Local participation where traditional monitoring has failed; assessing the participatory monitoring of saigas (*Saiga tatarica*) in Kalmykia, Russia

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DECLARATION OF OWN WORK

I declare that this thesis:

"Local participation where traditional monitoring has failed; assessing the participatory monitoring of saigas (Saiga tatarica) in Kalmykia, Russia"

is entirely my own work and that where material could be construed as the work of others, it is fully cited and referenced, and/or with appropriate acknowledgement given.

Signed……

Student: Leejiah Dorward

Supervisor: E.J. Milner-Gulland

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ACRONYMS

BPMP	Bridge Participatory Monitoring Project (2008-2009)
CWA	Centre for Wild Animals of the Republic of Kalmykia
CZBR	Chernye Zemli Biosphere Reserve
EJMG	Professor E.J. Milner-Gulland (Thesis supervisor)
HSM	Habitat Suitability Models
LJD	Leejiah Dorward
MoU	Memorandum of Understanding
MRB	Model of Responsible Behaviour
PC	Pre-Caspian
PMs	Potential Monitors
PMP	Participatory Monitoring Programme
RPMP	Rufford Participatory Monitoring Project (2010-2011)
SCA	Saiga Conservation Alliance
SNA	Social Network Analysis
SR	Stepnoi Nature Reserve
URs	Uninterested Respondents
USFWSPMP	US Fish and Wildlife Service Participatory Monitoring Project (2012)
YA	Professor Yuri Arylov (PMP project manager)
YBC	Yashkul' Breeding Centre

ABSTRACT

Participatory monitoring aims to involve local people in monitoring natural resources in their communities. It has gained popularity in recent years as a method of collecting low cost ecological data while engaging people in conservation and increasing their awareness of ecological issues surrounding their natural resources. In many areas with high biodiversity local people have low scientific capacity, raising questions about the usefulness and accuracy of the data collected.

Saiga antelope are critically endangered as a result of widespread poaching for their horns and meat throughout their range in Central Asia. This study assesses a participatory monitoring programme in Kalmykia, Russia, that has employed inhabitants of the steppe to record sightings of saiga (*Saiga tatarica*) in three projects between 2008 and 2012. Trends in saiga numbers over the three projects were investigated using data from the three projects, and a questionnaire survey investigated the social impacts of the programme.

Falling herd sizes and frequencies of sightings suggest a decrease in the population of saiga, however there is little evidence of a change in the saiga's distribution between 2008 and 2012. People wanting to be monitors already have positive views of saiga and so participation in the programme had little impact on people's attitudes. However analysis of monitors' motivations and social networks found a number of ways of increasing the project's efficiency and cost effectiveness. While this, and other, participatory monitoring projects have their limitations, they can nevertheless produce valuable and cost effective information for use in making management decisions.

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1 INTRODUCTION

1.1 LOCAL PEOPLE'S ROLE IN MONITORING BIODIVERSITY LOSS

In the last few centuries the impacts of our expanding human society on earth's geographical processes have brought about the dawn of the Anthropocene Epoch. Biodiversity loss is on the front line of human induced changes, with extinction rates rising to 100-1000 times background levels (Pimm et al., 1995). Despite global efforts over the last decade, rates of biodiversity decline have not slowed, with many of the pressures driving the decline increasing (Butchart et al., 2010).

Myers et al. (2000) defined 34 global biodiversity hotspots covering 1.4% of the world's surface but containing 44% of vascular plant and 35% of four major vertebrate groups. The majority of hotspots are in areas of widespread poverty with the risk of wildlife exploitation leading to vicious poverty-wildlife depletion cycles (Bradshaw et al., 2009; Fisher & Christopher, 2006). Increasing the involvement of local people in the management and conservation of their natural resources is being touted as a solution to their over-exploitation (Hutton et al., 2005; Wilshusen et al., 2011). While this new community based conservation paradigm is not without its critics (Barrett et al., 2001), it has become a fundamental part of modern conservation, with increased local participation in all aspects of conservation programmes.

Effective monitoring is key to the successful conservation of natural resources. Traditionally monitoring in countries with high biodiversity and low internal capacity has been conducted by external experts who dictate all aspects of the monitoring programme and the policy or management decisions that arise from their findings (Danielsen, et al, 2005). However under the new community conservation paradigm participatory monitoring (PM) schemes increasingly involve local people in monitoring their own natural resources.

Participatory monitoring can be cheaper and more efficient than externally driven monitoring and, by increasing local people's involvement in conservation activities, encourages responsible resource use. However, the reduced capacity of local monitors restricts the use of participatory monitoring to local scale changes and restricts the inferences that can be drawn from the data (Danielsen et al., 2005).

In response to: low saiga numbers; a lack of robust expert monitoring; and the exploitation of saigas by local poachers, a participatory monitoring programme was set up to monitor the Pre-Caspian (PC) saiga population in Kalmykia, Russia. The programme is run by a Kalmyk organization, the Centre for Wild Animals of the Republic of Kalmykia (CWA) with support from international experts through the Saiga Conservation Alliance (SCA). Monitors opportunistically record saiga sightings while working on the steppe. The programme's two objectives are to collect robust data on the saiga population for use in management decisions and to improve attitudes towards saiga and their conservation amongst steppe inhabitants.

1.2 Study Aims and Objectives

1.2.1 Aims

To critically evaluate the saiga Participatory Monitoring Programme (PMP) in Kalmykia as a case study of PMP; investigating the robustness and usefulness of data collected and investigating its influence on people's attitudes towards saigas and saiga conservation.

1.2.2 Objectives

1. To investigate people's motivations for involvement with the PMP, and why some monitors no longer want to be involved.
2. To determine the influence the PMP has had on monitors' attitudes and behavioural intentions towards saiga and saiga conservation.
3. To investigate the degree to which monitors' characteristics influence their effectiveness as advocates for Saiga conservation.
4. To use data collected by the PMP to assess changes in the saiga population over the years the PMP has run.
5. To produce recommendations for future participatory monitoring projects in Kalmykia.
6. To draw wider lessons about the value of PMP and about its effective use.

2 BACKGROUND

2.1 PARTICIPATORY MONITORING.

2.1.1 MONITORING IN CONSERVATION

Effective ecological monitoring provides invaluable knowledge of ecological systems which can be used to: inform when a system is changing in an undesirable way; measure the impact of previous management; and detect the effects of perturbations and disturbances (Legg & Nagy, 2006; Spellerberg, 2005). There has been increased recognition of monitoring's importance over the last few decades as it has become important for making management decisions, for justifying conservation funding and when lobbying policy makers (Legg & Nagy, 2006; Sutherland, 2004).

Monitoring programmes can be used to estimate different aspects of a species' ecology, providing a range of information to conservation managers (Table 2.1-overleaf). While planning what data to collect it is important to consider the aims of the monitoring programme, resources available to it and the technical capacity of those carrying out monitoring (Danielsen et al., 2005; Yoccoz, Nichols, & Boulinier, 2001).

Many monitoring programmes are constrained by poor planning during their design. It is often assumed that more information on a system is inherently useful and as result specific objectives or hypothesis for monitoring programmes are not developed. This "surveillance" monitoring has weaker power to detect changes in the system state, as compared with "targeted" monitoring designed to meet and test specific objectives and hypotheses (Nichols & Williams, 2006; Yoccoz et al., 2001).

Traditional monitoring where external experts or scientist is expensive, relies on external skills and may focus on species that are not important to local stakeholders (Danielsen et al., 2009; Sheil, 2001). There are also ethical arguments for improving local peoples control over their natural resources by increasing their involvement in conservation monitoring and management (Danielsen et al., 2009; Hutton et al., 2005; Wilshusen et al., 2011). As a result over recent years there has been increasing inclusion of local people in conservation management and monitoring.

Table 2.1 Advantages and disadvantages of different variables that monitoring programmes can survey.

Variable being monitored	Techniques	Advantages	Disadvantages
Absolute abundance[1,2]	Distance sampling, mark-recapture	Estimates of population size	High technical capacity in design and analysis stages. Require substantial datasets. Require fulfilment of major assumptions.
Relative abundance[3]	Encounter rates of; individuals, groups, tracks, signs etc.	Simpler to implement than measures of absolute abundance.	Cannot measure absolute population sizes or density Assumes constant detectability of individuals.
Presence/ Absence[4]	Individuals (or signs of individuals) recorded if present or not at fixed locations.	Simple to implement. Provides information on species distribution. Can be used to create predictive habitat suitability models.	Can only be used for very crude indexes of abundance. Low power to detect declines.
Presence[4]	Locations of sightings individuals (or signs of individuals).	Simple to implement. Provides data on species distribution. Can be used for predictive habitat suitability models. Easy to collect opportunistically.	Biases introduced as no record of effort or areas visited. Requires large amounts of data to get good precision.
Ecological Characteristics[5]	Record characteristics of encounters, group size, age, sex, condition etc.	Some characteristics simple to collect Can be collected opportunistically Can provide information on mechanisms by which pressures influence population size. Some characteristics can be used as indicators of population health.	Some characteristics cryptic, i.e. sex of many bird species. Requires good knowledge of a species' biology. Can only be used as an approximate indicator of abundance.

([1]Buckland et al., 2005; [2]Sinclair et al., 2006; [3]Yoccoz et al., 2001: [4]Joseph et al., 2006; [5]Skalski et al., 2010)

2.1.2 PARTICIPATORY MONITORING

Participatory monitoring entails some degree of inclusion of local people in planning, implementation or analysis of a monitoring programme. There is no level of local involvement that defines a monitoring programme as "participatory", instead Danielsen et al., (2009) listed five monitoring categories under which all monitoring programmes can be classified:

Category 1: No local involvement. Monitoring funded, designed, implemented and analysed by external experts.

Category 2: Local involvement in data collection. Programme design and analysis carried out externally.

Category 3: Local involvement in data collection and management-orientated decision making. Programme design and analysis carried out externally.

Category 4: Local involvement in data collection, interpretation or analysis and management decision making. External provision of advice or training.

Category 5: Entire monitoring process is funded, designed, implemented and interpreted by local people.

A review by Danielsen et al., (2005) found only two published examples comparing the performance of local and professional monitoring of terrestrial programmes outside of the USA or UK: Hellier et al. (1999) found local knowledge useful in rapidly assessing trends in abundance of locally useful species, however there were contradictions with professional collected data on vegetation changes; Noss (1999) used hunters' encounter rates of game species to calculate abundance indices and density estimates for four species, however only abundance indices could be accurately calculated for two species. In a study of a Madagascan crayfish fishery Hockley et al. (2005) found low economic and cultural value of the fishery meant the amount of monitoring local people were willing to do did not have enough power to detect changes in populations of crayfish. These studies show participatory monitoring by local people with low scientific capacity is not suitable in all scenarios and careful consideration must be given to limitations of any data collected. However it has potential to provide useful data for conservation management.

These studies focus on quality of data collected, ignoring the impact participatory monitoring can have on community engagement and sustainable resource use. Danielsen et al. (2007) compared participatory monitoring and government monitoring in two Philippine parks. They found combining the two systems provided a much more effective monitoring system than either on its own, enhanced *de facto* land rights of resource users and increased the numbers of conservation interventions taking place. Another programme in the Alaotra wetlands in Madagascar used local people to monitor

key species and natural resource use: this programme has increased respect for fishing regulations, raised awareness and helped transfer wetland management to communities as well as providing data on the fishery and waterbird and lemur hunting (Andrianandrasana, Randriamahefasoa, Durbin, Lewis, & Ratsimbazafy, 2005).

Singh & Milner-Gulland (2011) assess the suitability of participatory monitoring for monitoring Central Asian ungulates (Table 2.2). Low capacity and logistical and financial constraints make robust scientific monitoring in the region problematic, and so while uptake of participatory monitoring in the area has been slow it has been tested with promising results in a number of areas.

Table 2.2 Advantages and disadvantages of using local people in monitoring programmes, from Singh & Milner-Gulland (2011)

Advantages	Disadvantages
Can be used for presence/absence and relative abundance	May provide biased estimates if not designed properly
Cost effective and sustainable	Vulnerable to biased opinions or concealment of information
Generates sense of responsibility amongst local peoples	May not be ideal for cryptic species if observers inexperienced
Enables coverage of areas outside protected areas	May not be sustainable if local community dynamics change
Useful for migratory species and maybe helpful for cryptic species if experienced observers used	Requires training of local people in observing species

2.2 Introduction to Saigas and Their Ecology.

2.2.1 Saiga Behaviour and Ecology

Saiga antelope (*Saiga tatarica)* are a nomadic ungulate living in semi-arid steppe systems of Central Asia. They are unique in their genus with two subspecies split between five different populations. Four populations of *S.t tatarica* are found in Russia, Kazakhstan, Uzbekistan and, in extremely cold winters, Turkmenistan and one population of *S.t. mongolica* in Mongolia (Figure 2.1).

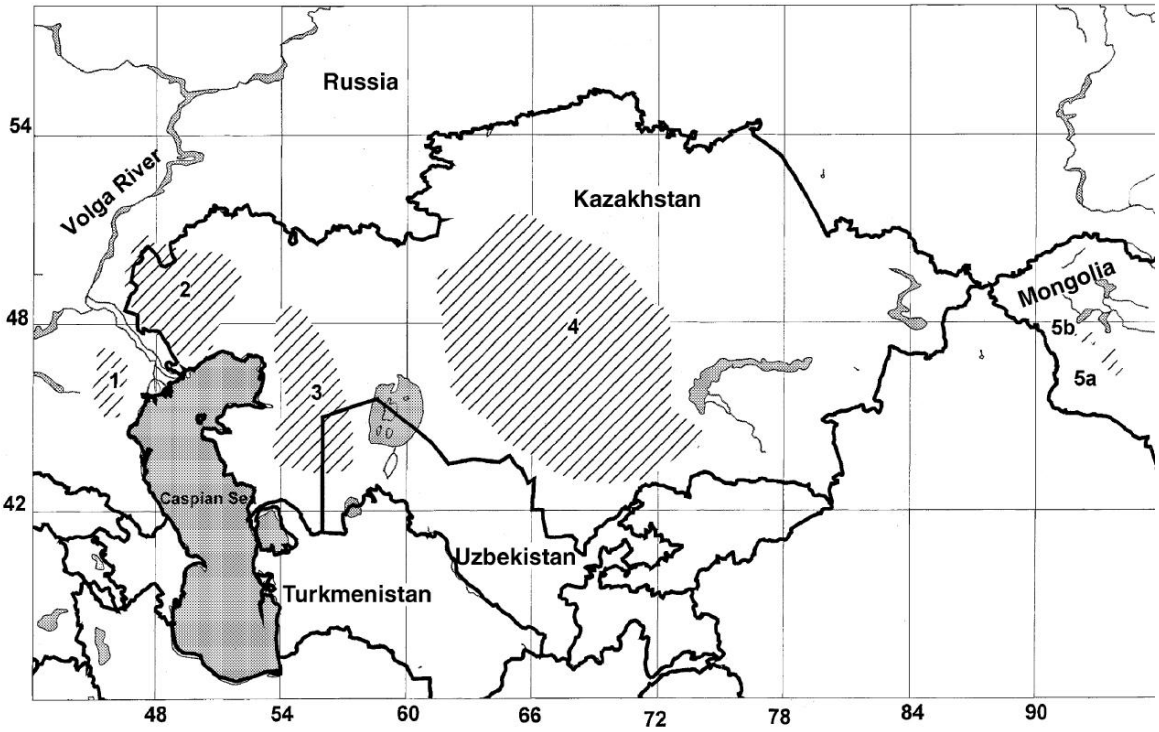

Figure 2.1 Current ranges of five remaining saiga populations, including country boundaries and latitude and longitude. S.t. tatarica: 1 – North West Pre-Caspian, 2 – Ural, 3 – Ustiurt, 4 – Betpak-Dala. S.t. mongolica: 5 – Mongolia (5a – Shargyn Gobi, 5b – Mankhan). From Milner-Gulland et al. (2001).

Saigas are highly gregarious and form herds thousands strong, especially during seasonal migrations between feeding grounds and breeding sites (Milner-Gulland et al., 2003; Singh et al., 2010) to reduce risk of predation during calving saigas give birth in mass aggregations of tens of thousands of animals (Bliznyuk, 2002; Milner-Gulland, 2001). Saigas are highly fecund; females mature at 8 months, give birth in their first year and twinning rates can be as high as 64% (Milner-Gulland et al., 2001).

2.2.2 Historical and Current Saiga Populations

Widespread hunting reduced global saiga numbers to a few thousand by the early 20th century (Milner-Gulland et al., 2001). Populations recovered under a Soviet ban on hunting, and commercial hunting for meat resumed in the 1950s (Robinson & Milner-Gulland, 2003). After the fall of the USSR in 1991 the rural economy collapsed in former Soviet states, with high levels of poverty and unemployment. Horns born by males (Figure 2.2) are highly sought after in the Chinese traditional medicine market, and after

opening the border for trade with China people turned to saiga poaching as a source of meat and to earn an income from horn sales (Li et al., 2007; von Meibom et al., 2010). Between 1993 and 2001 the global population fell from over 1,000,000 to less than 50,000, a 95% decline in less than 10 years (CMS, 2006; Milner-Gulland et al., 2001). In response saigas were listed as Critically Endangered by the IUCN in 2002 (Mallon, 2008).

Figure 2.2 Herd of captive saiga at the Yashkul' Breeding Centre. Males are distinguished from females by large horns.

The outlook for saiga has improved recently, a Memorandum of Understanding (MoU) under the Convention of Migratory Species (CMS) has led to substantial investment in saiga conservation and since 2002 the rate of decline has decreased throughout the saiga's range: four populations were stable or increasing in 2010 (CMS, 2010).

Despite these successes saigas face numerous problems. Small population sizes leave saigas vulnerable to stochastic events such as extreme weather conditions or diseases, which have caused large mortality events in the past (Kock et al., 2011; Robinson & Milner-Gulland, 2003). The second meeting of signatories to the MoU under the CMS in 2010 highlighted areas where insufficient progress had been made (CMS, 2010):

- Further investment in anti-poaching efforts needed.

- Monitoring of trends in abundance is subject to unquantifiable bias and error, and needs to be improved if trends are to be robustly detected.
- Human dimension remains relatively neglected; integrating local communities into saiga conservation is critical for long-term success.
- Evaluation of the success of conservation interventions and sharing of best practice is crucial.
- There has been insufficient attention to the issues of saiga disease.

2.3 SAIGA IN THE REPUBLIC OF KALMYKIA

2.3.1 NORTH-WEST PRE-CASPIAN SAIGA POPULATION.

Despite numbering 800,000 in the 1950's the north-west PC saiga population has followed global trends, crashing to a population of 15,000-20,000 in 2001 (Figure 2.3) (Milner-Gulland et al., 2001; Neronov et al., 2012).

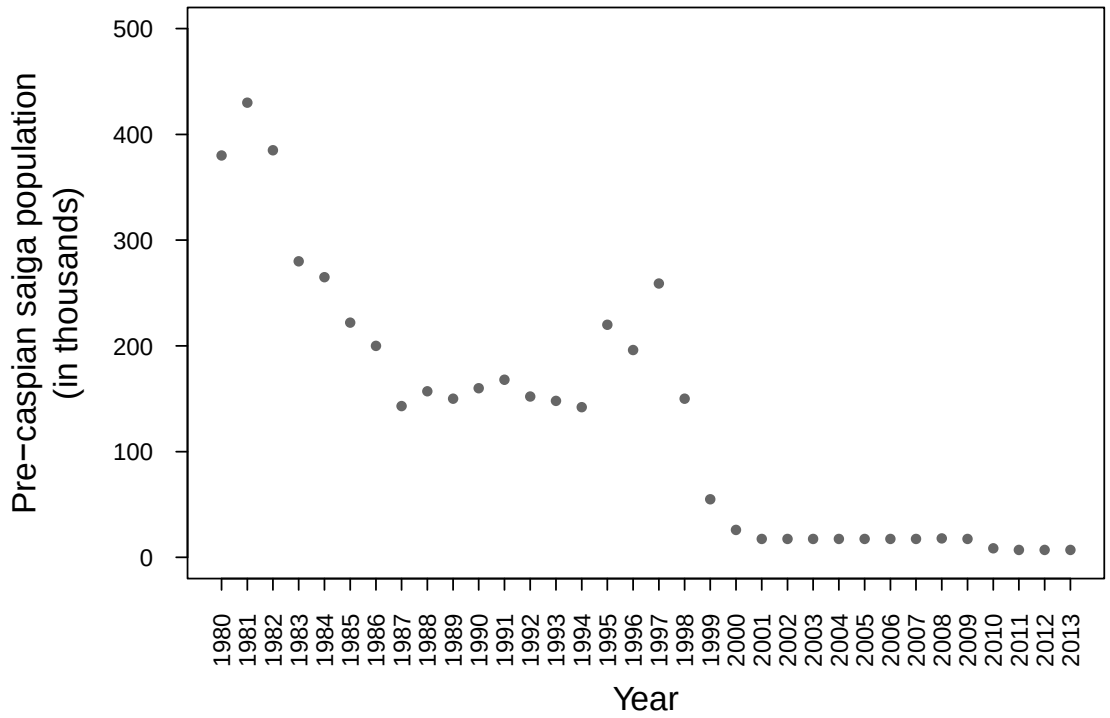

Figure 2.3 Graph plotting the size of the Pre-Caspian saiga population saigas from 1980-2013. 1980-2000 data from Milner-Gulland et al. (2001), 2001-2007 from CMS (2006,2010), 2008-2010 from Neronov (2012)*, 2011 from Arylov (2011), and 2012-2013 from Kuznetsov (2013).*

The population remained stable at 15-20,000 from 2001 to 2009, however, in 2010 the population estimate dropped to 8-9,000 and has remained low with the latest estimate of 7,000 in 2013 raising concern amongst Russian and Kalmyk governments and other conservation groups about the stability and future of the PC saiga population (CMS, 2010; Milner-Gulland, 2010; Neronov et al., 2012).

Two reserves have been created to protect saiga numbers in Kalmykia; in 1990 the federal Chernye Zemli Biosphere Reserve (CZBR) and in 2000 regional Stepnoi Nature Reserve (SR). As the population has decreased saiga have become more confined to these two remote protected areas (Neronov et al., 2012).

There is, however, a high degree of uncertainty surrounding recent changes in the PC population. Decentralization of responsibilities for wildlife management from the federal to Kalmyk government and budget limitations since 2008 have led to a lack of systematic, widespread monitoring, and government estimates of saiga abundance and distribution are currently based on expert opinion and anecdotal evidence (CMS, 2010; Whitebread, 2008). Accurate estimation of the population's size and distribution is the first step in assessing the population's state, trends in its numbers and drivers of those trends - all vital pieces of information for planning conservation management of the species.

2.3.2 KALMYKIA, ITS HISTORY AND PEOPLE

The Republic of Kalmykia is an autonomous region in the south of the Russia Federation (Figure 2.4) covering a land area of 76,100km^2, the majority of which is covered by semi-arid steppe (Grin, 2000). The climate is continental with hot dry summers (mean July temperatures 23.5°C - 25.5°C and highs exceeding 40°C) and cold dry winters with little snow (mean January temperatures -12°C to -7°C with lows exceeding -30°C). Annual precipitation is between 210mm and 340mm and strong winds are typical throughout the year (Republic of Kalmykia, 2002)

Figure 2.4 Map showing Kalmykia's location between the Black and Caspian Seas, on the border between Eastern Europe and Central Asia.

Kalmyks who make up 45% of the population are traditionally nomadic herders, descendants of a western Mongolian group who migrated to the areas surrounding the Volga and Caspian sea in the early 17th century. The majority of Kalmyks are Buddhist and Kalmykia is the only official Buddhist region of Europe (Grin, 2000).

Kalmykia is one of the poorest regions of Russia with incomes 32.8% of the national average (UNDP, 2007). Agriculture is the mainstay of the Kalmyk economy with 76% of the population living in rural areas (Grin, 2000). Increasing livestock numbers caused 30,000-50,000ha of steppe to turn to desert each year in the 1980s and 50% of the entire region has been exposed to desertification (UNESCO, 2004), forming Europe's first man made desert (Leprêtre, 2001; Lushchekina & Struchkov, 1998). Decreasing livestock levels in recent years have seen a reversal of these trends, allowing the steppe to recover in some areas (Hölzel,et al., 2002).

2.3.3 Saiga Conservation in Kalmykia to Date

The two reserves in Kalmykia have formed the mainstay of saiga conservation in the region for many years. Reserves are patrolled by rangers who carry out monitoring and anti-poaching activities (O'Neill, 2008), however their activities are restricted to the reserves and do not cover the entire saiga range.

In 2000 the CWA was set up by the Kalmyk Government. The CWA's main focus is the Yashkul' Breeding Centre (YBC), where there is captive breeding population of 146 saiga. The CWA also carries out an educational programme; with children visiting the YBC, school visits, production of educational material and saiga art competitions amongst school children.

There have also been a number of research projects carried out in Kalmykia investigating people's attitudes towards saigas and the socioeconomic drivers of saiga poaching.

Kühl (2009) conducted a questionnaire-based survey investigating attitudes towards poaching and declining saiga numbers. 50% of respondents blamed poaching for the decrease in saiga number with 10-14% of households in the two villages surveyed estimated to be involved in saiga poaching. With low prospects, average returns and high risks, poaching is a low status occupation carried out by the poor and unemployed.

In 2006 Howe et al. (2011) asked households that had been exposed to different conservation programmes how much would they be willing to pay towards saiga conservation. Livelihood enhancement resulted in low amounts pledged but also decreased protest bidding (refusal to contribute towards saiga conservation as respondent does not think it will work or because they do not feel it is their responsibility), fences and fines resulted in low pledges and high amounts of protest bidding, while low-level media coverage resulted in the highest average pledges.

In 2008 two research projects investigated different monitoring options in Kalmykia. O'Neil (2008) found significant biases in the spatial distribution of survey effort and in the sizes of herds recorded by rangers in the reserves. Whitebread (2008) evaluated the first 6 months of a participatory monitoring project, finding participatory monitors to be as accurate as rangers in recording saiga sightings and widespread support for a participatory monitoring project.

Leon (2009) questioned steppe inhabitants across Kalmykia about past saiga sightings to calculate saiga's distribution. She found the core saiga range to have shrunk since 2000. However, spatial biases in her survey means she may have under estimated the southern and eastern extents of the saiga's range. Elliot (2011) used data from the PMP

to create habitat suitability models, finding little seasonal variation in saiga distribution and large areas of potential saiga habitat across central and southern Kalmykia.

Waylen (2012) investigated the influence of the years spent under collectivism and Kalmyk Buddhist beliefs on people's attitudes towards conservation and positive environmental behaviour. Despite recognizing the roles of individuals in causing environmental damage, people perceived the action of higher bodies – government bodies or other agencies - to be responsible for solving environmental problems. However religious teachings that promoted caring for the environment and an understanding of the links between humans and the environment led to a greater sense of individual responsibility towards the environmental protection.

2.3.4 Participatory Monitoring Programme

In response to the continuing lack of systematic monitoring by other government agencies the CWA started running a PMP in 2008. This programme has involved three projects. The British Councils BRIDGE programme funded the first participatory monitoring project (BPMP) which started with a 6 month pilot scheme in 2008 (Whitebread, 2008) and continued into 2009. The Rufford Foundation funded a second project (RPMP) in 2010 and 2011 while the US Fisheries and Wildlife service funded a third project (USFWPMP) in 2012 (Table 2.3).

Table 2.3 The different years and months during which the BPMP, RPMP and USFWPMP projects ran.

	Month											
	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
2008			BPMP									
2009	BPMP											
2010										RPMP		
2011	RPMP											
2012		USFWPMP										

25 monitors worked on the BPMP, 25 on the RPMP and 43 on the USFWPMP, with some overlap of monitors from the BPMP and RPMP with the USFWPMP. All the monitors were managed by the CWA, except for 5 monitors in the RPMP who were managed by Anatoly Khludnev, the Director of the Stepnoi Nature Reserve. Monitors from the BPMP

were concentrated around the north and west of CZBR and SNR, with the subsequent projects expanding the spread of monitors further west and to the south of the reserves (Figure 2.5).

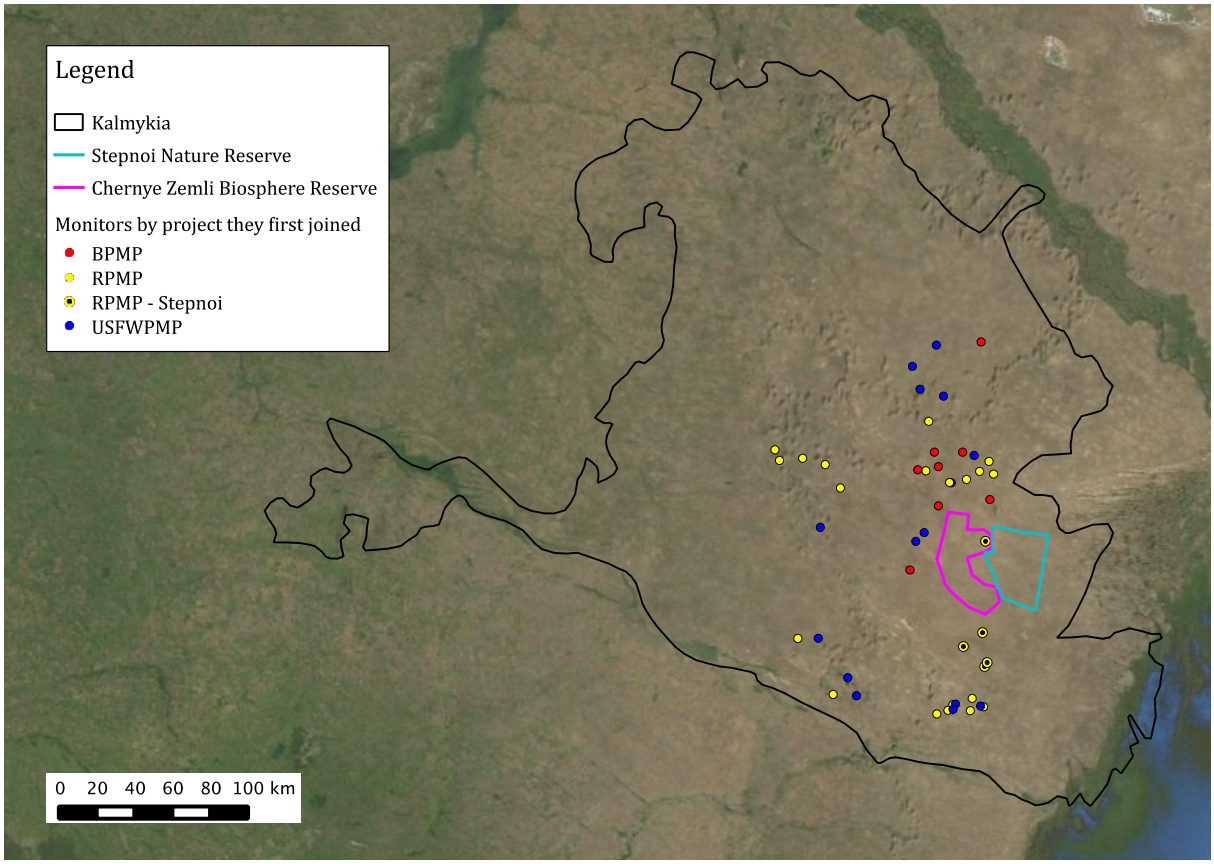

Figure 2.5 Locations of the 48 monitors whose records are held by the PMP. Monitors are coloured by their first project. All marked monitors participated in the USFWPMP apart from the RPMP-Stepnoi monitors who participated in the RPMP and did not continue into the USFWPMP.

Monitors were selected opportunistically under the following criteria: they lived inside the saiga's range (defined using information from the Kalmyk Ministry of Natural Resources and Environment), live and work on the steppe, and are a responsible adult (over 18) deemed trustworthy by CWA staff. To encourage sustainable resource use participatory monitoring programmes often employ local resource users as monitors (Andrianandrasana et al., 2005; Rijsoort & Jinfeng, 2005; Ticheler et al., 1998; Townsend et al., 2005), however as hunting for saiga is illegal in Kalmykia it was not possible to

specifically target poachers (though it is possible that some monitors do engage in saiga poaching or trade).

Monitors were provided with equipment (binoculars, a tally counter, clothes and a booklet of data sheets for recording sightings) and survey training at the beginning of the project. Visits were made periodically during projects and at the end of the project to collect data booklets and pay monitors, who were given £15-£20 per month depending on the project.

Data sheets allowed for the recording of: exact, minimum and maximum number of saigas seen, date and time of sighting, sex of saigas, distance and angle from observer, and other comments, though not all these variables were recorded by all the monitors. Some monitors recorded absences, though the majority did not. In the BPMP monitors were asked to carry out "control days" on the 1st and 15th of each month, where they covered their entire farm specifically looking for saigas, recording sightings as usual and also recording if they did not see any saigas (Whitebread, 2008), however this was not done by all the monitors. As a result the majority of the data collected records saiga presence with no measure of survey effort or absences.

Data from the PMP can be used to calculate a number of variables of interest to conservation managers (Table 2.1). Without a measure of survey effort it is not possible to calculate absolute or relative abundances across the whole project. However if it is assumed individual monitors maintain similar survey efforts from year to year effort can be control for by only using data from monitors who have participated in multiple projects, allowing abundance indices such as frequency of encounters to be used.

Comparing locations of monitors who did and did not record saiga sightings can be used as presence/absence data to assess the saigas' distribution. However, the power to accurately define extents of the saiga's range will be restricted by the spatial distribution of monitors, especially by lower numbers of monitors in the south and east of the saiga's range.

Data collected by monitors on a number of ecological characteristics, herd sizes, and sex and age ratios can also be used to detect trends in saiga populations. Herd sizes in saiga and other ungulates are known to decrease when a population is under certain pressures (Milner-Gulland, 2001; Vander Wal et al, 2013). As male saigas are selectively

poached changes in the sex ratio of male to female saigas indicate hunting pressure (Milner-Gulland et al., 2003) and the numbers of juveniles in herds indicate breeding success.

3 METHODS

3.1 INTERVIEWS

3.1.1 QUESTIONNAIRE DESIGN AND PILOT

A questionnaire (Appendix A) was designed to assess how participation in the PMP had influenced monitors' attitudes towards saiga, monitors' views of the PMP, and to investigate monitors' social networks. The questionnaire was split into 3 main sections, Attitudes, Motivations and SNA.

Section 1 was designed around Hines' (1987) Model of Responsible Behaviour (MRB) (Figure 3.1) and aimed to assess the impact of the PMP on monitors' attitudes to saiga conservation and their likelihood of engaging in positive behaviour towards saigas.

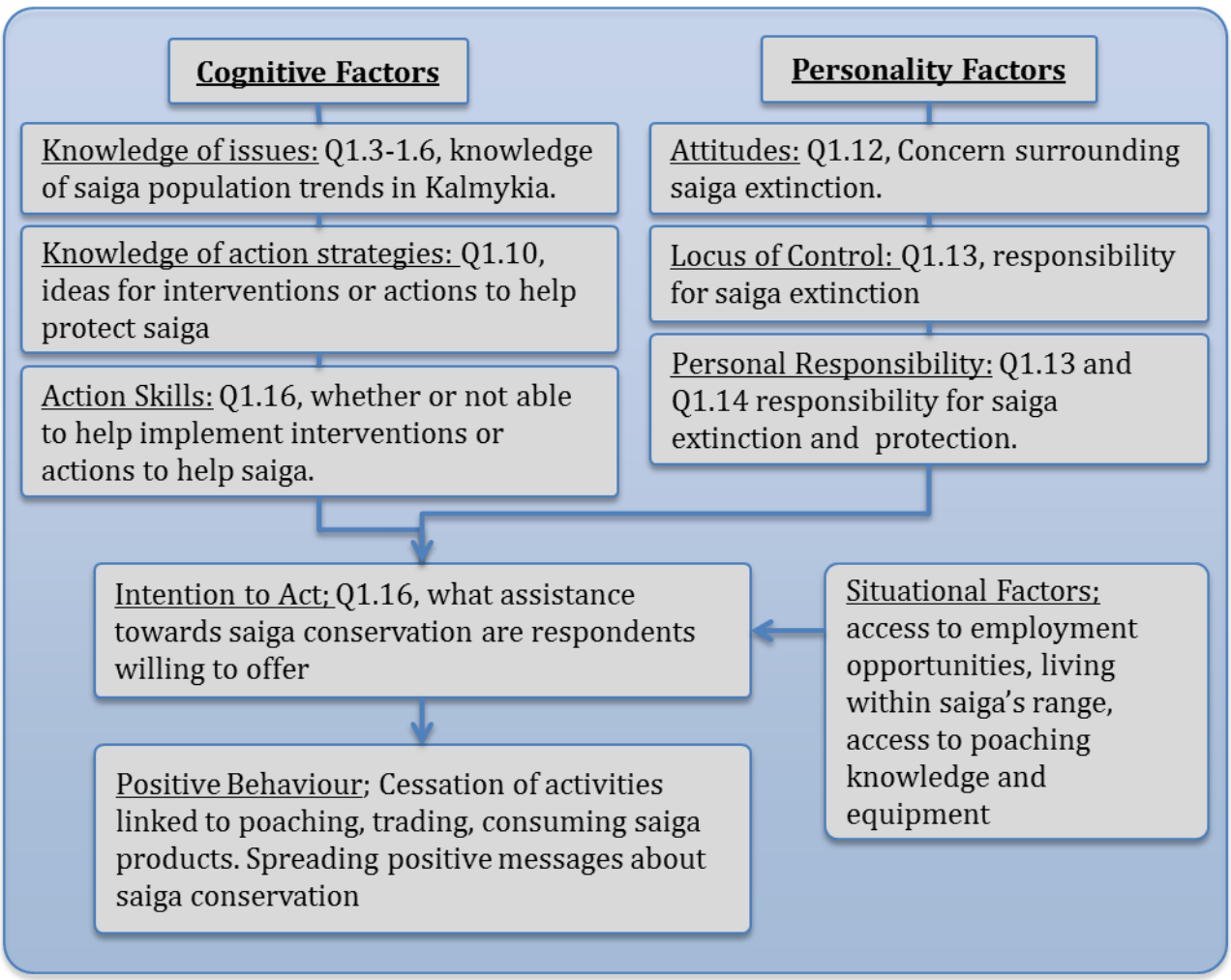

Figure 3.1 Hines' (1987) Model of Responsible Behaviour adapted to investigate changes in Monitors attitudes towards saiga conservation.

Section 2 used Clary et al.'s (1998) functional approach to volunteering (Table 3.1) to investigate people's motivations for wanting to be monitors, and why monitors who no longer wished to be a part of the project wanted to leave.

Table 3.1 How Clary et al.'s (1998) functional approach to volunteering was used to develop questions investigating monitors' motivations for being involved in the PMP

Functions served by volunteering		Examples from study
Value	Expression of altruistic values.	I want to help saiga
Understanding	Opportunity for learning experiences	I want to learn more about saiga
Social	Opportunities to meet new people	To meet new people
Career	Access to career related benefits	It may provide future employment opportunities
Protective	Protecting yourself from your own negative feelings or values	Helping saiga is an escape from my troubles
Enhancement	Promoting a more positive viewpoint of yourself and actions	I want to contribute to an international conservation programme

Section 3 investigated the social networks that respondents were a part of and their positions within these networks through Social Network Analysis (SNA). Respondents drew a social network of the 15 people whose relationships were most valuable to them, creating an ego-centric network consisting of the respondent (ego) centred amongst 15 others (alters) (Meisel et al., 2013; Scott, 2013).

The questionnaire was reviewed by EJMG and YA before being piloted on four English students. Listing 20 alters during the SNA was too long and tedious and so the network size was cut to 15. The questionnaire was then translated into Russian (including a back translation) and piloted on six Kalmyks (this pilot was used to train a translator who was carrying out the interviews); question 1.13, investigating the attributing of fault if saiga were to become extinct, was simplified by reducing the number of response options.

3.1.2 Interviewee Selection

The farms of 48 monitors were visited for interviews (Figure 2.5), these monitors represented all of those who had taken part in the three monitoring projects and whose details (primarily farm location) were still held by the CWA. 43 monitors visited were

monitors on the USFWPMP and the remaining five participated in the RPMP under the management of Anatoly Khludnev (director of the Stepnoi Nature Reserve).

A control group against which monitors could be compared was also interviewed. Farmsteads were visited opportunistically between visits to monitor's farms, if adults were present who fulfilled the criteria to be monitors a request to interview them was made. If multiple potential respondents were present the choice of who to be interviewed was left to the farm inhabitants, as would have been the case if asking for volunteers for the PMP. Normally the farm owner would be interviewed if present, if not then a member of their family (wife or son) or a farmhand.

3.1.3 Conducting Interviews

Interviews were conducted in Russian by a Kalmyk translator supervised by LJD. Descriptive responses were translated and recorded in English during the interview, allowing for further questioning or clarification by LJD. To encourage honest dialogue, if respondents mentioned hunting as a major problem (questions 1.3-1.7) they were asked conversationally, outside the structure of the questionnaire, if they knew the type of people who were poaching and why people poached. Interviews were conducted between 13th June 2013 and 8th July 2013 and averaged 27 minutes in length.

3.2 Participatory Monitoring Data

Data from the PMP were provided by EJMG and YA, and combined into a single dataset of all saiga sightings from 2008-2012. Monitors' datasheets were consistent throughout the programme, however data inputted and recorded from the three projects were inconsistent, with recorded data fields differing (Table 3.2).

Table 3.2 The different data fields that were provided for each PMP.

	Project		
Data Fields	BPMP	RPMP	USFWPMP
Monitor Name.	X		X
Location of monitors farm (GPS).		X	X
Date of saiga sighting.	X	X	X
Size of herd seen.	X	X	X
Sex ratio of herd.	X (for some observations)		X (for some observations)
Distance and bearing of herd from monitors' farm.	X (for some observations)		X (for some observations)

Limitations in the data collected by the PMP, primarily a lack of survey effort or recording of absences, mean the data cannot be used to calculate population densities (McCabe, 2012; Preston, 1948). While data collected by the RPMP was used to create MAXENT habitat suitability models (HSM) (Elliott, 2011), low numbers of observations from the USFWPMP, low geographic spread of monitors in the BPMP and a lack of data on observation locations for data from the BPMP or USFWPMP makes the data unsuitable for habitat suitability models.

In place of density estimates or HSMs other indicators of abundance were investigated. Herd sizes are indicative of population size; smaller herds indicating a population under pressures and stresses (Milner-Gulland, 2001; Vander Wal et al., 2013). Encounter rates by monitors were investigated; if monitors see saiga herds less frequently it is likely that there are fewer herds to be seen. Simple analysis of changes in the saiga's range was carried out by mapping changes in locations of sightings between projects. While some monitors collected data on the sex and age ratios of herds, it was decided to not investigate these changes due to the difficulty of differentiating males, females and juveniles.

Due to the relationship between survey effort and encounter rates, comparisons of the frequency of saiga sightings were only conducted on data from monitors who participated on multiple projects, assuming individual monitors' survey effort is similar from year to year. The sizes of herds seen are independent of survey effort, however due to the possible impact of different monitor locations on herd sizes, analysis of changing herd sizes was conducted using data from monitors who had taken part in multiple projects as well as on data from the whole programme.

Data on monitors' names and farm locations (Table 3.2) were used to link monitors who had participated on multiple projects. This assumes that where names were used to link monitors between projects they remained on the same farm and where GPS locations were used to link monitors they lived at the same locations.

3.3 Statistical Analysis

Statistical analysis was carried out in R 3.0.1 (R Core Team, 2013), Microsoft Excel was used for data management and maps drawn in QGIS (QGIS development Team, 2013).

To assess the impact of being a monitor on people's attitudes towards saiga and their likelihood of displaying positive behaviour towards saiga conservation, monitors' responses are compared to those interested in becoming monitors but have not had the opportunity, from here referred to as potential monitors (PMs). Respondents who do not want to be involved in the programme, from here referred to as uninterested respondents (URs) will be used to investigate general attitudes towards saiga and changes in attitudes from previous surveys.

Shapiro-Wilks tests were used to test for normality and non-parametric tests used on non-normally distributed data. To test for differences between monitors', PMs' and URs' knowledge about and attitudes towards saiga's decline and conservation Fisher's exact test, Kruskal-Wallis test and Wilcoxon tests were used. Where Kruskal-Wallis tests showed significant differences between groups the kruskalmc post hoc test(in R package pgirmess)(Siegel & Castellan, 1988) was used to investigate which groups were significantly different. To investigate differences in respondents' feelings of concern regarding saiga extinction (question 1.12) responses "to a certain extent", "a little" and "No" were combined and Fisher's exact test used due to low expected values (Crawley, 2007). Wilcoxon tests were used to investigate different positions respondents hold within their social networks and for differences in centrality scores between the different groups of respondents. Descriptive, qualitative responses were coded and grouped into common themes.

Herd sizes were non-normally distributed (Shapiro-Wilks,$p<0.01$), therefore Kruskal-Wallis and Wilcoxon tests were used to investigate changes in herd sizes and the frequency of saiga sightings. Linear mixed effect models were used to test for differences in herd sizes seen by the same monitors over different projects and years.

3.3.1 Cultural Salience

The salience of words is a measure of the frequency and order of words mentioned, with higher salience indicating they are more central to people's ideas about "saiga" (Papworth, 2013; Quinlan, 2005). Equations from Quinlan (2005) were used to calculate the cultural salience scores of words mentioned in the free-listing exercise in question 1.1 (Appendix A). These were calculated for words mentioned by respondents using the following equation:

$$salience_i = \frac{1 + length_i - position_i}{length_i}$$

where *length* is the number of words mentioned by respondent *i,* and *position* is the location of the word in the list given by respondent *i*. Words not mentioned receive a salience score of 0. The cultural salience of each word amongst all respondents was calculated as the mean salience.

3.3.2 Ranked Data

The majority of questions that required respondents to rank preferences involved partial rankings. Where partial ranks were used (questions 1.4, 1.6, 1.13, 1.14, 2.4 and 2.5) ranks were reversed for analysis using the following equation:

$$x = (n - (r - 1))$$

where *x* is the reversed rank, *n* is the number of response options and *r* is the original rank. Unranked options were given a value of 0.

3.3.3 Social Network Analysis, Calculating Centralities

R's "igraph" package (Csardi & Nepusz, 2006) was used to calculate four centrality scores for each respondent; betweenness centrality (Scott, 2013) and three different alpha-centrality scores (Bonacich & Lloyd, 2001).

Betweenness Centrality measures the number of times a node lies on shortest path between other pairs of nodes, and indicates how much a person is able to control information flow between other nodes (Scott, 2013).

Alpha-centrality is an adapted form of eigenvector centrality that measures a nodes influence. Eigenvector centrality scores takes into account a node's direct connections

and its indirect connections, thus a nodes influence is not only affected by how many nodes it is connected to but also by how connected those other nodes are (Bonacich, 2007). Alpha-centrality builds on eigenvector centrality by allowing attributes of status that are external to the network graph to be attached to each node. In alpha-centrality calculations an α parameter weighs the relative importance of endogenous (network) versus exogenous (status) factors. An α parameter of 0.05 was found to provide the best weighting between the endogenous and exogenous factors in the alpha-centrality equation and was used in all alpha-centrality tests.

A focus group of four staff members from the YBC gave status values to all the professions of respondents and their alters. Professions mentioned during interviews were separated by geographical location and social status (Appendix B). Professions were placed into a table, rows were locations professions are predominantly linked to; the steppe (including small villages), the city, and professions that were indefinable or linked to both (e.g. unemployed), while columns were profession's social status'; high, medium or low, this was defined as how influential these different professions were in society, and how likely people would be to pay attention to their thoughts and ideas.

Geographical locations and status scores were used to calculate overall alpha-centrality, city alpha-centrality and steppe alpha-centrality. These scores estimated the influence respondents have in society in overall, within cities and on the steppe. Overall alpha-centrality was calculated using the profession's status score as the external status factor. To calculate city alpha-centrality scores professions from the city were given a score of 2, professions from the city and steppe or could not be defined were given a score of 1 and steppe jobs scored 0, location scores were then multiplied by status scores to give a city status score which was used as the external status factor in calculating city alpha-centrality scores. Steppe alpha-centrality scores were calculated in a similar manner, with steppe professions scoring 2 and city professions scoring 0.

Graph density was also calculated for each network. The density of a graph is a proportion of existing to maximum possible edges (Degenne & Forse, 1999). Networks with a high density reinforce cultural norms and value systems, and loose networks allow individuals to deviate from the norms of their social circle (Bott, 1957; Hawe, 2004).

4 MONITORS' ATTITUDES, MOTIVATIONS AND NETWORKS

114 interviews were conducted, 87 respondents had no connection to the PMP and 27 were former monitors. Out of 48 monitors visited only 27 were interviewed with (Figure 4.1); three monitors had died, eight moved, two refused to be interviewed, ten were away when visited and the occupants at one farm recorded as a monitor's location had no knowledge of the PMP. Analysis carried out but not directly relevant to the aims and objectives of this study have been listed in Appendix C.

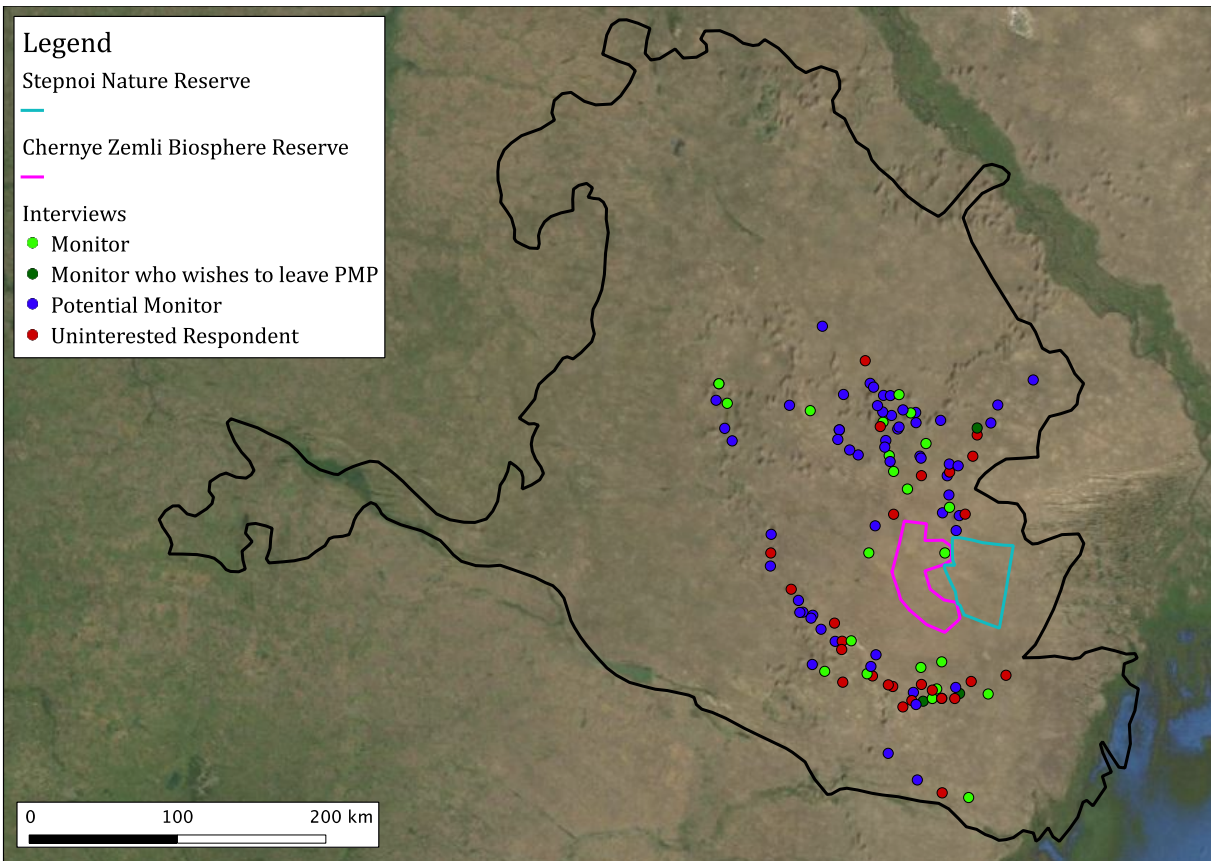

Figure 4.1 Locations of interviews by respondent type. Technical issues meant locations of two monitors, one potential monitor and one uninterested respondent were not recorded.

4.1 MONITORS MOTIVATIONS

When asked if they would like to become monitors 60 non-monitors answered "yes", referred to as potential monitors (PMs) and 27 replied "no", referred to as uninterested

respondents (URs). Respondents were not explicitly asked why they did not want to become monitors but the majority of reasons given informally were that respondents were too busy or that monitoring saiga was not their responsibility

Monitors and PMs had similar motivations for wanting to be involved in the project; both were motivated primarily by a desire to help saiga (Table 4.1); "because I wanted to help saiga" and "because society is not doing enough to help saiga" were in the top three motivations for both groups. Potential monitors were more interested in meeting new people than monitors and both groups also wanted to learn more about saiga. Personal financial gain was ranked very low, with "to earn money from monitoring" and "future employment opportunities" being in the bottom three ranks for both groups.

Table 4.1 Average ranks monitors and PMs gave for their motivations for wanting to join the PMP.

Mean Rank	Monitors' Motivation	Mean Rank	Potential Monitors' Motivation
8.9	Because I wanted to help saiga.	8.3	Because I wanted to help saiga.
3.7	Because society is not helping saiga enough.	4	To meet new people.
3.2	To learn more about saiga.	3.7	Because society is not helping saiga enough
2.2	To meet new people.	2.6	To learn more about saiga.
1.7	To contribute to an international conservation programme	1.1	To gain new skills.
1	Because helping saiga is an escape from my troubles	1	To contribute to an international conservation programme
0.59	To earn money from monitoring.	1	Because helping saiga is an escape from my troubles
0.56	To gain new skills.	0.38	Future employment opportunities.
0	Future employment opportunities.	0	To earn money from monitoring.

Only three respondents were monitors who no longer wished to be part of the PMP. The reasons given for leaving the PMP were "too busy with other work" (salience=0.61), "they did not meet any new people" (salience=0.33), "that they did not enjoy the work" (salience=0.22) and "the pay was too low" (salience=0.16).

When asked to list any benefits that have come out of the programme; to themselves, their communities or saigas, 8 monitors gave no responses, despite wishing to continue with the PMP. The most common benefit listed was that the programme successfully educated people about the problems saiga face and encouraged them to protect saiga (n=14). Other benefits listed were:

- "Taking part in this monitoring project gives me confidence" (n=1)
- "Helping saiga makes me feel good about myself" (n=1)
- "I have gained new skills and learned about saiga" (n=1)
- "I have met foreigners working on this project" (n=1)
- "It makes farmers feel good as they know that other people, from the cities and from other countries are also thinking about saiga" (n=1)
- "The project is good as it brings people together to help protect saigas" (n=1)

The majority of monitors had no suggestions for improvements to the PMP (n=19). Six monitors suggested increased focus on educating people about saiga and their conservation, and other monitors suggested:

- "To increase the size of the monitoring project" (n=1)
- "Improve the survey techniques used to count saigas, e.g. by using planes" (n=1)
- "Police, rangers and conservationists work together to stop the hunters" (n=1)

4.2 Free-listing and Cultural Salience.

44 words were mentioned in a free-listing exercise (expressing similar concepts were combined, such as beauty and beautiful). Table 4.2 shows the ten words that scored the highest cultural salience scores in each group. Salience scores indicate generally positive attitudes towards saiga, with "beauty", "rare" and "pity" scoring highest. Low saiga numbers were also at the forefront of people's minds with words such as "pity", "rare", "decreasing" and "childhood" scoring relatively highly. Words linked to negative attitudes or negative behaviours towards saiga were also mentioned: "hunters" was the 10th highest ranking word (salience=0.038), while "meat", "horns", "hunting" and "horn traders" had lower salience scores, 0.020, 0.010, 0.010 and 0.0088 respectively.

Similar words appeared in all the groups, with "rare" and "beauty" scoring highest in all groups. "pity" scored highly with monitors and PMs, 0.17 and 0.15 respectively, but only scored 0.062 with URs. Monitors and PMs also associated saigas with the steppe much more than URs, with respective salience scores of 0.16, 0.16 and 0.049.

Table 4.2 Ten words with the highest salience scores listed by all the interviewees, monitors, PMs and URs. Salience score of one means the word was mentioned first by every respondent while a salience score of zero means the word was not mentioned.

All interviewees			Monitors		
Word	Salience Score	Total word mentions	Word	Salience Score	Total word mentions
beauty	0.33	53	beauty	0.47	12
rare	0.29	44	rare	0.25	7
pity	0.12	20	steppe	0.16	4
steppe	0.12	19	pity	0.17	6
fast	0.080	13	freedom	0.12	3
good	0.056	7	nature	0.11	3
nature	0.050	9	need help	0.11	2
decreasing	0.047	6	childhood	0.088	2
childhood	0.038	6	fast	0.088	3
hunters	0.038	6	decreasing	0.070	2
Potential monitors			Uninterested respondents		
Word	Salience Score	Total word mentions	Word	Salience Score	Total word mentions
beauty	0.32	28	rare	0.41	14
rare	0.29	23	beauty	0.33	13
steppe	0.16	13	fast	0.086	3
pity	0.15	11	ancient	0.074	2
nature	0.061	6	decreasing	0.074	2
good	0.061	4	good	0.062	2
fast	0.058	7	horn	0.062	2
hunters	0.056	5	pity	0.062	3
holy	0.050	4	calm	0.049	2
sheep	0.050	4	need help	0.049	2

4.3 Comparing Attitudes.

4.3.1 Personality Factors

People's attitudes towards an environmental problem, their feelings of personal responsibility towards fixing that problem and if they have an internal or external locus of control are listed by Hines' (1987) as the personality factors influencing their likelihood to engage in positive environmental behaviour.

Question 2.12 asked how concerned respondents would be if saiga were to become extinct to assess attitudes towards saiga. 26 out of 27 monitors and 55 out of 60 PMs

would be “very concerned”; however Fisher’s exact test showed there was no significant difference between monitors’ and PMs’ concern regarding saiga extinction (p=0.67), however, monitors and PMs (81 out of 87) were significantly more likely than URs (20 out of 27) to be “very concerned” if saiga were to become extinct (p=0.012).

Monitors and PMs both deemed central organizations and hunters (for meat and horn with monitors and just for horn with PMs) to be more at fault if saiga were to become extinct than themselves (Table 4.3-overleaf). Regarding responsibility for protecting saiga both groups ranked the inhabitants of cities and the steppe below a number of central organisations: regional government and nature reserves. In all cases the regional government ranked higher than the federal government and city and steppe inhabitants ranked higher than just steppe inhabitants. These results agree with those of Waylen (2012) who found Kalmyks defer responsibility for addressing environmental problems to higher bodies, such as government agencies.

Kruskal Wallis tests showed no significant difference in how monitors, PMs or URs ranked steppe inhabitants and the inhabitants of the cities and the steppe regarding responsibility for potential saiga extinction (χ^2_2=1.3,p=0.51 and χ^2_2=0.22,p=0.89) or regarding responsibility for saiga protection (χ^2_2=2.5,p=0.28 and χ^2_2=0.80,p=0.66).

Table 4.3 also shows insights into Kalmykic’ locus of control. When asked about fault if saiga were to become extinct the response “Nobody’s fault, it is out of humans control” was ranked 11th for monitors and 10th for PMs suggesting an religious internal locus of control as humans have some responsibility and influence in the system. The majority of Kalmykics are Buddhist and so Karmic beliefs will encourage feelings of responsibility for ones’ actions and control over ones’ own destiny (Harvey, 2013).

However the fact that central organisations such as the regional and federal governments and nature reserves are deemed more at fault for saiga extinction and more responsible for saiga protection indicates that many respondents have a social external locus of control. This agrees with Waylen (2012) who found Kalmyk society still very influenced by the years spent under collectivism.

Table 4.3 Eight organisations or groups ranked as being most at fault if saiga become regionally extinct or as responsible for protecting saiga by monitors, PMs and URs.

		Monitors	Mean Rank	Potential Monitors	Mean Rank	Uninterested respondents	Mean Rank
1.13 If saiga were to disappear from Kalmykia/Astrakhan whose fault would this be?	1	Regional Government	8.6	Hunters for horn	9.3	Hunters for horn	10.4
	2	Hunters for horn	8	Regional Government	8.7	Regional Government	5.6
	3	Hunters for meat	5.3	Federal Government	6.2	Hunters for meat	5.4
	4	Federal Government	5.1	City and steppe Inhabitants	5.1	International Conservationists	4.4
	5	City and steppe Inhabitants	4.7	Hunters for meat	4.9	Those trading saiga horn	4.4
	6	People coming from other parts of Russia to hunt	4.7	Those trading saiga horn	4.3	City and steppe Inhabitants	4.1
	7	Those trading saiga horn	3.9	People coming from other parts of Russia to hunt	3	People coming from other parts of Russia to hunt	3.9
	8	Police	1.9	Police	2.3	Federal Government	3.7
1.14 Who is responsible for protecting saiga?	1	Nature Reserves	6.2	Regional Government	5.3	Nature Reserves	5.6
	2	Regional Government	5.8	Nature Reserves	4.7	Regional Government	4.3
	3	City and steppe Inhabitants	3.6	City and steppe Inhabitants	4.4	City and steppe Inhabitants	4
	4	Federal Government	2.9	Federal Government	4.3	Federal Government	3.7
	5	International conservationists	1.9	Police	2.4	Steppe inhabitants	2.3
	6	Police	1.1	International conservationists	1.9	International conservationists	1.9
	7	Steppe inhabitants	1.1	Steppe inhabitants	1.5	Police	1.5
	8	Other	0	Other	0	Other	0

4.3.2 Cognitive Factors and Intention to Act

Hines' (1987) MRB lists three different cognitive factors influencing people's willingness to engage in positive environmental behaviour: knowledge of environmental issues, knowledge of action strategies, and the action skills to implement action strategies. Due to difficulties in measuring the skills required to engage in saiga conservation, testing of action skills and intentions to act were combined, assuming that people would only be willing to volunteer to carry out an activity they have the skills to accomplish.

94% of all respondents thought hunting saiga was illegal, 4% thought it was legal and 3% unsure. Fisher's test showed there to be no difference between monitors, PMs' or URs knowledge of the legality of saiga hunting ($p_{27,60,27}$=1). Knowledge about changing saiga numbers since the break-up of the USSR in 1991 was high. 79% of respondents knew saigas in Kalmykia or Astrakhan had decreased since 1991, 20% did not know what the change in saiga numbers was and 1% claimed numbers had risen. There was no significant difference in the three groups knowledge about changing saiga numbers since 1991 (Chi-squared test, χ^2_2=0.084, p=0.95).

To test knowledge of action strategies related to falling saiga numbers, respondents were asked to list up to three methods for protecting saigas and raising saiga numbers (Table 4.4). Responses from the three groups were similar with solutions focussed on anti-poaching efforts, through increasing the effectiveness of rangers or harsher punishments for those breaking the law. Environmental education about the different problems saiga face also ranked highly amongst all groups. Potential monitors provided slightly more solutions on average than monitors ($\bar{x}$=1.6±0.1 and $\bar{x}$=1.3±0.17, Wilcoxon test, $W_{60,27}$=636, p=0.09) and were more likely to suggest improving rangers' effectiveness and education, URs were more likely to support the creation of nature reserves and shooting wolves than the other two groups. There was no significant difference in the numbers of suggestions between monitors and PMs, and URs ($\bar{x}$=1.5±0.0.089 and $\bar{x}$=1.2±1.6, Wilcoxon test,$W_{80,27}$=1353, p=0.20).

Table 4.4 Suggestions made by respondents for ways to protect saigas.

Solution	Number of suggestions			
	All	M	PMs	URs
Improve rangers effectiveness	44	9	30	5
Increase punishments for poachers	31	8	18	5
Education on the problems saiga face	20	4	14	2
More saiga breeding centres	16	5	9	2
Increase the size or number of reserves	15	2	6	7
Shoot wolves and other predators	11	3	4	4
Saiga should be left alone	10	2	4	4
Give saigas food or water	7	1	5	1
Job creation as the unemployed are the hunters	4	2	1	1
Surveys to find where saigas are	2	0	1	1
Stop horn traders	2	0	2	0
Allow "farming" of saigas.	1	0	1	0
Total	163	36	95	32

Hines (1987) model of responsible behaviour lists verbal or written intention to act as a factor in someone's likelihood to undertake positive environmental behaviour. All respondents bar four offered some assistance towards saiga conservation. Monitors ($\bar{x}$=5.0±0.33) and PMs ($\bar{x}$=5.0±0.27) did not differ in the average number of activities that they would be willing to help with (t test, $t_{59.26}$=0.078,p=0.94), however there is a significant difference between monitors and PMs ($\bar{x}$=5.0±0.29) and URs ($\bar{x}$=3.5±0.38) (t test, t_{44}=-3.6,p<0.001). "Talking to your friends, family and neighbours about saigas", "Patrolling and monitoring", "teaching children and young people about saigas" and "killing wolves" were the most popular options (Table 4.5). Responses between monitors and PMs were very similar, the main difference being PMs were more likely to be willing to provide financial assistance to conservation organisations. Uninterested respondents were generally less willing to provide any assistance and ranked killing wolves much higher in their response options than other groups.

Table 4.5 Different types of assistance offered towards saiga conservation by monitors, PMs and URs.

	Numbers of respondents able to offer each type of assistance to saiga conservation			
	Total	M	PM	UR
Patrolling and monitoring.	87	27	60	0
Talking to your friends, family and neighbours about saigas.	100	26	54	20
Raising saiga calves.	45	11	28	6
Taking part in a campaign to raise awareness about saigas through T.V., newspapers and other media.	44	14	25	5
Teaching children and young people about saigas.	86	19	50	17
Feeding saigas in their natural habitat.	42	12	25	5
Killing wolves.	77	18	40	19
Providing financial assistance to conservation organisations.	52	11	32	9

4.3.3 Overall Differences in Attitudes Between Groups.

Differences in responses between monitors and PMs, and URs suggests people wanting to be involved in the PMP already have more positive attitudes towards saigas, however similar responses between monitors and PMs (and in some cases more positive

responses from PMs) suggests monitors' involvement in the programme has not changed their attitudes towards saigas or their likelihood to engage in positive behaviour towards saigas (Table 4.6).

Table 4.6 Different salience scores and responses to questions investigating the factors of Hines et al.'s (1987) model of responsible behaviour.

Variable	Differences between monitors and PMs	Differences between monitors and PMs, and URs
Salience	Similar words and rankings, all highly ranked words positively associated with saigas and their plight.	Similar positive associations with saiga, however URs were less concerned with saiga's plight.
Attitudes	Similar concern if saiga were to become extinct	Uninterested respondents less concerned about saiga extinction
Personal Responsibility	Similar rankings for fault if saiga became extinct and of responsibilities for saiga protection	
Locus of Control	Similar rankings of human control over saiga's fate, and of the responsibilities of central organisations over individuals for saiga protection	
Knowledge of issues	Similar knowledge about legality of saiga hunting and changes in populations since 1991.	
Knowledge of action strategies	Potential monitors listed more suggestions and proposed more effective interventions such as education and increased anti-poaching efforts (CMS, 2010; Howe, Medzhidov, & Milner-Gulland, 2011).	Similar number and type of suggestions, URs more likely to propose nature reserves and shooting wolves as solutions, neither of which are prioritized by the wider conservation community (CMS, 2010).
Action Skills and Intention to act	Offer similar range and type of assistance. Potential monitors slightly more likely to offer financial assistance	Uninterested respondents less willing to offer assistance.

4.4 Social Networks Amongst Monitors and Steppe Inhabitants

SNA was carried out with 95 respondents, 19 respondents refused to answer the SNA aspects of the questionnaire (two monitors, nine PMs and eight URs), mostly as they did not want to speak about or on behalf of their friends.

Wilcoxon tests showed there to be no significant differences in the betweenness centrality ($W_{51,25}$=647,p=0.97), steppe alpha-centrality ($W_{51,25}$=658,p=0.93), city alpha-centrality ($W_{51,25}$=535,p=0.20) and overall alpha-centrality ($W_{51,25}$=626, p=0.80) between monitors and PMs. The difference in numbers of people within their network

that respondents from each group had spoken to about saiga in the last year was also non-significant ($W_{51,25}$=618,p=0.73).

There were significant differences between farm owners' (n=69) and farmhands' (n=21) centrality scores (Figure 4.2), other professions were only represented by one respondent so were removed from analysis. Farmhands have significantly higher betweenness centrality scores ($\bar{x}$=71.4 to $\bar{x}$=44.5, Wilcoxon test, $W_{69,21}$=491.5,p=0.026) and city alpha-centrality scores ($\bar{x}$=1.3 to $\bar{x}$=1.0, Wilcoxon test, $W_{69,21}$=517,p=0.047) compared to farm owners. Higher betweenness centrality scores mean farmhands have more control over information flow within their network.

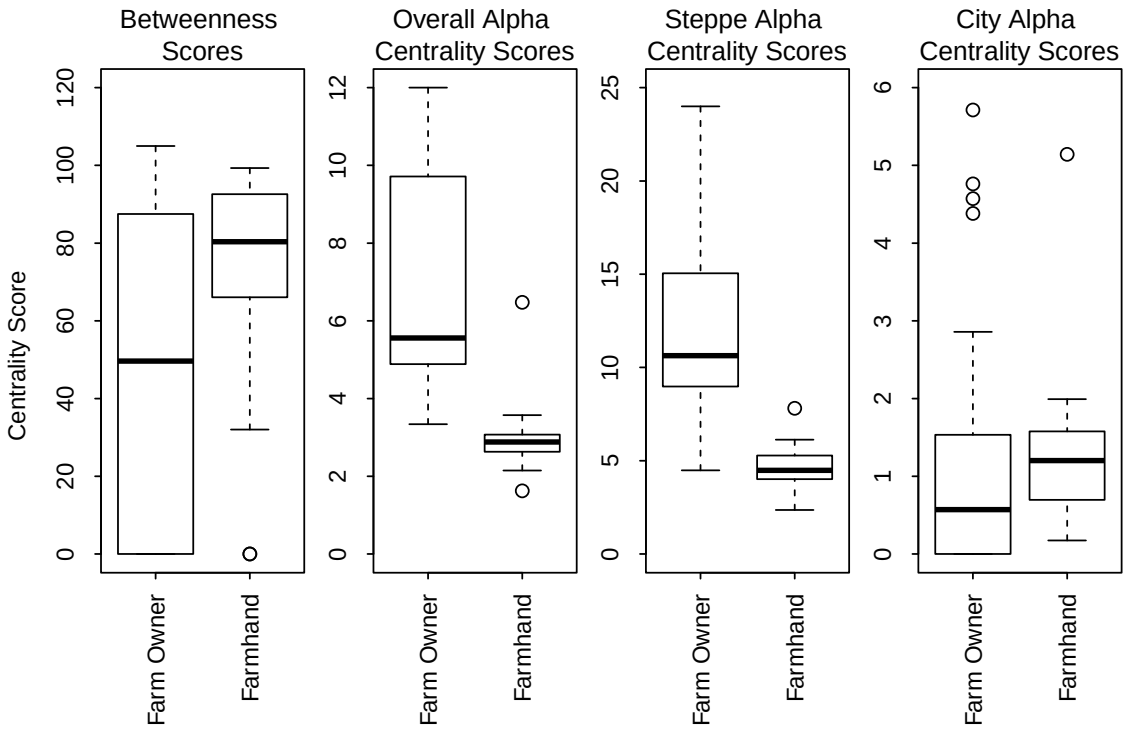

Figure 4.2 The betweenness centrality, overall alpha-centrality, steppe alpha-centrality and city alpha-centrality by farm owners and farmhands.

Farm owners have much greater overall alpha-centrality scores ($\bar{x}$=7.12 to $\bar{x}$=3.0, Wilcoxon test, $W_{69,21}$=1400,p<0.001) indicating their social networks are generally denser and contain more influential people than those of farmhands (farm owners networks were often dominated by surrounding farm owners). Both groups are more influential on the steppe with higher steppe alpha-centrality scores than city alpha-

centrality scores (Wilcoxon test, $W_{69,21}$=143.5,p<0.001), however farm owner's steppe alpha-centrality scores were significantly higher than those of farm hands ($\bar{x}$=13.2 to $\bar{x}$=4.7, Wilcoxon test, $W_{69,21}$=1427,p<0.001). Low city alpha-centrality scores indicate that neither group is influential in cities. Farmhands' higher city alpha-centrality score is likely to be as result of links with people with professions that could be either steppe or city, such as the unemployed, or drivers.

Monitors and PMs network densities were not significantly different (Wilcoxon test,$W_{51,25}$=649,p=1.0). However, farm owners' ($\bar{x}$=0.58) and farmhands' ($\bar{x}$=0.37) had significantly different network densities (Wilcoxon test,$W_{69,21}$=933,p=0.044)(Figure 4.3-overleaf). With general opinion on the steppe against saiga hunting and viewing saiga hunting as a low status job (Kühl et al., 2009), farm owners' denser networks will put them under more pressure to conform to this social norm than farmhands' looser networks. There was no significant different between how often the two professions spoke to their friends about saiga (Wilcoxon test,$W_{69,21}$=786,p=0.55).

4.5 Changes in Attitudes From Previous Studies

Concern about saiga extinction appears to be similar to studies in previous years: a survey carried out in 2003 found that 91% of respondents would mind "very strongly" (the strongest response of four options) if saiga were to become extinct (Kühl et al., 2009). A comparable group of respondents from this survey would be those whose attitudes have not been impacted by being part of the PMP, and 86% of these would be "very concerned" (again the strongest response of four options) if saiga became extinct, if including monitors 88% of respondents would be "very, concerned".

Although the majority of respondents were keen to be involved in the project, with 69% of those not already involved wishing to be part of the program, this is a drop from 80% and 96% of respondents from previous surveys who wished to part of a PMP (Kühl et al., 2009, Whitebread, 2008).

Lower saiga numbers could reinforce less positive attitudes towards saiga; as people see less saiga they fall out of their day to day life and become culturally less important, which could cause people to care less about their conservation. However a Kruskal-Wallis tests showed no significant relationship between the number of months since the respondent last saw a saiga and whether or not they wanted to take part in the PMP

(χ^2_{39}=44.6, p=0.25) or in their level of concern about saiga becoming extinct (χ^2_{12}=45.9,p=0.31).

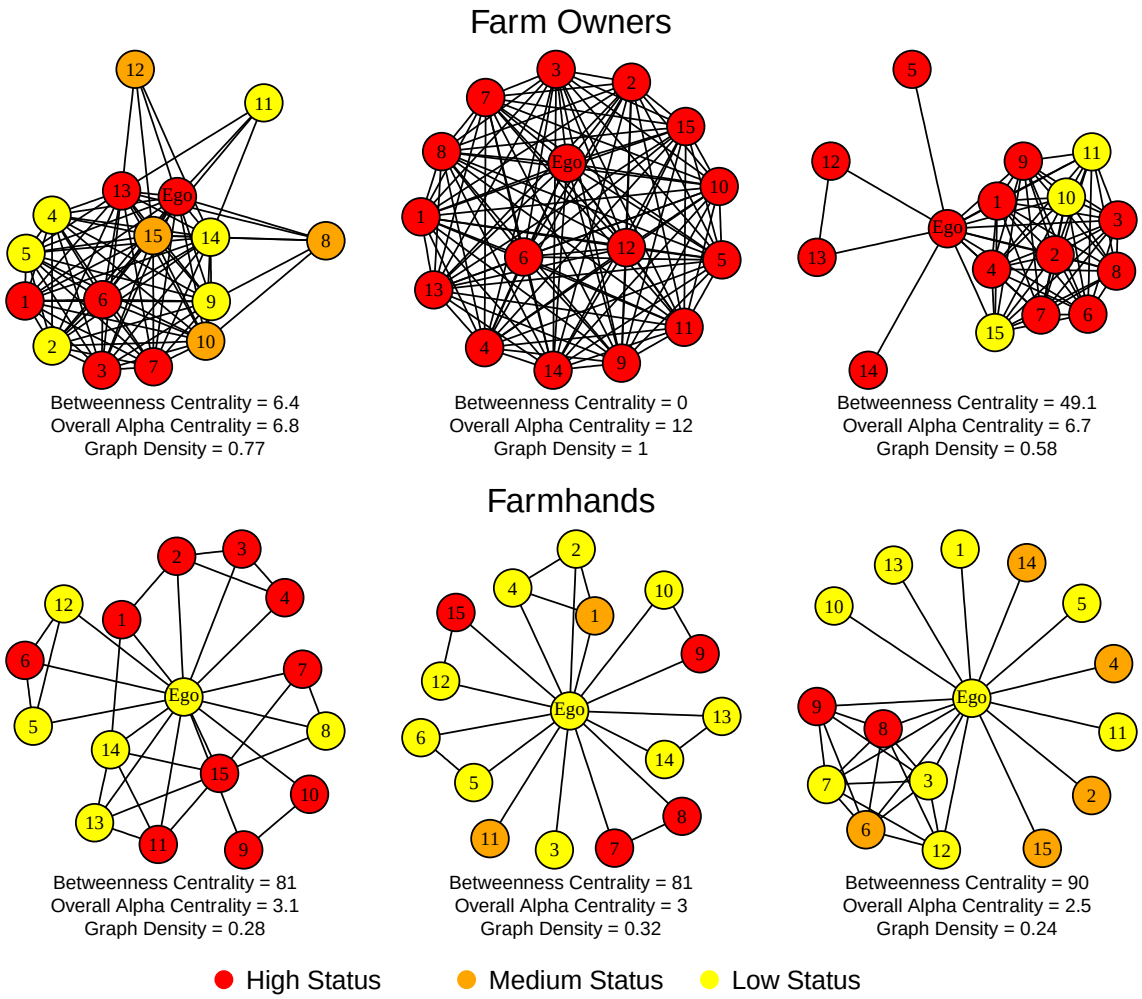

Figure 4.3 Social Network Graphs of three farm owners and three farm hands, showing how farm owners are usually part of denser networks and thus have a lower betweenness centrality, however their networks contain a higher proportion of alters with high status professions and thus they have a higher alpha-centrality. Nodes labelled "Ego" denote the respondent, numbered nodes denote alters. Edges connect nodes that are "friends" with each other. Colours show the social status of the node's profession.

5 CHANGING PATTERNS IN SAIGA NUMBERS AND SIGHTINGS

5.1 CHANGING HERD SIZES FOR ALL MONITORS AND PROJECTS

Seasonal variations in herd sizes (Bekenov, Grachev, & Milner-Gulland, 1998) were found in the data recorded by the PMP (Figure 5.1). Each year was split into spring (days 0 to 122), Summer (days 123-244) and Winter (days 245-365): where projects covered less than 50% of a season it was excluded from analysis (Summer 2011).

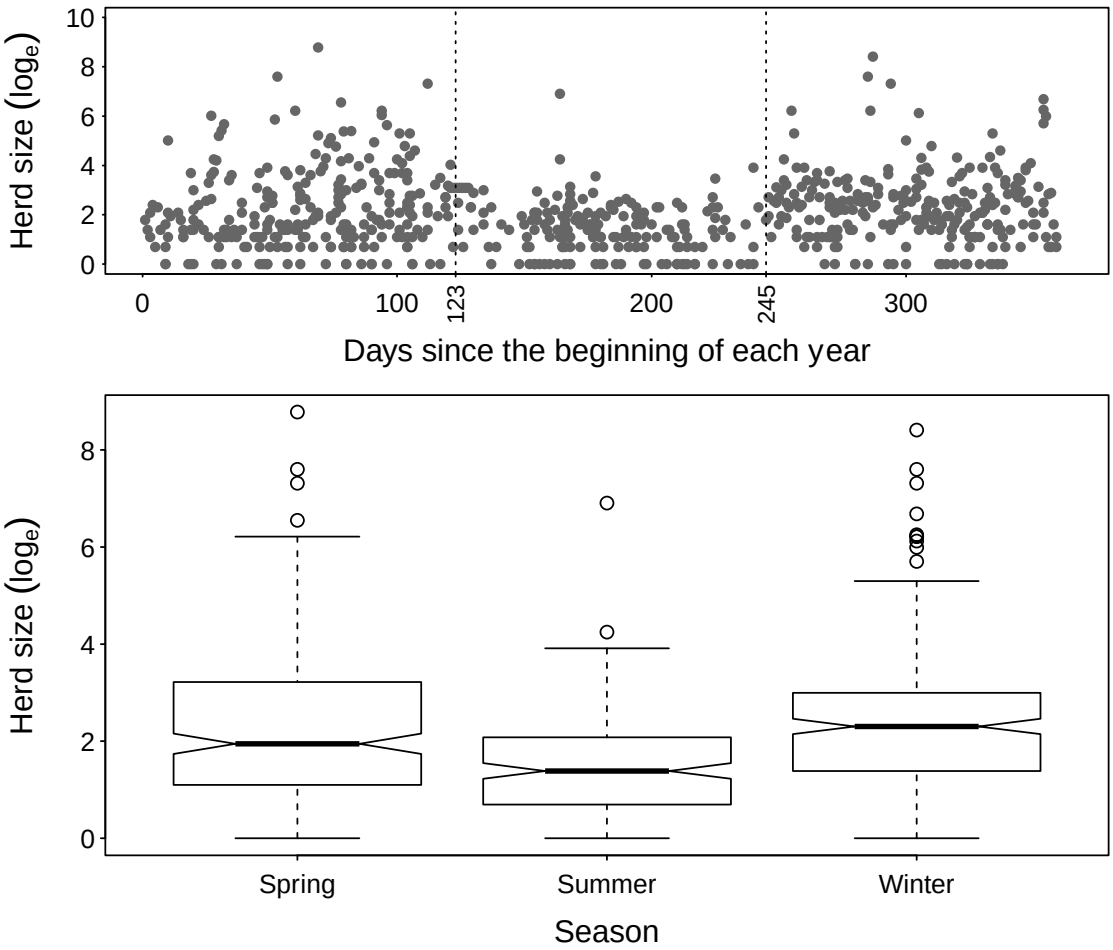

Figure 5.1 Scatter diagram shows herd sizes for all monitors and all years plotted against day of the year the herd was seen, showing where seasons were defined. Boxplots show the different medians and variances associated with the herd sizes from different seasons, where notches do not overlap there is "strong evidence" their medians differ (Chambers, 1983).

Herd sizes between seasons were significantly different (Kruskal-Wallis test, χ^2_2=46.2,p<0.001), with summer herds ($\tilde{x}$=4, IQR=6) significantly smaller than spring ($\tilde{x}$=7,IQR=22) and winter ($\tilde{x}$=10,IQR=16) herds (p<0.01), while spring and winter herds were not significantly different (p>0.05).

Spring herd sizes were significantly different between years (Kruskal-Wallis test, χ^2_2=12.0,p=0.008) with reductions in herd sizes between 2008 ($\tilde{x}$=12,IQR=37) and 2012 ($\tilde{x}$=4,IQR=5) (p<0.05) and between 2011($\tilde{x}$=8,IQR=34.75) and 2012 ($\tilde{x}$=4,IQR=5)(p<0.01)(Figure 5.2). There were no significant differences between summer (Kruskal-Wallis test, χ^2_2=3.6,p=0.16) and winter (Kruskal-Wallis test, χ^2_2=5.0,p=0.17) herd sizes in any of the years.

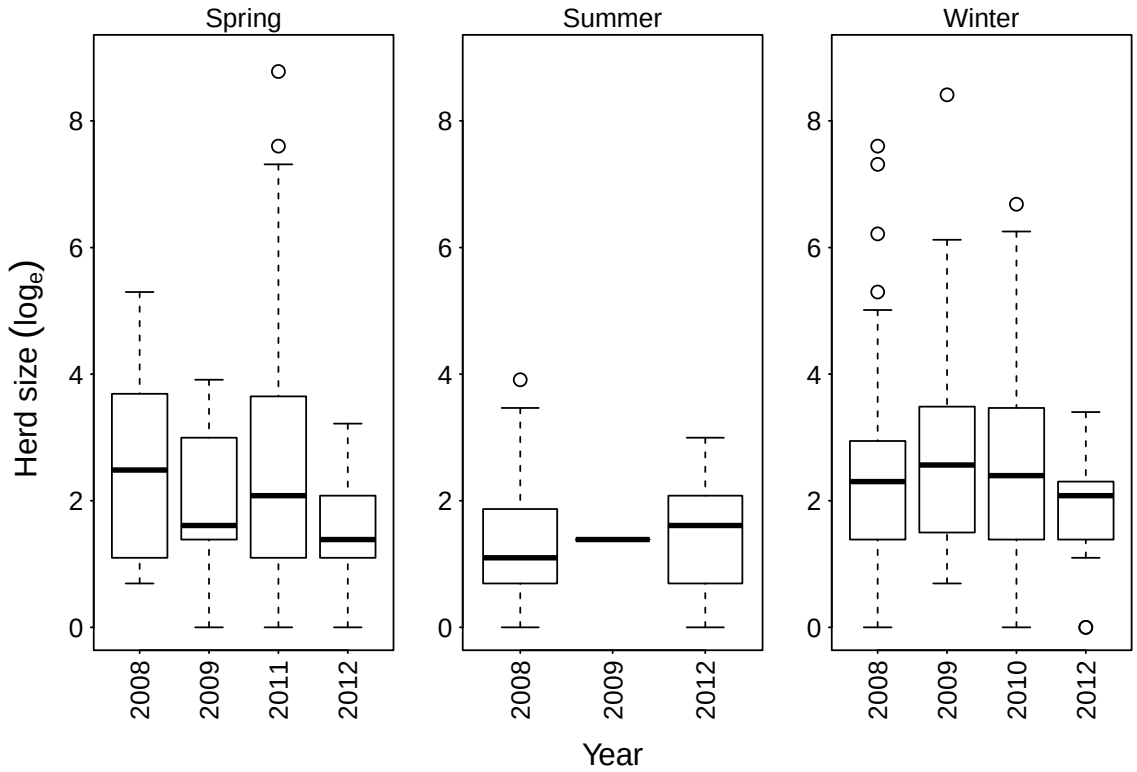

Figure 5.2 Differing herd sizes in each season and year of the PMP.

Despite greater numbers of monitors covering a larger area, there is a marked reduction in maximum and mean herd sizes in 2012 compared to all previous years (Table 5.1). As different seasons were covered in different years (Table 2.3) care must be taken in

interpreting these statistics, however it may indicate the loss of larger herd sizes and a change in population dynamics from previous years to 2012.

Table 5.1 The minimum, maximum and mean herd sizes recorded in each year that a participatory monitoring project has run.

Year	Minimum herd size	Maximum herd size	Mean herd Size	Numbers of sightings
2012	1	30	7±0.45	122
2011	1	6500	86±32	220
2010	1	800	48±13	89
2009	1	4500	544±440	46
2008	1	2000	32±11	222

There was a significant reduction in spring herd sizes from previous years combined ($\tilde{x}$=8,IQR=34) and 2012 ($\tilde{x}$=4,IQR=5)(Wilcoxon,W_{255}=6175,p=0.0012). There was little no significant difference between summer herd sizes in 2012 and previous years (Wilcoxon,W_{185}=3249,p=0.52). Winter herds were larger in previous years ($\tilde{x}$=11,IQR=6) than in 2012 ($\tilde{x}$=8,IQR=18.4) however this difference was not quite significant (Wilcoxon,W_{259}=3536,p=0.086).

5.2 Changing Herd Sizes Across Consistent Monitors

Links were made between 8 monitors who worked on the BPMP and USFWPMP and 20 monitors who continued from RPMP to USFWPMP. Linear mixed effects models were used to investigate changes in herd sizes seen by the same monitors in different years. Mod_1, with year of sighting as a fixed effect and the monitor who recorded the sighting as a random effect, was significantly better at predicting herd sizes than Mod_{null}, which contained just the random effect (ANOVA, χ^2_1=9.6,p=0.048). Mod_2 with year and season as fixed effects and monitor as a random effect did not significantly improve the prediction of herd size (ANOVA, χ^2_2=2.9,p=0.23). Mod_3 with year as a fixed effect and monitor and season as random effects did not increase the amount of variance explained by the model (ANOVA, χ^2_1=0,p=0.1).

Table 5.2 presents the Mod_1 which best explained the estimates of total herd size and the model's variance. ANOVA on the model fit confirmed that herd sizes differed significantly by year (F_4=3.9,p=0.004), with Tukey's HSD post hoc test showing that 2009 had significantly higher herd sizes than all other years (2009-2008, p=0.009;

2009-2010, p=0.03; 2009-2011, p=0.004; 2009-2012, p=0.002) however the differences between other years was not significant.

Table 5.2 Results of the linear mixed effect model explaining changing herd sizes recorded by monitors who participated between two participatory monitoring projects.

Effect	Parameter	Estimate	Std. Error
Fixed Effects			
Intercept; herd sizes in 2008	β_i	86.3	32.0
2009 (change from 2008 to 2009)	β_1	76.4	47.7
2010 (change from 2008 to 2010)	β_2	-61.5	50.1
2011 (change from 2008 to 2011)	β_3	-71.8	42.1
2012 (change from 2008 to 2012)	β_4	-71.1	36.7
Random Effects			
Monitor	${\sigma^2}_a$	4316	65.7
Total variance	${\sigma^2}_b$	60997	

Season's low explanatory power suggests the data collected by monitors who participated in multiple projects has a different seasonal variation to that collected by monitors over the whole PMP. There is still a significant difference in herd sizes by season (Kruskal-Wallis, ${\chi^2}_2$=39.0, p<0.0001), however spring ($\tilde{x}$=4, IQR=8) and summer herds ($\tilde{x}$=4, IQR=6) are not significantly different (Kruskalmc, p>0.30) and winter herds ($\tilde{x}$=9, IQR=13) are significantly bigger than both spring and summer herds (Kruskalmc, p<0.0.0001).

5.3 Impact of Monitors Location On Saiga Sightings

There is a significant difference between spring herd sizes from data collected by the entire PMP ($\tilde{x}$=7, IQR=22) and data collected by monitors who participated in multiple projects ($\tilde{x}$=4, IQR=8) (Wilcoxon Test, $W_{334,444}$=15522, p=0.0003). This difference is as a result of the Stepnoi–RPMP monitors who only participated in the RPMP project. These five monitors recorded 159 saiga sightings compared to 150 sightings recorded by the RPMP's 20 other monitors. They also recorded significantly larger herd sizes ($\tilde{x}$=17, IQR=46) than the other RPMP monitors ($\tilde{x}$=4, IQR=8) (Wilcoxon test, $W_{150,159}$=5448.5,p<0.0001). These differences in herd sizes are particularly evident with spring herd sizes recorded by Stepnoi–RPMP monitors ($\tilde{x}$=26.5, IQR=74.75) much higher than those from monitors from all the other projects ($\tilde{x}$=4, IQR=7.25) (Wilcoxon,

$W_{88,168}$=11592,p<0.0001). As they live just to the south of SR and CZBR (Figure 2.5) an area that is known to have constituted saiga's core breeding range from 1992-2000 (Lushchekina & Struchkov, 1998) it is likely the large spring herds seen by the Stepnoi–RPMP monitors are associated with birthing aggregations.

5.4 Changes in Numbers of Sightings per Month

Changing frequencies of saiga encounters by monitors between different projects were investigated as a proxy for saiga abundance on the steppe, with fewer encounters indicative of fewer herds on the steppe. Time of year (by month) did not affect the frequency of saiga sightings (Kruskal-Wallis, χ^2_{15}=14.8,p=0.45), and so season was not controlled for. There was a significant reduction in the numbers of sightings per month for the eight monitors who participated in the BPMP and the USFWPMP; from 1.6-0.5 sightings per month between 2008/2009 and 2012 (Pairwise Wilcoxon test, V_8=26,p=0.047). For the 20 monitors who participated in the RPMP and USFWPMP there was a significant reduction in average sightings per month from 0.89 to 0.32 (Paired Wilcoxon, V_{20}=188,p=0.0002).

5.5 Changes in Saiga range

Despite changes in the sizes of saiga herds and frequencies of sightings there is little to indicate a change in the saiga's range during the course of the PMP (Figure 5.3). The majority of monitors who participated in more than one project saw saiga during both projects (n=24) and the four monitors who saw saiga during the RPMP but did not see saiga in the USFWPMP lived near to monitors who did record saiga during the USFWPMP (between 5.7 and 12.1km).

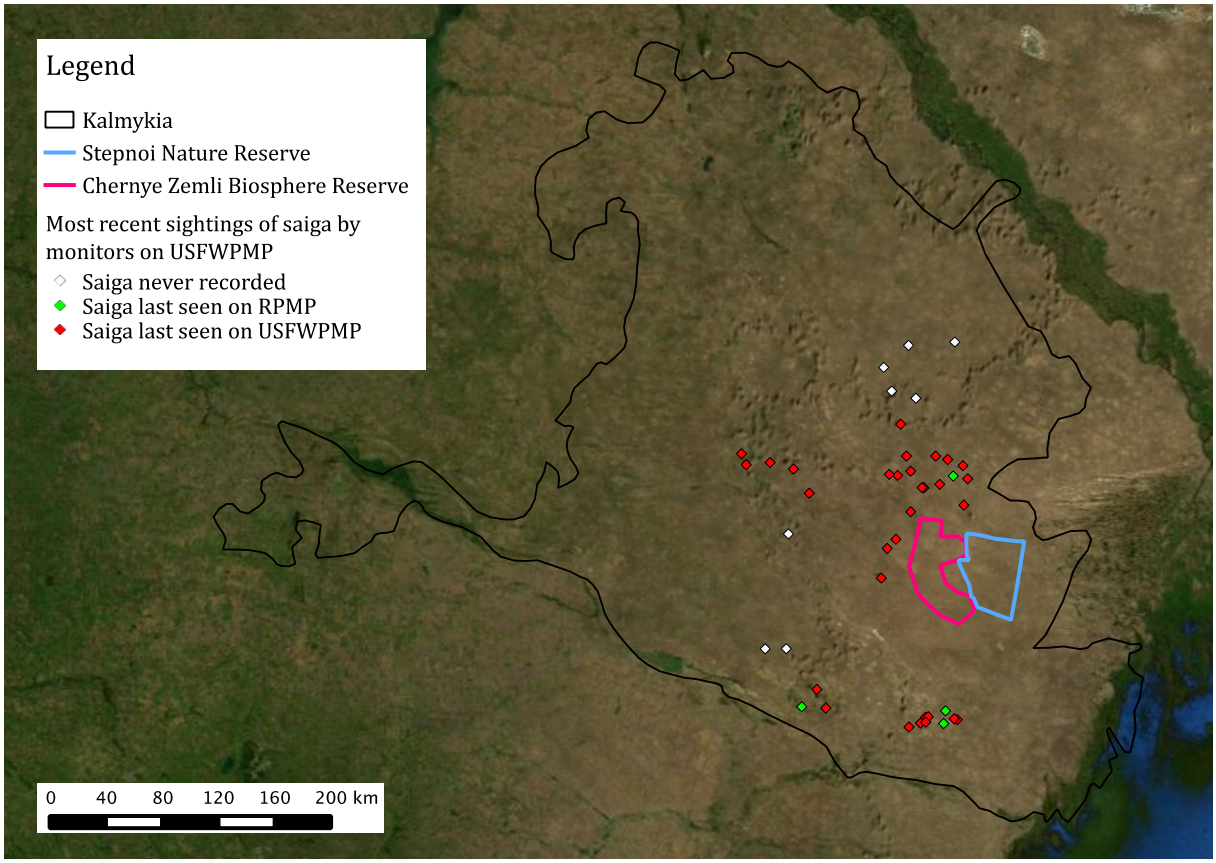

Figure 5.3 Map showing changes in saiga range from BPMP (2008/2009) and RPMP (2010/2011) to USFWPMP (2012). Points show locations of monitors on the USFWPMP coloured by the project during which they last saw a saiga.

6 DISCUSSION

6.1 STUDY OBJECTIVES

6.1.1 MOTIVATIONS BEHIND DECISIONS TO JOIN OR LEAVE THE PARTICIPATORY MONITORING PROGRAMME

The high proportion of respondents willing to become monitors agrees with the findings of Kühl et al. (2009) and Whitebread (2008) who both found high levels of support for participatory monitoring in Kalmykia.

To maintain monitors' motivations Andrianandrasana (2005) recommends factors being monitored have an economic interest to monitors. While some monitors may benefit economically from saigas, this is not the case for all monitors and other methods of maintaining motivation are required. Saiga's links to the "White Old Man", an important figure in Kalmyk Buddhist beliefs, show their cultural significance, especially amongst older Kalmyks (Kühl et al., 2009). This belief saiga's intrinsic value is shown in people's altruistic motivations to want to help saiga with two of the main reasons for involvement in the PMP focusing on Cary et al.'s (1998) "value" (I want to help saiga) and "understanding" (I want to learn about saiga) motivations. Very few monitors and PMs listed a financial incentive as an important motivation in wanting to join the PMP. Although low payment was mentioned as a reason for wanting to leave the programme, it received a very low salience score and as the sample size of monitors wanting to leave the programme was very small it is hard to draw inferences on low payment as a de-motivator.

The PMP currently commits significant resources to monitors' pay. In the USFWPMP 44% of overall project costs were spent on monitors' salaries. Supplementing monitors' payments with rewards that target people's "value", "understanding" or "social" motivations such as: reports highlighting how the PMP and other CWA conservation activities are helping saiga; educational material about saiga and steppe ecology; and opportunities to meet with other monitors, could reduce project costs while also increasing monitors' satisfaction and engagement with the project (Frey & Goette, 1999)

The economic status of respondents was not recorded, however, 60 out 87 monitors and PMs were farm owners, and so are likely to have higher than average incomes and thus

be less motivated by payment. Poachers tend to be poor or unemployed (Kühl et al., 2009), if the PMP aims to encourage people away from poaching by providing an alternate livelihood it will be important to continue to pay monitors, however the project should also explicitly recruit poorer steppe inhabitants to increase the chances of employing those at risk of resorting to saiga poaching.

6.1.2 Impact of the Participatory Monitoring Programme on Attitudes and Behavioural Intentions

Salience of words associated with saiga and responses to questions adapted from Hines et al.'s (1987) model of responsible behaviour showed generally positive attitudes for all respondents. However, it is a desire to be a part of the monitoring programme and not actual involvement that defines people's attitudes towards saiga. In other participatory monitoring projects where there have been improvements in positive environmental behaviour (such as improved compliance with fishing or forest harvesting quotas) monitors have been users of the species being monitored (e.g. Andrianandrasana et al., 2005; Danielsen et al., 2007). Where resource users are unknown, there is not an obvious pool of people whose behaviour needs to be changed and people willing to be monitors are likely to already be concerned with the state of the system and so a participatory monitoring programme will have less impact on positive environmental behaviour.

6.1.3 Selecting Monitors to increase Advocacy for Saiga Conservation.

As the ability for monitors to convey positive messages about saiga conservation was not considered in the projects' design, it is unsurprising that there are no differences in the social network characteristics of monitors or PMs. However, differences in the network characteristics of different professions show targeting individuals with specific characteristics could increase the PMP's ability to communicate positive messages about saiga conservation.

Farmhand's lower-income and looser networks mean they are more likely to engage in illegal saiga poaching (Bott, 1957; Degenne & Forse, 1999; Kühl et al., 2009). However their high betweenness means they can control information flow between alters in their social networks, which are more likely to be other poor ill-connected steppe inhabitants.

Increasing the numbers of farmhands employed as monitors will increase the likelihood of monitors being connected to poachers and improve the position of monitors to provide positive messages about saiga conservation. However their low influence means they have a low ability to change opinions outside of their immediate network.

Farm owners' links to high status individuals places them in more influential networks and are more able to communicate to a larger audience and change pervading social norms. However high network densities and low betweenness scores means their ability to control information flow and change opinions within their own network is weak. As attitudes to saiga and saiga conservation are generally high amongst steppe inhabitants (Howe et al., 2011; Kühl et al., 2009), using farmhands to try and reach those engaged in poaching is likely to be more effective than employing farm owners to re-enforce existing cultural norms.

6.1.4 Changes in the Saiga Population Since 2008

Herd sizes and frequencies of saiga sightings both provided useful proxies for abundance, detecting changes in saiga numbers between different years of the PMP. There was a high degree of variation in herd sizes with numbers rising and falling between years, however downward trends in both herd sizes and frequencies of sightings and particularly low numbers of saiga's recorded in 2012 indicate that pressures on the saiga's population have increased during the PMP. Presence-absence data from monitors indicate little change in saiga range during the project. However the spatial distribution of monitors, congregated in the north-west of the saiga's range, means the PMP's power to detect changes in the southern and eastern areas of the saiga's range is very weak.

6.1.5 Recommendations for Future Participatory Monitoring Projects in Kalmykia.

The impact of removing the five Stepnoi-RPMP monitors on herd sizes recorded between the RPMP and other projects shows the importance of considering the impacts of spatial variation in the survey design (Yoccoz et al., 2001). Currently monitors are both clustered and focused around the north and east of the saiga's range, with some monitors in the far southern reaches, and no monitors in the areas to the immediate south and east of the reserves (though spreading monitors east of SR could be

problematic as it would involve working in areas outside of Kalmykia). For a migratory species like saiga with seasonally important breeding grounds, an even distribution of monitors throughout the species range is important when assessing changes in both distribution and abundance. A more comprehensive coverage would also allow more accurate assessments of the population's seasonal distributions.

Improving how the monitoring programme controls for survey effort would allow for more accurate abundance indices to be used. At a minimum, monitors should be maintained from project to project if possible, while a protocol requiring the recording of a simple indicator of survey effort (e.g. days spent on the steppe each month) would allow comparisons of numbers of sightings between monitors to be made.

As the PMP is not able to assess any changes in saiga population inside the reserves, if the saiga's abundance outside of reserves falls the spatial distribution of monitors will lead to underestimates of the population size (Yoccoz et al., 2001). In this case it will be important to work with rangers from the reserves to supplement sightings by monitors.

The PMP currently does not take into account monitors' characteristics during their selection. However preferentially selecting monitors from poorer sections of society, such as farmhands, is likely to increase the programme's chances of reaching those engaged in saiga poaching and of influencing their behaviour, (Howe et al., 2011) Educational activities were ranked highly by respondents as solutions to saiga poaching and as an activity that people would be willing to engage with, thus providing monitors with basic educational material may increase the spread of positive attitudes and behaviour amongst their networks.

6.2 Lessons Learnt for Saiga Conservation in Central Asia

As well as recommendations for future participatory monitoring in Kalmykia, the results from this project are pertinent for saiga conservation throughout central Asia. Table 6.1 highlights how this programme contributes towards three of the five areas of saiga conservation highlighted by the CMS (2010) as needing attention.

Table 6.1 How the PMP and this study address saiga conservation needs.

Area needing attention	Contribution of this study
Monitoring of trends in abundance is subject to unquantifiable bias and error	While subject to their own biases and errors, participatory monitoring is another tool that conservation managers can use to relatively cheaply gather data on changes in saiga numbers and distributions across large areas where other methods are failing.
The human dimension remains relatively neglected	While the impact of this PMP has had little impact on monitors' attitudes, careful consideration of who to use as monitors will increase projects' chances of influencing people's opinions.
Evaluation of the successes of conservation interventions and sharing of best practice is crucial	This study has evaluated the success of the PMP and will allow lessons learnt from this project to be accessed by others working in saiga conservation.

6.3 Lessons Learnt About Participatory Monitoring's Contribution to Conservation Management

Yoccoz et al. (2001) criticise many monitoring projects for a lack of specific aims and objectives. Participatory monitoring projects can be particularly open to this criticism as they are often designed and run by individuals or organisations with access to lower scientific knowledge or capacity. Noss (1999) proposes the better integration of monitoring, management and research in the development of objectives and hypotheses for monitoring programmes. While this study focused on the assessment of data produced and not on re-examining the projects objectives it shows how the collaboration of researchers and participatory monitoring programmes can be used to critically examine, and make recommendations for the improvement of, monitoring programmes.

This project highlights some of the strengths and weaknesses of using participatory monitoring to help inform conservation management decisions. The PMP highlights how cost effectiveness participatory monitoring can be, employing 43 monitors over a 10 month period spread over a large and remote area at a cost of $26,600, and while data collected by professional monitors may be of higher quality the higher costs would be unaffordable. There are definite restrictions in the type and quality of data collected (Danielsen et al., 2005), even fairly basic protocols were not followed by monitors in the

PMP (recording absences, weekly "control" survey). As a result it is not suitable to use the complex protocols, such as distance sampling, required for absolute abundance estimates. However fairly basic changes to the programmes design and protocols: the introduction of simple measures of survey effort; and a more representative distribution of monitors across the saiga's range; could increase the programme's power to measure relative abundances and track changing spatial and temporal trends.

6.4 Study Strengths and Limitations

This study has shown that despite its limitations, data collected by participatory monitors in Kalmykia can be used to inform saiga conservation management in the region. Assessing the impact of the PMP on people's attitudes has also allowed recommendations to be made for the selection of monitors for future projects to maximize its potential to reach those engaged in saiga poaching. There are however a number of limitations to this study listed in Table 6.2.

Table 6.2 Limitations, and their impact, of this study

Limitations	Impact in study
Respondents withholding information	Respondents may have withheld information about poaching in their area or by their friends, especially monitors if they feel that their job is at risk or that they may be prosecuted
Different definitions of social relations.	While different social relations were defined, respondents are likely to define acquaintances, friends and close friends differently when defining social networks.
Small sample size of monitors.	Interviews were only conducted with 27 monitors, reducing the power of statistical tests investigating monitors' attitudes.
Spatial sampling	Non-monitors were visited while moving between monitors' farms, and so similar spatial biases as those in the monitors distribution were introduced, with few interviews in the east of the saiga's range.
Time between data collection and analysis.	The long time between data collected on the BPMP and this analysis meant some data from that project has been lost, such as the GPS locations for monitor's farmsteads.
Assumptions used to control for survey effort.	Assuming that monitors' survey effort from year to year is constant may have introduced biases as there are many factors that could change a how much time a monitor spends on the steppe from year to year

6.5 CONCLUDING REMARKS

The data collected by the PMP suggests saiga in Kalmykia are still facing severe pressures with numbers of sightings and average herd sizes dropping through the project. This is important information for conservation management in the area, especially in the light of the uncertainty surrounding saiga numbers from other sources. Despite no measureable impact on monitors' attitudes towards saiga, consideration of social networks of PMs may increase the PMP's ability engage with those involved in saiga poaching.

This study also highlights the potential for conservation managers and researchers to work together to better understand how a project is monitoring a system state and improve the projects effectiveness.

> "A good monitoring programme will collect data that provide sufficient evidence to reject the null hypothesis if it is false… (a) typical null hypothesis may be 'the system has not changed beyond the predetermined limits of acceptable change'" (Legg & Nagy, 2006).

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8 APPENDICES

8.1 APPENDIX A – ENGLISH VERSION OF QUESTIONNAIRE

Participatory Monitoring Evaluation Questionnaire

Name Age
Profession
Date
Interview Number
GPS co-ordinates N_____ E_____

Section 1: Attitudes

In this section we will ask questions about your attitude and knowledge of saiga and their conservation.

1.1. What are the first 3 words that come into your head when you think about saiga?

1.	2.	3.

1.2. When was the last time you saw a saiga?
____ MONTH ____YEAR NEVER

1.3. Do you think there has been a change in the number of saigas within these areas in the last 12 months? *Please tick 1 column for each area.*

AREA	INCREASE	DECREASE	NO CHANGE	DON'T KNOW
Within 5km of your farm/house				
In your raion				
In Kalmykia/Astrakhan				

1.4. If you have noticed an INCREASE or DECREASE in Kalmykia/Astrakhan what has been the main reason behind this change? *Please rank the top 3 from the following list (1-3).*

INCREASE		DECREASE	
They have moved here		They have moved away	
Reduced hunting		Increased hunting	
Less predators		More predators	
Increased habitat		Reduced habitat	
Changing climate		Changing climate	
Other (Specify)		Other (Specify)	

1.5. Do you think there has been a change in the number of saigas within these areas since the breakup of the USSR in 1991? *Please tick one column for each area.*

AREA	INCREASE	DECREASE	NO CHANGE	DON'T KNOW
Within 5km of your farm/house				

In your raion				
In Kalmykia/Astrakhan				

1.6. If you have noticed an INCREASE or DECREASE in Kalmykia/Astrakhan what has been the main reason behind this change? *Please rank the top 3 from the following list (1-3)*

INCREASE		DECREASE	
They have moved here		They have moved away	
Reduced hunting		Increased hunting	
Less predators		More predators	
Increased habitat		Reduced habitat	
Changing climate		Changing climate	
Other (Specify)		Other (Specify)	

1.7. If you think hunting is causing changes in saiga populations why do people hunt for saiga? *Please rank the following options (1-3).*

Meat for sale	
Meat for own consumption	
Horns for sale	

1.8. In recent times is hunting for saiga permitted by law in Russia?
YES – 0, NO – 1, SOMETIMES - 2 DO NOT KNOW – 3

1.9. If hunting is SOMETIMES allowed when is this?

1.10. In your opinion what would be the best way of protecting saiga and increasing their numbers? *Please list up to 3 solutions*.

.	
.	
.	

1.11. Which of these solutions do you think you have the ability to help implement? *Please tick all that apply*.

. 1 . 2 . 3

1.12. If no saigas remained in the world (e.g., they became extinct), would you be concerned by this?

YES, VERY MUCH – 0,
YES, TO A CERTAIN EXTENT – 1,
YES, A LITTLE - 2,

NO – 3

1.13. If saiga were to disappear from Kalmykia/Astrakhan whose fault would this be? *Please rank the 4 organisations or groups who would have the greatest fault (1-4), if another group are to blame who are they and why?*

The Kalmykian Government / Astrakhan Provincial Government	
The Federal government	
The police	
International Conservationists	
Everyone who lives in Kalmykia/Astrakhan (in the cities and on the steppe)	
Those who live on the steppe in Kalmykia/Astrakhan	
Recent migrants into Kalmykia/Astrakhan	
People coming from other parts of Russia to hunt	
Hunters for horn	
Hunters for meat	
Those trading saiga horn	
Those trading saiga meat	
Those eating saiga meat	
Nobody's fault, it is something outside of human control	
Other (SPECIFY)	

1.14. Who is responsible for protecting saiga? *Please rank the 4 organisations or groups who have the greatest responsibility (1-4), if another group are responsible who are they and why?*

The Kalmykian Government / Astrakhan Provincial Government	
The federal government	
The police	
International conservationists	
Everyone who lives in Kalmykia/Astrakhan (in the cities and on the steppe)	
Those who live on the steppe in Kalmykia/Astrakhan	
Nature Reserves	
Other (SPECIFY)	

1.15. Would you be ready to take action to help restore saiga numbers in Russia?

YES – 0 NO- 1

1.16. If yes what kinds of assistance can you offer? *Please tick all that apply*.

Patrolling and monitoring.	
Talking to your friends, family and neighbours about saigas.	
Raising saiga calves.	
Taking part in a campaign to raise awareness about saigas through T.V., newspapers and other media.	
Teaching children and young people about saigas.	
Feeding saigas in their natural habitat.	
Killing wolves.	
Providing financial assistance to conservation organisations.	

Other (SPECIFY)

Section 2: Motivation

In this section we will ask you questions about what has motivated your involvement in the saiga monitoring programme.

2.1. Before today have you heard about the Saiga Monitoring Project?
YES – 0 NO- 1

2.2. What is your relationship with the monitoring programme? *Please tick one.*

Current monitor	
Past monitor.	
Wish to be a monitor	
I have no relationship with the project	
Other (SPECIFY)	

2.3. If you are or have been a monitor when did you join the saiga monitoring programme?
2008 2009 2010 2011 2012

2.4. If you have been a monitor what were your main motivations when joining the programme? Or if you have not been a monitor but wish to be a monitor why do you want to be a monitor? *Please rank the 3 most important reasons (1-3). Please give some detail behind your answer in the "Other" box.*

To earn money from monitoring.	
Because I wanted to do something to help saiga.	
Because society is not doing enough to help saiga.	
To learn more about saiga.	
To gain new skills.	
To meet new people.	
Because it might provide future employment opportunities.	
To contribute to an international conservation programme	
Because helping saiga is a good escape from my own troubles	
Other (SPECIFY)	

2.5. If you are no longer a monitor why did you leave the programme? *Please rank the 3 most important reasons (1-3). Please give some detail behind your answer in the "Other" box.*

The pay was too low.	
Did not feel the programme was helping save saiga.	
Did not feel my contribution was helping save saiga.	

I did not enjoy being part of the programme.	
To busy with other work.	
I was not learning anything new about saiga	
I did not gain any new skills.	
I did not meet any new people.	
Lack of time due to new social or family commitments.	
The particular project I was involved in finished.	
I did not see any saigas.	
I did not see how being part of the programme would benefit me in the future.	
Other (SPECIFY)	

2.6. Can you list up to three positives that have come out of the monitoring programme? These can be positives for you, for your community or for saiga.

1.
2.
3.

2.7. Can you list up to three ways in which you think the monitoring programme could be made more effective?

1.
2.
3.

Section 3: SNA

In this section we will ask questions about your social networks, the people you know and how you interact with them.

3.1. Please write the names of the 15 people, excluding those who sleep and eat in this house, whose relationship with you, you value the most.

1.

2.

3.

4.

5.

6.

7.

8.

9.

10.

11.

12.

13.

14.

15.

3.1. Persons Number from **3.1.**	**3.2.** What is this person's age?	**3.3.** What is this person's sex? (M/F)	**3.4.** In the last 12 months how often have you communicated with this person? (DAILY-0, WEEKLY-1, MONTHLY-2, LESS FREQUENTLY-3)	**3.5.** Would you be willing to give a small loan (300-600Rub.) to this person? (YES/NO)	**3.6.** How do you know this person? (AQUITANCE - 0, FRIEND – 1, CLOSE FRIEND – 2, FAMILY – 3)*	**3.7.** What is this person's profession or position in society?	**3.8.** In the last 12 months have you talked about saiga with this person? (YES/NO)
1.							
2.							
3.							
4.							
5.							
6.							
7.							
8.							
9.							
10.							
11.							
12.							
13.							
14.							
15.							
* an acquaintance is someone whose name you know and would say hello to if you met them, a friend is someone you make an effort to spend time with, a close friend is someone who you would talk to about your troubles an ask for advice from.							

3 .9. On the diagram from **Q3.1** could you please draw lines between all the people that are friends.

3.10. Of the people listed how many of them are involved in using saigas in the last 12 months? Either hunting saiga, trading saiga horn or meat or eating saiga meat. *Please tick one option.*

0	
1-5	
6-10	
11-15	

Section 4: Monitor Distribution

5.1. While working on your farm what are the furthest distances you travel to the North, South, East and West on a weekly basis?

N___

W___ E___

S___

5.2. Do you know that saiga are not included in the Russian Red List?
Yes No

5.3. Do you think including saiga to the red list will help saiga conservation?
Yes.
It will not influence conservation of saigas.
It will negatively influence the saiga population.
It is hard to answer.

5.4. If you have any other comments on the problems saiga face, their conservation or the participatory monitoring programme please list them here:

8.2 APPENDIX B – JOB LIST

List of professions of respondents and those in respondents networks. Importance scores and location scores given during a focus group with staff at the Saiga Breeding Centre.

Job Title	Social influence (0-Low,1-Middle,2-High	Location (0-Steppe, 1-Both, 2-City)	Job Title	Social Influence (0-Low,1-Middle,2-High	Location (0-Steppe, 1-Both, 2-City)
Accountant	1	2	Lorry driver	0	1
Artist	0	2	Mechanic	0	1
Baker	0	1	Nurse	1	2
Bank clerk	1	2	Office worker	1	2
Builder	1	1	Operator	0	1
Businessman	1	2	Personal assistant	0	2
Café owner	1	2	Plumber	1	1
Car dealer	2	1	Policeman	1	1
Child	0	1	Postman	1	1
Cleaner	0	1	Ranger	1	0
Clothes trader	1	1	Retired	1	1
Company director	2	2	Salesman	1	1
Computer programmer	1	2	School Student	0	1
Doctor	2	1	School teacher	2	1
Driver	1	1	Scientist	2	1
Economist	1	1	Secretary	0	2
Electrician	1	1	Security guard	1	2
Engineer	1	1	Sheep Shearer	0	0
Farm Guard	0	0	Shop assistant	1	0
Farm owner	2	0	Shop manager	2	2
Farm owners wife	1	0	Shop owner	2	1
Farmhand	0	0	Soldier	0	2
Fire fighter	1	1	Sports coach	0	1
Fire stoker	0	1	Sports Teacher	0	2
Fisherman	0	0	Sportsman	1	2
Gasman	0	2	Tailor	1	1
Geologist (oil)	1	0	Taxi driver	0	2
Hairdresser	1	2	Teacher	2	1
Head of farm owners	2	0	Tractor driver	0	0

association					
Head of pension fund	2	2	Train conductor	0	2
Headmaster	2	1	Unemployed	0	1
Horse Herder	2	0	University Student	0	2
Housewife	1	1	Vet	1	1
Imam	2	2	Village administration	1	0
Judge	2	2	Village chair	2	0
Lawyer	2	2	Waitress	0	2
Librarian	1	1	Wine-taster	0	2
Livestock Dealer	1	0	Vet	1	1
			Zoologist	2	1

8.3 Appendix C – Further Results

Analysis and results carried out but not directly relevant to studies aims and objectives.

8.3.1 Reasons for Hunting

64 respondents categorised poachers during general discussions on saiga hunting. 21 respondents thought poachers were steppe inhabitants, 17 thought poachers were from the cities, and 16 thought both city and steppe inhabitants poached. According to 21 respondents poachers are predominantly poor and unemployed, however 8 respondents thought hunting was mainly carried out by the rich and 13 thought hunting was not constrained to the rich or the poor. However when people did talk about the rich and the poor hunting there was consensus that the rich hunt for pleasure while the poor hunt to make money.

8.4 Opinions on Changing Saiga Numbers Over the Last Year

34% of all respondents thought saiga numbers had dropped in Kalmykia in the last year while 56% did not know if there had been a change in numbers and 5% thought saiga numbers had risen. This cannot be used to test respondents' knowledge as there is little reliable evidence on the current status of the PC population. However it suggests saiga numbers are still falling, if not as drastically as before.

Amongst all respondents increased hunting was considered the highest ranked cause of falling saiga numbers both in the last year ($\bar{x}$=1.5±0.20) and since 1991 ($\bar{x}$=3.7±0.20). Increased predators, predominantly wolves, was the ranked second over the last year ($\bar{x}$=0.92±0.16) and third since 1991 ($\bar{x}$=1.7±0.19) while climate change was ranked third over the last year ($\bar{x}$=0.83±0.15) and second since 1991 ($\bar{x}$=1.8±0.18), with many respondents citing reduced rainfall and increasing desertification of the steppe as a major problem.