and Mathur, 2012; Kansky and Knight, 2014; Macura et al., 2011; Schumann et al., 2012).

2.5.2 Attitudes to wildlife

Numerous factors can influence attitudes towards wildlife (Karanth et al., 2013). Therefore, understanding conservation psychology is a useful step towards understanding this process. A social-psychological model has been proposed based on how past experiences and current context and motives, often reinforced by social groups, shape attitudes to wildlife (Clayton and Brook, 2005). It is not just knowledge by itself but also values and beliefs, held individually and collectively, that contribute to these attitudes (Fischer et al., 2012; Reading and Kellert, 1993). These can differ at various scales: for example, large carnivores can be viewed negatively locally but imbued with a high existence value globally (Dickman et al., 2011). In addition, while attitudes to wildlife may be positive, this may not result in concrete conservation action (Balčiauskas and Kazlauskas, 2014; Nepal and Spiteri, 2011; Saunders et al., 2006), a trend referred to as the ‘values-action gap’. These values can often be based on a combination of extrinsic and intrinsic motivations (Loomis and White, 1996; Richardson and Loomis, 2009), as also noted in other environmental (De Young, 1996; Pelletier et al., 1998), social (Degli Antoni, 2009; Ryan and Deci, 2000) and economic (Benabou and Tirole, 2003) contexts.

Some of the key predictors of attitudes to wildlife are listed in Table 2.1. Strongly held cultural beliefs and values can be especially influential (Dickman, 2013; Hussain, 2002; Mikusiński et al., 2014; Negi, 2010). Buddhism in particular has long been associated with a pro-environmental stance (Ogyen Trinley Dorje, 2011), and snow leopards, for example, are venerated in Buddhist mythology (Ale et al., 2007, 2014; Li et al., 2014). Other subjective social norms can have the opposite effect. The killing of jaguars in Brazil has been linked to issues of identity and tradition amongst cattle ranchers (Marchini and Macdonald, 2012). Social groups are therefore particularly significant in shaping attitudes to wildlife (Naughton-Treves et al., 2003; Soto-Shoender and Main, 2013; Treves and Bruskotter, 2014).

Table 2.1 Predictors of attitudes to wildlife

Predictor	**Source(s)**
Age	Carter et al., 2012; Murphy and Macdonald, 2010; Romanach et al., 2007; Suryawanshi et al., 2014; Williams et al., 2002; Zimmermann et al., 2005
Attack/threat to family member	Carter et al., 2014
Diversified livelihoods	Bagchi and Mishra, 2006; Romanach et al., 2007; Suryawanshi et al., 2014; Tessema et al., 2010; Zimmermann et al., 2005
Education	Carter et al., 2012, 2014; Romanach et al., 2007; Suryawanshi et al., 2014; Williams et al., 2002
Ethnicity	Carter et al., 2014; Rust et al., 2016
Exposure to and experience with a species	Kansky and Knight, 2014
Extrinsic motivations	Loomis and White, 1996; Richardson and Loomis, 2009
Gender	Alexander et al., 2015; Balčiauskas and Kazlauskas, 2014; Bhatia et al., 2016; Carter et al., 2012, 2014; Romanach et al., 2007; Suryawanshi et al., 2014
Governance model	Karanth and Nepal, 2012
Income	Williams et al., 2002
Intangible benefits	Kansky and Knight, 2014; Karanth and Chellam, 2009; Murphy and Macdonald, 2010
Intangible costs	Inskip et al., 2013; Kansky and Knight, 2014; Karanth and Chellam, 2009; Murphy and Macdonald, 2010
Intrinsic motivations	Loomis and White, 1996; Richardson and Loomis, 2009
Knowledge	Barthwal and Mathur, 2012

Legal status of land	Kansky and Knight, 2014
Local/non-local origin	Barthwal and Mathur, 2012; Carter et al., 2012; Reading and Kellert, 1993; Romanach et al., 2007
Media coverage	Sakurai et al., 2013
Number of livestock owned	Carter et al., 2012; Hemson et al., 2009; Suryawanshi et al., 2014; Tessema et al., 2010; Zimmermann et al., 2005
Occupation	Carter et al., 2014; Hemson et al., 2009; Tessema et al., 2010; Williams et al., 2002
Rural/urban residence	Balčiauskas and Kazlauskas, 2014; Hemson et al., 2009; Williams et al., 2002
Religion	Ale et al., 2014; Bhatia et al., 2016; Li et al., 2014
Religiosity	Bhatia et al., 2016
Stakeholder type	Kansky and Knight, 2014; Reading and Kellert, 1993; Treves and Bruskotter, 2014
Tangible costs	Barthwal and Mathur, 2012; Carter et al., 2012; Inskip et al., 2013; Karanth and Chellam, 2009; Suryawanshi et al., 2014; Tessema et al., 2010; Zimmermann et al., 2005
Tangible benefits	Karanth and Chellam, 2009; Tessema et al., 2010

Negative attitudes towards snow leopards often result from real or perceived livestock losses (Bagchi and Mishra, 2006; Ikeda, 2004; Oli et al., 1994). Indeed, Bagchi and Mishra reported strongly negative attitudes amongst 30% and 45% of the population in Kibber and the Pin Valley, India, respectively. More recent studies found more positive attitudes (Alexander et al., 2015; Li et al., 2013; Suryawanshi et al., 2014), while others have noted that a wide range of attitudes to snow leopards can be held in a single community (Hussain, 2002). Also in India, one study found that non-native respondents had a more positive view of snow leopards than those from the region of Ladakh (Barthwal and Mathur, 2012).

Realities *and* perceptions can also drive attitudes towards other felid species seen as a threat to human lives or livelihoods (Inskip et al., 2013). Studies of tigers (Carter et al., 2012), jaguars (Cavalcanti et al., 2010; Marchini, 2010; Zimmermann et al., 2005), lynx *Lynx lynx* (Alexander et al., 2015) and pumas *Puma concolor* (Murphy and Macdonald, 2010), among others, have shown the strength of negative feeling towards the species in question, albeit with a spread of opinions, and of influences upon them. With tigers in

Nepal, people who wanted fewer tigers in the future tended to perceive them negatively in the present, raising questions about continued coexistence (Carter et al., 2012).

This attitudinal complexity has also been described for other carnivore species (Alexander et al., 2015; Gittleman et al., 2001; Li et al., 2013; Ripple et al., 2014; Williams et al., 2002), as well as for other wildlife taxon, whether large, such as bison (Balčiauskas and Kazlauskas, 2014) and elk *Cervus canadensis* (Crank et al., 2010), or small, such as prairie dogs *Cynomys spp.* (Reading and Kellert, 1993) and other rodents (Li et al., 2013). With carnivore conservation, attitudes to prey species can matter as much as attitudes to the predatory species, such as with the black-footed ferret *Mustela nigripes* and prairie dogs (Reading and Kellert, 1993), but also with snow leopards and wild *ovids* or *caprids*, such as the blue sheep *Pseudois nayaur* (Alexander, 2015). Understanding such relationships with snow leopards and other species, as well as the complexity of attitudes and perceptions, is key to informing effective human-wildlife coexistence (HWC) (Dickman, 2010), including with conservation itself.

2.5.3 Attitudes to wildlife conservation

Attitudes to wildlife conservation have been studied much less frequently than attitudes to wildlife itself. This may be, in part, because of conservation's historical ontological bias towards natural, and apolitical, science (Ghosal et al., 2013). Nevertheless, research and practice that considers attitudes to the social process that is conservation is a necessary part of HWC, for many of the reasons outlined previously. In particular, the sometimes divisive role of PAs makes a consideration of how they are perceived by inhabitants and neighbours important (Tessema et al., 2010; Udaya Sekhar, 2003; Walpole and Goodwin, 2001). For example, positive attitudes to PA presence and PA staff in Ethiopia were predicated upon benefits from the PA, as well as respondent age, family size and income source (Tessema et al., 2010).

In India, support for conservation has been linked to benefits from wildlife tourism (Udaya Sekhar, 2003). Conversely, there was lower than expected support for a local PA from those benefiting from ecotourism in Indonesia (Walpole and Goodwin, 2001). As with attitudes to wildlife, knowledge has been proposed as a key influence on attitudes to wildlife conservation. Such a trend was observed with Reserved Forests outside of PAs in India (Macura et al., 2011). Equally, the study also found that participation in management groups for these forests was correlated with a negative attitude to Reserved Forests. In addition, some respondents who were positive toward conservation generally were not supportive of specific practices, such as regulation or zoning (Layden et al., 2003).

Gender is another factor that can shape attitudes towards wildlife conservation. While one study found no gender diferences in attitudes to several PAs in Nepal (Allendorf and Allendorf, 2012), women perceived more difficulties in resource extraction, a trend also noted in India (Ogra 2008). Barring a recent analysis of a livestock compensation scheme in Qomolongma Nature Reserve, China (Chen et al., 2016), no studies to date have *comprehensively* considered attitudes towards snow leopard conservation in general, including gendered dimensions. A previous study in Nepal found mostly negative attitudes towards snow leopard conservation but its small sample size (n = 17) and country location renders it unrepresentative (Ikeda, 2004). Research to address this critical knowledge gap has been called for (Rosen et al., 2012).

2.6 Wildlife impacts and conservation conflicts

We feel that conflict with wildlife is our destiny to live with...The Development God has not yet been born so we just wait. What else to do?

Indian villager quoted in Ogra 2009

2.6.1 Conflicts and coexistence

The step beyond knowledge and attitudes, towards physical interactions with wildlife and those who conserve them, has usually been termed human-wildlife conflict. However, conflict does not belong ‘to the glossary of ecological terms’ (Marchini, 2014). Accordingly, the phrase, having been applied almost universally to human interaction with large, charismatic wild animals, has less to do with their potential for causing damage and more to do with their power to evoke polarised opinions amongst different stakeholder groups (Linnell et al., 2005).

In a review of 100 published papers on human-wildlife conflict, 97 of them were found to be about conflict between wildlife conservation and other human activities, particularly livelihoods (Redpath et al., 2015). It proposed that instead of the anthropomorphic term 'conflict', conservationists should distinguish between human-wildlife impacts (HWI), on one hand, and human-human conflicts (HHC) on the other. This study, and others

(McShane et al., 2011), also acknowledge the need to be more explicit about the different stakeholders with an interest in wildlife, of which conservation is but one, and the trade-offs needed to a find management compromise for HWC. This distinction between human-wildlife impacts and human-human conflicts has recently been made explicitly for snow leopards (Mishra et al., 2016).

HWIs are recognised as a major threat to numerous species around the world (Gittleman et al., 2001; Inskip and Zimmerman, 2009; Ripple et al., 2014). Understanding the patterns and trends associated with these interactions is therefore necessary for informed and effective mitigation (Dar et al., 2009; Dickman, 2010; Inskip and Zimmerman, 2009), the various forms of which will be considered in greater detail in Section 2.7. HWIs can take a number of forms, varying in intensity, from crop raiding to livestock depredation through to human injury and fatality. Actual *or* perceived costs incurred by people affect their responses, both in terms of their level of hostility to the species and its conservation, as well as to direct and indirect consequences resulting from this, whether species persecution, habitat loss or similar (Dickman, 2010). It can also lead to conflict with conservation authorities and institutions, as discussed in Section 2.6.4. Various authors frame the determinants of HWI within separate environmental and social categories (Carter et al., 2012; Dickman, 2010).

2.6.2 The environmental dimensions of human-wildlife impacts

Geographical factors have significant influences on HWI. The spatial dimensions of HWI are numerous, varied and context-specific. A range of factors have been found to be important in explaining livestock losses to different felid species, including: ruggedness with snow leopards in China (Chen et al., 2016; Xu et al., 2008); water levels with pumas and jaguars in Paraguay (Tortato et al., 2015); distance from riparian corridors also with pumas and jaguars in Brazil (Michalski et al., 2006; Palmeira et al., 2008); and proximity to villages with tigers in China (Li et al., 2009). In addition, hippo *Hippopotamus amphibius* and crocodile *Crocodylus niloticus* attacks on people in Mozambique were clustered along the country's main rivers (Dunham et al., 2010).

Such events also have temporal aspects. Many authors have found associations between the frequency of livestock depredations and the summer period (Chen et al., 2016; Tamang and Baral, 2008), sometimes with extensions into Spring and/or Autumn (Li et al., 2009; Sangay and Vernes, 2008). Conversely, others have found that winter can be the peak time for such losses (Johansson et al., 2015). A determining influence on when such attacks occur can also be birthing time for livestock, when herds are most vulnerable to predation (Michalski et al., 2006; Palmeira et al., 2008; Sangay and Vernes, 2008).

As previously mentioned, the taxonomic dimensions of HWI are characterised by a particular focus on large and/or carnivorous mammals (Marchini, 2014; Ripple et al., 2014). In relation to carnivores, these have included felids (Inskip and Zimmerman, 2009), ursids (Wang and Macdonald, 2006), canids (Mishra, 1997; Silva Rodríguez et al., 2009), hyaenids (Romanach et al., 2007) and mustelids (Schwerdtner and Schwerdtner, 2007). This propensity to predate on livestock, and, sometimes, people, coupled with combinations of other biological and ecological factors – such as low population densities – can make carnivores especially vulnerable to retaliation (Gittleman et al., 2001; Karanth and Chellam, 2009; Ripple et al., 2014). Extirpation, however, can result in mesopredator release, which can also result in sustained or even additional HWI (Ripple et al., 2014; Taubmann et al., 2016).

Among the felidae, a correlation exists between increasing body mass and increasing HWI, as well as conservation impacts (Inskip and Zimmerman, 2009; Ripple et al., 2014). The relevant species include leopard *Panthera pardus* (Dar et al., 2009), puma (Murphy and Macdonald, 2010), jaguar (Marchini and Macdonald, 2012), cheetah (Marker et al., 2010), lion *Panthera leo* (Hemson et al., 2009), tiger (Carter et al., 2012, 2014) and snow leopard (Jackson et al., 2010). Resource partitioning within felid guilds can result in different sizes of livestock being taken by cat species of differing sizes (Sangay and Vernes, 2008), or where prey-richness is lacking, in competition between felids and similar-sized predators (Jumabay-Uulu et al., 2013). Resource partitioning has also been noted with snow leopards, between adult males, on one hand, and females and sub-adults on the other, with the former taking considerably more livestock at study sites in Mongolia (Johansson et al., 2015).

Snow leopard predation on livestock is endemic across its range (Jackson et al., 2010). Table 2.2 details the proportion of livestock remains in snow leopard scat from several studies, as well as of rates of livestock predation by snow leopards. The range for remains in scat lies between 17.8% and 42.0%. For predation rates, the range is between 0.3%

and 12.0%. A study from Manang, Nepal, showed scat sample percentages represented an estimated livestock predation rate of 3.9%, a figure concurrent with village records of 4.0% (Wegge et al., 2012). However, it has been suggested that, due to technical limitations at the time, earlier food-habit studies may have underestimated the proportions of large ungulates, whether wild or domestic, in snow leopard scat (Weiskopf et al., 2016).

Table 2.2 Percentage of livestock remains in snow leopard scat and of annual livestock predation rates by snow leopards.

Method	Author(s)	Location	Sample size	% Livestock
Scat analysis	Oli et al., 1994	Manang, Nepal (ACA)	213	17.8
	Bagchi and Mishra, 2006	Pin Valley, India	51	23.6
	Bagchi and Mishra, 2006	Kibber, India	44	38.5
	Lovari et al., 2009	Khumbu, Nepal (SNP)	106	23.0
	Anwar et al., 2011	Baltistan, Pakistan	49	36.5
	Shehzad et al., 2012	South Gobi, Mongolia	81	19.7
	Wegge et al., 2012	Manang, Nepal (ACA)	41	42.0
	Devkota et al., 2013	Shek Phoksundo NP, Nepal	40	30.0
	Jumabay-Uulu et al., 2013	Sarychat-Ertash Reserve, Kyrgyzstan	47	0.0
	Maheshwari et al., 2013	Uttarakhand & Himachel Pradesh, India	9	36.0
	Chetri et al., 2017	Annapurna-Manaslu landscape	182	27.0
	---	---	**Mean**	**26.7**
Predation rate	Mishra, 1997	Kibber, India	80	12.0
	Jackson and Wangchuk, 2001	Hemis NP, India	79	6.8
	Namgail et al., 2007	Gya-Miru Wildlife Reserve, India	63	2.9
	Devkota et al., 2013	Shek Phoksundo NP, Nepal	250	5.1
	Li et al., 2013	Sangjiangyuan, China	144	1.3
	Maheshwari et al.,	Uttarakhand &	16	1.2

	2013	Himachel Pradesh, India		
	Aryal et al., 2014	Upper Mustang, Nepal (ACA)	611	1.0
	Ale et al., 2014	Mustang, Nepal (ACA)	275	3.3
	Alexander et al., 2015	Qilianshan,China	109	0.3
	Chen et al., 2016	Qomolongma NP, China	116	0.3
	---	---	**Mean**	**3.4**

2.6.3 The social dimensions of human-wildlife impacts

Social issues can also influence HWI. Crop and livestock losses, exacerbated by increasing human and animal populations (Mishra, 1997), as well as poor guarding practices (Jackson and Wangchuk, 2001; Peña-Mondragón et al., 2017; Wang and Macdonald, 2006), can all drive impacts on livelihoods. This is especially true when compounded by underlying vulnerabilities, such as poverty (Inskip et al., 2013), and livelihood insecurity and uniformity (Dickman, 2010; Hemson et al., 2009; Ikeda, 2004; Romanach et al., 2007). The stochastic nature of these events – such as the potential for frenzy killings when snow leopards enter corrals – can further exacerbate their impact on poorer households with inadequate access to assets (Dickman et al., 2011; Jackson and Wangchuk, 2001; Rosen et al., 2012).

So too can inadequate access to influence, whether in the form of economic inequality (Dickman et al., 2011), gender inequality (Ogra and Badola, 2008; Ogra, 2008) or a lack of appropriate fora for community management of HWI (Dinerstein et al., 1999; Gurung et al., 2008). Less influential individuals, households or communities may also be more prone to the so-called ‘hidden’ dimensions of HWI, including health impacts and opportunity costs (Barua et al., 2013; Dickman et al., 2011; Ogra, 2008).

Social spaces can also influence HWI. Impacts can occur in and around PAs, especially where these act as sources for populations of large, and potentially destructive, mammal species (Karanth et al., 2013; Sarker and Roskaft, 2010; Yihune et al., 2009). This is true of PAs maintained under centralised management structures (Karanth et al., 2012) *and* those under decentralised regimes (Bajracharya et al., 2006).

Impacts can also occur in social spaces outside of PAs (Nyhus and Tilson, 2004). The success of community forestry programmes in Nepal have led to improved leopard habitat in some locations, and hence, to increased livestock predation (Gautam et al., 2002). Similarly, in southern Africa, unrestricted wildlife movement in connectivity corridors between PAs has had impacts for people (Dunham et al., 2010). There is considerable scope for HWI to increase where conservation strategies depend upon linking source populations of large mammals through more densely populated areas like these, such as with jaguars (Rabinowitz and Zeller, 2010), tigers (Goodrich, 2010; Walston et al., 2010) and large carnivores in general (Minin et al., 2016).

Conservationists, however, are divided on the role that human density plays in driving HWI, and co-existence more generally. While some have found it to be a strong predictor (Dickman et al., 2015; Johnson et al., 2006; Woodroffe, 2000), others have found it to be less significant (Alexander et al., 2016; Linnell et al., 2001; Sangay and Vernes, 2008). However, there is greater consensus on the correlation between livestock densities and HWI, especially where these high densities negatively impinge on wild prey populations (Alexander et al., 2016; Bagchi et al., 2004; Berger et al., 2013; Ripple et al., 2014; Tumursukh et al., 2016).

Husbandry practices are therefore another important social predictor of HWI. Factors including herd composition (Berger et al., 2013; Tortato et al., 2015), birthing practices (Peña-Mondragón et al., 2017), guarding practices (Hemson et al., 2009; Jackson and Wangchuk, 2001; Kolowski and Holekamp, 2006), stocking density (Suryawanshi, 2013), improper carcass disposal (Peña-Mondragón et al., 2017) and rotation patterns (Daniel Kissling et al., 2009) can all affect predation. However, the perception can differ from the reality. For example, a study from the Chinese side of Mt. Everest found that 74% of respondents blamed livestock depredation on increased carnivore abundance rather than on poor guarding practices (Chen et al., 2016). In mountain areas where livestock are important as pack animals for tourism, this practice can simultaneously increase livestock populations in wildlife habitats (Geneletti and Dawa, 2009) *and* reduce the amount of labour available for guarding livestock (Ale et al., 2014).

Human-snow leopard impacts are recognised as an important focal area for research, policy and practice (GSLEP, 2013; Jackson et al., 2013; McCarthy and Chapron, 2003;

WWF, 2006, 2015). Yet, due in part to conservation's ontological bias towards natural science, including in felid conservation (Alexander, 2015; Ghosal et al., 2013), much research on these topics has tended to be appended to ecological studies rather than constitute the main focus of the study. There is therefore a need for a comprehensive social analysis of HWI in relation to snow leopards, as well as how it relates to knowledge, attitudes, access, influence and snow leopard conservation.

2.6.4 Conservation conflicts

As previously discussed in Section 2.6.1, much 'conflict' between humans and wildlife is a form of conflict between humans and wildlife conservation practices and organisations. In particular, the strong emotions evoked by large carnivores and their inevitable impacts on human ideas and livelihoods, can lead to acute conflict with those who conserve them (Linnell et al., 2005). The importance of understanding the socio-economic and cultural context of such relationships has been recognised, rather than just ascribing them to ecological influences or prescribing technical management solutions for them (Rust et al., 2016). A political ecology perspective like this can present a clearer picture of the influences on HCC. Yet, as with attitudes to conservation compared to attitudes to wildlife, there is a relative dearth of research on the matter compared to HWI, a point made in relation to snow leopard conservation (Rosen et al., 2012).

As with HWI, livelihood type can be an important predictor of conflict between people and conservation (Adams and Hutton, 2007; Hussain, 2000). The impact of tangible and intangible costs of conservation interventions on the economic viability of households can be further compounded by economic inequality (Dickman, 2013), racial inequality (Rust et al., 2016) and gender inequality (Allendorf and Allendorf, 2012). The presence of PAs, and any inhibitions on resource use that they stipulate, can be also be a catalyst for various forms of conflict (Khan and Bhagwat, 2010). In fact, park-people relationships are one area of conservation conflict that have received more attention, especially in the Global South (Adams and Hutton, 2007; Rastogi et al., 2012; Tamang and Baral, 2008). Less research, however, has focused on wildlife corridors between PAs, and any HCC therein (Dunham et al., 2010; Goodrich, 2010; Walston, 2010).

Ecotourism activities, including benefit sharing from them, have been proposed as a solution to address people-park conflict around Nanda Devi Biosphere Reserve, India

(Kala and Maikhuri, 2011). However, these are not a panacea. Numerous challenges exist, including revenue capture by local or external elites or the uneven distribution of benefits (Dickman et al., 2011; Munanura et al., 2016; Sandbrook and Adams, 2012). Similar problems can exist with compensation and incentive schemes set up to mitigate both HCC and HWI (Bulte and Rondeau, 2005; Wilman and Wilman, 2016), an issue considered in greater depth in Section 2.7. Whether for conservation conflicts or for wildlife impacts, it is clear that a more nuanced approach that integrates data on livelihoods, governance, knowledge and attitudes is essential. The same is true for mitigation methods.

2.7 Mitigation

...systems of livestock production can adapt to the presence of large carnivores to the extent that livestock depredation is kept to levels that are acceptable to the range of economic, ecological, social and ethical interests that exist.

Linnell et al., 2012

2.7.1 Overview

Given the scale and potential severity of HWI *and* HHC, there have been numerous conservation interventions to mitigate their causes and effects over the short and long term. With carnivores specifically, numerous mitigation measures to address various forms of predation have been listed (Inskip and Zimmerman, 2009; Linnell et al., 2012; Treves et al., 2009), with Linnell et al. usefully detailing responses based on disrupting the six behavioural stages of a predation sequence: search, identify, approach, attack, kill and consume. There is also an important link to human behavioural responses: mitigation methods that address both the real *and* perceived impacts of wildlife interactions may be necessary (Zimmermann et al., 2010).

The wide range of mitigation measures used for large carnivores can vary widely in terms of labour intensity and cost (Linnell et al., 2012). However, interventions have suffered from a lack of empirical testing as to their effectiveness and efficiency. For example, one survey found that only 31% had been rigorously assessed (Inskip and Zimmerman, 2009). Having recommended hazing with bright lights and loud noises as a mitigation method for human-tiger impacts (Goodrich, 2010), one research program in Russia later found that it was positively correlated with incidents of repeated tiger attacks (Goodrich et al., 2011). Some studies have found that, while single mitigation methods can be ineffective when deployed individually, they can have a significant impact when utilised in combination with other measures (Karanth et al., 2013; Thapa, 2010).

While a lack of information can be a limitation on designing effective mitigation measures, the *socio-political* need for prompt actions can necessitate interventions even when adequate data are unavailable (Barlow et al., 2010). The same study noted that stakeholder participation in designing, implementing and managing mitigation programmes was also key to the success of mitigation methods. In addition, a meta-analysis of 37 studies of successful wildlife co-existence projects found that participation was a crucial element in their planning (Treves et al., 2009), a theme noted elsewhere in Disaster Risk Reduction projects (Mercer et al., 2008) and other HWI mitigation programs (Bauer et al., 2017; Gurung et al., 2008; Inskip et al., 2013; Thapa, 2010). Conversely, a lack of genuine participation can result in their failure. A community-based mitigation project in Uganda to reduce crop-raiding by primates, for instance, failed due to a lack of community input and ownership at the design phase (Webber et al., 2007).

2.7.2 Translocations and reintroductions

Wildlife translocations and reintroductions have the potential to be used as methods to mitigate HWI. Most research, though, has focused on these processes as conservation goals in their own right, such as with wolves *Canis lupus* in North America (Williams et al., 2002), rather than as mitigation methods to address, for example, crop damage by elk (Crank et al., 2010). In addition, as with conservation research in general (Ghosal et al., 2013), the socio-economic and political ramifications of translocations and reintroductions have been neglected compared to their biological and ecological aspects (Armstrong and Seddon, 2008). This is despite IUCN guidelines strongly suggesting the need for social feasibility studies as part of conservation translocations (IUCN/SSC, 2013).

The potential of *prey* species translocations and reintroductions as a means of HWI mitigation has not received much attention, whether in ecological or socio-economic terms (Balčiauskas and Kazlauskas, 2014). The rationale, as suggested with blue sheep in Nepal (Aryal et al., 2013; Ferretti et al., 2014; Lovari and Mishra, 2016), is that it will reduce the number of livestock depredations by carnivores, in this case snow leopards, by increasing the availability of wild prey. Prey availability is often a key predictor of carnivore density and abundance (Alexander et al., 2016), but in the case with wild ungulates in the mountains of Central Asia, carnivore conservation still fails to align itself with prey species conservation (Tumursukh et al., 2016). Yet there are a number of caveats to translocations and reintroductions of prey species as mitigation methods.

Firstly, the real or perceived impacts from prey species may outweigh those from predators. This was observed in a study in the USA with black-footed ferrets and prairie dogs, where ranchers held more negative attitudes towards the latter than the former (Reading and Kellert, 1993). In China, some negative impacts from, and negative attitudes towards, blue sheep, due to competition with livestock for pasture have been noted, even where there was general tolerance of snow leopards (Alexander et al., 2015). Secondly, the actual process of translocation or reintroduction may change attitudes to the species in question. While one study found support rates for wolf restoration of 60% in Europe and North America, it also noted that this was often correlated with those with the least experience of wolves (Williams et al., 2002). Reintroduction, therefore, had the potential to reduce positive attitudes through increased human exposure to wolves, and a more realistic perspective on this.

2.7.3 Compensation and incentive schemes

A more widely recommended and implemented mitigation measure, particularly for carnivore species and including snow leopards, is payment schemes. These can be based on compensation, insurance or incentive models, with differing levels of herder involvement and accountability (Hussain, 2000; Ikeda, 2004; Mishra, 1997; Pettigrew et al., 2012; Rosen et al., 2012; Wang and Macdonald, 2006). They have the potential to offset costs associated with HWI and HHC, to improve attitudes to predators, livestock losses and PAs (Bajracharya et al., 2006; Bauer et al., 2017; Hemson et al., 2009; Romanach et al., 2007). Protecting local livelihoods is often a paramount concern with such approaches, though they often cover livestock fatalities only, rather than livestock injuries as well, as has been suggested (Alexander, 2015).

Such financial instruments to incentivise human-carnivore coexistence have been termed as ‘payments to encourage coexistence’ (PEC) (Dickman et al., 2011). These have been defined as ‘schemes whereby (i) carnivore presence is ascribed high external value, (ii) which is translated into local payments for those negatively affected by carnivore-presence (iii) to encourage human-carnivore coexistence’. Where compensation schemes are more formalised and involve contracts and performance-based payments, such as the Snow Leopard Trust's incentive schemes in Mongolia and India (Mishra et al., 2003), they can represent a form of PES (Dickman et al., 2011; Jackson, 2012), an increasingly common form of market-based conservation (Ellison and Daily, 2003; Ferraro, 2001). There are, however, a number of critiques of compensation payments for wildlife impacts.

Financial sustainability is a major concern at various scales (Dickman et al., 2011; Mishra and Madhusudan, 2002), particularly where livestock have increased in financial value due to agricultural intensification (Berger et al., 2013; Wilman and Wilman, 2016). For example, criticisms have been made of the proportion of the Wildlife Department's budget in Ladakh, India, being spent on livestock compensation (Namgail et al., 2007). Instead, it has been argued that these funds could be better invested in more effective forms of mitigation.

Bureaucracy and corruption have also been cited as significant problems with such schemes (Chen et al., 2016; Rosen et al., 2012; Sangay and Vernes, 2008). Several studies have found instances of compensation not being paid (Chen et al., 2016; Karanth et al., 2013); in only 31% of cases in Karanth et al's study. On the other hand, appropriate audits and checks were found to prevent any reported cases of corruption with a compensation program that was analysed in Kenya (Hemson et al., 2009). Ironically, greater diligence in this regard can increase the levels of bureaucracy.

Compensation schemes have also been criticised as a form of agricultural subsidy, by encouraging habitat conversion, increasing labour flows into farming and increased stocking densities (Bulte and Rondeau, 2007, 2005). It has also been argued that perverse incentives can be created by such schemes, where the security of compensation reduces husbandry standards (Dickman et al., 2011; Maclennan et al., 2009; Wilman and Wilman, 2016). Yet arguing for rural exodus as one solution to HWI, as has been suggested (Bulte and Rondeau, 2007, 2005), ignores the considerable body of evidence suggesting that such emigration practices can have negative effects on traditional, and often more labour intensive, forms of sustainable land management, such as livestock guarding (Ale et al., 2014; Chandy et al., 2012).

Perhaps the most significant consensus amongst these various critics is that payment schemes of all kinds should be tied to prearranged conservation outcomes (Bauer et al., 2017; Bulte and Rondeau, 2007, 2005; Dickman et al., 2011; Mishra et al., 2003; Nepal and Spiteri, 2011; Rosen et al., 2012). However, while this may be achievable for HWI and HHC outcomes, it can be harder to shape attitudes. One the one hand, a study in India found that attitudes to snow leopards were better in a community that had an NGO-supported compensation scheme, despite higher levels of predation than in a similar community (Bagchi and Mishra, 2006). Meanwhile, others have observed that farmers and bear hunters who had been compensated for livestock losses to wolves were not more positive towards the species (Naughton-Treves et al., 2003). Furthermore, and despite the challenges, payment schemes remain popular where probabilities and costs of HWI are high (Karanth et al., 2012; Ogra and Badola, 2008).

2.7.4 Other mitigation methods

A wide range of other mitigation measures have been used in numerous contexts. Many, if not most, livestock are lost to predators by lax guarding practices (Hemson et al., 2009). Therefore, a common response is to confine livestock, usually at night and, preferably, in robust enclosures (Atickem et al., 2010; Jackson and Wangchuk, 2001; Mishra, 1997; Ogra, 2009; Rosen et al., 2012). This is an approach which has met with success in some cases (Karanth et al., 2012; Silva Rodríguez et al., 2009). In others, herders have been unwilling to change their husbandry practices (Hemson et al., 2009; Jackson et al., 1996; Oli et al., 1994).

Increasing livestock populations can also lead to increased conflict with carnivores *and* their prey species (Xu et al., 2008). Intensification through pasture management, livestock vaccinations and productivity improvements have all been suggested as agronomic strategies to limit numbers and increase income through improving livestock quality (Jackson et al., 2010; Jackson, 2012; Jackson et al., 2013; Johnson et al., 2006; McCarthy and Chapron, 2003). Improved livestock husbandry practices, such as employing professional animal herders, have also been proposed (Bhattacharya and Sathyakumar, 2011; Li et al., 2009; Maclennan et al., 2009).

Trophy hunting programmes have been suggested as a suitable mitigation option to encourage human coexistence with carnivores. This can involve harvesting of predatory species, such as with lion conservation (Loveridge et al., 2010), or harvesting of prey species, as with snow leopard conservation (Hussain, 2000; Mishra et al., 2003). One study, however, found that the successful implementation of an ungulate trophy hunting programme in Pakistan actually increased negativity towards snow leopards (Hussain, 2003). Villagers stood to lose not just livestock from predation incidents but also markhor *Capra falconeri* worth US $4,000 per hunt, an example of property rights being extended to prey species (Wilman and Wilman, 2016). Concerns have also been raised about whether those most affected by livestock losses will benefit substantially from trophy hunting programmes (Loveridge et al., 2010).

Tourism is often proposed as an important mitigation option, including for snow leopard conservation. The rationale is that it will provide direct benefits from species that otherwise can incur significant costs for people (Snyman, 2012; Stander et al., 1997; Udaya Sekhar, 2003; Walpole and Leader-Williams, 2002). As with trophy hunting, how evenly benefits are distributed has been questioned, given limited numbers of direct employment opportunities in tourism and the disproportionate allocation of HWI costs to farmers and those directly dependent on natural resources for their livelihoods (Hemson et al., 2009; Munanura et al., 2016; Sandbrook and Adams, 2012), as discussed briefly in Section 2.6.4.

Many of these mitigation methods that also function as conservation-related development interventions, have been criticised on a number of grounds. It has been argued that they should be limited to wilderness areas where conventional development institutions are lacking (Redford et al., 2008), while others believe them to be complex to implement, ambiguous in the conservation incentives they generate, and often unaligned with localised socio-ecological conditions and conservation objectives (Ferraro, 2001). These are similar criticisms to those discussed in Section 2.7.3 with compensation schemes. As an alternative to conservation-related development interventions, direct conservation payments have been proposed instead (Ferraro, 2001).

Responding to these criticisms, some have argued that distinguishing between development interventions and conservation payments may not be practical or popular on the ground (Mishra et al., 2003). Indeed, others argue that snow leopard conservation, for example, often cannot be separated from sustainable rural development amidst the communities who coexist with the species (Jackson et al., 2010). However, among published studies of conservation-related livelihood diversification, almost none appear to have consulted locals about the various options open to them. In contrast, one study from India, which asked respondents their opinion on a range of diversification options, as well as reasons for declining them, stands out as unique in this regard (Silori, 2007).

Other relevant mitigation measures include zoning (Linnell et al., 2005); linkages to agricultural policy (Linnell et al., 2012); education and the promotion of intrinsic values (Jackson et al., 2010; Marchini, 2010; Zimmermann et al., 2005); guard dogs (Atickem et al., 2010; Marker et al., 2010); trapping (Webber et al., 2007); hazing (Goodrich, 2010); and genuine community involvement in wildlife co-management (Ikeda, 2004; Rosen et al., 2012). Nonetheless, as with livelihoods, governance and the various aspects of HWC discussed in Sections 2.4 through to 2.7, trade-offs between biodiversity conservation and human welfare will remain.

2.8 Summary and conclusions

After a theoretical overview, this chapter reviewed the literature on livelihoods, governance and HWC. It first discussed the links between conservation and development at the global and local levels, focusing particularly on sustainable livelihoods and livelihood diversification. That conservation is closely interconnected with development in general, and rural development in particular, is a given. The real challenge is to understand and positively influence the nature of these interactions. This also applies to the links between farming and conservation, which can be exclusionary or positive. Whether at the global or local scale, for peasant farmers or for pastoralists, it is a critical issue for the future of biodiversity in general, and for snow leopards in particular.

The next section examined the issue of governance globally, and in relation to conservation, PAs, and poverty alleviation. A key theme here was the importance of social capital for natural and social resource management. Three sections on the varied dimensions of HWC then followed: knowledge and attitudes; wildlife impacts and conservation conflicts; and mitigation. There was a particular focus on relating the literature on livelihoods and governance to that on coexistence between people and wildlife. Based on this review, there is a firm case to be made that access to assets and access to influence do indeed shape interactions with nature generally, and with snow leopards specifically. The following chapter will now consider this in relation to the conservation context in Nepal and at the two study sites.

3. Human-snow leopard coexistence in Nepal

3.1 Introduction

The previous chapter reviewed key aspects of the literature on livelihoods, governance and HWC, as they relate to this study. As with the general literature review, an important issue throughout is that access to assets and access to influence do indeed shape coexistence between people and snow leopards on the 'Roof of the World'. This chapter builds on that overview by considering these same broad themes, first in relation to Nepal, and then to the two study sites of ACA and SNP. Nepal's conservation context is reviewed in the Royalist and Republican eras. For the purposes of this chapter, the Royalist period will be taken to mean the time period up until the beginning of the Nepalese civil war in 1996, while the Republican period will refer to the ten years of the civil war, the aftermath, and from the foundation of republican government in 2008 until the introduction of the new constitution in 2015. Recent changes of District Development Committees (DDC) to District Coordination Committees, and of Village Development Committees (VDC) to Rural Municipalities, in March 2017 (Government of Nepal, 2017), are not accounted for. In relation to the study sites, the geography of ACA and SNP is considered first, followed by a consideration of their history. The specific literature on livelihoods, governance and human-snow leopard coexistence is then reviewed, and key knowledge gaps are identified.

3.2 Nepal conservation context

...a strategy based not only on protected enclaves but also on landscapes, using an integrated grassroots approach that essentially reduces poverty and addresses the needs for human beings and that of wildlife.'

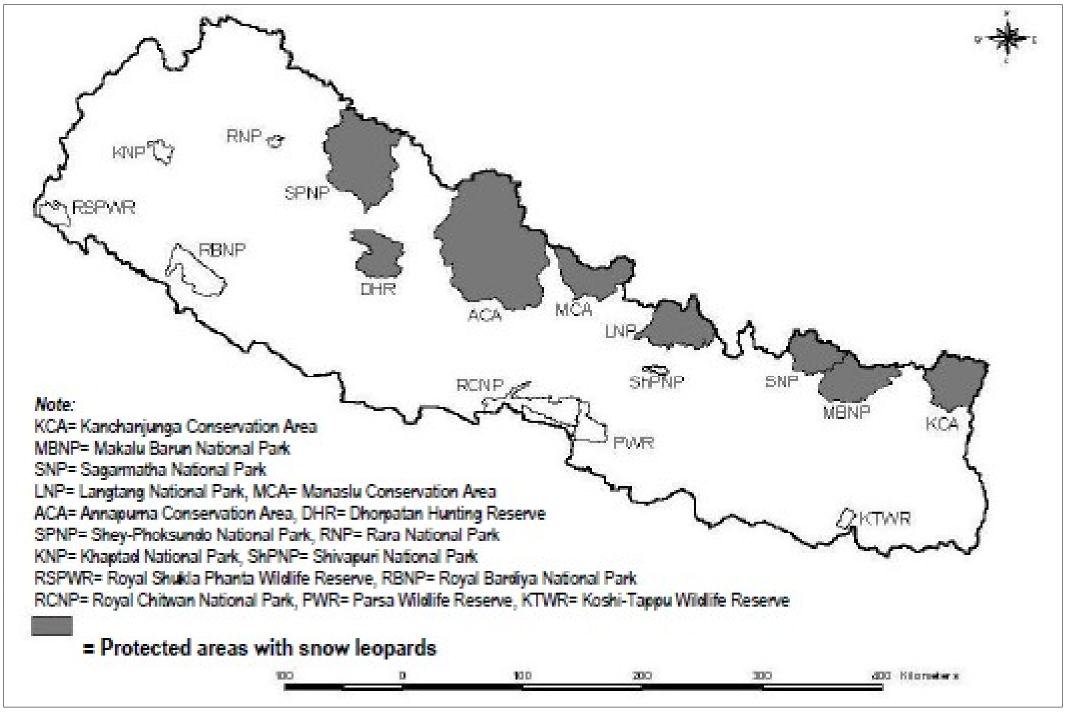
Ale and Karky, 2002

3.2.1 Royalist Nepal

Modern conservation has a hybrid relationship with colonialism and its legacy, being both a product of, and a reaction against it (Adams and Mulligan, 2003; Section 2.2.1). Although never formally colonised, Nepal's proximity to British India ensured that a colonial legacy also strongly influenced the conservation context in Nepal (Allendorf, 2007). In particular, the debate over, and tension between, preservationist and sustainable use approaches that has characterised Indian conservation since 1947 (Ghosal et al., 2013; Madhusudan and Raman, 2003), has also manifested itself in Nepal (Budhathoki, 2004).

Modern conservation in Nepal began in 1973, with the passage of the National Park and Wildlife Conservation Act (Mehta and Heinen, 2001). This gave the Department of National Parks and Wildlife Conservation (DNPWC) power to gazette PAs (Baral et al., 2007), which, by 2004, had increased to 16 in number, covering 18% of the country's surface area across its three geographic zones: the Terai, the Middle Hills and the High Himalaya (Ale and Karky, 2002; Budhathoki, 2004). However, the initial creation of strict PAs in the 1970s was marked by the exclusion and displacement of communities (Baral et al., 2007), with negative impacts on patterns of informal risk sharing, familial networks and food security (Lam and Paul, 2013). This has often resulted in the continued presence and involvement of the Nepali army in conservation opertions (Mehta and Heinen, 2001; Shrestha and Alavalapati, 2006).

Figure 3.1 Protected areas in Nepal (Ale and Karky, 2002)



A contributing factor to this centralised and authoritarian conservation approach was the 'Theory of Himalayan Environmental Degradation' (THED). Popular in the 1970s and 1980s, it blamed rapid population growth amongst Himalayan subsistence farmers for deforestation and soil erosion that contributed to increased downstream flooding (Ives, 2004; Karki, 1993). This trend towards blaming peasant livelihood practices has also happened in Egypt (Gilbert, 2013) and Central Asia (Kerven et al., 2012). A critical political economy perspective was lacking (Blaikie and Brookfield, 1987; Partap, 1999; Paudel and Thapa, 2001). While THED was largely discredited by 1989, as a narrative it nevertheless led directly to the establishment of Sagarmatha National Park (SNP) around Mt. Everest in 1976 (Brower, 1991), and affected natural resource management policies across the region (Ives, 2004).

This approach began to change by the 1990s (Ale and Karky, 2002). This period was marked by a progressive shift towards a community-based approach to conservation in Nepal, with the devolution of some authority and income generation towards local institutions (Mehta and Heinen, 2001). This included the designation of buffer zones around most National Parks in the mid 1990s, following amendments to the 1973 Act (Budhathoki, 2004). It also included the growth of community forestry and its Forest User Groups (FUGs), especially outside of PAs (Dhakal et al., 2007), as well as community-based tourism both inside and outside PAs (Allendorf and Gurung, 2016). Following the implementation of such policies, many positive conservation and development outcomes, particularly the growth of grassroots organisations, were noted (Bajracharya et al., 2005, 2006; Gautam et al., 2002; Parker and Thapa, 2012). In certain cases, these also included more positive attitudes towards PA authorities (Mehta and Heinen, 2001; Nepal and Spiteri, 2011).

Nevertheless, challenges remained. For example, sub-contracting conservation governance to NGOs and CBOs, rather than truly devolving authority (Heinen and Mehta 1999). This approach left these same organisations without the mandate to enforce regulations, which was especially problematic for sensitive species (Heinen and Mehta 1999; Baral et al 2007). Further reforms to conservation in Nepal that have been proposed include: increasing the representation of different habitat types in protected areas (Hunter and Yonzon, 1993); improved biological monitoring (Heinen and Mehta, 1999); environmental impact assessments by third parties (Mehta and Heinen, 2001); a focus on gender and caste equality (Allendorf and Allendorf, 2012; Baral et al., 2007); and greater integration with tourism (Mehta and Heinen, 2001; Nepal, 2000).

3.2.2 Republican Nepal

The transition from Royalist to Republican Nepal began with the onset of the civil war in 1996. It had significant ramifications for conservation in the short-term, although the longer-term impacts remain to be seen (Bajracharya et al., 2005; Baral and Heinen, 2005). These short-term effects included an increase in poaching and the illegal wildlife trade, as well as attacks on the staff and infrastructure of both governmental and non-governmental conservation agencies. These experiences call into question the role of the military in conservation enforcement in Nepal, given concerns, for instance, about the army's human rights record (Baral and Heinen 2005), as well as pointing to need for conservation organisations to be both politically neutral and financially independent in fragile states.

In the aftermath of the civil war, conservation in Republican Nepal continued its pivot towards CBC, thereby maintaining a trajectory begun in the 1990s, as discussed above. A 2005 Amendment to the 1973 Act formally recognised the devolution of PA management to non-governmental and community organisations (Bhuju et al., 2007). As with conservation worldwide, the need for landscape-level and trans-boundary approaches that connect networks of PAs is increasingly recognised, notably in the Kanchenjunga region of Eastern Nepal (Chettri et al., 2007). However, some of the win-win assumptions about conservation and development promoted in such approaches need to be tempered with more realistic expectations of trade-offs (Allendorf and Gurung, 2016).

Meanwhile, other challenges remain. For example, gender equality, over issues such as people-park relationships, remains a concern (Allendorf and Allendorf 2012), as does the issue of caste equality (Baral et al., 2007; Baral and Stern, 2011). Additionally, in light of the catastrophic earthquake of May 2015, the vulnerability of poorer nations like Nepal to adequately fund the rebuilding of their physical and social infrastructure, including for conservation, is acute (Bardsley, 2003). It also remains to be seen if and how the new 2015 constitution (Suresh, 2015) will affect the development of conservation in the country.

Both versions of the Snow Leopard Conservation Action Plan (SLCAP) for Nepal provide an indicator of many of these trends (DNPWC, 2017, 2013), recognising, as they do, that the participation of local communities is key to coexistence with snow leopards across their range (Johansson et al., 2016). Nevertheless, some gaps and inconsistencies exist in the documents. These include the enforcement gap discussed above (Baral et al., 2007; Heinen and Mehta, 1999), between decentralised conservation's regulatory remit on the one hand, and its legal inability to enforce regulations without external assistance on the other hand. The SLCAP 2017 – 2021, for example, noted that sustainable use of NTFPs and MAPs in snow leopard habitat, recommended by the SLCAP 2005 – 2015, had not been developed or implemented. Strategies for snow leopard conservation in Nepal include the use of PAs, landscape-level conservation outside of PAs, ecotourism and the implementation of ICDPs across snow leopard habitat (Ale et al., 2016).

3.3 Study site context

[In Khangsar VDC, ACA]...the affected livestock were either unguarded or poorly tended...Yet few appear willing to improve their obviously inadequate guarding practices, at least of their own accord.

Jackson et al., 1996

3.3.1 Geography of ACA and SNP

Gazetted in 1986, the ACA comprises 7,629 km² of protected landscape in north-central Nepal and is Nepal's largest PA (Baral and Heinen, 2005). Table 3.1 lists a number of key geographical characteristics of the site while Figure 3.2 provides a map of the site. There are are both Himalayan and Trans-Himalayan climatic zones within the park (Bhuju et al., 2007), and habitat gradients range from sub-tropical sal forest at 790m to perennial snow at 8,091m.

Figure 3.2 Annapurna Conservation Area (ACA) showing sampling locations and timeframe.

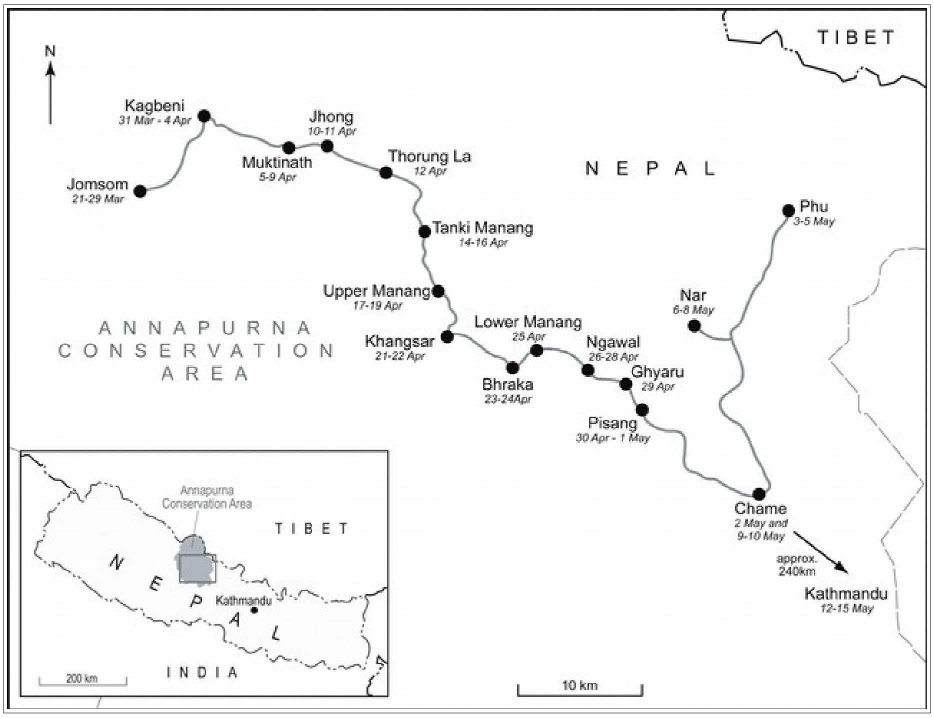


Figure 3.3 Typical ACA snow leopard habitat (photo by J H Hanson)

The sub-alpine, alpine and nival zones in ACA that snow leopards favour are characterised by alpine and steppe plant communities (Ale and Karky, 2002), while presence of blue sheep, particularly in the Manang and Mustang districts, form the prey base for a significant population of snow leopards (Ale et al., 2014; Aryal et al., 2014; Wegge et al., 2012). Other large mammal species include lynx, wolf, brown bear *Ursus arctos*, wild ass *Equus kiang* and argali *Ovis ammon* (Ale and Karky, 2002) and there are also an estimated 100,000 people living within ACA (Bhuju et al., 2007).

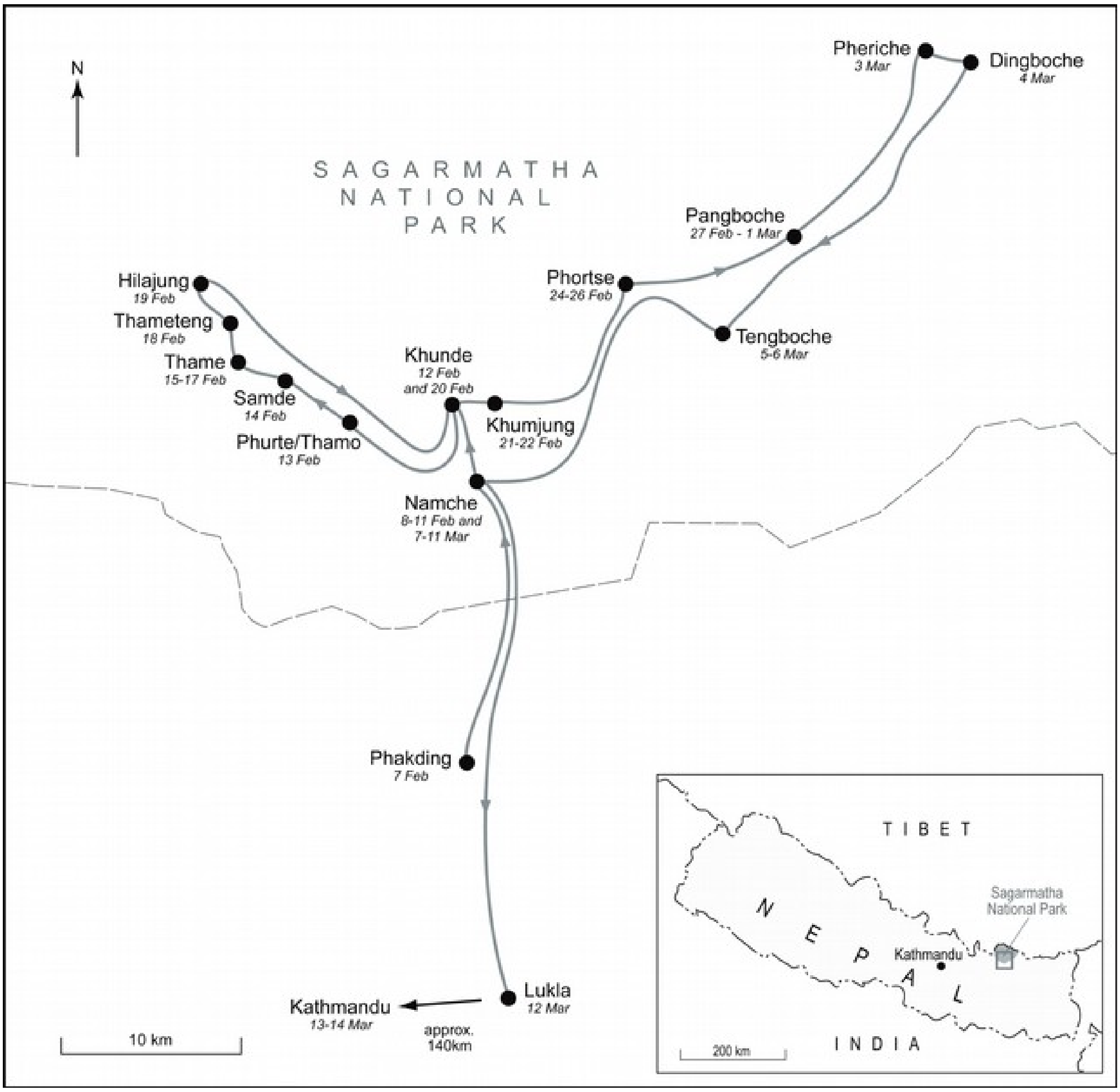
Table 3.1 Selected geographical characteristics of ACA and SNP (from Bhuju et al., 2007)

Characteristic	ACA	SNP
Area	7,629 km²	1,148 km²
Lowest altitude	790m	2,845m
Highest altitude	8,091m	8,848m
Physiographic zones	4	3
Bioclimatic zones	10	6
Ecosystem types	28	8
Vegetation types	15	8
Mammal species	101	26
Bird species	474	162
Reptile species	39	13
Amphibian species	22	
Flora species	3,430 (estimate)	1,074 (estimate)
Vascular plants	456	160
Founded	1986	1976
Number of districts	5	1
Buffer zone	No	Yes (from 2002)
Number of VDCs	55	2
Human population	100,000	3,500*

* Data from Government of Nepal, 2012

SNP was established in the north-eastern part of Nepal in 1976 and a buffer zone aroun the southern perimeter was introduced in 2002 (Baral and Heinen, 2005). Table 3.1 details various geographical characteristics of SNP while Figure 3.2 provides a map of the area. Unlike ACA, however, SNP has a single Himalayan climatic zone (Bhuju et al., 2007), and 70% of its surface area is covered by ice, snow, glaciers, rocks and bare soil (Bajracharya, 2010). However, habitat gradients exist between temperate oak and pine forests at 2,845m, to permanent snow at 8,848m (Bhuju et al., 2007).

Figure 3.4 Sagarmatha National Park (SNP) showing sampling locations and timeframe.



Snow leopards prefer the vegetation lying between 3,500 and 5,500m in the sub-alpine, alpine and nival zones. These support similar plant genera to the contemporary zones in ACA (Ale and Karky, 2002). SNP has a reasonably abundant population of Himalayan tahr *Hemitragus jemlahicus* (Lovari et al., 2009), and over the last 15 years snow leopards have recolonised the SNP after an absence of several decades due to local extinction (Ale et al., 2007; Lovari et al., 2013b). Other large mammals include musk deer *Moschus leucogaster*, common leopard and black bear. There are also 3,500 people living in 63 settlements within SNP (Bhuju et al., 2007; Government of Nepal, 2012).

Figure 3.5 Typical SNP snow leopard habitat (photo by J H Hanson)

3.3.2 History

The Manang and Mustang districts of Nepal have been part of important trade routes, between Tibet and lowland Nepal, throughout recorded history (Nepal, 2000). The capital of Mustang, Lo Manthang, became particularly wealthy through control and taxation of the salt trade that passed through the Kali Gandahki Valley, and continued as a quasi-independent feudal kingdom until republican government began in 2008 (Wright, 2015). The culture of the region is steeped in Tibetan Buddhism, often mixed with remnants of the earlier Bon-po faith (Ale et al., 2014; Brower, 1996 Thapa, 2005).

In 1986, following disenchantment with a centralised and often authoritarian conservation governance model in Nepal, the ACA was designated as Nepal’s first conservation area (Baral and Heinen, 2005). The project began as a pilot in a single VDC, but was expanded incrementally to cover a total of 55 VDCs (Bhuju et al., 2007). The conservation area management regulations introduced in 1996 gave Conservation Area Management

Committees (CAMC) established in each VDC the legal authority to oversee their own development and conservation (Baral et al., 2007). The area was a noted stronghold of the Maoist rebels during the civil war, 1996 – 2006, including cases of tourist extortion and attacks on conservation staff and infrastructure (Baral and Heinen, 2005).

Historically, the Khumbu region of Nepal also functioned as a trading route between lowland Nepal and Tibet, and the area’s Sherpa people had begun to emigrate there from south-eastern Tibet in the 16th century (von Fürer-Haimendorf, 1964). However, the region is now less known as a trading route, and more with various attempts to climb Mt. Everest, and the associated growth in mountaineering and adventure tourism since the first successul ascent in 1953 (Byers, 2005).

Largely due to the THED's mostly unfounded environmental concerns, the VDCs of Namche and Khumjung were gazetted as Sagarmatha National Park in 1976 (Brower, 1991; Ives, 2004). Designation as a UNESCO World Heritage Site followed in 1979 (Bhuju et al., 2007). Initially, the management plan for SNP centralised state control over resources and tourism revenues. However, the 2002 Buffer Zone policy and more recent management plans have devolved more authority and 30 – 50% of SNP revenues to local development (Daconto and Sherpa, 2010). In addition, since 1953, mountaineering-related philanthropy has been a significant source of investment in the area’s infrastructure, including education, transport and healthcare (Rasley, 2010; Trunzo-Lute, 2012).

3.3.3 Livelihoods

The human population of 100,000 in ACA, at a density of 13.1 km², relies heavily for their livelihoods on agro-pastoralism, and increasingly on tourism (Bajracharya et al., 2005, 2006; Jackson et al., 1996; Oli et al., 1994). Between 1999 and 2004, an average of 54,956 tourists visited ACA annually (Baral et al., 2008). However, livestock herding remains particularly important, and numerous, in the NarPhu region of Manang district in ACA, where tourist access is limited (Thapa, 2005). In Upper Mustang, a total of 30,127 livestock were documented grazing over 1,347 km² in six VDCs (Aryal et al., 2014). However, studies in ACA have not employed a political ecology approach, the Sustainable Livelihoods framework or access theory to understand and analyse local livelihoods.

The socio-economic benefits of CBC in ACA generally outweigh the costs in financial terms (Bajracharya et al., 2006), even though many of the livelihood benefits, such as bridges, were directed at the community rather than at household level. However, these authors found that only 14.9% of their respondents had received direct financial income from tourism. Kerosene and wood were the primary sources of energy for the tourism industry, but use of renewable energy and energy-saving technologies has increased (Nepal, 2008). The NTNC has been a significant contributor to innovation and adaptation amongst farmers in ACA (Aase et al., 2013).

As in ACA, the 3,500 people living within SNP, at a density of 3.0 km², are also engaged in a combination of agro-pastoralism and tourism for their livelihoods. Livelihood innovation occurs on an individual household level, with diverse combinations of animal husbandry and agricultural production depending on local conditions (Brower, 1991, 1996). Unlike in ACA, however, sheep and goats have been phased out from SNP for conservation reasons (Bhuju et al., 2007). Yet even three decades ago, the livelihood system was changing from a traditional subsistence agricultural one to a transitional one, with diversification to tourism and other activities from the 1950s onwards (Bjønness, 1983). Climate-related hydrological changes have also begun to put pressure on both agricultural and tourism practices in the area, particularly by reducing the availability of water (McDowell et al., 2013).

Tourist visits to SNP have increased from c. 1,400 in 1972/3 to >20,000 in 2004 (Ale et al., 2007), with 46% of households having some involvement in trekking and related activities (Bhuju et al. 2007). These visits have had negative environmental effects, including on agro-pastoral practices, forest and shrub cover, and water availability (Bjønness, 1980, 1983; Byers, 2005; McDowell et al., 2013; Padoa-Schioppa and Baietto, 2008). Nevertheless, no conclusive connection between herd size and overgrazing has been found (Padoa-Schioppa and Baietto 2008). Furthermore, as the number of local young people employed in the industry increases, the number available for livestock herding has decreased (Ale et al., 2007).

In reality, unregulated adventure tourism, rather than agriculture, has been the main driver of environmental degradation in this area of Nepal (Byers 2005), with the livelihoods benefits for some not being matched by a concomitant commitment to ecological stewardship. This challenges the trend towards livelihood diversification via tourism that is popular amongst donors, development agencies and some NGOs (Byers 2005). The potential trade-offs between conservation and development goals need to be acknowledged. In addition, concerns have been raised about the increasing stratification of Sherpa society due to unequal benefit distribution from tourism (Nepal, 2000), as well as increasing market capture by outside business elites (Daconto and Sherpa, 2010).

Additionally, remoteness, and even competition with other PAs, can limit the viability of ecotourism as a major livelihood option. Makalu-Barun National Park (MBNP) and the Kanchenjunga Conservation Area (KCA) in Nepal (Figure 3.1), for example, both receive relatively few tourists compared to the geographically similar but better known SNP and ACA (Bajracharya et al., 2005; Jha, 2003; Parker and Thapa, 2012). Yet in MBNP, which borders SNP, a survey found widespread support for ecotourism development, and community forestry, as well as considerable dissatisfaction with existing community development initiatives (Mehta and Kellert, 1998). Further to the east, high levels of resource dependence were found recently in KCA, especially at higher altitudes (Parker and Thapa 2012). However, this was often partly ameliorated through receipt of remittances from outside the area.

3.3.4 Governance

The ACA was established as an example of a decentralised approach to conservation, that was co-managed by a Nepalese NGO, the NTNC, and local communities, through their CAMCs (Bhuju et al., 2007). The CAMCs largely replaced traditional resource management committees called *Ghama-Ngerba* from 1986 onwards (Ale and Karky, 2002). It is these devolved institutions that have been credited with much of the success of integrated conservation and development in ACA (Bajracharya et al., 2005), although they are part of a larger ‘innovation system’ which includes the NTNC, international NGOs and the Government of Nepal (Aase et al., 2013). The ACA programme has focused on natural resources, alternative energy generation, community development, agricultural development, livestock development, gender-based development, tourism development and cultural heritage (Bhuju et al., 2007).

Higher levels of CAMC conservation activity in ACA were associated with longer project life-cycles and institutional development (Baral et al., 2007), while, amongst the 190 members of 30 CAMCs surveyed, institutional resilience was significantly associated with higher levels of human and social capital (Baral and Stern, 2011). The relationship to natural capital was parabolic: moderate amounts of natural capital were associated with the most resilient CAMCs in terms of their social capital. Clearly, the development of social capital, and of strong institutions through which people can access influence, is critical for conservation and development, but also time-consuming. In addition, gaps still remain, particularly in realising equal female and lower-caste access to resources (Baral et al., 2007). Neither has the potential impacts of this management model been compared directly with similar, but less decentralised, PAs in Nepal.

SNP operates a more traditional centralised approach to conservation as a government-managed NP, albeit with increasing community participation and devolution since 2002 (Daconto and Sherpa, 2010). Like ACA, the imposition of state-led conservation, from 1976 onwards has largely, but not entirely, replaced traditional environmental governance fora, called *Nawas*, in the area (Bajracharya, 2010). Indeed, the integration of mountain PAs like SNP into the global economy has often resulted in the weakening of such traditional mechanisms of conservation (Daconto and Sherpa, 2010).

Meanwhile, the 1970s and 1980s witnessed a turn towards authoritarian centralised conservation in SNP (Budhathoki, 2004). However, the designation of a buffer zone and three buffer zone user committees in 2002 resulted in an increased level of community participation, including the establishment of a local Pollution Control Committee (Bhuju et al., 2007; Budhathoki, 2004). Compared with ACA, however, there is still less devolution of governance, as well as the absence of a local NGO, with access to significant international funding, to coordinate various stakeholders. Such co-management is practised in the adjacent MBNP (Jha, 2003), while participatory processes were also identified as essential to success in KCA, an ecologically similar PA to the east of SNP (Parker and Thapa, 2012). Co-management may also be critical to coexistence between people and snow leopards. FUGs, common in Nepal outside outside PAs (Dhakal et al., 2007), are less relevant here due to the existence of alternative governance structures in both SNP and ACA, as well as the limited amount of forest in snow leopard habitat.

3.3.5 Human-snow leopard coexistence

Along with India and Mongolia, Nepal's snow leopard population is one of the more intensively studied (Riordan et al., 2015). In ACA, densities of between 1.6 and 5 snow leopards per 100 km² have been estimated for various parts of the PA, with blue sheep as the principal prey species (Ale et al., 2014; Aryal et al., 2014; Thapa, 2005). In SNP by contrast, snow leopard were believed to have been absent for 40 years, but have now recolonised it over the last 15 years (Ale et al., 2007). With an estimated density of 1.8 per 100 km² (DNPWC, 2013), the habitat preferences of snow leopards are cliffs, open forest and pastureland (Ale et al., 2007; Wolf and Ale, 2009). The principle prey species is Himalayan tahr (Ale and Brown, 2009), albeit with some dietary overlap with the common leopard (Lovari et al., 2013a).

No empirical research has been conducted on knowledge of snow leopards in either ACA or SNP, or of attitudes to the species in SNP. In ACA, where earlier work found widespread negativity towards the species (Oli et al., 1994), mostly because of livestock depredation, a more recent study has suggested more balanced views exist (Ale et al., 2014). Crucially, neither study sought to explain empirically these attitudes on the basis of respondent attributes. The role of Buddhist beliefs and values has been suggested as an important determinant of tolerance for the species generally (Bhatia et al., 2016), in Nepal (Ale et al., 2016), in ACA (Ale et al., 2014), and in SNP (Ale et al., 2007). However, this relationship has yet to be empirically tested in Nepal. Clear knowledge gaps are apparent and so there is a need for a comprehensive assessment of individuals' attitudes to, and knowledge levels of, snow leopards at both sites. In particular, it is very important to know whether improved livelihood diversification can improve attitudes, as suggested elsewhere (Bagchi and Mishra, 2006; Suryawanshi et al., 2014).

Research has been conducted on the impacts of snow leopards on livestock herding. The percentage of livestock remains in snow leopard scat, and of annual livestock predation rates by snow leopards in ACA and SNP are summarised in Table 3.2. In ACA, livestock depredation has been observed to increase during in winter (Oli et al., 1993). There is an information gap for SNP in terms of social surveys to comprehensively estimate the predation rate, although a figure of 1.9% is claimed for the Phortse area of SNP in 2004 (Ale et al. 2007). Neither in Nepal or elsewhere has a political ecology approach, Sustainable Livelihoods framework or access theory been utilised to connect human ecology with human-snow leopard impacts. Additionally, the influence of governance models on human-snow leopard coexistence has yet to be assessed.

Table 3.2 Percentage of livestock remains in snow leopard scat and of annual livestock predation rates by snow leopards in ACA and SNP.

Method	**Author(s)**	**Location**	**Sample size**	**% Livestock**
Scat analysis	Oli et al., 1994	Manang, Nepal (ACA)	213	17.8
	Lovari et al., 2009	Khumbu, Nepal (SNP)	106	23.0
	Wegge et al., 2012	Manang, Nepal (ACA)	41	42.0
	---	---	**Mean**	**29.8**
Social surveys	Aryal et al., 2014	Upper Mustang, Nepal (ACA)	611	1.0
	Ale et al., 2014	Mustang, Nepal (ACA)	275	3.3
	---	---	**Mean**	**2.15**

No empirical research has been conducted *on* snow leopard conservation or its impacts at either study site. This lack of data follows broadly similar trends to those seen elsewhere in the species' range (Rosen et al., 2012; Sections 2.5.3 & 2.6.4). People may fear censure or fines from the authorities in ACA if they kill a snow leopard in retaliation for killing their livestock (Jackson et al., 1996). Meanwhile, formal complaints to park authorities about livestock depredations were found to be minimal (Ale et al., 2007). As with snow leopards, access theory, the Sustainable Livelihoods framework and a political ecology perspective have not been applied to date, to understand the correlations between livelihoods and human-snow leopard conservation conflicts.

Nevertheless, neighbouring PAs provide some more detail. There is widespread dissatisfaction with the livestock compensation scheme in Qomolongma National Park, adjoining SNP on the Tibetan side (Chen et al., 2016). In KCA, livestock herders were mostly negative towards snow leopard conservation policy (Ikeda, 2004). However, attitudes to CBC in MBNP and ACA were mostly positive, although they did not consider snow leopard conservation specifically (Mehta and Heinen, 2001; Mehta and Kellert, 1998). The overriding assumption here, as in Nepal generally (Ale and Karky, 2002) and across the species range (Jackson et al., 2010), is that decentralised and participatory governance models are the most suitable and effective for snow leopard conservation. However, this assumption has yet to be empirically tested.

Several studies have suggested human-wildlife impact mitigation options but none has assessed social attitudes to these proposals. Translocating a population of blue sheep to SNP to reduce depredation on livestock, based on a favourable habitat assessment, has been proposed (Aryal et al., 2013). However, a social feasibility assessment has not been conducted to date. In ACA, an insurance scheme has been proposed for livestock, predator-proof corrals, livelihood diversification and conservation education as combined mitigation methods for snow leopards impacts on households (Aryal et al. 2014). Again, however, social attitudes to such suggestions were not considered, a common failing of conservation interventions worldwide (Silori, 2007; Webber et al., 2007).

3.4 Summary and conclusion

This chapter has reviewed the literature on livelihoods, governance and human-snow coexistence in Nepal and at my two study sites, ACA and SNP. The chapter began with a general assessment of the conservation context in the country. This assessment sub-divided Nepal's conservation history into the Royalist period, which lasted until the beginning of the civil war in 1996, and the Republican period, comprising the conflict years of 1996 – 2006, the aftermath of the war, and from the establishment of Republican government in 2008 until the introduction of the new constitution in 2015. Beginning in the first of these eras, conservation in Nepal has charted a gradual movement away from authoritarian centralised conservation towards a more participatory approach.

This trend is apparent at both ACA and SNP study sites, although the devolution of governance is significantly more complete and better established in ACA. Otherwise, despite the differences in their management model, both PAs are similar in terms of their ecology and their human ecology. Of particular note is that agro-pastoral livelihoods systems are being increasingly changed by tourism. However, considerable knowledge gaps exist in relation to how livelihoods and governance in both ACA and SNP interact with and shape coexistence with snow leopards and snow leopard conservation. In addition, the differences between the two sites, and the potential impact of governance models on these differences, have not yet been the subject of study to date. Therefore, the next chapter sets out the methods used to address all of these important information gaps.

4. Methodology

4.1 Introduction

Chapter Three discussed the context in which this study took place, both within Nepal generally, as well as specifically within the two protected areas of Sagarmatha National Park (SNP) and Annapurna Conservation Area (ACA). This chapter gives the methodology of this study as it is pursued within this context. Firstly, an overview provides the theoretical and practical background for the research, and details the logistical elements of fieldwork, which took place in a particularly challenging environment. Secondly, the chapter examines the main data collection instrument used the study - household questionnaires – with sections on preparation, administration and analysis. Thirdly, it follows the same format to set out the methodology of the structured interviews used as the secondary form of data collection. Note that the chapter, and the rest of the study, refers to the pre-March 2017 administrative units of DDC and VDC.

4.2 Theoretical overview

4.2.1 Ontology

Ontology is concerned with the nature of reality and how it is organised. Specifically, it addresses to what extent the social world, whether as entities (Bryman and Bell, 2007) or actors (Newing et al., 2011), mimics the discrete laws and mechanisms of the natural world. At one end of the ontological spectrum, subjectivity regards social entities as social constructions fashioned by the outlooks and actions of social actors. Research from this angle tends to focus on the individuals who make up organisations, and their perspectives and opinions (Newing et al, 2011). Qualitative research approaches are usually favoured in subjectivism.

As a counter-point to this view, objectivity considers social entities as existing independently of social actors, as tangible objects which can be studied in their own right. This objectivist slant is an external point-of-view which recognises social organisations as 'comprised of consistently real process and structures' (Bryman and Bell, 2007). It also tends to favour more quantitative research strategies. Conservation is regarded as a diverse social process which is *both* created by, and acts upon, individuals and institutions through, among other things, policies and interventions (Sandbrook, 2015). This study has therefore adopted a hybrid ontological stance between subjectivity and objectivity.

4.2.2 Epistemology

Linked to the ontological debate, epistemology considers what constitutes appropriate knowledge, especially whether a research process based on the natural science model can be applied to studies of the social world (Bryman and Bell, 2007). The position which argues that this natural approach cannot be successfully applied socially, interpretivism, regards knowledge as subjective and recognises a distinction between the study of the natural and social worlds (Newing et al., 2011). At the other end of the epistemological spectrum, positivism, states that, among other principles, knowledge can and must be acquired in a manner that is value-free and empirical (Blaikie, 1993). Positivism in this form tends to apply natural-science research approaches to social enquiry.

As with its ontological position between objectivity and subjectivity, this study recognises an independent and objective reality but also the important role of the researcher in attempting to understand this reality. As such, this position, a hybrid of positivism and interpretivism, is termed realism and often utilises mixed methods of data collection (Bryman and Bell, 2007). More specifically, taking a critical realist position, this study recognises that that even objective realities and data are viewed and interpreted subjectively. Therefore, objective quantitative data regarding, for example, access to various forms of capital to enable livelihood creation, or household livestock losses to snow leopards, were complemented by more subjective qualitative information, such as opinions on a proposed conservation intervention at each study site.

4.2.3 Axiology

The researcher's position on the role of values in the research process is termed ‘axiology’ (Bryman and Bell, 2007). As the researcher will always be influenced by conscious and sub-conscious perspectives, and considering that these can impact at any or all of the stages in the research process, it is impossible to hold an entirely objective position. Researcher values can and will affect the research process. This is particularly true in the field of conservation, which has been described as both a crisis discipline (Bradshaw et al., 2007) and a mission-driven discipline (Meine et al., 2006).

On the one hand, my enthusiasm for my research topic has been shaped by a lifelong fascination with mountains, large cats, farming and poverty alleviation. On the other hand, a belief in community-based and integrated snow leopard conservation and development, for instance, could itself be regarded as a particular moral viewpoint, with certain activities regarded as right or wrong, and with implications for judgements made in the research process. An awareness that research is value laden is an important first important step in recognising the factors which shape the process (Kingdon and Knight, 2006; Newing et al., 2011). The acknowledgement of such values is key to ensuring that their role in the research process is understood.

4.2.4 Research approach

Personal preferences and values also influence the approach taken to conducting research, as will the character of the relationship between theory and research (Bryman and Bell, 2007; Kingdon and Knight, 2006). The inductive approach takes the view that research generates theories based on data, while the deductive perspective implies that theory informs and guides research, but with subsequent modification of theory (Whetten, 1989). The former is more often associated with qualitative enquiry and the latter with quantitative. The approach can also be influenced by the breadth and depth of the existing body of knowledge (Newing et al., 2011). Where little is known, a broad, exploratory inductive approach may be bested suited. In contrast, where the field is well developed, a more tightly-focused, deductive study may generate additional, detailed knowledge.

In relation to this study, both empirical (Suryawanshi et al., 2014) and theoretical (Jackson et al., 2010) papers have already suggested links between livelihoods, governance and snow leopard conservation. Therefore, this research adopted a deductive strategy, exploring and testing how access theory (Ribot and Peluso, 2003), specifically access to assets (i.e. livelihoods) and influence (i.e. governance), shapes co-existence between people and snow leopards. This deductive approach complements both a critical realist epistemological position and a hybrid objective-subjective ontological viewpoint.

4.3 Research overview

4.3.1 Research design

The function of the research design is to provide 'a framework for the collection and analysis of data' (Bryman and Bell, 2007). Research design structures include: formal experimental approaches with measured interventions; less formal quasi-experimental approaches also with interventions but with less control; and observational approaches that do not involve interventions in the research but only observation. In addition, observational studies can be case studies, comparative case studies, cross-sectional studies or longitudinal studies (Newing et al., 2011).

Given the applied and descriptive nature of this study, and its potential contribution to policy, a cross-sectional structure was adopted, gathering data from a representative sample of the population in both PAs. A cross-sectional research design involves the collection of data from more than one case in relation to at least two variables, from a single point in time. The information is then analysed to determine trends and relationships (Saunders, 2011). The intention was to analyse the populations from both study sites together in relation to snow leopard conservation and livelihoods, as well as to analyse the samples from both PAs comparatively, specifically in relation to their contrasting governance approaches. Therefore, the resulting research design structure is a hybrid comparative, cross-sectional one.

Validity is also an important factor in research design. Validity considers whether the research design structure adequately addresses the study's research questions (Newing et al., 2011), and there are three main types relevant here, internal, external and context (measurement validity is considered in Sections 4.5 and 4.6). Internal validity allows conclusions to be drawn that are theoretically rigorous. It is weaker in cross-sectional and comparative designs than in experimental models, because only correlation between variables, rather than causation, can be proven.

External validity, or to what extent results can be generalised to the wider population, is highest with cross-sectional designs. This is due to the generalisations that can be made beyond the sample when sampling is conducted randomly. Thirdly, there is context, or ecological, validity. This addresses to what extent the way the research is conducted is representative of real-life situations. It is strongest in case studies with participant observation, weakest in experimental designs and between these two extremes for cross-sectional approaches. In summary, therefore, the research design of this study has weak internal validity, strong external validity and medium contextual validity.

The specification of hypotheses, more associated with experimental research, was not carried out with this design. Instead, general theoretical considerations, based on the literature review generally, and the research questions specifically, have acted as the guiding principles throughout the research process (De Vaus, 2002).

4.3.2 Methods

Employing a critical realist perspective and utilising a comparative, cross-sectional research design dictated that the data to be collected within this framework were predominantly quantitative. This was to ensure that correlations and trends between livelihoods, governance models and snow leopard conservation could be identified and contrasted empirically (Saunders, 2011). Nevertheless, critical realism also recognises the subjective interpretation of objective data, and often utilises mixed-methods designs to facilitate this (Bryman and Bell, 2007), the qualitative data adding depth to the breadth of quantitative data.

As a consequence, a concurrent, mixed-methods methodology was developed (Newing et al., 2011), employing household questionnaires as the primary form of data collection, with additional open questions added to capture respondents' qualitative perspectives on certain variables and issues. In addition, a smaller number of structured interviews were also carried out (c. 10% of the number of questionnaires). Their open questions were analysed both quantitatively, to allow for triangulation with the data from the household questionnaires, and qualitatively, to add subjectivity to the more objective empirical data from the questionnaire.

Admittedly, a trade-off was made in choosing structured, rather than semi-structured, interviews. It was felt that the need to provide quantitative data from a parallel source in order to triangulate, and therefore validate, the questionnaire results outweighed the value of additional qualitative data that may have been gathered from a semi-structured approach. The methods of data collection are considered in greater detail in Sections 4.5 and 4.6. A concurrent design was also chosen for practical reasons, allowing both forms of data collection to occur simultaneously during field trips. Such practicalities are a significant, if under-reported, contributor to research designs (Newing et al., 2011).

4.3.3 Scoping

During the scoping phase of the study, 15 semi-structured and unstructured interviews were carried out with key informants, either at offices in Kathmandu and Pokhara, or in ACA. Snowball sampling was used, following Chen at al. (2016). These interviews gathered background information on the study sites and the suitability of the proposed methodology. This added an additional sequential stage to the research design: the qualitative data gathered here helped to inform the final design of the household questionnaires and structured interviews (Newing et al., 2011).

Unfortunately, SNP could not be visited during the scoping study, as the appropriate DNPWC research permit had not been issued. However, a previous visit in 2009, and extensive discussions with scoping interviewees and the Snow Leopard Conservancy, ensured an acceptable level of familiarity with the site. Table 4.1 summarises the details of the scoping interviews. This scoping phase also coincided with the piloting of the household questionnaire (see Section 4.5).

Beyond methodological reasons, participation was also a motivating factor for the scoping stage. Although a full participatory approach was beyond the scope of this study, its participatory ethos meant that this stage of the research process was important for avoiding two pitfalls of applied snow leopard research. First, that research topics are often not of interest to PA authorities; and, second that local communities are often excluded from the research process (Jackson et al., 2010). This is discussed further in Section 4.4.4.

Appropriate modifications were made to the indicators and methodology based on this scoping phase. Principally, this involved the development of a mitigation section for ACA to be added to the household questionnaire, to complement the mitigation section on the proposed blue sheep reintroduction in SNP (Aryal et al., 2013). This ACA section examined potential components of a snow leopard conservation incentive scheme that shared the costs and benefits of conservation and development, particularly tourism, more widely, equitably and sustainably. Minimising the risks and maximising the benefits of human co-existence with large carnivores, in such a manner, is recognised as a key conservation strategy both for the Order C*arnivora* more generally (Dickman et al., 2011) and for snow leopards specifically (Jackson et al., 2010). Yet this is an area that has often been under-researched (Ghosal et al., 2013).

Table 4.1 Scoping interviews during Fieldtrip 1

Number	Location	Position
1	Kathmandu	Senior NTNC staff member
2	Pokhara	Senior ACAP-NTNC staff member
3	ACA	Hospital administrator
4	ACA	Hotel owner
5	ACA	ACAP-NTNC staff member
6	ACA	CAMC chairperson
7	ACA	ACAP-NTNC staff member
8	ACA	ACAP-NTNC staff member
9	ACA	Hotel owner
10	ACA	Hotel owner
11	ACA	Pilot
12	Kathmandu	Senior NTNC staff member
13	Kathmandu	Senior DNPWC staff member
14	Kathmandu	ICIMOD staff member
15	Kathmandu	Senior WWF staff member

4.4 Logistical overview

4.4.1 Ethics

Based on the completion of the University of Cambridge Research Ethics Self-Assessment Form for postgraduates (Appendix 12.1), this study raised two particular ethical issues that needed to be satisfactorily addressed before fieldwork could be conducted. These were that:

1. the study required the informed consent of its subjects, and

2. the study may involve the discussion of sensitive topics, specifically relating to human conflict with wildlife. Furthermore, this may potentially include activity considered by some to be illegal.

In relation to informed consent, a brief and accessible overview of the research was given to all households and interviewees prior to commencement of each data collection session, including the option to end the questionnaire or interview at any time (Bryman and Bell, 2007). The independence of the researcher from government (e.g. DNPWC), local NGO (e.g. NTNC-ACAP) or local association (e.g. CAMC) ties was also stressed, to encourage respondents to be comfortable, honest and frank in their responses. During the brief introduction, the confidential nature of the research was also noted, as well as the fact that data would not be shared with the previously mentioned groups other than in anonymised, amalgamated forms. Given the often normative nature of conservation and conservation research (Meine et al., 2006; Newing et al., 2011), as discussed previously in Section 4.2.3 on axiology, it was also confirmed, if necessary, that the collection of data did not represent a commitment on the part of the researcher to become actively involved in the situation.

The conservation researcher's position in, and perspective on, the research makes this an ethically challenging environment. There is a tension between, on one hand, a commitment to the conservation of a species in its natural environment. On the other hand, extractive methods of undertaking research have been criticised (Jackson et al., 2010). However, a compromise solution was adopted in this case, by mentioning to respondents that the overall results would be used by the site managers to improve management.

As the study collected data on the coexistence between people, snow leopards and snow leopard conservation, there was much scope for the discussion of sensitive topics. These included impacts from wildlife that cause economic damage, such as livestock losses, as well as human responses that may, on occasion, be of an illegal nature, such as poaching. Potentially strained relationships with conservation institutions and authorities were also to be discussed. As with the informed consent, I stressed that as the researcher I was independent of these institutions and authorities, and that all responses would be treated with the utmost care and confidence. In addition, the constructive and applied nature of the findings was stressed In addition, the opportunity for the researchers to learn from the local communities themselves was highlighted (Jackson and Wangchuk, 2001).

The study's ethics were approved by the Department of Geography's Ethics Review Group (see Appendix 12.2). As part of this, a number of other ethical issues relevant to good research practice were also considered (Bryman and Bell, 2007; Newing et al., 2011; Saunders, 2011), including:

1. Maintenance of data protection. All personal data obtained were to be kept by the researcher and stored in files back in the UK, including post-PhD. As the questionnaires were needed for analysis, they could not be deposited in an archive in Nepal. This raw data was not be shared with the PA authorities or conservation institutions working in them.

2. Respect and openness towards others. Sensitivity to the local cultural context was demonstrated in a number of ways. Firstly, through experience gained on a previous visit to one of the protected areas, SNP. Secondly, through contact with a number of NGOs active in the study sites. Thirdly, and most significantly, through the first fieldtrip undertaken in Autumn 2013 during which the methodology was scoped and trialled, and community, NGO and PA authority leaders were met and interviewed.

3. Damage to the environment. This was to be minimal as the research involved questionnaires and interviews with households and individuals residing on or near well-established networks of hiking trails in both PAs. The relevant permits from both PA authorities were also be sought before beginning the research.

4.4.2 Risks

In addition to its ethics, fieldwork, particularly in remote, mountainous regions, can also involve numerous and substantial risks (Newing et al., 2011; Price, 1986). A Department of Geography risk assessment form was therefore prepared, submitted and approved (see Appendix 12.3). This form included relevant sections on emergency contacts, details of fieldwork, local contacts and travel insurance details, as well as a personal risk assessment and an equipment risk analysis.

4.4.3 Timeframe

Table 4.2 sets out the timeframe for the fieldwork elements of the study, while Tables 4.3 and 4.4 outline the detailed fieldwork itineraries at SNP and ACA respectively, with names of the relevant settlement for SNP and names of the relevant VDCs for ACA.

Table 4.2 Fieldwork schedule

Fieldtrip	Date from	Date to	Sites visited
1	21/10/13	15/11/13	Kathmandu, Pokhara, ACA
2	3/2/14	25/2/14	SNP
2a*	25/2/14	14/4/14	SNP
3a*	21/3/14	23/4/14	ACA
3	23/4/14	15/5/14	ACA

* **A**bsent from field during these periods due to family commitments

Table 4.3 Detailed fieldwork itinerary for SNP with names of relevant settlements

Date	Location	Date	Location	Date	Location	Date	Location
07/02	Phakding	16/02	**Rest day**	25/02	Phortse	06/03	Tengboche
08/02	Namche	17/02	Thame	26/02	Phortse	07/03	Namche
09/02	**Rest day**	18/02	Thameteng	27/02	Pangboche	08/03	Namche
10/02	Namche	19/02	Hilajung	28/02	Pangboche	09/03	**Rest day**
11/02	Namche	20/02	Khunde	01/03	Pangboche	10/03	Namche
12/02	Khunde	21/02	Khumjung	02/03	**Rest day**	11/03	Namche
13/02	Phurte/ Thamo	22/02	Khumjung	03/03	Pheriche	12/03	Lukla
14/02	Samde	23/02	**Rest day**	04/03	Dingboche	13/03	Kathmandu
15/02	Thame	24/02	Phortse	05/03	Tengboche	14/04	Kathmandu

See also Figure 3.3.

Table 4.4 Detailed fieldwork itinerary for ACA with names of relevant VDCs

Date	Location	Date	Location	Date	Location	Date	Location
21/3	Jomsom	4/4	Kagbeni	18/4	Upper Manang	2/5	Chame
22/3	Jomson	5/4	Muktinath	19/4	Upper Manang	3/5	Phu
23/3	**Rest day**	6/4	**Rest day**	20/4	**Rest day**	4/5	**Rest day**
24/3	Jomsom	7/4	Muktinath	21/4	Khangsar	5/5	Phu
25/3	Jomsom	8/4	Muktinath	22/4	Khangsar	6/5	Nar
26/3	Jomsom	9/4	Muktinath	23/4	Bhraka	7/5	Nar
27/3	Jomsom	10/4	Jhong	24/4	Bhraka	8/5	Nar
28/3	Jomsom	11/4	Jhong	25/4	Lower Manang	9/5	Chame
29/3	Jomsom	12/4	Thorung La	26/4	Ngawal	10/5	Chame
30/3	**Rest day**	13/4	**Rest day**	27/4	**Rest day**	11/5	**Rest day**
31/3	Kagbeni	14/4	Tanki	28/4	Ngawal	12/5	Kathmandu

			Manang				
1/4	Kagbeni	15/4	Tanki Manang	29/4	Ghyaru	13/5	Kathmandu
2/4	Kagbeni	16/4	Tanki Manang	30/4	Pisang	14/5	Kathmandu
3/4	Kagbeni	17/4	Upper Manang	1/5	Pisang	15/5	Kathmandu

See also Figure 3.2.

4.4.4 Collaboration

Collaboration in this study took three forms. Firstly, with Dr Rodney Jackson of the Snow Leopard Conservancy (SLC). Dr Jackson provided invaluable practical and theoretical assistance on the design and implementation of the study from the project inception in 2010, through the development of the initial concept note in 2011 (see Appendix 12.4) and the PhD application in 2012, through to fieldwork contacts and advice. Furthermore, there is ongoing collaboration regarding the SLC's current and planned work at both study sites in Nepal.

Secondly, collaboration took place with Nepali organisations with responsibility for management of the two PA study sites. In part, this was due to concerns that social research in conservation in general (Schreckenberg et al., 2010), and in snow leopard conservation in particular (Jackson et al., 2010), is not sufficiently focused on application to PA and landscape management. Therefore, I worked closely with the relevant authorities, communities and NGOs at the scoping stage, to ensure their concerns and data collection requirements were incorporated into the research design. In addition, these Nepali organisations provided critical logistical support.

I also took note of another major criticism of social research in conservation: that data from social assessments is often not upwardly aggregated beyond individual PAs (Schreckenberg et al., 2010). Therefore, the study attempted to compare and contrast results from two similar yet different study areas. This was to ensure application beyond that of a single PA and to attempt to investigate the relationships between conservation governance models and human-snow leopard coexistence.

The third, albeit more minor, form of collaboration was with Dublin Zoo (see Appendix 12.7). This took the form of a fieldwork blog (Hanson, 2014a) and photo-stream (Hanson, 2014b) which I updated from the field and which were then shared via social media by the zoo. Table 4.5 is a summary of its reach and impact. The justification for the blog was two-fold. Firstly, it allowed for popular engagement with the research process, a crucial target audience often missed by academic research (Newing et al., 2011). Secondly, it provided a tangible connection between the zoo's captive snow leopards and the wild population (Lind et al., 2016).

Table 4.5 Summary table of fieldwork blog data

Statistic	Posts	Views	Visits	Followers	Countries blog visited from
Quantity	34	5,915	2,991	35	94

Data from Hanson, 2014a.

4.4.5 Research language and assistance

A language barrier can be a major barrier to conducting effective and rigorous fieldwork (Newing et al., 2011). Accordingly, an attempt was made to learn basic Nepali via an intensive four-week spoken Nepali course at the University of Heidelberg in August 2013. However, for various reasons, the course did not meet my training needs or expectations and was not completed. Therefore, I developed only perfunctory abilities in the Nepali language. This represented a limitation in terms of the extent to which I was able to become immersed in the language and culture of my field sites, particularly when English was not spoken by respondents.

This also meant that the study relied heavily on research assistants for data collection, as only a small number of questionnaires and interviews were conducted in English. One research assistant was selected and hired for the first fieldtrip on the strength of a personal recommendation. However, for the main data collection phase a more rigorous process was pursued, with a role description and advertisement being prepared and circulated via relevant networks and contacts in Nepal (Appendix 12.8).

A total of 70 applications were received, of which 15 were discounted immediately due to not meeting the basic application requirements (C.V. and covering letter). The remaining 55 – 15 men and 40 women – were scored according to how their application met the essential and desirable criteria in the role description, with the three highest scoring individuals of each gender being interviewed by Skype. The interviews were scored by two interviewers and the highest scoring candidate of each gender was offered the position.

Considering the gender balance of research assistants was considered appropriate due to sensitivities surrounding the position of women in conservative, rural cultures (Newing et al., 2011), and specifically the ease with which male research assistants might be able to interview them. In practice, the high volume of tourists at both study sites, as well as the relatively informal, non-stratified Buddhist culture of the field sites, rendered this concern largely irrelevant. An intensive induction and training workshop was held with the research assistants on 6th February 2014. Further information on methodology-specific training, back-checking and validation with the research assistants and their data is contained in Sections 4.5 and 4.6. Maurice Schutgens, a childhood friend and conservation biologist, was also employed to assist with fieldwork management duties, particularly when I was absent from the field due to family commitments (see Table 4.2). Maurice assisted with the management of the research assistants and the data collected.

4.5 Questionnaires

4.5.1 Preparation

4.5.1.1 Design

As discussed in Sections 4.3.1.and 4.3.2, due to the critical realist and deductive perspectives, and the cross-sectional design of this study, a multiple-methods approach to data collection was taken. This incorporates the breadth of quantitative data as well as the depth of qualitative information (Newing et al., 2011; Wilder and Walpole, 2008). The main data gathering mechanism was a household questionnaire with questions, based on the indicators discussed below, addressing each of the research questions. In this case, the survey had both descriptive and confirmatory roles, profiling variables and testing relationships between them (Forza, 2002; Oppenheim, 1992). Research assistants were used to extend the potential sampling scope (Section 4.4.5).

Based on a review of 127 ecological studies where questionnaires were used, White et al. (2005) recommended that researchers consider the use of more interpretive methods for assessing motivations and perceptions of locals. The potential of this approach for understanding human-carnivore coexistence has been recently demonstrated by qualitative research in Namibia (Rust, 2016; Rust et al., 2016). The focus of this study was on assessing the perceptions and practicalities involved in human-snow leopard co-existence *and* relating them to access to assets (livelihoods) and influence (governance) (Ribot, 2014; Ribot and Peluso, 2003). Therefore, although the majority of the questionnaire was designed to involve closed questions, additional open questions were added where appropriate, especially when discussing attitudes and perceptions. Although the survey considered the household as the main unit of analysis, a common approach in conservation social science (Schreckenberg et al., 2010), the section on attitudes gathered data from at the individual level within the household, as attitudes can only be held individually rather than corporately (De Vaus, 2002).

4.5.1.2 Indicators

Developing a relevant and applicable set of indicators is one of the first stages in developing a methodology. Indicators are operational measures used to quantify and simplify complex phenomenon (Fraser et al., 2006; Mikkelsen, 2005; Reed, 2006; Woodhouse et al., 2000). In part, they are developed from an extensive review of the literature. Table 4.6 outlines the characteristics of some of the most pertinent studies reviewed for this study. As discussed by Mikkelsen (2005) and Schreckenberg et al. (2010), indicators should be 'SMART' – specific, measurable, attainable, relevant and time-bound. Over various drafts, a set of variables was developed for this study drawing upon Newing et al's (2011) guidelines for doing so: 1) identify concepts; 2) identify variable(s); 3) identify response categories; 4) identify response codes; 5) develop questions. Question development is considered in greater detail in Section 4.5.1.3.

Table 4.6 Methodological profiles of pertinent studies reviewed

Author(s)	Year	Nation(s)	Context	Main approach	Sample	Comment
Alexander et al.	2015	China	Attitudes to snow leopards	Individual questionnaires	109	
Bagchi and Mishra, 2006	2006	India	HWC with snow leopards	Household interviews	57	
Beyene, 2012	2012	Ethiopia	Livelihood diversification	Household surveys	596	
Bajracharya et al., 2006	2006	Nepal	Social impacts of CBC, ACA	Household surveys	150	Follow up interviews
Bhatia et al.	2016	India	Attitudes to	Individual	194	Religion

			snow leopards	questionnaires		considered
Bjønness, 1980	1980	Nepal	Livestock grazing, SNP	Household surveys	401	
Carter et al.	2014	Nepal	Attitudes to tigers	Individual questionnaires	499	Likert scale used
Dar et al., 2009	2009	Pakistan	HWC with carnivore spp.	Household surveys	148	Pilot sample of 50
Hunzai et al., 2011	2011	Hindu Kush-Himalayas	Status/trends of mountain poverty	National census data	6	Multiple dimensions of poverty
Ikeda, 2004	2004	Nepal	HWC with snow leopards	Household interviews	9	
Inskip and Zimmerman, 2009	2009	Global	HWC with felids	Systematic review of literature sources	349	
Inskip et al., 2013	2013	Bangladesh	HWC with tigers	Semi-structured interviews	54	Also follow up surveys
Karanth et al., 2012	2012	India	HWC and compensation	Household surveys	735	
Karanth and Nepal, 2012	2012	India and Nepal	PA benefits and losses	Household surveys	777	
Marchini and Macdonald, 2012	2012	Brazil	HWC with jaguars	Rancher interviews	268	
Mishra, 1997	1997	India	HWC with snow leopards	Household interviews	80	
Nautiyal and Kaechele, 2009	2009	India	PA resource management	Household surveys	1,648	
Nepal and Spiteri, 2011	2011	Nepal	Conservation-livelihood links	Household surveys	189	
Ogra and Badola, 2008	2008	India	HWC compensation	Household surveys	54	
Oli et al., 1994	1994	Nepal	HWC with and attitudes to snow leopards	Household surveys	102	Likert scale used
Romanach et al., 2007	2007	Kenya	HWC with predators spp.	Farmer surveys	416	
Sakurai et al., 2013	2013	Japan	Media coverage, black	Content analysis	348	Inter-observer

			bear HWC			consistency
Steimann, 2005	2005	Pakistan	Livelihood strategies	Household surveys	236	Sustainable livelihoods approach
Suryawanshi et al.	2014	India	Attitudes to snow leopards	Individual questionnaires	381	Livelihood considered
Wang and Macdonald, 2006	2006	Bhutan	HWC with carnivore spp.	Household surveys	274	
Wiesmann et al., 2005	2005	Switzerland	Conservation-development balance	Individual surveys	268	Combined with stakeholder forums
Yamaguchi, 2011	2011	China	Agrodiversity and mountain pastoralism	Household surveys	86	
Zimmermann et al., 2005	2005	Brazil	HWC with jaguars	Rancher surveys	50	

As underlying concepts are multi-dimensional and complex, and to increase reliability and validity, multi-variable scales should be used for the measurement of latent variables (Nepal and Spiteri, 2011; Oppenheim, 1992). This study followed the guidance of Spector (1992) for developing summated rating scales that are: (i) involve multiple items; (ii) an underlying measurement continuum; (iii) responses that are subjective; and (iv) responses that are statements. Spector also argues that such multi-item scales are superior to single-item measures because they have less random measurement error, discriminate between finer degrees of attributes and have greater scope. Table 4.7 lists the multi-variable scales used in this study, drawing particularly upon a number of recent studies (Alexander et al., 2015; Bhatia et al., 2016; Carter et al., 2014; Nepal and Spiteri, 2011; Suryawanshi et al., 2014). While some have suggested that Likert scales are not accurate in distinguishing between degrees of difference, especially in Asian cultures (Suryawanshi et al., 2014), others have successfully used them when measuring attitudes to large felids (Carter et al., 2014; Oli et al., 1994; Zimmermann et al., 2005).

Table 4.7 Composite scales used in study

Scale	Number of items	Questionnaire numbers*
Attitudes to snow leopards	2	3.2.1 & 3.2.3
Attitudes to snow leopard conservation	9	3.3.1, 3.3.3, 3.3.5, 3.3.7, 3.3.9, 3.3.11, 3.3.13, 3.3.15 & 3.3.17
Attitudes to proposed blue sheep translocation (SNP only)	2	4.1.& 4.4
Attitudes to proposed snow leopard conservation incentive scheme (ACA only)	11	4.3, 4.5, 4.7, 4.9, 4.11, 4.13, 4.15, 4.17, 4.19, 4.21 & 4.23

* See Appendices 12.9 and 12.10

In contrast to scales that measure underlying latent variables (Field, 2013; Spector, 1992), composite indices are preferable for aggregating more objective data. This method, rather than monitoring indicators separately, makes it simpler to analyse trends, as well as to assess joint distributions within populations (Maasoumi and Yalonetzky, 2013). It also allows for relationships between the index and various explanatory variables to be explored (Forza, 2002). There have also been criticisms of the excessive focus on econometrics in such indices, particularly for poverty measurement (Campbell and Holland, 2005; Kingdon and Knight, 2006).

As a result, more nuanced and holistic measures, such as the Human Development Index, the Multi-Dimensional Poverty Index and the Sustainable Livelihoods framework, have been developed (Kreutzmann, 2001; Woodhouse et al., 2000). This study adapts Steimann's (2005) questionnaire, which quantified the Sustainable Livelihood framework for use amongst households in Pakistan, to create a Sustainable Livelihoods Index (SLI). Steimann’s questionnaire was itself based on DfID’s (1999) Sustainable Livelihoods guidance sheets, which were also consulted here. By utilising the well-established Sustainable Livelihoods framework as its basis, the index avoids a significant criticism of sustainability indices: that they often feature arbitrary aggregations of indicators and unweighted variables in the asset pentagon (Böhringer and Jochem, 2007). The index was treated as a continuous variable for further analysis, following similar indices such as the Human Development Index (UNDP, 2013) and the Multi-Dimensional Poverty Index (Alkire et al., 2013). The index variables and sections were not weighted differentially as there was no strong basis for this, following Baral and Stern (2011).

Another criticism of such indices is their lack of holism. A review of over 200 indicators for social assessment in conservation found that quantitative measures of human, physical and financial livelihood aspects were preferred, with gaps in relation to political and socio-cultural impacts (Schreckenberg et al., 2010). This is another area where the Sustainable Livelihood framework is pertinent, given its attempt to measure access to assets across five distinct classes, including the likes of social capital (Chambers and Conway, 1992; Scoones, 2009, 1998). Accordingly, this study attempted to holistically measure social phenomenon via the household questionnaire, including political and socio-cultural dimensions, such as access to political representation.

Measurement validity is an important issue in indicator development and includes face, concurrent and convergent validity (Newing et al., 2011). For this study, face validity was assessed during the various stages of drafting by continually reviewing the indicators and questionnaire. Concurrent validity was assessed after data collection based on the results of data analysis and found to be appropriate (Section 4.5.3.3). By using structured interviews with key informants, cross-methods triangulation was used to ensure convergent validity amongst the indicators and questions. Internal reliability was assessed via Cronbach's alpha, and this is also discussed further and reported on in Section 4.5.3.1.

The use of multi-variable scales for measurement also increases validity, as well as reliability (Nepal and Spiteri, 2011; Spector, 1992). One form of reliability – stability – was regarded as less relevant for this study as it is more associated with experimental and longitudinal designs (Bryman and Bell, 2007). Internal reliability and inter-observer consistency, on the other hand, were pertinent to this study's indicators and questionnaire. Inter-observer consistency was tested for and this is presented and discussed in Section 4.5.3.3. Internal reliability concerns the consistency of indicators in measuring concepts (Saunders, 2011), and by using theoretically-rigorous indicators from the literature, internal reliability was maintained. It was also tested for empirically using Cronbach's alpha (see

Table 4.14). Finally, replicability was ensured by the clear outlining and justification of the relevant methods and procedures (Bryman and Bell, 2007).

4.5.1.3 Questions

Developing and ordering the questions to capture data on the relevant indicators was the next stage in the development of the household questionnaire. Once again, Newing (2011) provided invaluable guidance on the process, including on question order and questionnaire layout, as well as question and questionnaire review. The question formats took a variety of forms, depending on the type of data to be collected. Closed questions used included closed checklists, ranking questions and Likert scales. Open-ended questions were asked when data was needed on motivations and attitudes, as recommended by White (2005), and typically after a Likert scale, to assess the respondent's motivation for holding their previously expressed position. Numbers of household livestock lost to snow leopards, and numbers of household conflicts with snow leopard conservation were collected as self-reported data. Although the limitations of such information has been acknowledged in a similar study (Karanth et al., 2012), various steps such as triangulation were taken in this study to address the validity of the data. In addition, official data sources were either not available for this purpose or were believed to be unreliable. Appendices 12.9 and 12.10 detail the final questionnaire formats for both study sites.

Two questions in the main body of the questionnaire were connected with snow and common leopard identification. This used a photo plate of similar-sized carnivores present in one or both study sites (see Appendix 12.11). An additional colour plate of contemporaneous large herbivore species was also used for one identification question in the mitigation section of the SNP survey (see Appendix 12.12). These plates were developed based on data from the literature outlined in Chapter Three, particularly Bhuju et al. (2007). A suitable, representative photo of each species was taken from a wildlife media website (Wildscreen, 2014).

Question order was dictated largely by the research design and theoretical approach to the study, with questions on livelihoods following the format of the Sustainable Livelihoods household questionnaire developed by Steimann (2005) and DfID (1999). To this was then added relevant sections on human-snow leopard co-existence, including impacts, conflicts and attitudes, as well as the final part on a potential mitigation option at both study sites: blue sheep translocation in SNP and a conservation incentive scheme in ACA. As well as these previous considerations, questionnaire layout followed Newing et al.'s (2011) recommendations, including the use of an appropriate font size and the numbering of all questions. Finally, questionnaire development also utilised Newing et al's (2011) checklists for reviewing first the questions, and then the questionnaire itself, in terms of subject matter, order, layout and presentation.

4.5.1.4 Piloting

Before being used for the data collection phase of the study, the draft household questionnaire was trialled with a sample of 24 households in ACA. This allowed the draft indicators and questions to be assessed in relation to local conditions (Heinen, 2010), drawing particularly on Newing et al.'s (2011) checklist of practical tips for the pilot stage of a research project. For logistical reasons the trial stage occurred parallel to the scoping phase discussed in Section 4.3.3, which also meant that the instrument could not be piloted in SNP. However, the pilot phase did lead to appropriate modifications of the survey instrument, which are listed in Table 4.8. These included practical changes, such as the inclusion of a box to record research assistant initials so that inter-observer consistency could be tested (Sakurai et al., 2013) (Section 4.5.3.2).

They also included more theoretical changes. For instance, the seven-point Likert scale in the pilot questionnaire was changed to a five-point Likert scale in the final questionnaire. This was justified on the grounds that it shortened and simplified attitudinal assessment amongst respondents and had better construct validity, particularly when applied amongst Asian cultures (Lee et al., 2002). This may have been at the expense of capturing a greater breadth of opinion, as respondents can avoid scalar extremities, particularly in face-to-face contexts (Newing et al., 2011). In addition, open-ended questions in the trial questionnaire were also used to shape more extensive, closed checklists in the final draft (Newing et al., 2011).

Table 4.8 Changes made to household questionnaire after piloting

Change(s) made	**Question/section number(s) in final draft**
Box to record research assistant's initials added	Prior to 1
Collection of 'natural products' in 'natural assets' section split into 'fuelwood', 'construction wood' and 'medicinal plants' (NTFPs)	1.3.9, 1.3.10. 1.3.13
'Women's groups' and 'school associations' added to list of formal organisations households had membership of	1.4
Question added on whether household had received compensation if livestock lost to snow leopards	2.1.39
Timescale for livestock losses to snow leopards changed from Western to Nepali months	2.1.38
Question added on differentiation between common and snow leopard	2.1.41
Question added on whether respondent was a native of the area	3.1.4
Additional snow leopard conservation measures added to attitudes to snow leopards conservation section	3.3
Seven-point Likert scales changed to five-point Likert scales	3.2, 3.3, 4

4.5.1.5 Triangulation

Triangulation is also an important and necessary part of social science research (Campbell and Holland, 2005). However, one study found that verification of the data obtained in ecology and conservation questionnaire studies was undertaken in less than 10% of cases (White et al., 2005). For the questionnaire part of this study, data were triangulated both quantitatively and qualitatively. Concurrent cross-methods triangulation in the form of structured interviews was used with key informants, mostly community leaders and PA staff, with the questions closely matching the general themes of the household questionnaires (Valentine, 1997). These data were then analysed quantitatively and qualitatively to provide both subjective and objective triangulation of the questionnaire results (see Section 4.6 for more on the semi-structured interview methodology). Tables 4.10 and 4.11 detail how the triangulation sampling of interviews related to the questionnaire sampling.

4.5.2 Administration

4.5.2.1 Sampling

As the study used a cross-sectional approach for maximum policy impact, a representative probability sample of households was essential so that inferences could be made to the larger populations of both areas (Bryman and Bell, 2007). In addition to testing for relationships between variables within this overall sample, the study also compared the human populations of both PAs. For this reason, the household questionnaire samples for SNP and ACA needed to be large enough for statistically valid generalisations to be made of each sub-population (Saunders, 2011). Table 4.9 provides an overview of the total study sample at both field sites.

Table 4.9 Sample overview.

	Protected Area		
Household information	**ACA**	**SNP**	**Combined**
Total households	1702	1032	2734
Households surveyed	445	260	705
% of households surveyed	26.1	25.2	25.8

Note. Data from Government of Nepal, 2012

Despite the availability of a recent national census (Government of Nepal, 2012), given the informal nature of many settlements in Nepal, there was no sampling frame at the household level for the study sites. Systematic sampling is recommended as the next best option to ensure a representative sample (Newing et al., 2011). Census data provided the number of households in each DDC and VDC and 25% of these – giving a target sample size of 700 – was considered a realistic and achievable goal given the time and resources available, as well as the other methodologically-pertinent studies (Table 4.7). In a survey of attitudes to snow leopards in north-west India, for instance, 23% of households were sampled in one if the study areas (Bhatia et al., 2016). In practice, therefore, every fourth house in each settlement was sample, a similar approach to household survey carried out in the Middle Hills of Nepal, where every third house was sampled (Paudel and Thapa, 2001).

Table 4.10 SNP VDCs and settlements sampled.

VDC	Settlement	Households	Questionnaire sample	Interviews and back-checking
Namche	Namche	224	56	7
	Phurte	24	6	1
	Thamo	48	12	
	Samde	28	7	2
	Thame	84	21	
	Thameteng	36	9	1
	Hilajung	36	9	1
	Sub-total 1:	**480**	**120**	**12**
Khumjung	Khumjung	188	48	4
	Khunde	60	15	2
	Phortse	132	34	3
	Tengboche	16	4	1
	Deboche	8	2	
	Pangboche	104	26	3
	Pheriche	24	6	1
	Dingboche	20	5	
	Sub-total 2:	**552**	**140**	**14**
---	**Total:**	**1032**	**260**	**26**

Note. Data from Government of Nepal, 2012; DNPWC 2014, *pers comm.*

Sample sizes were considered for each study site, DDC and VDC or settlement sampled (Tables 4.10 & 4.11). The vast majority of the data was from the 2011 Nepal census (Government of Nepal, 2012). Note also that SNP lies entirely within Solokhumbu DDC and, due to the size of its VDCs, has numerous settlements in each. Data on household numbers in each of these settlements were collected from the DNPWC headquarters in SNP prior to commencing sampling. In four settlements in each VDC in SNP, household numbers were too small to triangulate and back-check one case for each. A random number generator was used to decide which of the adjacent settlements would be selected for triangulation, with the other in the pair was selected for back-checking. On the other hand, although the area of ACA surveyed covered two neighbouring DDCs, its smaller VDCs meant that most had only one larger settlement in each.

Table 4.11 ACA DDCs and VDCs sampled

DDC	VDC	Households	Questionnaire sample	Interviews and back-checking
(Lower) Mustang	Jomsom	430	108	10
	Kagbeni	274	69	7
	Muktinath	198	50	5
	Jhong	85	23	2
	Sub-total 1:	**987**	**250**	**24**

Manang	Tanki Manang	110	28	3
	Upper Manang*	100	26	3
	Lower Manang*	31	9	1
	Khangsar	58	16	2
	Bhraka	83	21	2
	Ngawal	73	19	2
	Ghyaru	33	10	1
	Pisang	105	28	3
	Nar	86	23	2
	Phu	36	10	1
	Sub-total 2:	**715**	**190**	**20**
---	**Total:**	**1702**	**440**	**44**

Note. Data from Government of Nepal, 2012. * Upper Manang and Lower Manang VDCs are spatially distinct despite being a single administrative entity.

4.5.2.2 Data collection and response rate

The data were collected from SNP and ACA between February and May 2014 (see Tables 4.2 to 4.4). As previously discussed, the informal nature of many of the settlements and the absence of a sampling frame for them necessitated particular care when systematically sampling for data collection. A specific concern here is the ease with which a household could be sampled more than once (Newing et al., 2011), especially with two research assistants at work. To prevent any such overlap in area or in sampling, on entering a settlement, the research assistants made a plan to divide the settlement into two parts, with each having responsibility for data collection in one half of the settlement.

Data were entered to a spreadsheet by the research assistants as soon as possible after collection, usually that evening. This data entry for each questionnaire was then cross-checked by myself or Maurice Schutgens for any errors. Any differences between the questionnaire and the spreadsheet were then checked in person with the relevant research assistant before the case was amended to the correct value. This added an additional validation stage to the data collection phase and helped to ensure high levels of data quality.

To calculate response rates, the number of individuals who completed a questionnaire – 705 - was divided by the total number of individuals who were invited to complete a questionnaire – 733 - and the result multiplied by 100, to gives a response rate of 96.2%. This figure is similar to the high rate of 99.8% reported for a study of attitudes to tigers in Nepal (Carter et al., 2014), but higher than the figure of 76.4% reported from a study of attitudes to snow leopards in India (Bhatia et al., 2016). Neither of the other two most recent studies of attitudes to snow leopards reported their response rates (Alexander et al., 2015; Suryawanshi et al., 2014).

4.5.2.3 Back-checking

In addition, a proportion of surveys carried out by research assistants were back-checked to promote and ensure reliability (Bryman and Bell, 2007; Newing et al., 2011). A random number generator was used to select approximately 10% of households to back-check, which were then located using the data collected from Section 1.1 of the questionnaire: VDC; settlement; household head's name; house name/distinguishing features; adjacent landmarks. Once respondents were located they were asked to confirm when they had completed the survey, how long it had taken and to describe the research assistant who had conducted it. The back-checking process uncovered no cases of mistaken data collection.

4.5.3 Analysis

4.5.3.1 Data preparation and coding

At the beginning of the data analysis phase, the spreadsheet data was imported into IBM SPSS. The data was then prepared by making the necessary choices for each variable in the SPSS menu: selection of appropriate data types, whether ordinal, categorical or continuous; and coding of missing data by inserting '99'. Responses to open questions were then coded, using coding lists developed with Newing et al.'s (2011) recommendations. Table 4.12 lists the variables with open questions coded in this manner.

Table 4.12 Open questions from questionnaire coded during data preparation

Variable	**Question number**
Reasons for conflict with snow leopard conservation*	2.2.2, 2.2.4
Types of conflict with snow leopard conservation*	2.2.2, 2.2.4
Reasons for attitude to snow leopards^	3.2.2
Reasons for attitude to future presence of snow leopards	3.2.4.
Reasons for attitude to park management	3.3.2
Reasons for attitude to local conservation groups^	3.3.4

Reasons for attitude to ban on the killing of snow leopards	3.3.6
Reasons for attitude to ban on the killing of snow leopard prey	3.3.8
Reasons for attitude to livestock compensation scheme	3.3.10
Reasons for attitude to corral construction	3.3.12
Reasons for attitude to environmental education	3.3.14
Reasons for attitude to limits on the collection of NTFPs^	3.3.16
Reasons for attitude to limits on the collection of wood	3.3.18
Reasons for attitude to proposed blue sheep translocation in SNP**,^	4.5
Reasons for interest in proposed conservation incentive scheme in ACA***	4.2
Reasons for attitude to higher price for local yak products paid to herders	4.4
Reasons for attitude to higher price for local livestock products paid to herders	4.6
Reasons for attitude to higher price paid by tourists for local livestock products	4.8
Reasons for attitude to money raised for local snow leopard conservation activities^	4.10
Reasons for attitude to agreement on livestock numbers/density	4.12
Reasons for attitude to livestock-free wildlife zones	4.14
Reasons for attitude to no retaliation clauses	4.16
Reasons for attitude to annual conservation-dependent bonus for herders^	4.18
Reasons for attitude to higher rate of compensation for livestock killed by snow leopards	4.20
Reasons for attitude to livestock replacement for livestock killed by snow leopards	4.22
Reasons for attitude to raising awareness of snow leopards amongst tourists	4.24

* Data from 2.2.2 and 2.2.4 combined due to low response rate; additional analysis of conflict type added;
** SNP questionnaire only; *** ACA questionnaire only; ^ tested for inter-coder reliability.

The multi-variable scales developed and used in this study, when amalgamated from their respective categorical variables, were all treated as continuous data for the purposes of analysis (Table 4.13). This follows the trend in recent snow leopard (Alexander et al., 2015; Suryawanshi et al., 2014), tiger (Carter et al., 2014) and jaguar (Cavalcanti et al., 2010) attitudinal analyses. Consultations with statisticians at the University of Cambridge and the Institute of Public Health in Northern Ireland confirmed that this was a suitable method of analysis, provided the results were used in regression models focused on explanation rather than prediction (Mac Nally, 2000). Due to the Likert scales used, where a lower number equalled a more positive attitude, the final attitudinal scales were reverse-scored, following Nepal and Spiteri (2011). This allowed for positive correlations to be more clearly displayed and communicated.

Table 4.13 Internal reliability for composite scales

Scale	Cronbach's alpha score
Attitudes to snow leopards	.878
Attitudes to snow leopard conservation	.664
Attitudes to proposed blue sheep translocation (SNP only)	.820
Attitudes to proposed snow leopard conservation incentive scheme (ACA only)	.730

4.5.3.2 Diagnostics

Various diagnostic tests were used to assess the quality of the data collected. These included tests for reliability and validity. In terms of reliability, inter-observer consistency between the two research assistants was first assessed by independent t-tests (Field, 2013). A random number generator was used to select 10% of closed-question variables for checking. Levene's test for homogeneity of variance was not used as large samples, such as were collected in this study, can skew the results (Field, 2013). Table 4.14 lists the variables sampled and tested. None were found to be inconsistent.

For the open-question variables, a random number generator was again used to select 10% of the questions listed in Table 4.12 (those marked with '^'). A colleague was then asked to code these questions using the same coding lists developed by myself. Following Sakurai et al. (2013), inter-coder reliability was then tested using paired sample t-tests, and no questions were found to have been inconsistently coded.

Table 4.14 Questionnaire variables tested for inter-observer consistency

Variable	Question number
Number of infants in household	1.2.4
Access to television	1.2.13
Access to district-level political representatives	1.4.11
Access to a building used for tourism	1.5.9
Access to land for cultivation	1.3.7
Access to wood for construction	1.3.10
Membership of VDC	1.4.2
Access to other types of transport	1.5.17
Priority of wood as a source of financial income	1.6.13

Number of cattle lost by household in previous 12 months	2.1.2
Positive differentiation between snow and common leopard	2.1.41
Attitudes towards the future presence of snow leopards	3.2.3
Attitudes towards the ban on the killing of snow leopards	3.3.5
Attitudes towards park management	3.3.1
Positive identification of blue sheep*	4.3
Attitudes towards higher prices paid for other local livestock products paid to herders**	4.5
Attitudes towards no retaliation clause**	4.15

* SNP questionnaire only; ** ACA questionnaire only.

Internal reliability was then tested for the four composite scales developed in this study. Although Guttman's Lambda 4 and Cronbach's alpha tests were both considered, the former can be positively biased when sample sizes are <1000 and the number of items in the scale is large (Benton, 2015). Cronbach's alpha was therefore used and Table 4.13 lists the test scores. While some authors have argued on theoretical grounds that only scores of >.7 are reliable (Nunnally, 1978), in practice, test scores of >.6 are reported in the medical (Bosma et al., 1997; McKinley et al., 1997) and conservation literature (Nepal and Spiteri, 2011). Given that only one of the four scales in this study has a test score of <.7, and that this example is at the upper end of .6 - .7 range, internal reliability of the scales was considered to be acceptable.

As previously mentioned in Section 4.5.1.2, concurrent validity was assessed by informally checking that patterns of variation between explanatory and dependent variables were consistent (Newing et al., 2011). As the results section will detail, levels of education, for example, were found to be significantly correlated with positive attitudes to snow leopards and their conservation, a trend seen in other similar studies (Carter, 2013; Suryawanshi et al., 2014; Tessema et al., 2010). Based on this and similar patterns with other variables, concurrent validity was also considered to be acceptable. Finally, following Field (2013), diagnostic tests for skewness and kurtosis were not carried out for the data because of the large sample size, which can skew the results for these particular tests.

4.5.3.3 Descriptive analysis

Descriptive statistics are used for exploratory analysis and to summarise results (Newing et al., 2011). Indeed, they were used in a variety of ways for this study. Where the data were numerical, descriptive analysis included total, mean, median, minimum, maximum and standard deviation. Charts were also used where appropriate. Where the data were ordinal results, they were most commonly analysed in terms of percentages, particularly for the Sustainable Livelihood framework section of the questionnaire. In each case the sample size for each question was given.

To transform the Sustainable Livelihoods framework data for each household into the Sustainable Livelihoods Index (SLI) for each household, ordinal variables were given scores of 1 for a 'yes' response and 0 for a 'no' response. This changed them into categorical data. Continuous variables included in the section were transformed into categorical data, with scores between 1 and 0. The exceptions to this rule were adult literacy and school attendance rates, were the data was treated as ratio data and included directly in the index as a ratio with a value between 1 and 0.

Data were then aggregated and expressed as a number between 1 and 0 for each question, then for each asset section – human, natural, social, physical and financial – and then, finally, for a cumulative total. Each of the 15 variables had equal weight within their respective sections and each of the five sections had equal weight within the index. Table 4.15 lists the variables and variable types included in the Sustainable Livelihood Index. For the four composite scales used in the study (Tables 4.7 and 4.13), the data were aggregated and then divided by the number of items in the scale to give a total between 1 and 0, based on the theoretical justification discussed in Section 4.5.1.2.

Table 4.15 Sustainable Livelihood Index variables and sub-sections

Asset section	**Variable name**	**Questionnaire data type**	**Index data type**	**Questionnaire number(s)**
Human	Adult literacy rate	Ratio	Ratio	1.2.2
	School attendance rate	Ratio	Ratio	1.2.3
	Medical treatment access	Ordinal	Categorical	1.2.4 - 7
	Media access	Ordinal	Categorical	1.2.8 - 11
Natural	Grazing land access	Ordinal	Categorical	1.3.1
	Livestock access	Continuous	Categorical	1.3.2 - 6
	Cultivatable land access	Ordinal	Categorical	1.3.7
	Natural products access	Ordinal	Categorical	1.3.9 -13
	Water access	Ordinal	Categorical	1.3.14 - 18
Social	Formal organisation membership	Ordinal	Categorical	1.4.1 - 9

	Political representatives access	Ordinal	Categorical	1.4.10 - 12
Physical	Fuel access	Ordinal	Categorical	1.5.1 - 6
	Buildings access	Ordinal	Categorical	1.5.7 - 10
	Transport access	Ordinal	Categorical	1.5.11 - 17
Financial	Household income	Categorical	Categorical	1.6.1

4.5.3.4 Inferential analysis

Rather than simply profiling variables, inferential statistics test relationships between them (Forza, 2002; Saunders, 2011). Inferential statistics were used in this study to specifically examine how access to assets and influence shaped human co-existence with snow leopards, in terms of conflict, impacts, attitudes and, to a lesser extent, knowledge. To compare and contrast the results from both study sites, independent t-tests were used (Field, 2013). These checked for significant differences between PAs with all of the variables in the questionnaire, as well as with the various scales and the sustainable livelihood index detailed above. However, given the weak internal validity of cross-sectional research designs, causation, in terms of the impact of conservation governance, could not be proven here (Newing et al., 2011). This is why a mixed-methods approach, incorporating qualitative data that add nuance and depth, is so important (Rust et al., 2016).

Regression models were used to test the relationships between livelihoods and human-snow leopard co-existence. Multiple regression models were used for continuous dependent variables and logistic regression models were used for dichotomous dependent variables, following Field (2013). An overview of these models is provided in Table 4.16. Prior to constructing the models, I assessed whether the data met the necessary assumptions (Field, 2013; Osborne and Waters, 2002), which for multiple regression are linearity, reliability, homoscedasticity and normality. Furthermore, multicollinearity between variables was assessed and none were found to exceed Field's (2013) recommended limit of 0.9, or Green et al's (2013) limit of 0.7. Standard error, rather than deviation, was reported for all regression models, again following Field (2013).

For multiple regression models, linear regression models, including ANOVAs, were first constructed for each predictor variable to assess linearity between continuous variables; independent t or Mann-Whitney U tests were used for dichotomous explanatory variables.

For logistic regression models, independent t or Mann-Whitney U tests were used to check for significant differences between categories, and individual logistic regression models were also constructed for each predictor variable. In some cases, variables that were analysed and profiled as non-significant explanatory factors in univariate analysis, were included in the multivariate models. This was due to the presence or absence of the SLI variable in the models, which altered the sample size considerably and therefore some of the statistical relationships (see Section 5.2.5 for more details on this particular variable and its non-response category). Where this has occurred, it is clearly indicated and discussed in the text.

Table 4.16 Regression analysis overview

Dependent variable	**Dependent variable type**	**Predictor variable types**	**Regression model type**
Number of household livestock killed by snow leopards	Continuous	Dichotomous & Continuous	Multiple
Number of household conflicts with snow leopard conservation	Continuous	Dichotomous & Continuous	Multiple
Sustainable livelihoods index	Continuous	Dichotomous & Continuous	Multiple
Attitudes to snow leopards scale	Continuous	Dichotomous & Continuous	Multiple
Attitudes to snow leopard conservation scale	Continuous	Dichotomous & Continuous	Multiple
Attitudes to proposed blue sheep translocation scale (SNP only)	Continuous	Dichotomous & Continuous	Multiple
Attitudes to proposed snow leopard conservation incentive scheme scale (ACA only)	Continuous	Dichotomous & Continuous	Multiple
Snow leopard identification	Dichotomous	Dichotomous & Continuous	Logistic

As mentioned in Section 4.5.3.1, these models focussed on explanation rather than prediction. Consequently, hierarchical selection and entry is recommended for explanatory models (Mac Nally, 2000), as those based on statistical significance alone can be biased by the number of predictors and subject to severe artefacts, a concern shared by others (Field, 2013). Hierarchical entry involves prioritising the entry of predictor variables based on their theoretical suitability, as determined by the existing literature (Field, 2013). Hierarchical model selection uses goodness-of-fit r^2 measures to determine the most suitable, parsimonious model (Mac Nally, 2002), procedures that were followed for all of the regression models in this study (Table 4.16).

Relevant regression models were also constructed for each study site, with the exception of household conflict in SNP, where the number of conflict = 10. This allowed for further comparisons between the field sites in a manner that complemented the t-test mentioned above. Finally, all of the models were subject to various diagnostic tests shown in Table 4.17. Almost all of the diagnostic tests were passed satisfactorily, with the exception of the P-P plot to test for normality in multiple regression models. As these tests consistently showed some evidence of non-normality, bootstrapping was used for all multiple regression models, again following Field (2013).

Table 4.17 Regression models diagnostic tests

Multiple regression diagnostic tests		**Logistic regression diagnostic tests**	
Test	**Diagnosing**	**Test**	**Diagnosing**
Correlation matrix	Multicollinearity	Standard errors	Predictor data completeness
Model summary	Independent errors	Cook's distance	Influential cases
VIF coefficients	Multicollinearity	Leverage values	Influential cases
Tolerance coefficients	Multicollinearity	Standardized residuals	Outliers
Casewise diagnostics	Bias	DFBeta	Outliers
Cook's distance	Outliers	Linearity of the logit	Linearity
P-P plot	Normality	VIF coefficients	Multicollinearity
---	---	Tolerance coefficients	Multicollinearity

4.6 Interviews

4.6.1 Preparation

As the focus of the structured interviews was to provide concurrent, cross-methods triangulation with the questionnaire data by interviewing key informants (Valentine, 1997), the structure, indicators and questions followed the outline of the household survey: Sustainable Livelihood framework; household impacts and conflict; individual attitudes; mitigation methods (see Appendices 12.13 and 12.14). However, the questions for each section were entirely open, rather than closed. The exceptions to this were questions 1.3.5 to 1.3.8, which gathered quantitative data on the current market value of sub-adult cattle, sheep/goats, equines and yaks/yak hybrids, as well as question 1.6.1 on household incomes. Here, minimum and maximum estimations were taken to enable a range of values to be calculated.

As the structure of the interviews was based on the household questionnaires, the scoping phase discussed in Section 4.3.3, and the scoping interviews listed in Table 4.1, also helped to shape this method of data collection. Given the overlap in structure between the two methods, the interviews were therefore not piloted separately. Preparation for the administration of the interviews followed the guidelines of King and Horrocks (2010).

4.6.2 Administration

Like structure, interview sampling followed the framework developed for the household questionnaires, with the aim of collecting 10% of the quantity of the surveys administered i.e. 70 (see Tables 4.10 and 4.11). Table 4.18 lists the interview sampling by PA and VDC. Sampling followed a convenience sampling technique in which interviewees were selected from each VDC and/or settlement based on their role, experience, standing in the community and availability.

Table 4.18 Interview sampling by Protected Area and Village Development Committee.

PA	**VDC**	**Frequency**	**Percentage**
SNP	Khumjung	14	20.0
	Namche	12	17.1
ACA	Jomsom	10	14.3
	Kagbeni	7	10.0
	Muktinath	5	7.1
	Manang	4	5.7
	Tanki Manang	3	4.3
	Pisang	3	4.3
	Jhong	2	4.3
	Khangsar	2	2.9
	Bhraka	2	2.9
	Ngawal	2	2.9
	Nar	2	2.9
	Ghyaru	1	1.4
	Phu	1	1.4
	Total:	**70**	**100.0**

The interviewees had varied roles and positions (Table 4.19). As the sample was not intended to be representative, there is a bias towards community and conservation leaders, with monks, teachers and women's groups leaders being the next three most numerous groups. The interviews were usually administered in Nepali by a research assistant, with either myself or Maurice Schutgens always present, although a small number of interviewees were happy to be interviewed in English. A translation after each question was provided by the research assistant, and each interview was also recorded with a sound recorder.

Table 4.19 Interviewee roles

Role	**Frequency**	**Percentage**
Community leader	14	20.0
Conservation leader	12	17.1
Teacher	8	11.4
Monk	7	10.0
Women's leader	7	10.0
Health worker	5	7.1
Savings and credit cooperative officer	4	5.7
Government employee	3	4.3
Park officer	3	4.3
Youth leader	3	4.3
Herder	1	1.4
Hotelier	1	1.4
Army officer	1	1.4
Tourism officer	1	1.4
Total:	**70**	**100.0**

4.6.3 Analysis

As soon as possible after data collection, the interview was translated and typed into a computer by the relevant research assistant. This was then cross-referenced, by Maurice Schutgens or myself, with the notes from the translation made during the interview and any anomalies checked with the research assistant, or additional data added. This is a form of cross-researcher triangulation intended to promote reliability in interview methodology (Newing et al., 2011).

The interview data were then analysed both quantitatively and qualitatively to triangulate and complement the survey analysis described above (Mikkelsen, 2005). Quantitative analysis involved manual coding of the interview questions in a similar manner to the open questions in the household survey (see Section 4.5.3.1). Descriptive statistics were then carried out to profile the questions, with the results used as cross-method triangulation with the questionnaire results. Data were presented mostly as percentages based on 'yes/no' responses, with the exception of continuous data on livestock values and categorical data on household incomes. Due to the structure of the interviews and their correspondence with the structures of the questionnaires, the qualitative results were not coded but inserted directly into the narrative in the results and discussion section to add depth to the quantitative questionnaire results. This follows Nepal and Spiteri's (2011) similar approach with their analysis of livelihoods and conservation in the Makalu-Barun Conservation Area, neighbouring SNP.

4.7 Chapter summary and conclusions

Chapter Four has set out the main methodologies used in the study. The overview provided the theoretical, practical and logistical background to the study. This included crucial issues such as strategy, design, ethics, risks, collaboration and research assistance, among others. Successive sections then dealt separately with the preparation, administration and analysis of the study's 705 household questionnaires and 70 structured interviews. In total, this chapter describes a challenging but achievable set of methodological goals that were achieved in order to successfully complete this study. The next chapter details and discusses its first set of results relating to household livelihoods.

5. Livelihoods

5.1 Introduction

Chapter Four reviewed the literature on livelihoods, governance and human-snow leopard coexistence in the study's two field sites in SNP and ACA respectively. This chapter provides the results on household access to assets, better known as 'livelihoods', in these two PAs. Furthermore, it discusses the results in relation to the local and wider literature. First, the descriptive results, based on the five asset classes of the Sustainable Livelihoods framework, are reviewed and aggregated, followed by inferential relationships between the Sustainable Livelihoods Index (SLI), a composite livelihoods index, and various explanatory variables. Secondly, all of these factors are considered in a multiple regression model that seeks to determine which factors, whether singly or in combination, best explain livelihood diversity and sustainability. Overall, the chapter seeks to answer the following research question: what do household livelihoods involve, in terms of access to various asset classes, and which factors best explain them?

5.2 An overview of household livelihoods

5.2.1 Household assets

Most of them are literate...But they don't have a sense of equity.

Buddhist lama, SNP

Demographic data showed that a mean of 3.81 adults per household were living in the study areas (Table 5.1). This figure is similar to that of 3.44 from the 15 relevant Village Development Committees (VDCs) in the 2011 Nepal Census (Government of Nepal, 2012). The slight difference between the two sets of figures may be attributed to the sample size of 705 households, which represented only 25.7% of the total households in each study area, and was therefore lower than the Census estimate. Similarly, extrapolating from the figure of 3.81 in this study, the estimate of all adults in the study areas would be 10,451, substantially higher than the estimates of 9,400 from the 2011 census. Time of year may explain the difference between these two estimates as the data from Manang, and to a lesser extent Lower Mustang, was collected during the tourist season, when, as in other areas of the Nepal Himalayas, some households may temporarily increase in size due to the seasonal nature of the tourist trade (Nepal, 2000).

Table 5.1 Descriptive results for combined sample of household members.

Household members	N	Median	Maximum	Sum	Mean ± SD
Adults (≥18)	705	3	12	2686	3.81 ± 1.90
School age children (4-17)	705	1	6	783	1.11 ± 1.12
Infants (<4)	705	0	3	129	0.18 ± 0.4
Total	**705**	**5**	**15**	**3598**	**5.10 ± 2.10**

The proportion of children attending school was 0.97 (Table 5.2). This was similar to results derived from triangulation interviews, where 98.6% and 87.1% of children attended primary and secondary school, respectively. Triangulation interviews (see Appendix 12.15.3) mentioned tertiary education in only 21.4% of cases. However, interviewees recorded that many students were boarding at colleges outside of the region, and, occasionally, at universities outside of the country[1]. The adult literacy rate of 53% is somewhat lower than the national average of 59.6% (Government of Nepal, 2012). A lack of educational provision in SNP and ACA during previous decades may have contributed to this result, although school in parts of the former have benefited from mountaineering-related philanthropy (Rasley, 2010; Trunzo-Lute, 2012).

Table 5.2 Mean household human assets results for combined sample.

Indicator	N	Mean ± SD
School attendance rate	429	0.97 ± 0.15
Educational access index (i.e. adult literacy rate)	**705**	**0.53 ± 0.32**
Self-administered traditional medicine	702	0.59 ± 0.49
Self-administered ‘Western’ medicine	705	0.46 ± 0.50
Visit to local clinic in Protected Area	705	1.00 ± 0.00
Visit to clinic outside of Protected Area	705	0.99 ± 0.11
Medical access index	**702**	**0.76 ± 0.20**
Newspaper	705	0.03 ± 0.17
Radio	705	0.71 ± 0.46
Television	705	0.84 ± 0.37
Internet	705	0.22 ± 0.41
Media access index	**705**	**0.45 ± 0.21**
Human assets index	**702**	**0.58 ± 0.17**

Note. Indices in bold. Educational access index equals adult literacy rate. Medical and media access indices equal means of respective preceding variables. Human assets index equals mean of educational, medical and media access indices.

Data on medical access shows there was universal access to clinics within the PAs, and almost universal access to clinics outside PAs, but with lower rates of traditional medicine

1 Park officer, SNP; Conservation leader, SNP; Teacher, ACA.

– known as *amchi* – usage (Table 5.2). Triangulation interviews (see Appendix 12.15.3) confirm the widespread access to clinics within the PAs, but suggest higher rates of traditional medicine use than in the questionnaire, although they do note that its availability and importance is decreasing, particularly amongst younger generations[2]. Media access is largely a product of mountain logistics. Newspaper usage is almost non-existent, with relatively high rates of access to radio and television, and increasing levels of internet access.[3] These media access results are replicated in the triangulation interviews data (see Appendix 12.15.3).

5.2.2 Natural assets

Before no one migrated so there were enough people to look after livestock but now that so many migrate to study elsewhere there aren't enough people to look after livestock properly.

Conservation leader, ACA

Rangelands occupy 86% of the Hindu-Kush Himalayan region (Partap, 1999), and pastoralism continues to play an important role in both ACA and SNP. While 84% of households have access to grazing land, only 77% actually kept livestock. Furthermore, numbers of livestock kept per household differed markedly, with cattle being the most frequently kept. Sheep/goats and yaks were less commonly kept but herd sizes were likely to be larger than for *Bos* species. The mean total number of livestock per kept household was 15.48. This total was considerably lower than for a study of livestock ownership in Manang two decades previously (Oli et al., 1994).

2 Conservation leader and teacher, SNP; Tourism officer, ACA; Health worker, ACA; Conservation leader x2, ACA.

3 Note that mobile phones are not included in the media index for several reasons. Firstly, it is about access to types of media and not types of communication device, and mobile phones do not represent a media type in and of themselves. Rather, they are a communication medium through which various media types can be accessed. Secondly, mobile phone ownership and usage is increasingly ubiquitous and the inclusion of the variables would therefore have been unlikely to alter the index results.

Table 5.3 Household livestock descriptive results for combined sample.

Livestock type	N	Median	Maximum	Sum	Mean ± SD
Cattle	705	1	40	1332	1.89 ± 2.66
Sheep/goats	705	0	250	5392	7.65 ± 25.57
Horses/mules/ donkeys	705	0	13	512	0.73 ± 1.5
Yaks/yak hybrids	705	0	110	3396	4.82 ± 12.08
Other	705	0	66	330	0.47 ± 3.08
Total	**705**	**0**	**312**	**10962**	**15.48 ± 30.53**

Triangulation interviews confirmed these general numerical trends (see Appendix 12.15.4), while data from Aryal et al. (2014) in Upper Mustang, divided by households per VDC (Government of Nepal, 2012), show the mean number of livestock per household to be 1.23 cattle, 15.06 sheep/goats, 0.93 equines, 0.88 yaks and 18.09 in total. The absence of sheep and goats from SNP (Bhuju et al., 2007) may explain the lower averages in this sample.

Table 5.4 Trends in livestock production for combined sample based on triangulation interviews.

Aspect of livestock production		N	%
Sale of surplus and/or commercial production		39	55.7
Decreasing production		18	25.7
Reasons for decrease	No reason	3	16.7
	Tourism	10	55.5
	Migration	2	11.1
	Motorised transport	2	11.1
	Increased predation	1	5.6

A majority of respondents suggested that semi-commercial or commercial livestock production is occurring in both study sites (Table 5.4). Elsewhere in Central Asia, this has been identified with threats to populations of large wild mammals, particularly when linked to commercialised cashmere production which drives higher livestock densities (Berger et al., 2013). In contrast, however, a few interviewees thought that livestock production was decreasing. The main reason given for this was tourism, a potential threat to traditional livelihoods and land management systems that is also recognised by numerous researchers across the region, particularly when conducted at inappropriate scales (Kreutzmann, 2012; Nautiyal et al., 2003; Nautiyal and Kaechele, 2009; Yamaguchi, 2011). The estimates of livestock value (Table 5.5) are considerably higher than the estimates from elsewhere in ACA (Aryal et al., 2014). However, this may be explained due much smaller sample sizes of livestock and different geographical locations than recorded in this previous study.

Table 5.5 Financial values of livestock for combined sample, based on triangulation interviews.

Livestock class		**Price (US$)**
Cattle	N	55
	Median	**125.00**
	Mean ± SD	159.41 ± 87.02
	Minimum	38.00
	Maximum	375.00
Sheep/ goats	N	41
	Median	**150.00**
	Mean ± SD	140.22 ± 42.79
	Minimum	45.00
	Maximum	215.00
Equines	N	56
	Median	**950.00**
	Mean ± SD	1057.11 ± 570.97
	Minimum	150.00
	Maximum	2500
Yaks/yak hybrids	N	61
	Median	**450.00**
	Mean ± SD	547.87 ± 299.68
	Minimum	90.00
	Maximum	1750.00

While 94% of households had access to land for cultivation, only 56% sold surplus crops, notably potatoes (both sites) and apples (ACA only) (Table 5.7). While interview data in Table 5.6 suggests a higher rate of commercial or semi-commercial cultivation than questionnaire data suggest, it does not identify a decreasing trend as much as it does for livestock. The reasons given any real or perceived decreases compare with those in the wider literature, such as an increase in the availability of cheap imports, often associated with infrastructure improvements and tourism (Mertz et al., 2005; Negi et al., 2009; Partap, 1999).

Table 5.6 Trends in crop production for combined sample based on triangulation interviews.

Aspect of crop production		**N**	**%**
Sale of surplus and/or commercial production		51	72.9
Decreasing production		7	10.0
Reasons for decrease	No reason	2	28.6
	Tourism	2	28.6
	Cheaper imports	2	28.6
	Switch to cash crops	1	14.2

With the exception of medicinal plants (which may be linked to the decline in traditional medicine usage discussed in Section 5.2.1), the indicators for the natural assets index show that households have near universal levels of access to natural materials (Table 5.7). In turn, this underlines the importance of biodiversity as a livelihoods safety-net (Roe et al., 2013). In terms of water access, almost all households have access to outside taps, while inside taps are less common. Although the questionnaire did not consider how access to water is changing, as was the case for access to livestock and cultivation, other research in the Khumbu region of Nepal has shown that households are experiencing increased vulnerability from climate-related changes in precipitation patterns (McDowell et al., 2013). These include reduced water availability for household use, crop irrigation, increased tourist demand and hydroelectricity generation.

Table 5.7 Mean household natural assets results for combined sample.

	N	**Mean ± SD**
Livestock access index	**705**	**.33 ± .26**
Grazing land access index	**705**	**.84 ± .37**
Sale of surplus crops	661	.56 ± .50
Cultivating land access index	**705**	**.94 ± .25**
Fuelwood	705	.99 ± .11
Construction wood	705	.92 ± .27
Human food	704	.95 ± .22
Animal food	699	.96 ± .20
Medicinal plants	700	.79 ± .41
Natural products access index	**699**	**.92 ± .16**
Spring	705	.27 ± .44
Well	705	.00 ± .07
Handpump	705	.00 ± .05
Outside tap	705	.99 ± .11
Inside tap	705	.44 ± .50
Water access index	**705**	**.34 ± .11**
Natural assets index	**699**	**.68 ± .13**

Note. Indices in bold. Livestock access index equals household ownership or absence of each of the five preceding livestock classes, with a minimum score of 0.00, a maximum score of 1.00 and intervals of 0.20. Grazing and cultivating land access indices equals household access to grazing and cultivating land respectively. Natural products and water access indices equal means of respective preceding variables. Natural assets index equals mean of livestock, grazing land, cultivating land, natural products and water access indices. 'Sale of surplus crops' is not part of any index.

5.2.3 Social assets

There is no access to district and national level representation, especially if less well-off.

Microcredit cooperative officer, SNP

Despite its importance in the Sustainable Livelihoods framework (Carswell and Jones, 2004; DFID, 1999; Steimann, 2005), and access theory (Ribot, 2014; Ribot and Peluso, 2003), social capital has remained difficult to quantify in household surveys. Access to organisations is one measure, of which there are a wide range of options (Table 5.8). Membership of women and youth organisations was most common, with approximately one in eight households having membership of a conservation committee. Triangulation interviews also identified that these three were the organisations in which households were most frequently involved (see Appendix 12.15.8).

Table 5.8 Mean household natural assets results for combined sample.

Indicator	**N**	**Mean ± SD**
Conservation committee	701	.12 ± .32
Village development committee	702	.05 ± .22
Tourism association	702	.10 ± .30
Microcredit group	702	.03 ± .17
Co-operative	702	.06 ± .24
Women's group	703	.51 ± .50
School association	702	.09 ± .29
Youth group	703	.40 ± .49
Other	702	.08 ± .27
Organisational access index	**701**	**.16 ± .15**
Local	704	.98 ± .15
District	704	.66 ± .48
National	704	.06 ± .23
Political access index	**704**	**.56 ± .20**
Social assets index	**701**	**.36 ± .14**

Note. Indices in bold. Organisational and political access indices equal means of respective preceding variables. Social assets index equals mean of preceding social indices.

Political access is another measure of social capital that it is mediated by geographical distance. In this study, national representation in Kathmandu was the most difficult to access (Table 5.8). This compares with the political marginalisation of mountain regions observed elsewhere (Ellis-Jones, 1999; Hurni et al., 2012; Magnani, 2012) and was corroborated by triangulation interviews (see Appendix 12.15.8). Interviewees, like the one quoted at the start of this section[4], also noted the importance of wealth and power in accessing political representation, as a proxy for accessing power, an important component of access theory (Ribot and Peluso, 2003)

5.2.4 Physical assets

Four to five years ago there was a home stay system...but now it no longer functions.

Microcredit cooperative officer, SNP

Access to physical assets, such as firewood[5], continues to be an important source of energy for households, followed by electricity, cylinder gas and animal dung (Table 5.9). These four energy sources were also the most commonly mentioned in triangulation interviews (see Appendix 12.15.9). The significance of fuelwood for households echoes similar findings in ACA (Nepal, 2008), in Kyrgyzstan and Tajikistan (Förster et al., 2011), and in Kenya (Gichuki, 1999).

Table 5.9 Mean household physical assets results for combined sample.

Indicator	N	Mean ± SD
Fuelwood	705	0.96 ± 0.19
Cylinder gas	705	0.61 ± 0.49
Kerosene oil	705	0.37 ± 0.48
Electricity	705	0.79 ± 0.41
Animal dung	705	0.60 ± 0.49
Other	705	0.05 ± 0.21
Fuel access index	**705**	**0.56 ± 0.17**
Residential building	705	0.76 ± 0.43
Joint tourist/residential building	705	0.24 ± 0.43
Tourist building	705	0.02 ± 0.13
Other	705	0.09 ± 0.29
Building access index	**705**	**0.28 ± 0.08**
Foot	705	1.00 ± 0.07

4 Microcredit cooperative officer, SNP.

5 Note that fuelwood has been double-counted, once in the access to natural products index and once in the fuel access index. However, given that in both cases access to fuelwood is nearly universal, its inclusion in the Sustainable Livelihoods Index is unlikely to have altered the statistical analysis.

Animal	705	0.47 ± 0.50
Bicycle	705	0.01 ± 0.09
Bus/taxi	705	0.51 ± 0.50
Aeroplane	705	0.51 ± 0.50
Motorcycle	705	0.21 ± 0.41
Other	705	0.03 ± 0.17
Transport access index	**705**	**0.39 ± 0.13**
Physical assets index	**705**	**0.41 ± 0.08**

Note. Indices in bold. Fuel, building and transport access indices equal means of respective preceding variables. Physical assets index equals mean of preceding fuel, building and transport access indices.

The other constituents of the physical assets index are access to buildings and access to transport (Table 5.9). Given that only 26% of households had access to either a joint tourist/residential building or a tourist building, it would suggest that the tourist industry in ACA and SNP is controlled by a minority of the population, a concern raised by several researchers for the latter PA (Daconto and Sherpa, 2010; Nepal, 2000). For transport access, the results indicate a shifting mixture of transportation types, with the gradual construction of a road into Manang providing increased opportunities for vehicular access (Bhuju et al., 2007). Conversely, as indicated by a number of interviewees[6], this has resulted in a decreased use of animal transport.

5.2.5 Financial assets

[Households range] from very poor to stupidly rich. Poor people survive on daily wages.

Teacher, ACA

An analysis of mean household incomes show that many respondents were earning more than NR 250,001 (USD 2,500) per annum (Table 5.10) This figure suggests that earnings were higher than anticipated and probably indicates that the distribution of wealth is weighted towards those households who can effectively access and control the lucrative tourist trade in both PAs. It also raises questions about how rising inequality might change the aspirations of local communities (Ray, 2006) and how rising levels of consumption can be reconciled with local, regional and global ecological considerations (Fischer et al., 2012; Jorgenson, 2003; Walpole, 2006), of particular importance in fragile mountain ecosystems like the Nepal Himalayas. Other negative impacts of increasing inequality include the creation of class tensions within communities, and the erosion of trust and solidarity (Baland et al., 2007; Boyce, 1994). A large proportion of respondents were also

6 Teacher, ACA; Hotelier and community leader, ACA.

unwilling to share information on their household income, though not on the value their livestock. As a result, the financial assets index comprised data from 608 households rather than 705 (see Section 4.5.3.4 for the methodological implications of this for inferential analysis).

Table 5.10 Mean household financial assets results for combined sample.

Income (US$)	Frequency	Total %	Index %	Score/Mean
0-50	78	11.1	12.8	0.167
50-100	97	13.8	16.0	0.334
100-150	63	8.9	10.4	0.501
150-200	69	9.8	11.3	0.668
200-250	42	6.0	6.9	0.835
>250	259	36.7	42.6	1.000
Financial assets index	**608**	**---**	**100.0**	**0.69 ± 0.32**
Prefer not to say	97	13.8	---	---
Total	705	100.0	--	---

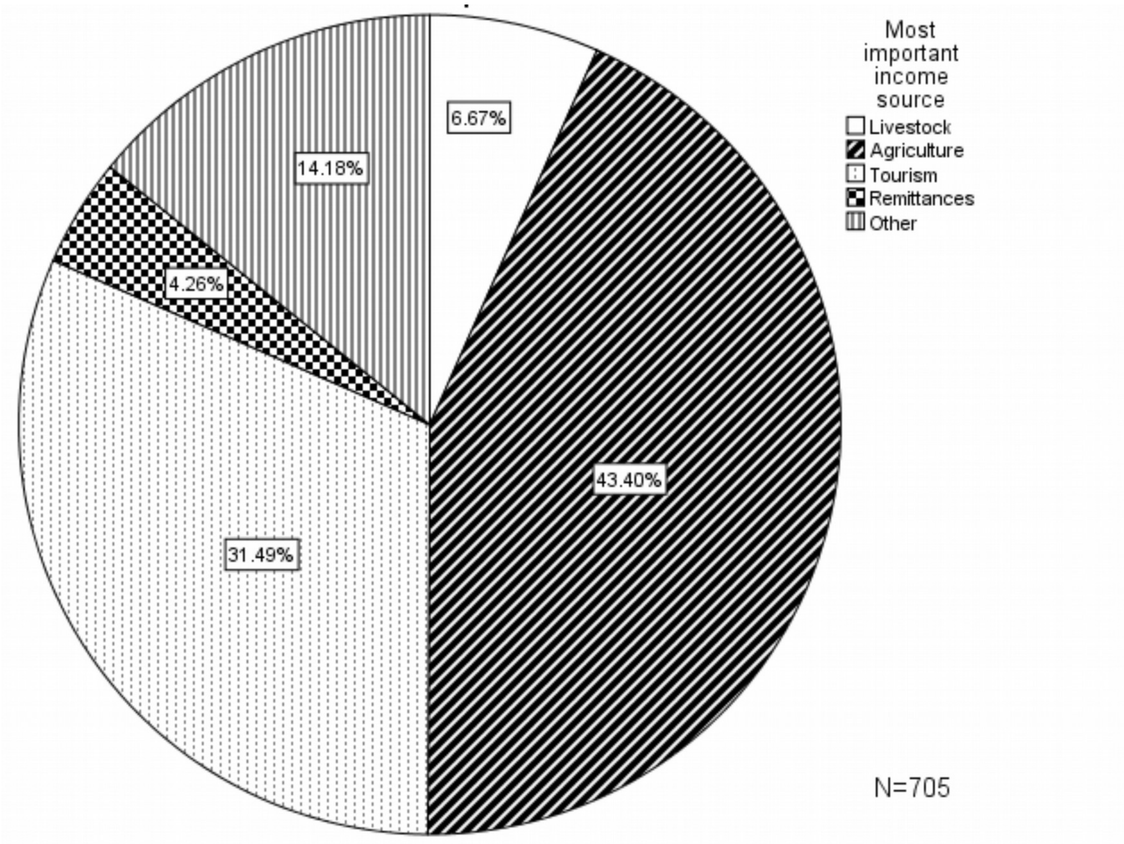
Note. Index in bold. Financial assets index equals score allocated per household based on income classes, with a minimum score of 0.167 for 0-50,000, a maximum score of 1.00 for >250,001, and intervals of 0.167. Those in the income class 'prefer not to say are excluded from the index.

Cultivation, followed by livestock herding and then tourism, was the most commonly accessed source of financial income (Table 5.11). Figure 5.1 shows these same sources as income priorities. Agriculture and tourism are the most important activities, with livestock herding being much less so, indicating pastoralism may provide a constant, low level of income. Agro-pastoralism continues to be significant livelihood for communities here, as well as across the region (Aase et al., 2013; ICIMOD, 2011; Partap, 1999).

Table 5.11 Mean access to sources of household financial income for combined sample.

Income source	N	Mean ± SD
Livestock	705	.56 ± .50
Cultivation	705	.83 ± .38
Wood	705	.00 ± .05
Other natural products	705	.07 ± .26
Tourism	705	.42 ± .49
Remittances	705	.15 ± .36
Savings	705	.08 ± .27
Loans	705	.01 ± .12
Other	705	.28 ± .45

Figure 5.1 Most important sources of financial income for combined sample.



5.2.6 Sustainable Livelihoods Index totals

Incomes are generally not from one source but are very diverse – people are involved in many things at once.

Teacher, ACA

Access to asset class for households in ACA and SNP varied considerably (Table 5.12). The methodologies used to construct these composite indices are explained in greater detail in Section 4.5.1.2. In brief, the methods adopted follow the asset classes of the Sustainable Livelihoods framework (Carswell and Jones, 2004; Chambers and Conway, 1992; DFID, 1999; Scoones, 2009), and particularly of Steimann's (2005) application of them in questionnaire format. As a measure of livelihood diversification and resilience, the Sustainable Livelihoods Index (SLI) comprises higher levels of human, natural and financial assets, and lower levels of social and physical assets. Particularly high levels of income amongst a large proportion of households may contribute to the skewed distribution curve (Figure 5.2).

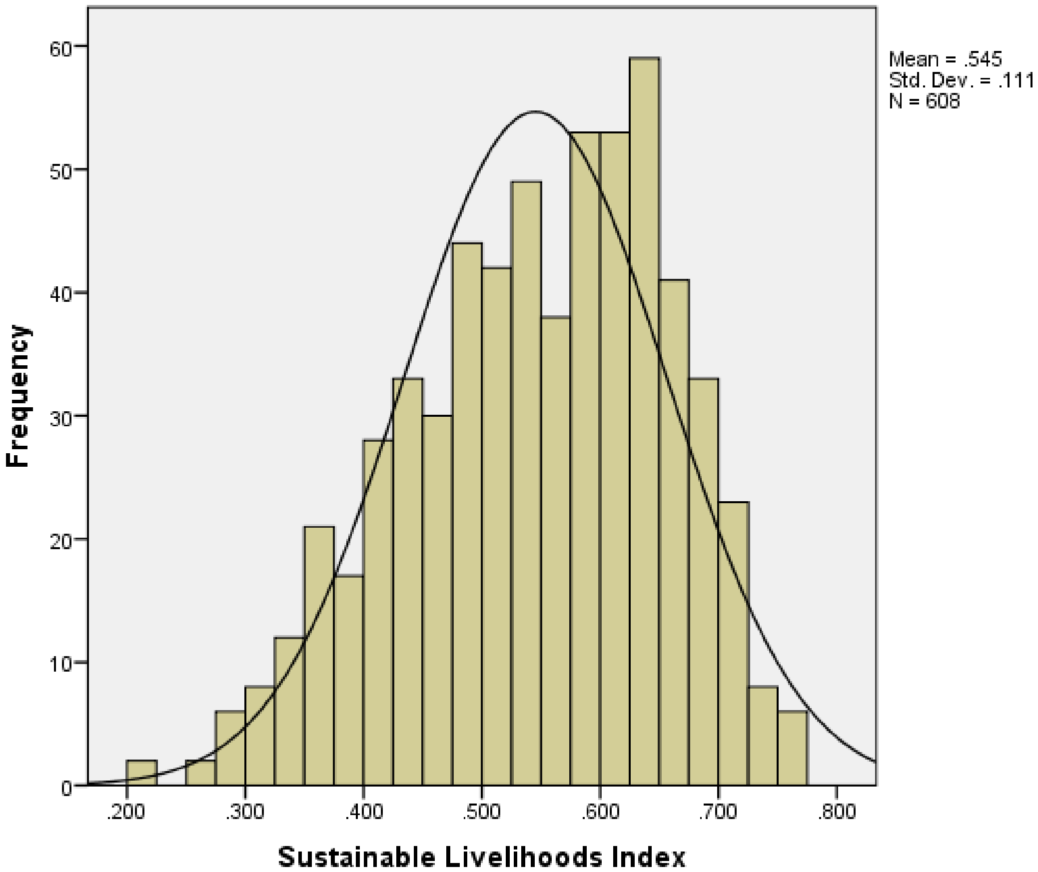
Table 5.12 Household sustainable livelihoods indices combined.

Index	N	Mean ± SD	Median	Minimum	Maximum
Human assets	702	.58 ± .17	.58	.083	1.00
Natural assets	699	.68 ± .13	.72	.080	0.88
Social assets	701	.36 ± .14	.33	.00	0.89
Physical assets	705	.41 ± .08	.39	.19	0.66
Financial assets	608	.69 ± .32	.67	.17	1.00
Sustainable livelihoods index	**608**	**.55 ± .11**	**.55**	**.21**	**0.77**

Note. Sustainable livelihoods index equals mean of indices from each of the five asset classes.

Elsewhere, households with more assets tend to be more resilient to risks, such as with lower levels of food insecurity in Tanzania (Salerno et al., 2015). In line with access theory (Ribot, 2014; Ribot and Peluso, 2003), the relationship between increased assets and resilience to the real and perceived risk of snow leopards is considered in Chapters Seven and Eight. In the remainder of this chapter, the focus is on understanding and explaining higher levels of asset access by households.

Figure 5.2 Sustainable Livelihoods Index



5.3 Explanations for household livelihoods

Agriculture and animal husbandry are so interrelated...if you don't have animals you have no manure and when you don't have agriculture you don't have fodder for the animals.

Teacher, SNP

This section discusses the relationships between household SLI scores and various household characteristics. Each explanatory variable is considered in both univariate and multivariate contexts. The order of discussion is based on the contribution of each variable to the multiple regression model (Table 5.13), with the most significant considered first. The order of inclusion in the model is hierarchical and theoretical, based on a review of similar livelihood studies (Babulo et al., 2008; Block and Webb, 2001; Fasse and Grote, 2013; Parker and Thapa, 2012).

Table 5.13 Linear model explaining household Sustainable Livelihoods Index scores.

R^2 = .32 N = 608	***b***	***SE B***	***Standardised b***	***p***
Constant	.34 (.31, .37)	.015	---	p = .001
Household size	.013 (.009, .017)	.002	.25	p = .001
Savings income*	.054 (.028, .081)	.013	.13	p = .001
Remittance income*	.031 (.010, .051)	.010	.11	p = .001
Livestock income*	.027 (.009, .044)	.008	.12	p = .003
Cultivation income*	.021 (-.002, .045)	.012	.071	p = .093
Tourism income*	.12 (.11, .14)	.009	.55	p = .001

Note. * = 0 = no; 1 = yes. Potential predictor variables not included in analysis due to small sample size in 'yes' category: income from wood (n=2); income from loans (n=10). Cronbach's Alpha not applicable for the Sustainable Livelihoods Index as its is not a scale measuring latent variables but an aggregation of a series of separate indicators. This model had the highest significant R^2 change score (.15, p = <.001) out of the nine models tested; variables excluded from final model due to lower R^2 change scores when included in successive models: other sources of income; NTFP income; study site.

5.3.1 Tourism income

The variable with the single biggest effect on SLI scores in a univariate analysis was income from tourism (Table 5.14). Households also listed it as the third most accessible source of income, after cultivation and livestock (see Table 5.11), and the second most important income source, after cultivation (see Figure 5.1). This would seem to corroborate findings that 46% of households had some involvement in the industry (Bhuju et al., 2007). Interviewees also confirmed suggestions in the literature (Bjønness, 1983; Byers, 2005; Padoa-Schioppa and Baietto, 2008) that tourism is reducing the levels of livestock farming.[7]

In multivariate analysis, income from tourism was also the most influential explanatory factor (Table 5.13). Given that tens of thousands of, mostly foreign, tourists visit SNP and ACA each year (Ale et al., 2007; Baral et al., 2008), it is no surprise that access to this lucrative industry can contribute to livelihood improvements and sustainability, particularly in terms of financial income. However, as has been noted with PAs in East Africa (Munanura et al., 2016; Sandbrook and Adams, 2012), concerns persist about the equitable distribution of benefits from tourism within both (Nepal, 2000), as well as the increasing market share of external business interests, both national and international (Daconto and Sherpa, 2010).

7 Hotelier, SNP; Buddhist lama, SNP; Microcredit cooperative officer, SNP; Teacher, SNP; Youth leader, SNP; Conservation leader, ACA; Hotelier and community leader, ACA.

Table 5.14 Independent t-tests comparing mean Sustainable Livelihoods Index scores by access to income sources.

Variable	Access to income mean ± SD	No access to income mean ± SD	Difference	*t*	*df*	*p*	Effect size
Tourism income	.59 ± .006	.51 ± .006	-.084 (-.10, -.069)	-10.14	587	.000	.36
Savings income	.61 ± .13	.54 ± .005	-.065 (-.091, -.038)	-3.95	606	.000	.33
Livestock income	.56 ± .005	.53 ± .007	-.028 (-.045, -.011)	-3.03	500	.004	.13
Remittance income	.59 ± .010	.54 ± .005	-.051 (-.075, -.027)	-4.32	606	.000	.23
Cultivation income	.55 ± .005	.50 ± .013	-.051 (-.080, -.023)	-3.62	125	.000	.21
Non-Timber Forest Products income	.59 ± .010	.54 ± .004	-.053 (-.074, -.031)	-4.85	68	.000	.26
Income from other sources	.52 ± .009	.55 ± .009	.032 (.013, .053)	3.23	606	.001	-.13

Table 5.15 Linear model explaining Sustainable Livelihoods Index scores by total household members.

	b	*SE B*	*Standardised b*	*p*
Constant	.45 (.43, .47)	.012	---	.001
Total household members	.019 (.014, .024)	.002	.36	.001

Table 5.16 Independent t-test comparing mean Sustainable Livelihoods Index scores by study site.

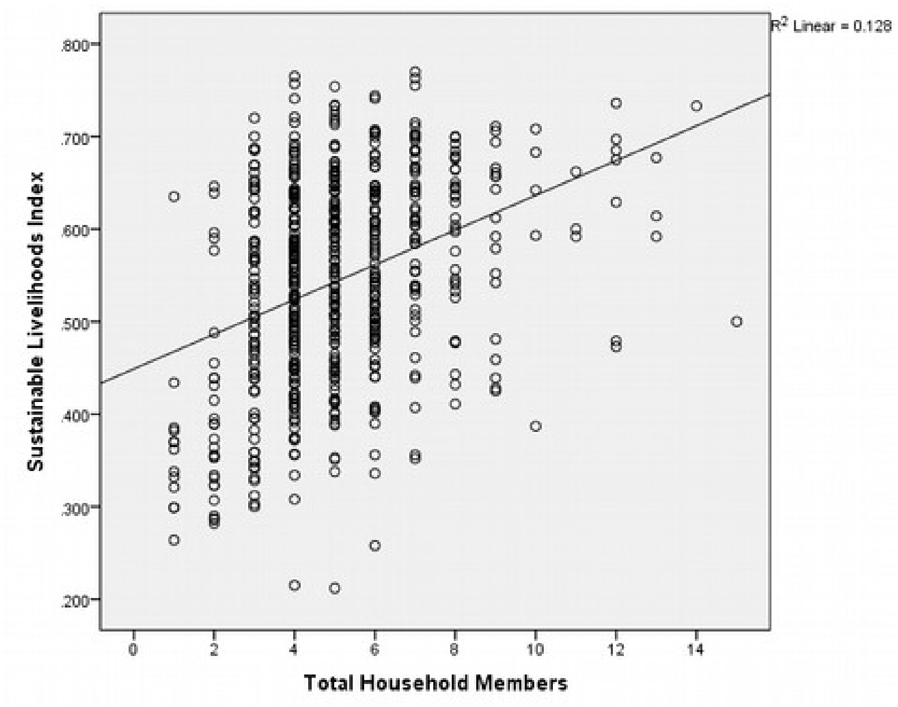
SNP mean ± SD	ACA mean ± SD	Difference	*t*	*df*	*p*	Effect size
.53 ± .008	.55 ± .005	-.023 (-.042, -.003)	-2.42	449	.016	.09

5.3.2 Household members

A scatterplot shows the positive relationship between total household members and SLI scores (Figure 5.3), while the linear model confirms that it involves a significant positive correlation in univariate terms (Table 5.15). From the perspective of a Sustainable Livelihoods framework perspective, this may be explained in terms of the quantity – rather than quality – of human assets available to engage in livelihood creation (Berzborn, 2007). More household members may equate to employing a more diverse range of livelihood strategies, a trend also observed in an assessment of livelihood diversification predictors in Ethiopia (Block and Webb 2001).

Household size was also an important explanatory factor in the multiple regression model (Table 5.13). Although it was approximately half as influential as income from tourism, it was twice as influential as any of the other variables. It may also interact with these other factors by providing additional family members to be involved in additional income generating activities; it is common in Nepal for men to work in paid employment outside of the home, region or country, while women, children and other dependents maintain the home, farm and other local activities (Sunam and McCarthy, 2016).

Figure 5.3 Scatterplot showing the relationship between Sustainable Livelihoods Index scores and total household members.



5.3.3 Savings income

Only 8% of households recorded access to income from savings (Table 5.11). Yet as univariate analysis shows, those who did had significantly higher SLI scores than those who did not (Table 5.14). Households with pre-existing reserves of financial capital are likely to be better able to diversify their income, a trend also noted in Ethiopia (Beyene, 2012; Block and Webb, 2001). To a lesser extent, the Savings and Credit Cooperative organised by the Snow Leopard Conservancy in four SNP communities may also contribute to this income diversification trend, although the sums involved are relatively small.[8]

In multivariate analysis, access to income from savings was the third-most influential explanatory variable in the multiple regression model (Table 5.13). Access to savings may make income from tourism, for instance, more easily acquired, by providing financial capital for investment in the tourism business. Access to assets can in turn reproduce access to further assets, which fits with Ribot and Peluso's (2003) theory of access.

5.3.4 Livestock income

Livestock were the third most common income source listed by respondents (Table 5.11), although much less so than with agriculture and tourism. Those with access to income from livestock also had higher SLI scores than those who did not have such access (Table 5.14). More than half of triangulation interviewees suggested that households engaged in sale of surplus livestock and/or commercial production (Table 5.4). Even though only 6.67% of households identified livestock as their most important source of income, this positive, if weak, relationship to household SLI scores demonstrates the importance of livestock as an asset bank and income source, in addition to cultural dimensions (Devendra, 2012; Devendra and Chantalakhana, 2002).

Income from livestock was also a significant factor in explaining household SLI scores during multivariate analysis (Table 5.13). Even when considered in relation to other variables, livestock remains a significant contributor to livelihoods in SNP and ACA, whether for transport, meat, manure, milk or fibre (Padoa-Schioppa and Baietto, 2008). As elsewhere, livestock also represent a highly liquid form of asset storage and insurance (Berzborn, 2007; FAO, 2008).

8 Microcredit cooperative officers x4, SNP.

5.3.5 Remittance income

Remittances also contributed to significantly higher SLI scores, as univariate analysis shows, though to a lesser extent than savings (Table 5.14). This was despite 15% of households receiving income from this source, compared to 8% from savings (see Table 5.11). Interviewees also recorded households receiving remittance income[9], something also found in the nearby Kanchenjunga Conservation Area (KCA), where such households had significantly lower level of natural resource dependency (Parker and Thapa, 2012).

Remittance income was also a significant factor in the multiple regression model explaining household SLI scores (Table 5.13). As with savings, studies in Ethiopia have noted that livelihood diversification was positively correlated with higher incomes and the ownership of non-farm assets (Beyene, 2012; Block and Webb, 2001). In this sample, this trend seems to be replicated, given the link between access to financial capital, via remittances and also via savings, and greater SLI scores.

5.3.6 Cultivation income

In univariate analysis, income from the cultivation of crops was associated with significantly higher SLI scores, with a greater effect size than for livestock alone, but less than for remittances or savings (Table 5.14). As previously mentioned, 73% of interviewees noted that such cultivation involved the sale of surplus crops and/or commercial production (Table 5.6). My results therefore provide a more recent confirmation of earlier findings that agriculture in SNP continues to shift from a subsistence to a transitional agricultural system, more dependent on external influences and markets (Bjønness, 1983; Padoa-Schioppa and Baietto, 2008). Infrastructure developments in ACA, particularly roads, are likely to contribute to similar changes there, although the National Trust for Nature Conservation's (NTNC) agricultural extension programmes have been supporting such a shift since the 1990s (Aase et al., 2013).

Meanwhile, income from cultivation was not found to be significant in the multiple regression model, despite its inclusion in the final iteration (Table 5.13). This finding was particularly surprising given the ubiquity *and* priority of cultivation for household incomes (Table 5.11 and Figure 5.1). Nevertheless, this suggests that despite the ongoing agricultural transition in both study sites (Aase et al., 2013; Padoa-Schioppa and Baietto,

9 Microcredit cooperative officers, SNP; Park officer, ACA; Teacher, ACA.

2008), cultivation remains primarily a subsistence activity for a majority of households and is not a major contributor to SLI scores in comparison to other activities.

5.3.7 Non-Timber Forest Product income

NTFPs, including medicinal and aromatic plants (MAPs), are important for poverty alleviation (Larsen and Smith, 2004; Rasul et al., 2012). Indeed, contributions range from 19% to 32% of household income in north-eastern India (Saha and Sundriyal, 2012). NTFPs play a similarly significant role for some households in SNP and ACA, with a medium effect size of .26 in univariate analysis. A number of interviewees commented on the particular importance of the valuable *Cordiceps* fungus,[10] while others listed additional plants of medicinal value.[11]

Nevertheless, model selection excluded income from NTFPs in the final multiple regression model (Table 5.13). As only 7% of respondents listed NTFPs as a source of financial income (Table 5.11), it is likely that they represent an important and significant income source to these households, but the effect is too small to be transmitted into the wider community. Equally, given the relative ease with which NTFP and MAP resources can be over-exploited (Larsen and Smith, 2004), ongoing limitations on the harvesting may also contribute to their limited importance to household SLI scores in comparison to other explanatory factors.

5.3.8 Other sources of income

Income from another source was the only explanatory factor negatively correlated with household SLI scores in univariate analysis (Table 5.14). Table 5.11 shows that it was the fourth most accessible form of income, although, as the ‘other category’ in Figure 5.1 amalgamated various low-scoring variables, its self-reported priority as a form of income cannot be ascertained. It is possible that this income category includes insecure low-paid, seasonal and/or migrant wage labourers, such as the 16% and 6% of households without access to grazing or arable land respectively (Table 5.7).

During multivariate analysis, however, model selection excluded income from other sources from the final multiple regression model (Table 5.13). Compared to more common

10 Park officer, ACA; Teacher, ACA; Conservation leader, ACA; Community leader, ACA.
11 Health worker, SNP; Community leader, SNP; Teacher, ACA; Health worker, ACA.

and lucrative forms of income, such as from tourism, livestock herding, savings and remittances, other forms of income do not appear to contribute to improved household SLI scores. As well as low-paid wage labourers mentioned above, this group may also represent single-member households without the additional human assets to engage in additional or more commercialised forms of livelihood production (Berzborn, 2007).

5.3.9 Study site

A key hypothesis of this study is that access to influence in conservation governance, often via community-based schemes, should theoretically improve livelihood sustainability, among other things (Adams, 2009; Adams and Mulligan, 2003). That households in ACA, with a decentralised governance model, had significantly higher SLI scores during univariate analysis than SNP, with its top-down approach, would seem to bear this out (Table 5.16). However, the effect size was the smallest of all the variables considered, possibly because SNP has also experienced a degree of decentralised management, introduced via its buffer zone user committees since 2002 (Budhathoki, 2004; Daconto and Sherpa, 2010).

Moreover, the study site variable was not included in the final multiple regression model because R^2 change scores were of much lower significance. Clearly there are other variables that have much more influence in multivariate analysis. In addition, it is difficult to isolate causation associated with governance models in this non-experimental approach, as a range of other socio-economic and ecological differences between the two sites may influence the distinction in their household SLI scores (Bhuju et al., 2007). Chapter Six will consider the differences between the two study sites, and the potential influence of governance on these, in greater detail.

5.4 Summary and conclusions

This chapter has presented and discussed access to assets from a combined sample of SNP and ACA households. It first listed the descriptive results, based on the five asset classes of the Sustainable Livelihoods framework, including human, natural, social, physical and financial assets. The data in each section were also aggregated into indices, with the SLI as a composite of these.

Inferential relationships between the SLI and different variables were also discussed, including household size, as well as income from livestock, cultivation, tourism, NTFPs, other sources, remittances and savings. All were found to have significant positive relationships with the dependent variables, except for other income sources, which had a significant negative relationship. All relevant variables were then entered into a multiple regression model, with income from tourism and household size being the most important variables explaining high household SLI scores. The differences between these scores, and the contribution of governance model to this, will be considered in Chapter Six.

Chapter 6. Governance

6.1 Introduction

The previous chapter reviewed the availability of assets within both study areas. In contrast, this chapter will compare how access to assets differs between SNP and ACA. In particular, it will focus on how the contrasting governance models employed at each site impacts upon access to natural and other resources. Firstly, the descriptive results for human, natural, social, physical and financial asset classes will be compared between the two study sites on a variable-by-variable basis. Secondly, separate multiple regression models will be presented to explain household livelihood scores in both SNP and ACA. While causation, in relation to governance, cannot be assumed, significant differences between the two PAs are identified and discussed. Overall, the chapter seeks to answer the following research question: how do household livelihoods vary between SNP and ACA, and to what extent does governance explain this variation, among other factors?

6.2 A comparison of household livelihoods in SNP and ACA

6.2.1 Human assets

No Amchi [traditional medicine] available these days in Manang, only the ACAP clinic and the Himalayan Rescue Association clinic, and the last option is the Government clinic, which is not efficient and has poor-quality medicines.

Conservation leader, ACA

Households were of much larger mean size in ACA than in SNP (Table 6.1). This difference is also seen in the shape of their respective population pyramids (Figure 6.1). This difference is mostly due to the larger number of adults supported per household in ACA.

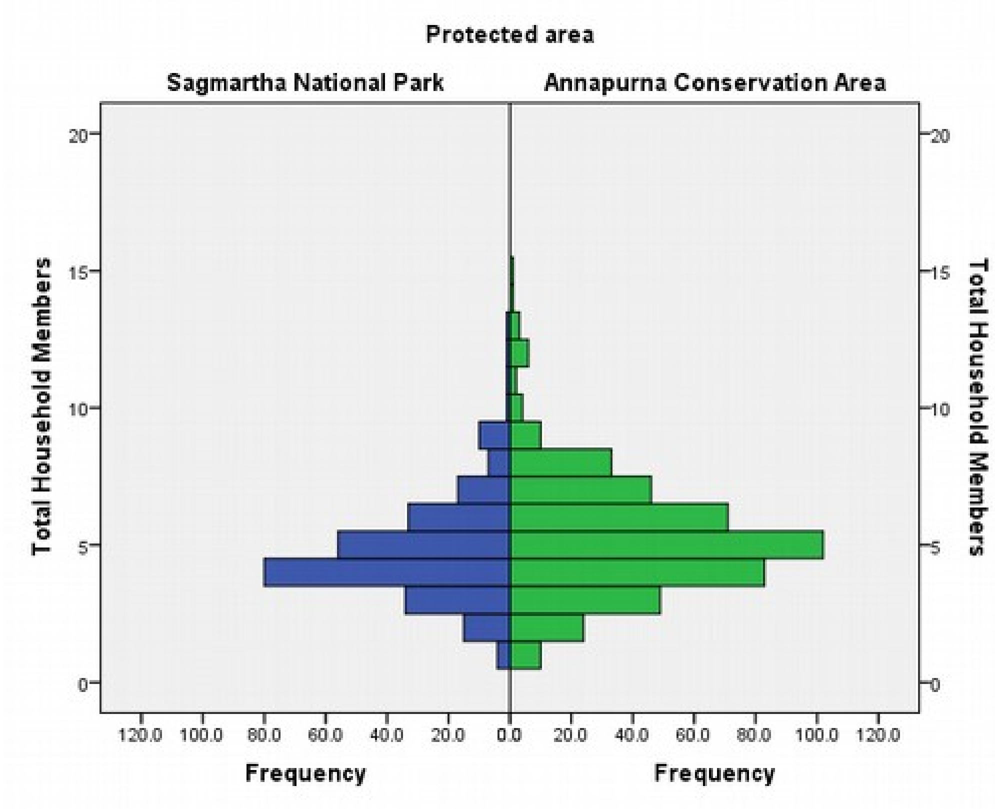
Table 6.1 Household members in SNP and ACA.

Indicator	SNP				ACA				Difference
	N = 260				N = 445				
	Med.	**Max.**	**Sum**	**Mean ± SD**	**Med.**	**Max.**	**Sum**	**Mean ± SD**	
Total	4	13	1248	4.79 ±1.87	5	15	2350	5.28 ±2.21	*t* (616) = -3.17*
Adults (≥18)	3	12	916	3.52 ±1.81	4	12	1770	3.98 ±1.93	*t* (703)= -3.09*
School age children (4-17)	1	6	273	1.05 ±1.10	1	6	510	1.15 ±1.13	*t* (703)= -1.10
Infants (<4)	0	3	59	0.23 ±0.47	0	2	70	0.16 ±0.41	*t* (479)= 1.99*

* $p = \leq 0.05$

By contrast, there was no significant difference in numbers of school-age children between SNP and ACA. Indeed, SNP even had more infants than ACA, which is suggestive of a younger population. As shown in Chapter Five (Table 5.13), household size can be correlated with higher and more sustainable household incomes. Yet, as noted for both SNP (Ale et al., 2007) and ACA (Ale et al., 2014), the increasing number of young people entering the tourism industry means that there are often fewer young people available for livestock herding.

Figure 6.1 Household members in SNP and ACA.



Comparisons of the educational status of residents from both PAs show that the adult literacy rate, which also functions as the educational access index, is significantly higher in SNP than in ACA (Table 6.2). This may reflect the significant educational, and other forms of, investment made in the area by mountaineering related-philanthropy from 1953 onwards (McDowell et al., 2013; Rasley, 2010; Trunzo-Lute, 2012). Indeed, this may serve as a positive counter-balance to the negative effects of such tourism outlined by Byers (2005). In contrast, the NTNC has only been active in ACA, including in education, since 1986 (Bhuju et al., 2007), potentially further resulting in the adult literacy gap reflected here (Table 6.2). Furthermore, the recent impact on education in ACA by the NTNC may be reflected in the equal current school attendance rates at the two sites.

Table 6.2 Mean household assets access in SNP and ACA.

	N	SNP ± SD	N	ACA ± SD	Difference
School attendance rate	152	0.97 ± 0.14	277	0.97 ± 0.16	*t* (427)= -0.23
Adult literacy rate/educational access index	**260**	**0.59 ± 0.33**	**445**	**0.50 ± 0.30**	***t* (503) = 3.32***
Self-administered traditional medicine	257	0.49 ± 0.50	445	0.64 ± 0.48	*t* (515) = -4.11*
Self-administered 'Western' medicine	260	0.60 ± 0.49	445	0.38 ± 0.49	*t* (703)= 5.55*
Visit to local clinic in Protected Area**	260	1.00	445	1.00	n/a
Visit to clinic outside of Protected Area	260	0.97 ± 0.16	445	1.00 ± 0.05	*t* (285)= -2.39*
Medical access index	**257**	**0.76 ± 0.22**	**445**	**0.76 ± 0.19**	***t* (482)= 0.36**
Newspaper	260	0.00 ± 0.06	445	0.04 ± 0.20	*t* (573) = -3.76*
Radio	260	0.70 ± 0.46	445	0.71 ± 0.45	*t* (703)= -0.52
Television	260	0.78 ± 0.41	445	0.87 ± 0.34	*t* (466)= -2.66*
Internet	260	0.28 ± 0.45	445	0.18 ± 0.39	*t* (477)= 3.06*
Media access index	**260**	**0.44 ± 0.23**	**445**	**0.45 ± 0.19**	***t* (467)= -0.53**
Human assets index	**257**	**0.60 ± 0.19**	**445**	**0.57 ± 0.16**	***t* (466)= 1.88**

* *p* = ≤0.05.Note indices in bold.

Comparisons of the accessibility of traditional and 'Western' medicines for residents from both PAs show that access to the former is significantly higher in ACA, while access to the latter is significantly higher in SNP (Table 6.2). Adult literacy may also be a factor in explaining this differential, despite provision of healthcare in ACA by the NTNC (Bhuju et al., 2007), a service welcomed by several interviewees.[12] Clinics were accessible within the boundaries of both PAs but the greater access to clinics outside of the PA by ACA residents is most likely due to greater vehicular access.[13] However, the medical access index scores are not significantly different between the two sites. Considered overall, the greater community investment in ACA may be balanced by greater philanthropic investment in SNP, particularly mountaineering-related, and especially in health and education (McDowell et al., 2013; Rasley, 2010; Trunzo-Lute, 2012).

12 Community leader, ACA; Conservation leader x2, ACA;
13 Community leader, ACA.

Logistics also play a role in accessing media sources at both sites.[14] Newspapers require greater vehicular access for delivery, and are significantly more accessible in ACA than in SNP (Table 6.2). ACA also has significantly higher levels of access to television, while SNP has significantly higher levels of internet access. Access to radio in both PAs is roughly the same, as are the overall media access index scores. Governance approaches do not appear to have any significant bearing on household access to media sources. Overall, however, while a decentralised approach might be expected to provide greater access to education and healthcare, the lack of a significant overall difference in human assets between ACA and SNP may be due to other sources of investment in the latter. In particular, this might include those related to mountaineering-related philanthropy and ODA, thereby offsetting the community-NGO spending in ACA.

6.2.2 Natural assets

The ownership of forests mostly lies with the community...everything' s shared.

Health worker, ACA

In ACA, 85.8% of households keep livestock, while 62.7% do in SNP. ACA also supported more animals per household than SNP overall, and for cattle, sheep/goats, equines and other livestock (Table 6.3 and Figure 6.2). Therefore, ACA also scores significantly higher on the livestock access index. Mean livestock per household of 21.4 here is similar to a figure of 26.6 reported from Manang (Oli et al., 1994) and of 18.1 reported from Upper Mustang (Aryal et al., 2014). The only category in which there is general parity between the two PAs is in the ownership of yaks and yak hybrids.

14 As mentioned in the previous chapter, mobile phones are not included in the media index for several reasons. Firstly, it is about access to types of media and not types of communication device, and mobile phones do not represent a media type in and of themselves. Rather, they are a communication medium through which various media types can be accessed. Secondly, mobile phone ownership and usage is increasingly ubiquitous and the inclusion of the variables would therefore have been unlikely to alter the index results.

Table 6.3 Mean household livestock in SNP and ACA.

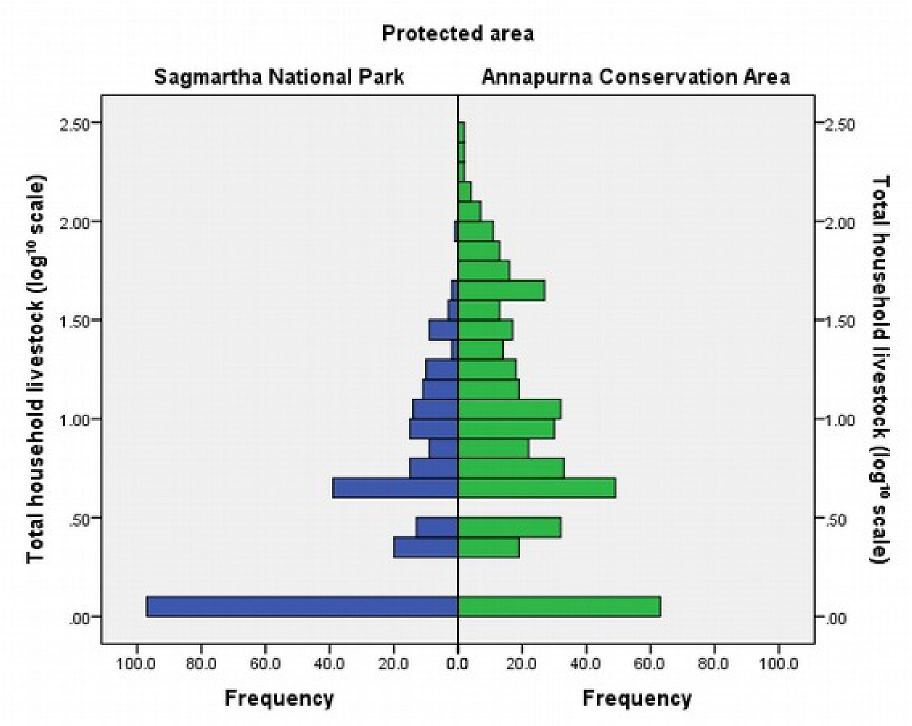
Indicator	SNP				ACA				Difference
	N = 260				N = 445				
	Med.	**Max.**	**Sum**	**Mean ± SD**	**Med.**	**Max.**	**Sum**	**Mean ± SD**	
Cattle	0	40	242	0.92 ±2.99	2	14	1090	2.45 ±2.30	*t* (442) = -7.12*
Sheep/goats	0	4	4	0.02 ±0.25	0	250	5388	12.11 ±31.35	*t* (444)= -8.14*
Equines	0	3	16	0.06 ±0.35	0	13	496	1.11 ±1.77	*t* (501)= -12.19*
Yaks/yak hybrids	0	45	1147	4.41 ±7.85	0	110	2249	5.05 ±13.98	*t* (702)= -0.78
Other	0	1	4	0.02 ±0.12	0	66	326	0.73 ±3.85	*t* (446)= -3.93*
Total	2.5	80	1413	5.43 ±9.04	7	312	9549	21.35 ±36.56	*t* (532)= -8.74*
Livestock access index	**---**	**---**	**---**	**0.17 ±0.15**	**---**	**---**	**---**	**0.43 ±0.26**	***t* (703) = -16.73***

* p = ≤0.05. Note index in bold. Note also that livestock access index equals household ownership or absence of each of the five preceding livestock classes, with a minimum score of 0.00, a maximum score of 1.00 and intervals of 0.20.

Various factors may explain these data. Sheep and goats have gradually been eliminated from SNP to reduce deforestation (Bhuju et al., 2007). This may have only been possible under a centralised conservation governance model, where the PA authorities have the power necessary to dictate overall policy objectives. Equines, principally used for transport, have long been associated with the trading routes that pass through ACA to and from Tibet (Wright, 2015). Yaks and yak hybrids may be equally present at both sites due to their cultural significance.[15]

15 Teacher, ACA; Conservation leader, ACA.

Figure 6.2 Total household livestock (log10 scale) in SNP and ACA.



There are also contrasting trends in livestock production in SNP and ACA (Table 6.4). More livestock farmers engaged in semi-commercial or commercial production in SNP, despite the livestock extension programme of the NTNC in ACA (Bhuju et al., 2007), including the introduction of higher-yielding Jersey cross cows.[16] Several interviewees commented that the greater commercialisation seen in SNP may be a by-product of the transportation for the tourism industry,[17]. By contrast, in ACA a number, or combination, of reasons reported might explain a decreasing trend in livestock production. However, access to grazing land did not differ significantly between the two PAs.

16 Youth leader, ACA.
17 Conservation leader x 2, SNP;

Table 6.4 Trends in livestock production for SNP and ACA based on triangulation interviews.

Aspect of livestock production		SNP		ACA	
		N = 26		N = 44	
		N	**%**	**N**	**%**
Sale of surplus and/or commercial production		19	73.1	20	45.5
Decreasing production		7	10.0	11	25.0
Reasons for decrease	No reason	0	0.0	3	27.3
	Tourism	7	100.0	3	27.3
	Migration	0	0.0	2	18.2
	Motorised transport	0	0.0	2	18.2
	Increased predation	0	0.0	1	9.0

The comparison of access to agricultural land showed that it was more widespread in ACA than in SNP (Table 6.6), perhaps due to the larger land area of ACA. In keeping with this result, surplus crops were sold more often in ACA than in SNP (Table 6.6), a factor that triangulation of interview data corroborated (Table 6.5). However, fewer respondents than for livestock production felt that agricultural production was decreasing and the range of reasons provided for this trend was broadly similar at both sites, although none mentioned switching to cash crops in SNP. The role of the NTNC in providing an agricultural extension service in ACA (Aase et al., 2013), including the development of social capital, as well easier market access via roads, may explain why agriculture is more commercialised in ACA than in SNP.

Table 6.5 Crop production characteristics in SNP, ACA and combined based on triangulation interviews.

Aspect of crop production		SNP		ACA	
		N = 26		N = 44	
		N	**%**	**N**	**%**
Sale of surplus and/or commercial production		18	69.2	33	75.0
Decreasing production		3	11.5	4	9.1
Reasons for decrease	No reason	1	33.3	1	25.0
	Tourism	1	33.3	1	25.0
	Cheaper imports	1	33.4	1	25.0
	Switch to cash crops	0	0.0	1	25.0

Various natural products were readily available to households in both ACA and SNP (Table 6.6). Fuelwood and fodder were equally accessible between the sites. Construction wood and human food, however, were more available in SNP, while access to medicinal plants was more common in ACA. The latter may be explained by the greater number of ecosystem and vegetation types in ACA (see Bhuju et al., 2007), while the former is unexpected given the smaller degree of governance decentralisation in SNP, and hence the reduced ease of access to natural resources (Budhathoki, 2004).

Table 6.6 Mean household natural assets access and indices in SNP and ACA.

	N	SNP ± SD	N	ACA ± SD	Difference
Grazing land (index)	**260**	**0.87 ± 0.33**	**445**	**0.82 ± 0.38**	***t* (603) = 1.84**
Sale of surplus crops	231	0.43 ± 0.50	430	0.63 ± 0.48	*t* (460)= -5.09*
Cultivating land (index)	**260**	**0.89 ± 0.32**	**445**	**0.96 ± 0.19**	***t* (367) = -3.52***
Fuelwood	260	1.00 ± 0.06	445	0.98 ± 0.13	*t* (688) = 1.69
Construction wood	260	0.95 ± 0.22	445	0.90 ± 0.30	*t* (666) = 2.39*
Human food	259	0.98 ± 0.12	445	0.93 ± 0.25	*t* (686) = 3.67*
Animal food	254	0.96 ± 0.19	445	0.95 ± 0.21	*t* (697) = 0.74
Medicinal plants	225	0.69 ± 0.46	445	0.84 ± 0.36	*t* (435) = -.4.52*
Natural products access index	**254**	**0.92 ± 0.15**	**445**	**0.92 ± 0.17**	***t* (697) = -0.40**
Spring	260	0.23 ± 0.42	445	0.29 ± 0.46	*t* (578) = -1.93
Well	260	0.01 ± 0.11	445	0.00 ± 0.00	*t* (259) = 1.74
Handpump	260	0.01 ± 0.09	445	0.00 ± 0.00	*t* (259) = 1.42
Outside tap	260	0.97 ± 0.17	445	1.00 ± 0.05	*t* (282) = -2.60*
Inside tap	260	0.37 ± 0.48	445	0.48 ± 0.50	*t* (558) = -2.97*
Water access index	**260**	**0.32 ± 0.13**	**445**	**0.35 ± 0.10**	***t* (442) = -3.97***
Natural assets index	**254**	**0.64 ± 0.14**	**445**	**0.70 ± 0.13**	***t* (697) = -5.91***

* p = ≤0.05.Note indices in bold.

Sources of water were mostly equally accessible across both PAs, with the exceptions of outside and inside water taps. The greater availability of taps in ACA is probably linked to NTNC community development programmes (Bhuju et al., 2007). As a result the water access index scores were significantly higher in ACA than in SNP, reflecting also the increasing pressure being put on water supplies in SNP by climate-related hydrological changes (McDowell et al., 2013). Overall, the larger area and greater variety of landscapes in ACA may explain why natural assets are more widely available there (Table 6.6). Equally, access to these assets is mediated by a devolved governance regime, including the supportive role of the NTNC, which is more tailored to participatory and sustainable use in ACA than in SNP.

6.2.3 Social assets

WWF [World Wildlife Fund] had established the eco club but now the club is being managed by the buffer zone management...the buffer zone management is more involved with conservation activities in the park.

Teacher, SNP

Household membership of various types of organisations showed that ACA scored slightly higher on this index. However, any differences were small (Table 6.7). This is surprising given the decentralised governance model in ACA, and the investment in co-management and social capital made by the NTNC and local communities (Baral et al., 2007; Baral and Stern, 2011). However, organisational membership is not necessarily synonymous with devolved governance, and despite greater devolution to three buffer zone user committees in SNP from 2002 onwards (Budhathoki, 2004), active control of conservation and development is still not as comprehensively community-based as in ACA.

Table 6.7 Mean household social assets in SNP and ACA.

Indicator	N	SNP ± SD	N	ACA ± SD	Difference
Conservation committee	256	0.15 ± 0.36	445	0.10 ± 0.30	*t* (464) = 1.79
Village development committee	257	0.06 ± 0.24	445	0.04 ± 0.20	*t* (700) = 0.93
Tourism association	257	0.11 ± 0.31	445	0.09 ± 0.29	*t* (700) = 0.72
Microcredit group	257	0.06 ± 0.24	445	0.01 ± 0.09	*t* (302) = 3.38*
Co-operative	257	0.15 ± 0.36	445	0.01 ± 0.11	*t* (282) = 6.01*
Women's group	258	0.28 ± 0.45	445	0.64 ± 0.48	*t* (567) = -10.29*
School association	257	0.06 ± 0.24	445	0.11 ± 0.32	*t* (657) = -2.58*
Youth group	258	0.38 ± 0.49	445	0.41 ± 0.49	*t* (544) = -0.98
Other	257	0.09 ± 0.28	445	0.07 ± 0.26	*t* (700) = 0.66
Organisation access index	**256**	**0.15 ± 0.17**	**445**	**0.17 ± 0.14**	***t* (448) = -1.67**
Local	259	0.94 ± 0.23	445	1.00 ± 0.00	*t* (258) = -3.98*
District	259	0.69 ± 0.47	445	0.64 ± 0.48	*t* (555) = 1.33
National	259	0.12 ± 0.32	445	0.02 ± 0.16	*t* (330) = 4.29*
Political access index	**259**	**0.58 ± 0.25**	**445**	**0.55 ± 0.17**	***t* (410) = 1.65**
Social assets index	**256**	**0.36 ± 0.17**	**445**	**.36 ± .12**	***t* (408) = 0.27**

* $p = \leq 0.05$. Note indices in bold.

Household access to political representation in ACA and SNP shows no difference overall (Table 6.7), although this masks significantly better access to local elected representatives in ACA, and significantly better access to national-level elected representatives in SNP.

Easier local access in ACA may be due to the smaller VDCs in Manang and Mustang districts (Government of Nepal, 2012). Better national access in SNP could be explained by the large number of Sherpa hoteliers living in Kathmandu on a permanent or seasonal basis,[18] or by the direct flights between Solukhumbu district and Kathmandu (Bhuju et al., 2007).

6.2.4 Physical assets

There are bigger problems than snow leopard conservation. The ACA is being ruined by roads and pollution...Soon nobody will come to trek except the Israelis who want everything for free

Youth leader, ACA

Fuel types are more accessible in SNP than in ACA, with the exception of fuelwood and cylinder gas (Table 6.8).[19] Even though the NTNC has organised alternative energy and energy efficiency programmes in ACA (Nepal, 2008), SNP has benefited from significant investment in numerous micro-hydro schemes.[20] As with medical and educational spending, this may be largely funded by mountaineering-related philanthropy and development assistance, such as via the Swiss and New Zealand governments (McDowell et al., 2013; Rasley, 2010; Trunzo-Lute, 2012).

Access to buildings also differs across SNP and ACA (Table 6.8). While households in ACA have significantly more access to residential buildings, households in SNP have significantly more access to joint tourist/residential buildings. This would seem to support suggestions that residents in SNP are more involved in the tourism industry than in ACA (Bajracharya et al., 2006; Bhuju et al., 2007), despite significant NTNC-supported development of tourism activities in the latter. However, overall access to buildings of all types, represented by the buildings access index, is equal across the two sites.

18 Park officer, SNP.

19 As noted in the previous chapter, fuelwood has been double-counted, once in the access to natural products index and once in the fuel access index. However, given that in both cases access to fuelwood is nearly universal, its inclusion in the Sustainable Livelihoods Index is unlikely to have altered the statistical analysis.

20 Park officer, SNP.

Table 6.8 Mean physical assets access in SNP and ACA.

Indicator	N	SNP ± SD	N	ACA ± SD	Difference
Fuelwood	260	0.94 ± 0.24	445	0.98 ± 0.14	*t* (365) = -2.53*
Cylinder gas	260	0.40 ± 0.49	445	0.74 ± 0.44	*t* (496) = -9.02*
Kerosene oil	260	0.58 ± 0.49	445	0.25 ± 0.44	*t* (489) = 8.84*
Electricity	260	0.95 ± 0.23	445	0.70 ± 0.46	*t* (686) = 9.62*
Animal dung	260	0.90 ± 0.31	445	0.42 ± 0.50	*t* (701) = 15.63*
Other	260	0.08 ± 0.27	445	0.03 ± 0.16	*t* (373) = 2.74*
Fuel access index	**260**	**0.64 ± 0.15**	**445**	**0.52 ± 0.17**	***t* (703) = 9.38***
Residential building	260	0.62 ± 0.49	445	0.85 ± 0.36	*t* (423) = -.6.75*
Joint tourist/residential building	260	0.35 ± 0.48	445	0.17 ± 0.38	*t* (447)= 5.18*
Tourist building	260	0.02 ± 0.15	445	0.01 ± 0.12	*t* (703)= 0.95
Other	260	0.12 ± 0.33	445	0.07 ± 0.26	*t* (451)= 2.05*
Building access index	**260**	**0.28 ± 0.08**	**445**	**0.28 ± 0.08**	***t* (703)= 0.14**
Foot	260	1.00 ± 0.00	445	0.99 ± 0.08	*t* (444) = 1.74
Animal	260	0.53 ± 0.50	445	0.44 ± 0.50	*t* (703) = 2.54*
Bicycle	260	0.00 ± 0.0	445	0.01 ± 0.12	*t* (444) = -2.46*
Bus/taxi	260	0.04 ±0.19	445	0.78 ± 0.41	*t* (676) = -32.59*
Aeroplane	260	0.89 ±0.31	445	0.28 ± 0.45	*t* (684) = 21.27*
Motorcycle	260	0.01 ± 0.09	445	0.33 ± 0.47	*t* (495) = -13.90*
Other	260	0.07 ± 0.26	445	0.00 ± 0.05	*t* (269) = 4.34*
Transport access index	**260**	**0.36 ± 0.10**	**445**	**0.41 ± 0.15**	***t* (678) = -4.37***
Physical assets index	**260**	**0.43 ± 0.07**	**445**	**0.40 ± 0.08**	***t* (619) = 4.47***

* *p* = ≤0.05. Note indices in bold.

Thirdly, access to transport is a largely a product of the differing logistical scenarios at each site. SNP is served by a well-established airport in the Solukhumbu district, whereas the airport in ACA was constructed recently (Bhuju et al., 2007). This explains the significantly greater access to transport by aeroplane and other means – including helicopter – in SNP (Table 6.8). As air transport is not routinely used for bulk freight, it also explains the greater use of animals for transport. In contrast, ACA has roads into both Manang and Mustang districts, with the former still under construction (Bhuju et al., 2007). This explains the greater access to bus/taxi and motorcycle transport in ACA, and also contributes to significantly higher transport access index scores here (Table 6.8). However, when all three physical assets indices are aggregated, SNP has better access overall to physical assets, but this is largely a product of factors other than governance, such as infrastructure.

6.2.5 Financial assets

People with hotels and yaks make good money but people dependent on agriculture do not earn much, and most are dependent on agriculture.

Community leader, ACA

Households in SNP and ACA have access to similar financial incomes, and financial assets (Table 6.9). Both sites have similar proportions of households in each income class, except for the ranges of '50,001 – 100,000' and '200,001 – 250,000', where SNP was more strongly represented. Meanwhile 'prefer not to say', was more strongly represented in ACA. Therefore, it appears that SNP has a greater proportion of lower-income households (50.5% vs 46.3%) *and* a higher proportion of higher-income households (21.6% vs 18.6%) than ACA. Concerns about such income inequality in SNP, and its negative side effects, have been raised previously (Daconto and Sherpa, 2010; Nepal, 2000). The significantly higher financial assets index scores in ACA may be attributed, at least in part, to the greater involvement of the community in conservation and development activities, as well as the supporting role of the NTNC (Aase et al., 2013; Bajracharya et al., 2005; Baral and Stern, 2011).

Table 6.9 Mean financial assets index in SNP and ACA

Income in US$	**SNP**			**ACA**			
	Frequency	**%**	**Mean ± SD**	**Frequency**	**%**	**Mean ± SD**	**Difference**
0-500	89	34.2	---	170	38.2	---	---
500-1000	42	16.2	---	36	8.1	---	---
1000-1500	23	8.8	---	40	9.0	---	---
1500-2000	28	10.8	---	41	9.2	---	---
2000-2500	21	8.1	---	21	4.7	---	---
>2500	35	13.5	---	62	13.9	---	---
Financial assets index	**238**	**---**	**0.65 ± 0.33**	**370**	**---**	**0.71 ± 0.31**	***t* (606) = -2.02***
Prefer not to say	22	8.5	---	75	16.9	---	---
Total	260	100.0	---	445	100.0	---	

* *p* = ≤0.05. Note index in bold. Note also that financial assets index (in bold) equals score allocated per household based on income class, with a minimum score of 0.167 for 0-50,000, a maximum score of 1.00 for >250,001, and intervals of 0.167. Those in the income class 'prefer not to say' are excluded from the index.

In terms of household access to financial income from various sources, livestock herding is of equal importance in both PAs, and income from wood is negligible in both (Table 6.10). Cultivation is significantly more important for income in ACA, while income from tourism is significantly more important in SNP, as discussed previously in Section 6.2.4 and echoing the findings of others (Bajracharya et al., 2006; Bhuju et al., 2007). The role of the NTNC in supporting livelihood diversification and innovation in ACA (Aase et al., 2013) may have made households there less dependent on tourism alone. There is also significant variation in the degree to which households access financial income from the five sources in the table.

Table 6.10 Mean household access to types of financial income in SNP and ACA.

Income type	**N**	**SNP ± SD**	**N**	**ACA ± SD**	**Difference**
Livestock	260	0.55 ± 0.50	445	0.57 ± 0.50	t (703) = -0.64
Cultivation	260	0.67 ± 0.47	445	0.92 ± 0.27	t (363) = -7.71*
Wood	260	0.00 ± 0.06	445	0.00 ± 0.05	t (703) = 0.39
Other natural products	260	0.00 ± 0.00	445	0.11 ± 0.32	t (444) = -7.58*
Tourism	260	0.72 ± 0.45	445	0.24 ± 0.43	t (522) = 14.02*
Remittances	260	0.07 ± 0.25	445	0.21 ± 0.41	t (702) = -5.75*
Savings	260	0.12 ± 0.33	445	0.05 ± 0.22	t (393) = 3.22*
Loans	260	0.04 ± 0.19	445	0.00 ± 0.00	t (259) = 3.22*
Other	260	0.18 ± 0.39	445	0.33 ± 0.47	t (626) = -4.50*

* p = ≤0.05

The third dimension of financial income is the relative priority of the various sources between SNP and ACA (Table 6.11). However, a number are not listed due to insufficient importance to household financial income, and hence insufficient sample size for robust computation. The starkest significant differences are in the proportion of those who list cultivation and tourism as their primary income source. In SNP, these are 9% and 63%, respectively, while in ACA it is 63% and 13%, respectively. This is also a trend confirmed by triangulation interviews (see Appendices 12.15.11 and 12.15.12).

Table 6.11 Mean household financial income priorities in SNP and ACA.

	N	SNP ± SD	N	ACA ± SD	Difference
Livestock	260	0.09 ± 0.29	445	0.05 ± 0.23	*t* (450) = 1.67
Cultivation	260	0.09 ± 0.29	445	0.63 ± 0.48	*t* (702) = -18.61*
Tourism	260	0.63 ± 0.48	445	0.13 ± 0.34	*t* (406) = 14.96*
Remittances	260	0.02 ± 0.14	445	0.06 ± 0.23	*t* (703) = -2.67*
Other	260	0.14 ± 0.35	445	0.12 ± 0.32	*t* (703) = 0.98

* p = ≤0.05

6.2.6 Sustainable Livelihoods Index

Incomes are comparatively high compared to other rural areas of Nepal. Fifty percent of the park entrance fees are spent in the local area.

Army officer, SNP

SLI scores are higher for ACA than SNP (Table 6.12). It is not possible to attribute causation to these differences on the basis of governance model alone, as a comparison of livelihoods and wildlife impacts in and around CBC areas in northern Tanzania also noted (Salerno et al., 2015). However, it is likely that the decentralised management model in ACA does contribute to its higher SLI scores. The gap between the two is less than expected, which is likely due to the 2002 policy change which saw the creation of buffer zone user groups in SNP (Budhathoki, 2004), as well as to a heritage of mountaineering-related philanthropy and ODA in the area (Byers, 2005; McDowell et al., 2013; Rasley, 2010; Trunzo-Lute, 2012).

Table 6.12 Mean household sustainable livelihoods indices in SNP and ACA.

Index	**N**	**SNP ± SD**	**N**	**ACA ± SD**	**Difference**
Human assets	257	0.60 ± 0.19	445	0.57 ± 0.16	*t* (466)= 1.88
Natural assets	254	0.64 ± 0.14	445	0.70 ± 0.13	*t* (697) = -5.91*
Social assets	256	0.36 ± 0.17	445	0.36 ± 0.12	*t* (408) = 0.27
Physical assets	260	0.43 ± 0.07	445	0.40 ± 0.08	*t* (619) = 4.47*
Financial assets	238	0.65 ± 0.33	370	0.71 ± 0.31	*t* (606) = -2.02*
Sustainable Livelihoods Index	**238**	**0.53 ± 0.12**	**370**	**0.55 ± 0.10**	***t* (449) = -2.42***

* p = ≤0.05. Sustainable Livelihoods Index equals mean of indices from each of the five asset classes.

However, access to these assets is not the same as access to the increased influence which co-management/decentralisation brings. The role of the NTNC is particularly noteworthy, as part of such an innovation system in ACA that also includes local communities, the Government of Nepal and international agencies and donors (Aase 2013). In addition, access to assets, and undoubtedly access to influence in its various forms also, is lacking more amongst female and lower-caste park residents (Baral et al., 2007). However, an assessment of this was beyond the scope of this study because the household, rather than the individual, was the main unit of analysis in this and most other livelihood studies, because assets are usually owned, controlled or accessed at this level (Schreckenberg et al., 2010). However, Chapters Seven to Nine consider various types of attitude and interaction at the individual level.

6.3 A comparison of factors explaining household livelihoods in SNP and ACA

With the national park, they have given us the right to control the park for local consumption in some ways but we really don't have any authority to make serious decisions.

Conservation leader, SNP

The separate multiple regressions to ascertain the best explanations of household SLI scores showed some notable differences, as well as some similarities, for both SNP and ACA (Tables 6.13 and 6.14). For example, the SNP model has three significant explanatory factors while the ACA model has four. The entry of variables into both models was hierarchical, based on a review of similar studies (Babulo et al., 2008; Block and Webb, 2001; Fasse and Grote, 2013; Parker and Thapa, 2012), while the discussion of these variables begins here with the most significant first.

Income from tourism clearly shows the largest influence on SLI scores for both models. In SNP, its standardised *b* score/contribution to the model is .50, while in ACA it is .45. The greater contribution of tourism to household incomes in SNP than in ACA is unsurprising and consistent with the literature (Bajracharya et al., 2006; Bhuju et al., 2007), as discussed previously (Sections 6.2.4 and 6.2.5). In part, this may be due to the investment of the NTNC, alongside local CAMCs and VDCs, in forms of livelihood creation other than tourism, something that the less centralised SNP lacks (Aase et al., 2013).

Similarly, household size was the second-most important contributor to higher SLI scores at both study sites. In SNP, its standardised *b* score was .20, while in ACA household size contributed .28 to the model. As previously mentioned in Section 5.3.1, a greater number of available family members can equate to a greater number of people engaged in economically-productive activity (Berzborn, 2007), and therefore to more sustainable livelihoods. This has also been noted in assessments of livelihood diversification in Ethiopia (Block and Webb, 2001). The reason that household size is a more significant contributor in ACA than in SNP, may be the same reason that tourism is less important in ACA: namely the difficulties of making investment in other livelihoods options, in the context of a decentralised governance system (Aase et al., 2013).

Table 6.13 Linear model explaining household Sustainable Livelihoods Index scores in Sagarmatha National Park.

R^2 = .367 N = 238	***b***	***SE B***	***Standardised b***	***p***
Constant	.37 (.32, .41)	.019	---	p = .001
Household size	.013 (.007, .019)	.003	.20	p = .001
Savings income*	.068 (.027, .11)	.020	.18	p = .002
Cultivation income*	.021 (-.008, .053)	.015	.081	p = .15
Tourism income*	.12 (.093, .15)	.014	.45	p = .001

Note. * = 0 = no; 1 = yes. Potential predictor variables not included in analysis due to small sample size in 'yes' category: income from wood (n=1); income from loans (n=10); NTFP income (n=0); income from remittances (n=17). Potential predictor variable excluded from regression modelling due to equality of mean: livestock income (t = -0.15, *p* = .88). Cronbach's Alpha not applicable for the Sustainable Livelihoods Index as its is not a scale measuring latent variables but an aggregation of a series of separate indicators. This model had the highest significant R^2 change score (.18, p = <.001) out of the five models tested; variable excluded from final model due to a lower R^2 change score when included in the successive model: other income sources. Some results differ from those in previous tables due to the smaller sample size necessitated by the SLI index (n**=** 608 rather than n = 705).

After tourism and household members, the two models then diverge in their similarities. Livestock, for instance, were found to be a significant contributor to higher SLI scores in ACA but not SNP. Part of this can undoubtedly be explained due to higher mean livestock ownership per household in ACA (Table 6.3 and Figure 6.2), a trend which is itself partly explained by the elimination of sheep and goats from SNP for conservation reasons (Bhuju et al., 2007). An additional factor may be the enhanced access to ACA via roads into both Manang and Mustang districts, something altogether lacking in SNP. However, as frequently mentioned in this chapter, and specifically in relation to livestock herding in Section 6.2.2, livestock extension services have been provided by the NTNC, in partnership with local CAMCs and VDCs (Aase et al., 2013; Bajracharya et al., 2006). In this sense, co-management of this PA may therefore contributed directly to livestock being a significant and important income source for households I ACA.

Access to financial income from various sources was the next-most significant factor in explaining higher SLI scores at both sites. However, the precise nature of this source differed, as income from savings was an important contributor in SNP (standardised *b* = .18), while income from remittances was important in ACA (standardised *b* = .10). Triangulation interviews (see Appendices 12.15.11 and 12.15.12) also appeared to confirm these findings. Remittances were mentioned more frequently as an income source in ACA than in SNP, and savings were mentioned in SNP and not in ACA. Access to financial capital is associated with more sustainable, diverse livelihoods in the literature (Beyene, 2012; Block and Webb, 2001), and in SNP can be partly credited to significantly higher microcredit group membership (see Table 6.7) rather than governance model *per se*.

Table 6.14 Linear model explaining household Sustainable Livelihoods Index scores in Annapurna Conservation Area.

R^2 = .622 N = 370	***b***	***SE B***	***Standardised b***	***p***
Constant	.39 (.35, .44)	.020	---	p = .001
Household size	.013 (.008, .018)	.002	.28	p = .001
Remittance income*	.025 (.003, .048)	.010	.10	p = .019
Livestock income*	.044 (.027, .060)	.009	.21	p = .001
Cultivation income*	.026 (-.011, .060)	.019	.068	p = .16
Tourism income*	.12 (.099, .13)	.010	.50	p = .001

Note. * = 0 = no; 1 = yes. Potential predictor variables not included in analysis due to small sample size in 'yes' category: wood (n=1); loans (n=0); savings (n=22). Potential predictor variable excluded from regression modelling due to equality of mean: other sources of income (t = 0.76, p = .45). Cronbach's Alpha not applicable for the Sustainable Livelihoods Index as its is not a scale measuring latent variables but an aggregation of a series of separate indicators. This model had the highest significant R^2 change score (.24, p = <.001) out of the six models tested; variable excluded from final model due to lower R^2 change score when included in the successive model: NTFP income. Some results differ from those in previous tables due to the smaller sample size necessitated by the SLI index (n= 608 rather than n = 705).

Income from cultivation was included in both multiple regression models as a factor that was a significant factor explaining higher SLI scores in univariate tests (see also Appendices 12.15.11 and 12.15.12 for triangulation data from interviews). Yet the effect was not evident in multivariate analyses (Tables 6.13 & 6.14). The standardised effects in the models, although insignificant, were slightly higher in ACA than in SNP, a trend discussed in Section 6.2.2, particularly Table 6.5. As with livestock, this is probably due to agricultural extension services provided by the NTNC as part of the co-management model in ACA (Aase et al., 2013), as well as to greater vehicular access (Bhuju et al., 2007) and higher levels of semi-commercial or commercial production.[21] The relative non-significance of income from cultivation in the multivariate model may be due to higher levels of financial income from other sources, suggesting a less commercial approach to cultivation than triangulation interviews suggest.

Finally, various additional income sources listed in Table 6.10 were absent from both models, including wood, loans, NTFPs and other. As Table 6.6. shows, access to the resource does not necessarily equate to access to financial income from it. This is particularly the case with natural products, such as wood, NTFPs and MAPs, which, although comprising a disproportionate share of poor household’s income (Angelsen et al., 2014; DeClerck, 2006; Larsen and Smith, 2004; Roe et al., 2013; Samal et al., 2003), do not necessarily do so in a financial manner. That these explanatory factors were not present in either the ACA multiple regression model, nor in the SNP regression model, suggests that the more centralised governance approach in the SNP is not restricting natural product usage more than the more decentralised regime in ACA. The national buffer zone and participation reforms of 2002, which particularly affected SNP (Budhathoki,

21 Park officer, ACA; Teacher, ACA; Health worker, ACA.

2004; Daconto and Sherpa, 2010; see also Sections 3.2.2. and 3.3.2), may explain the overall similarity between the two sites.

6.4 Summary and conclusions

This chapter has compared access to human, natural, social, physical and financial assets between SNP and ACA and considered the extent to which their contrasting governance models explained any significant differences. It also considered the variation between separate multiple regression models explaining SLI scores in both PAs. In summary, the two sites showed considerable variation in results on a case-by-case basis, albeit with more sustainable livelihoods in ACA overall. Regression modelling also seemed to confirm more diverse, and less tourism-dependent livelihoods, in ACA too.

Although my research aim suggests that a more decentralised management approach would contribute to just such an outcome, it is impossible to ascribe this to the governance model alone. However, qualitative and quantitative data from triangulation interviews lend weight to the idea that the co-management system in ACA, and particularly the coordinating role of the NTNC, has had a positive impact on livelihoods. Despite outliers, exceptions and a greater degree of devolution in SNP since 2002, this would seem to broadly confirm Ribot and Peluso's (2003) theory of access, that access to influence does indeed shape access to assets. Chapter Seven will now consider how access to both of these phenomenon shape attitudes to and knowledge of snow leopards and their conservation.

Chapter 7: Attitudes and knowledge

7.1 Introduction

The previous chapter compared and contrasted the livelihood systems in SNP and ACA, and attempted to establish the contribution of the governance model to any observed differences between these systems. This chapter aims to understand peoples' perceptions towards snow leopards: their knowledge of, and attitudes towards, the species; and their attitudes to its conservation. The chapter also relates the livelihoods data of Chapter Five and the site comparison data of Chapter Six to assess how access to assets and access to influence shape human-snow leopard coexistence in the two study sites. The descriptive and inferential results are considered in turn, first for knowledge, then for attitudes towards snow leopards and finally for attitudes to snow leopard conservation. Overall, the chapter seeks to answer the following research question: what are individuals' knowledge of snow leopards, attitudes to snow leopards and attitudes to snow leopard conservation, and which factors best explain these?

7.2 Respondent attributes

Younger people have more perception of, and support for, the species as they know that it's rare. The older generation have more religious and cultural reasons for their attitudes – they perceive it as a religious deity.

Teacher, SNP

Numerous factors shape knowledge of, and attitudes towards, wildlife and its conservation. Among them are various demographic variables, the most relevant of which are listed and discussed in this section, based on their inclusion in the studies listed in Table 2.1 in Chapter Two. In addition, variables at the household level, presented in Chapter Five, are also used later in the chapter as explanatory variables of knowledge and attitudes. This is due to factors beyond the individual-level having an impact on individuals' perceptions and understanding (Kansky and Knight, 2014; Suryawanshi et al., 2014). In the rest of this section I focus on discussing the various attributes in the context of data from the 2011 Nepal-wide census, as well comparing the results from the two study sites.

Table 7.1 Respondent age and education results.

Indicator	Combined N = 705			SNP N = 260			ACA N = 445			Diff.
	Mean ± SD	**Min.**	**Max.**	**Mean ± SD**	**Min.**	**Max.**	**Mean ± SD**	**Min.**	**Max.**	
Age	42.66 ± 15.29	16	86	41.28 ± 16.12	16	86	43.47 ± 14.74	16	83	t (703) = -1.83
Years of education	3.88 ± 4.51	0	18	4.08 ± 4.39	0	15	3.76 ± 4.58	0	18	t (703) = 0.90

* p = ≤0.05

Different recording categories make it difficult to undertake a like-for-like comparison with the 2011 Nepal census data. Its median age results, for example, include children as aged 0 – 14, rather than including them as adults aged from 16 years and older, as in this survey. The majority (59.8%) of the study population was aged 15 – 64 years, while only 5.3% is aged 65-years and over (Government of Nepal, 2012). Of these, a population pyramid demonstrates that as groups increase in age, in increments of five years, they decrease in number. Of the two study sites sampled, neither had a significantly older population than the other (Table 7.1).

The number of years of education also did not differ much between the two PAs (Table 7.1). This is in contrast to the results discussed in Section 6.2.1, where SNP was shown to have a significantly higher adult literacy rate than ACA, suggesting that education in the SNP may be more effective, or longer and better established, than in ACA. The combined mean of 3.88 years of education is consistent with 2011 census data, which shows that the most common level of educational attainment is primary, representing 36.4% of adults (Government of Nepal, 2012).

Table 7.2 Respondent gender and nativity results.

Indicator		Combined Frequencies		SNP Frequencies		ACA Frequencies		Difference
Gender	**Male %**	367	52.1	148	56.9	219	49.2	---
	Female %	338	47.9	112	43.1	226	50.8	---
	Total %	705	100.0	260	100.0	445	100.0	---
	Mean ± SD **	705	.48 ± .50	260	.43 ± .50	445	.51 ± .50	t (546) = -1.98*
Nativity	**Non-local %**	75	10.6	43	16.5	32	7.2	---
	Local %	630	89.4	217	83.6	413	92.8	---
	Total %	705	100.0	260	100.0	445	100.0	---
	Mean ± SD ***	705	.89 ± .31	260	.83 ± .37	445	.93 ± .26	t (407) = -3.58*

* p = ≤0.05. ** male = 0, female = 1. *** non-local = 0, local = 1.

More men than women completed the survey, which is surprising given the slightly greater number of women than men in the Nepalese population (Government of Nepal, 2012). This finding may be explained because women are generally less willing or able to talk to researchers, despite including one male and one female research assistant in my research team. Nevertheless, my finding is consistent with research conducted in other socially conservative mountainous areas (Steimann, 2005). Mean data shows that the respondent sample was significantly more male in SNP than in ACA (Table 7.2).

In terms of nativity, or whether respondents were native to the area or not, the sample was less local in SNP than in ACA (Table 7.2). This supports a claim that the tourist market in the Everest area is attracting increased attention and investment from foreign and Nepali outsiders, to the detriment of locals (Daconto and Sherpa 2010). A total of 10.6% of respondents were found to originate from outside of the area, which is broadly consistent with 2011 census data, showing that 14.3% of the national population had moved from the district of their birth (Government of Nepal, 2012).

Table 7.3 Respondent religion and religiosity results.

Indicator		Combined Frequencies		SNP Frequencies		ACA Frequencies		Difference
Religion	**None %**	0	0.0	0	0.0	0	0.0	---
	Buddhist %	646	91.6	227	87.3	419	94.2	---
	Bon %	0	0.0	0	0.0	0	0.0	---
	Hindu %	53	7.5	30	11.5	23	5.2	---
	Other %	6	0.9	3	1.2	3	0.6	---
	Total %	705	100.0	260	100.0	445	100.0	---
	Mean ± SD**	705	.08 ± .28	260	.13 ± .33	445	.06 ± .24	*U* = 53888*
Religiosity	**Very religious %**	417	59.1	132	50.8	285	64.0	---
	Quite religious %	263	37.3	120	46.2	143	32.1	---
	Neutral %	20	2.8	7	2.7	13	2.9	---
	Not very religious %	5	0.7	1	0.4	4	0.9	---
	Not religious at all %	0	0.0	0	0.0	0	0.0	---
	Total %	705	100.0	260	100.0	445	100.0	---
	Mean ± SD***	705	.59 ± .49	260	.51 ± .50	445	.64 ± .48	*t* (524) = -3.45*

* p = ≤0.05. ** Buddhist = 0, other = 1. *** Less than very religious = 0, very religious = 1. Note Religiosity based on Likert scale from 1 = very religious to 5 = not religious at all.

Buddhism is predominant in the Himalayan region of Nepal, including in both SNP and ACA (von Fürer-Haimendorf, 1964; Wright, 2015), even though Hinduism is the most common religion nationally (Government of Nepal, 2012). The sample in SNP was significantly less Buddhist than in ACA (Table 7.3), perhaps due to the influx of Hindu and other outsiders capitalising on the business advantages of the tourist market in SNP. In addition, it is the lower reaches of the ACA, outside of snow leopard territory, that are more Hindu than Buddhist. In terms of religiosity, or the degree of religious conviction, the level shown by the sample is striking, confirming the significance of religion in local culture and life, as measured, for instance, by the ubiquity of prayer flags, stones and walls (von Fürer-Haimendorf, 1964; Wright, 2015). However, religiosity scores in ACA were significantly higher than in SNP and this is probably because a greater proportion of (mainly Buddhist) locals are present in the areas surveyed (Table 7.2).

7.3 Knowledge of snow leopards

Twenty-five years ago people didn't really talk about the snow leopard and its importance, However with the knowledge disseminated regarding the importance of the snow leopard species in the region people are more aware and are positive towards the animal and its existence.

Teacher, SNP

People were better able to recognise snow leopards in ACA than in SNP (Table 7.4), expressed as higher identification scores. This was by positive identification of a snow leopard from the colour plate (see Appendix 12.11), or for positive differentiation between it and the common leopard included in the same colour plate (see Appendix 12.11). This is probably due to the continuous presence of snow leopards at higher densities in ACA (Ale et al., 2014; Aryal et al., 2014), as opposed to the more recent recolonisation of SNP by the species, at relatively low densities, after several decades of absence (Ale et al., 2007; DNPWC, 2013).

Table 7.4 Mean snow leopard identification scores.

	N	Combined ± SD	N	SNP ± SD	N	ACA ± SD	Difference
Positive identification of snow leopard**	705	.53 ± .50	260	.42 ± .49	445	.60 ± .49	t (703) = -4.71*
Positive differentiation between snow and common leopard**	705	.47 ± .50	260	.31 ± .46	445	.56 ± .50	t (574) = -6.91*

* p = ≤0.05. ** No = 0, Yes = 1. Note identification based on colour plate with six mid- and large-sized canid and felid species found in one or both study areas (see Appendix 12.11).

Positive identification of the snow leopard was used as a proxy for knowledge of snow leopards. Regarding the ability to differentiate snow leopards from the common leopard, there is often overlap between the two species, as seen commonly in SNP (Lovari et al., 2013), but this was less substantiated in ACA. Indeed, more people were able to identify the snow leopard, than were able to differentiate between it and the common leopard (see also Table 7.4). This appears to be the first time that identification of snow leopards has been empirically tested in Nepal, and therefore adds valuable data on people's knowledge of the species. A previous study in India had found that 96.6% (N = 381) of respondents were able to correctly identify a snow leopard (Suryawanshi et al., 2014), a much higher figure than those found in either SNP and ACA. This may be explained by the absence of common leopard from the Indian study's field areas (K. Suryawanshi, *pers comm*).

7.4 Explaining knowledge of snow leopards

They are very well aware about snow leopard conservation. We have been doing annual programmes in awareness like documentary shows, project updates to people and encouraging them in conservation.

Park officer, ACA

This section examines the factors that, in combination, best explain knowledge of snow leopards. The first three tables set out the results of logistic regression models explaining the identification of snow leopards by individuals, for a combined sample (Table 7.5), for SNP (Table 7.6) and for ACA (Table 7.7). The inclusion of SLI scores in the model automatically reduced the maximum sample size in each model (see Section 5.2.5 for a more detailed explanation), in turn altering some of the bivariate relationships discussed in Tables 7.8 and 7.9. In addition, a large number of explanatory factors that were significantly associated with snow leopard identification individually, lost this significant relationship in the multivariate models. Variable entry was hierarchical, based on a review of similar studies (Huxham et al., 2006; Keane et al., 2011; Kellert, 1980; Nyhus and Tilson, 2003). The order of discussion for each variable, first in its univariate, and then in its multivariate contexts, is based on its presence and significance in the joint logistic regression model, followed by in the SNP and ACA models.

Table 7.5 Logistic regression model explaining snow leopard identification.

$R^2 = .183$	*b*	95% CI for Odds Ratio			*p*
N = 585		**Lower**	**Odds**	**Upper**	
Constant	-4.00 [-6.07, -2.02]	---	---	---	p = .001
Gender**	-1.52 [-1.92, -1.22]	0.15	0.22	0.32	p = .001
Sustainable Livelihoods Index	0.95 [-0.97, 2.70]	0.44	2.57	15.15	p = .29
Number of household livestock (log^{10} scale)	0.26 [-0.11, 0.68]	0.90	1.30	1.86	p = .16
Native*	0.30 [-0.53, 1.13]	0.67	1.35	2.69	p = .39
Religion***	-0.17 [-1.03, 0.63]	0.39	0.85	1.82	p = .71
Religiosity*****	0.38 [-0.011, 0.82]	0.98	1.46	2.16	p = .069
Study site*******	0.82 [0.36, 1.28]	1.52	2.28	3.41	p = .001
Attitudes to snow leopards	0.001 [-0.22, 0.21]	0.80	1.00	1.25	p = .99
Attitudes to snow leopard conservation	0.79 [0.24, 1.37]	1.28	2.20	3.80	p = .005

Note. * 0 = no; 1 = yes. ** 0 = male; 1 = female. *** 0 = other; 1 = Buddhist. **** 0 = less than very religious; 1 = very religious. ***** 0 = SNP; 1 = ACA. Potential predictor variables excluded from regression modelling due to equality of mean: age ($t = -1.79$, $p = .075$). Potential predictor variables excluded from regression modelling due to violating the assumption of the linearity of the logit: number of years of education ($p = .049$); number of household livestock lost to snow leopards (log^{10} scale) ($p = .012$). Cronbach's Alpha of the snow leopard conservation attitudinal scale is 0.664 and of the snow leopard attitudinal scale is 0.878. This model ($x^2 = 7.97$, p = <.005) had the highest significant R^2 change scores (Cox & Snell = .19; Nagelkerke = .26) out of the nine models tested.

Table 7.6 Logistic regression model explaining snow leopard identification in SNP.

$R^2 = .088$	*b*	95% CI for Odds Ratio			*p*
N = 260		**Lower**	**Odds**	**Upper**	
Constant	0.19	---	---	---	p = .25
Gender*	-1.29	0.16	0.28	0.47	p = .001

Note. * 0 = male; 1 = female. Potential predictor variables excluded from regression modelling due to equality of mean: number of years of education (t = -1.61, *p* = .11); age (t = -1.48, *p* = .14); Sustainable Livelihoods Index (t = -1.82, *p* = .071); number of household livestock lost to snow leopards (log^{10} scale) (t = -1.79, *p* = .075); total household livestock (log^{10} scale) (t = -1.75, *p* = .081); nativity (t = -1.36, *p* = .17); religion (t = 1.45, *p* = .15); religiosity (t = 0.34, *p* = .74); attitudes to snow leopards (t = -1.45, *p* = .15). This model (x^2 = 23.81, p = <.001) had the highest significant R^2 change scores (Cox & Snell = .088; Nagelkerke = .12) out of the two models tested; variable excluded due to lower significant R^2 change score in the successive model: attitudes to snow leopard conservation.

Table 7.7 Logistic regression model explaining snow leopard identification in ACA.

R^2 = .219	***b***	**95% CI for Odds Ratio**			***p***
N = 347		**Lower**	**Odds**	**Upper**	
Constant	-4.37 [-7.08, -2.22]	---	---	---	p = .003
Gender*	-1.99 [-2.56, -1.57]	0.080	0.14	0.24	p = .001
Number of years of education	0.054 [-0.14, 0.13]	0.99	1.06	1.13	p = .14
Household Sustainable Livelihoods Index	1.04 [-1.79, 3.85]	0.20	2.84	40.00	p = .48
Number of household livestock (log^{10} scale)	0.15 [-0.35, 0.69]	0.73	1.16	1.83	p = .56
Religiosity**	0.92 [0.21, 1.72]	1.38	2.51	4.56	p = .007
Attitudes to snow leopards	-0.066 [-0.42, 0.25]	0.70	0.94	1.26	p = .68
Attitudes to snow leopard conservation	1.16 [0.38, 2.11]	1.48	3.20	6.90	p = .003

Note. * 0 = male; 1 = female. ** 0 = less than very religious; 1 = very religious. Potential predictor variables excluded from regression modelling due to equality of mean: age (t = -0.70, *p* = .48); religion (t = 1.41, *p* = .16); nativity (t = -1.15, *p* = .25). Potential predictor variables excluded from regression modelling due to violating the assumption of the linearity of the logit: number of household livestock lost to snow leopards (log^{10} scale) (*p* = .048). Cronbach's Alpha of the snow leopard conservation attitudinal scale is 0.664 and of the snow leopard attitudinal scale is 0.878. This model (x^2 = 9.50, p = <.005) had the highest significant R^2 change scores (Cox & Snell = .23; Nagelkerke = .31) out of the seven models tested.

7.4.1 Gender

Numerous studies have cited gender as an important factor explaining wildlife knowledge (Huxham et al., 2006; Kellert, 1980; Nyhus and Tilson, 2003), with men typically having greater knowledge than women. The results from this study appear to corroborate these previous findings on a univariate basis: men were significantly more accurate at identifying snow leopards than women (Table 7.8). This may be due to male respondents spending more time outdoors at higher altitudes, increasing the likelihood of sighting a snow leopard. Gender was also the only explanatory variable that was present and significant in all three multivariate models. The results confirm its significance for explaining wildlife knowledge in relation to other socio-demographic factors (Huxham et al., 2006; Kellert, 1980; Nyhus and Tilson, 2003). Its inclusion as the only explanatory factor in the SNP model is consistent with this variable's significance in other regression models from this site, including of attitudes to the proposed blue sheep translocation (see Sections 9.2 and 9.3).

7.4.2 Study site

A study in Madagascar found that that knowledge of wildlife laws was significantly higher amongst members of forest management organisations (Keane et al., 2011), suggesting decentralised management may improve wildlife knowledge. Otherwise, there are limited grounds for connecting wildlife knowledge with study sites and their governance models in other contexts. However, in this study, positive identification of snow leopards was significantly higher among residents of the decentralised ACA rather than the centralised SNP during univariate analysis (Table 7.8). In multivariate analysis, study site was also a significant explanatory factor, with identification rates significantly higher in ACA than SNP (Table 7.5). Nevertheless, it is impossible to prove causality, in terms of the contribution of the study site governance model to this result. While greater participation in conservation management in ACA may indeed expose individuals to snow leopards and their conservation more frequently, the relationship is also likely to be influenced by the absence of the species from SNP for some decades, compared to its continual presence in ACA (Ale et al., 2007, 2014).

Table 7.8 Individual independent t-tests comparing mean snow leopard identification scores for a joint sample.

Variable	Category 0	Mean ± SD	Category 1	Mean ± SD	Difference	*t*	*df*	*p*	Effect size
Gender	Male	.68 ± .47	Female	.37 ± .48	.31 (.24, .38)	8.77	693	.001	.31
Nativity	No	.40 ± .49	Yes	.50 ± .55	-.15 (-.27, -.029)	-2.47	93	.015	-.14
Religion	Buddhist	.55 ± .50	Other	.37 ± .49	.18 (.043, .31)	2.64	70	.010	.18
Religiosity	Less than very religious	.49 ± . 50	Very religious	.57 ± .50	-.080 (-.16, -.005)	-2.09	614	.037	-.08
Study site	Sagarmatha	.42 ± .49	Annapurna	.60 ± .49	-.18 (-.26, -.11)	-4.71	703	.001	-.18

Note that snow leopard identification variable was categorised and scored as No = 0, Yes = 1 enabling means for each predictor category to be calculated.

Table 7.9 Individual logistic regression models explaining snow leopard identification for a joint sample.

Variable	Constant *b*	Constant SE *B*	Constant *p*	Variable *b*	Variable *SE B*	Exp(B)	*Variable p*
Livelihood scores	-1.60	.42	.001	3.17	.76	.20	.001
Livestock owned	-0.32	.13	.011	0.58	.13	1.79	.001
Attitudes to snow leopards	-0.45	.27	.10	0.17	.075	1.18	.024
Attitudes to snow leopard conservation	-3.25	.78	.001	0.85	0.20	2.33	.001
Age	-0.24	.23	.28	0.009	.005	1.01	.075
Years of education	-0.016	.099	.87	0.039	.017	1.04	.021
Livestock killed	0.020	.081	.81	1.52	.41	4.57	.001

7.4.3 Attitudes to snow leopard conservation

Though knowledge of conservation has been linked to support for conservation (Macura et al., 2011), the relationship between knowledge of wildlife and attitudes to wildlife conservation remains largely unexplored in the literature. However, in this instance, positive attitudes towards snow leopard conservation was a significant factor explaining snow leopard identification in univariate analysis (Table 7.9).

In multivariate analysis, attitudes to snow leopard conservation was the only other significant explanatory factor that was present in the combined model (Table 7.5) as well as in the ACA model (Table 7.7). It was positively associated with identification of snow leopards, demonstrating its importance in relation to other explanatory variables. These results confirm a positive relationship between knowledge and attitudes that is also broadly described elsewhere, though the focus to date has been more on wildlife than on wildlife conservation (Barthwal and Mathur, 2012; Kansky and Knight, 2014; Macura et al., 2011; Schumann et al., 2012).

7.4.4 Religiosity

Like religion, religiosity has not usually been assessed for its relationship to wildlife knowledge. However, a study in the USA found that those who rarely or never attended religious services were amongst the more knowledgeable of societal groups about American animals (Kellert, 1980). In this study the reverse was true in univariate analysis: those who were more religious were better at identifying the snow leopard (Table 7.8).

Religiosity was also the final significant explanatory variable in multivariate analysis, though only in the ACA model. Greater religious conviction can have an effect on perceptions of snow leopards that has been noted amongst Buddhist, but not Muslim, communities in north-west India (Bhatia et al., 2016). This may be due, in part, to the frequent presence of snow leopards in Buddhist mythology (Ale et al., 2014; Li et al., 2014).

7.4.5 Livestock owned

Few analyses have focussed on the potential links between livestock ownership and wildlife knowledge. However, one study conducted in the USA found that livestock owners had amongst the least knowledge of a range of animal species among the groups tested

(Kellert, 1980). By contrast, this study showed an opposite effect with increased household livestock correctly explaining improved snow leopard identification rates (Table 7.9). This may be due to increased opportunities for wildlife viewing while herding livestock, as well as heightened awareness regarding potential threats to domestic stock.

In multivariate analysis, the variable was included in the combined and ACA models, but not the SNP model. In both cases, however, it was not significant. In relation to other factors, like gender, the study site and attitudes to snow leopard conservation, livestock herding appears to be less important. As discussed in Chapter Eight, it remains important in explaining livestock losses to snow leopards.

7.4.6 Livelihoods

Types of livelihoods are less commonly examined as potential factors explaining wildlife knowledge, partly because they are frequently measured at the household level, including with the Sustainable Livelihoods framework (Chambers and Conway, 1992; Scoones, 1998). Yet they can still be linked to wildlife knowledge, for example with higher income through employment in tourism (Keane et al., 2011). Similar findings are confirmed in this study at the univariate level, in which higher SLI scores significantly and positively explain snow leopard identification (Table 7.9). However, livelihood scores were not significant in either the joint (Table 7.5) or ACA (Table 7.6) multivariate models in which they were included, with other explanatory variables taking precedence.

7.4.7 Attitudes to snow leopards

Considerable attention has been paid to the positive relationship between wildlife knowledge and attitudes towards wildlife (Barthwal and Mathur, 2012; Kansky and Knight, 2014; Schumann et al., 2012). This positive relationship is confirmed again here in univariate analysis (Table 7.9): more positive attitudes towards the species significantly explained better identification. Several interviewees, at both sites, commented on formal and informal environmental education initiatives that simultaneously improved awareness of, and attitudes towards, snow leopards.[22] Despite its inclusion in the combined (Table 7.5) and ACA (Table 7.7) models, this variable was not found to be significant in the context of multivariate analysis. As Section 7.4.2 has discussed, attitudes to snow leopard

22 Teacher x 2, SNP; Park officer, ACA; Conservation leader, ACA.

conservation, rather than towards the species itself, were more important when all other factors were taken into account.

7.4.8 Nativity

Natives successfully and significantly identified the snow leopard more frequently than non-natives in univariate analysis (Table 7.8). However, the evidence in the literature for this trend occurring elsewhere is mixed. On the one hand, native Sumatrans had better mean wildlife knowledge scores than non-natives, although not significantly so (Nyhus and Tilson, 2003). On the other hand, teachers educated in rural locations in Ladakh, India, had significantly lower knowledge scores of Ladakhi wildlife than those from urban areas and from outside of the state (Barthwal and Mathur, 2012). In multivariate analysis, nativity was included in the joint model, but was not significant (Table 7.5). Its lack of significance in relation to other variables would seem to corroborate its varying importance as an explanatory factor.

7.4.9 Religion

In Asia, several authors have suggested a positive link between religion and knowledge of biodiversity, whether with South Asian religions and sacred groves in India (Anthwal et al., 2010), or with Buddhism and snow leopards in China (Li et al., 2014). However, empirical analyses have been lacking until now (Bhatia et al., 2016). This study provides evidence for such a link, demonstrating that snow leopards were significantly more likely to be positively identified by Buddhists than by those who were not (Table 7.8). Religion was not, however, included in either the ACA or SNP model during multivariate analysis, and was not significant in the combined model (Table 7.5). This adds weight to recent research from India that found religion to be significantly associated with positive attitudes to snow leopards in univariate, but not multivariate, terms (Bhatia et al., 2016).

7.4.10 Education

Education is often positively associated with higher wildlife knowledge scores (Keane et al., 2011; Kellert, 1980; Nyhus and Tilson, 2003). However, the relationship can be negative, as with knowledge of European bison in Lithuania (Balčiauskas and Kazlauskas, 2014). For the combined sample in this study, univariate analysis showed that more years of education significantly explained the positive identification of snow leopards. Multivariate analysis included education in the ACA model only (Table 7.7), but it was not significant. This is surprising but knowledge of snow leopards may not be a major focus of the Nepalese school curriculum. The role of extra-curricular environmental education, such as by NGOs, in raising awareness of the species locally may be more important, as mentioned by several interviewees[23].

7.4.11 Livestock killed

Although not explored in other studies of wildlife knowledge to date (Huxham et al., 2006; Keane et al., 2011; Kellert, 1980; Nyhus and Tilson, 2003), greater numbers of household livestock killed, by snow leopards in this case, significantly explained better snow leopard identification (Table 7.9). As discussed previously, this may also be due to increased time spent outdoors herding livestock and heightened awareness of potential threats to them. The active compensation scheme for livestock losses to snow leopards at both study sites may also result in a financial incentive to positively associate livestock losses with the identification of snow leopards. However, in multivariate analysis, this variable was not present in any of the logistic regression models. As with household livestock owned, it has more relevance in explaining self-reported conflicts with snow leopard conservation, as Chapter Eight discusses.

7.4.12 Age

Age of respondent is a common factor explaining wildlife knowledge. The relationship can either be positive, as found in several studies (Huxham et al., 2006; Nyhus and Tilson, 2003), or more complex. For example, the age groups with the least knowledge of American animals were over 75-year olds and under 25-year olds (Kellert, 1980). In this study, the data revealed a neutral relationship between age and knowledge in univariate analysis, as the age of the respondent was not a significant factor explaining the identification of snow leopards (Table 7.9). In multivariate analysis, age was not included in any of the logistic regression models. This may be explained by older residents' more frequent sightings of snow leopards[24] being offset by improved education amongst the young.

23 Teacher, SNP; Park officer, ACA.
24 Community leader, ACA.

7.5 Attitudes to snow leopards

Snow leopards are a big problem – they have killed many livestock. People are scared to move around after dusk because they might be attacked. They want them captured and translocated. They should be killed – they cause losses and why should we not be allowed to retaliate?

Women's group officer, ACA

Of the combined sample, just over 50% of respondents were positive towards snow leopards on the five-point Likert scale (Table 7.10), a somewhat higher proportion than triangulation interviews suggested (see Appendix 12.15.16). While older studies found more negative attitudes to the species (Bagchi and Mishra, 2006), including in ACA (Oli et al., 1994), more recent studies have found greater levels of positivity (Alexander et al., 2015), a trend confirmed with this sample. However, different methods of measuring attitudes make direct comparisons difficult, in terms of percentages. The most common reason(s) for respondent attitudes to snow leopards were positive, intrinsic motivations (36.7%), while the second-most common reasons(s) were negative ones (21.6%) (Table 7.13). Intrinsic motivations are common for pro-wildlife and environmental stances (De Young, 1996; Pelletier et al., 1998; Richardson and Loomis, 2009). However, a meta-analysis of attitudes to large mammals causing damage to humans found that intangible costs – a form of negative motivation – were the most common factor explaining negative attitudes to the species in question (Kansky and Knight, 2014).

Table 7.10 Respondent attitudes to snow leopards.

	Combined		**SNP**		**ACA**	
	Frequency	**%**	**Frequency**	**%**	**Frequency**	**%**
Very positive	73	10.4	35	13.5	38	8.5
Positive	353	50.1	131	50.4	222	49.9
Neutral	134	19.0	45	17.3	89	20.0
Negative	116	16.5	43	16.5	73	16.4
Very negative	29	4.1	6	2.3	23	5.2
Total	705	100.0	260	100.0	445	100.0

Note. Based on Likert scale from 1 = very positive to 5 = very negative.

Respondents' preferences for the future presence of snow leopards were similar to current attitudes to snow leopards, although with slightly lower levels of neutrality and slightly higher levels of negativity or significant negativity. Positive intrinsic and negative reasons were the two most common reasons for these attitudes (Table 7.13), demonstrating the same mix of motivations as for the current presence of snow leopards. In this case, the levels of positivity found by the triangulation interviews were the same as from the household questionnaire (see Appendix 12.15.16). Attitudes to future presence are not something that snow leopards researchers have considered to date, with one exception from a study in Nepal with a small sample size (N = 17) (Ikeda, 2004). However, other research amongst local communities in Nepal found a link between present and future negativity towards tigers (Carter et al., 2012).

Table 7.11 Respondent preference for future presence of snow leopards.

	Combined		SNP		ACA	
	Frequency	**%**	**Frequency**	**%**	**Frequency**	**%**
Completely agree	116	16.5	47	18.1	69	15.5
Agree	316	44.8	122	46.9	194	43.6
Neutral	107	15.2	33	12.7	74	16.6
Disagree	123	17.4	49	18.8	74	16.6
Completely disagree	43	6.1	9	3.5	34	7.6
Total	705	100.0	260	100.0	445	100.0

Note. Based on Likert scale from 1 = completely agree to 5 = completely disagree.

Mean respondent attitudes to snow leopards, including the snow leopard attitudinal scale also show above-average positive perceptions of the species (Table 7.12). Section 4.5.1.2 of Chapter Four discusses the rationale and validity of this scale in greater detail, illustrated here by the high Cronbach's alpha score of 0.878. Similar multi-variable scales have been used for measuring attitudes to snow leopards (Alexander et al., 2015; Bhatia et al., 2016; Suryawanshi et al., 2014). A combined listing of reasons (see Table 7.13) for these combined attitudes to snow leopards in this study shows that positive intrinsic reasons (37.8%) were the most common, followed by negative reasons (22.5%). As with many wildlife species (Kansky and Knight, 2014; Loomis and White, 1996; Richardson and Loomis, 2009), mixed valuations - positive *and* negative, intrinsic *and* extrinsic – are also apparent for the snow leopard.

Table 7.12 Mean respondent snow leopards attitudes results.

	N	Combined ± SD	N	SNP ± SD	N	ACA ± SD	Difference
Attitudes to snow leopards	705	2.54 ± 1.02	260	2.44 ± 0.99	445	2.60 ± 1.03	t (703) = -2.01
Preference for future presence of snow leopards	705	2.52 ± 1.14	260	2.43 ± 1.09	445	2.57 ± 1.16	t (703) = -1.65
Snow leopards attitudinal scale	705	2.53 ± 1.02	260	2.43 ± 0.97	445	2.59 ± 1.04	t (703) = -1.93
Snow leopards attitudinal scale**	705	3.47 ± 1.02	260	3.57 ± 0.97	445	3.42 ± 1.04	t (703) = 1.93

* p = ≤0.05. ** reverse scored. Scale equals mean of preceding variables. Cronbach's alpha for snow leopard attitudinal scale = 0.878.

There was a degree of contrast between the two study sites in relation to attitudes to snow leopards. Respondents in SNP were slightly more positive and slightly less negative to snow leopards than in ACA (Table 7.10 & Table 7.11). This may be due to the historical absence of the snow leopards from their former range in SNP for some decades (Ale et al., 2007), confirming a trend noted with wolves (Williams et al., 2002, p. 2), where direct exposure to the species resulted in reduced support.

Table 7.13 Reasons for respondent attitudes to snow leopards.

Reason(s) for attitudes to...	**Site**	**N**	**Response (%)**					
			No rea-son	**+ve in-trinsic reason**	**+ve ex-trinsic reason**	**>1 +ve rea-son**	**+ve & -ve rea-sons**	**-ve rea-sons**
Snow leopards	Com-bined	705	11.5	37.6	15.5	9.3	4.4	21.6
	SNP	260	8.1	32.9	19.8	13.2	4.7	21.3
	ACA	444	13.6	40.4	12.9	6.9	4.3	21.8
Future presence of snow leopards	Com-bined	676	12.5	37.9	9.4	8.1	8.7	23.4
	SNP	258	11.2	28.8	15.0	12.3	6.5	26.2
	ACA	418	13.3	37.4	6.1	5.6	9.9	27.7
Combined snow leopards	Com-bined	138 1	12.0	37.8	12.4	8.7	6.6	22.5
	SNP	518	9.6	30.9	17.4	12.8	5.5	23.8
	ACA	862	13.5	38.9	9.5	6.2	7.1	24.8

There was no significant difference, however, between the two sites, whether for current, future or combined attitudes, respectively (Table 7.12). Of note when comparing the reasons for these attitudes (Table 7.13), is the lower intrinsic and higher extrinsic scores in SNP. This may suggest a more instrumental valuation of snow leopards here, possibly linked to the greater dependence on tourism (Bajracharya et al., 2006; Bhuju et al., 2007). The relationships between various explanatory variables and the snow leopard attitudinal scale are now considered in the following section.

7.6 Explaining attitudes to snow leopards

People involved in tourism like the snow leopard but those whose livelihood is fully-dependent on livestock don't like the snow leopard.

Conservation leader, SNP

In this section, multiple regression models are used to explain individuals' attitudes to snow leopards. These include for a combined sample (Table 7.14), for SNP (Table 7.15) and for ACA (Table 7.16). The order of inclusion in the model is hierarchical and based on similar modelling undertaken in other published studies (Alexander et al., 2015; Barthwal and Mathur, 2012; Bhatia et al., 2016; Carter et al., 2014; Romanach et al., 2007; Suryawanshi et al., 2014; Tessema et al., 2010; Zimmermann et al., 2005). The order of discussion here is based on the standardised *b* scores listed in the combined model, with each variable being considered first under univariate analysis and second under multivariate analysis.

Table 7.14 Linear model explaining individual attitudes to snow leopards.

R^2 = .385 N = 608	***b***	***SE B***	***Standardised b***	***p***
Constant	-0.22 (-1.03, 0.64)	.44	---	p = .63
Number of years of education	0.033 (0.015, 0.053)	.009	.15	p = .002
Gender**	– 0.26 (- 0.40, - 0.12)	.075	-.13	p = .001
Household Sustainable Livelihoods Index score	0.64 (-0.002, 1.28)	.34	.070	p = .051
Number of household livestock killed by snow leopards (log^{10} scale)	-0.66 (-1.02, -0.30)	.17	-.15	p = .001
Number of household livestock (log^{10} scale)	-0.29 (-0.43, -0.15)	.070	-.17	p = .001
Age	-0.005 (-0.011, 0.001)	.003	-.078	p = .061
Native to area*	0.005 (-0.28, 0.30)	.14	.002	p = .98
Positive identification of snow leopard*	0.038 -.11 -0.18)	.072	.019	p = .61
Religion***	0.077 (-0.17, 0.36)	.13	.021	p = .54
Religiosity****	-0.006 (-0.17, 0.16)	.077	-.003	p = .93
Attitudes to snow leopard conservation	0.96 (0.76, 1.15)	.096	.38	p = .001

Note. * 0 = no; 1 = yes. ** 0 = male; 1 = female. *** 0 = Buddhist; 1 = other. **** 0 = less than very religious; 1 = very religious. Potential predictor variable excluded from regression modelling due to equality of mean: governance model (t = 1.93, *p* = .055). Cronbach's Alpha of the snow leopard conservation attitudinal scale is 0.664 and of the snow leopard attitudinal scale is 0.878. This model had the highest significant R^2 change score (.15, p = <.001) out of the nine models tested.

Table 7.15 Linear model explaining individual attitudes to snow leopards in SNP.

R^2 = .423 N = 238	***b***	***SE B***	***Standardised b***	***p***
Constant	0.86 (-0.52, 2.29)	.69	---	p = .20
Number of years of education	0.011 (-0.015, 0.037)	.013	.049	p = .42
Gender**	–0.36 (-0.57, -0.14)	.12	-.18	p = .005
Household Sustainable Livelihoods Index score	0.99 (0.12, 1.88)	.47	.12	p = .036
Number of household livestock killed by snow leopards (log^{10} scale)	-0.99 (-1.93, -0.096)	.46	-.12	p = .039
Number of household livestock (log^{10} scale)	-0.46 (-0.71, - 0.22)	.13	-.23	p = .002
Age	-0.007 (- 0.14, 0.01)	.004	-.11	p = .097
Native to the area*	-0.28 (-0.56, 0.004)	.15	-.11	p = .064
Religion***	0.052 (-0.22, 0.33)	.13	.018	p = .67
Religiosity****	-0.038 (0.43, 1.11)	.12	-.019	p = .75
Attitudes to snow leopard conservation	0.78 (0.76, 1.15)	.17	.32	p = .001

Note. * 0 = no; 1 = yes. ** 0 = male; 1 = female. *** 0 = Buddhist; 1 = other. **** 0 = less than very religious; 1 = very religious. Potential predictor variable excluded from regression modelling due to equality of mean: snow leopard identification (t = -1.45, *p* = .15).. Cronbach's Alpha of the snow leopard conservation attitudinal scale is 0.664 and of the snow leopard attitudinal scale is 0.878. This model had the highest significant R^2 change score (.15, p = <.001) out of the nine models tested.

Table 7.16 Linear model explaining individual attitudes to snow leopards in ACA.

R^2 = .383 N = 370	***b***	***SE B***	***Standardised b***	***p***
Constant	-0.70 (-1.86, 0.73)	.64	---	p = .27
Number of years of education	0.047 (0.022, 0.072)	.013	.21	p = .001
Gender**	–0.25 (- 0.45, -0.070)	.097	-.12	p = .008
Household Sustainable Livelihoods Index score	0.65 (0.054, 2.32)	.47	.065	p = .16
Number of household livestock killed by snow leopards (log¹⁰ scale)	-0.64 (- 0.99, -0.30)	.18	-.17	p = .001
Number of household livestock (log¹⁰ scale)	-0.22 (-0.41, -0.041)	.090	-.13	p = .016
Age	-0.003 (-0.10, 0.004)	.004	-.044	p = .44
Positive identification of snow leopard*	0.002 (-0.21, 0.22)	.11	.001	p = .99
Religiosity***	-0.69 (-0.27, 0.14)	.10	-.032	p = .49
Attitudes to snow leopard conservation	1.07 (0.81, 1.31)	.13	.41	p = .001

Note. * 0 = no; 1 = yes. ** 0 = male; 1 = female. *** 0 = less than very religious; 1 = very religious. Potential predictor variables excluded from regression modelling due to equality of mean: nativity (t = 0.13, *p* = .90) Potential predictor variables excluded from regression modelling due to sample size: religion (non-Buddhist = 26). Cronbach's Alpha of the snow leopard conservation attitudinal scale is 0.664 and of the snow leopard attitudinal scale is 0.878. This model had the highest significant R^2 change score (.15, p = <.001) out of the nine models tested.

7.6.1 Attitudes to snow leopard conservation

As univariate analysis shows (Figure 7.1 and Table 7.18), there is a positive and significant relationship between attitudes to snow leopards and attitudes to snow leopard conservation. This appears to be the first time that such a relationship has been considered empirically for snow leopards, and similar analyses are also lacking for other species of large carnivore. A recent study that measured attitudes to leopards in Iran, for instance, did not statistically relate it to their concurrent measure of attitudes to leopard conservation (Babrgir et al., 2017). The empirical relationship shown here suggests that how a species is conserved can affect how it is perceived, and confirms Rosen et al.'s (2012) contention that studying attitudes to snow leopard conservation, as well as attitudes to snow leopards, is important.

The significance of snow leopard conservation continued with multivariate analysis. This is illustrated by the consistently high standardised *b* score for this variable across all three models (Tables 7.14, 7.15 & 7.16), which, in the joint model, was twice the effect of the next most influential variable, number of household livestock. Its importance may be explained by considering snow leopard conservation as a form of influence (Ribot, 2014; Ribot and Peluso, 2003), the relation of people to which mediates their perception of the species itself. This would corroborate recent empirical work on so-called human-wildlife conflict at both fine (Rust et al., 2016) and coarse (Redpath et al., 2015) scales, which found that interactions between social groups and conservation often influence interactions between people and wildlife.

Figure 7.1 Scatterplot showing the relationship between attitudes to snow leopards and attitudes to snow leopard conservation.

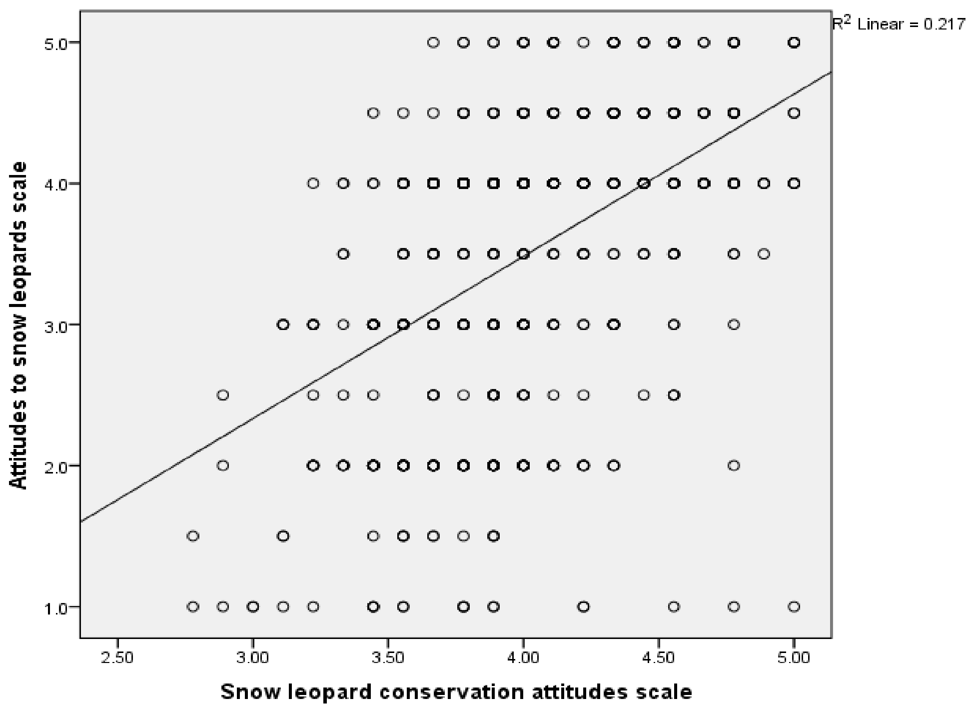


Table 7.17 Individual independent t-tests comparing mean snow leopard attitude scores for a joint sample.

Variable	Category 0	Mean ± SD	Category 1	Mean ± SD	Difference	*t*	*df*	*p*	Effect size
Gender	Male	3.65 ± .051	Female	3.27 ± .059	.38 (.22, .52)	5.004	686	.001	.19
Nativity	Non-native	3.81 ± .11	Native	3.43 ± .04	.38 (.14, .62)	3.38	99	.005	.19
Identification	Unidentified	3.38 ± .053	Identified	3.55 ± .053	-.17 (-.33, -.013)	-2.26	703	.027	-.08
Religion	Buddhist	3.43 ± .04	Other	3.89 ± .10	-.46 (-.65, -.25)	-4.14	77	.002	-.24
Religiosity	Less than very religious	3.64 ± .054	Very religious	3.35 ± .53	.29 (.14, .44)	3.89	669	.001	.14
Protected Area	Sagarmatha	3.57 ± .059	Annapurna	3.42 ± .048	.15 (.006, .30)	1.93	703	.055	.07

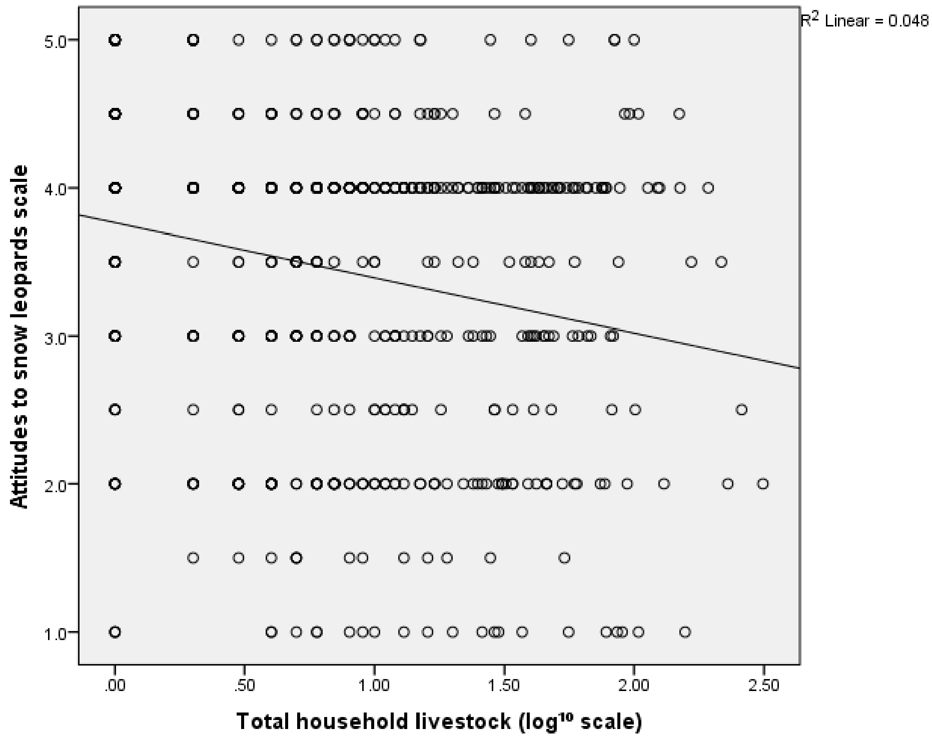
Table 7.18 Individual linear models explaining attitudes to snow leopards for a joint sample.

Variable	Constant *b*	Constant SE *B*	Constant *p*	Variable *b*	Variable *SE B*	Variable *Standardised b*	*Variable p*
Years of education	3.12 (3.03, 3.21)	.049	.001	0.089 (0.074, 0.10)	.007	.40	.001
Livelihood scores	2.37 (1.99, 2.74)	.19	.001	2.03 (1.36, 2.69)	.34.	.22	.001
Livestock owned	3.77 (3.65, 3.88)	.057	.001	-0.37 (-0.50, -0.24)	.063	-.22.	.001
Livestock killed	3.57 (3.49, 3.65)	.040	.001	-1.16 (1.49, -0.86)	.17	.-.25	.001
Age	4.31 (4.11, 4.52)	.097	.001	-0.020 (-0.024, -0.016)	.002	-.30	.001
Attitudes to snow leopard conservation	-1.12 (-1.68, -0.52)	.33	.002	1.15 (0.96, 1.31)	.081	.47	.001

7.6.2 Livestock owned

Attitudes to snow leopards and number of livestock owned per household showed a significant negative relationship in univariate analysis (Figure 7.2 and Table 7.18): those with more livestock were more negative towards the species. It is an example of how a factor beyond the individual scale, in this case at the household level, can still affect individual attitudes (Suryawanshi et al., 2014). It was also a relationship commented on by interviewees.[25] Furthermore, it adds additional weight to the body of knowledge detailing this relationship between wildlife attitudes and livestock ownership (Carter et al., 2014; Tessema et al., 2010; Zimmermann et al., 2005), including with snow leopards (Hussain, 2003; Ikeda, 2004; Suryawanshi et al., 2014). In multivariate analysis, household livestock ownership was an important explanatory factor in all three multiple regression models (Table 7.14, 7.15 & 7.16). The variable had a stronger influence in the model for SNP than in the model for ACA, which may be due to the concentration of livestock ownership among a smaller number of owners in SNP (85.8% of households in ACA keep livestock, while in SNP only 62.7% do).

Figure 7.2 Scatterplot showing the relationship between attitudes to snow leopards and number of livestock owned by household (log¹⁰ scale).

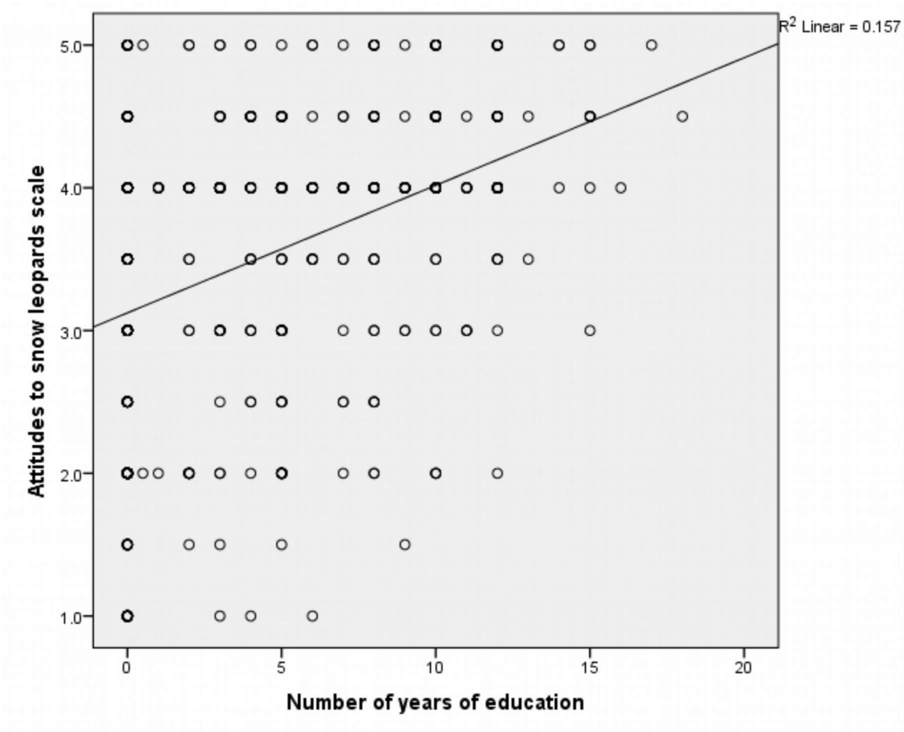


25 Conservation leader, SNP; Herder, SNP.

7.6.3 Education

Education levels are often positively related to attitudes towards wildlife (Carter et al., 2014; Romanach et al., 2007; Tessema et al., 2010; Zimmermann et al., 2005), including with attitudes to snow leopards (Suryawanshi et al., 2014). The results from this study corroborate these findings in univariate terms, providing the first known empirical data on this relationship in Nepal (Figure 7.3 and Table 7.18). Several interviewees also commented on the influence of education, both formal and informal, in shaping attitudes to snow leopards.[26] In multivariate analysis, education was an influential variable in the combined (Table 7.14) and ACA (Table 7.16) models. However, it was not significant in the model for SNP. This result may be explained by the significantly higher adult literacy rate in SNP (see Table 6.2), meaning that additional education has less impact than in ACA.

Figure 7.3 Scatterplot showing the relationship between attitudes to snow leopards and number of years of education.



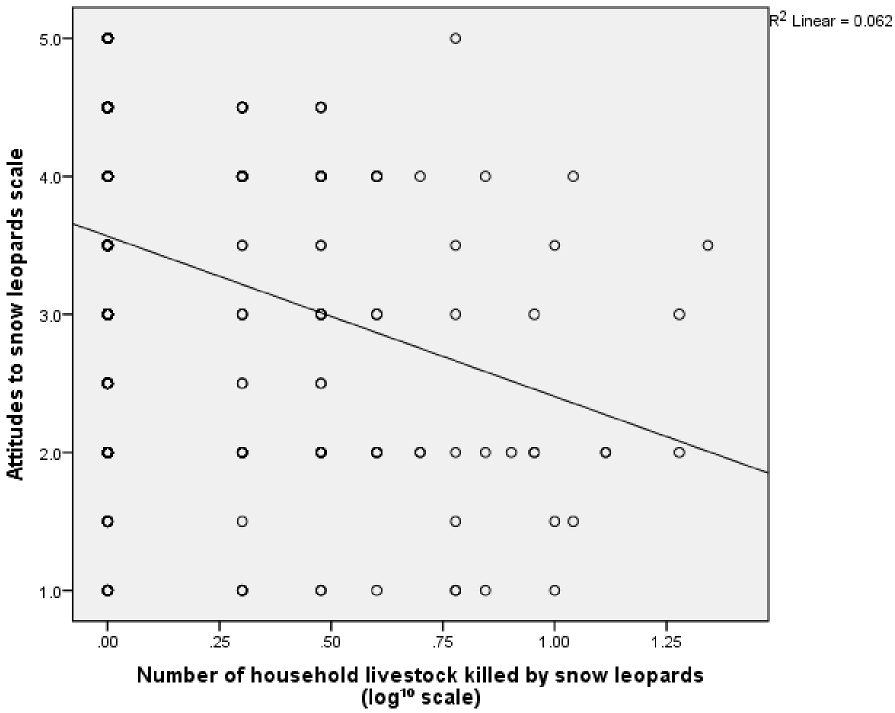
7.6.4 Livestock killed

In univariate analysis, another significant negative relationship was found to exist between attitudes to snow leopards and number of household livestock killed by snow leopards (Figure 7.4 and Table 7.18). Whether real or perceived, such losses have also been found

26 Buddhist monk, SNP; Teacher, SNP; Park officer, ACA.

to affect attitudes to snow leopards in other contexts (Bagchi and Mishra, 2006; Hussain, 2003; Ikeda, 2004; Oli et al., 1994), and with other carnivore species (Hemson et al., 2009). In Iran, conversely, the intensity of cattle predation by leopards did not significantly influence attitudes to leopards (Babrgir et al., 2017). In multivariate analysis, the number of livestock killed by snow leopards was also significant in all three models (Tables 7.14, 7.15 & 7.16), although the variable had a bigger influence in the ACA model than in the SNP model. This difference may be due to the significantly higher levels of livestock losses to snow leopards in ACA (see Table 8.7).

Figure 7.4 Scatterplot showing the relationship between attitudes to snow leopards and the number of household livestock killed by snow leopards (log¹⁰ scale).



7.6.5 Gender

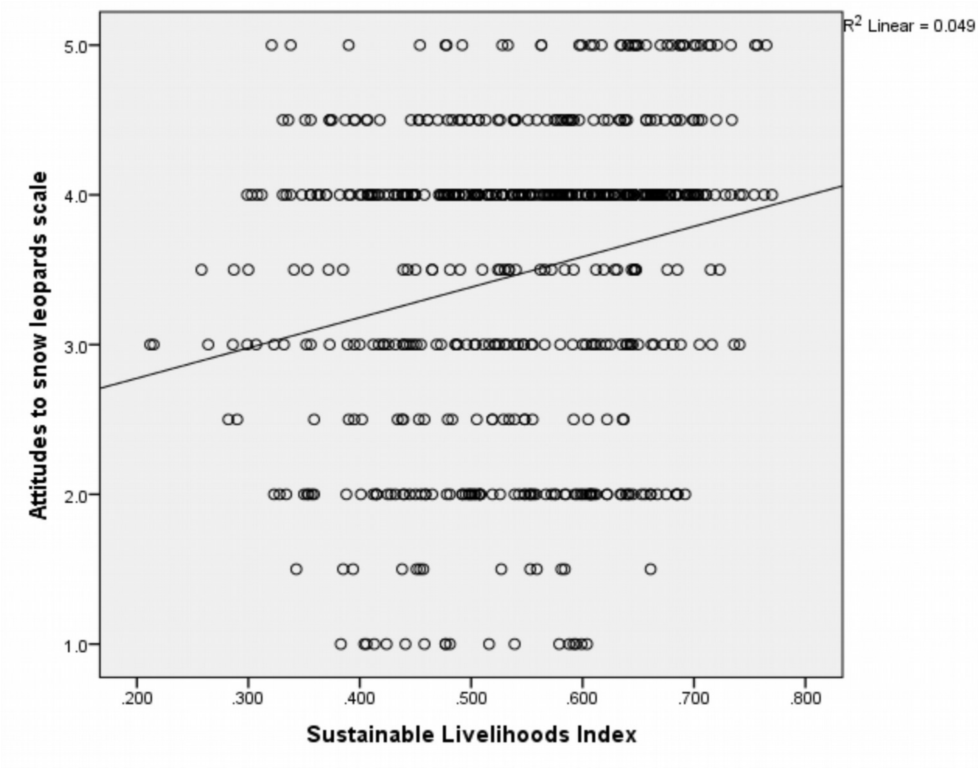
Gender is another variable that is often found to have a significant relationship with wildlife attitudes (Babrgir et al., 2017; Balčiauskas and Kazlauskas, 2014; Carter et al., 2014; Romanach et al., 2007), usually with men being more positive than women. This trend has also been noted with attitudes to snow leopards (Alexander et al., 2015; Bhatia et al., 2016; Suryawanshi, 2013). In this study, gender had a significant influence on attitudes to the species in univariate analysis: women were significantly less positive than men (Table 7.17). With snow leopards, it has been suggested that this may be due to women bearing higher costs associated with impacts from the species (Alexander et al., 2015), a conclusion shared from a separate study examining gender and conservation in India (Ogra, 2008). These have included changes in workload and decreases in food and livelihood security, through, for example, livestock predation. In multivariate analysis, gender was also the last explanatory variable that was consistently significant across all three models. Women were significantly less positive throughout, with the effect being more pronounced in SNP than in ACA, despite a significantly more male sample in SNP (see Table 7.2).

7.6.6 Livelihoods

The role of livelihoods in shaping positive attitudes to wildlife has been less clearly explored or defined than with other variables, such as education or gender. Yet some authors have found links: with income sources other than livestock or agriculture (Romanach et al., 2007; Tessema et al., 2010); with involvement in tourism (Romanach et al., 2007; Zimmermann et al., 2005); occupation (Carter et al., 2014). In all of these studies, livelihoods were a significant factor in explaining attitudes to the species in question. Using green pea production as a proxy for livelihood diversification, livelihoods have also been positively associated with attitudes to snow leopards in India (Suryawanshi et al., 2014). The same is true here, with a significant positive relationship between household SLI scores and attitudes to snow leopards demonstrated in univariate analysis (Figure 7.5 and Table 7.18).

In multivariate analysis, household SLI score was a significant explanatory variable in the SNP model (Table 7.15). By contrast, the relationship was not significant in the ACA (Table 7.16) or in the combined models (Table 7.14). Indeed, the influence of SLI scores on attitudes was less than anticipated, suggesting that it is intangible factors, and livestock-specific factors, that most shape perceptions of the species rangewide, as with other large mammal species (Kansky and Knight, 2014). Nevertheless, the relationship corroborates the findings of a diversification-positivity link between livelihoods and snow leopards found elsewhere (Bagchi and Mishra, 2006; Suryawanshi et al., 2014).

Figure 7.5 Scatterplot showing the relationship between attitudes to snow leopards and Sustainable Livelihoods Index scores.

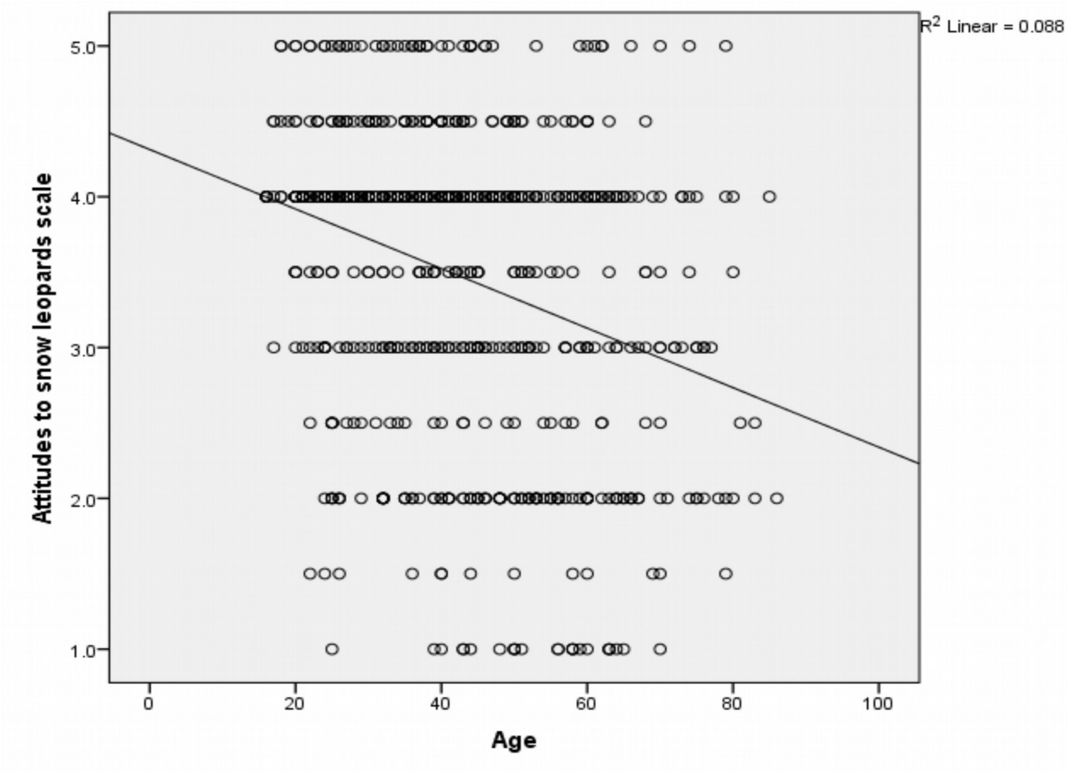


7.6.7 Age

Along with gender and education, age is one of the most commonly cited factors explaining attitudes to wildlife (Carter et al., 2012a; Murphy and Macdonald, 2010; Romanach et al., 2007; Williams et al., 2002; Zimmermann et al., 2005), typically with a negative correlation. This has also been recorded for snow leopards (Alexander et al., 2015; Suryawanshi et al., 2014). In other cases, as with leopards in Iran, no significant association has been found (Babrgir et al., 2017). Here, the relationship is also significant and negative (Figure 7.6 and Table 7.18), confirming that older people are more likely to be negative towards the species. Interestingly, several interviewees suggested that the positivity amongst younger generations was connected to the snow leopards' value to tourism.[27] It may also be connected to lower levels of livestock ownership among the young. In multivariate analysis, age was present in each of the three multiple regression models but was not significant in any of them (Tables 7.14, 7.15 & 7.16). This underlines the importance of multivariate analysis that assess explanatory variables in relation to others and helps to avoid false conclusions being drawn (Bhatia et al., 2016).

27 Teacher, SNP; Conservation leader, ACA.

Figure 7.6 Scatterplot showing the relationship between attitudes to snow leopards and age.



7.6.8 Religion

The link between religion and attitudes to wildlife has received limited attention, particularly with carnivores (Bhatia et al., 2016). A positive link between Buddhism and snow leopards conservation has been widely suggested by researchers generally (Ale and Karky, 2002; Li, 2013), in SNP (Ale et al., 2007) and in ACA (Ale et al., 2014), but Bhatia et al.'s (2016) recent study is the first to explore this relationship empirically. With univariate analysis they found that Buddhists were significantly more negative towards snow leopards than Muslims. The findings from this study would seem to confirm this trend, with Buddhists significantly more negative towards snow leopards than non-Buddhists (Table 7.17). In multivariate analysis, religion was not included in the ACA model (Table 7.16) and was not significant in the SNP (Table 7.14) or combined (Table 7.15) models. This 'fading away' of religion's significance when other variables are factored in, is identical to the findings from the study on snow leopards and religion in India (Bhatia et al., 2016): despite snow leopards' relative prominence in Buddhism, compared to other faiths, other factors appear to play a more dominant role in shaping attitudes to the species.

7.6.9 Knowledge

As discussed in Sections 7.3 and 7.4, there is a documented link between wildlife knowledge and attitudes towards wildlife (Barthwal and Mathur, 2012; Kansky and Knight, 2014; Schumann et al., 2012). The potential link in relation to snow leopards, however, has not been tested by recent studies (Alexander et al., 2015; Bhatia et al., 2016; Suryawanshi et al., 2014). In this sample, respondents who could positively identify snow leopards were found to be significantly more positive towards them (Table 7.17). A number of interviewees suggested that local environmental education initiatives have helped to increase awareness of snow leopards *and* improve attitudes.[28] In multivariate analysis, this variable was not included in the SNP model (Table 7.15) and was not significant in the joint (Table 7.14) and ACA (Table 7.16) models.

7.6.10 Religiosity

Religiosity, or the degree of religious conviction, has had even less attention paid to its relationship with attitudes to wildlife than religion. However, the same study by Bhatia et al. (2016) found that levels of religiosity in Buddhist, but not Muslim, villages were positively associated with attitudes to snow leopards. However the reverse relationship is shown here: respondents identifying as ‘less than very religious’ were significantly more positive towards snow leopards than those who identified as ‘very religious’ (Table 7.17), something not suggested in interviews.[29] In multivariate analysis, religiosity was not significant in the joint (Table 7.14) or SNP (Table 7.15) models. It was, however, significant in the ACA model (Table 7.16), which may be explained by the significantly higher degree of religious conviction present at this site (see Table 7.3).

7.6.11 Nativity

Nativity, or respondent origin, has rarely been considered as a factor that can shape attitudes to wildlife. Yet, in one study from Ladakh (Barthwal and Mathur, 2012), local teachers were significantly more negative towards snow leopards than teachers who were from areas where snow leopards were not present. In this study, non-natives were significantly more positive to snow leopards than natives of either SNP or ACA (Table 7.17), adding weight to Barthwal and Mathur’s finding. This is particularly relevant for SNP, where the proportion of non-natives is significantly higher (see Table 7.2). In

28 Buddhist monk, SNP; Teacher, SNP; Park officer, ACA.
29 Teacher, SNP; Government employee, SNP; Conservation leader, SNP.

multivariate analysis, nativity was not included in the ACA model (Table 7.16) and was not significant in the SNP (Table 7.15) or combined (Table 7.14) models.

7.6.12 Study site

In Ethiopia, individuals who had benefited from a PA – arguably more likely under a decentralised conservation model – were significantly more supportive of wildlife and their coexistence with people (Tessema et al., 2010). Various authors infer or suggest that a decentralised approach is also the best option for snow leopard conservation (Ale and Karky, 2002; Jackson et al., 2010; Jackson, 2012; Johansson et al., 2016), though this has not been tested empirically. Nevertheless, this would fit well with one of the main theoretical struts of this study: that access to influence improves resilience (Ribot, 2014; Ribot and Peluso, 2003), including in this case attitudes to snow leopards. However, there was no significant difference between attitudes to snow leopards in the two PAs (Table 7.17) and this was also true under multivariate analysis. It is impossible to separate how much of this result is due to contrasting governance models, and how much is due to ecological (Ale et al., 2007, 2014) or economic differences (Bajracharya et al., 2006; Bhuju et al., 2007) between ACA and SNP. Influence may be mediated more through snow leopard conservation itself, and perceptions of that (see Section 7.6.1), than through governance model.

7.7 Attitudes to snow leopard conservation

People feel positive good towards the [conservation] organisations...They have helped to save our forest from being destroyed by outside people. The park also helps to avoid illegal activities in the region.

Buddhist lama, SNP

A majority of respondents were either positive or very positive towards park management actors (Table 7.19). In the case of SNP this is the DNPWC, while in the case of ACA it is the NTNC. Positivity towards local conservation committees was slightly less than towards park management, with a higher proportion being neutral and a smaller percentage identifying as negative or very negative. This is surprising given the theoretical role of CBC in transferring ownership of conservation to localised organisations (Bajracharya et al., 2005, 2006; Nautiyal and Kaechele, 2007). Triangulation interviews suggested roughly similar proportions of positive, negative and neutral attitudes (see Appendix 12.15.17).

Table 7.19 Respondent attitudes to snow leopard conservation actors.

Attitudes towards...	Site	N	Response (%)				
			Very positive	Positive	Neutral	Negative	Very negative
Park management	Combined	703	18.9	47.2	27.0	5.3	1.6
	SNP	260	28.5	51.9	17.7	1.5	0.4
	ACA	443	13.3	44.5	32.5	7.4	2.3
Local conservation committee	Combined	679	15.2	39.8	43.3	1.5	0.3
	SNP	260	21.5	44.6	33.5	0.0	0.4
	ACA	419	11.2	36.8	49.4	2.4	0.2

Note based on Likert scale from 1 = very positive to 5 = very negative.

The reasons for these attitudes, with the combined sample, varied (Table 7.20). For park management, the majority gave a positive intrinsic reason for their attitudes, followed by no reason. For local conservation committees, these two factors were also the most common reasons given to explain attitudes, but their positions were reversed, with 40.6% giving no reason for their attitude. Triangulation interviews confirmed that no reason and a positive intrinsic reason were the two most common attitudinal justifications (see Appendix 12.15.17). However, a large number of interviewees in ACA were negative towards the NTNC in particular, questioning the number of regulations, their use of park entrance fees and their overall involvement in PA management.[30]

30 Teacher, ACA; Women's leader, ACA; Youth leader, ACA; Conservation leader, ACA.

Table 7.20 Reasons for respondent attitudes to snow leopard conservation actors.

Reason(s) for attitudes towards...	Site	N	Response (%)					
			No reason	+ve intrinsic reason	+ve extrinsic reason	>1 +ve reason	+ve & -ve reasons	-ve reasons
Park management	Combined	701	19.1	40.9	13.0	12.7	3.9	10.4
	SNP	259	10.0	65.6	6.2	12.0	3.1	3.1
	ACA	442	24.4	26.5	17.0	13.1	4.3	14.7
Local conservation committee	Combined	673	40.6	25.4	17.8	12.5	0.4	3.3
	SNP	259	29.3	44.4	5.4	18.5	1.2	1.2
	ACA	414	47.6	13.5	25.6	8.7	0.0	4.6
Combined snow leopard conservation actors	Combined	1374	29.9	33.1	15.4	12.6	2.1	6.9
	SNP	518	19.7	55.0	5.8	15.3	2.1	2.1
	ACA	856	36.0	20.0	21.3	10.9	2.1	9.7

Attitudes to both park management and to local conservation committees were significantly more positive in SNP than in ACA (Table 7.21). This was also the case with the combined conservation actors' scale (Table 7.21). This is seemingly at odds with the suggestions in the general conservation literature (Foggin, 2012; McShane et al., 2011; Torri and Herrmann, 2010) and in the snow leopard conservation literature (Jackson et al., 2010; Jackson, 2012; Johansson et al., 2016) that decentralised management should improve attitudes. It may be due to the increased presence and accessibility of conservation actors in ACA. This would also support research in India which found that participation in forest management groups was correlated with negative attitudes to Reserved Forests (Macura et al., 2011). In addition, the long-standing nature of conservation in ACA, compared with the more recent deregulation and community-focus in SNP, may have created a situation where conservation actors in ACA have 'over-promised' and 'under-delivered' in the former, and 'under-promised' and 'over-delivered' in SNP.

Table 7.21 Mean snow leopard conservation actors results.

Attitudes towards...	N	Combined ± SD	N	SNP ± SD	N	ACA ± SD	Difference
Park management	703	2.23 ± 0.87	260	1.93 ± 0.75	443	2.41 ± 0.89	*t* (620) = -7.56*
Local conservation committee(s)	679	2.32 ± 0.75	260	2.13 ± 0.76	419	2.44 ± 0.73	*t* (677) = -5.24*
Conservation actors combined	679	2.29 ± 0.65	260	2.03 ± 0.63	419	2.43 ± 0.81	*t* (677) = -8.27*
Ban on the killing of snow leopards	703	1.85 ± 0.89	260	1.70 ± 0.72	443	1.94 ± 0.96	*t* (663) = -3.84*
Ban on the killing of snow leopard prey	702	1.63 ± 0.62	260	1.61 ± 0.61	442	1.64 ± 0.63	*t* (700) = -0.59
Livestock compensation scheme	701	2.23 ± 0.86	260	2.41 ± 0.89	441	2.12 ± 0.83	*t* (516) = 4.27*
Corral construction	701	2.07 ± 0.78	260	2.59 ± 0.64	441	1.77 ± 0.68	*t* (699) = 15.63*
Environmental education	701	1.80 ± 0.71	260	1.73 ± 0.64	441	1.83 ± 0.74	*t* (608) = -1.83
NTFP collection limits	701	2.08 ± 0.84	260	2.32 ± 0.82	441	1.95 ± 0.82	*t* (541) = 5.78*
Wood collection limits	701	1.76 ± 0.77	260	1.72 ± 0.87	445	1.79 ± 0.71	*t* (462) = -1.10
Conservation interventions combined	701	1.92 ± 0.46	260	2.01 ± 0.42	445	1.86 ± 0.48	*t* (601) = 4.29*
Snow leopard conservation attitudinal scale	678	2.00 ± 0.41	260	2.00 ± 0.39	418	2.00 ± 0.42	*t* (676) = -0.012
Snow leopard conservation attitudinal scale**	678	3.98 ± 0.41	260	3.98 ± 0.39	418	3.98 ± 0.42	*t* (676) = 0.012

* *p* = ≤0.05. ** reverse scored. Scale equals mean of preceding variables and reverse scoring. Cronbach's alpha for snow leopard conservation attitudinal scale = 0.664.

In contrast to attitudes to conservation actors, with conservation interventions it is the respondents from ACA that are significantly more positive than the respondents from SNP (Table 7.21). This seems to confirm the findings of research from around several PAs in South Asia, including ACA, where respondents were positive about PA presence but negative about PA staff (Karanth and Nepal, 2012). In addition, another study in the USA found that some respondents were positive to conservation generally, but not to specific, especially government, interventions (Layden et al., 2003). The various snow leopard conservation interventions are now considered individually in order of their popularity, with attitude data taken from Table 7.22, Table 7.23 providing attitudinal justification data and Table 7.21 contributing site comparison results.

The ban on the killing of snow leopard prey was the most popular conservation intervention for snow leopards. Almost 95% of respondents were either positive or very positive towards it, with several interviewees also commenting on it favourably and from a religious point-of-view.[31] In fact, more than 77% listed their motivation for this perspective as a positive intrinsic one, valuing the species in and of themselves rather than for any real or perceived benefit from them. This level of support was also shared consistently across both field sites, reaffirming the importance of prey species conservation alongside predator conservation (Alexander et al., 2015; Reading and Kellert, 1993; Tumursukh et al., 2016).

The next most popular policy was limits on the collection of wood, which was supported by 87.4% of respondents, again with no significant differences between the two PAs. More than 50% of individuals gave a positive extrinsic reason for their attitude. This instrumental valuation of wood is consistent with its importance to rural livelihoods (Angelsen et al., 2014; Förster et al., 2011; Gichuki, 1999; Nepal, 2008). However, a number of interviewees mentioned the particular challenge of these limitations for poorer households.[32]

Environmental education was viewed with similar level of positivity (83.0%) to wood collection limits. As with the previous two interventions there was no significant difference between the study sites. This is a snow leopard conservation activity frequently recommended in the literature (DNPWC, 2013; Jackson et al., 2010) due to the well-documented positive relationship between knowledge and attitudes (Barthwal and Mathur, 2012; Kansky and Knight, 2014; Schumann et al., 2012; Suryawanshi et al., 2014). A positive intrinsic reason for the popularity of environmental education in this study was shared by questionnaire respondents and interviewees alike.[33]

The final snow leopard conservation activity that was viewed with similar levels of support to the preceding three was the ban on the killing of snow leopards. More than 80% of respondents viewed this ban favourably, but this was 12.2% less than the level of support for the ban on the killing of its prey. People in SNP were significantly more positive towards this policy than in ACA, probably reflecting the lower density and infrequent presence of the snow leopard here over the last half century (Ale et al., 2007). As with the

31 Buddhist lama, SNP; Teacher, SNP.
32 Teacher, SNP; Teacher, ACA.
33 Teacher, SNP; Park officer, ACA; Conservation leader, ACA.

prey species, the reason most commonly given for this intervention was a positive intrinsic one 63.3%), a view also mentioned by some interviewees.[34]

Table 7.22 Respondent attitudes to snow leopard conservation interventions.

Attitudes towards...	Site	N	Response (%)				
			Very positive	Positive	Neutral	Negative	Very negative
Ban on the killing of snow leopards	Com-bined	703	39.5	43.1	11.2	5.0	1.1
	SNP	260	43.1	46.2	9.2	1.2	0.4
	ACA	443	37.5	41.3	12.4	7.2	1.6
Ban on the killing of snow leopard prey	Com-bined	702	43.4	51.4	3.8	1.3	0.0
	SNP	260	45.4	48.5	5.8	0.4	0.0
	ACA	442	42.3	53.2	2.7	1.8	0.0
Livestock compensation scheme	Com-bined	701	19.4	44.9	31.1	2.4	2.1
	SNP	260	16.9	32.3	46.2	1.9	2.7
	ACA	441	20.9	52.4	22.2	2.7	1.8
Corral construction	Com-bined	701	25.7	42.2	31.1	1.0	0.0
	SNP	260	7.3	27.7	63.8	1.2	0.0
	ACA	441	36.5	50.8	11.8	0.9	0.0
Environmental education activities	Com-bined	701	37.4	45.6	17.0	0.0	0.0
	SNP	260	37.3	51.9	10.8	0.0	0.0
	ACA	441	37.4	42.0	20.6	0.0	0.0
NTFP collection limits	Com-bined	701	26.0	44.5	25.2	3.9	0.4
	SNP	260	17.3	38.5	40.4	3.1	0.8
	ACA	441	31.1	48.1	16.3	4.3	0.2
Wood collection limits	Com-bined	701	39.9	47.5	9.6	2.3	0.7
	SNP	260	48.1	37.7	10.0	2.7	1.5
	ACA	441	35.1	53.3	9.3	2.0	0.2
Other	Com-bined	10	50.0	50.0	0.0	0.0	0.0
	SNP	10	50.0	50.0	0.0	0.0	0.0
	ACA	0	0.0	0.0	0.0	0.0	0.0

Note based on Likert scale from 1 = very positive to 5 = very negative.

The next three snow leopard conservation interventions enjoyed notably lower levels of support and all three differed significantly between study sites. The main reason for the higher levels of support for corral construction in ACA is likely to be the involvement of the

34 Buddhist lama, SNP; Teacher, SNP.

NTNC in providing support for this activity,[35] which is frequently recommended in the literature (Jackson and Wangchuk, 2001). Unsurprisingly, the main reason given for these attitudes, especially in ACA, was a positive extrinsic one, or that respondents valued these interventions because of various real or perceived benefit emanating from them, namely the protection of livestock.

Limits on the collection of NTFPs was the intervention with the second-lowest level of support, though this was significantly higher in ACA, where this activity appears to be more common than SNP. The potential importance of NTFPs for providing income, mentioned in the literature (Larsen and Smith, 2004; Saha and Sundriyal, 2012; Saxena et al., 2002) and by interviewees,[36] may explain why limits on their collection are less popular than, say, limits on the collection of wood. The large number of extrinsic and negative reasons given for these attitudes would also suggest the financial importance of NTFPs to respondents, principally of *cordiceps* (caterpillar fungus).

35 Park officer, ACA.
36 Park officer, ACA; Teacher, ACA; Conservation leader, ACA; Community leader, ACA.

Table 7.23 Reasons for respondent attitude to snow leopard conservation interventions.

Reason(s) for respondents attitudes towards...	Site	N	Response (%)					
			No reason	+ve intrinsic reason	+ve extrinsic reason	>1 +ve reason	+ve & -ve reasons	-ve reasons
Ban on the killing of snow leopards	Combined	701	7.6	63.3	4.9	13.0	4.1	7.1
	SNP	259	6.6	61.8	5.8	21.6	2.3	1.9
	ACA	442	8.1	64.3	4.3	7.9	5.2	10.2
Ban on the killing of snow leopard prey	Combined	695	1.7	77.3	2.9	16.3	0.3	1.6
	SNP	259	1.9	66.4	6.2	23.9	0.8	0.8
	ACA	436	1.6	83.7	0.9	11.7	0.0	2.1
Livestock compensation scheme	Combined	699	12.9	1.3	38.6	1.8	24.4	21.0
	SNP	260	18.5	1.2	27.7	2.3	24.6	25.8
	ACA	439	9.7	1.3	44.9	1.6	24.3	18.2
Corral construction	Combined	668	18.3	0.0	67.4	1.8	0.6	11.9
	SNP	235	33.5	4.6	36.2	0.0	0.8	25.0
	ACA	433	9.4	0.0	85.6	0.2	0.4	4.3
Environmental education activities	Combined	700	15.0	54.4	10.6	18.0	0.0	2.0
	SNP	260	8.1	51.2	7.3	31.9	0.0	1.5
	ACA	440	19.1	56.4	12.5	9.8	0.0	2.3
Limits on the collection of NTFPs	Combined	698	12.3	23.1	40.7	5.0	1.4	17.5
	SNP	258	16.3	18.2	25.6	7.8	2.7	29.5
	ACA	440	10.0	25.9	49.5	3.4	0.7	10.5
Limits on the collection of wood	Combined	700	3.6	31.9	51.1	4.7	3.6	5.1
	SNP	259	1.9	36.3	41.7	5.4	6.9	7.7
	ACA	441	4.5	29.3	56.7	4.3	1.6	3.6
Other*	Combined	10	0.0	100.0	0.0	0.0	0.0	0.0
	SNP	10	0.0	100.0	0.0	0.0	0.0	0.0
	ACA	0	0.0	0.0	0.0	0.0	0.0	0.0
**Combined snow leopard conservation interventions ** **	Combined	4861	10.2	35.9	30.9	8.6	4.9	9.5
	SNP	1790	12.3	34.2	21.4	13.3	5.4	13.4
	ACA	3071	8.9	37.3	36.3	5.6	4.6	7.3

* Other' category = 'research' (n = 1); 'encouraging non-wood fuel use' (n = 9).** = 'Other' category not included.

The livestock compensation scheme was the lowest-scoring snow leopard conservation intervention, and was significantly less popular in SNP than in ACA. Still, 64.3% of respondents claimed to be positive or very positive towards it. However, given the large proportion of neutral attitudes, various interviewees' comments,[37] and the fact that it was the only activity with a majority of negative or mixed reasons for these levels of support, it could be argued that there are considerable grievances with the functioning and quantity of the compensation, if not its existence. Grievances with the livestock compensation scheme for snow leopard depredations in two PAs in China have been noted (Alexander et al., 2015; Chen et al., 2016), but others have noted the popularity of compensation schemes even when problems persist (Karanth et al., 2012; Ogra and Badola, 2008).

Overall, as discussed above, respondents were significantly more positive to snow leopard conservation actors in SNP but significantly more positive towards snow leopard conservation interventions in ACA. This disconnect seems to support the findings of research from other South Asia PAs (Karanth and Nepal, 2012), as previously mentioned, where respondents were positive to PA presence but not to PA staff. However, the *total* snow leopard conservation attitudinal scale scores were exactly the same across both sites.

The overall motivations for these attitudes to snow leopard conservation, combining both actors and interventions, were dominated by positive intrinsic (37.3%) and extrinsic (36.3%) attitudes. Motivations for attitudes to conservation have been considered less than motivations for attitudes to particular species. Yet mixed intrinsic and extrinsic motivations are common for a range of environmental (De Young, 1996; Pelletier et al., 1998) and socio-economic scenarios (Benabou and Tirole, 2003; Degli Antoni, 2009; Ryan and Deci, 2000).

This data adds to limited analyses of aspects of snow leopard conservation (Alexander et al., 2015; Chen et al., 2016; Ikeda, 2004). It also helps to address the important information gap on attitudes to snow leopard conservation (Rosen et al., 2012). Drawing on access theory (Ribot, 2014; Ribot and Peluso, 2003), it may be useful to consider snow leopard conservation itself as a form of influence, with attitudes to it shaping access to and engagement with the actors and interventions involved.

37 Livestock herder, SNP; Park officer, ACA; Conservation leader, ACA; Community leader, ACA.

7.8 Explaining attitudes to snow leopard conservation

There are too many rules and regulations. Locals are questioning their [the NTNC's] existence in the park, as the they don't know how the entrance fee is used. Local people would like to take over management of the park.

Women's leader, ACA

In this section, the attitudes of individuals to snow leopard conservation are explained using multiple regression models. The results of these analyses are shown in Table 7.24 for a combined sample, Table 7.25 for SNP and Table 7.26 for ACA. The order of discussion here is based on the standardised *b* scores listed in the combined model. The order of inclusion in the model was hierarchical, based on other published studies (Barthwal and Mathur, 2012; Karanth and Nepal, 2012; Mehta and Kellert, 1998; Tessema et al., 2010; Walpole and Goodwin, 2001).

Table 7.24 Linear model explaining attitudes to snow leopard conservation.

R^2 = .524 N = 585	***b***	***SE B***	***Standardised b***	***p***
Constant	3.32 (3.11, 3.53)	.11	---	p = .001
Number of years of education	-0.003 (-0.011, 0.005)	.004	-.029	p = .53
Household Sustainable Livelihoods Index score	0.47 (0.19, 0.78)	.14	.13	p = .005
Number of household livestock lost to snow leopards (log¹⁰ scale)	-0.040 (-0.16, 0.70)	.062	-.023	p = .52
Age	-0.003 (-0.001, -0.005)	.001	-.11	p = .011
Native*	-0.090 (-0.21, 0.025)	.057	-.070	p = .11
Positive identification of snow leopard*	0.083 (0.26, 0.14)	.029	.10	p = .005
Attitudes to snow leopards	0.16 (0.13, 0.20)	.018	.41	p = .001

Note. * 0 = no; 1 = yes. Potential predictor variables excluded from regression modelling due to equality of mean: religiosity (t = 0.019, *p* = .99); religion (t = -1.01, *p* = .27); governance (t = 0.012, *p* = .99); gender (t = 1.45, *p* = .15). Potential predictor variables excluded from regression modelling due to lack of correlation:

number of household livestock (log^{10} scale) (r = -0.019, *p* = .62); household size (r = 0.024, *p* = .54). Cronbach's Alpha of the snow leopard conservation attitudinal scale is 0.664 and of the snow leopard attitudinal scale is 0.878. This model had the highest significant R^2 change score (.15, p = <.001) out of the seven models tested.

Table 7.25 Linear model explaining attitudes to snow leopard conservation in SNP.

R^2 = .557 N = 237	***b***	***SE B***	***Standardised b***	***p***
Constant	3.16 (2.83, 3.50)	.16	---	p = .001
Number of years of education	-0.002 (-0.015, 0.011)	.007	-.019	p = .81
Household Sustainable Livelihoods Index score	0.79 (0.44, 1.13)	.19	.24	p = .001
Gender**	-0.074 (-0.18, 0.29)	.052	-.092	p = .16
Age	-0.002 (-0.005, 0.001)	.002	-.095	p = .12
Positive identification of snow leopard*	0.070 (-0.019, 0.16)	.046	.087	p = .14
Attitudes to snow leopards	0.15 (0.081, 0.20)	.031	.36	p = .001

Note. * 0 = no; 1 = yes. ** 0 = male; 1 = female. Potential predictor variables excluded from regression modelling due to equality of mean: religiosity (t = -0.063, *p* = .95); religion (t = -0.78, *p* = .44); nativity (t = 0.43, *p* = .67). Potential predictor variables excluded from regression modelling due to lack of correlation: number of household livestock killed by snow leopards (log^{10} scale) (r = -0.11, *p* = .090); number of household livestock (log^{10} scale) (r = -0.044, *p* = .48); household size (r = 0.046, *p* = .46). Cronbach's Alpha of the snow leopard conservation attitudinal scale is 0.664 and of the snow leopard attitudinal scale is 0.878. This model had the highest significant R^2 change score (.10, p = <.001) out of the six models tested.

Table 7.26 Linear model explaining attitudes to snow leopard conservation in ACA.

R^2 = .539 N = 346	***b***	***SE B***	***Standardised b***	***p***
Constant	3.61 (3.30, 3.93)	.15	---	p = .001
Number of years of education	-0.007 (-0.019, 0.003)	.005	-.082	p = .19
Household Sustainable Livelihoods Index score	0.23 (-0.17, 0.63)	.20	.059	p = .25
Number of household livestock lost to snow leopards (log^{10} scale)	-0.006 (-0.13, 0.12)	.063	-.004	p = .92
Age	-0.004 (-0.006, -0.001)	.001	-.14	p = .008
Native*	-0.27 (-0.45, -0.094)	.090	-.17	p = .006
Positive identification of snow leopard**	0.089 (0.19, 0.16)	.036	.11	p = .017
Attitudes to snow leopards	0.18 (0.13, 0.22)	.023	.46	p = .001

Note. * 0 = non-native; 1 = native; ** 0 = no; 1 = yes. Potential predictor variables excluded from regression modelling due to equality of mean: gender (t = -0.86, *p* = .39) religiosity (t = 0.070, *p* = .94). Potential predictor variables excluded from regression modelling due to lack of correlation: number of household livestock (log^{10} scale) (r = 0.013, *p* = .79); household size (r = -0.009, *p* = .86). Potential predictor variables not included in analysis due to small sample size in one category: religion (non-Buddhists = 24); nativity (non-natives = 29). Cronbach's Alpha of the snow leopard conservation attitudinal scale is 0.664 and of the snow leopard attitudinal scale is 0.878. This model had the highest significant R^2 change score (.16, p = <.001) out of the seven models tested.

7.8.1 Attitudes to snow leopards

Univariate analysis showed that attitudes to snow leopard conservation had a significant positive influence on attitudes to snow leopards (Figure 7.7 and Table 7.28). As discussed above in Section 7.6.1, the explicit link between attitudes to a species and attitudes to its conservation does not appear to have been considered in the literature to date, including for snow leopards. Therefore these data provide the first analysis of the clear positive correlation between the two variables, from the reverse direction shown in Section 7.6.1. It also fulfils an important information gap for snow leopard conservation policy (Rosen et al., 2012). The results suggest again that how a species is perceived can affect how its conservation, both in terms of actors and interventions, is perceived. In multivariate analysis, attitudes to snow leopards were also the only consistent variable across all three models (Tables 7.24, 7.25 & 7.26), with slightly higher standardised *b* scores in ACA (.46) than in SNP (.36). This may be due to the greater densities and impacts of snow leopards at the former (Ale et al., 2014), as well as the greater visibility and accessibility of conservation, via the NTNC and local CAMCs (Baral and Stern, 2011).

Figure 7.7 Scatterplot showing the relationship between attitudes to snow leopard conservation and attitudes to snow leopards.

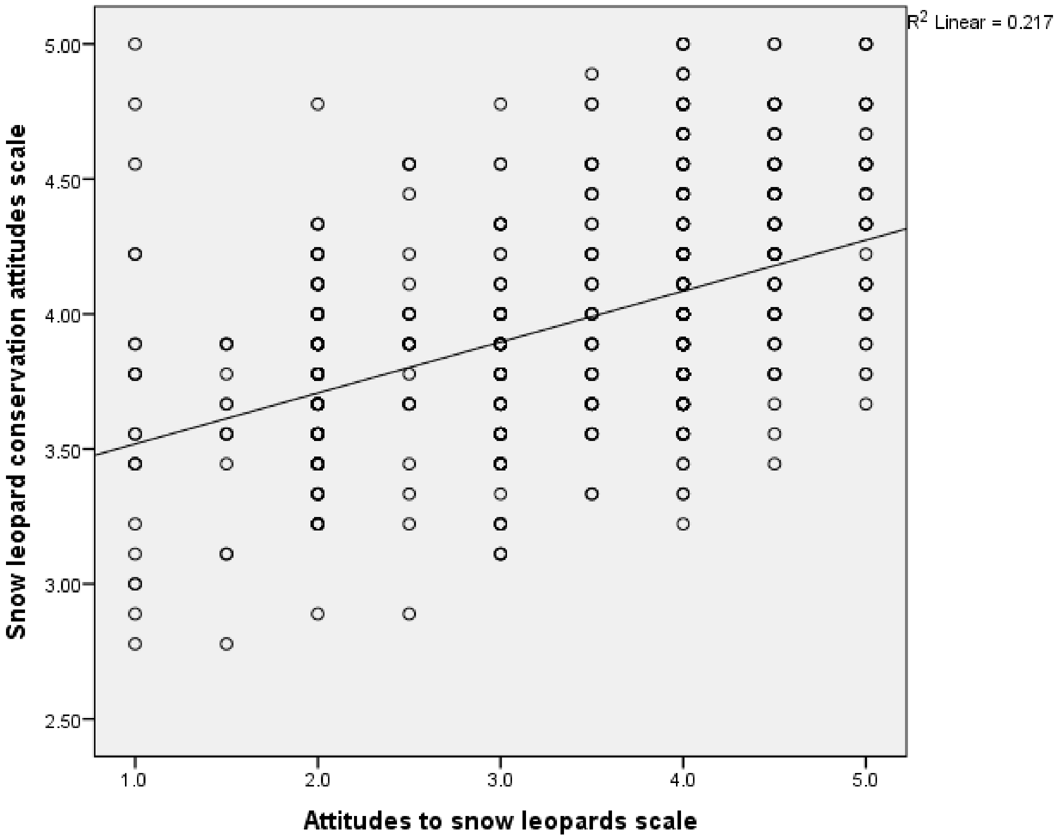


Table 7.27 Individual independent t-tests comparing mean snow leopard conservation attitude scores for a joint sample.

Variable	Access to income mean ± SD	No access to income mean ± SD	Difference	*t*	*df*	*p*	Effect size
Protected Area	3.98 ± 023	3.98 ± .020	.00040 (-.060, .056)	.012	676	.99	0
Gender	4.01 ± .022	3.96 ± .023	.046 (-.019, .11)	1.45	676	.15	.06
Nativity	4.09 ± .047	3.97 ± .017	.12 (.017, .22)	2.32	676	.021	.15
Knowledge	3.91 ± .022	4.05 ± .022	-.14 (-.20, -.07)	-4.45	676	.001	-.017
Religion	3.98 ± .016	4.04 ± .044	-.062 (-.16, .040)	-1.10	676	.27	-.08
Religiosity	3.98 ± .024	3.98 ± .022	.00061 (-.062, .063)	.019	676	.99	0

Table 7.28 Individual linear models explaining attitudes to snow leopard conservation for a joint sample.

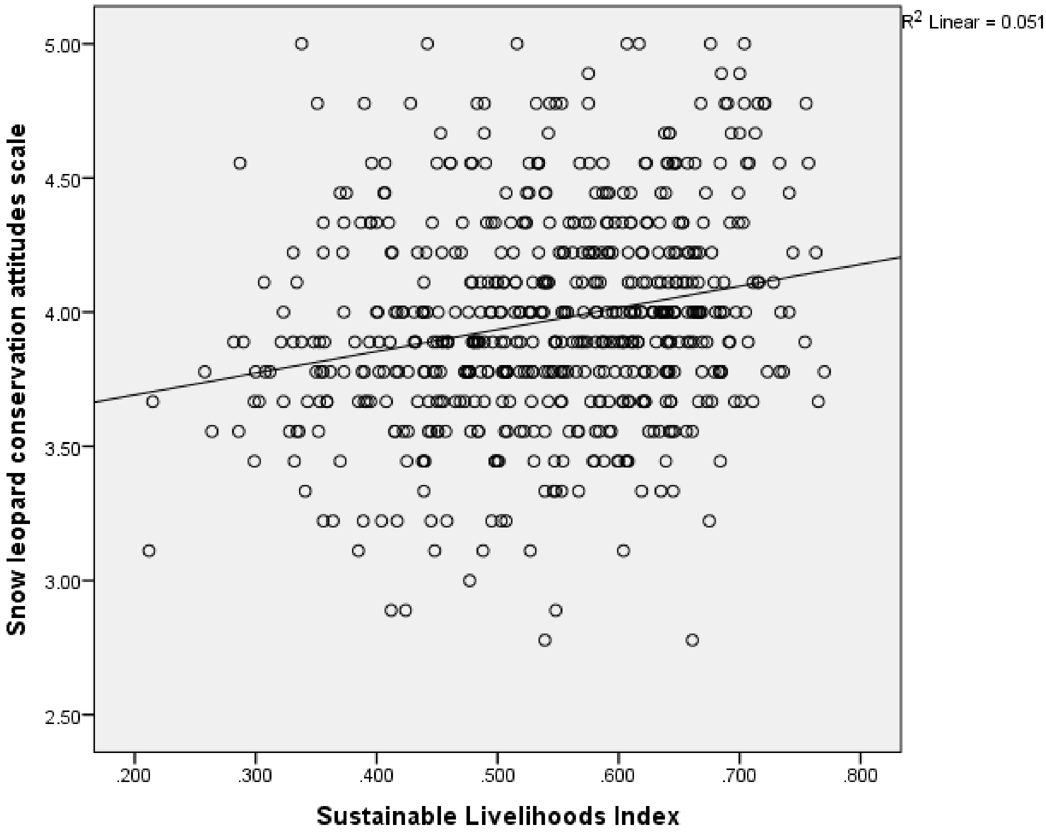
Variable	Constant *b*	Constant SE *B*	Constant *p*	Variable *b*	Variable *SE B*	Variable *Standardised b*	*Variable p*
Years of education	3.90 (3.85, 3.94)	0.021.	.001	0.023 (0.017, 0.029)	0.003.	.25	.001
Livelihood scores	3.53 (3.34, 3.70)	.080	.001	0.81 (0.52, 1.09)	.14	.23	.001
Livestock killed	-0.21 (-0.35, -0.080)	.071	.001	-0.21 (-0.35, -0.080)	.071	-.11	.008
Livestock owned	3.99 (3.94, 4.04)	.026	.001	-0.013 (-0.063, 0.036)	.027	-.019	.62
Age	4.25 (4.16, 4.34)	.046	.001	-0.006 (-0.008, -0.004)	.001	-.23	.001
Household members	3.96 (3.87, 4.05)	.044	.001	0.005 (-0.011, 0.022)	.008	.024	.55
Attitudes to snow leopards	3.33 (3.22, 3.44)	.056	.001	0.19 (0.16, 0.22)	.015	.47	.001

7.8.2 Livelihoods

Household SLI scores were also found to have significant positive relationship with attitudes to snow leopard conservation in univariate analysis (Figure 7.8 and Table 7.28), with an effect size almost exactly the same as for their link to attitudes to snow leopards (see Section 7.6.6). The results from the literature, however, are more mixed. While several authors have found a similar positive relationship between aspects of livelihoods and attitudes to conservation (Karanth and Nepal, 2012; Tessema et al., 2010; Udaya Sekhar, 2003), others have found the reverse (Walpole and Goodwin, 2001). For snow leopards, livelihood diversification has been associated with improved attitudes to the species (Bagchi and Mishra, 2006; Suryawanshi et al., 2014), but its connection to snow leopard conservation has not been assessed to date.

In multivariate analysis, SLI scores were present in all three models (Tables 7.24, 7.25 & 7.26), but only significant in the combined and SNP models. This may be due to livelihoods being less livestock-based and more tourism-based in SNP than in ACA (see Tables 6.10 and 6.11). It also demonstrates that the diversification-positivity link demonstrated elsewhere (Bagchi and Mishra, 2006; Suryawanshi et al., 2014) also applies to perceptions of snow leopard conservation, as well as to snow leopards. This holds with the access theory tenet of this study (Ribot and Peluso, 2003): that access to assets will improve attitudes and therefore coexistence between people, snow leopards and snow leopard conservation.

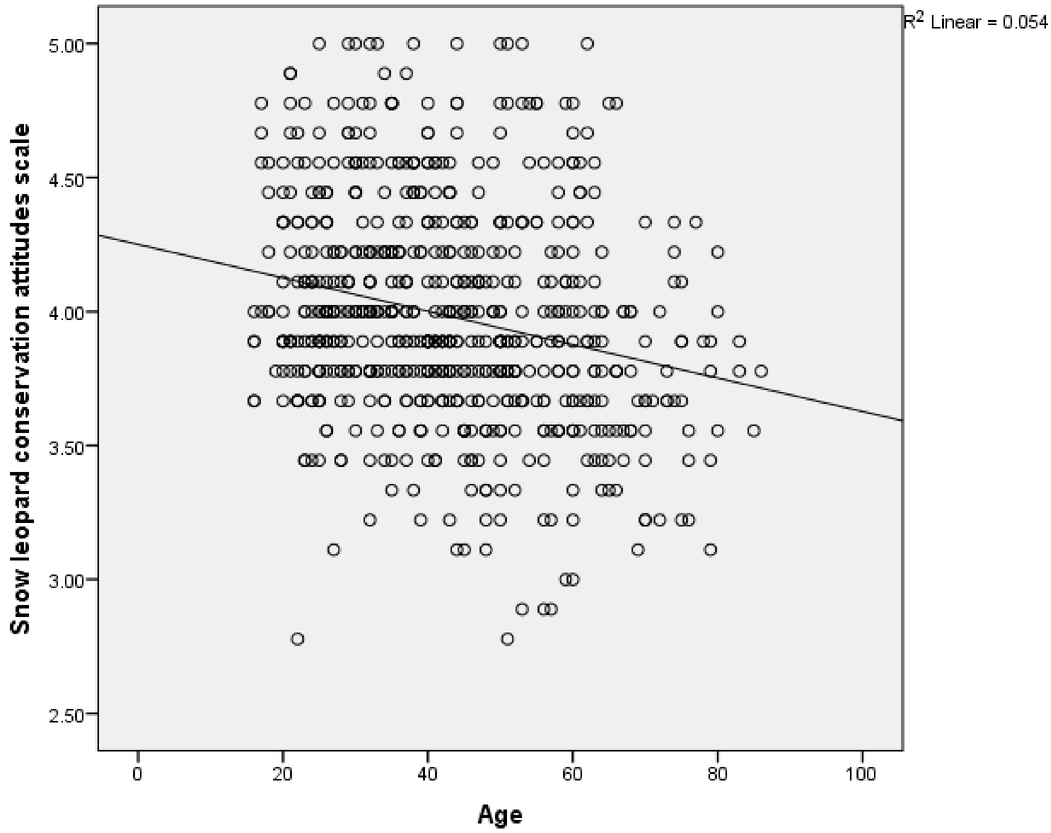
Figure 7.8 Scatterplot showing the relationship between attitudes to snow leopard conservation and Sustainable Livelihoods Index scores.



7.8.3 Age

As discussed in Section 7.6.7, age has a common association with wildlife attitudes, but its connection to wildlife conservation attitudes has been less frequently explored. Nevertheless, in Ethiopia, increased age was found to be a significant factor explaining support for the importance of PAs for wildlife conservation (Tessema et al., 2010). However, the present study suggests the opposite, as age negatively influenced attitudes to snow leopard conservation (Figure 7.9 and Table 7.28). Univariate analysis found that the relationship between age and attitudes was less negative for snow leopard conservation (b = -.23) than for snow leopards (b = -.30). In multivariate analysis, age remained an important explanatory factor. It was present in all three models (Tables 7.24, 7.25 & 7.26) but was only significant in the joint and ACA models. This may be explained by the significantly older population in the ACA sample (Table 7.1).

Figure 7.9 Scatterplot showing the relationship between attitudes to snow leopard conservation and age.



7.8.4 Knowledge

Those who successfully identified the snow leopard from a photo plate – a proxy for knowledge of snow leopards - were significantly more positive towards snow leopard conservation (Table 7.27). This parallels the positive relationship between knowledge of snow leopards and attitudes towards the species itself also found in this study (Table 7.17). These findings support research from India, where a positive relationship was found between knowledge of and attitudes to Reserved Forests (Macura et al., 2011). Elsewhere, knowledge has been found to be an important factor in understanding attitudes to wildlife (Barthwal and Mathur, 2012; Kansky and Knight, 2014; Schumann et al., 2012), though its link to wildlife conservation has received less attention to date. In multivariate analysis, knowledge was present in all three multiple regression models (Tables 7.24, 7.25 & 7.26). However, it was only significant in the joint and ACA models. The significantly higher snow leopard identification scores from ACA (Table 7.4) may explain this trend.

7.8.5 Nativity

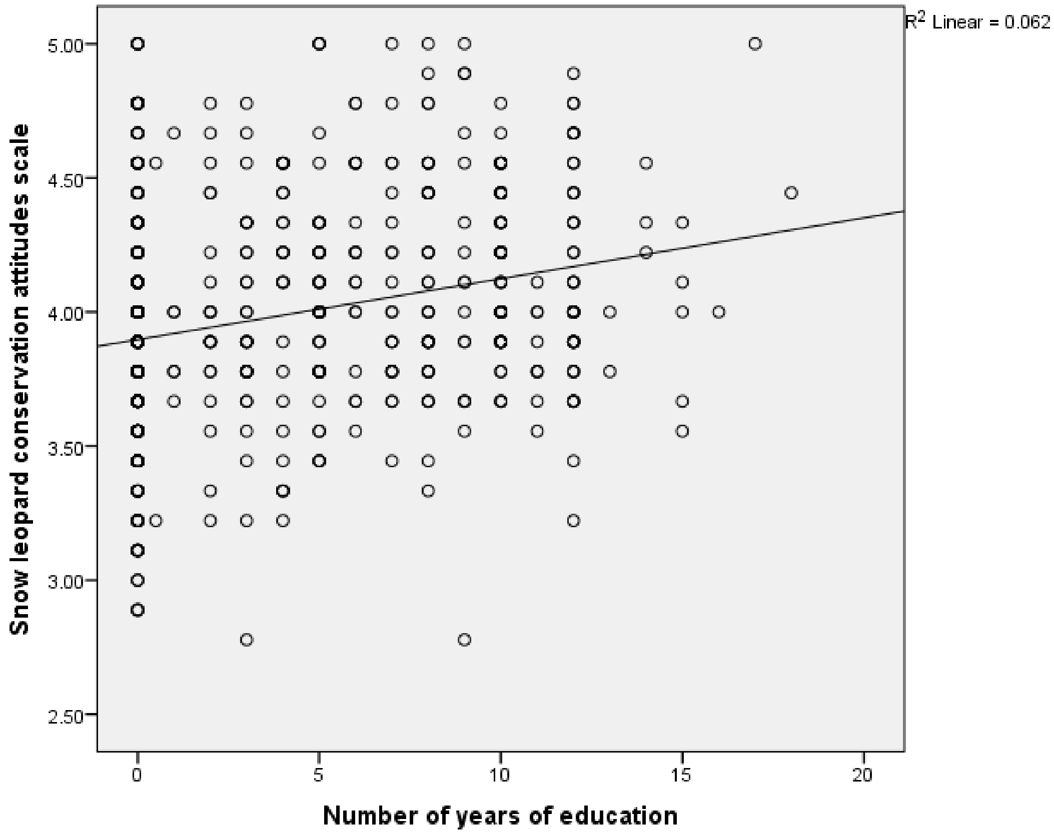
Non-natives were significantly more positive towards snow leopard conservation than natives of ACA or SNP (Table 7.27). This is a similar link to that found with nativity and attitudes to snow leopards, as Section 7.6.11 discussed and as observed in India (Barthwal and Mathur, 2012). Yet the same study, of teachers in Ladakh, found that natives scored higher on a conservation attitudinal index than non-natives, though they did not analyse the results in relation to snow leopard conservation specifically. The direction of the relationship between nativity and conservation attitudes in this study is therefore the opposite of that observed in the Indian study. In multivariate analysis, nativity was significant in the ACA multiple regression model (Table 7.26) but not in the combined model (Table 7.24) or the SNP (Table 7.25) model, where it was not present. This may be explained by the significantly smaller number of non-native respondents in ACA (7.2%), when compared with SNP (16.5%), giving them a disproportionate statistical effect in SNP (Table 7.2).

7.8.6 Education

Education was found to have a significant positive relationship with attitudes to snow leopard conservation (Table 7.28 and Figure 7.10). This adds to the findings of other studies that found a similar trend (Karanth and Nepal, 2012; Tessema et al., 2010). That the standardised *b* score here was lower than for the influence of education on attitudes to snow leopards (see Section 7.6.1), may be due to the focus of environmental education efforts on attitudes to the species itself rather on specific snow leopard conservation actors and interventions.[38] In multivariate analysis, years of education was present in all three multiple regression models was but was not significant in any of them (Tables 7.24, 7.25 & 7.26). Its lack of significance when other variables are taken into account may reflect the greater importance of snow leopard- and snow leopard conservation-specific knowledge in explaining attitudes to the species, rather than more generalised learning.

38 Buddhist monk, SNP; Teacher, SNP; Park officer, ACA.

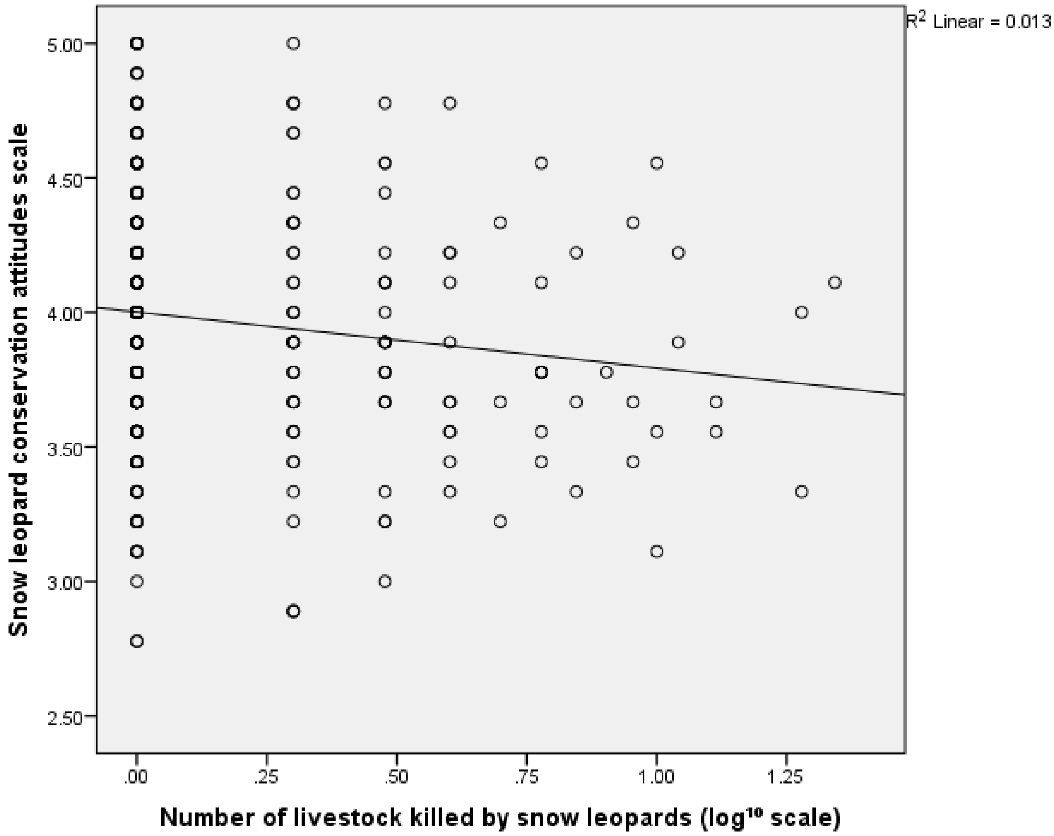
Figure 7.10 Scatterplot showing the relationship between attitudes to snow leopard conservation and number of years of education.



7.8.7 Livestock killed

The number of household livestock killed had a significant negative relationship with attitudes to snow leopard conservation (Figure 7.11 and Table 7.28). This is a trend also noted in Ethiopia (Tessema et al., 2010), where losses of crops and/or livestock to wildlife contributed to respondents' support for PA de-gazettement (Tessema et al., 2010). However, the effect of this variable on attitudes to snow leopard conservation (*b* = -.11) was less than half its effect on attitudes to the species itself (*b* = -.25). In multivariate analysis, the variables was included in the joint (Table 7.24) and ACA (7.26) models, but was not significant. It was not included in the SNP model (Table 7.25). The number of household livestock killed by snow leopards relates less tangibly to attitudes to snow leopard conservation than to attitudes to the species itself. This may therefore explain the difference between these figures and the results in Section 7.6.4, which show a significant negative relationship between livestock killed and attitudes to snow leopards.

Figure 7.11 Scatterplot showing the relationship between attitudes to snow leopard conservation and number of household livestock killed by snow leopards (log^{10} scale).



7.8.8 Gender

Compared to the other explanatory factors in Section 7.8, gender is a variable that has attracted considerable attention in terms of its impact on attitudes to conservation, notably via people-park relationships (Allendorf and Allendorf, 2012; Ogra, 2008). However, no gender gap in attitudes to several PAs in Nepal was found in one study (Allendorf and Allendorf, 2012). The findings from this study would seem to support these findings, as no significant difference was found in attitudes to snow leopard conservation between men and women (Table 7.27). In the multivariate analyses, gender was included in the SNP model (Table 7.25), but was not significant. It was not included in the joint (Table 7.24) or ACA (Table 7.26) models based on non-significant R^2 change scores. Snow leopard conservation may impact both genders equally and this may explain the uniformity of response, compared to the species itself, where women may bear higher tangible and intangible costs associated with snow leopard depredation (Alexander et al., 2015), and as noted elsewhere in Asia with conservation generally (Ogra, 2008).

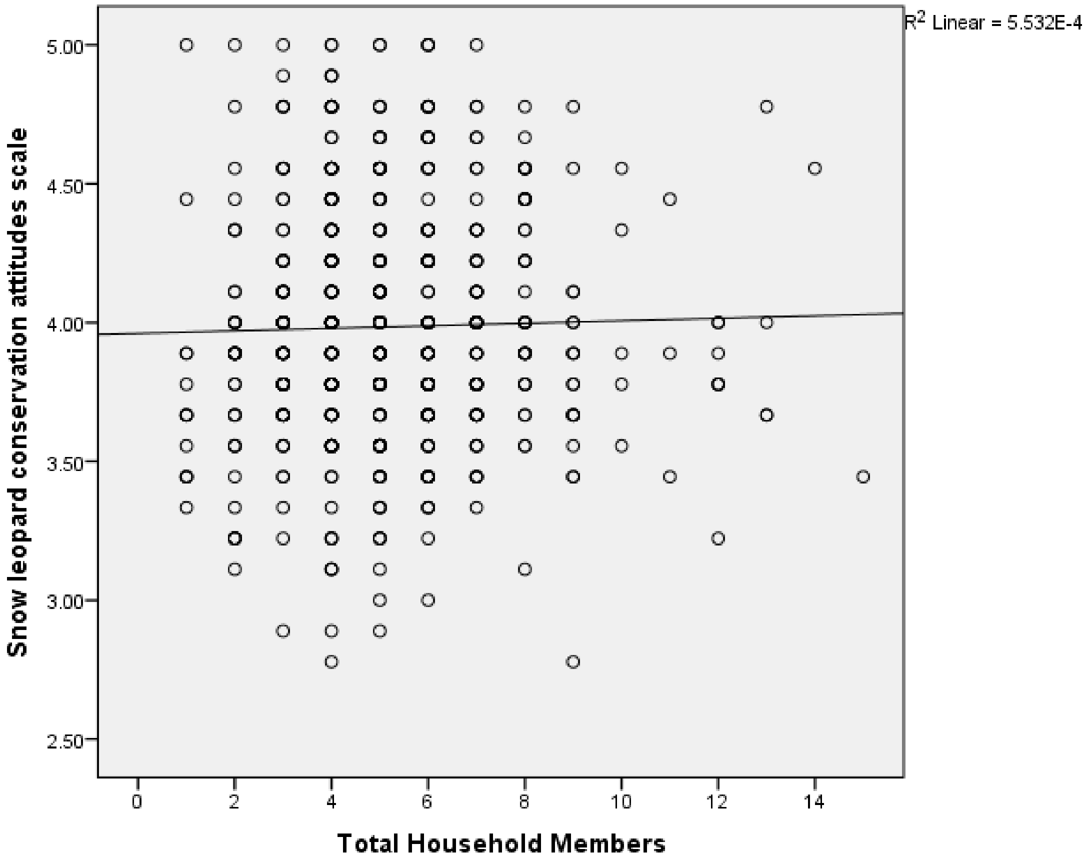
7.8.9 Religion

While a positive relationship between religion, particularly Buddhism, and snow leopards has been frequently suggested (Li et al., 2014; Suryawanshi et al., 2014), and recently tested (Bhatia et al., 2016), the link between religion and snow leopard conservation has not been assessed to date. In this study, no significant difference was found between Buddhist and non-Buddhist respondents in terms of their attitudes to snow leopard conservation (Table 7.27). This may be due to the presence of a similar non-violent conservation ethic in Hinduism (Mikusiński et al., 2014), the next most common religion in and around both PAs. In terms of multivariate analysis, religion was not included in any of the multiple regression models on the basis of non-significant R^2 change scores.

7.8.10 Household size

Household size was the only variable included as a potential factor explaining attitudes towards snow leopard conservation that was not included in the analysis of attitudes towards snow leopards. This was based on its absence from the literature on wildlife attitudes but its inclusion in a study of attitudes to conservation in Ethiopia (Tessema et al., 2010), who found that individuals with larger families were more supportive of PAs roles in wildlife conservation. Here, however, household size did not have any bearing on attitudes to snow leopard conservation in univariate analysis (Figure 7.12 and Table 7.28). On the basis of non-significant R^2 change scores during multivariate analysis, household size was therefore not included in any of the multiple regression models.

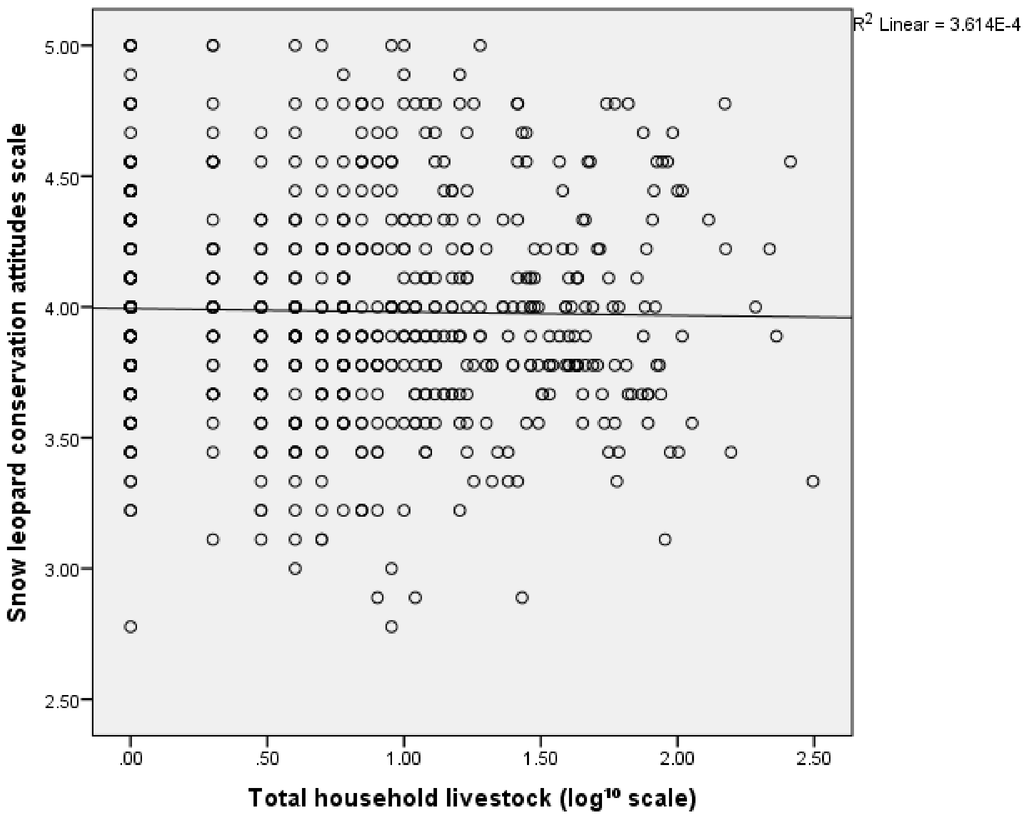
Figure 7.12 Scatterplot showing the relationship between attitudes to snow leopard conservation and total household members.



7.8.11 Livestock owned

With attitudes to snow leopards, the number of livestock owned had a significant negative influence on the dependent variable (Section 7.6.2). However, the number of livestock owned by the respondent's household did not have a significant relationship with attitudes to snow leopard conservation (Figure 7.13 and Table 7.28). In fact, the relationship was almost non-existent in univariate analysis. In multivariate analysis also, the relationship was non-significant and not included in any of the three multiple regression models based on non-significant R^2 change scores during model testing. This would seem to be corroborated by the results of a study in Ethiopia, where number of livestock explained attitudes to wildlife protection, but did not factor in attitudes to PAs or their staff (Tessema et al., 2010). The physical and conceptual separation between livestock and conservation, as opposed to between livestock and snow leopards, may explain this trend in this study.

Figure 7.13 Scatterplot showing the relationship between attitudes to snow leopard conservation and total household livestock (log¹⁰ scale).



7.8.12 Religiosity

Similarly, there was no difference, significant or otherwise, between less than very religious respondents and very religious respondents in their attitudes to snow leopard conservation (Table 7.27). Religiosity has not been considered to date as a factor explaining attitudes to snow leopard conservation. This includes in a recent analysis of the connection between religiosity and attitudes to snow leopards (Bhatia et al., 2016), where increased religiosity was correlated with positivity to the species in Buddhist villages. Several interviewees[39] in this study suggested that a Buddhist non-violent conservation ethic was widespread and this may influence both very religious and less than very religious respondents alike in their support for snow leopard conservation. In multivariate analysis, on the basis of non-significant R^2 change scores, religiosity was not included in any of the multiple regression models. As with attitudes to snow leopards (see Section 7.8.3), given that age is more of a

39 Conservation leader, SNP; Community leader, ACA.

factor in explaining attitudes to snow leopard conservation, it may also correlate negatively with religiosity, in that older people are more likely to be more religious.

7.8.13 Study site

The prevailing governance model is often suggested as an important contributor to perceptions of conservation (Udaya Sekhar, 2003; Walpole and Goodwin, 2001). It is also a form of access to influence (Ribot, 2014; Ribot and Peluso, 2003), and therefore a key consideration in this study, with improved access to influence theoretically improving attitudes towards snow leopards and to their conservation. Yet this has rarely been tested (Karanth and Nepal, 2012). In part this is because variations between study sites cannot be definitely linked to one factor alone, such as governance. In this case, there was no significant difference in attitudes to snow leopard conservation between the less decentralised SNP and the more decentralised ACA (Table 7.27). This suggests that the theoretical assumption in the snow leopard conservation literature that decentralisation is the best option for snow leopard conservation (Ale and Karky, 2002; Jackson et al., 2010; Johansson et al., 2016) may be mediated, in practice, by more nuanced local contexts. On the basis of non-significant R^2 change scores, study site was not included in any of the multiple regression models during multivariate analysis.

7.9 Summary and conclusions

This chapter examined knowledge of and attitudes towards snow leopards, as well as attitudes to snow leopard conservation. My findings suggest that the majority of respondents could positively identify a snow leopard, were positive themselves towards the current and future presence of snow leopards and were also positive towards snow leopard conservation. The most significant factors explaining knowledge of snow leopards were the site, the gender of respondents and attitudes to snow leopard conservation. For attitudes to snow leopards the most important variables were the number of household livestock and attitudes to snow leopard conservation. Attitudes to snow leopards and household SLI scores were the most significant factors explaining attitudes to snow leopard conservation. This suggests that access to assets, especially livestock, can and does shape attitudes to snow leopards and their conservation, as noted previously in India (Suryawanshi et al., 2014). The result also show that there are close relationships between these attitudes and knowledge of snow leopards.

It is more challenging to equate access to influence to knowledge and attitudes. The significantly higher snow leopard identification scores in ACA, for example, are likely to be due the greater densities and more sustained presence of the species there rather than due to a more decentralised governance model. While there were no significant differences between attitudes to snow leopards or attitudes to snow leopard conservation between the sites, the latter index results mask significantly more positive attitudes to snow leopard conservation actors in SNP and to snow leopard conservation interventions in ACA. Indeed, snow leopard conservation may itself be seen as a form of influence, with attitudes to it shaping access to and engagement with its actors and interventions. This suggests that access to influence does shape attitudes to snow leopards conservation at the individual level, but in a more nuanced way than anticipated. The next chapter considers how livelihoods and governance, among other factors, affect livestock losses to snow leopards and conflicts with snow leopards at the household level.

8. Snow leopard impacts and snow leopard conservation conflicts

8.1 Introduction

The previous chapter analysed knowledge of and attitudes towards snow leopards, as well as attitudes to their conservation. This chapter examines human-snow leopard impacts and human-snow leopard conservation conflicts, at SNP, ACA and both sites combined during the previous 12 months. For impacts, it does so via self-reported household livestock losses to snow leopards and, for conflicts, it does so via self-reported household conflicts with snow leopard conservation. Impacts are analysed first, followed by conflicts. In both cases, I first present descriptive results, followed by inferential univariate and then multivariate results. Overall, the chapter seeks to answer the following research question: what impacts from snow leopards, and conflicts with snow leopard conservation, do households face, and which factors best explain these?

8.2 Snow leopard impacts

People were afraid with leopards, as leopards used to enter the corral and kill livestock. People were scared that leopards may attack them

Youth leader, ACA

Of the studies that have have analysed livestock depredation rates by snow leopards (see Table 2.2), only a few have also reported total herd losses per annum. These have included rates of 11.1% in western Nepal (Devkota et al., 2013), 10.6% in central China (Li et al., 2013), 12.6% also in central China (Alexander et al., 2015), and 19.0% in ACA, Nepal (Ale et al., 2014). In this study, the total of self-reported losses to all sources of mortality across all livestock classes gave an annual herd loss of 9.3% (Table 8.1). Therefore my findings are similar to those previously published studies. The one exception surveyed only half of the 20 settlements in their study area and the data may therefore be unrepresentative (Ale et al., 2014).

Table 8.1 Total household livestock losses in previous 12 months.

	Combined N = 705			SNP N = 260			ACA N = 445		
	Median	**Max.**	**Sum**	**Median**	**Max.**	**Sum**	**Median**	**Max.**	**Sum**
Cattle	0	7	152	0	5	47	0	7	105
Sheep/goats	0	18	435	0	0	0	0	18	435
Horses/mules/ donkeys	0	3	38	0	1	3	0	3	35
Yaks/yak hybrids	0	23	328	0	20	103	0	23	225
Other	0	10	64	0	0	0	0	10	64
Total losses	0	40	1017	0	6	153	0	40	864
Total losses as % of total herd	---	---	9.3	---	---	10.8	---	---	9.0

Mean losses of livestock by households differed significantly between study sites for some livestock categories (Table 8.2). ACA suffered higher rates of loss of sheep/goats, equines and other livestock species. Meanwhile rates of loss of cattle and yaks/yak hybrids were similar across the two sites. However, ACA experienced significantly higher levels of mean household livestock losses overall, probably because sheep and goats were phased out from SNP due to meet prevailing conservation policy (Bhuju et al., 2007), and also because snow leopard densities were higher in ACA (Ale et al., 2014; Aryal et al., 2012; DNPWC, 2013).

Table 8.2 Mean household livestock losses in previous 12 months.

	N	Combined ± SD	N	SNP ± SD	N	ACA ± SD	Difference
Cattle	705	0.28 ± 0.79	260	0.28 ± .077	445	0.28 ± 0.80	*t* (703) = 0.093
Sheep/goats	705	0.80 ± 2.31	260	0.00 ± 0.00	445	1.14 ± 2.70	*t* (579)= -8.27*
Horses/mules/ donkeys	705	0.07 ± 0.31	260	0.02 ± 0.13	445	0.09 ± 0.36	*t* (633)= -3.48*
Yaks/yak hybrids	705	0.60 ± 2.27	260	0.61 ± 1.82	445	0.59 ± 2.44	*t* (703)= 0.10
Other	705	0.12 ± 0.82	260	0.00 ± 0.00	445	0.17 ± 0.98	*t* (579)= -3.36*
Total	705	1.38 ± 3.20	260	0.49 ± 1.00	445	1.90 ± 3.86	*t* (540)= -7.31*

* $p = \leq 0.05$

Only one of the snow leopard predation studies listed above examined the financial impact of livestock losses overall. The economic value of total livestock losses to households in their sample from Central China was US$ 6,193 each over the previous 12 months (Li et al., 2013). This is considerably higher than the US$ 492 per herding household noted for SNP and ACA combined (Table 8.3) in this study. This difference may be due to higher average holdings of livestock in the study by Li et al (2013), particularly of more valuable large-bodied stock, such as yaks.

Table 8.3 Household livestock losses in financial terms in previous 12 months.

	Median value per animal (US$)	**Combined** N = 705		**SNP** N = 260		**ACA** N = 445	
		Lost	**Total value of losses (US$)**	**Lost**	**Total value of losses (US$)**	**Lost**	**Total value of losses (US$)**
Cattle	125	152	19,000	47	5,875	105	13,125
Sheep/ goats	150	435	65,250	0	0	435	65,250
Horses/ mules/ donkeys	950	38	36,100	3	2,850	35	33,250
Yaks/yak hybrids	450	328	147,600	103	46,350	225	101,250
Total value	---	953	267,950	153	55,075	864	212,875
Total value losses per household with livestock	---	---	492	---	338	---	557

Of the most important reasons for household livestock losses, snow leopards were found to be the primary cause of livestock mortality in this study (Table 8.4), a trend confirmed by some other studies (Aryal et al., 2014; Devkota et al., 2013) and by triangulation interviews (see Appendix 12.15.12). However, additional studies listed different factors, including predation by other carnivore species, as the main contributor to livestock losses (Ale et al., 2014; Alexander et al., 2015; Li et al., 2013). Several interviewees cited common leopards in SNP and jackals in ACA as significant predators of livestock.[40]

40 Teacher and microcredit cooperative officer, SNP; Conservation leader, SNP; Park officer, ACA; Buddhist lama, ACA.

Table 8.4 Most important reasons for household livestock losses in previous 12 months.

	Combined		**SNP**		**ACA**	
	Frequency	**%**	**Frequency**	**%**	**Frequency**	**%**
Disease	62	22.8	14	18.9	48	24.2
Weather	26	9.6	1	1.4	25	12.6
Snow leopards	90	33.1	23	31.1	67	33.8
Other predators	48	17.6	6	8.1	42	21.2
Theft	0	0.0	0	0.0	0	0.0
Accident	33	12.1	27	36.5	6	3.0
Other	13	4.8	3	4.1	10	5.1
Total	272	100.0	74	100.0	198	100.0

Having considered total livestock mortality, I now move to consider losses specifically caused by snow leopards. The overall loss of livestock to snow leopards experienced by households was 16.6%, comprising 11.5% in SNP and 18.0% in ACA. The annual overall loss to the species as a percentage of the total herd was 3.4% (Table 8.5), approximately a third of total losses, which is also consistent with the proportions of those reporting the species as the primary cause of livestock loss (Table 8.4). This figure is also the same as the mean of the studies detailed in Table 2.2, which reported annual livestock predation rates by snow leopards of between 0.3% and 12.0% (Ale et al., 2014; Alexander et al., 2015; Aryal et al., 2014; Chen et al., 2016; Devkota et al., 2013; Jackson and Wangchuk, 2001; Li et al., 2013; Maheshwari et al., 2013; Mishra, 1997; Namgail et al., 2007). There appear to be no published estimates of livestock losses to snow leopards in SNP, apart from a figure of 1.9% estimated for the Phortse area (Ale et al., 2007). The figure of 3.7% recorded in this study for SNP may be may higher due to common leopards kills being conflated with snow leopards kills (S. Lovari*, pers comm*).

Table 8.5 Household livestock losses to snow leopards in previous 12 months.

	Combined N = 705			**SNP** N = 260			**ACA** N = 445		
	Med-ian	**Max.**	**Sum**	**Med-ian**	**Max.**	**Sum**	**Med-ian**	**Max.**	**Sum**
Cattle	0	5	44	0	3	19	0	5	25
Sheep/goats	0	12	107	0	0	0	0	12	107
Horses/mules/ donkeys	0	2	22	0	1	3	0	2	19
Yaks/yak hybrids	0	21	200	0	9	30	0	21	170
Other	0	0	0	0	0	0	0	0	0
Total	0	21	373	0	9	52	0	21	321
Total losses as % of total herd	---	---	3.4	---	---	3.7	---	---	3.36

When mean household livestock losses to snow leopards are compared and contrasted between SNP and ACA, the data shows two significant differences (Table 8.6): (i) killings of sheep/goats were higher in ACA, where significantly higher numbers occurred (see Table 6.3), (ii) while killings of cattle were significantly higher in SNP, even though there were significantly lower numbers of cattle in SNP than in ACA (see Table 6.3). The difference may be due to the absence of sheep/goats from SNP for conservation reasons (Bhuju et al., 2007) and the relatively low densities of Himalayan tahr (Lovari et al., 2009), leading to increased snow leopard predation on cattle. Losses of yaks/yak hybrids and equines were not significantly different between the two study sites, even though ACA supports significantly higher numbers of equines.

Table 8.6 Mean household livestock losses to snow leopards in previous 12 months.

	N	**Combined ± SD**	**N**	**SNP ± SD**	**N**	**ACA ± SD**	**Difference**
Cattle	705	0.28 ± 0.76	260	0.61 ± 0.80	445	0.20 ± 0.73	*t* (443) = -2.61*
Sheep/goats	705	0.69 ± 1.92	260	0.00 ± 0.00	445	0.86 ± 2.11	*t* (523) = 4.56*
Horses/mules/ donkeys	705	0.14 ± 0.42	260	0.09 ± 0.30	445	0.15 ± 0.44	*t* (703) = 0.72
Yaks/yak hybrids	705	1.27 ± 2.97	260	0.97 ± 1.70	445	1.35 ± 3.20	*t* (489)= 0.91
Other	705	0.00 ± 0.00	260	0.00 ± 0.00	445	0.00 ± 0.00	n/a
Total	705	0.65 ± 2.10	260	0.26 ± 0.60	445	0.82 ± 2.46	*t* (475) = 4.16*

* $p = \leq 0.05$

The value of livestock losses to snow leopards was less evenly spread between the two sites than the value of livestock losses overall (Table 8.7), with a bias towards ACA. This is probably due to smaller populations of snow leopards and sheep/goats in SNP (Bhuju et al., 2007; DNPWC, 2013). The combined figure of US$ 243 worth of livestock losses per herding household in the previous 12 months is within the range of figures reported elsewhere. These included widely varying figures of US$ 33.80 in Upper Mustang, ACA (Aryal et al., 2014), US$ 128 and US$ 190 in Ladakh, India (Mishra, 1997; Namgail et al., 2007) and US$ 646 in central China (Li et al., 2013).

Table 8.7 Household livestock losses to snow leopards in financial terms in previous 12 months.

	Mean value per animal (US$) ± SD	**Combined** N = 705		**SNP** N = 260		**ACA** N = 445	
		Lost	**Total value of losses (US$)**	**Lost**	**Total value of losses (US$)**	**Lost**	**Total value of losses (US$)**
Cattle	125	44	5,500	19	2,375	25	3,125
Sheep/ goats	150	107	16,050	0	0	107	16,050
Horses/ mules/ donkeys	950	22	20,900	3	2,850	19	18,050
Yaks/yak hybrids	450	200	90,000	30	13,500	170	76,500
Total	---	373	132,450	52	18,725	321	113,725
Total value losses per household with livestock	---	---	243	---	115	---	298

Analysis of the spatial dimensions of livestock losses to snow leopards indicated a clear bias towards high pastures (Table 8.8). The figure of 71.1% from questionnaires is also corroborated by triangulation interviews, which gave an estimate of 61.4% (see Appendix 12.15.13). The influence of geographical factors in depredation rates is well documented in the literature for snow leopards (Chen et al., 2016; Xu et al., 2008), as well as for other carnivore species (Li et al., 2009; Michalski et al., 2006; Palmeira et al., 2008; Tortato et al., 2015).

Table 8.8 Most frequent locations of household livestock losses to snow leopards in previous 12 months.

	Combined N = 114		SNP		ACA	
	Frequency	**%**	**Frequency**	**%**	**Frequency**	**%**
High pasture	81	71.1	14	45.2	67	80.7
Low pastures	15	13.2	8	25.8	7	8.4
Barren land	2	1.8	0	0.0	2	2.4
Cultivated land/ settlement	15	13.2	9	29.0	6	7.2
Other	1	0.9	0	0.0	1	1.2
Total	114	100.0	31	100.0	83	100.0

The temporal dimensions of livestock losses to snow leopards showed that half of such killings took place during winter (Table 8.9), a clear trend reported elsewhere in the literature for Nepal (Devkota et al., 2013), including for ACA (Aryal et al., 2014; Oli et al., 1994). The same trend has also been observed in in Mongolia (Johansson et al., 2015). Triangulation interviews also confirmed winter as the key time for livestock kills by snow leopards in both ACA and SNP, with a combined figure of 50% (see Appendix 12.15.13).

Table 8.9 Most frequent timings of household livestock losses to snow leopards in previous 12 months.

	Combined		**SNP**		**ACA**	
	Frequency	**%**	**Frequency**	**%**	**Frequency**	**%**
Winter (mid-Nov to mid-Feb)	55	50.0	14	51.9	41	49.4
Spring (mid-Feb to mid-May)	16	14.5	2	7.4	14	16.9
Summer (mid-May to mid-Aug)	16	14.5	3	11.1	13	15.7
Autumn (mid-Aug to mid-Nov)	14	12.8	5	18.5	9	10.8
Not sure	9	8.2	3	11.1	6	7.2
Total	110	100.0	27	100.0	83	100.0

8.3 Explaining snow leopard impacts

Last year, few snow leopards were seen. This year, many people have gone to Kathmandu and left animals unprotected in pastures.

Community leader, SNP

The social factors which explain impacts on households from snow leopards, i.e. livestock losses, have been less considered than the ecological factors. In this study, eleven independent variables were therefore analysed for their potential role in explaining livestock losses to snow leopards, in both univariate (Tables 8.13 & 8.14) and multivariate analyses (Tables 8.10, 8.11 & 8.12). The order of inclusion in the multiple regression models was hierarchical, based on similar modelling in other published studies (Dar et al., 2009; Hemson et al., 2009; Karanth et al., 2012; Suryawanshi, 2013). The order of discussion below is based on the standardised *b* scores listed in the combined model (Table 8.10).

Table 8.10 Linear model explaining household livestock losses to snow leopards.

R^2 = .430 N = 705	***b***	***SE B***	***Standardised b***	***p***
Constant	.019 (-.007, .044)	.013	---	p = .18
Number of livestock owned by household (log^{10} scale)	-.022 (-.049, .001)	.013	-.061	p = .094
Total household members	-.004 (-.010, .002)	.003	-.040	p = .17
Number of livestock lost by household (log^{10} scale)	.47 (.37, .55)	.044	.69	p = .001

Note. Potential predictor variables excluded from regression modelling due to equality of mean: cultivation as primary source of household income (t = -0.38, *p* = .71); other types as primary source of household income (t = -0.86, *p* = .39). Potential predictor variables excluded from regression modelling due to a lack of correlation: household adult literacy rate (r = -0.058, *p* = .12); Sustainable Livelihoods Index score (t = 0.30, *p* = .46). This model had the highest significant R^2 change score (.32, p = <.001) out of the seven models tested; variables excluded from final model due to lower R^2 change scores when included in successive models: livestock as primary source of household income; tourism as primary source of household income; number of conflicts with snow leopard conservation; governance model.

Table 8.11 Linear model explaining household livestock losses to snow leopards in SNP.

R^2 = .388 N = 260	*b*	*SE B*	*Standardised b*	*p*
Constant	.00 (-.029, .032)	.016	---	p = .99
Number of livestock owned by household (log^{10} scale)	.002 (-.024, .027)	.013	.006	p = .90
Total household members	.00 (-.007, .006)	.003	-.003	p = .97
Number of livestock lost by household (log^{10} scale)	.38 (.26, .52)	.065	.62	p = .001

Note. Potential predictor variables not included in analysis due to small sample size in a category: livestock as primary source of household income (yes = 23); cultivation as primary source of household income (yes = 23); household conflicts with snow leopard conservation (yes = 10). Potential predictor variables excluded from regression modelling due to equality of mean: other types as primary source of household income (t = 1.45, *p* = .15); tourism as primary source of household income (t = -0.97, *p* = .33). Potential predictor variables excluded from regression modelling due to a lack of correlation: household adult literacy rate (r = 0.39, *p* = .53); Sustainable Livelihoods Index score (r = 0.50, *p* = .45). This model had the highest significant R^2 change score (.30, p = <.001) out of the three models tested.

Table 8.12 Linear model explaining household livestock losses to snow leopards in ACA.

R^2 = .431 N = 445	*b*	*SE B*	*Standardised b*	*p*
Constant	-.049 (-.11, .017)	.030	---	p = .10
Number of livestock owned by household (log^{10} scale)	-.035 (-.076, .003)	.020	-.078	p = .088
Number of livestock lost by household (log^{10} scale)	.49 (.39, .59)	.052	.69	p = .001

Note. * = 0 = no; 1 = yes. Potential predictor variables excluded from regression modelling due to equality of means: tourism as primary source of household financial income (t = 1.22, *p* = .23); cultivation as primary source of household financial income (t = 1.44, *p* = .15); other types as primary source of household financial income (t = -1.25, *p* = .22). Potential predictor variables excluded from regression modelling due to a lack of correlation: household adult literacy rate (r = -0.069, *p* = .15); household size (r = 0.049, *p* = .30); Sustainable Livelihoods Index score (r = 0.004, *p* = .93). This model had the highest significant R^2 change score (.34, p = <.001) out of the four models tested; variables excluded from final model due to lower R^2 change scores when included in successive models: livestock as primary source of financial income; number of conflicts with snow leopard conservation.

8.3.1 Livestock lost

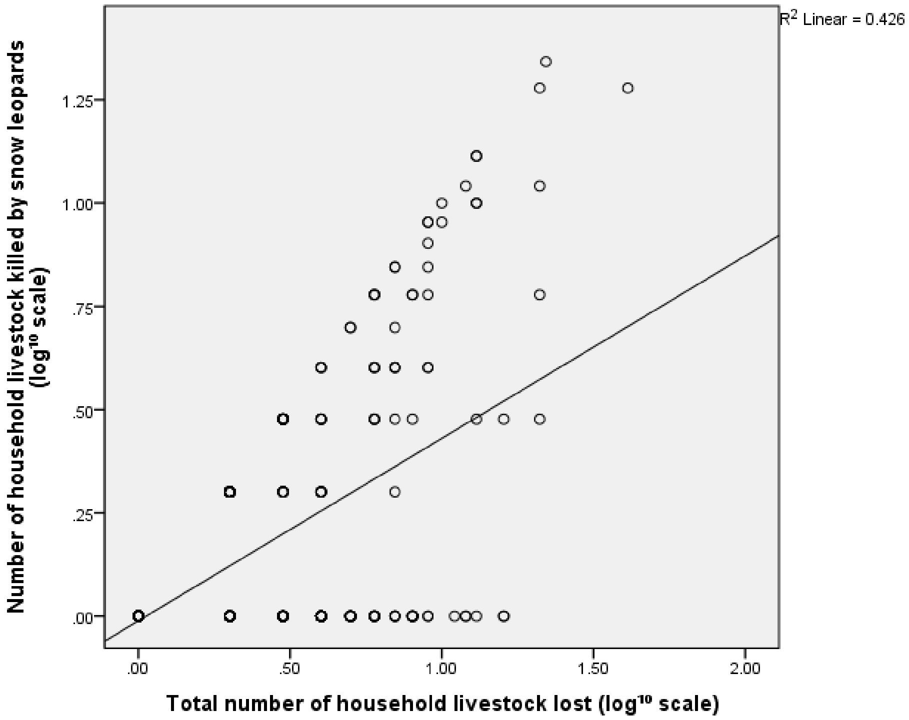
Many studies have noted a connection between livestock losses to predators and poor guarding or husbandry practices (Daniel Kissling et al., 2009; Karanth et al., 2012; Kolowski and Holekamp, 2006; Peña-Mondragón et al., 2017; Wang and Macdonald, 2006). In this study, using the total number of household livestock lost to all sources of mortality (Table 8.4) as a proxy for husbandry standards,[41] the data showed a strong, positive relationship between this indicator and livestock killed by snow leopards in univariate analysis (Figure 8.1 and Table 8.14). The effect size was almost twice that of total household livestock owned. Yet, where husbandry has been identified as a problem previously, herders were either unwilling to change their practices (Jackson and Wangchuk, 2001) or perceived that predator population increases were to blame (Chen et al., 2016). In addition, the growth of tourism in snow leopard habitat may reduce the availability of labour for livestock guarding in both ACA (Ale et al., 2014) and SNP (Ale et al., 2007), as some interviewees also suggested.[42]

Overall, household livestock losses was also the only explanatory variable that was significant in each of the three multivariate models. It explained 69% of the variation in ACA (Table 8.12), 62% in SNP (Table 8.11) and 69% overall (Table 8.10). As discussed in Section 8.3.2, this variable is used as a proxy for husbandry standards in this study. Studies in Argentina (Daniel Kissling et al., 2009), India (Karanth et al., 2012), Kenya (Kolowski and Holekamp, 2006), and Bhutan (Wang and Macdonald, 2006) have all found a correlation between husbandry practices and livestock losses to carnivores. Various researchers have also identified husbandry practices as a key concern for snow leopard conservation (Ale et al., 2014, 2007; Chen et al., 2016; Jackson et al., 2010; Jackson and Wangchuk, 2001). The importance of this variable was approximately equal in both SNP and ACA, despite significantly lower livestock holdings in the former (see Table 6.3).

41 Note that this proxy is used because farmers who lose livestock to one form of mortality due to poor husbandry standards, such as irregular checking, are also more likely to be losing more livestock to other forms of mortality due to the same poor husbandry standards. Therefore overall livestock losses are likely to rise as husbandry standards decrease, and vice versa.

42 Hotel owners, SNP; Buddhist monk, SNP; Teacher, SNP; Community leader, ACA.

Figure 8.1 Scatterplot showing the relationship between household livestock losses to snow leopards (log¹⁰ scale) and total number of household livestock lost (log¹⁰ scale).



8.3.2 Livestock owned

A significant positive relationship between the total number of household livestock owned and the total number of household livestock killed by snow leopards was also found during univariate analysis (Figure 8.2 & Table 8.14). This is consistent with the findings of other studies of carnivores in Pakistan (Dar et al., 2009), India (Karanth et al., 2012) and Botswana (Hemson et al., 2009). To date, this variable does not seem to have been considered in other analyses of livestock losses to snow leopards. However, a positive correlation with density of stock has been found in several cases (Alexander et al., 2016; Berger et al., 2013; Suryawanshi, 2013; Tumursukh et al., 2016).

Total livestock owned per household was also the only explanatory variable included in all three of the multivariate models (Tables 8.10, 8.11 & 8.12). However, it was not significantly associated with losses to snow leopards in any of them. While other studies have found numbers of livestock owned to be significant in their regression models of livestock killed by carnivores (Dar et al., 2009; Karanth et al., 2012), its absence here suggests that total livestock lost rather than total livestock owned may be a more accurate factor explaining snow leopard depredations here.

Figure 8.2 Scatterplot showing the relationship between household livestock losses to snow leopards (log¹⁰ scale) and total household livestock owned (log¹⁰ scale).

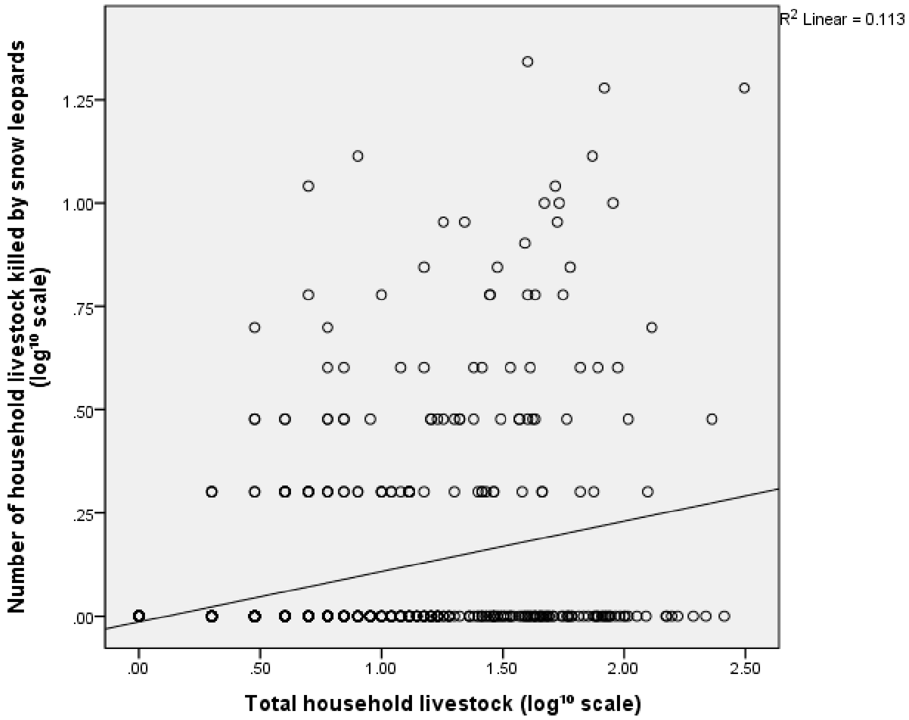


Table 8.13 Individual independent t-tests comparing household livestock killed by snow leopards for a joint sample.

Variable	Category 0	Mean ± SD	Category 1	Mean ± SD	Difference	*t*	*df*	*p*	Effect size
Livestock as primary income	No	.074 ± .0081	Yes	.20 ± .047	-.12. (-.22, -.036)	-2.61	49	.016	-.22
Tourism as primary income	.No	.095 ± .011	Yes	.054 ±.011	.041. (.012, .073)	2.71	617	.012	.10
Study site	Sagarmatha	.043 ± .0076	Annapurna	.11 ± .012	-.063 (-.090, -.035)	-4.40	682	.001	-.16
Other sources as primary income	No	.080 ± .0085	Yes	.10 ± .028	-.021. (-.080, .035)	-0.86	703	.50	-.041
Cultivation as primary income	No	.080 ± .011	Yes	.086 ± .013	-.0063 (-.039, .030)	-0.38	703	.69	-.014

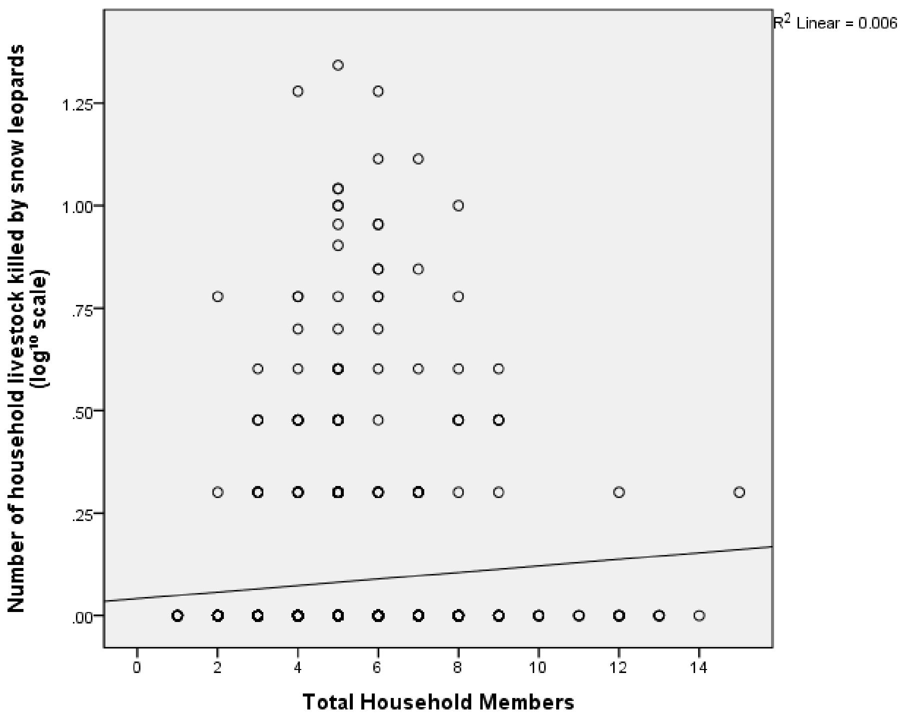
Table 8.14 Individual linear models explaining household livestock killed by snow leopards for a joint sample.

Variable	Constant *b*	Constant SE *B*	Constant *p*	Variable *b*	Variable *SE B*	Variable *Standardised b*	*Variable p*
Livelihood scores	.051 (-.018, .11)	.035	.15	.062 (-.070, .21)	.065	.030	p = .35
Livestock owned	-.014 (-.032, .004)	.009	.13	.12 (.092, .16)	.017	.34	p = .001
Livestock lost	-.011 (-.019, -.003)	.004	.004	.44 (.36, .52)	.040	.65	p = .001
Household size	.041 (.008, .075)	.016	.010	.008 (.002, .014)	.003	.077	p = .005
Conflicts with snow leopard conservation	.074 (.060, .091)	.008	.001	.086 (.015, .17)	.039	.14	p = .021
Household adult literacy rate	.10 (.069, .14)	.018	.001	-.040 (-.090, .008)	.026	-.058	p = .13

8.3.3 Household size

A significant positive relationship between household livestock killed by snow leopards and total household members was found to exist during univariate analysis (Figure 8.3 & Table 8.14). However, the effect, shown by standardised *b* scores, was weak. While considerable attention has been paid to the link between human population density and human-wildlife impacts (Ripple et al., 2014; Woodroffe, 2000), at the finer scale of the household level, less analyses have considered this variable. One study, though, found it to be significantly and positively associated with self-reported livestock losses around a central Indian PA (Karanth et al., 2012). In multivariate analysis, household size was included in the SNP and combined models, but not the ACA model. In both cases, however, it was not significant as an explanatory variable, which was unsurprising given the weak, positive univariate relationship discussed above. Its inclusion in the SNP, but not the ACA, model may be explained by the significantly smaller mean household size in SNP (see Table 6.1).

Figure 8.3 Scatterplot showing the relationship between household livestock losses to snow leopards and total household members.



8.3.4 Livestock as primary income source

Households whose primary income came from livestock had experienced significantly higher losses of livestock to snow leopards (Table 8.14). Loses of livestock had the strongest effect size of the five binary explanatory variables considered. Of the studies reviewed, this variable had not been considered as a potential explanatory factor of livestock losses (Dar et al., 2009; Hemson et al., 2009; Karanth et al., 2012), despite numerous studies correlating it with attitudes to carnivores (Carter et al., 2014; Romanach et al., 2007; Tessema et al., 2010). In multivariate analysis, livestock as the primary source of household income was excluded due to lower R^2 change scores in the joint (Table 8.10) and ACA (Table 8.12) models. With the SNP model (Table 8.11), the sample size in the 'yes' category was less than 30 and the variable was therefore discounted from multivariate analysis.

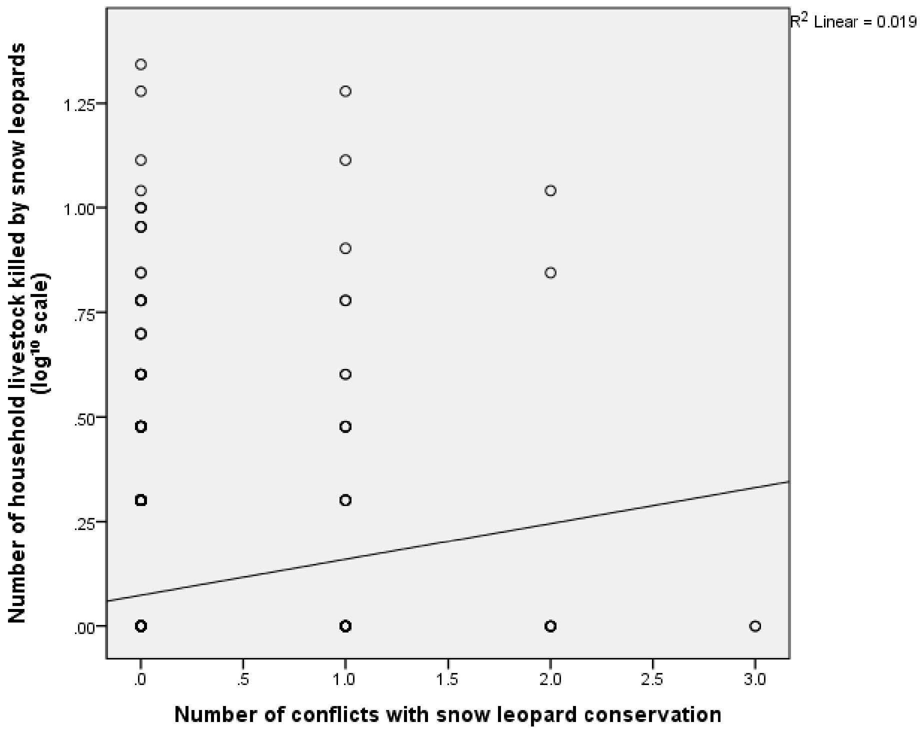
8.3.5 Tourism as primary income source

Like households where livestock was the primary income source, the impacts of snow leopards on households that relied on tourism as their main livelihood were also significantly different from those who did not. However, the relationship in this case was the reverse of the previous one: households that were more reliant on tourism experienced significantly less livestock losses to snow leopards (Table 8.14). Although the use of pack animals for tourism can increase their numbers in snow leopard habitat (Geneletti and Dawa, 2009), such livestock may be less likely to be unguarded in high pastures and in winter, they key places and times for livestock kills by snow leopards in both SNP and ACA (see Tables 8.8 & 8.9). In multivariate analysis, tourism as the primary source of household income was excluded from the combined multiple regression model due to lower R^2 change scores (Table 8.10). It was not included in either the SNP (Table 8.11) or ACA (Table 8.12) models due to its non-significant relationship with the dependent variable. As discussed in the previous chapter, the inclusion of the SLI scores variable in the models reduced the sample size compared to the univariate analysis discussed in this section.

8.3.6 Snow leopard conservation conflicts

Although much less emphatic than the relationship between attitudes to snow leopards and attitudes to snow leopard conservation (see Section 7.3.1), univariate analysis showed that a significant positive relationship existed between household livestock losses to snow leopards and household conflicts with snow leopard conservation (Figure 8.4 & Table 8.14). This is assumed in the snow leopard conservation literature (Jackson et al., 2010) but has not been considered empirically to date (Rosen et al., 2012). Given the potential impacts of snow leopard predations, such as the loss of up to 21 yaks/yak hybrids by a single household in ACA (Table 8.5), it is, in fact, surprising that the relationship is not stronger. The direction, however, is likely to be the reverse i.e. that losses drive conflict rather than that conflicts drive losses. In multivariate analysis, household conflicts with snow leopard conservation was excluded from the combined (Table 8.10) and ACA (Table 8.12) multiple regression models due to lower R^2 change scores. In addition, it not included in the SNP model (Table 8.11) due to its non-significant relationship with the dependent variable.

Figure 8.4 Scatterplot showing the relationship between household livestock losses to snow leopards and number of conflicts with snow leopard conservation.



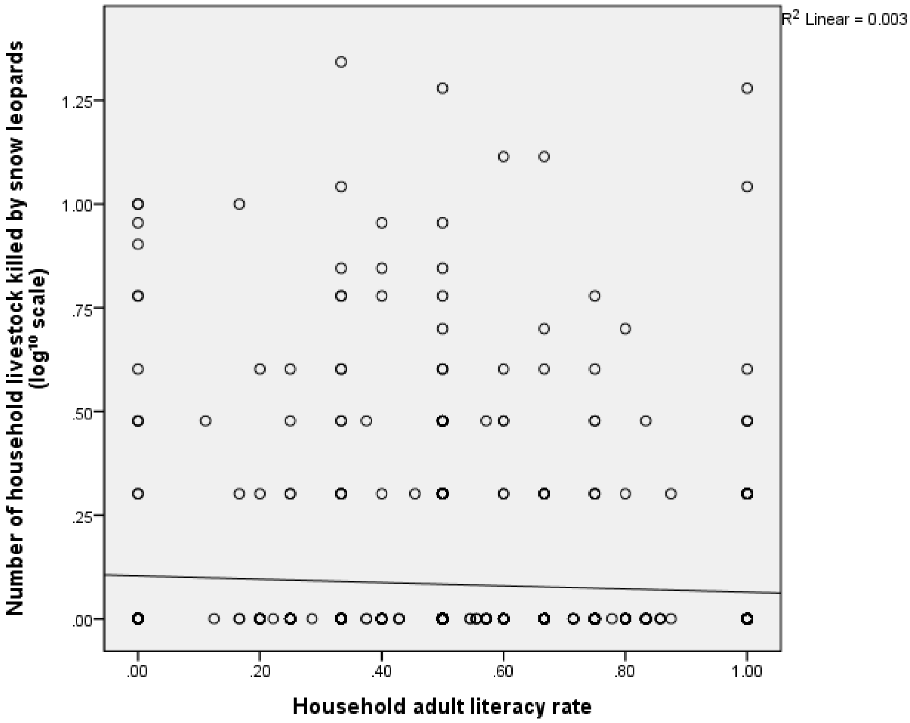
8.3.7 Study site

Livestock losses to snow leopards were significantly higher in ACA than in SNP in univariate analyses (Table 8.13). This is likely to be due to the socio-economic and ecological characteristics of these PAs, principally lower numbers of snow leopards and sheep/goats in SNP (Bhuju et al., 2007; DNPWC, 2013), rather than their governance models. Governance model is more likely to have a bearing on social interactions, such as household conflicts with snow leopard conservation, which is considered from Sections 8.4 to 8.5. For example, a study in Tanzania found that there were higher levels of HWI in CBC programme areas than in control areas outside of PAs (Salerno et al., 2015), but they did not compare HWI levels between decentralised and centralised PAs. In multivariate analysis, lower R^2 change scores resulted in household conflicts being excluded from the combined (Table 8.10) and ACA (Table 8.12) models. Due to the small number of households (n = 10) recording conflicts with snow leopard conservation in SNP, the variable was excluded from multivariate analysis in this model (Table 8.11).

8.3.8 Household adult literacy

Literacy rate is a factor that has often been considered in analyses of attitudes to carnivores, albeit it at the individual level (Carter et al., 2014; Romanach et al., 2007; Suryawanshi et al., 2014). However, none of the studies of human-wildlife impacts which were reviewed considered it as an explanatory factor (Alexander et al., 2015; Dar et al., 2009; Hemson et al., 2009; Karanth et al., 2012; Li et al., 2013). In this case, univariate analysis showed a weak, negative and non-significant relationship between the household adult literacy rate and numbers of household livestock lost to snow leopards (Figure 8.5 & Table 8.14). In multivariate analysis, due to this lack of significance, household adult literacy rate was not included in any of the multiple regression models (Tables 8.10, 8.11 & 8.12).

Figure 8.5 Scatterplot showing the relationship between household livestock losses to snow leopards and household adult literacy rate.



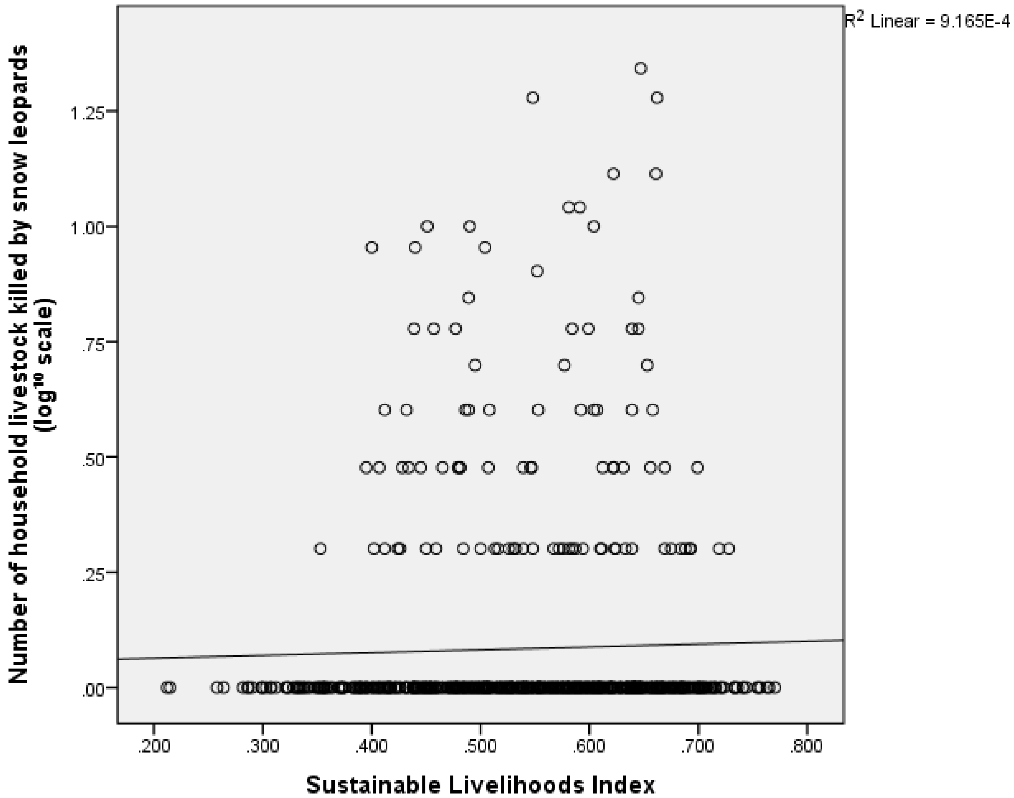
8.3.9 Other primary income sources

There was a non-significant difference between households who had other primary income sources and households who did not, i.e. who were reliant on livestock, tourism or cultivation as their main source of income. While household livestock losses were higher amongst those reliant on other income sources, they were not significantly higher (Table 8.13). As Section 5.3.7 discusses, this demographic may include low-paid wage labourers who lack access to land or livestock. It was associated with lower SLI scores in this case. In a Tanzanian PA, those with access to fewer assets were more vulnerable to livestock losses (Salerno et al., 2015), an assessment shared by others (Dickman, 2010; Hemson et al., 2009; Ikeda, 2004; Inskip et al., 2013; Romanach et al., 2007). The variable was not included in any of the multiple regression models because its univariate relationship with household livestock losses to snow leopards was not significant.

8.3.10 Livelihoods

Livelihood issues have been considered less as factors explaining livestock losses than of attitudes, largely because of the autonomous nature of carnivores acting independently of livestock herders and their circumstances. However, social factors, including livelihoods, as well as environmental ones, also shape human-wildlife impacts (Carter et al., 2012; Dickman, 2010). A study in a Tanzanian PA, for example, found a correlation between levels of food insecurity and levels of HWI (Salerno et al., 2015), while a significant association between livestock lost to predators and presence of an electricity supply was observed in Pakistan (Dar et al., 2009). In this study, livelihoods, as measured by Sustainable Livelihoods Index scores, were not significantly correlated with numbers of livestock killed by snow leopards in univariate analysis (Table 8.14). This is despite several interviewees in SNP suggesting that wealthier owners left livestock alone when they migrated to Kathmandu for the winter, making them more vulnerable to predation and other forms of livestock mortality.[43] Wealthy livestock owners are also more able to absorb the costs of livestock losses than poorer herders. As a result of this non-significant relationship, SLI scores were not included in any of the multivariate models (Tables 8.10, 8.11 & 8.12).

Figure 8.6 Scatterplot showing the relationship between household livestock losses to snow leopards and Sustainable Livelihoods Index scores.



43 Community leader, SNP; Livestock herder, SNP.

8.3.11 Cultivation as primary income source

The agroecological systems common in the Himalayan regions often rely on livestock as source of fertility and traction for cultivation (Aase et al., 2013; Partap, 1999). This study found that households reliant on cultivation experienced more livestock losses than those who were not (Table 8.13). However, households whose primary income source was from cultivation did not suffer significantly higher levels of livestock loss to snow leopards than households whose primary income was not cultivation. Impacts related to crop cultivation are more often associated with herbivores (Karanth et al., 2012); blue sheep in the case of ACA (Ale et al., 2014) and Himalayan thar in the case of SNP (Ale and Brown, 2009). In multivariate analysis, this non-significant relationship meant that it was excluded from both the combined (Table 8.10) and ACA (Table 8.12) models, while the small number of households reporting cultivation as their primary income source in SNP (n = 23) resulted in the variable being excluded from the SNP model (Table 8.11).

8.4 Snow leopard conservation conflicts

Locals blame ACAP for not helping [with compensation] but they should blame the government for funding snow leopard research projects and not putting money in the compensation fund. The process is also too difficult for locals.

Park officer, ACA

This appears to be the first study to empirically assess conflict between people and snow leopard conservation, alongside the well-documented ‘conflict’ between people and snow leopards discussed above. Therefore, this provides initial data on the trend, filling an information gap outlined previously by (Rosen et al., 2012). However, as no other known research exists on the topic, including with other large carnivores and despite suggestions in the literature of its importance (Linnell et al., 2005), there are no sources of data with which to compare these figures.

What is striking, however, is that instances of conflict were experienced by only 7.7% of households surveyed (Table 8.15). This confirms anecdotal evidence from ACA (Jackson et al., 1996) and SNP (Ale et al., 2007) that conflict with snow leopard conservation is relatively infrequent. These figures can also be compared with 16.6% of total households who experienced livestock losses to snow leopards (see Section 8.2), suggesting that approximately half of these households also experienced conflict with snow leopard conservation. Triangulation interviews, however, found considerably higher rates of conflict (see Appendix 12.15.15), suggesting that actual cases of conflict may be under-reported.

Table 8.15 Household conflicts with snow leopard conservation in previous 12 months.

	Combined N = 705		**SNP** N = 260		**ACA** N = 445	
	Frequency	**%**	**Frequency**	**%**	**Frequency**	**%**
Zero	651	92.3	250	96.2	401	90.1
One	44	6.2	7	2.7	37	8.3
Two	8	1.1	2	0.8	6	1.3
Three	2	0.3	1	0.4	1	0.2
Total	705	100.0	260	100.0	445	100.0

Instances of household conflict with snow leopard conservation can also be compared across study sites. There were significantly more cases of such conflict in ACA than in SNP (Table 8.16). In part, this is due to the significantly higher rates of livestock losses to snow leopards in ACA (Table 8.6), which itself occurs due to differing socio-economic and ecological conditions in the two PAs (Ale et al., 2014, 2007; Bhuju et al., 2007). However, as conflict with conservation is also a product of conservation governance (Marchini, 2014; Redpath et al., 2015), the higher rate in ACA may be due to real or perceived mismanagement of snow leopard conservation by the NGO partner, and/or the CBOs, in the PA's decentralised co-management model.[44]

Table 8.16 Mean household conflicts with snow leopard conservation in previous 12 months.

Household conflicts with snow leopard conservation	**N**	**Combined ± SD**	**N**	**SNP ± SD**	**N**	**ACA ± SD**	**Difference**
	705	.09 ± .35	260	.05 ± .30	445	.12 ± .38	*t* (643) = -2.44*

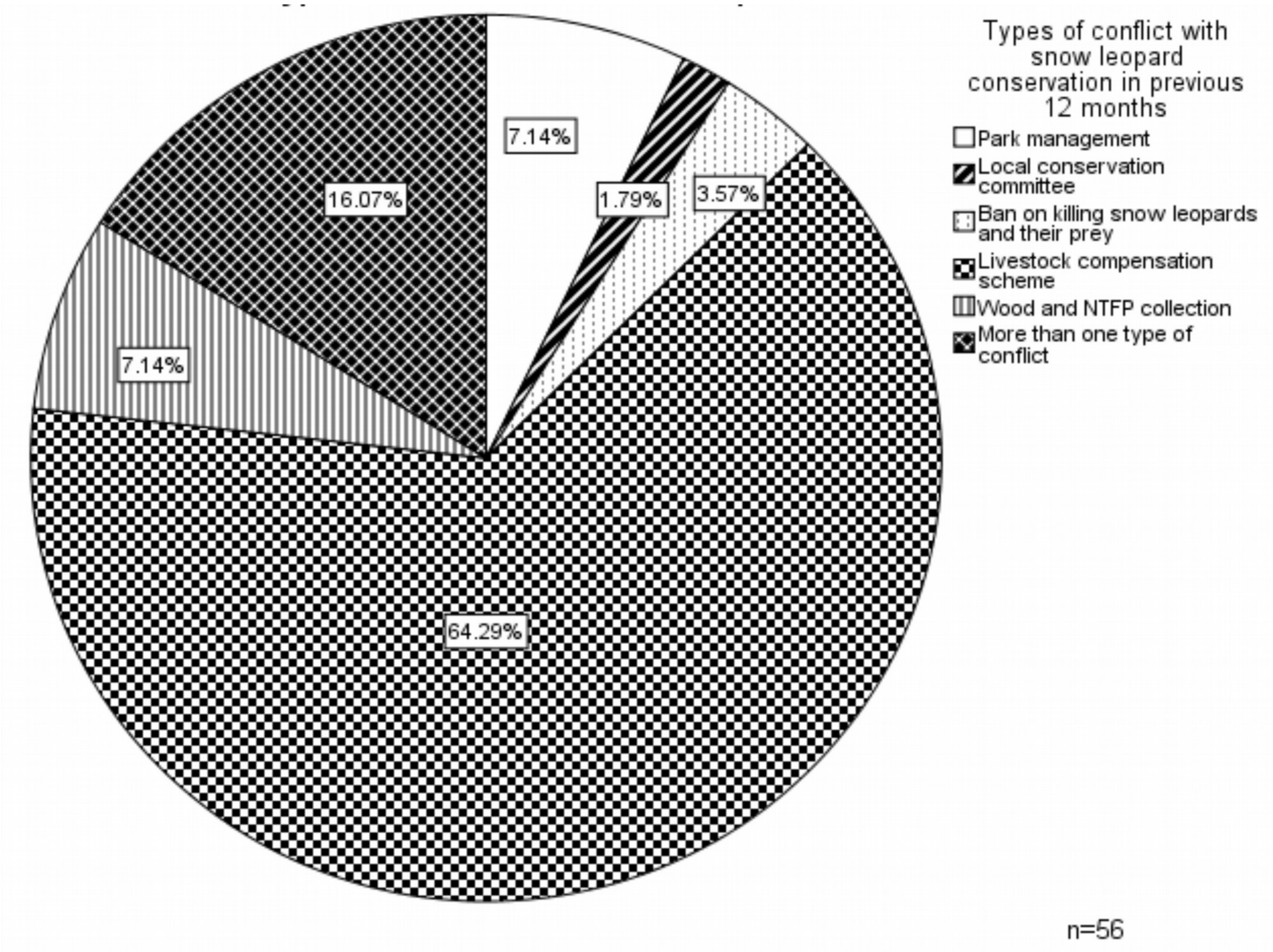
* *p* = ≤0.05

Household conflicts with snow leopard conservation can also be broken down into conflicts with particular snow leopard conservation actors and specific snow leopard conservation interventions (Figure 8.7). Among the former, there are more conflicts with PA authorities – the DNPWC in SNP and the NTNC in ACA – than there are with local conservation committees, a trend consistent with the literature on CBC (Bajracharya et al., 2006;

44 Teacher, ACA; Youth leader x 2, ACA; Community leader, ACA.

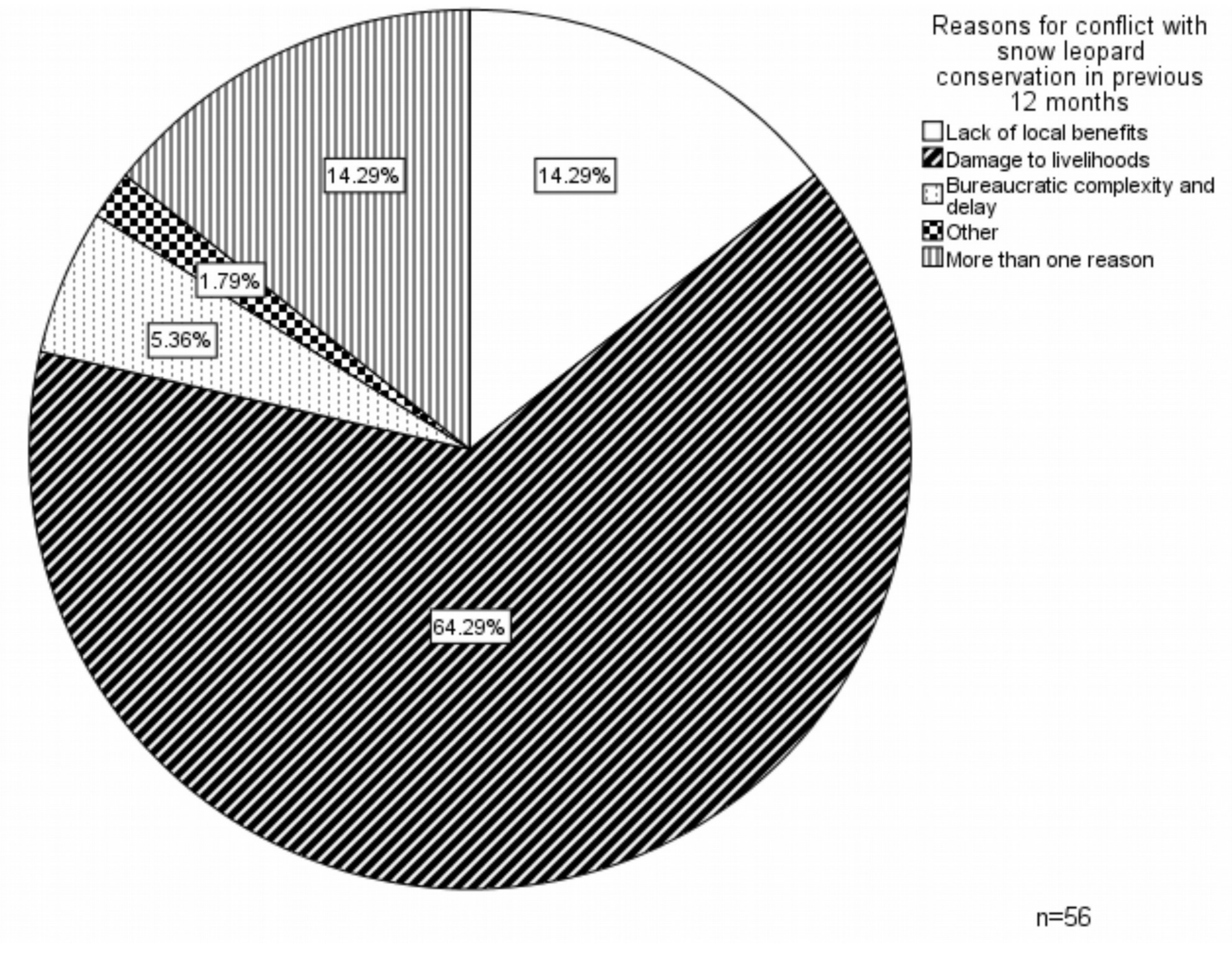
Budhathoki, 2004; Foggin, 2012; Wells and McShane, 2004). However, the most frequent conflict types were related to various interventions, suggesting that household altercations with snow leopard conservation can be complex and multi-faceted, as found with other carnivore species in Namibia (Rust et al., 2016). Of these, the livestock compensation scheme was the most frequently cited element of snow leopard conservation that was cited as problematic, an occurrence noted elsewhere in the snow leopard literature (Alexander et al., 2015; Chen et al., 2016). This is discussed in greater detail below.

Figure 8.7 Types of household conflict with snow leopard conservation in previous 12 months.



The reasons for these household conflicts are also varied (Figure 8.8). As with types of conflicts, the relative frequency of >1 reason suggests that negative household interactions with snow leopard conservation can have more than one cause, as suggested for other carnivore species in Namibia (Rust et al., 2016). However, damage to livelihoods is clearly the most common reason for these altercations, with almost two-thirds of respondents citing this in each PA. Triangulation interviews corroborated these findings (see Appendix 12.15.15), with 89% of interviewees suggesting 'livelihood damage' and 'bureaucracy and livelihood damage' as the main reasons for conflicts. These observations are also consistent with the literature, particularly on the potential constraints of PAs on livelihoods (Adams and Hutton, 2007; Budhathoki, 2004; Hussain, 2000; Khan and Bhagwat, 2010; Rastogi et al., 2012; Tamang and Baral, 2008).

Figure 8.8 Reasons for household conflict with snow leopard conservation in previous 12 months.



Compensation for livestock losses to snow leopards was also analysed separately. Of the 111 households eligible for compensation, 93% had not, or not yet, received it. This is similar to findings in India (Karanth et al., 2013) and China (Alexander et al., 2015), with payment made in only 31% of cases in the Indian study. There was, however, no significant difference in the mean likelihood of compensation for livestock losses to snow leopards between SNP and ACA (Table 8.17). This is despite the scheme being more comprehensive and better established in ACA, as compensation likelihood in triangulation interviews suggests (Table 8.18). This may explain why ACA has significantly higher levels of household conflict with snow leopard conservation (Table 8.16). For example, CBC may have effectively over-promised and under-delivered in ACA, resulting in heightened expectations of effective conservation solutions, such as compensation schemes, and greater disappointment when these fail, are perceived to have failed or suffer from any number of challenges. This may also explain the significantly less positive attitudes to park management and to local conservation committees in ACA than in SNP (Table 7.21). The DNPWC have recently increased the rates of compensation available (M. Dhakal, *pers comm*), but it is not known how this may affect conflicts over the issues, particularly if real or perceived administrative problems are not addressed.

Table 8.17 Mean likelihood of household compensation for livestock losses to snow leopards in previous 12 months.

	N	Combined ± SD	N	SNP ± SD	N	ACA ± SD	Difference
Household compensation	119	.07 ± .25	31	.03 ± .18	88	.08 ± .27	t (117) = -1.09

* p = ≤0.05

The most common reason for households not receiving compensation that triangulation interviews suggested was ‘bureaucracy’ (Table 8.18). This has been has been a frequent critique of compensation schemes (Chen et al., 2016; Rosen et al., 2012; Sangay and Vernes, 2008). Yet the need for prompt payment has to be balanced with appropriate audits, checks and balances (Hemson et al., 2009), a time-consuming process in itself.[45] The next most frequent reason was a multiple one, suggesting that the reasons for compensation schemes malfunctioning can be numerous and complex (Dickman et al., 2011). Thirdly, the considerably higher proportion of interviewees in SNP than in ACA (31% v 5%) citing lack of awareness and/or non-reporting as the main reason for compensation not being received, adds additional weight to the idea that the scheme in SNP is less established and comprehensive than in ACA.

45 Women’s leader, SNP; Microcredit cooperative officer, SNP; Teacher, ACA.

Table 8.18 Community compensation for livestock losses by snow leopards based on triangulation interviews.

Question	Response	Combined		SNP		ACA	
		N	%	N	%	N	%
Received compensation	No	33	68.8	19	100.0	14	48.3
	Yes	10	20.8	0	0.0	10	34.5
	Sometimes	5	10.4	0	0.0	5	17.2
	Total	48	100.0	19	100.0	29	100.0
Reason(s) for not receiving compensation	Bureaucracy	16	41.0	5	29.4	11	50.0
	Limited amount	3	7.7	0	0.0	3	13.6
	Not insured	2	5.1	0	0.00	2	9.1
	Scheme collapsed/irrelevant	3	7.7	1	5.9	2	9.1
	Haven't reported/not aware of scheme	7	17.9	6	31.3	1	4.5
	> 1 negative reason	8	20.5	5	29.4	3	13.6
	Total	39	100.0	17	100.0	22	100.0

8.5 Explaining snow leopard conservation conflicts

There is no conflict but locals are not happy with the ACAP in regards to Snow Leopard Conservation. Locals say that the organization is only concentrating on spreading awareness and making rules and regulations nobody is looking after the locals.

Teacher, ACA

The social factors that explain human conflicts with snow leopard conservation, or other forms of large carnivore conservation, do not appear to have not been quantitatively analysed to date. Here, 11 potential explanatory variables were tested for relationships with self-reported household conflicts with snow leopard conservation in both univariate (Tables 8.21 7 8.22) and multivariate contexts (Tables 8.19 & 8.20). A linear model was not computed for the SNP sample as the number of households reporting conflicts with snow leopard conservation was too small (n = 10). The order of inclusion in the models was hierarchical, and based on similar analyses in other published studies of HWI (Dar et al., 2009; Hemson et al., 2009; Karanth et al., 2013; Suryawanshi, 2013), due to the relative absence of empirical analyses of predictors of HCC. The order of discussion below is based on the variables' standardised *b* scores listed in the combined model, as well as for the reasons given for their exclusion from this model listed below Table 8.19. Overall, however, the models had very low explanatory power.

Table 8.19 Linear model explaining household conflicts with snow leopard conservation.

R^2 = .040	***b***	***SE B***	***Standardised b***	***p***
N = 705				
Constant	.050 (-.024, .14)	.042	---	p = .23
Study site**	-.012 (-.063,.041)	.027	-.016	p = .69
Total household livestock (log^{10} scale)	-.004 (-.060, .051)	.028	-.006	p = .89
Household adult literacy rate	-.040 (-.14, .046)	.048	-.036	p = .41
Number of livestock lost by household (log^{10} scale)	.17 (.028, .31)	.071	.16	p = .019

Note. * 0 = no; 1 = yes. ** 0 = SNP; 1 = ACA. Potential predictor variables excluded from regression modelling due to equality of mean: livestock as primary source of financial income (t = 1.88, *p* = .060); tourism as primary source of financial income (t = 1.79, *p* = .074); other source as primary source of financial income (t = 0.43, *p* = .67). Potential predictor variables excluded from regression modelling due to a lack of correlation: household size (r = 0.33, *p* = .38); Sustainable Livelihoods index (r = 0.72, *p* = .077). This model had the highest significant R^2 change score (.020, p = <.001) out of the six models tested; variables excluded from final model due to lower R^2 change scores when included in successive models: number of household livestock killed by snow leopards (log^{10} scale); cultivation as primary source of household income.

Table 8.20 Linear model explaining household conflicts with snow leopard conservation in Annapurna Conservation Area.

R^2 = .045	***b***	***SE B***	***Standardised b***	***p***
N = 445				
Constant	-.010 (-.076, .071)	.036	---	p = .78
Total household livestock (log^{10} scale)	-.002 (-.078, .076)	.039	-.003	p = .95
Number of livestock lost by household (log^{10} scale)	.21 (.039, .37)	.083	.20	p = .019

Note. Potential predictor variables not included in analysis due to small sample size in a category: livestock as primary source of household income (yes = 24). Potential predictor variables excluded from regression modelling due to equality of mean: tourism as primary source of financial income (t = 1.15, *p* = .26); other source as primary source of financial income (t = 0.81, *p* = .42). Potential predictor variables excluded from regression modelling due to lack of correlation: household adult literacy rate (r = -0.038, *p* = .43); household size (r = 0.36, *p* = .45); Sustainable Livelihoods index (r = 0.91, *p* = .080). This model had the highest significant R^2 change score (.028, p = <.001) out of the four models tested; variables excluded from final model due to lower R^2 change scores when included in successive models: number of household livestock killed by snow leopards (log^{10} scale); cultivation as primary source of household income.

8.5.1 Total livestock lost

The single most significant factor explaining household conflicts with snow leopard conservation in univariate analysis was the total number of livestock lost to all sources of mortality per household (Figure 8.9 & Table 8.22). This was a similar finding to household livestock losses to snow leopards but the effect with conflicts with snow leopard conservation was noticeably smaller. Again using this variable as a proxy for husbandry standards, this relationship confirms the significance of livestock management approaches for carnivore, and snow leopard, conservation (Daniel Kissling et al., 2009; Jackson et al., 2010; Karanth et al., 2012; Kolowski and Holekamp, 2006; Peña-Mondragón et al., 2017; Wang and Macdonald, 2006). Nevertheless, there is a lack of quantitative empirical studies of HCC with which to compare. However, a recent qualitative analysis of Namibian livestock and game farms did find a link between husbandry standards and HCC, at the intra-farm level (Rust et al., 2016).

In multivariate analysis, total numbers of livestock lost to all source of mortality, whether snow leopards, other predators, disease, accidents, bad weather and various other causes (Table 8.4), was the only explanatory variable that was significant across both explanatory models. This was also the only factor that was consistently significant for all three models explaining livestock losses to snow leopards (see Section 8.3). As such, it confirms the relevance of total livestock losses, which were taken as a proxy for husbandry standards, not only for HWI, but also for HCC. It also adds to the body of knowledge on the relationship between livelihoods and HCC (Adams and Hutton, 2007; Hussain, 2000; Rust et al., 2016; Tamang and Baral, 2008). However, the relative explanatory weakness of this variable and therefore this model in explaining household conflicts with snow leopard conservation, as opposed to explaining livestock losses to snow leopards (standardised *b* = .69), suggests that environmental factors, such as snow leopard and snow leopard prey densities, rather than social factors may be the main drivers here.

Figure 8.9 Scatterplot showing the relationship between number of household conflicts with snow leopard conservation and total number of household livestock lost (log^{10} scale).

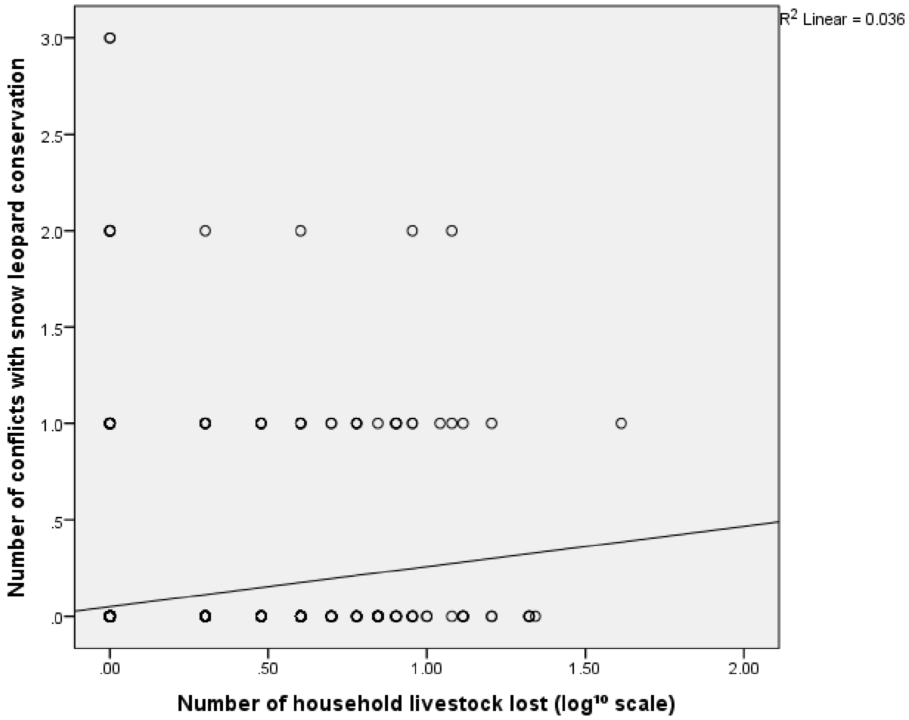


Table 8.21 Individual independent t-tests comparing household conflicts with snow leopard conservation for a joint sample.

Variable	Category 0	Mean ± SD	Category 1	Mean ± SD	Difference	*t*	*df*	*p*	Effect size
Livestock as primary income	No	.10 ± .014	Yes	.00 ± .00	.10 (.073, .13)	7.055	657	.001	.19
Tourism as primary income	No	.11 ± .017	Yes	.06 ± .019	.051 (-.001, .11)	1.98	553	.058	.074
Study site	Sagarmatha	.05 ± .019	Annapurna	.12 ± .018	-.063 (-.11, -.015)	-2.44	643	.019	-.10
Other sources as primary income	No	.10 ± .014	Yes	.08 ± .040	.017 (-.092, .096)	.41	111	.70	.027
Cultivation as primary income	No	.06 ± .014	Yes	.14 ± .024	-.089 (-.14, -.031)	-3.17	513	.004	-.11

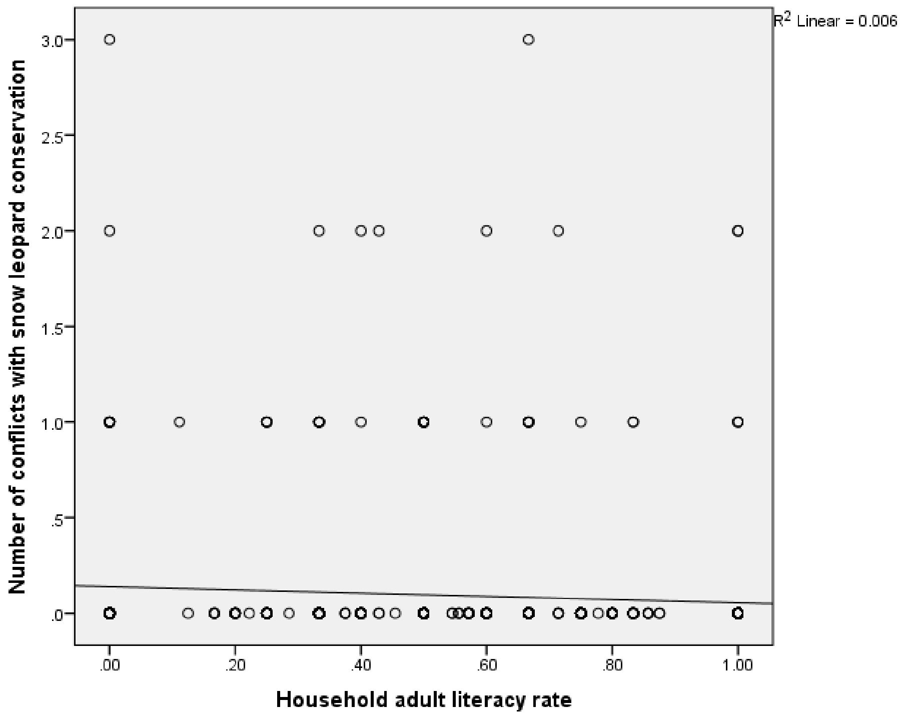
Table 8.22 Individual linear models explaining household conflicts with snow leopard conservation for a joint sample.

Variable	Constant *b*	Constant SE *B*	Constant *p*	Variable *b*	Variable *SE B*	Variable *Standardised b*	*Variable p*
Livelihood scores	-.028 (-.14, 0.088)	.064	.69	.24 (-.015, .51)	.12	.072	p = .052
Livestock owned	.037 (.001, .077)	.020	.060	.072 (.027, .12)	.024	.12	p = .002
Livestock lost	.050 (.026, .082)	.015	.004	.21 (.10, .31)	.054	.19	p = .001
Household size	.065 (-.004, .13)	.034	.062	.006 (-.006, .019)	.006	.033	p = .38
Livestock killed by snow leopards	.075 (.051, .10)	.013	.001	.23 (0.065, .38)	.091	.14	p = .015
Household adult literacy rate	.14 (.085, .20)	.031	.001	-.084 (-.18, .011)	.046	-.076	p = .069

8.5.2 Household adult literacy rate

The same weakly negative but non-significant relationship between household literacy levels and household livestock losses to snow leopards (Section 8.3.8), was also described here for household literacy levels and household conflicts with snow leopard conservation (Figure 8.10 & Table 8.22). Increasing age being correlated with decreasing positivity of attitudes towards carnivores has been well documented for other carnivores (Carter et al., 2014; Romanach et al., 2007; Suryawanshi et al., 2014), including snow leopards in this study. However, none of the studies of HWI reviewed considered literacy rate as a potential explanatory factor. Of the smaller number of studies considering drivers of HCC, only a qualitative nuanced analysis of HWI and HCC in Namibia suggested that farm workers' education levels may drive both losses to carnivores through poor husbandry standards, and conflicts with farm owners through poor job motivation and satisfaction (Rust et al., 2016). In multivariate terms, household literacy rate was included in the combined model but was not significant (Table 8.19). Its inclusion, despite its non-significance in univariate analysis, is due to the inclusion of the household SLI scores variables in multivariate analysis, which reduced the sample size and therefore altered some of the original bivariate relationships discussed earlier in this section.

Figure 8.10 Scatterplot showing the relationship between number of household conflicts with snow leopard conservation and household adult literacy rate.



8.5.3 Study site

The Annapurna region had significantly higher mean numbers of household conflicts with snow leopards conservation than the Everest region in univariate analysis (Table 8.21). However, for the purposes of this analysis, the result is surprising given the inferences in the general conservation (Foggin, 2012; Khan and Bhagwat, 2010; Wells and McShane, 2004) and snow leopard conservation (Ale and Karky, 2002; Jackson et al., 2010; Rosen et al., 2012) literature that a greater degree of decentralised conservation governance will reduce conflict, both with wildlife and with those who conserve it.

As discussed previously, socio-economic and ecological differences between ACA and SNP undoubtedly played a part (Ale et al., 2014, 2007; DNPWC, 2013), and it is also impossible to prove causality in analyses like these (Salerno et al., 2015). However, qualitative interview data suggests that there has been a breakdown in the co-management relationship in ACA between some sections of the local communities and the NGO, the NTNC.[46] This is likely to be driving the greater incidences of conflict at this site, as is the greater accessibility of conservation management and the failings of the more widely-available compensation scheme (see Section 8.4). In multivariate analysis, study site was included in the joint model but was not significant (Table 8.19). That these effects faded away during multivariate analysis demonstrates again the significance of total livestock losses – i.e. husbandry – as an important factor explaining HCC (Rust et al., 2016).

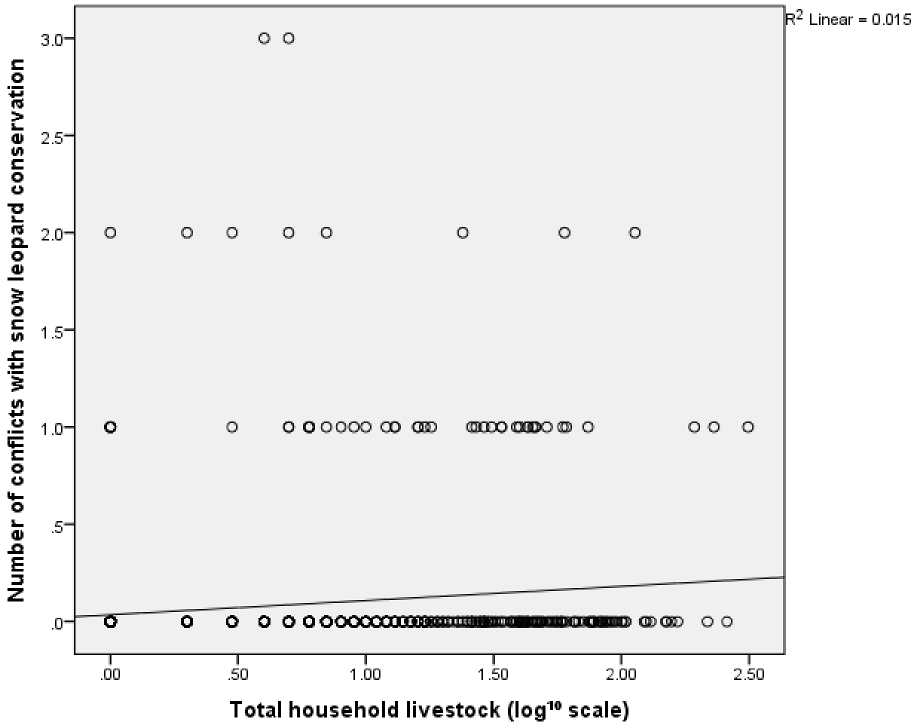
8.5.4 Livestock owned

A weak positive and significant relationship existed in univariate analysis between the number of livestock owned per household and the number of conflicts with snow leopard conservation per household (Figure 8.11 & Table 8.22). Yet, on the basis of standardised *b* scores, the explanatory effect is much less than the same variable’s influence on number of household livestock lost to snow leopards, with a score of .34 (see Section 8.3.2). There is a general dearth of research on HCC compared to HWI, as pointed out for snow leopard conservation (Rosen et al., 2012). The conservation literature, however, does point to livelihood issues as a significant factor explaining conflict with conservation (Adams and Hutton, 2007; Hussain, 2000), of which livestock are particularly significant in the agro-pastoral communities of the Himalayas (Bhasin, 2011; Partap, 1999). In

46 Teacher, ACA; Women’s leader, ACA; Youth leader, ACA; Conservation leader, ACA; Hotelier, ACA.

multivariate analysis, livestock owned per household was included in both the joint (Table 8.19) and ACA (Table 8.20) models but was non-significant in both cases. This relationship demonstrates that total livestock losses, i.e. husbandry, may be more influential in explaining household conflicts with snow leopard conservation than total livestock owned.

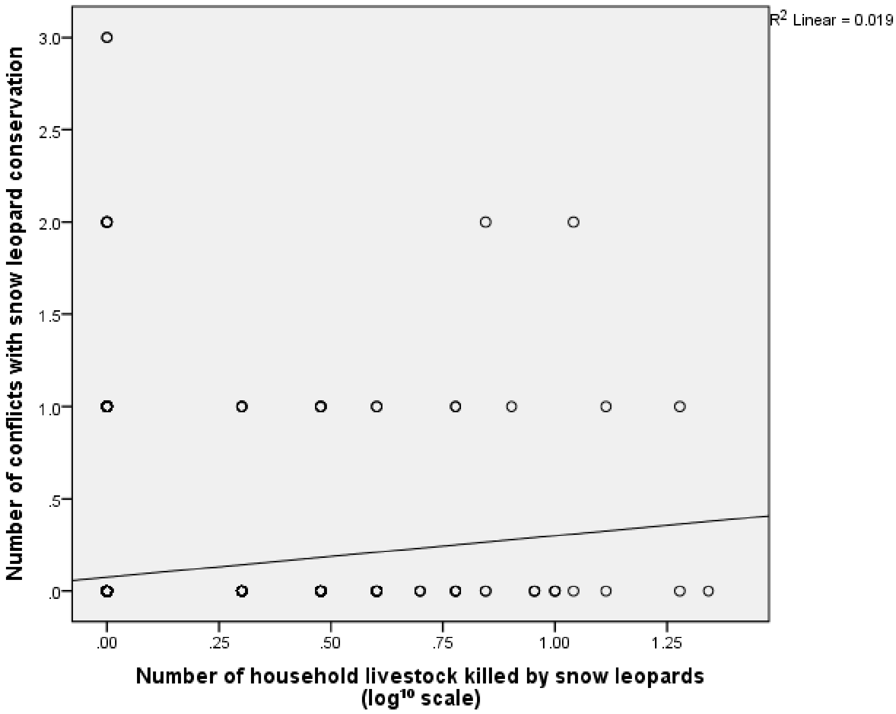
Figure 8.11 Scatterplot showing the relationship between number of household conflicts with snow leopard conservation and total household livestock owned (log¹⁰ scale).



8.5.5 Livestock killed by snow leopards

The correlation between household livestock losses to snow leopards and household conflicts with snow leopard conservation has already been described above (Section 8.3.6). Here, the weak but positive significant relationship between the two variables is again demonstrated in univariate analysis, but in reverse (Figure 8.12 & Table 8.21). The fact that total household livestock losses, to all sources of mortality, explains household conflicts with snow leopard conservation better than household livestock losses to snow leopards, underscores that depredation by snow leopards alone may not be the main driver of conflicts, something at odds with the general suggestion in the literature (GSLEP, 2013; Jackson et al., 2010; Rosen et al., 2012). In multivariate analysis, the variable was excluded from both final multiple regression models due to lower R^2 change scores when included in successive models.

Figure 8.12 Scatterplot showing the relationship between number of household conflicts with snow leopard conservation and number of household livestock killed by snow leopards (log¹⁰ scale).



8.5.6 Cultivation as primary income source

In univariate analysis, households whose primary income came from cultivation had significantly more conflicts with snow leopard conservation than households whose primary income was not from cultivation (Table 8.21). This is in contrast to household livestock losses to snow leopards, where there was no significant difference on the basis of cultivation (see Section 8.3.11). At first glance, this may appear to be a counter-intuitive result. However, given the agro-ecological production systems described in the literature for the region (Bhasin, 2011; Partap, 1999) and the study sites (Aase et al., 2013; Bajracharya et al., 2006; Bjønness, 1980; Padoa-Schioppa and Baietto, 2008), and by interviewees,[47] it is likely that those dependent on cultivation are also dependent on a small number of livestock, often house cows, for fertility and sometimes traction. Loss of these livestock may therefore drive more acute conflicts with snow leopard conservation

47 Teacher, SNP; Microcredit cooperative officer, SNP; Youth leader, ACA.

than for those with larger number of extensively-reared livestock who practise less cultivation. In multivariate analysis, however, the variable was excluded from both final multiple regression models due to lower R^2 change scores when included in successive models.

8.5.7 Livestock as primary income source

The interaction between livestock as the primary household income source and the number of conflicts with snow leopard conservation per household was also counter-intuitive. In univariate analysis, households whose primary income source was not livestock had significantly more conflict with snow leopard conservation than households whose primary income was from livestock (Table 8.21). This result also contrasts with Section 8.3.4, where households with livestock as primary income source lost significantly more livestock to snow leopards.

Yet the trend in this section suggests that it is households who keep livestock for subsistence but not commercial reasons that conflict most with snow leopard conservation, something touched upon by several interviewees in SNP.[48] They noted that wealthier households who could afford to spend the winters in Kathmandu often left their livestock unattended during their absence, probably leading to more depredations by snow leopards. This may drive the conflict trend with snow leopard conservation identified here. In multivariate analysis, livestock as primary income source was not included in either of the multiple regression models due to a non-significant bivariate relationship with the dependent variables. The change from the univariate analysis discussed earlier in this section is due to the inclusion of the household SLI scores variables which reduced the sample size considerably and altered the statistical relationship.

8.5.8 Tourism as primary income source

With tourism as their primary income source, households were less likely to have conflicts with snow leopard conservation, but the trend was non-significant in univariate analysis (Table 8.22). This supports a central thesis of this study, namely that access to a greater variety of assets, especially non-agricultural ones like from tourism, will reduce conflict with snow leopard conservation. Other studies have also noted that livelihood diversification improved attitudes to snow leopards, despite higher livestock losses (Bagchi and Mishra,

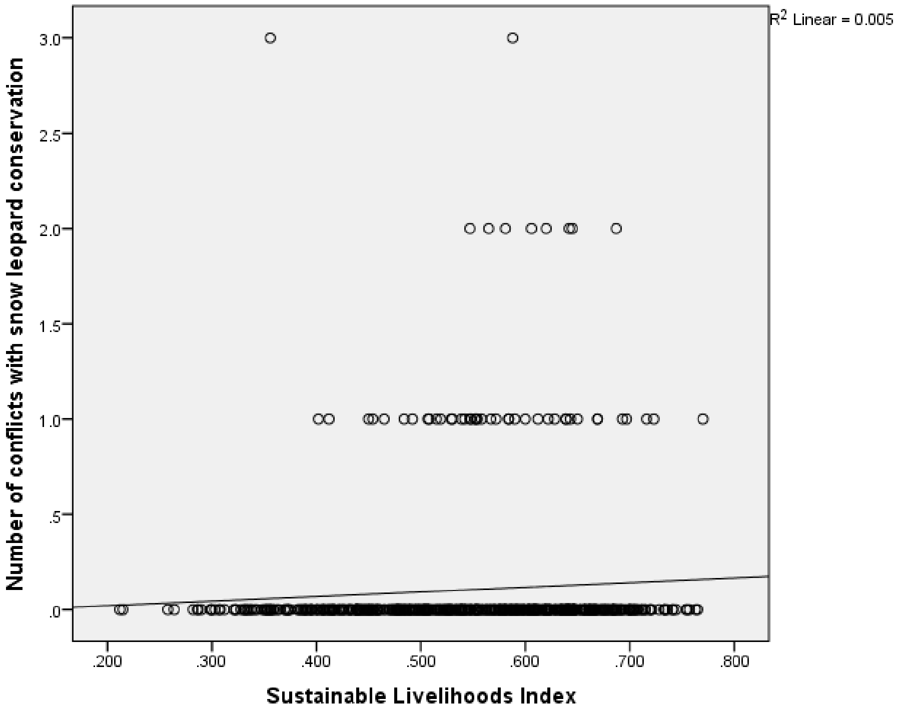
48 Community leader, SNP; Livestock herder,SNP.

2006; Suryawanshi et al., 2014), but it has not been considered for conflicts with snow leopard conservation to date (Rosen et al., 2012). As Ale (2014, 2007) discusses for both ACA and SNP, though, increased involvement in tourism can reduce the availability of labour for husbandry, and hence its effectiveness, in turn driving conflict with snow leopard conservation. Subtle nuances such as this need to be considered more widely in carnivore conservation (Rust et al., 2016). In multivariate analysis, the variable was not included in either multiple regression model (Tables 8.19 & 8.20) due to its lack of significant relationship with the dependent variable.

8.5.9 Livelihoods

There was a weakly positive relationship between household SLI scores and household conflicts with snow leopard conservation, but it was not a statistically significant one in univariate analysis (Figure 8.13 & Table 8.22). This was identical to the relationship between household SLI scores and household livestock losses to snow leopards (Section 8.3.10). In multivariate analysis, the variable was not included in either multiple regression model due to non-significance (Tables 8.19 & 8.20). The lack of a significant relationship is surprising given the considerable literature on how livelihoods constraints, often in or around PAs, can drive conflict with conservation (Adams and Hutton, 2007; Khan and Bhagwat, 2010; Rastogi et al., 2012; Tamang and Baral, 2008). However, these results challenge a central argument of this thesis, that increased access to assets will decrease conflict with conservation. Clearly, damage to a particular class of asset – livestock – from various sources is much more influential.

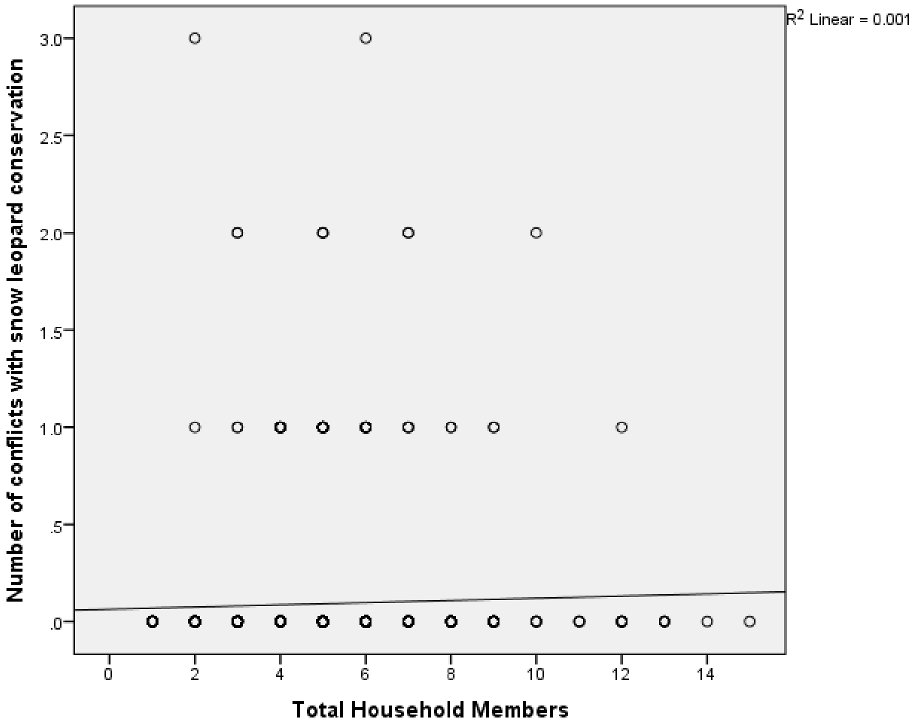
Figure 8.13 Scatterplot showing the relationship between number of household conflicts with snow leopard conservation and Sustainable Livelihoods Index scores.



8.5.10 Household size

Like with household livestock losses to snow leopards (see Section 8.3.3), total household members also had a weakly positive relationship with household conflicts with snow leopard conservation in univariate analysis (Table 8.22). However, unlike the previous, this relationship was not statistically significant. Only one of the studies reviewed considered household size as a factor explaining livestock losses (Karanth et al., 2012). For HCC studies, none of those reviewed considered household size in their analyses, suggesting that an information gap for snow leopards, as well as for other species and conservation contexts, may exist. This lack of correlation in univariate analysis also led to household size being excluded from the joint (Table 8.19) and ACA (Table 8.20) multiple regression models.

Figure 8.14 Scatterplot showing the relationship between number of household conflicts with snow leopard conservation and total household members.



8.5.11 Other primary income source

In univariate analysis, household conflicts with snow leopard conservation did not vary significantly between those whose primary income sources was 'other', and those whose primary income source was not 'other' (Table 8.21). This is identical to the situation with livestock losses to snow leopards (Section 8.3.9). This cohort of households may include poorer and/or migrant wage-labourers without access to as many assets, like livestock, that explain conflicts with snow leopard conservation (see also Section 5.3.8 for further discussion on this group). In multivariate analysis, the variables was not included in either the joint (Table 8.19) or ACA (Table 8.20) multiple regression models due to non-significant relationships with the dependent variable.

8.6 Summary and conclusions

Chapter Eight considered both HWI, measured by the number of self-reported household livestock killed by snow leopards, and HCC, measured as the number of self-reported household conflicts with snow leopard conservation, in the last 12 months in SNP and ACA. Descriptive, univariate inferential and multivariate inferential analysis were used to describe and analyse these dependent variables and the various factors that influenced them. The key findings were that ACA had significantly higher levels of both HWI and HCC than SNP, partly due to socio-economic and ecological differences and partly due to a negative relationship between parts of the community in ACA and the co-managing NGO, the NTNC. In addition, livestock losses to all sources of mortality - taken as a proxy for husbandry standards – was the single factor that best explained both impacts from snow leopards and conflict with snow leopard conservation, though the model was a better fit with the former than the latter.

This suggests that it is damage to some assets, rather than reduced access to all assets, that is the main rationale for household conflict with snow leopards and those who conserve them. It also suggests that access to more influence, via a greater degree of conservation governance decentralisation, does not necessarily reduce snow leopard impacts and snow leopard conservation conflicts. Particularly with the latter, increased involvement in conservation management and improved accessibility to park management - as is the case with the co-management of ACA between local communities and the NTNC – may offer households more opportunities for conflict. This may be especially true when financial issues, such as park entrance fees and compensation schemes, are involved. The next chapter now considers support for proposed conservation mitigation options at both sites: blue sheep translocation in SNP and a conservation incentive scheme in ACA.

9. Mitigation

9.1 Introduction

The previous chapter discussed how access to assets and influence shaped human-snow leopard impacts and human-snow leopard conservation conflicts. This chapter explores how access to these same phenomena can influence attitudes to two mitigation methods that have been proposed to ameliorate the impacts of conflicts described previously: (i) proposed translocation of blue sheep to SNP and (ii) the introduction of a proposed conservation incentive scheme to ACA, including the reform of the current compensation scheme. Descriptive, univariate inferential and multivariate inferential results are presented and discussed, first for the mitigation methods proposed for SNP and then for ACA. Overall, the chapter seeks to answer the following research question: what are individuals' attitudes to two proposed mitigation methods, namely the translocation of blue sheep to SNP and a conservation incentive scheme in ACA, and which factors best explain these?

9.2 Attitudes to the translocation of blue sheep in SNP

We should focus on conserving the species here and the blue sheep in its own habitat. Introducing it will hamper the conservation of other species here.

Teacher

As with the exploration of knowledge about snow leopards in Chapter Seven, this chapter begins by assessing respondents' knowledge of blue sheep. Most of those surveyed were unfamiliar with the species and were unable to positively identify it from a colour plate (Table 9.1). Few other studies among local people have assessed their knowledge of reintroduced or translocated species, with the exception of a retrospective study on European bison in Lithuania (Balčiauskas and Kazlauskas, 2014).

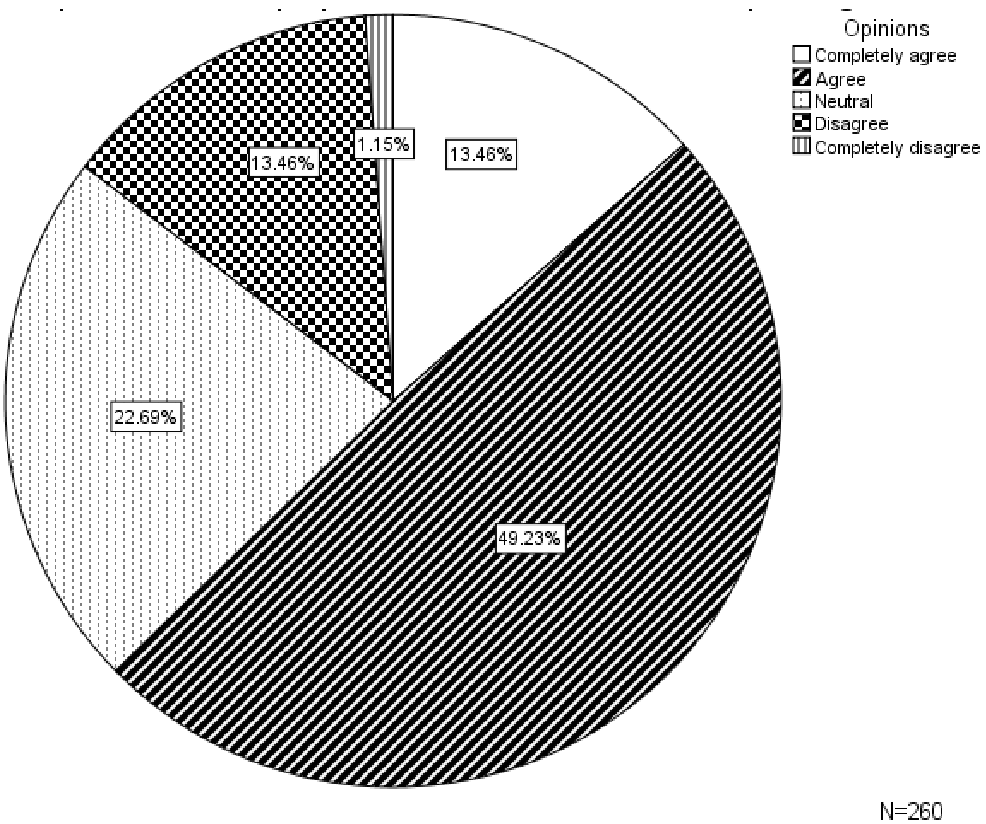
Table 9.1 Identification of blue sheep by respondents in SNP.

	N	Response (%)		Mean ± SD
		Yes	No	
Prior familiarity with blue sheep (0 = no; 1 = yes)	260	26.9	73.1	.27 ± .44
Positive identification of blue sheep (0 = no; 1 = yes)	260	23.5	76.5	.23 ± .43

Note. Identification based on colour plate with four similar-sized wild sheep and goat species found in one or both study areas (see Appendix 12.12).

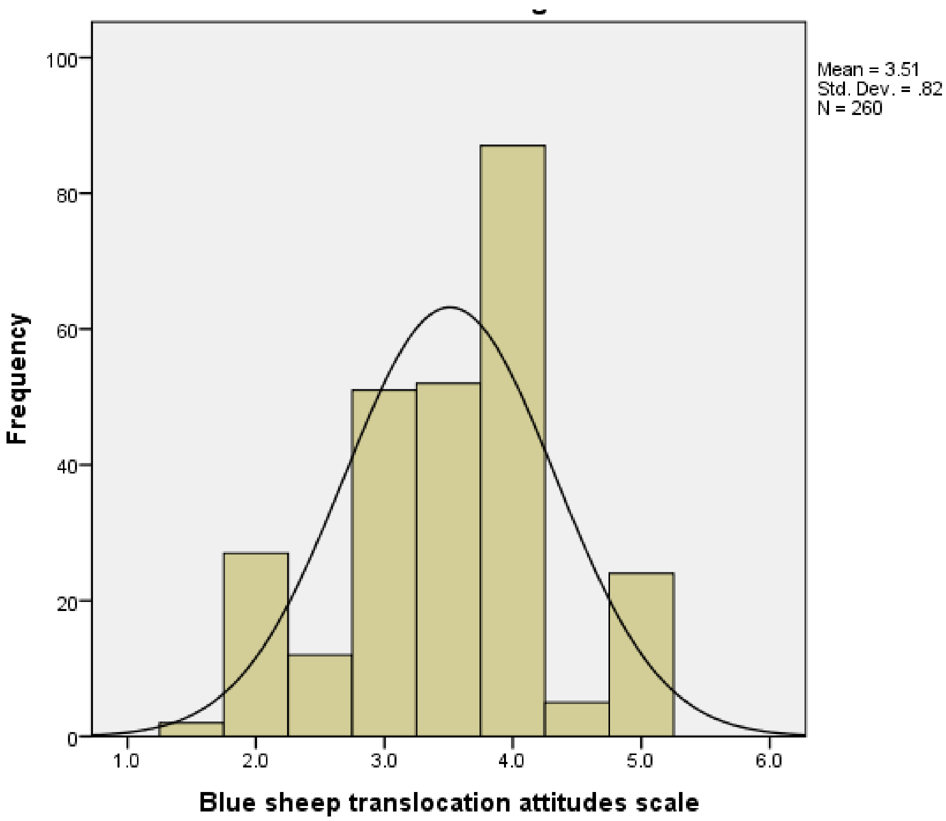
Most (62.7%) respondents completely agreed or agreed with the proposed translocation of a population of blue sheep to SNP (Figure 9.1). Respondents were also asked whether they thought translocating a new prey species would reduce livestock depredation by snow leopards. Ten percent completely agreed, 35.4% agreed, 41.5% were neutral, 12.3% disagreed and 0.8% completely disagreed (N = 260). The Likert scale results from these two questions were combined to create a blue sheep translocation attitudinal scale (Figure 9.2). Social viability assessments, like these, are recommended by the relevant IUCN guidelines as an essential part of the conservation translocation process (IUCN/SSC, 2013).

Figure 9.1 Opinions towards proposed blue sheep translocation to SNP.



Triangulation interviews (N = 26; see Appendix 12.15.18) showed similar levels of support, though with slightly higher levels of (38.5%) of neutral sentiment, and a smaller proportion (42.3%) agreeing with the idea. Although the ecological viability of translocating blue sheep to SNP has been considered (Aryal et al., 2013; Ferretti et al., 2014; Lovari and Mishra, 2016), its social viability has not, a common omission in reintroduction and translocation projects (Armstrong and Seddon, 2008). Yet participation and consultation have been identified as critical factors in the success of numerous human-wildlife coexistence projects (Gurung et al., 2008; Inskip et al., 2013; Thapa, 2010; Treves et al., 2009; Webber et al., 2007), and are recommended by the IUCN guidelines on conservation translocations (IUCN/SSC, 2013).

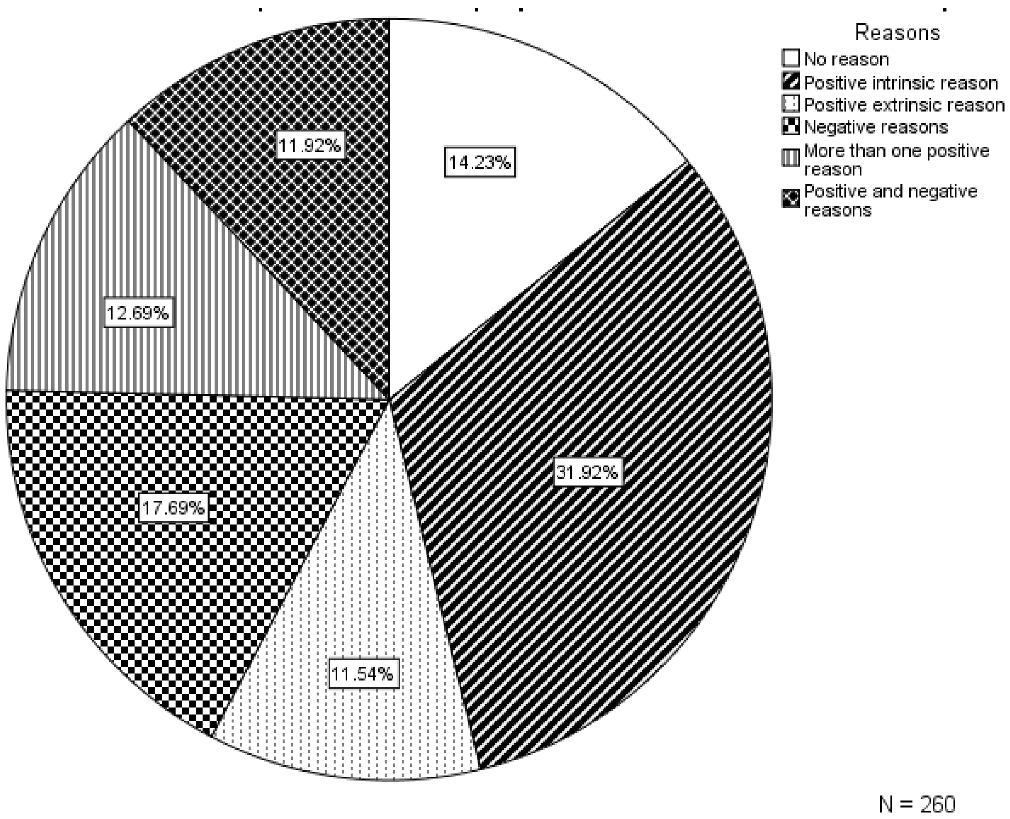
Figure 9.2 Scale of attitudes to translocating blue sheep.



.The reasons for respondents' attitudes to the proposed translocation of blue sheep to SNP (Figure 9.3), were corroborated by triangulation interviews (see Appendix 12.15.18). Approximately one third gave an intrinsic motivation for their attitude, a common and important rationale for environmental and wildlife conservation (De Young, 1996; Loomis and White, 1996; Pelletier et al., 1998; Richardson and Loomis, 2009). Of those who had negative reasons, potential crop damage was a common concern.[49] This perception of likely crop damage is consistent with findings with blue sheep in China (Alexander et al., 2015) and with prairie dogs in the USA (Reading and Kellert, 1993).

49 Microcredit cooperative officer; Conservation leader x 2; Youth leader.

Figure 9.3 Reasons for attitudes towards proposed blue sheep translocation in SNP.



9.3 Explaining attitudes to the proposed translocation of blue sheep to SNP

If it also destroys the crops in the way the thar do then it's not to good to translocate it...In that case people won't accept blue sheep here.

Youth leader

This section explores the factors that explain attitudes to the proposed translocation of blue sheep to SNP. It does so in both multivariate (Table 9.2) and univariate (Table 9.3 & Table 9.4) terms. The order of inclusion in the model was hierarchical, and was therefore based on the relative importance of variables in other published studies on attitudes to reintroductions (Balčiauskas and Kazlauskas, 2014; Reading and Kellert, 1993; Williams et al., 2002). The order of discussion here is based on the importance of variables in the multiple regression model. It highlights segments of society whose particular concerns would need to be addressed before the translocation project could proceed further, as per IUCN guidelines (IUCN/SSC, 2013). However, the explanatory power of the model was very low overall.

Table 9.2 Linear model explaining attitudes to proposed blue sheep translocation in SNP.

R^2 = .096 N = 260	*b*	*SE B*	*Standardised b*	*p*
Constant	3.97 (3.58, 4.34)	.21	---	p = .001
Number of years of education*	0.009 (-0.019, 0.038)	.014	.046	p = .54
Age	-0.005 (-0.012, 0.002)	.004	-.10	p = .14
Number of household livestock (log¹⁰ scale)	-0.24 (-0.44, -0.053)	.097	-.14	p = .013
Gender*	–0.36 (-0.56, -0.17)	.10	-.22	p = .001

Note. * 0 = male; 1 = female. Potential predictor variables excluded from regression modelling due to equality of means: nativity (t = 0.19, *p* = .99); religion (t = -1.18, *p* = .24); blue sheep identification (t = -0.38, *p* = .71); snow leopard identification (t = 1.24, *p* = .22). Potential predictor variables excluded from regression modelling due to lack of correlation: number of household livestock killed by snow leopards (log^{10} scale) (r = -0.10, *p* = .11); household Sustainable Livelihoods Index score (r = 0.12, *p* = .076); attitudes to snow leopards (r = 0.11, *p* = .084). Cronbach's Alpha of the blue sheep translocation attitudinal scale is 0.954, of the snow leopard conservation attitudinal scale is 0.664 and of the snow leopard attitudinal scale is 0.878. This model had the highest significant R^2 change score (.040, p = <.001) out of the six models tested; variables excluded due to lower significant R^2 change scores in successive models: religiosity; attitudes to snow leopard conservation.

9.3.1 Gender

The influence of gender on attitudes to wildlife reintroductions and translocations is mixed. Separate studies have found men to be more negative (Williams et al., 2002) and women as more negative (Balčiauskas and Kazlauskas, 2014). In SNP, univariate analysis showed that women were more negative towards the proposed translocation of blue sheep than men (Table 9.3). In multivariate analysis, gender made the single biggest contribution to attitudes in the model (Table 9.2), where women were less positive than men. In both studies cited above, however, gender was ranked as the 5th and 4th most important explanatory variable respectively, rather than the foremost. The difference in priority here may be the developing-world context, where women are often more involved in and dependent on resource extraction, including agro-pastoralism, than men, and therefore more likely to feel negative towards perceived threats to such activities, like blue sheep (Allendorf and Allendorf, 2012; Ogra, 2008).

9.3.2 Livestock owned

Attitudes to translocation also showed a negative relationship with the number of livestock owned in univariate analysis (Figure 9.4 & Table 9.4). This result probably arose from the perceived potential competition for livestock forage from blue sheep. Likewise, livestock farmers in Europe and North America were more negative towards wolf reintroduction than those without livestock (Williams et al., 2002). Livestock owned remained an important explanatory factor in the multiple regression model (Table 9.2). Although the justification for the proposed translocation of blue sheep to SNP has been to reduce livestock depredation by increasing wild prey availability for snow leopards (Aryal et al., 2013), these findings suggests that it is those most likely to benefit who appear among the most opposed. As participation and consultation have been identified as critical factors in the success of numerous human-wildlife coexistence projects (Gurung et al., 2008; Inskip et al., 2013; Thapa, 2010; Treves et al., 2009; Webber et al., 2007), the concerns of households with livestock would need to be met for the project to proceed successfully.

Figure 9.4 Scatterplot showing the relationship between attitudes to proposed blue sheep translocation in SNP and total household livestock (log¹⁰ scale).

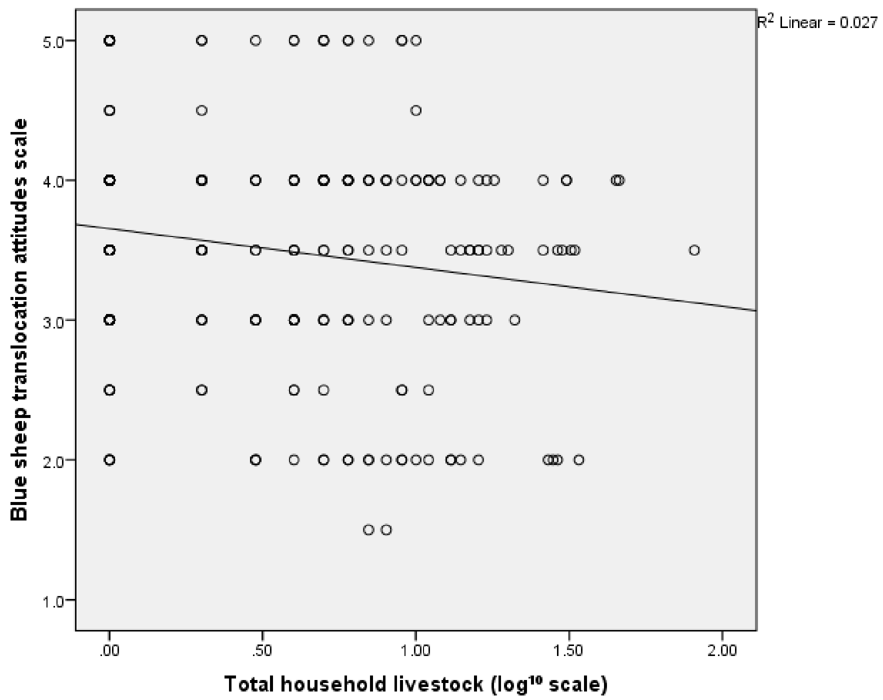


Table 9.3 Individual independent t-tests comparing mean blue sheep translocation attitude scores in SNP.

Variable	Category 0	Mean ± SD	Category 1	Mean ± SD	Difference	*t*	*df*	*p*	Effect size
Gender	Male	3.67 ± .072	Female	3.30 ± .065	.38 (.19, .57)	3.89	258	.00	.23
Nativity	Non-native	3.51 ± .10	Native	3.51 ± .057	.0024 (.-.23, .22)	.018	258	.98	.00
Identification of snow leopards	Unidentified	3.56 ± .062	Identified	3.44 ± .086	.13 (-.081, .33)	1.20	210	.23	.072
Religion	Buddhist	3.49 ± .055	Other	3.67 ± .70	-.18 (-.44, .10)	-1.18	258	.24	.-.12
Religiosity	Less than very religious	3.66 ± .073	Very religious	3.36 ± .30	.30 (.11, .48)	3.04	258	.009	.18
Identification of blue sheep	Unidentified	3.50 ± .054	Identified	3.55 ± .13	-.052 (-.29, .20)	-.38	84	.71	-.028

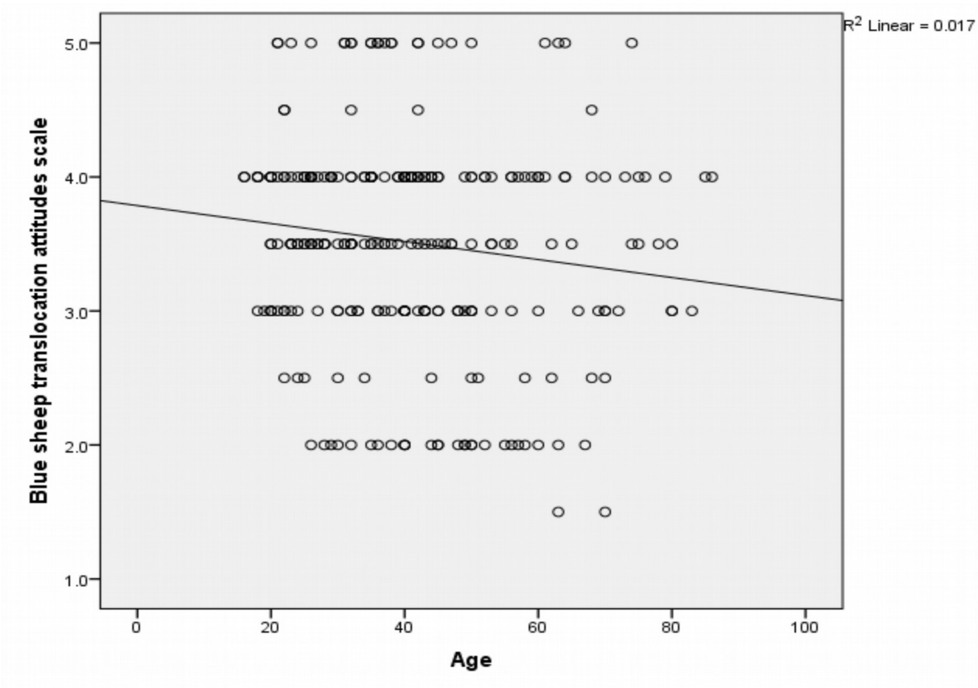
Table 9.4 Individual linear models explaining attitudes to the translocation of blue sheep in SNP.

Variable	Constant *b*	Constant SE *B*	Constant *p*	Variable *b*	Variable *SE B*	Variable *Standardised b*	*Variable p*
Years of education	3.36 (3.23, 3.50)	.068	.001	0.036 (0.014, 0.060)	.011	.20	.002
Livelihood scores	3.10 (2.64, 3.57)	.25	.001	0.80 (-0.10, 1.63)	.46	.12	.079
Livestock owned	3.65 (3.53, 3.79)	.068	.001	-0.28 (-0.49, 0.071)	.10	-.17	.006
Livestock killed	3.54 (3.44, 3.65)	.054	.001	-0.67 (-1.58, 0.24)	.46	-.10	.14
Age	3.79 (3.52, 4.06)	.13	001	-0.007 (-0.013, -0.001)	.003	-.13	.024
Attitudes to snow leopard conservation	2.98 (2.63, 3.32)	.17	.001	.15 (.052, .24)	.048	.17	.005
Attitudes to snow leopards	2.62 (1.54, 3.83)	.55	.001	.22 (-.055,.48)	.14	.11	.13

9.3.3 Age

Age has been negatively correlated with attitudes to reintroduction in several studies (Balčiauskas and Kazlauskas, 2014; Williams et al., 2002). Here, it also had a negative relationship with attitudes to the proposed blue sheep translocation in univariate analysis (Figure 9.5 & Table 9.4). By comparison, however, the size of the effect was smaller than for the influence of age on attitudes to snow leopard conservation (see Section 7.8.3). In multivariate analysis, age was included in the model but did not make a significant contribution (Table 9.2).

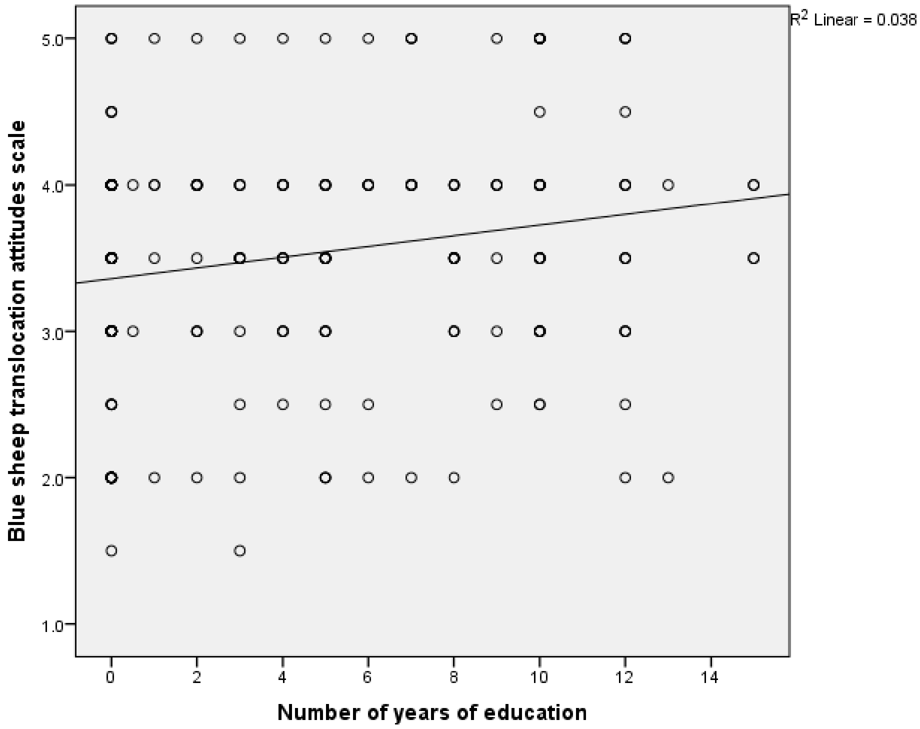
Figure 9.5 Scatterplot showing the relationship between attitudes to proposed blue sheep translocation in SNP and age.



9.3.4 Education

Attitudes to the proposed blue sheep translocation correlated positively with years of education in univariate analysis (Figure 9.6 & Table 9.3). The strength of the correlation was similar to that found between education and attitudes to snow leopard conservation (Section 7.8.6). However, the relationship was weaker than found elsewhere in other studies (Balčiauskas and Kazlauskas, 2014; Williams et al., 2002). As with age, education was included in the multivariate analysis but did not make a significant contribution to the multiple regression model (Table 9.2).

Figure 9.6 Scatterplot showing the relationship between attitudes to the proposed blue sheep translocation in SNP and number of years of education.



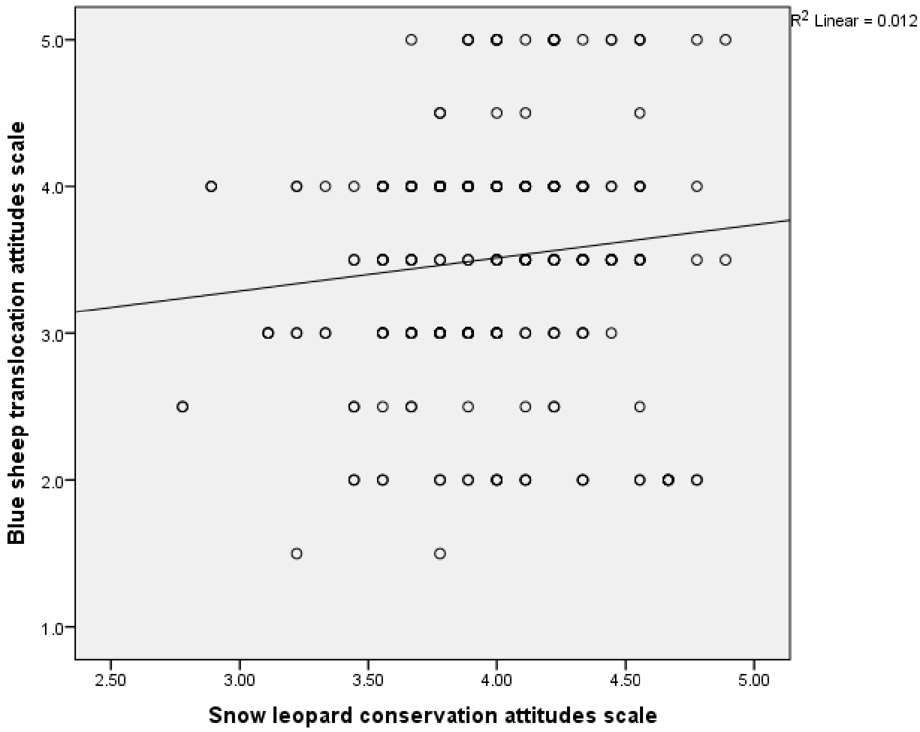
9.3.5 Religiosity

The relationship between religiosity and attitudes towards conservation has not been quantitatively tested to date, though a recent study has examined the links between religiosity and snow leopards (Bhatia et al., 2016). Religiosity showed a mixed effect in this study. In univariate analysis, less than very religious respondents were significantly more positive to the proposed blue sheep translocation than those who were very religious (Table 9.3). This is similar to the significantly more positive attitudes of relatively less religious respondents to snow leopards, but not to snow leopard conservation, discussed previously (see Sections 7.6.10 and 7.8.12 respectively). However, in multivariate analysis, religiosity was excluded from the final models due to lower R^2 change scores when included in successive models (Table 9.2). This would appear to support recent findings where the effect of religiosity faded away somewhat when other factors were accounted for (Bhatia et al., 2016).

9.3.6 Attitudes to snow leopard conservation

There was a weakly positive, but significant, relationship between attitudes to snow leopard conservation and attitudes to the proposed translocation of blue sheep to SNP (Figure 9.8 & Table 9.4). The influence of attitudes to the conservation of a predatory species on attitudes to the translocation of a prey species does not appear to have been tested before. However, the results confirm the importance of linking snow leopard conservation with conservation of snow leopard prey species (Alexander et al., 2016; Tumursukh et al., 2016). In multivariate analysis (Table 9.2), though, the attitudes to snow leopard conservation variable was not included in the final regression model due to lower R^2 change scores when included in successive models. Therefore, a strong connection between snow leopard conservation and the blue sheep translocation does not appear to exist when other factors are taken into account, despite the importance of snow leopard conservation as a rationale for the proposed translocation project (Aryal et al., 2013).

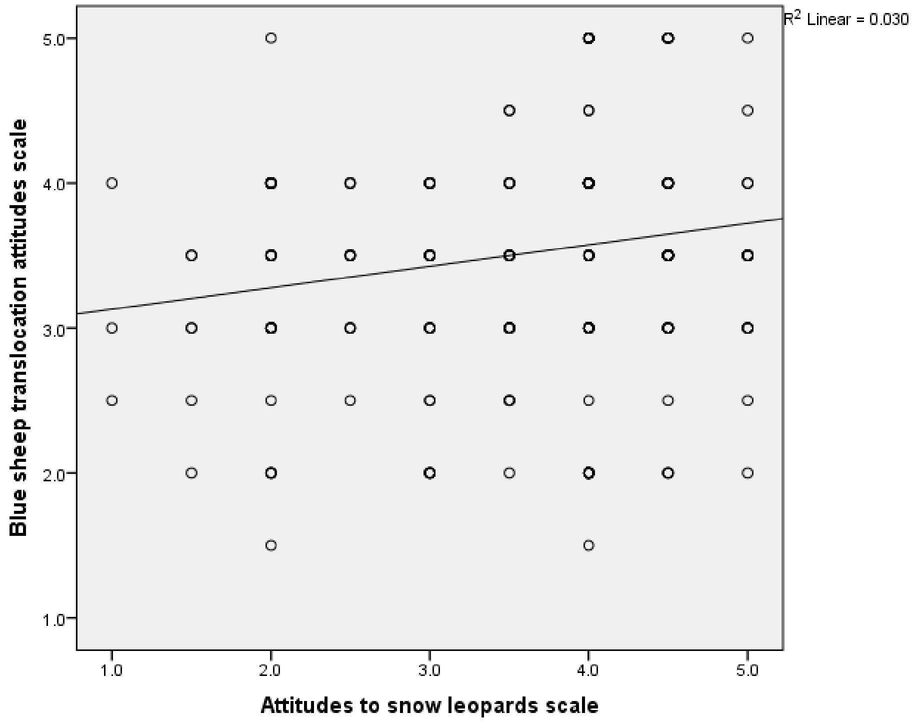
Figure 9.7 Scatterplot showing the relationship between attitudes to proposed blue sheep translocation in SNP and attitudes to snow leopard conservation.



9.3.7 Attitudes to snow leopards

Attitudes to snow leopards showed a positive but non-significant relationship with attitudes to the proposed blue sheep translocation in univariate analysis (Figure 9.7 & Table 9.4). This contrasts with the strong, positive correlation between this variable and attitudes to snow leopard conservation in Section 7.8.13. This also differs from attitudes to black-footed ferret reintroductions, which were closely linked to attitudes towards prairie dogs (Reading and Kellert, 1993). In multivariate analysis, attitudes to snow leopards were excluded due to the lack of significance in univariate analysis (Table 9.2). This would suggest that the connection to snow leopards, which is a primary theoretical imperative of the translocation proposal (Aryal et al., 2013), does not currently translate into perceptions or correlations on the ground.

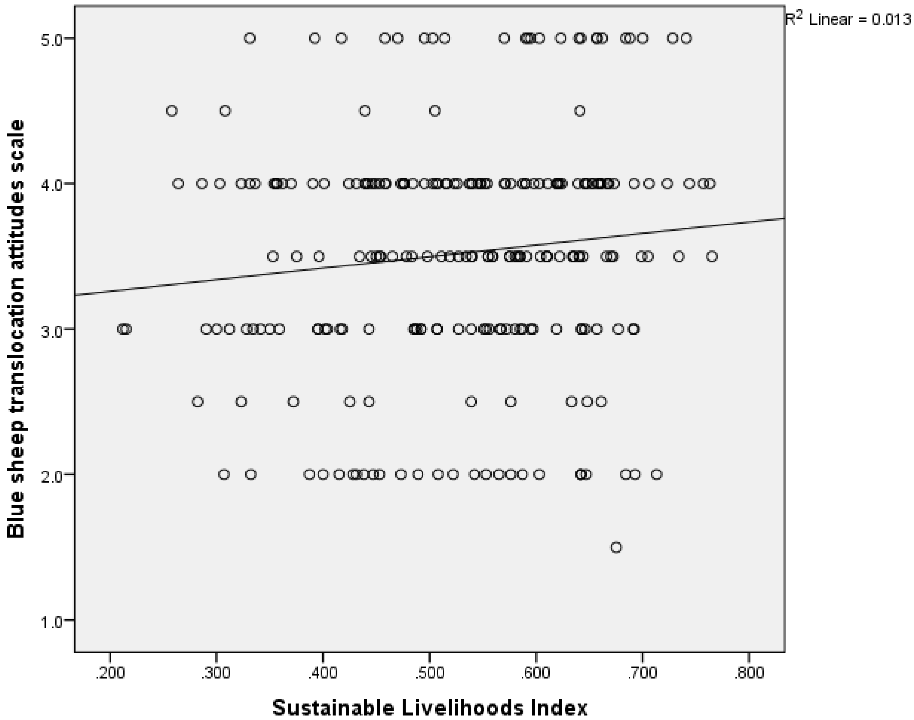
Figure 9.8 Scatterplot showing the relationship between attitudes to proposed blue sheep translocation in SNP and attitudes to snow leopards.



9.3.8 Livelihoods

The positive relationship between attitudes to the proposed translocation and SLI scores did not tend to significance in univariate analysis (Figure 9.9 & Table 9.4). This is in direct contrast to the relationship between attitudes to snow leopard conservation, where there was a positive correlation with SLI scores (see section 7.8.2). Similarly, livelihoods were found to be a significant factor explaining attitudes to wolf reintroductions in Europe and North America (Williams et al., 2002). The variable was therefore excluded from multivariate analysis on the basis of its non-significance (Table 9.2). Livestock specifically appear to have a greater influence on attitudes to the blue sheep translocation than livelihoods generally.

Figure 9.9 Scatterplot showing the relationship between attitudes to proposed blue sheep translocation in SNP and Sustainable Livelihoods Index scores.



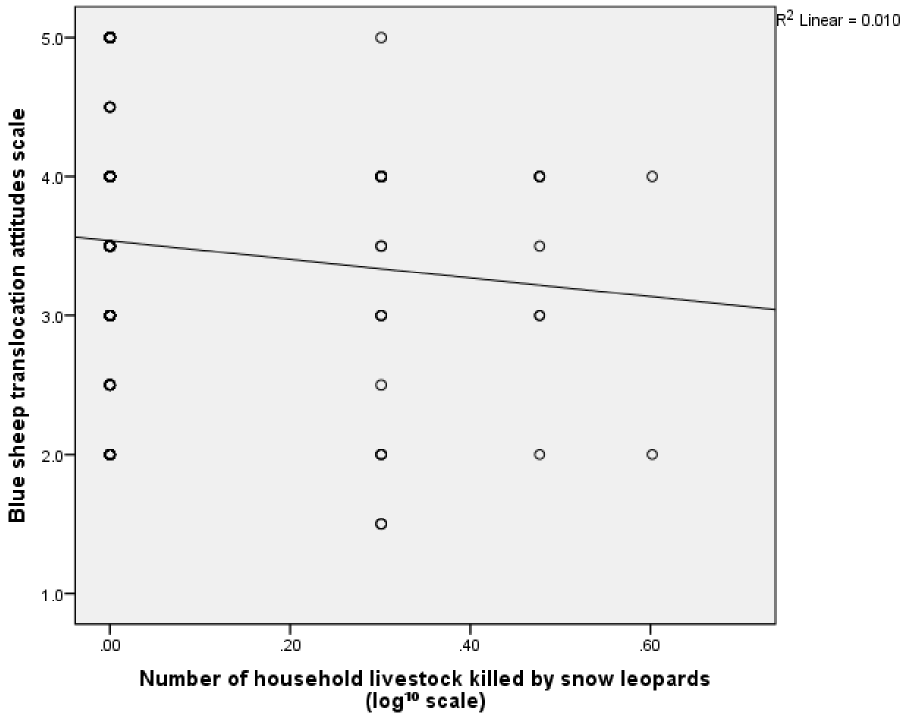
9.3.9 Livestock killed

Attitudes to the proposed translocation and the number of livestock killed by snow leopards were correlated, but the negative relationship was not significant in univariate analysis (Figure 9.10 & Table 9.4). In multivariate analysis, the variable was therefore excluded due to this lack of significance. This trend is seemingly at odds with the intention of the translocation, which proposes that livestock losses would decrease due to increased wild prey availability (Aryal et al., 2013). From this perspective, those who had lost livestock to snow leopards would, theoretically, be more supportive of the translocation. However, fears over competition for livestock forage and crop losses may inhibit a positive relationship.[50] This supports previous works on black-footed ferret reintroductions, where it

50 Microcredit cooperative officer; Conservation leader x2; Youth leader.

was the possible competition for and damage to grassland that influenced more negative attitudes to its primary prey species than to the predator itself (Reading and Kellert, 1993).

Figure 9.10 Scatterplot showing relationship between attitudes to proposed blue sheep translocation in SNP and number of household livestock killed by snow leopards (log¹⁰ scale).



9.3.10 Religion

The relationship between religion and attitudes to conservation actions such as reintroductions and translocation does not appear to have been empirically tested to date. Here, non-Buddhists tended to be more positive to the proposed translocation of blue sheep than Buddhists, but the relationship was not significant in univariate analysis (Table 9.3), a similar finding for to attitudes to snow leopard conservation in Section 7.8.9. In multivariate analysis, religion was not included in the multiple regression model due to this lack of significance (Table 9.2). These findings support a recent study of the influence of religion on attitudes to snow leopard in north-west India (Bhatia et al., 2016). Although religion had a significant relationship with the dependent variable in univariate analysis, it was not significant in multivariate analysis, suggesting that religion may be less important in explaining individual attitudes to wildlife and conservation in South and Central Asia than previously suggested.

9.3.11 Snow leopard identification

In univariate analysis, there was no difference in attitudes to the proposed blue sheep translocation between those who had correctly identified a snow leopard and those who had not (Table 9.3). This was the opposite result compared to the influence of snow leopard identification on attitudes to snow leopard conservation (see Section 7.8.4). However, the significance of prior knowledge in shaping attitudes to reintroduction has been noted elsewhere (Balčiauskas and Kazlauskas, 2014; Reading and Kellert, 1993). In multivariate analysis, the variable was excluded from the multiple regression model due to a lack of significance on a univariate basis (Table 9.2).

9.3.12 Blue sheep identification

Attitudes to the proposed translocation of blue sheep did not differ between those who were able to identify the species and those who were not in univariate analysis (Table 9.3). This differs from the positive relationship between knowledge and attitudes to reintroductions found elsewhere (Balčiauskas and Kazlauskas, 2014; Reading and Kellert, 1993). In addition, those able to positively identify a snow leopard in this study were significantly more positive to its conservation (see Section 7.8.4). The variables was not included in multivariate analysis due this lack of significance (Table 9.2).

9.3.13 Nativity

There was no difference in attitudes to the proposed blue sheep translocation between native and non-native respondents in univariate analysis (Table 9.3). This contrasts with other published studies that found urbanites to be more positive to reintroductions than those in rural areas (Reading and Kellert, 1993; Williams et al., 2002), and vice versa (Balčiauskas and Kazlauskas, 2014). It also contrasts with findings from this study, where non-natives were significantly more positive towards snow leopard conservation than natives (see Section 7.8.5). In multivariate analysis, nativity was excluded due to its lack of significant relationship with the dependent variable (Table 9.2).

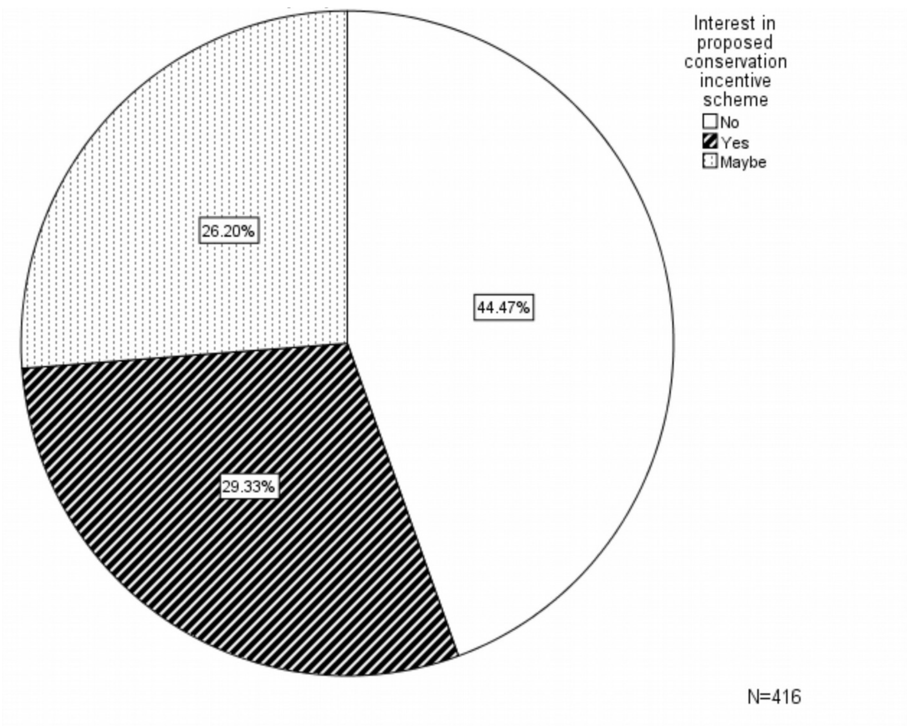
9.4 Attitudes to the proposed conservation incentive scheme in ACA

We need to find a way to raise conservation funds – it won't come naturally.

Conservation leader

A conservation incentive scheme in ACA has been recommended that involves a reformed livestock compensation/insurance scheme tied to conservation outcomes, including eco-certification of snow leopard-friendly livestock products; and conservation education amongst tourists. This follows Aryal et al's (2014) suggestions for ACA specifically, as well as other authors' recommendations for similar schemes elsewhere (Dickman et al., 2011; Treves and Jones, 2010). The success of such programmes can often be linked to community consultation on, and participation in, their design, as with a compensation scheme for lion depredation on a community rangeland in Kenya (Bauer et al., 2017), and other existing or proposed schemes elsewhere (Rust, 2016; Treves et al., 2009; Webber et al., 2007). Here, this data represents the first known appraisal of local opinions on a reformed scheme. Approximately equal proportions of respondents were interested or dis-interested in the idea of the scheme overall, with the remainder being unsure (Figure 9.11). Triangulation interviews confirmed that a majority were undecided (see Appendix 12.15.19).

Figure 9.11 Attitudes to proposed snow leopard conservation incentive scheme in ACA



In relation to the individual components of the proposed scheme, respondents were also asked for their attitudes to them (Table 9.5), as well as their reasons for these attitudes (Table 9.6). Environmental education among tourists was the most popular aspect, and the main reason for this was a positive intrinsic motivation. Often suggested for local communities (DNPWC, 2013; Jackson et al., 2010), education amongst visiting tourists has less often been promoted for snow leopard conservation (Anand et al., 2012).

Suggested parts of the scheme that involved reforming the existing compensation scheme – conservation bonuses, higher or different compensation rates – were also viewed positively. This affirms the popularity of such schemes despite their shortcomings (Karanth et al., 2012; Ogra and Badola, 2008). However, reasons given for these attitudes were more extrinsic than intrinsic, a common approach when the value placed on an environmental good or service is more instrumental than intrinsic (De Young, 1996; Loomis and White, 1996; Pelletier et al., 1998; Richardson and Loomis, 2009).

Table 9.5 Respondent attitudes to proposed snow leopard conservation incentive scheme interventions in ACA.

Attitudes towards...	N	Attitudes (%)				
		Very positive	Positive	Neutral	Negative	Very negative
Higher price for local yak products paid to herders	403	8.2	33.5	31.0	8.9	18.4
Higher price for other local livestock products paid to herders	402	11.4	34.3	43.0	8.2	3.0
Higher price paid by tourists for local livestock products	402	18.4	15.2	46.3	18.7	1.5
Money raised for local snow leopard conservation activities	402	24.9	20.1	45.8	8.2	1.0
Agreement on livestock numbers/density	403	14.9	3.7	43.9	34.7	2.7
Livestock-free wildlife zones	402	5.2	5.7	44.0	36.6	8.5
No retaliation clause	402	7.0	15.7	72.1	3.5	1.7
Annual conservation-dependent bonus for herders	401	20.2	25.9	47.4	5.7	0.7
Higher rate of compensation for livestock killed by snow leopards	401	36.9	19.0	26.2	17.2	0.7
Livestock replacement for livestock killed by snow leopards (non-financial)	400	38.5	7.0	28.5	25.0	1.0
Raising awareness of snow leopards amongst tourists	401	35.4	20.9	41.4	2.0	0.2

Note based on Likert scale from 1 = very positive to 5 = very negative.

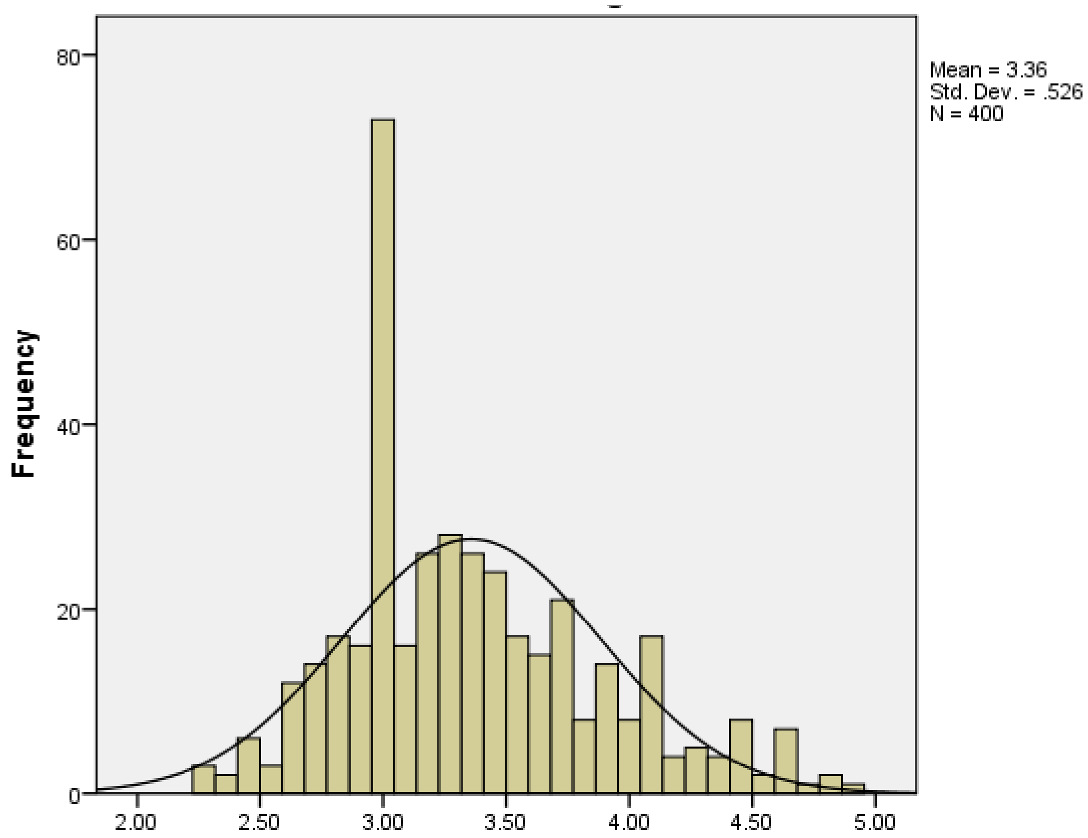
Results from the first four questions - attitudes towards possible components of an eco-certification scheme for snow leopard-friendly livestock products - were less positive and more neutral. Indeed, such schemes contain a trade-off between credibility and verification effort, the latter of which can dissuade producers from participating due to significant opportunity costs (Treves and Jones 2010). The reasons behind such attitudes were a combination of positive extrinsic and negative motivations. Such mixed valuations are frequently noted in a range of environmental (De Young, 1996; Pelletier et al., 1998), social (Degli Antoni, 2009; Ryan and Deci, 2000) and economic (Benabou and Tirole, 2003) contexts.

Table 9.6 Reasons for respondent attitudes to proposed snow leopard conservation incentive scheme interventions in ACA.

Reason(s) for respondents attitudes towards...	N	Response (%)					
		No reason	+ve intrinsic reason	+ve extrinsic reason	>1 +ve reason	+ve & -ve reasons	-ve reasons
Higher price for local yak products paid to herders	402	15.2	0.2	32.8	2.2	0.5	49.0
Higher price for other local livestock products paid to herders	399	20.8	0.0	37.3	3.8	1.1	37.1
Higher price paid by tourists for local livestock products	395	29.4	0.0	20.0	12.2	36.5	2.1
Money raised for local snow leopard conservation activities	399	40.9	18.3	21.3	6.5	0.3	12.8
Agreement on livestock numbers/density	403	39.0	1.5	14.4	1.2	1.2	42.7
Livestock-free wildlife zones	401	38.2	4.7	1.5	1.2	5.0	49.4
No retaliation clause	402	67.4	6.0	0.0	10.0	9.5	7.2
Annual conservation-dependent bonus for herders	401	44.6	4.2	28.7	11.0	1.9	9.5
Higher rate of compensation for livestock killed by snow leopards	399	21.3	5.3	24.6	18.3	2.8	27.6
Livestock replacement for livestock killed by snow leopards (non-financial)	401	22.7	4.7	6.7	30.7	4.2	30.9
Raising awareness of snow leopards amongst tourists	401	36.2	37.9	15.0	3.7	0.0	7.2

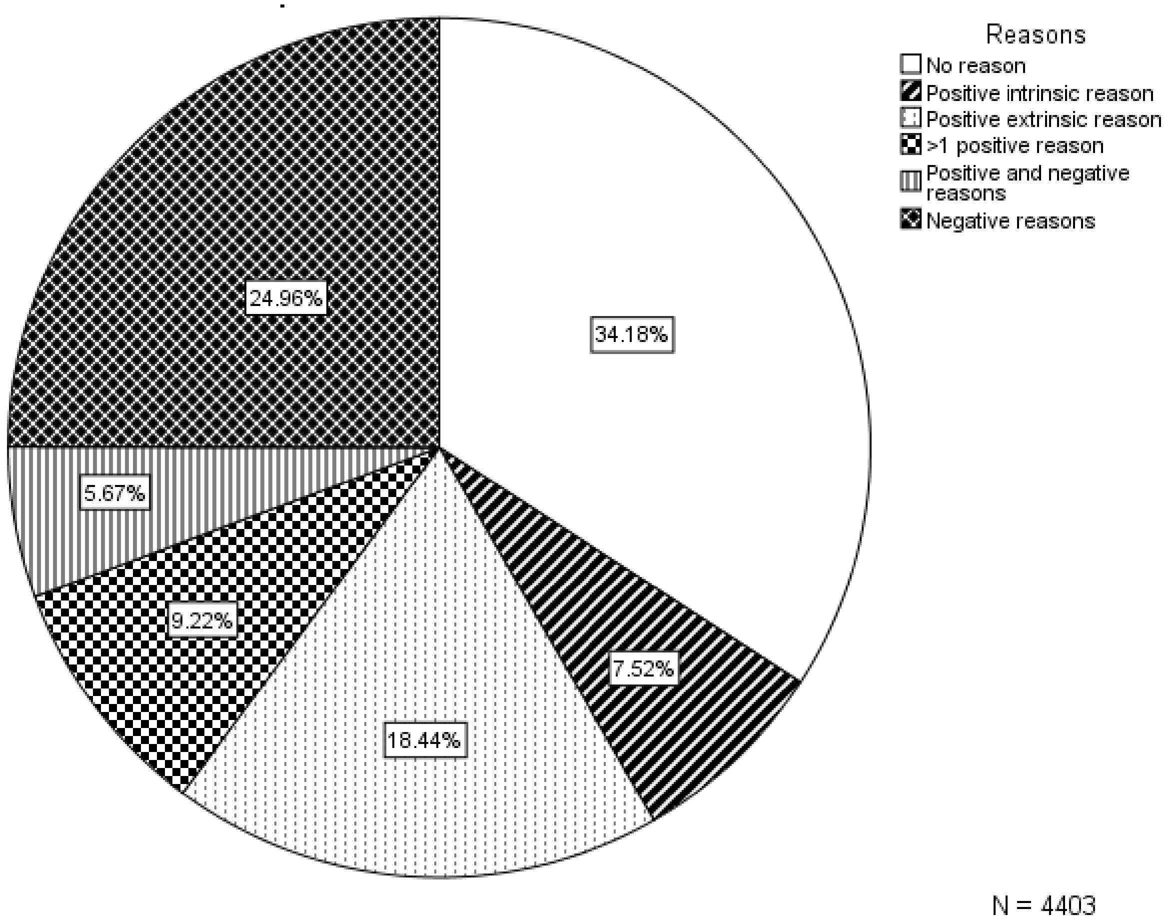
The least popular parts of the proposed scheme, involving livestock densities/numbers, zoning and no retaliation clauses, involved behaviour regulation. Resistance to regulation of livestock production practices has been described elsewhere (Layden et al., 2003; Reading and Kellert, 1993). Here, these variables had high levels of non-responses in terms of justification, as well as considerable number of respondents who gave negative reasons. Where extrinsic motivations towards, or valuations of, activities exist, any existing or proposed interventions that reduce the real or perceived benefits from these are likely to be perceived negatively (De Young, 1996; Loomis and White, 1996; Pelletier et al., 1998; Richardson and Loomis, 2009), as with the suggested changes to livestock husbandry practices discussed here.

Figure 9.12 Scale of attitudes to snow leopard conservation incentive scheme.



The data was also reverse-scored and aggregated into a snow leopard conservation incentive scheme attitudinal scale (Figure 9.12), and an aggregated summary of the reasons for these attitudes was also developed (Figure 9.13). Overall, respondents had above neutral attitudes to the proposed scheme. Given the large number of respondents choosing a score of ‘3’, this may indicate a problem with the use of Likert scales, as suggested elsewhere in snow leopard research (Suryawanshi et al., 2014). The findings may suggest that snow leopard conservation interventions that simultaneously address local livelihoods are likely to be more popular with local communities (Jackson et al., 2010; Mishra et al., 2003; Rosen et al., 2012). Positive reasons for these attitudes also outweighed negative ones. Numerous respondents, however, commented that, while the scheme sounded promising, the challenge would be in effective and equitable implementation.[51]

Figure 9.13 Summary of reasons for attitudes to snow leopard conservation incentive scheme.



51 Park warden; Community leader x 2; Teacher x 3; \women's leader; Conservation leader.

9.5 Explaining attitudes to the proposed snow leopard conservation incentive scheme in ACA

It's a good scheme but it's difficult in its implementation. It's more social work but these days everyone is concerned with their own profit.

Community leader

A multiple regression model that explained individuals' attitudes to the proposed snow leopards conservation incentive scheme was developed (Table 9.7). The order of inclusion in the model was hierarchical, drawing on similar models in other published studies (Karanth and Nepal, 2012; Mehta and Kellert, 1998; Tessema et al., 2010; Walpole and Goodwin, 2001). The order in which explanatory variables are discussed below is based on standardised *b* scores in the model, with the most influential being considered first. Results from univariate analysis are also presented (Tables 9.8 & 9.9) and discussed. The inclusion of SLI scores in the multivariate model automatically reduced the maximum sample size (see Section 5.2.5 for more information on this) and altered some of the univariate relationships presented initially. This explains why some variables, such as number of household livestock killed by snow leopards, were not significant in univariate analysis but were significant in multivariate analysis. For the same reason, religion was significant in univariate, but not multivariate, analysis.

Table 9.7 Linear model explaining attitudes to proposed snow leopard conservation incentive scheme in ACA.

R^2 = .285 N = 341	***b***	***SE B***	***Standardised b***	***p***
Constant	1.53 (0.92, 2.23)	.31	---	p = .001
Household Sustainable Livelihoods Index score	-1.45 (-1.93, -1.00)	.26	-.29	p = .001
Positive identification of snow leopard*	0.026 (-0.070, 0.13)	.050	.025	p = .61
Age	0.002 (-0.002, 0.007)	.002	.058	p = .36
Number of years of education	0.019 (0.006, 0.031)	.006	.17	p = .004
Number of household livestock killed by snow leopards (log^{10} scale)	0.30 (0.090, 0.54)	.12	.16	p = .018
Attitudes to snow leopards	-0.014 (-0.078, 0.047)	.032	-.028	p = .69
Attitudes to snow leopard conservation	0.61 (0.47, 0.76)	.076	.47	p = .001

Note. * 0 = no; 1 = yes. Potential predictor variables excluded from regression modelling due to equality of means: gender (t = -0.99, *p* = .32); nativity (t = 1.81, *p* = .071); religion (t = -1.95, *p* = .051); religiosity (t = 1.30, *p* = .19). Potential predictor variables excluded from regression modelling due to lack of correlation: number of household livestock (log^{10} scale) (r = 0.02, *p* = .97). Cronbach's Alpha of the snow leopard conservation incentive scheme attitudinal scale is 0.730, of the snow leopard conservation attitudinal scale is 0.664 and of the snow leopard attitudinal scale is 0.878. This model had the highest significant R^2 change score (.16, p = <.001) out of the seven models tested.

9.5.1 Attitudes to snow leopard conservation

A strong and significant positive relationship between attitudes to snow leopard conservation and attitudes to the proposed incentive scheme was found in univariate analysis (Figure 9.14 & Table 9.9). It suggests that those supportive of conserving the species are also supportive of the reforms and additions to its conservation that the scheme involves. This also provides the first evidence of support for some of Aryal et al's (2014) recommendations for improved snow leopard conservation in ACA. In multivariate analysis, attitudes to snow leopard conservation maintained its primary influence on attitudes to the proposed scheme (Table 9.7). While conservation will always be a contested social process with both supporters and detractors (Robbins, 2011), this suggests that support for new or amended conservation interventions can be garnered by working with those who already support existing conservation measures. Others have already pointed out the importance of consultation in designing and reforming HWC programs (Treves et al., 2009; Webber et al., 2007).

Figure 9.14 Scatterplot showing the relationship between attitudes to proposed snow leopard conservation incentive scheme in ACA and attitudes to snow leopard conservation.

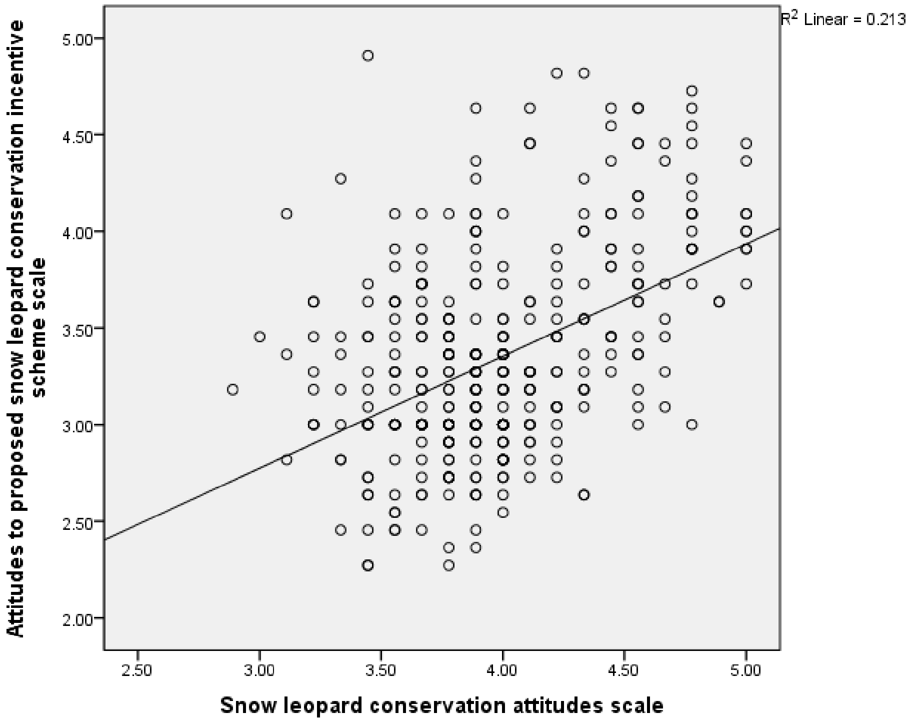


Table 9.8 Individual independent t-tests comparing mean conservation incentive scheme attitude scores in ACA.

Variable	Category 0	Mean ± SD	Category 1	Mean ± SD	Difference	*t*	*df*	*p*	Effect size
Gender	Male	3.33 ± .037	Female	3.39 ± .037	-.052 (-.15, .40)	-1.00	398	.32	-.057
Nativity	Non-native	3.54 ± .11	Native	3.35 ± .027	.19 (-.021, .41)	1.81	398	.071	.17
Identification of snow leopard	Unidentified	3.27 ± .036	Identified	3.41 ± .036	-.14 (-.24, -.027)	-2.67	375	.009	-.14
Religion	Buddhist	3.34 ± .027	Other	3.55 ± .087	-.21 (-.40, -.048)	-1.95	398	.023	-.21
Religiosity	Less than very religious	3.40 ± .037	Very religious	3.33 ± .036	.067 (-.037, .16)	1.30	361	.19	.069

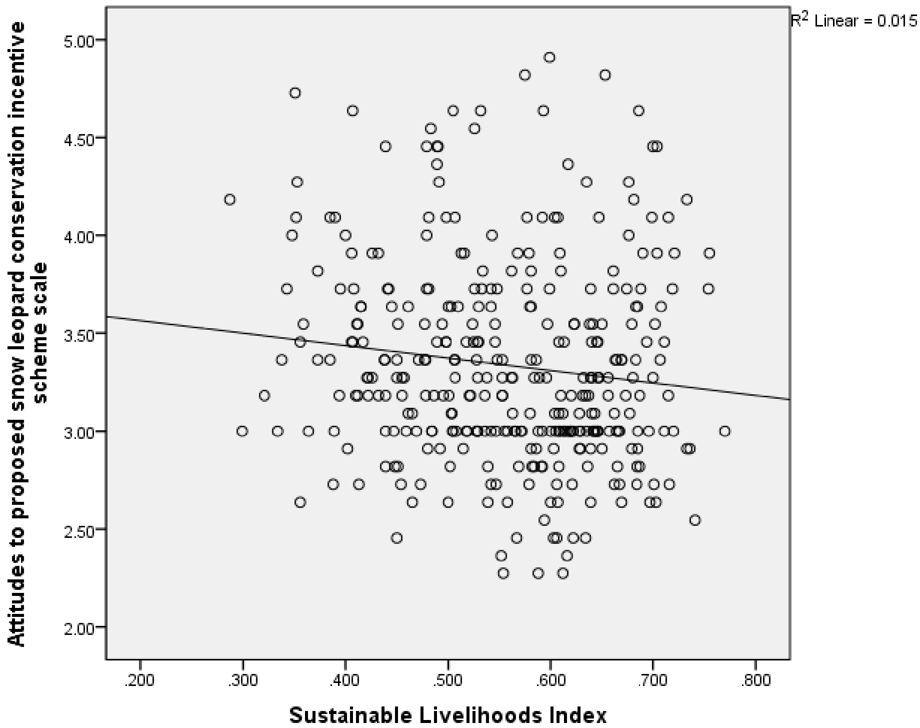
Table 9.9 Individual linear models explaining attitudes to a proposed conservation incentive scheme in ACA.

Variable	Constant *b*	Constant SE *B*	Constant *p*	Variable *b*	Variable *SE B*	Variable *Standardised b*	*Variable p*
Years of education	3.28 (3.21, 3.35)	.036	.001	0.021 (0.011, 0.031)	.005	.19	.001
Livelihood scores	3.69 (3.35, 4.01)	.16	.001	-0.63 (-1.15, -0.095)	.28	-.12	025
Livestock owned	3.36 (3.27, 3.44)	.046	.001	0.002 (-0.092, 0.10)	.046	.002	.96
Livestock killed	3.34 (3.28, 3.39)	.027	.001	0.21 (-0.14, 0.51)	.12	.10	.085
Age	3.61 (3.45, 3.78)	.080	.001	-0.006 (-0.009, -0.003)	.002	-.16	.001
Attitudes to snow leopard conservation	1.03 (0.54, 1.594)	.24	.001	.58 (.46, .70)	.060	.46	,001
Attitudes to snow leopards	3.02 (2.83, 3.21)	.10	.001	.099 (.043 , .16)	.028	.19	.002

9.5.2 Livelihoods

In univariate analysis, there was a significant negative relationship between household SLI scores and individual attitudes to the proposed incentive scheme (Table 9.9 & Figure 9.15). In multivariate analysis, household SLI scores were the second most important factor in the model. These findings contrast with the opposite direction of the relationship found between SLI scores and attitudes to snow leopard conservation in Section 7.8.2. This contrast may be explained by the proposed scheme's intended benefit-sharing from tourism and eco-certification, which may threaten local elites who currently benefit disproportionately from control of the tourism market (Daconto and Sherpa, 2010; Munanura et al., 2016; Sandbrook and Adams, 2012). But they are consistent with the finding that landowners with access to less land were more positive to conservation in ACA (Karanth and Nepal, 2012), a situation that the same study found to hold true in and around several other South Asian PAs.

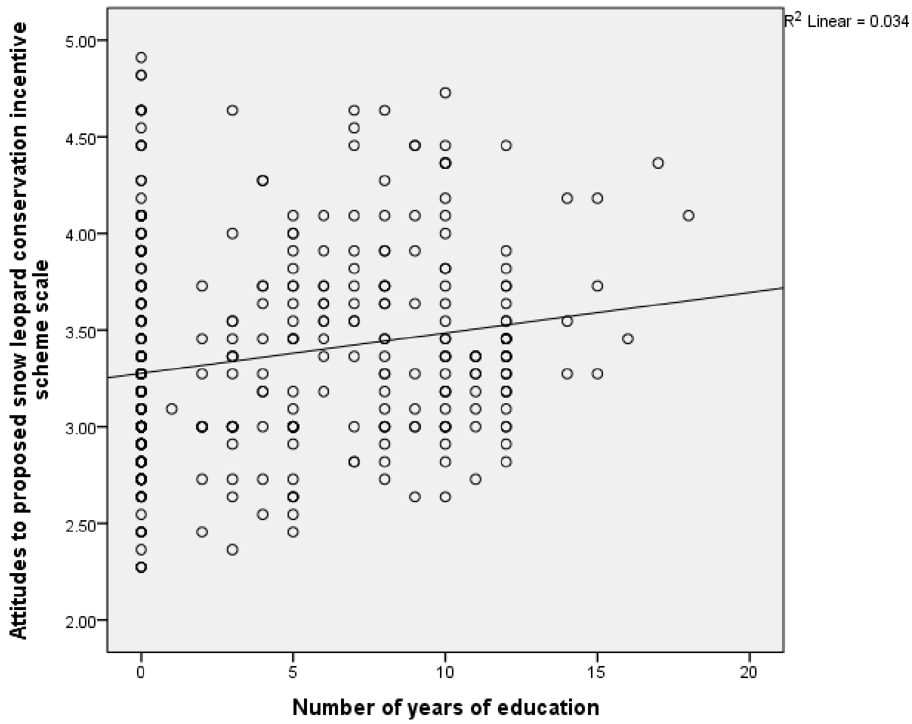
Figure 9.15 Scatterplot showing the relationship between attitudes to proposed snow leopard conservation incentive scheme in ACA and Sustainable Livelihoods Index scores.



9.5.3 Education

There is more consistency in the literature regarding the influence of education on attitudes to conservation. Indeed, numerous studies have reported a positive relationship (Karanth and Nepal, 2012; Mehta and Kellert, 1998; Tessema et al., 2010), which this study further confirmed in univariate analysis (Figure 9.16 & Table 9.8). The effect size is similar to that with attitudes to snow leopard conservation (see Section 7.8.6). Number of years of education also had a significant positive relationship with the dependent variable in multivariate analysis. This, however, contrasts with multiple regression models of factors explaining attitudes to snow leopard conservation for a joint sample (Table 7.25) and in ACA (Table 7.27), where education did not make a significant contribution. The reason for this may be the relative novelty and complexity of the proposed scheme, compared to the better known and established aspects of snow leopard conservation already underway, where increased education may help with comprehending the former.

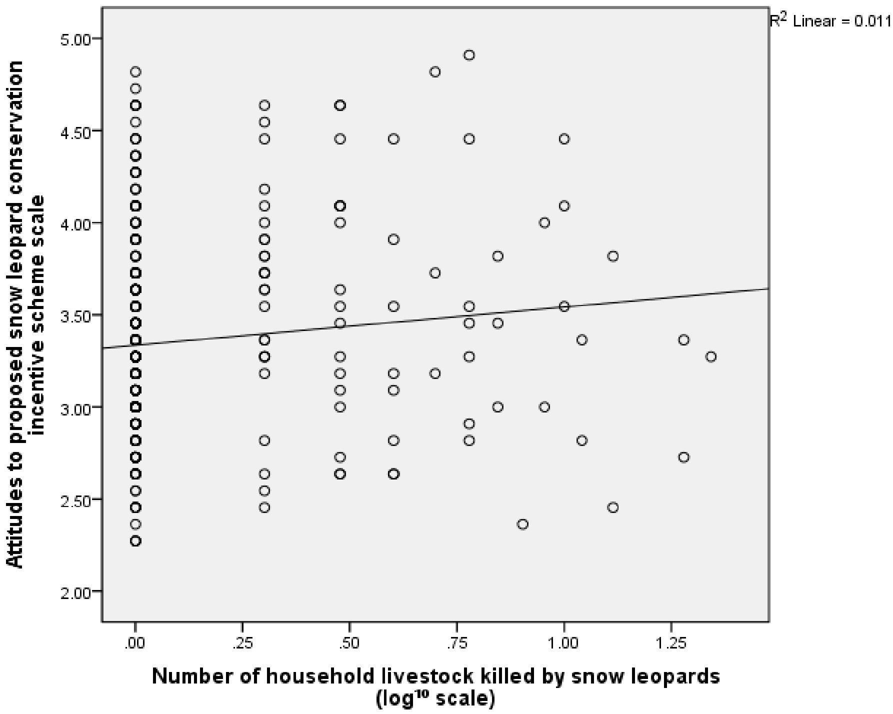
Figure 9.16 Scatterplot showing the relationship between attitudes to proposed snow leopard conservation incentive scheme in ACA and number of years of education.



9.5.4 Livestock killed

The impact of livestock killing has often been considered to drive negative attitudes to carnivores (Ripple et al., 2014). However, its influence on attitudes to conservation appears not to have been assessed to date and results from this study provide mixed evidence of the connection between the two. Univariate analysis showed a weak positive, but non-significant, relationship between the variables and attitudes to the proposed conservation incentive scheme (Figure 9.17 & Table 9.9). However, in multivariate analysis, the number of livestock killed by snow leopards had a significant positive relationship with the dependent variable (its inclusion was due to the presence of the SLI scores variable in the multivariate model which altered sample sizes and therefore some statistical relationships). Interestingly, the direction of the relationship was the opposite of that reported with attitudes to snow leopard conservation (see Section 7.8.7). This is despite various regulations on pastoralism proposed in the scheme; its potential support amongst livestock keepers therefore confirms the popularity of compensation for livestock losses, despite numerous failings and challenges (Karanth et al., 2012; Ogra and Badola, 2008), and identifies potential support for reform.

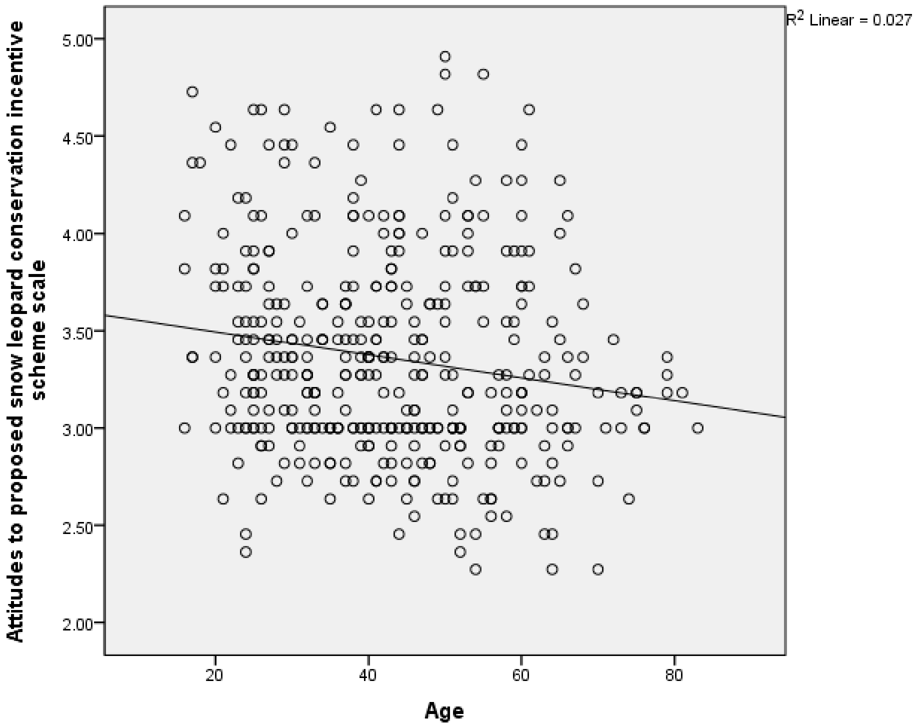
Figure 9.17 Scatterplot showing the relationship between attitudes to proposed snow leopard conservation incentive scheme in ACA and number of household livestock killed by snow leopards (log¹⁰ scale).



9.5.5 Age

The literature shows that increasing age can be correlated with increasing support for conservation (Tessema et al., 2010; Walpole and Goodwin, 2001), and vice versa (Mehta and Kellert, 1998). Here, the results support the latter's findings: that support decreased with age. In univariate analysis, a significant negative relationship between age and attitudes to the proposed scheme was uncovered (Figure 9.18 & Table 9.9), similar to the influence of age on snow leopard conservation (see Section 7.8.3). However, age did not make a significant contribution to the dependent variables in multivariate analysis (Table 9.7). This contrasts with its significance in the multiple regression model explaining attitudes to snow leopard conservation in ACA (Table 7.26). The difference may be explained by the relative importance of education in the incentive scheme model compared to the snow leopard conservation attitudes model, rendering age less influential.

Figure 9.18 Scatterplot showing the relationship between attitudes to proposed snow leopard conservation incentive scheme in ACA and age.



9.5.6 Snow leopard identification

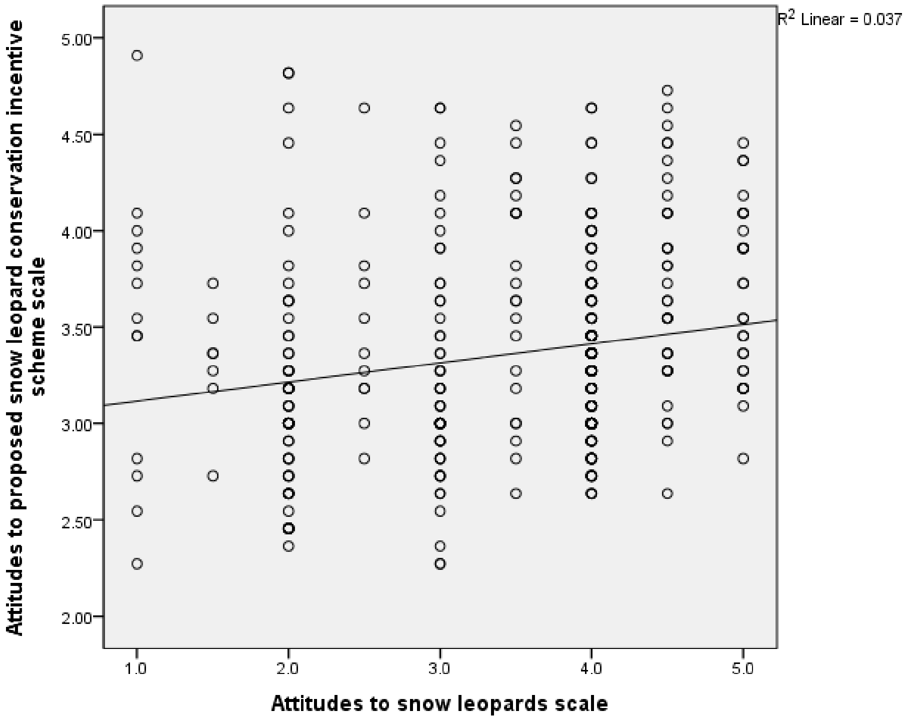
Ability to identify a snow leopard, used as a proxy for knowledge, was shown to have a significant influence on attitudes to the proposed snow leopard conservation incentive scheme in univariate analysis (Table 9.8). The same effect was found with attitudes to snow leopard conservation in Section 7.8.4. In India, it was found that increased knowledge was positively associated with attitudes to forest conservation in (Macura et al., 2011). However, the variable was not significant in multivariate analysis here (Table 9.7). This contrasts with its significance in the multiple regression model explaining attitudes to snow leopard conservation. The link between knowledge of snow leopards and the proposed incentive scheme may therefore be more tenuous than with snow leopard conservation itself.

9.5.7 Attitudes to snow leopards

There is little information regarding the relationship between attitudes to wildlife and attitudes to wildlife conservation in the literature. A recent study, for instance, measured attitudes to leopards and to leopard conservation in Iran, but did not test for a relationship between the two (Babrgir et al., 2017). In this study, univariate analysis found a strong, positive and significant correlation between attitudes to snow leopards and attitudes to its conservation (see Section 7.8.4). In this section, there was also a significant and positive, though less strong, univariate relationship between attitudes to snow leopards and attitudes to the proposed scheme (Figure 9.19 & Table 9.9).

However, although it was present in the multivariate model, attitudes to snow leopard did not make a significant contribution (Table 9.7). This contrasts with its primary importance in the model explaining attitudes to snow leopard conservation in ACA (Table 7.26). As with knowledge of snow leopards discussed previously, there may be a less tangible connection between snow leopards and the proposed incentive scheme, which may explain this difference. This disconnect would need to be addressed for the scheme to proceed further, as weak connections to biodiversity conservation are a common criticism for incentive schemes (Bulte and Rondeau, 2005; Dickman et al., 2011).

Figure 9.19 Scatterplot showing the relationship between attitudes to proposed snow leopard conservation incentive scheme in ACA and attitudes to snow leopards.



9.5.8 Religion

A previous study found that Hindus were significantly less positive towards conservation in ACA than non-Hindus (Karanth and Nepal, 2012). The results from this study, though, would seem to suggest the reverse. Univariate analysis showed that non-Buddhists, including Hindus, were significantly more positive to the proposed snow leopard conservation incentive scheme than Buddhists (Table 9.8). A spatial split within ACA between the Buddhist-majority north and the Hindu-majority south may contribute to these contrasting findings. This is because the southern parts of the park contain little snow leopard habitat and its human inhabitants are likely to be less familiar with snow leopards, their impacts and their conservation, including if they migrate northwards into snow leopard territory.

In multivariate analysis, religion was not included in the model, the only one of the remaining explanatory variables that were significant in univariate analysis but excluded from multivariate analysis. The practical reason for this is the inclusion of SLI scores in the multiple regression model, which altered the sample size and hence the statistical relationship (see Section 5.2.5 for more information). In theoretical terms, this finding confirms recent work on religion and snow leopard conservation in India, where the factor was non-significant when considered in conjunction with other variables (Bhatia et al., 2016).

9.5.9 Nativity

Nativity has been infrequently considered as a predictor of attitudes to conservation. However, one study in Indonesia found that urbanites had more positive attitudes than those living in rural areas (Walpole and Goodwin, 2001). In this study, however, there was no significant difference in attitude between natives and non-natives in univariate analysis (Table 9.8). The variable was therefore excluded from multivariate analysis (Table 9.7). This contrasts, however, with its significance in explaining attitudes to snow leopard conservation in ACA (Table 7.26). Again, the less concrete conceptual link between the novel incentive scheme proposal and snow leopards may explain this difference, compared to the more accessible link between the species and its conservation.

9.5.10 Religiosity

Religiosity is another variable whose relationship to attitudes to conservation has not been considered to date. In univariate analysis, there was no significant difference to the dependent variables on this basis (Table 9.8), a trend also found with attitudes to snow leopard conservation in Section 7.8.12. Nevertheless, recent research from India has shown that it can have a significant relationship with attitudes to snow leopards in univariate but not multivariate terms (Bhatia et al., 2016). Here, religiosity was not included in the multiple regression model explaining attitudes to the proposed incentive scheme due to its non-significance in bivariate analysis. As discussed with attitudes to snow leopard conservation, the ubiquity of a Buddhist, and Hindu, non-violent conservation ethic across the population of ACA may explain this uniformity (Ale et al., 2014).

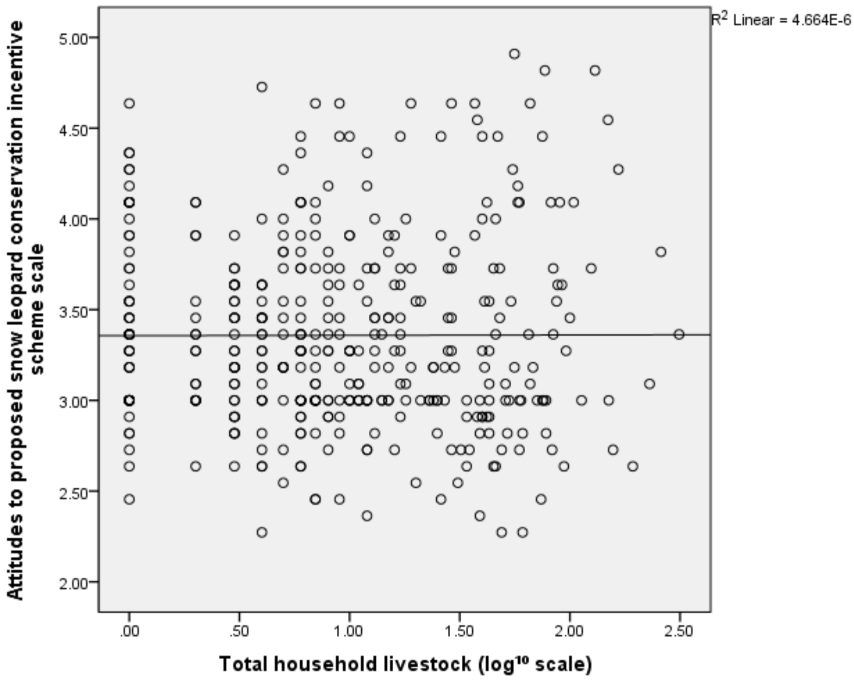
9.5.11 Gender

In univariate analysis, there was no significant difference in attitudes to the proposed conservation incentive scheme on the grounds of gender (Table 9.9). This is consistent with a study of local attitudes to several PAs in Nepal (Allendorf and Allendorf, 2012). However, another study, in the Makalu-Barun Conservation Area (MBCA) adjacent to SNP, observed that women were significantly less positive to CBC than men (Mehta and Kellert, 1998). Similarly, and due to the lack of significance in univariate terms, gender was not included in the multiple regression model (Table 9.7), which was identical for the multivariate model explaining attitudes to snow leopard conservation in ACA (Table 7.27). Although the real or perceived impact snow leopards may affect women more than men (Alexander et al., 2015), the proposed incentive scheme, as well as snow leopard conservation itself, may affect both genders equally.

9.5.12 Livestock owned

In univariate analysis, there was no relationship between the number of livestock owned per household and individual attitudes to the proposed snow leopard conservation incentive scheme (Figure 9.18 & Table 9.9). Yet other studies have found that involvement in farming, particularly ownership of livestock, can drive negativity to conservation (Tessema et al., 2010; Walpole and Goodwin, 2001). This lack of significance also ensured that livestock ownership was not included in the multivariate model (Table 9.7). Given that the scheme is overtly focused on addressing livestock depredation by snow leopards, this explains why livestock ownership is less influential in explaining attitudes to the scheme than livestock killed.

Figure 9.20 Scatterplot showing the relationship between attitudes to proposed snow leopard conservation incentive scheme in ACA and total household livestock (log¹⁰ scale).



9.6 Summary and conclusions

This chapter considered, first, individuals' attitudes to the proposed translocation of blue sheep to SNP and, second, individuals' attitudes to a proposed snow leopard conservation incentive scheme in ACA. At the beginning of both sections, attitudes to both forms of mitigation were reported and discussed, followed by the factors that best explained these attitudes. Practically, the findings provide valuable information on the social viability of both schemes, complementing the ecological data provided by SNP (Aryal et al., 2013; Ferretti et al., 2014; Lovari and Mishra, 2016) and ACA (Aryal et al., 2014) respectively, and highlighting segments of the population who have particular levels of concern or support.

Theoretically, the findings are consistent with the first part of the study's main thesis, that access to assets and access to influence shapes human coexistence with snow leopards. In the case of the proposed blue sheep translocation, access to livestock influenced attitudes negatively, though less so than gender. With the proposed conservation incentive scheme, a lack of assets, shown via SLI scores, shaped support for the concept, but to a lesser extent than attitudes to snow leopard conservation. While access to influence was considered less for this chapter than for others, as each proposal was unique to one study site, it is clear that access to assets can shape attitudes to proposed mitigation methods, often in locally-specific and varying ways.

10. Conclusion

The real long-term challenge lies with moving communities beyond their harsh and insecure subsistence livelihood into more economically viable and environmentally friendly activities...They must also assume greater responsibility for protecting their herds from predators. This will enable an enduring coexistence between predators and humans across snow leopard range.

Jackson et al. 2010

10.1 Thesis outline

Given the prevalence of both poverty and pastoralism across the mountainous ranges of the snow leopard, this thesis sought to address the inter-relationships involved in improving coexistence between local communities, snow leopards *and* snow leopard conservation. These interrelationships comprised the predications that (i) access to more diverse and sustainable livelihoods, or assets, by locals would contribute to the goal of coexistence; and (ii) that access to a decentralised conservation governance model, or influence, by local communities would also further help to achieve this goal.

In order to further test these assumptions, together with other relevant factors described in the literature, the study drew upon a political ecology perspective (Adams, 2013; Blaikie and Brookfield, 1987; Robbins, 2011), access theory (Ribot, 2014; Ribot and Peluso, 2003), the Sustainable Livelihoods framework (Carswell and Jones, 2004; Chambers and Conway, 1992; Scoones, 2009), and a mixed-methods approach (Ghosal et al., 2013; Raymond et al., 2010; White et al., 2005). Using systematic sampling, a quantitative questionnaire was administered to 705 households at two sites in the Himalayas of Nepal: comprising Sagarmatha National Park (SNP), with a centralised governance model, and Annapurna Conservation Area (ACA), with a decentralised management model. Seventy qualitative interviews were also collected for cross-methods triangulation. Regression models were the main form of inferential quantitative analysis.

The study first assessed household access to assets via the Sustainable Livelihoods framework (DFID, 1999; Steimann, 2005), and then compared these same results based on access to influence i.e. across study sites. It then assessed knowledge of, and attitudes towards, snow leopards; attitudes to snow leopard conservation; losses of household livestock to snow leopards; and conflicts between people and snow leopard conservation. Additionally, perceptions of several proposed mitigation methods - translocation of blue sheep, as an additional snow leopard prey species to SNP, and a conservation incentive scheme in ACA - were also examined. In each case, the relationship with livelihoods, whether as an aggregate index or as separate components, was tested, as was the influence of a range of other relevant variables reported in the literature. Apart from proposed mitigation methods, the results were also compared across two study sites to quantify and explain possible variations between the governance of the two PAs.

10.2 Conceptual conclusions

10.2.1 Political ecology

While the explicit focus of political ecology is on power, it has also been widely used to critique the often uneven power dimensions of wildlife conservation in the Global South. Particular attention has been paid to the relationships between relatively influential conservation NGOs and government departments, on one hand, and relatively weak local communities on the other hand (Adams and Mulligan, 2003; Adams and Hutton, 2007). This has been the case for PAs especially, given their potential to constrain and control local communities and their livelihood options, via ‘fortress’ or ‘fences-and-fines’ conservation (Brockington et al., 2006; West et al., 2006).

Nevertheless, political ecology has paid relatively little attention to the positive impacts of conservation in general, and of PAs in particular, on local communities. This study sought to asses livelihoods in two PAs with differing degrees of local involvement. Thus, the significantly higher livelihood scores in the more decentralised ACA would suggest that PAs can have a positive influence on local communities. This is undoubtedly due, in part, to the multilateral funds and grants that the co-management approach in Annapurna has attracted (Bajracharya, 2005, 2006). In addition, while the increased influence over conservation practices can improve relations between conservation authorities and local communities, it can also increase the potential for conflicts over conservation benefits and resources, as interview data from this study have clearly demonstrated (see Sections 7.7 and 8.4).

Conservation has also tended to focus on localised livelihood and socio-economic issues, given that the the principal threats to biodiversity usually occur on the ground. In doing so, political ecology has often failed to appreciate the more significant scale and scope of threats posed by global supply chains and socio-economic trends to nature (Lenzen et al. 2012), as well as the direct and indirect impacts these may have on local livelihood strategies and, therefore, biodiversity (Adams, 2013). Political ecology has played a role in understanding and explicating these relationships.

In SNP and ACA, the tourism industry, with its global, national and local components has been cited as a driver of various negative social and ecological trends, including water shortages and deforestation (Byers, 2005; McDowell, 2013). It has also attracted labour, especially of young people, away from livestock herding, which can, in turn, reduce husbandry standards and make livestock more vulnerable to predation by snow leopards and other carnivores (Ale et al., 2007). This political ecology perspective on the role of tourism in the Sagarmatha and Annapurna is a nuanced antidote to earlier, simplistic analyses, such as the Theory of Himalayan Environmental Degradation (THED), which blamed local population increases for elevated deforestation rates and associated downstream flooding (Ives, 2004).

10.2.2 Access theory

Access theory defines 'access' as 'the ability to derive benefits from things' as 'a bundle of powers', in contrast to property's more formal 'right to derive benefits' as 'a bundle of rights' (Ribot and Peluso, 2003). This more expansive and nuanced understanding of the way in which individuals and households access benefits from various types of tangible and intangible assets to create a livelihood lends itself to the Annapurna and Sagarmatha regions, where customary practices for accessing resources predate formal conservation practices. For instance, 84% of households surveyed in this study had access to grazing land, while 94% of households has access to land for cultivation.

A later application of access theory analysed how increased access to assets enhanced resilience and reduced vulnerabilities, notably to climate change-related disasters (Ribot, 2014). It also identified social protections as an important part of reducing risk for affected households and communities. Large carnivores, such as snow leopards, are typically not viewed as environmental stressors in the same manner as natural disasters. However, given their potential to cause livestock losses, and, with some species, human fatalities, as well as the stochastic nature of these events, the effects can be similar (Dickman et al., 2010; Inskip et al., 2013). The extent to which increased access to assets reduced vulnerability to coexisting with snow leopards is a significant part of this thesis, with those with increased access generally more positive to snow leopard conservation and, to a lesser extent, to snow leopards themselves. Social protections, in the form of livestock compensation, insurance and incentive schemes, can also be a factor in facilitating coexistence (Dickman et al., 2011).

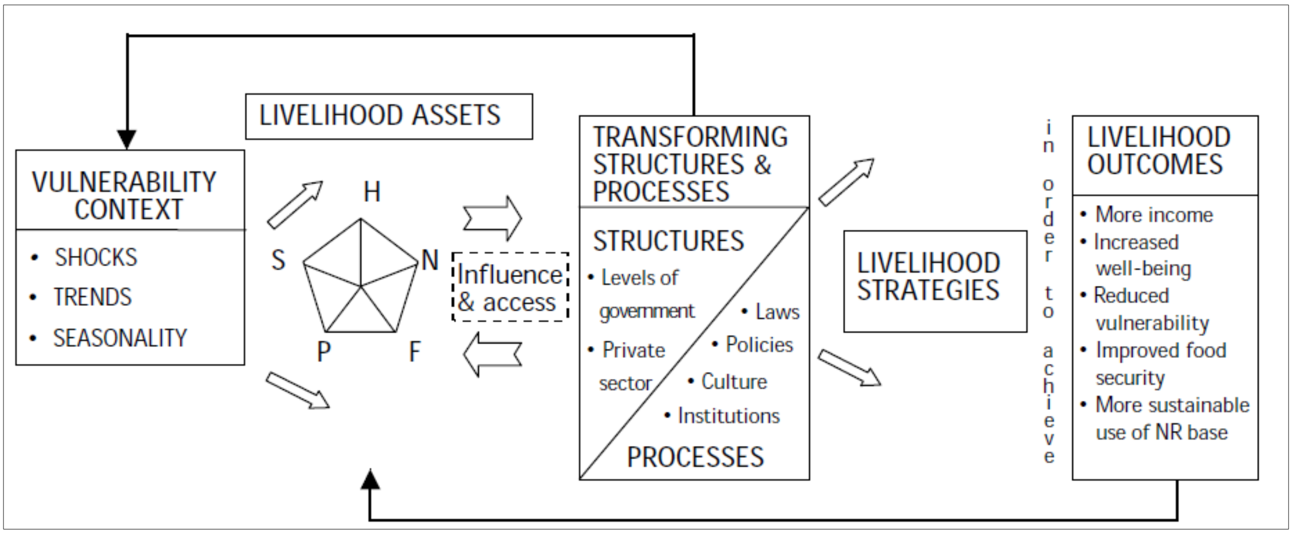
Access to influence or power, and how this may shape access to assets, is another component of the theory of access (Ribot and Peluso, 2003). Authority is identified as one of the 'access mechanisms' by which influence is mediated. In this study, the main subject of enquiry is conservation authority or governance. The extent to which communities are included in decision-making, and therefore influence conservation actors and interventions, is considered by comparing the more centralised SNP with the more decentralised ACA across a range of outcomes via both quantitative and qualitative analysis. The results, summarised later in this chapter, vary from variable to variable but overall confirm wider trends in Nepal, often through Forest User Groups (FUGs) and Community Based Conservation (CBC), towards co-management and decentralisation in conservation (Budhathoki, 2004).

10.2.3 Sustainable Livelihoods

The primary purpose of the Sustainable Livelihoods framework (Figure 10.1) in this study has been its use of the asset pentagon. Its natural, financial, human, social and produced capital classes (DFID, 1999) have been used to quantitatively measure household access to the various categories of asset and their constituent parts. The aggregation of these data was used to create a Sustainable Livelihoods Index (SLI) as a measure of livelihood security, diversification and resilience.

However, the use a political ecology perspective, as well as access theory, has been integrated with other parts of the Sustainable Livelihoods framework, namely, the significance of influence and access, and structures and processes, in combining with assets to create livelihood strategies and outcomes (Scoones, 1998; DFID, 1999). The framework is a useful additional to conservation analyses, including of large carnivores such as snow leopards, which have traditionally been dominated by natural science data and perspectives (Ghosal 2013). The results from this study make clear that nuanced understandings of how livelihoods interact with snow leopards and with snow leopard conservation are essential for conservation to be effective *and* equitable.

Figure 10.1 Sustainable livelihoods framework



Source: DFID, 1999. Key: H = Human Capital; N = Natural Capital; F = Financial Capital; S = Social Capital; P = Physical Capital.

10.3 Thesis research questions and empirical conclusions

10.3.1 Livelihoods

What do household livelihoods involve, in terms of access to various asset classes, and which factors best explain them?

Chapter Five, the first empirical chapter, quantified household livelihoods across the five asset classes of the Sustainable Livelihoods framework and aggregated the results into a Sustainable Livelihoods Index (SLI). It did so based on a combined sample of SNP and ACA households. The most significant factors explaining higher SLI scores were access to income from tourism, followed by larger household size, both of which are consistent with the findings of other studies (Baral et al., 2008; Block and Webb, 2001; Nepal, 2000). The finding that access to assets, in this case tourism-related capital and human capital in the form of family members, reproduces access to further assets, in this case higher SLI scores, is consistent with the theory of access (Ribot and Peluso, 2003).

10.3.2 Governance

How do household livelihoods vary between SNP and ACA, and to what extent does governance explain this variation, among other factors?

Chapter Six compared household livelihoods across the two study sites and considered the extent to which their contrasting governance models explained any significant differences in access to assets. There was considerable variation in results between the two sites on a case-by-case basis, although HLI scores were significantly higher in ACA overall. As noted elsewhere (Salerno et al., 2015), these sorts of differences cannot be ascribed to governance model alone in non-experimental settings, due to other important variations between the study sites.

Nevertheless, in this case, triangulation interview data suggested that the ACA's co-management system, particularly the role of the NTNC, has made a positive contribution to livelihoods. This corroborates Ribot and Peluso's (2003) theory that access to influence or power, can improve access to assets and their management. It is also consistent with the findings of other studies of CBC in ACA, which noted the benefits of the co-management approach for both social and ecological outcomes (Aase et al., 2013; Bajracharya et al., 2005).

10.3.3 Knowledge and attitudes

What are individuals' knowledge of snow leopards, attitudes towards snow leopards and attitudes to snow leopard conservation, and which factors best explain these?

The first empirical chapter to relate SLI scores, and other variables, to data on snow leopards was Chapter Seven. It assessed individual knowledge of snow leopards and found that individuals from ACA, men and those with more positive attitudes to snow leopard conservation all had significantly higher snow leopard knowledge scores. Chapter Seven then assessed individual attitudes to snow leopards. For this aspect of coexistence, attitudes to snow leopard conservation, followed by number of household livestock owned, had the biggest influence, positively and negatively, respectively.

Thirdly, Chapter Seven also assessed individual attitudes to snow leopard conservation and found that more positive attitudes to snow leopards, followed by higher household SLI scores, were the most significant contributors to support for snow leopard conservation. Crucially, aspects of attitudes to snow leopard conservation varied significantly between the two study sites. Attitudes to snow leopard conservation among actors were significantly lower in ACA, while attitudes to snow leopard conservation interventions were significantly lower in SNP. Overall, however, there was no significant difference in attitudes to snow leopard among actors between the two sites.

These data suggest that access to assets can shape attitudes to snow leopards, which is consistent with other recent studies (Alexander et al., 2015; Suryawanshi et al., 2014). However, access to assets did not affect knowledge of snow leopards, which has not been assessed elsewhere to date. The data also suggest that access to assets can influence attitudes to snow leopard conservation, and this appears to be another research gap that has not previously been addressed (Rosen et al., 2012).

The most important finding, however is that attitudes to snow leopard conservation had the most significant impact on attitudes to snow leopards and, to a lesser extent, knowledge of snow leopards. This adds another dimension to access theory, suggesting that attitudes to influence – in this case snow leopard conservation – can shape attitudes to a species as well as access to influence itself. While there was no overall difference in attitudes to snow leopard conservation between SNP and ACA, triangulation data suggested that a breakdown in the relationship between parts of the community in ACA and the NTNC may have contributed to less positive attitudes to snow leopard conservation actors in ACA.

10.3.4 Impacts and conflicts

What impacts from snow leopards, and conflicts with snow leopard conservation, do households face, and which factors best explain these?

Chapter Eight assessed how assets, influence and other variables shaped human-snow leopard impacts, as measured via self-reported household livestock losses to the species in the previous 12 months. The study also quantified how these same factors influenced human-conservation conflicts, similarly measured by self-reported household conflicts during the last 12 months. In both cases, the strongest explanatory factor was the number of household livestock lost to all sources of mortality. Taken as a proxy for husbandry standards, given that livestock owners with poor husbandry are likely to lose more livestock to a range of mortalities, this is consistent with numerous other studies (Daniel Kissling et al., 2009; Karanth et al., 2012; Kolowski and Holekamp, 2006; Wang and Macdonald, 2006).

ACA supported significantly higher levels of impacts and conflicts than SNP, in part because of socio-economic and ecological differences between the two sites. However, it is also partly due to the negative relationship between sectors of the community in ACA and the NTNC that has developed, as suggested by triangulation data. This negative relationship is likely to have affected conflicts with snow leopard conservation in particular. Overall, damage to rather than access to assets, principally livestock, appears to be the main social driver of these tangible impacts from snow leopards and conflicts with snow leopard conservation. Greater involvement in conservation governance does not appear to automatically reduce conflicts with snow leopard conservation and may, in fact, increase them, due to the improved community access to park management in ACA, as well as due due to the perceived mismanagement of the compensation scheme and of revenue sharing from tourism.

10.3.5 Mitigation

What are individuals' attitudes to two proposed mitigation methods, namely the translocation of blue sheep to SNP and a conservation incentive scheme in ACA, and which factors best explain these attitudes?

The final empirical chapter of the thesis was Chapter Nine. It assessed individual attitudes to the proposed translocation of blue sheep to SNP and found that men and those with fewer livestock per household were significantly more positive about the idea. Chapter Nine also assessed individual attitudes to a proposed snow leopard conservation incentive scheme in ACA. More positive attitudes to snow leopard conservation and lower household SLI scores were the strongest factors explaining support for this proposal. This affirms again the significance of attitudes to snow leopard conservation – a form of influence.

In both PAs, decreased access to assets, livestock in SNP and overall livelihood assets in ACA, improved positive attitudes to the proposed mitigation methods in question. This appears to be at odds with the key tenet of access theory (Ribot, 2014), namely that improved access to assets and influence will improve the ability to cope with risks, in this case snow leopards. However, given that translocating blue sheep to SNP, and introducing an incentive scheme that more equitably shares the benefits of the tourism trade, threaten those with more livestock and more access to tourism income respectively, the proposed mitigation methods themselves represent a potentially greater risk to these households' livelihoods than snow leopards. This explains their reduced support for the mitigation measures, compared to households with fewer livestock and lower SLI scores.

10.4 Thesis conclusions and future directions

The conceptual conclusions in Section 10.2. and the chapter summaries contained in Section 10.3, highlight the main findings of the study. However, a few important themes emerge that lead to some notable overall conclusions for the thesis. The study's overall aim was to understand how access to assets and access to influence, in relation to other factors, shape coexistence between humans, snow leopards and snow leopard conservation.

Firstly, increased access to assets does generally improve human coexistence with snow leopards. This also appears to be the first application of access theory to the conservation of large carnivores (Ribot, 2014; Ribot and Peluso, 2003). However, the connections appear more nuanced and complex than the straightforward relationship between more livelihood diversification and more positive attitudes to snow leopards that was originally suggested by Bagchi and Mishra (2006), was successfully tested by Suryawanshi et al. (2014), via the simplistic proxy of green pea production, and was also proposed in this study.

In particular, ownership of or damage to a specific type of asset, principally livestock, appeared here as a key driver of human-snow leopard-snow leopard conservation perceptions and interactions, consistent with the literature on snow leopards (Alexander et al., 2015; Jackson et al., 2010; Suryawanshi et al., 2013) and other large carnivores (Cavalcanti et al., 2010; Hemson et al., 2009; Ripple et al., 2014). It was also important in explaining the negative correlation between livestock ownership and attitudes to the proposed blue sheep translocation, signifying that wild prey species can also be perceived as a threat to livestock production (Alexander et al., 2015). Furthermore, despite livestock being the primary financial income source for only c. 7% of households in this study, their wider importance in both study areas, and hence the potential for ongoing negative interactions with both snow leopards and snow leopard conservation over this asset type in particular, persists for a number of reasons. Firstly, 77% of household own livestock and 56% of households derive *some* financial income from them. Secondly, they remain crucial for soil fertility and traction in the largely agro-ecological farming systems practised throughout SNP and ACA. Thirdly, livestock remain important for cultural reasons in societies that are still very religious, such as providing butter for butter lamps used in Buddhist ceremonies. Fourthly, livestock provide critical logistical support for the trekking and climbing industries, in the form of pack animals for expeditions that often have base camps in snow leopard habitat.

Locally-specific issues also mediated the asset-coexistence relationship at the centre of this thesis. Household SLI scores, for example, are a measure of livelihood diversification and resilience, and were both positively and negatively associated with various aspects of snow leopard conservation measures used in this study, depending on the risk they posed to livelihoods. Where they did not pose a direct threat to livelihoods there was a positive association, as with attitudes to snow leopard conservation in general. Where they did pose a real or perceived direct threat to livelihoods, as with the proposed incentive scheme in ACA, there was a negative association.

Secondly, there was much less clarity about the link between access to influence or power, the second dimension of access theory (Ribot, 2014; Ribot and Peluso, 2003), and how this influenced human coexistence with snow leopards. This is partly due to both anticipated and unanticipated socio-economic and ecological differences between the two study sites (Bhuju et al., 2007), such as the lack of sheep and goats in SNP. It is also due to the empirical impossibility of ascribing causation in non-experimental research settings (Newing et al., 2011; Salerno et al., 2015). However, the significant link uncovered between attitudes to snow leopard conservation and attitudes to, and knowledge of, snow leopards, suggests that *attitudes to influence itself* can have a significant bearing on the species in question. This raises important questions about how conservation is perceived and pursued. In addition, qualitative data from triangulation interviews suggests that, as discussed above with access to assets, access to influence can have varying links to coexistence. These include, for example, the positive, such as investment in livelihoods diversification in ACA by the NTNC and CAMCs that greater influence facilitates. However, they also include the negative, such as increased contact and conflict between sections of the ACA community and the NTNC over fiscal issues, that greater influence *also* facilitates.

Thirdly, tourism emerged as a critical factor that affected human coexistence with snow leopards, relating to both livelihoods and governance. It was found to be a major factor driving conflict between and within local communities in ACA, and especially with park management. These conflicts and animosities mostly concerned benefit sharing of tourism-related revenue, a common occurrence elsewhere (Munanura et al., 2016; Sandbrook and Adams, 2012). In addition, the presence of and access to tourism was a significant contributor to livelihood improvement and diversification, particularly through revenues earned. This included being the most influential factor in explaining significantly higher household SLI scores. Tourism's potential contribution to improved livelihoods through improved earnings is widely recognised (Anand et al., 2012; Nepal, 2002, 2000). However, not all of its contributions to human-snow leopard coexistence were positive. In fact, as noted in previous studies (Ale et al., 2014, 2007), the tourism industry, by competing with agriculture and pastoralism for employment, can reduce the availability of labour for livestock herding. In turn, this can contribute to the poorer husbandry standards that is the best explanatory factor for both snow leopard livestock depredations and conflicts with snow leopard conservation in this study (see Chapter 8).

Further research on human-snow leopard coexistence could take a number of approaches. Firstly, the links between governance, attitudes to and conflicts with snow leopard conservation could be explored across a wider range of snow leopard habitats, governance models and range states. Secondly, as successfully used here and in Namibia (Rust, 2016; Rust et al., 2016), qualitative research should be used more routinely in snow leopard conservation research, to explicate deep and nuanced aspects of coexistence that broad and reductionist quantitative approaches can miss. Thirdly, research on human-snow leopard existence and its socio-economic, cultural and political dimensions should be carried out between and outside of PAs, as with the long-running snow leopard conservation and research program in Spiti, India (Bagchi and Mishra, 2006; Bhatia et al., 2016; Mishra et al., 2017; Suryawanshi et al., 2014).

In summary, access to assets and access to influence do shape human coexistence with snow leopards, albeit in more nuanced and context-specific ways than anticipated. Issues of livestock ownership and loss remain the most tangible influence on human-snow leopard coexistence, yet attitudes towards snow leopard conservation appears here empirically for the first time as a critical component of how the species is known and perceived. In addition, the role of tourism in shaping the context of snow leopard coexistence was also apparent. For there to be snow leopards and sustainability, for there to be a balance of livelihoods, governance and coexistence issues between humans and snow leopard conservation, these two issues need to be better understood and addressed across the range of the species.

10.5 Recommendations

The results and conclusions of this study suggest the following recommendations to improve prospects for the ongoing coexistence of people, snow leopards and snow leopard conservation:

1. Research on snow leopards should better integrate more critical socio-economic tools and perspectives into its analyses and responses, including political ecology, access theory and the Sustainable Livelihoods framework.
2. Snow leopard conservation should attempt to better understand the relationships between tourism, livestock, snow leopards and snow leopard conservation, given tourism's importance for livelihoods in SNP and ACA, as well as at other sites across the range of snow leopards.
3. Stakeholders involved in the management of SNP and ACA should undertake participatory research to explore how best to improve the livelihoods of those not accessing income from tourism in these areas.
4. The Department of National Parks and Wildlife Conservation (DNPWC) should consider how to increase the meaningful participation of other stakeholders, particularly local communities, in the governance and management of SNP.
5. Snow leopard conservation in SNP and ACA should focus on improving attitudes to snow leopards and snow leopard conservation amongst livestock owners in particular.
6. The National Trust for Nature Conservation's (NTNC) Annapurna Conservation Area Project, and its Conservation Area Management Committees, should explore ways to improve dialogue with local communities where there is conflict or animosity especially over revenue sharing and livestock compensation.
7. The DNPWC, and other conservation stakeholders in Nepal, should review and reform the current compensation scheme for livestock killed by large carnivores, including snow leopards, to make it more effective, accountable and responsive.

8. Conservation stakeholders in ACA and SNP should seek to improve standards of livestock husbandry to reduce livestock losses to snow leopards and to reduce conflicts with snow leopard conservation.

9. The DNPWC and other conservation stakeholders in SNP should undertake more consultations and research about the social and ecological feasibility of translocating blue sheep to the area, including analyses of the species' historical presence in SNP.

10. The NTNC and other conservation stakeholders in ACA should undertake more consultations and research about the feasibility of introducing a comprehensive snow leopard conservation incentive scheme to the area. This could incorporate a reformed compensation/insurance program; the development of snow leopard conservation tourism services; and the development of 'snow leopard-friendly' livestock products.

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12. Appendices

12.1 Ethics assessment form

Preliminary Research Ethics Self-Assessment Form 2

(Postgraduate)

This form provides a checklist that will assist self-assessment, and must be completed for every postgraduate research project that involves human participants or personal data, or that has the potential to cause significant environmental damage or harm to animal welfare. Before completing this form, postgraduates will have checked the principles underlying Personal Research Ethics and Project Research Ethics on the Departmental Research Ethics web-site. Using the links to other resources provided through the website, they will have developed awareness of the ethical issues which may arise in their research and discussed these with their supervisor.

Section I: Project Details

1. Project title: Snow leopards and sustainability: snow leopard conservation and sustainable livelihoods in the Himalayas

Section II: Applicant Details

2. Name of Postgraduate: Jonathan Hanson

3. Status (PhD, MPhil course) PhD

4. E-mail address: jh847@cam.ac.uk

5. Supervisor: Nigel Leader-Williams

6. Supervisor's e-mail address: nl293@cam.ac.uk

Section III: Research Checklist

Please answer each question by ticking the appropriate box:

	YES	NO
1. Does the study require the informed consent of its subjects?	x	
2. Does the study involve participants who are particularly vulnerable or unable to give informed consent? (e.g. children, people with learning disabilities, your own students)		x
3. Will the study require the co-operation of a gatekeeper for initial access to the groups or individuals to be recruited? (e.g. students at school, members of self-help group, residents of nursing home)		x
4. Will it be necessary for participants to take part in the study without their knowledge and consent at the time? (e.g. covert observation of people in non-public places)		x
5. Will the study involve discussion of sensitive topics (e.g. sexual activity, drug use)?	x	

6. Will the study involve any invasive, intrusive or potentially harmful procedures?		x
7. Will blood or tissue samples be obtained from participants?		x
8. Is pain or more than mild discomfort likely to result from the study?		x
9. Could the study induce psychological stress or anxiety or cause harm or negative consequences beyond the risks encountered in normal life?		x
10. Will the study involve prolonged or repetitive testing?		x
11. Will financial inducements (other than reasonable expenses and compensation for time) be offered to participants?		x
12. Will the study involve recruitment of patients or staff through the NHS?		x
13. Will the study be associated with significant damage to the environment?		x
14. Will the study involve potential harm to animal welfare?		x

If the answer to any questions on the checklist in Section III is 'yes', this form must be signed and submitted to the Chair of the Department's Ethics Review Group, **together with**:

- a summary of the research proposal including main research objectives and proposed methods;
- an ethics statement showing that you have fully engaged with the ethical issues raised by the proposed research and describing how such issues will be addressed;
- any other relevant supporting material (see information under Procedural Guidelines for Postgraduates).
- Answering 'yes' to question 12 will necessitate an application to the appropriate external health authority ethics committee *after* receiving approval from the Departmental Ethics Review Group.

All materials must be submitted no later than the end of the last day of Lent Full Term (M.Phil. students) or by the division of the Easter Term (Ph.D. students).

Please note that in signing the form below, you are also confirming:

- that you are aware of the Data Protection Act and will make provision to comply with the principles enshrined in the Act;
- and that you have read and will comply with the University of Cambridge's policy on plagiarism.

Signed: Jonathan Hanson

Date: 28th May 2013

Signature of Supervisor:

Date: 28th May 2013

12.2 Ethics approval letter

UNIVERSITY OF CAMBRIDGE

Department of Geography

13th June, 2013

Jonathan Hanson
PhD student, Department of Geography

Dear Jonathan,

I am writing formally in response to your submission of material to the Department's Research Ethics Review Group for an assessment of the research ethics associated with your PhD investigation on 'Snow leopards and sustainability: snow leopard conservation and sustainable livelihoods in the Himalayas'. You submitted a completed Self Assessment form in which you identified that the study will involve the informed consent of your research participants, and that it will involve discussion of sensitive topics, as areas where your research methods might raise ethical issues. You also provided an outline of your research summarizing the proposed methods and an ethics statement.

Your ethics statement demonstrates that full consideration has been given to the process of gaining informed consent and to confidentiality and the storage of data. You show awareness of the need to stress your independence from NGOs and government institutions, and to handle potentially difficult topics sensitively. The Review Group noted your previous experience and existing contacts in the field, and the way in which this has informed the process of planning an ethical approach to your PhD research. Indeed, your ethics statement shows that you have fully engaged with the ethical issues raised by your proposed research, and have provided detailed information to demonstrate that you have thought about how to minimize harm to your research participants. On behalf of the Review Group, I am therefore pleased to give ethics approval for your research. Your project sounds really interesting and I wish you well with your fieldwork.

Yours sincerely,

Molly Warrington
Chair, Ethics Review Group

Downing Place, Cambridge, CB2 3EN, England

Tel: (01223) 333399 • *Direct line* (01223) 333370 • Fax: *National* (01223) 333392 • *International*: +44 1223 333392

Email: mjw29@cam.ac.uk

12.3 Risk assessment

Risk assessment form (#453 by jh847)

Your risk assessment has been approved, and so you are now permitted to undertake the activity in line with your submission. Many thanks for your careful attention. Please print it out and take it with you.

Description of this risk assessment

Submission ID: **453**.

PhD Fieldwork

Section A – basic questions

Your name:	J. Hanson
Your email:	jh847@cam.ac.uk
Position/course: (UL, RA/M.Phil. (title?), BA)	Postgraduate
College:	Hughes Hall

Person responsible

Your form will be reviewed by this person and will discuss it with you. It will also be reviewed by the Department.

This person is either:

- Undergraduates: Director of Studies
- Graduates: Supervisor
- Research staff: Principal Investigator (PI)
- Academic staff: Field course leader

Username/name of person responsible:	Prof Nigel Leader-Williams <nl293>

Emergency contact

Name of a personal contact to be used in the event of an accident:	Paula Hanson
Address of personal contact:	71 Rampton

	Drift Longstanton Cambridge CB24 3EW
Phone number of personal contact:	07546772452

Details of fieldwork

What country are you going to?	Nepal
Where are you going?	Annapurna and Everest regions of Nepal. Brief side trip to Ladakh, India.
What will you be doing there?	Household surveys, focus groups and interviews
When will you be there?	Nepal 20/10/13 - 10/11/13 India 11/11/13 - 15/11/13 Nepal 3/2/14 - 14/3/14 Nepal 14/4/14 - 23/5/14
Will your project involve importing foreign soil and/or plant material?	No
Have you checked the FCO website?	Yes
	No
Does the FCO advise against any travel to your intended destination?	The department will **not** endorse projects that take place in a country/ies or within an area where the UK Foreign and Commonwealth Office (FCO) advises against all travel (or the particular type of travel to be engaged in for the research project), before departure.

Local contact details (e.g. where you are staying)

Local address	No set address. Travelling between neighbouring valleys to interview and survey households
Local phone number	n/a

Local mobile number (if any)	sat phone number tbc
Names and contact details of anyone you will be travelling with	research assistant details tbc

Section B – Personal risk assessment

You should consider the hazards you might encounter (e.g. busy roads, dark streets, cliffs, deep or running water); the risks associated with them (e.g. road accidents, being attacked, falling, drowning or being swept away); and your measures for minimising or avoiding these risks.

What hazards do you perceive you might experience while undertaking this fieldwork?	What are the risks associated with these hazards. (For example: 'Fast-moving traffic', 'Trip hazard', 'Armed guards')	What do you consider is the likelihood of your being exposed to these risks?	How do you propose to avoid or reduce the likelihood of being exposed to the risk?	If you consider the risk requires that (a) you take advice locally, or (b) you inform someone locally of your intentions, who would this be?
1: Travel	Altitude sickness	Medium	Gradual acclimatisation by choosing lower fieldsite first. Previous experience of high altitude walking and climbing with no ill effects.	n/a

Fill in as many others as relevant, if any:

2: Travel	Trip/fall on steep terrain	Medium	Using proper walking boots. Ensuring adequate time for journeys to avoid rushing. Staying on marked paths and using map. Emergency equipment e.g. survival blanket, spare rations, whistle.	Presence of research guide/assistant who knows local area and routes. Local contacts will be made familiar with routes. Register for Trekkers' Information Management System.
3: Travel	Fast-moving and erratic traffic	Low	Minimal time will be spent on road journeys in Nepal; the majority of time will be spent off-road on foot.	n/a
4: Climate	Extremes of weather and temperature	High	Ensure suitable clothing and equipment for both very warm and cold environments e.g. waterproof gear, suncream, hat and gloves, etc.	n/a
5: Human	Theft/mugging	Low	Not travelling alone but with research	n/a

				assistant(s). Avoid the display of valuables e.g. satellite phone or laptop, and walking after dark.	
6:	Human	Approaching individuals/households for data collection	Low	Presence of local research assistant. Ensure permission granted by head of household before access for interview. Interviews conducted in public place or doorstep.	Advice will be taken from local research contacts on the best protocol for approaching and implementing household data collection. Local contacts will be informed of research schedule.
7:	Travel	Air travel	Low	Avoid using Sita Air due to safety concerns, as expressed by the UK Government.	n/a
8:	Human	Demonstrations	Medium	Heightened risk of demonstrations occurring in Kathmandu valley due to	n/a

				election on 19th November. Minimum time to be spent in Kathmandu. All demonstrations to be avoided.	
9:	-	-	-	-	-
10:	-	-	-	-	-

If you have taken advice from someone or used reference material in order to quantify the risks involved listed above, please note them here:
http://intranet.geog.cam.ac.uk/safety/fieldwork/
https://www.gov.uk/foreign-travel-advice/nepal/safety-and-security

Section C: Equipment risk analysis

Please make a *provisional* return here if you hope to borrow items of Departmental field equipment. You will be asked to complete a more detailed assessment in the Easter Term, including customs information and insurance details, and to apply the equipment using the online system at a later date.

If the equipment has a value of under £100 you do not need to list it here.

Equipment you envisage taking with you over the value of £100	Approximate value £	How will equipment be transported to your field location?	Will you obtain insurance cover for transit, overnight storage and field use?	Likelihood of loss, theft or damage from residence or field site	What arrangements will be made for the security of equipment and any valuables during your field studies

Fill in as many as relevant:

1:	Satellite phone	870	On my person/daypack/rucksack	Yes	Low	Satellite phone will be on my person or in my daypack or rucksack at all times.
2:	-	-	-	-	-	-
3:	-	-	-	-	-	-
4:	-	-	-	-	-	-
5:	-	-	-	-	-	-
6:	-	-	-	-	-	-
7:	-	-	-	-	-	-
8:	-	-	-	-	-	-
9:	-	-	-	-	-	-
10:	-	-	-	-	-	-

Section D: Customs and insurance information

Customs: Many countries have very strict customs regulations and when equipment is sent by courier or taken by hand, it must be accompanied by documentation required by that country. This usually consists of a Customs Carnet (costing around £200 plus a proportion of the import tax) with a full list of all equipment irrespective of the value of that equipment, complete with a signed statement that says you will be exporting the equipment back to the home country after use.

Country you are visiting	Finalised document reference numbers and dates (Put 'n/a' if not applicable)
Nepal	n/a
India	n/a
-	-

Insurance details: Please give details of insurance where relevant.

Provider	Policy number

Health insurance:	-	-
Travel insurance:	University of Cambridge	Trip 1: 302221745-1375272210 Trip 2: 302221745-1375272390 Trip 3: 302221745-1375272487
Equipment insurance:	-	

12.4 Initial study concept note

Snow leopards and sustainability: socio-economic aspects of snow leopard conservation in Nepal

Purpose

The purpose of this study is to explore the socio-economic aspects of snow leopard conservation in Nepal, in order to contribute to the sustainability of local economies, societies and ecosystems. Focusing on the human ecology of pastoral and agro-pastoral communities in snow leopard habitat, it will socio-economically profile these groups, assess the socio-economic impact of snow leopard conservation projects (SLCPs), and consider the potential for appropriate socio-economic incentive schemes in these communities..

Methodology

A mixed-methods approach will be utilised to gather both quantitative and qualitative information. A standardised framework for the the socio-economic profiling of local communities will be developed and, after trialling, disseminated via a questionnaire. The questionnaire will also gather data on other relevant issues, such as poaching levels, livestock encroachment, benefits from SLCPs, etc. Using additional data from previous studies, correlation between these topics and community socio-economic profiles will be assessed. In addition, in-depth interviews in each community will be conducted at random from amongst the individuals reached via the questionnaire, adding depth to the quantitative information obtained. In conjunction with the Snow Leopard Conservancy (SLC), a case study could also be undertaken with one particular community using Participatory Action Research (PAR) to analyse, and identify solutions to, their socio-economic problems.

Practical implications

The study will contribute specifically to an enhanced understanding of the relationships between snow leopard conservation and sustainability in local Nepalese communities. In range countries generally it will help to inform improved snow leopard conservation policy and practice. It will also seek to address a set of concerns from a particular local community about snow leopard conservation and sustainability.

Theoretical implications

The study will contribute to several bodies of knowledge, notably conservation and sustainable development in mountainous areas, and participatory, community-oriented conservation. It will also add to the growing body of knowledge on wild felid conservation, particularly the socio-economic aspects.

Originality/value

The value of this study lies in its fulfilment of an important research gap in a key snow leopard range nation, as outlined by the Snow Leopard Survival Strategy. It will also contribute, practically and conceptually, to the threat-based model for snow leopard conservation proposed by Jackson *et al* (2010) in 'Snow leopards: conflict and conservation', *Biology and Conservation of Wild Felids.*

Study area(s)

Working with the SLC and other snow leopard conservation bodies, suitable study areas will be identified in Nepal, with the western part of the country as a possible priority area. The communities chosen will be split between national parks with SLCPs, national parks without SLCPs, unprotected areas with SLCPs, and unprotected areas without SLCPs. Areas could include the Dolpo, Mustang, Langtang and Khumbu regions, including Shey-Phoksondo and Sagarmatha National Parks.

Logistical aspects

The support of an NGO, such as the SLC, with staff and volunteers directly involved in snow leopard conservation in Nepal will be crucial in identifying, contacting and working with local communities. All questionnaires and interview materials will need to be translated into the local languages for usage, and the responses translated back into English for analysis.

Dissemination of findings

To reach the wider conservation community, the findings will be published in relevant peer-reviewed journals. To reach the snow leopard conservation community, the findings will be disseminated via the Snow Leopard Network and Snow Leopard Symposiums. To reach the local community involved in the PAR section of the study, the SLC could disseminate the relevant findings in community meetings or via a (translated) written report.

12.5 Department of National Parks and Wildlife Conservation research permit

नेपाल सरकार
वन तथा भू-संरक्षण मन्त्रालय
राष्ट्रिय निकुञ्ज तथा वन्यजन्तु संरक्षण विभाग
(.................... ईकोलोजी .... शाखा)

फोन नं.: ४२२०८५०, ४२२०९१२, ४२२७९२६
फ्याक्स नं.४२२७६७५

संकेत नं.:-
पत्र संख्या :- २०७०।०७१ ईको।220
चलानी नं. :- 9459

पो. ब. नं. - ८६०
बबरमहल, काठमाडौ
Email: info@dnpwc.gov.np
http//:www.dnpwc.gov.np

मिति: २०७०।१०।२७

विषय: **अध्ययन अनुमति सम्बन्धमा ।**

श्री अन्नपुर्ण संरक्षण क्षेत्र आयोजना
हरियो खर्क, कास्की
श्री सगरमाथा राष्ट्रिय निकुञ्ज कार्यालय
नाम्चेबजार, सोलुखुम्बु

प्रस्तुत विषयमा वन तथा भू-संरक्षण मन्त्रालयको पत्र संख्या वाता ०७०।०७१ चलानी नं १०१ मिति २०७०।१०।२७ को पत्रानुसार University of Cambridge, UK का Ph. D Student बेलायती नागरिक Jonathan Henry Hanson (Passport No 651880312) र निजको सहयोगी नेदरल्याण्ड नागरिक Maurice Gilbert Schutgens (Passport No NR14R3173) समेत भई "Snow Leopard and Sustainability: Conservation and Livelihood in the Himalayas." विषयमा त्यस संरक्षण क्षेत्र । राष्ट्रिय निकुञ्जको क्षेत्रमा अध्ययन अनुसन्धान गर्न February 2014 देखि May 2014 सम्मका लागि अध्ययन अनुमति पाऊँ भन्ने निवेदन सम्बन्धमा कार्यवाही हुँदा देहायका शर्तहरुको आधारमा रही अध्ययन अनुसन्धान गर्न अनुमति दिने नेपाल सरकार (सचिवस्तर)को मिति २०७०।१०।२६ को निर्णयानुसार अध्ययन अनुमति दिईएको ब्यहोरा अनुरोध गर्दछु ।

शर्तहरु:

१) अध्ययन अनुसन्धान कार्य गर्दा रा.नि.तथा व.ज.सं.ऐन, २०२९ र अन्तर्गतका नियमावली र अन्य प्रचलित ऐन नियमहरु अनुसार गर्नु पर्ने ।
२) अध्ययनको लागि पेश भएको प्रस्तावको १ प्रति सम्बन्धित कार्यालयमा पेश गर्नु पर्ने ।
३) अध्ययन पश्चात १।१ प्रति Report यस विभाग र सम्बन्धित कार्यालयमा अनिवार्य रुपमा बुझाउनु पर्ने ।
४) कार्यालयले तोकेको प्रतिनिधीको रोहबरमा अध्ययन अनुसन्धान कार्य गर्नु पर्ने ।
५) कुनै प्रकारको जैविक नमूना संकलन नगर्ने नगराउने ।
६) योगदानका आधारमा यस विभाग र सम्बन्धित संरक्षित क्षेत्रका कर्मचारीको संलग्नतामा लेखहरु प्रकाशित गर्नुपर्नेछ ।

....
(डा. महेश्वर ढकाल)
ईकोलोजिष्ट

बोधार्थ:

श्री राष्ट्रिय प्रकृति संरक्षण कोष
सातदोबाटो, ललितपुर ।

श्री Jonathan Henry Hanson
University of Cambridge, UK: सम्बन्धित कार्यालयसँग समन्वय गरी अध्ययन अनुसन्धान गर्नहुन ।

12.6 National Trust for Nature Conservation research permit

NATIONAL TRUST FOR NATURE CONSERVATION
ANNAPURNA CONSERVATION AREA PROJECT
Headquarters, Pokhara

Ref: 161/070/071

Date: 21 October, 2013

Mr.Jonathan Hanson.
Ph D candidate
Department of Geography.

Re: Permission to conduct research in Annapurna Conservation Area.

We received your request letter regarding permission to conduct research on **"Snow Leopards and Sustainability: Conservation and Livehoods in the Himalayas."** You have been given permission for carrying out your field research at ACA with the following terms and conditions:

1. The research must be for scientific and academic purpose with the aim of making contribution in conservation and development of the area.
2. This permission will be valid from 26 october 2013 to 16th May 2014 only.
3. The research permit is valid for Manang and Lower Mustang area in ACA.
4. You have to follow the ACAP Minimum Impact Code and the Conservation Area Management Regulation 2053 during your entire stay in the Annapurna Conservation Area.
5. You will have access to the NTNC-ACAP Resource Library in Pokhara.
6. Upon the completion of the research, you must submit a copy of your report to the NTNC-ACAP/HQ.
7. You will maintain communication with the nearest ACAP field office.
8. Any dispute arose during the execution period will be solved by mutual understanding.
9. Any unsolved disputes will be handled as per the existing law of Nepalese government.

Thank you and wish you all the best.

Lal Prasad Gurung
Project Director

cc:
ACAP, UCO Manang, jomsom .

Central Office : P.O. Box 3712
Khumaltar, Lalitpur, Nepal
Tel. No. : 00977-1-5526571, 5526573
Fax : 00977-1-5526570
Website: www.ntnc.org.np

Headquarters : P.O. Box 183
Pokhara, Kaski, Nepal
Tel. No. : 00977-61-431102, 430802, 432288
Fax No. : 00977-61-431203
E-mail : info@acap.org.np

12.7 Fieldwork blog introduction

Hello. My name's Jonny Hanson. I'm a PhD researcher at the University of Cambridge, where I study the relationships between people and snow leopards in Nepal. There are only four to seven thousand of these endangered cats left in the wild, spread across 12 countries in South and Central Asia. One of the main threats they face is from conflict with local people, who often lose livestock to snow leopards, and can kill the cats in retaliation. In turn, snow leopards are a threat to the livelihoods of local communities, who are often quite poor and dependent on livestock farming.

My research is trying to help us understand these complex interactions. It seeks to build the most comprehensive picture so far of people's conflicts with and attitudes to snow leopards, and how these are affected by characteristics like age, gender and religion. Crucially, the study also looks at whether families who are less dependent on livestock for their income, and who are included, rather than excluded, from managing local conservation issues, are more likely to have better relations with snow leopards.

Towards the end of 2013, I travelled to Nepal to check out the areas where I would be working and to meet local conservation partners, including the National Trust for Nature Conservation and the Snow Leopard Conservancy. I also did a trial run with the questionnaire that I would be using to gather information Then, in February 2014, I headed back to Nepal for the main part of the project. Over three and a half months my research team and I travelled first to the Everest region and then to the Annapurna region to talk to more than 700 Nepali households. We walked hundreds of kilometres through some of the highest and most remote terrain on Earth; crossed mountain passes laden with heavy rucksacks full of important gear; and saw the most amazing scenery and wildlife. Unfortunately the amazing but elusive snow leopard decided not to show up!

Our research, though, is contributing to our understanding of this endangered species, and how we can help it to live alongside the remarkable communities who share its habitat. Along the way, myself and some other team members blogged – in words and photos – about our experiences in the field. Now that we're back at our desks, we'll also be posting the occasional article as interesting findings pop-up during the analysis phase of the project. But otherwise please enjoy reading about our adventures in Nepal.

From https://snowleopardresearchnepal.wordpress.com/about/ [Accessed 28th February 2017]

12.8 Research assistant advertisement

Snow leopard conservation PhD:
Research assistant advertisement

Introduction

This is an exciting opportunity to take part in a University of Cambridge PhD research project. The study will examine human conflict with, and attitudes to, snow leopards *Panthera uncia* and snow leopard conservation in Sagarmatha National Park and Annapurna Conservation Area, Nepal. Two to four research assistants are required to administer and process household questionnaires, and help with qualitative interviews and focus groups, from 4th February to 16th May 2014. This fieldwork will involve extensive trekking at altitudes of up to 5,500m.

Role description

Each research assistant position will include, but is not limited to, the following:

1. Paid working days of Monday – Saturday each week.
2. Orientation training in Kathmandu, 5/6th February 2014.
3. Working as part of a 5 – 6 person research team.
4. Under instruction from principal investigator and/or fieldwork manager, individually approach and sample households/individuals and conduct questionnaires of approximately 30 minutes each.
5. Carry out up to a maximum of 8 questionnaires per day.
6. As required, assist principal investigator and/or fieldwork manager in conducting/translating qualitative interviews and focus groups.
7. Assist with data processing, including interview/focus group transcription and spreadsheet data entry.
8. Travel to and from the study areas by bus/jeep/aeroplane/on foot with the rest of the research team.
9. Spend significant amount of time walking within study areas, carrying own personal belongings and some research materials, at altitudes of up to 5,500m and for up to 8 hours per day.

Essential criteria

- Fluency in written and spoken Nepali.
- Fluency in written and spoken English.
- Necessary equipment for trekking expedition, including warm and waterproof clothing, correct footwear, rucksack and 4 season sleeping bag.
- High level of physical fitness.
- Bachelors degree in an environmental or development-related subject, such as Forestry, Conservation, Sustainable Development, Rural Development, etc.

Desirable criteria

Voluntary and/or professional experience in the environment and/or development sectors.
Trekking experience, especially at altitudes of more than 3,000m.
Experience of being involved in a research project with a focus on an aspect of the environment or development.
Experience of delivering household questionnaires, qualitative interviews and/or focus groups.

Salary and expenses

The weekly salary will be NR 13,000 with a bonus of 100 for each questionnaire completed and a bonus of 200 for each interview/focus group completed. All travel expenses to and from the fieldsites, as well as travel insurance, will be paid for by the principal investigator but not food and accommodation costs.

Application process

Please send a C.V./résumé in English (including two referees contactable by email), along with a covering letter in English detailing why you are applying for the position and how you meet the criteria, to Jonny Hanson (jh847@cam.ac.uk) by 23:00 Nepali time on Sunday 5th January 2014. Late applications will not be accepted. Interviews will be carried out by Skype in mid January 2014.

12.9 Sagarmatha National Park questionnaire

RA initials ___

Human dimensions of snow leopard conservation:
SNP Household questionnaire

Section 1 Household

1.1 Household location

1.1.1 VDC

1.1.2 Settlement

1.1.3 Head of household's name.

.

1.1.4 House name/distinguishing features

1.1.5 Adjacent landmark(s)

1.2 Human assets

1.2.1 How many household members are there?

Total	Adults (18+)	School age children (4-18)	Infants (<4)

1.2.2 How many adult household members can read and write?

	N/A	

1.2.3 How many household members of school age are in education?

	N/A	

Which of the following types of medical treatment does your household have access to?

		Yes	No	N/A
1.2.4	Self-administered traditional medicine			
1.2.5	Self-administered ‘Western’ medicine			
1.2.6	Visit to local clinic in PA			
1.2.7	Visit to clinic outside of PA			

Which of the following types of media does your household have access to?

		Yes	No	N/A
1.2.8	Newspaper			
1.2.9	Radio			
1.2.10	Television			
1.2.11	Internet			

1.3 Natural assets

1.3.1 Does your household have access to land for grazing animals?

Yes		No		N/A	

How many of each type of livestock does your household own?

	Livestock	Number	N/A
1.3.2	Cattle		
1.3.3	Sheep/goats		
1.3.4	Horses/mules/donkeys		
1.3.5	Yaks/yak hybrids		
1.3.6	Other		

1.3.7 Does your household have access to land for agriculture/cultivation?

Yes		No		N/A	

1.3.8 Are you able to sell any surplus agricultural products from your land?

Yes		No		N/A	

Which of the following natural products does your household you have access to?

		Yes	No	N/A
1.3.9	Fuelwood			
1.3.10	Construction wood			
1.3.11	Human food			
1.3.12	Animal food			
1.3.13	Medicinal plants			

Which of the following forms of water supply does your household have access to?

		Yes	No	N/A
1.3.14	Spring			
1.3.15	Well			
1.3.16	Handpump			
1.3.17	Outside tap			
1.3.18	Inside tap			

1.4 Social assets

Is anyone in your household a member of any of the following formal groups/organisations?

		Yes	No	N/A
1.4.1	Conservation committee			
1.4.2	Village development committee			
1.4.3	Tourism association			
1.4.4	Microcredit group			
1.4.5	Co-operative			
1.4.6	Women's group			
1.4.7	School association			
1.4.8	Youth group			
1.4.9	Other			

Does your household have access to political representatives at the following levels?

		Yes	No	N/A
1.4.10	Local			
1.4.11	District			
1.4.12	National			

1.5 Physical assets

Which of the following types of fuel sources does your household have access to?

		Yes	No	N/A
1.5.1	Fuelwood			
1.5.2	Cylinder gas			
1.5.3	Kerosene oil			

1.5.4	Electricity			
1.5.5	Animal dung			
1.5.6	Other			

Which of the following types of buildings does your household have access to?

		Yes	No	N/A
1.5.7	Residential building			
1.5.8	Joint tourist/residential building			
1.5.9	Tourist building			
1.5.10	Other building			

Which of the following forms of transport does your household have access to?

		Yes	No	N/A
1.5.11	Foot			
1.5.12	Animal			
1.5.13	Bicycle			
1.5.14	Bus/taxi			
1.5.15	Aeroplane			
1.5.16	Motorcycle			
1.5.17	Other			

1.6 Financial assets

1.6.1 What was your total household income in the last 12 months (NR)?

0– 50,000	50,001–100,000	100,001–150,000	150,000-200,000	200,001-250,00	>250,001	Prefer not2say	N/A

Which of the following types of financial income does your household have access to?

		Yes	No	N/A
1.6.2	Livestock			
1.6.3	Agriculture/cultivation			
1.6.4	Wood			
1.6.5	Other natural products			
1.6.6	Tourism			
1.6.7	Remittances			
1.6.8	Savings			
1.6.9	Loans			
1.6.10	Other			

What are your most important sources of financial income as a household? RANK WITH 1 BEING THE MOST IMPORTANT.

		Rank

1.6.11	Livestock	
1.6.12	Agriculture/cultivation	
1.6.13	Wood	
1.6.14	Other natural products	
1.6.15	Tourism	
1.6.16	Remittances	
1.6.17	Savings	
1.6.18	Loans	
1.6.19	Other	

Section 2 Household conflict

2.1 Conflict with snow leopards

2.1.1 What was the total number of livestock lost by the household in the last 12 months?

Total number		N/A	

2.1.2 What were the numbers of each type of livestock lost by the household in the last 12 months?

Cattle	Sheep/goats	Horses/mules	Yaks/yak hybrids	Other	N/A

2.1.3 What were the most important reasons for these household livestock losses? RANK WITH 1 BEING THE MOST IMPORTANT.

Disease	Weather	Snow leopards	Other predators	Theft	Accident	Other	N/A

2.1.4 What was the total number of household livestock killed by snow leopards in the last 12 months?

Total number		N/A	

2.1.5 What were the numbers of each type of household livestock killed by snow leopards in the last 12 months?

Cattle	Sheep/goats	Horses/mules	Yaks/yak hybrids	Other	N/A

2.1.6 Where were the main locations of these livestock killings by snow leopards? RANK WITH 1 BEING THE MOST IMPORTANT.

High pastures	Low pastures	Barren land	Agriculture/ settlement	Scrubland	Other	N/A

2.1.7 Which were the main months when most of these livestock killings by snow leopards took place? RANK WITH 1 BEING THE MOST COMMON.

Jan/ Feb	Feb/ Mar	Mar/ Apr	Apr/ May	May/ Jun	Jun /July	Jul/ Aug	Aug/ Sep	Sep / Oct	Oct/ Nov	Nov/ Dec	Dec/ Jan	Not sure	N/A
Magh	Fal-gun	Chaitra	Bais-akh	Abhish-ek	Asar	Shra-wan	Bhadau	Asoj	Kartik	Man-gsir	Po-ush	---	---

2.1.8 Did your household receive compensation for the livestock killed by snow leopards?

Yes		No		Not yet		N/A	

2.1.9 Positive identification of snow leopard?

Yes		No		N/A	

2.1.10 Positive differentiation between snow leopard and common leopard?

Yes		No		N/A	

2.2 Conflict with snow leopard conservation

Has your household had a conflict with any of the following organisations involved in snow leopard conservation in the last 12 months and, if so, why was this?

		Yes	No	N/A
2.2.1	Park management			
2.2.2	Park management			
2.2.3	Local committee			
2.2.4	Local committee			

Has your household had a conflict with any of the following snow leopard conservation measures in the last 12 months and, if so, why was this?

		Yes	No	N/A
2.2.5	Ban on the killing of snow leopards			
2.2.6	Ban on the killing of snow leopards			

2.2.7	Ban on the killing of snow leopard prey			
2.2.8	Ban on the killing of snow leopard prey			
2.2.9	Livestock compensation scheme			
2.2.10	Livestock compensation scheme			
2.2.11	Corral construction			
2.2.12	Corral construction			
2.2.13	Environmental education activities			
2.2.14	Environmental education activities			
2.2.15	Limits on the collection of NTFPs			
2.2.16	Limits on the collection of NTFPs			
2.2.17	Limits on the collection of wood			
2.2.18	Limits on the collection of wood			
2.2.19	Other			
2.2.20	Other			

2.2.21 If other, please state what.

Section 3 Individual attitudes

3.1 Respondent attributes

3.1.1 What is your age?

3.1.2 What is your gender?

Male		Female	

3.1.3 How many years of education have you had?

3.1.4 Are you a native of the area?

Yes		No		N/A	

3.1.5 What is your religion?

None		Buddhist		Bon		Hindu		Other		N/A	

3.1.6 How religious would you define yourself?

Very religious	Quite religious	Neutral	Not very religious	Not religious at all
1	2	3	4	5

3.2 Attitudes to snow leopards

3.2.1 How do you feel about snow leopards?

Very positive	Positive	Neutral	Negative	Very negative
1	2	3	4	5

3.2.2 Why do you feel this way about snow leopards?

3.2.3 Should snow leopards be present in your area in the future?

Completely agree	Agree	Neutral	Disagree	Completely disagree
1	2	3	4	5

3.2.4 Why do you feel this way about the future presence of snow leopards in your area?

3.3 Attitudes to snow leopard conservation

What is your attitude to the following organisations involved in snow leopard conservation and why do you feel this way?

		Very +ve	+ve	Neutral	-ve	Very -ve	N/A
3.3.1	Park management	1	2	3	4	5	
3.3.2	Park management						
3.3.3	Local committee	1	2	3	4	5	
3.3.4	Local conservation						

How do you feel about the following snow leopard conservation measures and why do you feel this way?

		Very +ve	+ve	Neutral	-ve	Very -ve	N/A
3.3.5	Ban on the killing of snow leopards	1	2	3	4	5	
3.3.6	Ban on the killing of snow leopards						
3.3.7	Ban on the killing of snow leopard prey	1	2	3	4	5	
3.3.8	Ban on the killing of snow leopard prey						
3.3.9	Livestock compensation scheme	1	2	3	4	5	
3.3.10	Livestock compensation scheme						
3.3.11	Corral construction	1	2	3	4	5	
3.3.12	Corral construction						
3.3.13	Environmental education activities	1	2	3	4	5	
3.3.14	Environmental education activities						
3.3.15	Limits on the collection of NTFPs	1	2	3	4	5	
3.3.16	Limits on the collection of NTFPs						
3.3.17	Limits on the collection of wood	1	2	3	4	5	
3.3.18	Limits on the collection of wood						
3.3.19	Other	1	2	3	4	5	
3.3.20	Other						

3.3.21 If other, please state what.

Section 4 Blue sheep social viability survey

4.1 Would the translocation/movement of other prey species to SNP help to reduce the number of livestock lost to snow leopards?

Completely agree	Agree	Neutral	Disagree	Completely disagree
1	2	3	4	5

4.2 Have you heard of animal called the blue sheep (naur) before?

Yes		No		Maybe		N/A	

4.3 Positive identification of blue sheep.

Yes		No		N/A	

4.4 Should a population of blue sheep be translocated/moved to SNP?

Completely agree	Agree	Neutral	Disagree	Completely disagree
1	2	3	4	5

4.5 Why do you feel this w

12.10 Annapurna Conservation Area questionnaire

This was identical to 12.9, except for section 4, which focused on a different proposed conservation intervention, a snow leopard conservation incentive scheme that included an element of livestock certification.

Section 4 Livestock certification scheme viability analysis

EXPLAIN THAT SCHEME HAS BEEN PROPOSED AND THESE QUESTIONS ARE TO GAUGE LOCAL INTEREST AND SUPPORT. EXPLAIN THAT THIS IS ONLY THE CONCEPT PHASE AND ACTION IS NOT GUARANTEED.

4.1 The scheme would involve tourists paying higher prices for local livestock products to improve the livelihoods of local herders, raise money for snow leopard conservation and compensation, and increase tourist awareness of snow leopards. Would you be interested in such a scheme?

Yes		No		Maybe		N/A	

4.2 Why?

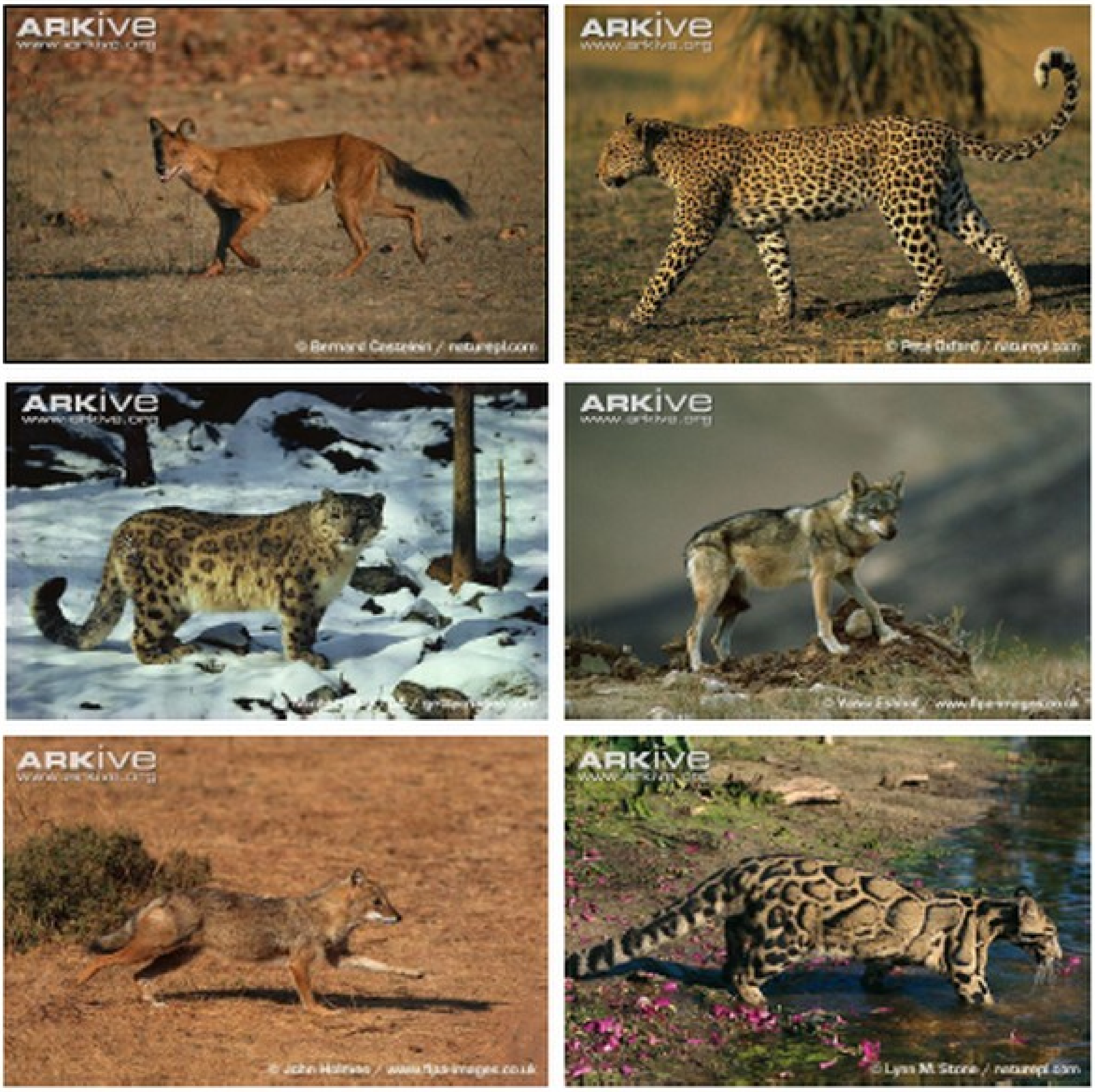
How would you feel about the potential parts of the scheme and why?

		Very +ve	+ve	Neutral	-ve	Very -ve	N/A
4.3	Higher price for local yak products paid to herders	1	2	3	4	5	
4.4	Higher price for local yak products paid to herders						
4.5	Higher price for other local livestock products paid to herders	1	2	3	4	5	
4.6	Higher price for other local livestock products paid to herders						
4.7	Higher price paid by tourists for local livestock products	1	2	3	4	5	
4.8	Higher price paid by tourists for local livestock products						
4.9	Money raised for local snow leopard conservation activities	1	2	3	4	5	
4.10	Money raised for local snow leopard conservation activities						
4.11	Agreement on livestock numbers/density	1	2	3	4	5	
4.12	Agreement on livestock						

	numbers/density						
4.13	Livestock free wildlife zones	1	2	3	4	5	
4.14	Livestock free wildlife zones						
4.15	No retaliation clause	1	2	3	4	5	
4.16	No retaliation clause						
4.17	Annual conservation-dependent bonus for herders	1	2	3	4	5	
4.18	Annual conservation-dependent bonus for herders						
4.19	Higher rate of compensation for livestock killed by snow leopards	1	2	3	4	5	
4.20	Higher rate of compensation for livestock killed by snow leopards						
4.21	Livestock replacement for livestock killed by snow leopards (non financial)	1	2	3	4	5	
4.22	Livestock replacement for livestock killed by snow leopards (non financial)						
4.23	Raising awareness of snow leopards amongst tourists	1	2	3	4	5	
4.24	Raising awareness of snow leopards amongst tourists						

12.11 Carnivore colour plate

Photo ID Sheet 1



12.12 Herbivore colour plate

Photo ID Sheet 2

12.13 Sagarmatha National Park interview sheet

Snow leopards and sustainability PhD:
SNP Interview sheet

RA INITIALS:
INVESTIGATOR INITIALS:

Section 1 Socio-economic profile

1.1 Characteristics

1.1.1 VDC:

1.1.2 Settlement:

1.1.3 Name/position/group:

1.2 Human assets

1.2.1 What are the standards of education like in the area?

1.2.2 Which types of medical treatment do household have access to?

1.2.3 Which types of media do households have access to?

1.3 Natural assets

1.3.1 What is livestock production like in the area?

1.3.2 What is agricultural production/cultivation like in the area?

1.3.3 Which (wild) natural products do households have access to?

1.3.4 Which forms of water supply do households have access to?

What is the current market value of the following livestock as sub-adults/adolescents (GIVE RANGE OF VALUES IF NECESSARY)?

1.3.5	1.3.6	1.3.7	1.3.8
Cattle	Sheep/goats	Horses/mules/donkeys	Yaks/yak hybrids

1.4 Social assets

1.4.1 Which formal groups/organisations do household have access to?

1.4.2 Which forms of political representation do households have access to?

1.5 Physical assets

1.5.1 Which types of fuel sources do households have access to?

1.5.2 Which types of buildings do households have access to?

1.5.3 Which forms of transport do households have access to?

1.6 Financial assets

1.6.1 What are household incomes (NR) like in the area?

1.6.2 Which sources of financial income do households have access to?

1.6.3 Which sources of financial income are most important?

Section 2 Household conflict

2.1 Conflict with snow leopards

2.1.1 What were the reasons for livestock losses in the area in the last 12 months?

2.1.2 What was the total number of livestock killed by snow leopards in the VDC in the last 12 months?

2.1.3 Where were the main locations of livestock killings by snow leopards?

2.1.4 Which were the main months when most of these livestock killings by snow leopards took place?

2.1.5 Did households receive compensation for the livestock killed by snow leopards?

2.2 Conflict with snow leopard conservation

2.2.1 Have households had conflict with organisations involved in snow leopard conservation in the last 12 months?

2.2.2 Have households had conflict with particular snow leopard conservation measures in the last 12 months?

Section 3 Attitudes

3.1 Attitudes to snow leopards

3.2.1 How do people in the area feel about snow leopards?

3.2.2 Do people in the area feel snow leopards should be present in here in the future?

3.2 Attitudes to snow leopard conservation

3.2.1 How do people in the area feel about organisations involved in snow leopard conservation?

3.2.2 How do people in the area feel about particular snow leopard conservation measures?

Section 4 Blue sheep social viability survey

EXPLAIN THAT SCHEME HAS BEEN PROPOSED AND THESE QUESTIONS ARE TO GAUGE LOCAL INTEREST AND SUPPORT. EXPLAIN THAT THIS IS ONLY THE CONCEPT PHASE AND ACTION IS NOT GUARANTEED.

4.1 Should a population of blue sheep be translocated/moved to SNP to reduce snow leopard predation on livestock?

12.14 Annapurna Conservation Area interview sheet

This was identical to 12.13, except for section 4, which focused on a different proposed conservation intervention, a snow leopard conservation incentive scheme that included an element of livestock certification.

Section 4 Livestock-certification conservation incentive scheme viability analysis

EXPLAIN THAT SCHEME HAS BEEN PROPOSED AND THESE QUESTIONS ARE TO GAUGE LOCAL INTEREST AND SUPPORT. EXPLAIN THAT THIS IS ONLY THE CONCEPT PHASE AND ACTION IS NOT GUARANTEED.

4.1 The scheme would involve tourists paying higher prices for local livestock products to improve the livelihoods of local herders, raise money for snow leopard conservation and compensation, and increase tourist awareness of snow leopards. What would you think of such a scheme?

12.15 Quantitative interview results

Section 1 Socio-economic profile

1.1 Sample

Table 12.15.1 Interviewee roles

Role	Frequency	Percentage
Community leader	14	20.0
Conservation leader	12	17.1
Teacher	8	11.4
Monk	7	10.0
Women's leader	7	10.0
Health worker	5	7.1
Savings and credit cooperative officer	4	5.7
Government employee	3	4.3
Park officer	3	4.3
Youth leader	3	4.3
Herder	1	1.4
Hotelier	1	1.4
Army officer	1	1.4
Tourism officer	1	1.4
Total:	**70**	**100.0**

Table 12.15.2 Interview sampling by VDC

VDC	Frequency	Percentage
Khumjung	14	20.0
Namche	12	17.1
Jomsom	10	14.3
Kagbeni	7	10.0
Muktinath	5	7.1
Manang	4	5.7
Tanki Manang	3	4.3
Pisang	3	4.3
Jhong	2	4.3

Khangsar	2	2.9
Bhraka	2	2.9
Ngawal	2	2.9
Nar	2	2.9
Ghyaru	1	1.4
Phu	1	1.4
Total:	**70**	**100.0**

1.2 Human assets

Table 12.15.3 Community access to human assets in SNP, ACA and combined based on triangulation interviews.

Human asset class	Asset type	Combined N = 70		SNP N = 26		ACA N = 44	
		N	%	N	%	N	%
Education	Primary	69	98.6	26	100.0	43	97.7
	Secondary	61	87.1	24	92.3	37	84.1
	Tertiary	15	21.4	6	23.1	9	20.5
Medical	Traditional medicine	56	80.0	20	76.9	36	81.8
	Self-administered Western medicine	8	11.4	6	23.1	2	4.5
	Visit to local clinic in protected area	67	95.7	24	92.3	43	97.7
	Visit to clinic outside of protected area	20	28.6	11	42.3	9	20.5
Media	Newspaper	18	25.7	1	3.8	17	38.6
	Radio	55	78.6	23	88.5	32	72.7
	Television	67	95.7	25	96.2	42	95.5
	Internet	45	64.3	21	80.8	24	54.5

1.3 Natural assets

Table 12.15.4 Community access to natural assets in SNP, ACA and combined based on triangulation interviews.

Natural asset class	Asset type	Combined N = 70		SNP N = 26		ACA N = 44	
		N	%	N	%	N	%
Livestock	Cattle	53	75.7	14	53.8	39	88.6
	Sheep/goats	38	54.3	1	3.8	37	84.1
	Horses/mules/donkeys	28	40.0	2	7.7	26	59.1
	Yaks/yak hybrids	58	82.9	21	80.8	37	84.1
	Other	3	4.3	0	0.0	3	6.8
Crops	Potatoes	65	92.9	25	96.2	40	90.9
	Cereals	57	81.4	17	65.4	40	90.9
	Legumes	4	5.7	1	3.8	3	6.8
	Green vegetables	44	62.9	17	65.4	27	61.4
	Fruit	23	32.9	1	3.8	23	52.3
	Other	1	1.4	0	0.0	1	2.3
Wild natural products	Fuelwood	61	87.1	23	88.5	38	86.4
	Construction wood	15	21.4	7	26.9	8	18.2
	Human food	48	68.6	21	80.8	27	61.4
	Animal food	7	10.0	6	23.1	1	2.3
	Medicinal plants	32	45.7	17	65.4	15	34.1
	Other	63	90.0	23	88.5	40	90.9
Water	Spring	23	32.9	11	42.3	12	27.3
	Well	1	1.4	1	3.8	0	0.0
	Handpump	0	0.0	0	0.0	0	0.0
	Outside tap	61	87.1	23	88.5	38	86.4
	Inside tap	48	68.6	13	50.0	35	79.5

Table 12.15.5 Livestock production characteristics in SNP, ACA and combined based on triangulation interviews.

Aspect of livestock production		Combined N = 70		SNP N = 26		ACA N = 44	
		N	%	N	%	N	%
Sale of surplus and/or commercial production		39	55.7	51	73.1	20	45.5
Decreasing production		18	25.7	7	10.0	11	25.0
Reasons for	No reason	3	16.7	0	0.0	3	27.3
	Tourism	10	55.5	7	100.0	3	27.3

decrease	Migration	2	11.1	0	0.0	2	18.2
	Motorised transport	2	11.1	0	0.0	2	18.2
	Increased predation	1	5.6	0	0.0	1	9.0

Table 12.15.6 Crop production characteristics in SNP, ACA and combined based on triangulation interviews.

Aspect of crop production		**Combined** N = 70		**SNP** N = 26		**ACA** N = 44	
		N	**%**	**N**	**%**	**N**	**%**
Sale of surplus and/or commercial production		51	72.9	18	69.2	33	75.0
Decreasing production		7	10.0	3	11.5	4	9.1
Reasons for decrease	No reason	2	28.6	1	33.3	1	25.0
	Tourism	2	28.6	1	33.3	1	25.0
	Cheaper imports	2	28.6	1	33.4	1	25.0
	Switch to cash crops	1	14.2	0	0.0	1	25.0

Table 12.15.7 Financial values of livestock in SNP, ACA and combined based on triangulation interviews.

Livestock class		**Price (US$)**		
		Combined	**SNP**	**ACA**
Cattle	N	55	18	37
	Mean ± SD	**159.41** ± 87.02	**163.75** ± 97.76	**157.30** ± 82.65
	Median	125.00	125.00	135.00
	Minimum	38.00	38.00	50.00
	Maximum	375.00	350.00	375.00
Sheep/ goats	N	41	4	37
	Mean ± SD	**140.22** ± 42.79	**114.00** ± 32.47	**143.05** ± 43.15
	Median	150.00	105.50	150.00
	Minimum	45.00	85.00	45
	Maximum	215.00	160.00	215
Equines	N	56	20	36
	Mean ± SD	**1057.11** ± 570.97	**976.25** ± 598.32	**1102.03** ± 558.67
	Median	950.00	825.00	1000.00
	Minimum	150.00	300.00	150.00
	Maximum	2500	2500.00	2500.00
Yaks/yak hybrids	N	61	24	37
	Mean ± SD	**547.87** ± 299.68	**469.17** ± 328.15	**598.92** ± 272.17
	Median	450.00	412.50	650.00

	Minimum	90.00	90.00	140.00
	Maximum	1750.00	1750.00	1375.00

1.4 Social assets

Table 12.15.8 Community access to social assets in SNP, ACA and combined based on triangulation interviews.

Social asset class	**Asset type**	**Combined** N = 70		**SNP** N = 26		**ACA** N = 44	
		N	**%**	**N**	**%**	**N**	**%**
Organ-isational	Conservation committee	56	80.0	22	84.6	34	77.3
	Village committee	14	20.0	5	19.2	9	20.5
	Tourism association	5	7.1	2	7.7	3	6.8
	Microcredit group	7	10.0	7	26.9	0	0.0
	Co-operative	2	2.9	2	7.7	0	0.0
	Women's group	63	90.0	22	84.6	41	93.2
	School association	17	24.3	5	19.2	12	27.3
	Youth group	62	88.6	22	84.6	40	90.9
	Other	31	44.3	11	42.3	20	45.5
Political	Local	67	95.5	25	96.2	42	95.5
	District	55	78.6	21	80.8	34	77.3
	National	8	11.4	5	19.2	3	6.8

1.5 Physical assets

Table 12.15.9 Community access to physical assets in SNP, ACA and combined based on triangulation interviews.

Physical asset class	**Asset type**	**Combined** N = 70		**SNP** N = 26		**ACA** N = 44	
		N	**%**	**N**	**%**	**N**	**%**
Fuel	Fuelwood	67	95.7	25	96.2	42	95.5
	Cylinder gas	65	92.9	23	88.5	42	95.5
	Kerosene oil	39	55.7	23	88.5	16	36.4
	Electricity	47	67.1	22	84.6	25	56.8
	Animal dung	42	60.0	23	88.5	19	43.2
	Other	7	10.0	3	11.5	4	9.1
Buildings	Residential	64	91.4	22	84.6	42	95.5

	Joint tourist/residential	55	78.6	22	84.6	33	75.0
	Tourist	27	38.6	11	42.3	16	36.4
	Other	10	14.3	5	19.2	5	11.4
Transport	Foot	60	85.7	26	100.0	34	77.3
	Animal	49	70.0	21	80.8	28	63.6
	Bicycle	0	0.00	0	0.00	0	0.00
	Bus/taxi/jeep	33	47.1	0	0.00	33	75.0
	Aeroplane	35	50.0	25	96.2	10	22.7
	Motorcycle	38	54.3	0	0.00	38	86.4
	Other	37	52.9	20	76.9	17	38.6

1.6 Financial assets

Table 12.15.10 Household financial incomes in SNP, ACA and combined, with standard deviation in parentheses, based on triangulation interviews.

Income class		**Income (US$)**		
		Combined	**SNP**	**ACA**
Low-end	N	28	8	20
	Mean ± SD	**660.71** ± 682.77	**987.50** ± 974.58	**530.00** ± 499.58
	Median	500.00	500.00	500.00
	Minimum	0	300	0
	Maximum	3000	3000	2000.00
Mid-point	N	29	10	19
	Mean ± SD	**5437.07** ± 6956.22	**4195.00** ± 6203.11	**6090.79** ± 7397.59
	Median	3500.00	2000.00	4850.00
	Minimum	125.00	1250.00	125
	Maximum	30100.00	21500.00	30100.00
High-end	N	30	10	20
	Mean ± SD	**15211.67** ± 22812.07	**17050.00** ± 31355.89	**14292.50** ± 18052.43
	Median	8500.00	3750.00	10000.00
	Minimum	250.00	2000.00	250.00
	Maximum	100000.00	100000.00	60000.00

Table 12.15.11 Community access to types of financial income in SNP, ACA and combined based on triangulation interviews.

Financial income type	Combined N = 70		SNP N = 26		ACA N = 44	
	N	**%**	**N**	**%**	**N**	**%**
Livestock	43	61.4	20	76.9	23	52.3
Cultivation	60	85.7	22	84.6	38	86.4
Wood	0	0.00	0	0.00	0	0.00
Other natural products (NTFPs)	2	2.9	0	0.00	2	4.5
Tourism	61	87.1	26	100.00	35	79.5
Remittances	22	31.4	4	15.4	18	40.9
Savings	1	1.4	1	3.8	0	0.00
Loans	1	1.4	1	3.8	0	0.00
Other	34	48.6	7	26.9	27	61.4

Table 12.15.12 Most important type of community financial income in SNP, ACA and combined based on triangulation interviews

Financial income type	Combined		SNP		ACA	
	N	**%**	**N**	**%**	**N**	**%**
Livestock	4	6.3	2	8.3	2	5.0
Cultivation	24	37.5	3	12.5	21	52.5
Other natural products (NTFPs)	1	1.6	0	0.0	1	2.5
Tourism	33	51.6	18	75.0	15	37.5
Remittances	1	1.6	1	4.2	0	0.0
Other	1	1.6	0	0.0	1	2.5
Total	64	100.00	24	100.00	40	100.00

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Section 2 Household conflicts

Table 12.15.13 Number of livestock lost by communities to snow leopards in SNP, ACA and combined, with standard deviation in parentheses, based on triangulation interviews.

		Combined N = 70		SNP N = 26		ACA N = 44	
		N	**%**	**N**	**%**	**N**	**%**
Causes of	Disease	32	45.7	4	15.4	28	63.6
	Weather	26	37.1	6	23.1	20	45.5

livestock losses	Snow leopards	55	78.6	21	80.8	34	77.3
	Other predators	38	54.3	8	30.8	30	68.2
	Theft	0	0.0	0	0.0	0	0.0
	Accident	26	37.1	21	80.8	5	11.4
	Other	19	27.1	13	50.0	6	13.6
Location of livestock losses to snow leopards	High pastures	43	61.4	10	38.5	33	75.0
	Low pastures	9	12.9	6	23.1	3	6.8
	Barren land	2	2.9	2	7.7	0	0.0
	Agriculture/settlement	20	28.6	11	42.3	9	20.5
	Scrubland	3	4.3	2	7.7	1	2.3
	Other	0	0.0	0	0.0	0	0.00
Timing of livestock losses to snow leopards	Winter	35	50.0	11	42.3	24	54.5
	Spring	4	5.7	2	7.7	2	4.5
	Summer	14	20.0	6	23.1	8	18.2
	Autumn	5	7.1	3	11.5	2	4.5

Table 12.15.14 Community compensation for livestock losses by snow leopards in SNP, ACA and combined based on triangulation interviews.

		Combined		**SNP**		**ACA**	
		N	**%**	**N**	**%**	**N**	**%**
Received compensation	Total	48	100.0	19	100.0	29	100.0
	No	33	68.8	19	100.0	14	48.3
	Yes	10	20.8	0	0.0	10	34.5
	Sometimes	5	10.4	0	0.0	5	17.2
Reason(s) for not receiving compensation	[Sample size]	39	100.0	17	100.0	22	100.0
	Bureaucracy	16	41.0	5	29.4	11	50.0
	Limited amount	3	7.7	0	0.0	3	13.6
	Not insured	2	5.1	0	0.00	2	9.1
	Scheme collapsed/irrelevant	3	7.7	1	5.9	2	9.1
	Haven't reported/not aware of scheme	7	17.9	6	35.3	1	4.5
	> 1 negative reason	8	20.5	5	29.4	3	13.6

Table 12.15.15 Community conflict with snow leopard conservation in SNP, ACA and combined based on triangulation interviews.

		Combined N = 70		SNP N = 26		ACA N = 44	
		N	**%**	**N**	**%**	**N**	**%**
Conflict with actors		20	28.6	3	11.5	17	38.6
Reason(s) for conflict with actors	[Sample size]	19		3		16	
	Lack of local benefits	1	5.3	1	33.3	0	0.00
	Livelihood damage	9	47.4	2	66.7	7	43.8
	Other	1	5.3	0	0.0	1	6.3
	Bureaucracy and livelihood damage	8	42.1	0	0.0	8	50.0
Conflict with interventions		26	37.1	11	42.3	15	34.1
Reason(s) for conflict with interventions	[Sample size]	26		11		15	
	Lack of local benefits	2	7.7	2	18.2	0	0.0
	Livelihood damage	18	69.2	7	63.6	11	73.3
	Other	1	3.8	3.8	9.1	0	0.0
	Bureaucracy and livelihood damage	5	19.2	3.8	9.1	4	26.7

Section 3 Individual attitudes

Table 12.15.16 Community attitudes to snow leopards in SNP, ACA and combined based on triangulation interviews.

		Combined		SNP		ACA	
		N	**%**	**N**	**%**	**N**	**%**
Attitudes towards snow leopards	[Sample size]	63		23		40	
	Positive	22	34.9	11	47.8	11	27.5
	Neutral	28	44.4	9	39.1	19	47.5
	Negative	13	20.6	3	13.0	10	25.0
Reason(s) for attitudes towards snow leopards	[Sample size]	62		22		40	
	No reason	17	27.4	5	22.7	12	30.0
	Positive intrinsic reason	12	19.4	7	31.8	5	12.5
	Positive extrinsic reason	4	6.5	4	18.2	2	5.0
	>1 positive reason	1	1.6	0	0.0	1	2.5
	Positive and negative reasons	15	24.2	4	18.2	11	27.5

	Negative reasons	13	21.0	4	18.2	9	22.5
Preference for future presence of snow leopards	[Sample size]	63		22		41	
	Agree	36	57.1	18	81.8	18	43.9
	Neutral	18	28.6	2	9.1	16	39.0
	Disagree	9	14.3	2	9.1	7	17.1
Reason(s) for preference for future presence of snow leopards	[Sample size]	62		21		41	
	No reason	22	35.5	6	28.6	16	39.0
	Positive intrinsic reason	13	21.0	7	33.3	6	14.6
	Positive extrinsic reason	8	12.9	4	19.0	4	9.8
	>1 positive reason	2	3.2	0	0.0	2	4.9
	Positive and negative reasons	8	12.9	1	4.8	7	17.1
	Negative reasons	9	14.5	3	14.3	6	14.6

Table 12.15.17 Community attitudes to snow leopard conservation in SNP, ACA and combined based on triangulation interviews.

		Combined		**SNP**		**ACA**	
		N	**%**	**N**	**%**	**N**	**%**
Attitudes towards snow leopard conservation actors	[Sample size]	66		25		41	
	Positive	45	68.2	21	84.0	24	58.5
	Neutral	14	21.2	3	12.0	11	26.8
	Negative	7	10.6	1	4.0	6	14.6
Reason(s) for attitudes towards snow leopards conservation actors	[Sample size]	66		25		41	
	No reason	35	53.0	13	52.0	22	53.7
	Positive intrinsic reason	10	15.2	6	24.0	4	9.8
	Positive extrinsic reason	4	6.1	1	4.0	3	7.3
	>1 positive reason	4	6.1	3	12.0	1	2.4
	Positive and negative reasons	6	9.1	1	4.0	5	12.2
	Negative reasons	7	10.6	1	4.0	6	14.6
Attitudes towards snow leopard conservation interventions	[Sample size]	65		24		41	
	Positive	42	64.6	17	70.8	25	61.0
	Neutral	22	33.8	7	29.2	15	36.6
	Negative	1	1.5	0	0.0	1	2.4
Reason(s) for attitudes	[Sample size]	65		24		41	
	No reason	28	43.1	5	20.8	23	56.1
	Positive intrinsic reason	14	21.5	12	50.0	2	4.9

towards snow leopard conservation interventions	Positive extrinsic reason	1	1.5	1	4.2	0	0.0
	>1 positive reason	2	3.1	0	0.0	2	4.9
	Positive and negative reasons	9	13.8	4	16.7	5	12.2
	Negative reasons	11	16.9	2	8.3	9	22.0

Section 4 Attitudes to proposed blue sheep translocation in SNP

Table 12.15.18 Community attitudes to proposed blue sheep translocation in SNP, ACA and combined based on triangulation interviews.

		N	**%**
Support for proposed blue sheep translocation	[Sample size]	26	
	Yes	11	42.3
	Maybe	10	38.5
	No	5	19.2
Reason(s) for opinion on proposed blue sheep translocation	[Sample size]	26	
	No reason	5	19.2
	Positive intrinsic reason	8	30.8
	Positive extrinsic reason	0	0.0
	>1 positive reason	2	7.7
	Positive and negative reasons	7	26.9
	Negative reasons	4	15.4

Section 5 Attitudes to proposed snow leopard conservation incentive scheme in ACA

Table 12.15.19 Community attitudes to proposed snow leopard conservation incentive scheme in SNP, ACA and combined based on triangulation interviews.

		N	**%**
Support for proposed snow leopard conservation incentive scheme	[Sample size]	39	
	Yes	7	17.9
	Maybe	18	46.2
	No	14	35.9
Reason(s) for opinion on proposed snow leopard conservation incentive scheme	[Sample size]	39	
	No reason	5	12.8
	Positive intrinsic reason	3	7.7
	Positive extrinsic reason	4	10.3

	>1 positive reason	1	2.6
	Positive and negative reasons	8	20.5
	Negative reasons	18	46.1

16. Diagnostics for regression models

16.1 Linear model explaining household Sustainable Livelihoods Index scores

1. **Correlation matrix** check for multicollinearity – no predictors highly correlated with each other (>.9).

2. **Model summary** assumption of independent errors met as Durbin-Watson statistic between 1 and 3 (1.291).

3. **Coefficients** check for multicollinearity - VIF values are less than 10 and not substantially greater than 1.

4. **Coefficients** check for multicollinearity – tolerance values are well above 0.2.

5. **Casewise diagnostics** check for bias – 5.26% cases >2, 1.48% cases >2.5, 3 cases >3.

6. **Cook's distance** check for outliers – no values above 1.

7. P-P plot check for normality – line curving round diagonal indicates non-normality, hence bootstrapping.

16.2 Linear model explaining household Sustainable Livelihoods Index scores in SNP

1. **Correlation matrix** check for multicollinearity – no predictors highly correlated with each other (>.9).

2. **Model summary** assumption of independent errors met as Durbin-Watson statistic between 1 and 3 (1.463).

3. **Coefficients** check for multicollinearity - VIF values are less than 10 and not substantially greater than 1.

4. **Coefficients** check for multicollinearity – tolerance values are well above 0.2.

5. **Casewise diagnostics** check for bias – 5.04% cases >2, 1.26% cases >2.5, one case >3.

6. **Cook's distance** check for outliers – no values above 1.

7. P-P plot check for normality – line curving round diagonal indicates non-normality, hence bootstrapping.

16.3 Linear model explaining household Sustainable Livelihoods Index scores in Annapurna Conservation Area

1. **Correlation matrix** check for multicollinearity – no predictors highly correlated with each other (>.9).

2. **Model summary** assumption of independent errors met as Durbin-Watson statistic between 1 and 3 (1.174).

3. **Coefficients** check for multicollinearity - VIF values are less than 10 and not substantially greater than 1.

4. **Coefficients** check for multicollinearity – tolerance values are well above 0.2.

5. **Casewise diagnostics** check for bias – 5.41% cases >2, 1.62% cases >2.5, two cases >3.

6. **Cook's distance** check for outliers – no values above 1.

7. P-P plot check for normality – line curving round diagonal indicates non-normality, hence bootstrapping**.**

16.4 Logistic regression model explaining individual identification of snow leopards

1. **Standard errors** check for completeness of predictor data – absence of unreasonably large standard errors (>2) from predictors.

2. **Cook's distance** check for influential cases – zero cases above one.

3. **Leverage values** check for influential cases – four cases greater three times the expected leverage ([11+1]/585 = 0.019), hence bootstrapping.

4. **Standardized residuals** check for outliers - <5% cases >1.96, <1% cases >2.58, four cases >3, hence bootstrapping.

5. **DFBeta** check for outliers – zero cases >1.

6. **Linearity of the logit** test revealed two continuous predictor variable had violated the assumption of linearity of the logit. Number of household livestock lost to snow leopards ($\log^{10}$ scale) and number of years of education were therefore removed from the model.

7. **Coefficients** check for multicollinearity - VIF values are less than 10 and not substantially greater than one.

8. **Coefficients** check for multicollinearity – tolerance values are well above 0.2.

16.5 Logistic regression model explaining individual identification of snow leopards in SNP

1. **Standard errors** check for completeness of predictor data – absence of unreasonably large standard errors (>2) from predictors.

2. **Cook's distance** check for influential cases – zero cases above one.

3. **Leverage values** check for influential cases – zero cases greater three times the expected leverage ([1+1]/260 = 0.0077).

4. **Standardized residuals** check for outliers - <5% cases >1.96, <1% cases >2.58, zero cases >3.

5. **DFBeta** check for outliers – zero cases >1.

6. **Coefficients** check for multicollinearity - VIF values are less than 10 and not substantially greater than 1.

7. **Coefficients** check for multicollinearity – tolerance values are well above 0.2.

16.6 Logistic regression model explaining individual identification of snow leopards in ACA

1. **Standard errors** check for completeness of predictor data – absence of unreasonably large standard errors (>2) from predictors.

2. **Cook's distance** check for influential cases – no cases above one.

3. **Leverage values** check for influential cases – four cases greater three times the expected leverage ([8+1]/347 = 0.026), hence bootstrapping.

4. **Standardized residuals** check for outliers - <5% cases >1.96, <1% cases >2.58, four cases >3, hence bootstrapping.

5. **DFBeta** check for outliers – zero cases >1.

6. **Linearity of the logit** test revealed one continuous predictor variable had violated the assumption of linearity of the logit. Number of household livestock lost to snow leopards (log^{10} scale) was therefore removed from the model.

7. **Coefficients** check for multicollinearity - VIF values are less than 10 and not substantially greater than 1.

8. **Coefficients** check for multicollinearity – tolerance values are well above 0.2.

16.7 Linear model explaining individual attitudes to snow leopards

1. **Correlation matrix** check for multicollinearity – no predictors highly correlated with each other (>.9).

2. **Model summary** assumption of independent errors met as Durbin-Watson statistic between 1 and 3 (1.573).

3. **Coefficients** check for multicollinearity - VIF values are less than 10 and not substantially greater than 1.

4. **Coefficients** check for multicollinearity – tolerance values are well above 0.2.

5. **Casewise diagnostics** check for bias – 4.27% cases >2, 1.15% cases >2.5, 1 case >3.

6. **Cook's distance** check for outliers – no values above 1.

7. P-P plot check for normality – line curving round diagonal indicates non-normality, hence bootstrapping.

16.8 Linear model explaining individual attitudes to snow leopards in SNP

1. **Correlation matrix** check for multicollinearity – no predictors highly correlated with each other (>.9).
2. **Model summary** assumption of independent errors met as Durbin-Watson statistic between 1 and 3 (1.573).
3. **Coefficients** check for multicollinearity - VIF values are less than 10 and not substantially greater than 1.
4. **Coefficients** check for multicollinearity – tolerance values are well above 0.2.
5. **Casewise diagnostics** check for bias – 4.60% cases >2, 1.26% cases >2.5, one case >3.
6. **Cook's distance** check for outliers – no values above 1.
7. **P-P plot** check for normality – line curving round diagonal indicates non-normality, hence bootstrapping.

16.9 Linear model explaining individual attitudes to snow leopards in ACA

1. **Correlation matrix** check for multicollinearity – no predictors highly correlated with each other (>.9).
2. **Model summary** assumption of independent errors met as Durbin-Watson statistic between 1 and 3 (1.651).
3. **Coefficients** check for multicollinearity - VIF values are less than 10 and not substantially greater than 1.
4. **Coefficients** check for multicollinearity – tolerance values are well above 0.2.
5. **Casewise diagnostics** check for bias – 4.32% cases >2, 1.08% cases >2.5, zero cases >3.
6. **Cook's distance** check for outliers – no values above 1.
7. **P-P plot check for normality –** line curving round diagonal indicates non-normality, hence bootstrapping.

16.10 Linear model explaining attitudes to snow leopard conservation

1. **Correlation matrix** check for multicollinearity – no predictors highly correlated with each other (>.9)

2. **Model summary** assumption of independent errors met as Durbin-Watson statistic between 1 and 3 (1.124)

3. **Coefficients** check for multicollinearity - VIF values are less than 10 and not substantially greater than 1

4. **Coefficients** check for multicollinearity – tolerance values are well above 0.2

5. **Casewise diagnostics** check for bias – 4.79% cases >2, 1.03% cases >2.5, 2 cases >3

6. **Cook's distance** check for outliers – no values above 1

7. P-P plot check for normality – line curving round diagonal indicates non-normality, hence bootstrapping.

16.11 Linear model explaining attitudes to snow leopard conservation in SNP

1. **Correlation matrix** check for multicollinearity – no predictors highly correlated with each other (>.9)

2. **Model summary** assumption of independent errors met as Durbin-Watson statistic between 1 and 3 (1.137)

3. **Coefficients** check for multicollinearity - VIF values are less than 10 and not substantially greater than 1

4. **Coefficients** check for multicollinearity – tolerance values are well above 0.2

5. **Casewise diagnostics** check for bias – 4.22% cases >2, 0.84% cases >2.5, one case >3

6. **Cook's distance** check for outliers – no values above 1

7. **P-P plot** check for normality – line curving round diagonal indicates non-normality, hence bootstrapping.

16.12 Linear model explaining attitudes to snow leopard conservation in ACA score

1. **Correlation matrix** check for multicollinearity – no predictors highly correlated with each other (>.9)

2. **Model summary** assumption of independent errors met as Durbin-Watson statistic between 1 and 3 (1.084)

3. **Coefficients** check for multicollinearity - VIF values are less than 10 and not substantially greater than 1

4. **Coefficients** check for multicollinearity – tolerance values are well above 0.2

5. **Casewise diagnostics** check for bias – 4.34% cases >2, 1.16% cases >2.5, one case >3

6. **Cook's distance** check for outliers – no values above 1

7. **P-P plot** check for normality – line curving round diagonal indicates non-normality, hence bootstrapping.

16.13 Linear model explaining household livestock losses to snow leopards

1. **Correlation matrix** check for multicollinearity – no predictors highly correlated with each other (>.9)

2. **Model summary** assumption of independent errors met as Durbin-Watson statistic between 1 and 3 (1.033)

3. **Coefficients** check for multicollinearity - VIF values are less than 10 and not substantially greater than 1

4. **Coefficients** check for multicollinearity – tolerance values are well above 0.2

5. **Casewise diagnostics** check for bias – 5.57% cases >2, 0.88% cases >2.5, two cases >3

6. **Cook's distance** check for outliers – no values above 1

7. **P-P plot** check for normality – line curving round diagonal indicates non-normality, hence bootstrapping.

16.14 Linear model explaining household livestock losses to snow leopards in SNP

1. **Correlation matrix** check for multicollinearity – no predictors highly correlated with each other (>.9)

2. **Model summary** assumption of independent errors met as Durbin-Watson statistic between 1 and 3 (1.016)

3. **Coefficients** check for multicollinearity - VIF values are less than 10 and not substantially greater than 1

4. **Coefficients** check for multicollinearity – tolerance values are well above 0.2

5. **Casewise diagnostics** check for bias – 5.76% cases >2, 0.77% cases >2.5, one case >3

6. **Cook's distance** check for outliers – no values above 1

7. **P-P plot** check for normality – line curving round diagonal indicates non-normality, hence bootstrapping.

16.15 Linear model explaining household livestock losses to snow leopards in ACA

1. **Correlation matrix** check for multicollinearity – no predictors highly correlated with each other (>.9)
2. **Model summary** assumption of independent errors met as Durbin-Watson statistic between 1 and 3 (1.041)
3. **Coefficients** check for multicollinearity - VIF values are less than 10 and not substantially greater than 1
4. **Coefficients** check for multicollinearity – tolerance values are well above 0.2
5. **Casewise diagnostics** check for bias – 5.39% cases >2, 0.89% cases >2.5, one case >3
6. **Cook's distance** check for outliers – no values above 1
7. **P-P plot** check for normality – line curving round diagonal indicates non-normality, hence bootstrapping.

16.16 Linear model explaining household conflicts with snow leopard conservation

1. **Correlation matrix** check for multicollinearity – no predictors highly correlated with each other (>.9)
2. **Model summary** assumption of independent errors met as Durbin-Watson statistic between 1 and 3 (1.566)
3. **Coefficients** check for multicollinearity - VIF values are less than 10 and not substantially greater than 1
4. **Coefficients** check for multicollinearity – tolerance values are well above 0.2
5. **Casewise diagnostics** check for bias – 6.41% cases >2, 2.63% cases >2.5, 10 cases >3, indicating some bias in sample, hence bootstrapping
6. **Cook's distance** check for outliers – no values above 1.
7. **P-P plot** check for normality – line curving round diagonal indicates non-normality, hence bootstrapping.

16.17 Linear model explaining household conflicts with snow leopard conservation in Annapurna Conservation Area

1. **Correlation matrix** check for multicollinearity – no predictors highly correlated with each other (>.9)
2. **Model summary** assumption of independent errors met as Durbin-Watson statistic between 1 and 3 (1.566)

3. **Coefficients** check for multicollinearity - VIF values are less than 10 and not substantially greater than 1

4. **Coefficients** check for multicollinearity – tolerance values are well above 0.2

5. **Casewise diagnostics** check for bias – 7.87% cases >2, 3.37% cases >2.5, eight cases >3, indicating some bias in sample, hence bootstrapping.

6. **Cook's distance** check for outliers – no values above 1

7. **P-P plot** check for normality – line curving round diagonal indicates non-normality, hence bootstrapping.

16.18 Linear model explaining attitudes to proposed blue sheep translocation in SNP

1. **Correlation matrix** check for multicollinearity – no predictors highly correlated with each other (>.9)

2. **Model summary** assumption of independent errors met as Durbin-Watson statistic between 1 and 3 (1.516)

3. **Coefficients** check for multicollinearity - VIF values are less than 10 and not substantially greater than 1

4. **Coefficients** check for multicollinearity – tolerance values are well above 0.2

5. **Casewise diagnostics** check for bias – 2.94% cases >2, 0 cases >2.5, zero cases >3

6. **Cook's distance** check for outliers – no values above 1

7. P-P plot check for normality – line curving round diagonal indicates non-normality, hence bootstrapping.

16.19 Linear model explaining attitudes to proposed snow leopard conservation incentive scheme in ACA

1. **Correlation matrix** check for multicollinearity – no predictors highly correlated with each other (>.9)

2. **Model summary** assumption of independent errors met as Durbin-Watson statistic between 1 and 3 (1.033)

3. **Coefficients** check for multicollinearity - VIF values are less than 10 and not substantially greater than 1

4. **Coefficients** check for multicollinearity – tolerance values are well above 0.2

5. **Casewise diagnostics** check for bias – 5.57% cases >2, 0.88% cases >2.5, 2 cases >3

6. **Cook's distance** check for outliers – no values above 1

7. P-P plot check for normality – line curving round diagonal indicates non-normality, hence bootstrapping.