SCALE Meeting - Ithala Game Reserve
South Africa
July 22-24, 2003

Overview of workshop (Hobbs)

- State of the project table – the table should be filled out for each research objective (see other attachment)
- Review progress toward research objectives
- Review case studies of research sites
- Develop plan for synthesis book

Discussion of Research Objectives

RO2: Complexity Framework and Analysis (Boone)

- Much work has already been done on the complexity framework and analyses. The purpose of this work is to summarize and provide a framework for understanding the kind of relationships we are talking about in the project.
- Randy needs the boundaries of each study area. If you have not given that to him yet, make sure he gets them soon.
- Randy is doing heterogeneity indices across sites (he can do within site heterogeneity if requested, not planned now).
- Global information (data) is needed for across site comparisons.
- An overview of climatic variables, including seasonality, at each site is needed for the book. This could be summarized as the coefficient of variation in temperature and precipitation by month.
- Several data sources and data layers are used for these analyses, including elevation, topography, NDVI (can portray this spatially), SPOT, MODIS, radar images from satellite (not yet available), AVHRR, and weather data.
- Within-a-year and between-year variations in NDVI can be looked at through time (something like this can be done for all sites).
- Things to keep in mind – we need to generalize how the effects of fragmentation change are related to heterogeneity, and we also need to understand that how you define site boundaries can make a big difference.
- Status of animal movements – sites involved: Moykium (Randy needs info/data on this site), Serengeti NP, Mara, Kajiado, and Jackson (add Yellowstone, Mongolia)

Discussion/Questions

- For the climatic variables, should we be looking for ways to split sites as well as to lump them? i.e., different indices for central Asian sites and tropical African sites?
- Could all be reduced to forage availability?
- Perhaps we could do regional analyses – temperate vs. tropical?
- Comparability – do we need to do this across all sites? Keep option open for disaggregation and reaggregation.

RO3: Herbivore Selection at the Paddock Scale (Ash and Stokes)

- Objectives: how spatial complexity and paddock size influence diet
- Dalrymple Shire (main paddock study-near Townsville)
    - Low diet quality in the dry season

    - There is pressure to intensify (infrastructure development) - fragmentation results (impacts diet, weight in dry season)
    - 32 paddocks (on 13 properties) of different sizes and complexities
    - Progress to date: paddocks identified and initial results in, in the process of gathering satellite imagery, land tenure history is completed
- Victoria River Downs
    - Large parcel of land, broken down into 4 parcels with different managers
    - Large commercial producer – they want to intensify production – break down paddocks into smaller plots and add more water points
    - Trade-offs – increase carrying capacity, lose individual performance (particularly in drought)
    - Progress to date: Animal records kept (diet quality), GPS collared animals (movement data)

RO4: Herbivore Movements in Fragmented vs. Intact Ecosystems (Reid)

- Robin presented data collected at sites in Kenya (i.e., GPS of herd position taken every minute, distance of grazing track to fence taken every 10 minutes, etc.)
- Idea for new analysis: total area covered by animal divided by total area that is open
- Understanding what limits/enhances access is important to understand – i.e., fences, human behavior, agreements with neighbors
- It was found that larger herds move farther – need to understand why
- For range access: distance travelled is important, also number of moves/yr and social networking
- Outstanding question: At what spatial and time scales is access to heterogeneity important?

Herbivore Movement Data

- Mongolia (Mong 1 and 2) – one project cancelled, may be able to get some data from another project (interviews with herders with GPS – land use change)
- IMAR - use existing research
- Australia – Dalrymple Shire and Victoria River Downs (Ash and Stokes)
- Kazakstan (Balkash and Moykium) – some data for both sites
    - Balkash – transect (3 former state farms), GPS water points and encampments mapped through communication with locals
    - Moykium – desert site, along river – collect data like Balkash site
- Turkmenistan – hasn't gotten rid of state farms, no decollectization
- Central Asian sites - NDVI, distance to water points, socio-economic analyses
- STEP – old data, may be some new data (literature search)
- NCA, Loliondo – data already intact
- SWPSA – livestock don't really move much here, wildlife is not an issue here, may be some theses with information
- Jackson – data are available, but not movement data (location data) – not resolved enough and may not be useful
- Yellowstone – Coughenour has some access to data (elk and bison)

RO5 and 7: Typology of Actual Land Use Patterns, Factors Driving Contemporary Trends in Land Use Change (Behnke)

- May not be able to complete these two ROs without extra funding
- Land tenure essays still needed (IMAR-China, Mongolia, and Turkana)
- NWPSA case study needs revision

- Identify critical case studies to keep
    - Australia: Focus on the bottom of the curve and explore the differences in trajectories that can come off of the curve, also include different regions in Australia to strengthen case
    - North Dakota: include the historical picture (get census of agriculture data historically to show change in farm/ranch size)
- Ask Jim Reardon-Anderson for literature on IMAR land tenure
- David Sneath publications for Mongolian land tenure
- Other case studies will be left out – Tarangire, NCA, Serengeti, Yellowstone
- Should we exclude national parks? Bring in another author who has expertise in this to help?

RO8 and 9: Economic Surveys and Analysis and PHEWS Model Assessments (Thornton)
- There has been no Australian work explicitly in these areas.
- They do have some data to contribute, however. Philip and the Australian researchers will need to be in contact to discuss the best way to deliver data.

RO11: Spatial Complexity, Temporal Variability, and Population Patterns (Hobbs)
- Goal: Comparison of data of unfenced wild ungulates and fenced domestic ungulates of a similar size
- Looking at the interplay of spatial heterogeneity with density dependence and climate - how does this affect dynamics of ungulate populations?
- Population modelling approach
- Human behavior influences on ungulate populations will be included in RO8 and 9

RO12: SAVANNA-PHEWS Complexity Fragmentation Experiments (Boone)
- Working within areas where SAVANNA has been applied (NCA, Kajiado, South Africa, Serengeti, Yellowstone, RMNP)
- Some work done – more of the same will be done
- Challenges – Asia site and multiple species
- These experiments don't take socio-economic decisions into account
- If heterogeneity increases with scale, there is an optimum scale where private ownership may be beneficial – may influence policy (only fragment by a certain % to take advantage of opportunities without causing harm)

RO13: Complexity and Fragmentation in Theoretical Ecosystems (Boone)
- Purpose – allows flexibility (trade-offs) because looking at hypothetical situations
- A SAVANNA application is applied to a theoretical system (based on South Africa)
- Results – cattle numbers decrease with decreasing parcel size
- Effects to be addressed: productivity, climatic variability, species richness (plants and animals), land cover detail, topographic heterogeneity, key resource fragmentation, modelling resolution

Discussion of Book Chapters (see outlines in other attachment)

Chapter 1: Fragmentation of Arid and Semi-Arid Landscapes (Hobbs and Reid)
- Goals: Allude to other chapters, capture readers' attention, present central thesis of book, introduce key concept and terms
- Organization of chapter

    - Vignettes
    - Central thesis
    - Key concepts – fragmentation, spatial and temporal heterogeneity, selectivity
    - Conceptual model
    - Organization of book
- Fragmentation = exclusivity of use (no matter how/why it occurs)
    - reduction in mobility, loss of access, compression of the spatial extent of interactions between people, livestock, and landscapes (could be fences, roads, national boundaries, social patterns, agricultural development)
    - Types of fragmentation: Excision, conversion, partition, retraction
- Idea to juxtapose tragedy of commons theory with theory that unfragmented lands require minimal inputs (fragmented lands require larger inputs) – plan to introduce both concepts and don't try to prove one or the other (don't focus on tragedy of commons idea heavily)
- Central thesis – modern land tenure systems fragment arid and semi-arid lands
- Key concept – scale and scale of interaction (extent)
- Conceptual model of effects of fragmentation on grazing ecosystems (see Figure 1)

Robin's view of fragmentation
- Biophysical perspective – habitat loss/conversion, fragmentation
- Organismal or social perspective – fragmentation for whom? (social and political rules concerning access)
- Organismal vs. population differences can also be included
- Need to include pastoral welfare – welfare of total society, or certain groups?
- Human welfare data is at the household level – don't have data on trade-offs between regional/household welfare
- Heterogeneity – should we use this word instead of complexity?
    - Complexity includes heterogeneity
    - Tom will leave this open for Mike to discuss in his chapter (Mike will discuss complexity in his chapter – include systems)
- Critical scale of fragmentation – depends on vegetation types and scale of interaction
    - If we use this in chapter 1, we need to include this in other chapters also

Robin's part of Chapter 1
- Map that needs to be included – pastoral systems of the world
- Can we make divisions based on climate zones – hot/cold, tropical/temperate, temperature/water limited (interannual or intra-annual variations)? Can we also include socio-economic divisions?
- Should we add a summary about why we choose pastoral systems? These ideas could apply to other systems as well, though (herbivore systems, grazing systems). *We need to resolve this!*

Chapter 2: The Drivers of Fragmentation Processes in Semi-arid and Arid Landscapes (Behnke and Stafford Smith)
- Include human population as a driver?
- Include likelihood of landscape fragmentation map (Robin)?
- Roy reviewed which land tenure essays are still outstanding (IMAR-China, Mongolia, and Turkana), and which ones need revision (NWPSA, Northern Great Plains).
- Critical case studies were chosen to be included in this chapter.
- Should we exclude national parks? Bring in another author who has expertise in this to help?

Chapter 3: Comparing Landscape and Socioeconomic Heterogeneity Within and Between Ecosystems (Boone and BurnSilver)

- In this chapter the sites will be introduced - include maps, climate, topography, soils, etc. (this may need to go earlier in the book).
- Should the concept of socio-economic heterogeneity be included?; socio-economic heterogeneity = diversity of resources available for households
- If the concept is used, measures to identify what is accessible to people in different areas need to be explicitly stated (compare sites and resources available). This impacts the kinds of decisions people can make.
- Examples of measures: wealth categories, degree of access to social and economic infrastructure (socio-economic heterogeneity), access to credit, access to market, access to subsidies, schools, roads, water points
- It might be more useful to characterize resource availability by site (compared to other sites), instead of talking about heterogeneity.
- This idea comes from the fact that with increasing fragmentation comes increasing input needs – an idea out of the proposal.
- Landscape heterogeneity will be analyzed for a selection of sites only. There will be different methods for different sites and different questions.
- A discussion of the importance of these heterogeneity metrics needs to be included, both in the discussion section of this chapter and in the case studies.
- This chapter will strive to document relationships between measures of heterogeneity as a function of spatial scale, and to plot spatial heterogeneity against temporal heterogeneity.
- Both within and between site heterogeneity will be explored to some degree, although heterogeneity within site is not the main focus.
- In addition to within site and between site comparisons, we may also need regional and national comparisons.
- In this chapter not all sites will be included for all metrics. Explanatory ones will be included – less heterogeneous and more heterogeneous sites.
- The discussion section of this chapter will follow after the paper is written, including a synthetic results section from the two metric sections (landscape heterogeneity and differences in resource availability).

Concerns/Questions

- By including the human aspect in this chapter, does it make it too similar to Ch. 4 (responses of pastoralists to land fragmentation)?
- Are these measures likely to be used in later chapters in this book?
- A lot of these ideas are useful, but it may not be possible across all sites.
- How much of this information do we have now?
    - We have some information now and could possibly use substitutions.
    - It may be easy for some sites and not others.
    - Are we going about this the wrong way? Should we decide what info we have now, and what is easy to collect, and go from there?
- This may actually be more of a research agenda and not a chapter on what we already know.

Chapter 4: Responses of Pastoralists to Land Fragmentation (Galvin and Kerven)

- How do pastoralists capture the resources needed to survive?
- This chapter will be framed in political economy and cultural capital theories.
- Conceptual model (see Figure 2)

- Carol's hypothesis to be included in chapter:
    - Hypothesis: Fragmentation of rangeland resources promotes economic inequality in pastoral societies. This propensity is exacerbated by the fragmentation of heterogeneous resources and retarded when the resource base is relatively homogeneous.
    - See Appendix A for more information
- In unfragmented systems, land resources do not tend to be privately owned. Fragmented lands provide opportunities for people to control land. The best pieces are excised first. Two responses follow: socio-economic differentiation begins along with political and economic change.
- This chapter can include vulnerability and socio-economic differentiation at two scales (enterprise level and regional scale).
- It was pointed out by Chuluun that in Mongolia land fragmentation happened a bit differently. There some people got richer and others got poorer due to fragmentation. He stressed the importance of linking science to policy.
- Social breakdowns can also happen with land fragmentation.

Questions
- How do we use information from Chapter 3 in this chapter? How do we link the two chapters?
    - Chapter 3 can provide a list of resources available (indices), and Chapter 4 can focus on processes and linkages (when fragmentation happens, different responses result)
- Is socio-economic differentiation a good or bad thing?
    - It's a process. We need to deal with it if we are going to link it to vulnerability.
- How do you increase the standard of living of people without getting them off of the land?
    - This gets to regional integration. This is a policy question and won't be dealt with here.

Chapter 5: The importance of spatial scale, movement, and heterogeneity in ecosystems with large herbivores (Coughenour)
- Can some sections be deleted? There may be too many to cover adequately.
- Do we need the modelling sections (sections 6-8)? Models are used to explain processes.
- Push factors should be added to section IID – reasons herbivores wouldn't want to be in a particular place. Do we have to weight these factors? This may be where modelling comes in.
- Can we use the word cultural landscape to describe human wants and needs?
- Where does complexity come in in this chapter? Can Mike include a section at the end of the chapter to link spatial heterogeneity and complexity (system level interactions)?

Discussion of Case Studies

NCA and Loliondo (Galvin)
- Comparisons of Ngorongoro Conservation Area (NCA) and Loliondo, Tanzania
- NCA – Pastoralists live under conservation policy. People from the outside have been moving into NCA. They are now kicking newer people out. Water resources are important here. It is often a refuge for neighboring populations during drought. Less than 1% of the NCA is cultivated, because high-level officials in charge are conservationists and they don't want cultivation. There was a recent study that found that more money would be generated

from grain production in these areas than what is received through tourism (wildlife viewing).

- Loliondo – Pastoralists here don't have many restrictions. It is more isolated, not many roads and markets.
- In the 1990s, there was limited access of Maasai to tourists. This is now changing.
- Fragmentation occurs here because of policy.

North West Province - South Africa (Galvin)

- This area includes commercial farming and communal areas (5 districts).
- History of apartheid needs to be explored.
- Fragmentation here happened a long time ago.
- There is a current aggregation of commercial farms/ranches (similar to the Dakotas), however, people are leasing farms, not selling them. Subsidies are going away and they need to get bigger.
- Livestock are used as savings accounts.
- Residents are very much integrated into the national economy.
- Quality of forage is low in the winter – winter feed supplementation is necessary.
- Government policies are changing very quickly in South Africa (new water and tenure laws).

Amboseli/Kajiado (BurnSilver)

- The emphasis of this case study will be on the fragmentation process.
- Through subdivision access is constrained on private parcels. Consequences of subdivision need to be explored.
- There is a trend towards economic sedentarization, around a coalition of key resources, and a progression of low to high exclusivity of land use. The interplay between subdivision and sedentarization will be explored.
- Drivers – climate and natural resources, government policies
    - Corruption is a major factor in this area.
- Proximate causes – land tenure change
- Human/ecological responses
    - Decreasing spatial scale, decreasing access of livestock to ecological heterogeneity
    - Declining TLUs, increasing costs, declines in human well-being
    - Household responses – intensification, diversification
- Long-term human and ecological impacts and feedbacks
    - Human population
    - Human-wildlife conflicts
    - Wildlife populations – declines and changes in spatial distribution
    - Vegetation structure
- Conclusions will include feedbacks and a discussion of fragmentation in relation to processes/trends occurring elsewhere in Kenya.
- It will be important to keep in mind the policy implications and economic development strategies of the book.
- Question: Is it going to be possible to look at direct drivers of fragmentation or just general socio-economic trends and changes? – yes, Shauna thinks so
- Question: How far to go back in history?

Serengeti (Coughenour)

- People were driven out of Serengeti National Park. They settled in NCA and Loliondo. What does this mean for Maasai grazing?
- Disease keeps Maasai out of some areas. They are forced into higher grazing lands.
- Wildlife example of wildebeests (migration). They need large-scale movement. What would happen if this broke down?
- There is conflict with non-Maasai neighbors (farmers) and poaching is a problem.
- This case study will look at the whole system (pastoral and wildlife portions).

Yellowstone (Coughenour)

- This is a spatially extensive grazing system for wildlife (elk and bison). It is the northern elk winter range.
- Snow drives the contraction and dispersion system presently.
- There is a debate on what controlled populations of wildlife in the past. Many people think populations are too high now.
- Many people think elk are artificially confined to parks. This is an example of conflicting human land use (fragmentation of grazing systems).
- The population of bison has increased since the 1970s (density dependent range expansion). They wander outside of the park and often cause conflicts with ranchers.
- The consequences of fragmentation in this system will be demonstrated. On the human side is ranch/wildlife conflict and predator conflict.
- There is a trend towards smaller properties. A lot of money is going into the region for recreational properties. This may lead to less conflict, as wildlife is often seen as desirable on recreational properties.

Jackson, Wyoming (Hobbs)

- This case study will include the history and geography of the region, patterns of land tenure and land use change, wildlife conflicts, and important economic forces.
- This case study adds a new dimension to the J-curve. Properties are once again becoming smaller here as the land is subdivided for recreational properties.
- Two types of fragmentation are discussed – policy (fences and feeding) and weather (snow).
    - Discussion point: Is snow a true cause of fragmentation? As herds contract because of fencing, snow becomes a factor only because the herds can't move to traditional winter range.

Dalrymple Shire and Victoria River Downs, Australia (Stokes)

- This case study will look at regional fragmentation of properties and local fragmentation within properties.
- There has been pastoral expansion from the Sydney area into tropical savannas.
- Current drivers include a cost-price squeeze, aggregation, and intensification. Historical drivers of fragmentation and aggregation will also be looked at.
- Degradation is important in this region.
- There is aggregation occurring among richer folks.
- When fragmentation first occurred, how was the size determined?
    - Access to water important
    - Dependent on how many squatters there were
- Consequences for people – are they better off? – data does exist on this question

Kazakstan (Behnke, Kerven, Alimaev, Temirbekov)

- This paper will be about Kazakstan as a country, not just the sites.
- Objective: introduce Kazak rangelands (less well known than other sites)
- Examine land tenure as institutional framework of ideas – observable pattern of land holdings
- Other influences (besides land tenure) will also be examined in the study.
- The Kazaks have been pushed through all tenure types historically.
- Conclusions: parts of Kazakstan are being privatized, the land tenure system doesn't rigidly constrain mobility
- The livestock population in Kazakstan has crashed with major events in history (civil war, decollectization, etc).
- Mobility wasn't as important at low stocking densities, but it is important with higher stocking densities.

Ilya Alimaev (Kazakstan contribution)

- Water is a key factor influencing fragmentation in Kazakstan.
- The value of livestock husbandry in the agricultural sector is decreasing.
- In this study, pasture fodder was looked at in 3 sites (dry steppe, semi-desert, and desert). These regions are heterogeneous (mountains in south, desert in north - temperature and precipitation gradients).
- Only about ¼ of total rangelands had accessible water.
- It was found that there is degradation around water sources. 75% of the livestock graze within 5 km of a water source, 18% graze within 7 km of a water source, and only 6% graze in distant pastures.
- There is also a decrease in humus content the closer soil is to water points. In this area, fragmentation decreases soil fertility.
- Much of the grasslands are now in a state of regeneration. Some are not grazed because there is no water.
- Undoubtedly, these areas will be used again once socio-economic conditions improve.

Mongolia (Chuluun)

- This case study will explore why there is a trend towards fragmentation in Mongolia, traditional land-use and how land-use changes occurred in the past, and recent land-use changes.
- Jim Reardon-Anderson may be able to help document the migrations of people in Mongolia.
- Historic land use change is documented from the 1200s.
- Traditional land use includes two movements between winter and summer camps. Although the camp sites are selected, trajectories can change.
- Traditional pastoral networks were nested hierarchies. In the summer, groups collected along the rivers in the highlands. In spring and fall they went down to the lowlands, and they dispersed in the winter.
- Population numbers increased until 1990. The switch to democracy caused a drop in population growth.
- The number of herders has doubled since 1990.
- There were declining numbers of households in the poorest group in the 1990s, and an increase in the small wealthy group.
- Since 1990, wells, livestock, and shelters have been privatized. The policies that caused this should be examined.

- The Mongolian government is now supporting new cooperatives (based on traditional pastoral networks).

Discussion of Book Time Frame

- Kathy will send all outlines into Kluwer Publishing Company.
- It was agreed that **book chapters will be completed by the end of the year**!

****Do not forget to acknowledge NSF (Grant No. DEB-0119618) on publications/ posters or for travel supported entirely, or in part, by the SCALE project.****

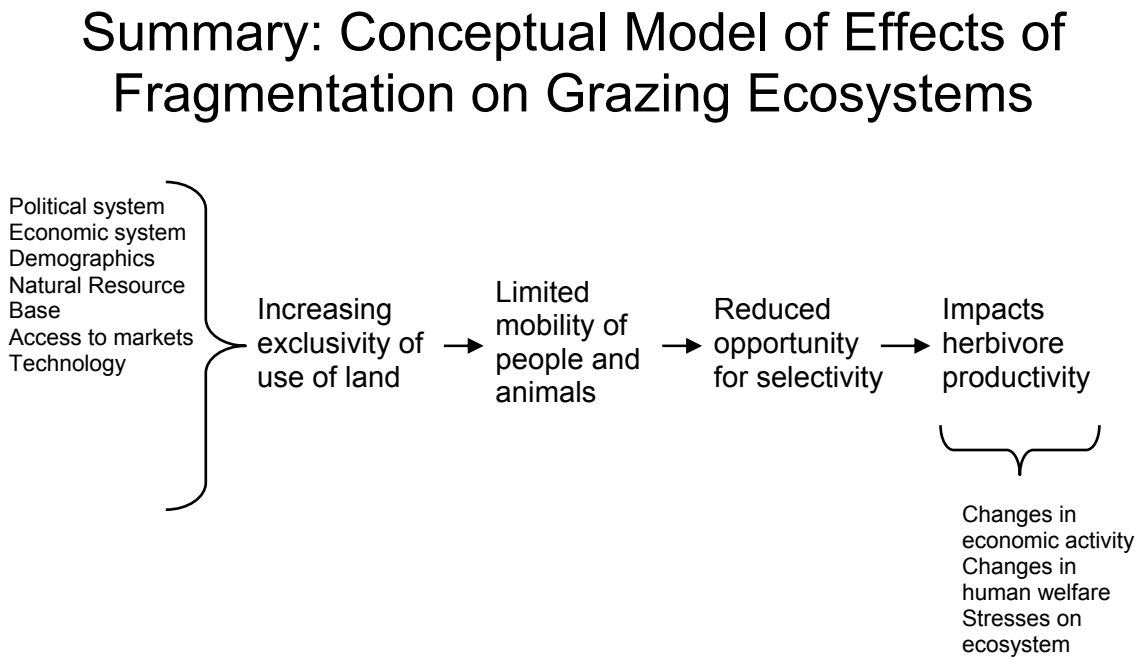

Figure 1

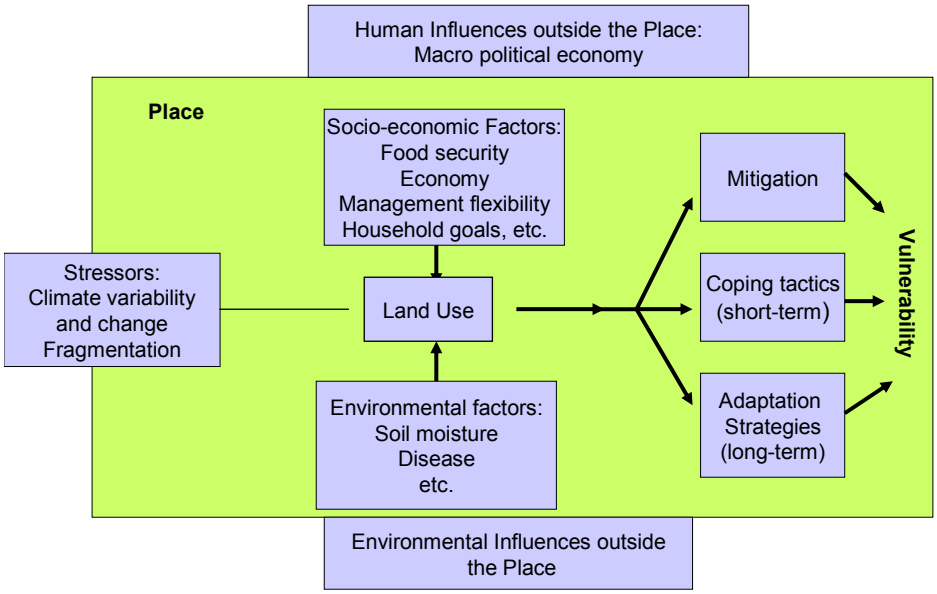
Human Influences outside the Place:
Macro political economy
Place
Socio-economic Factors:
Food security
Economy
Management flexibility
Household goals, etc.
Stressors:
Climate variability
and change
Fragmentation
Land Use
Environmental factors:
Soil moisture
Disease
etc.
Mitigation
Coping tactics
(short-term)
Adaptation
Strategies
(long-term)
Vulnerability
Environmental Influences outside
the Place

Figure 2

Appendix A

First ideas for NSF proposals relating to SCALE and Central Asia/Mongolia/Inner Mongolia (From Carol Kerven, 22 Aug 2003)

1. Hypothesis: *Fragmentation of rangeland resources promotes economic inequality in pastoral societies. This propensity is exacerbated by the fragmentation of heterogeneous resources and retarded when the resource base is relatively homogeneous.*

2. Expansion of hypothesis:
In pastoral societies where rangeland is unfragmented, land areas are not individually owned or controlled, regardless of whether these societies are egalitarian or hierarchical. Land stewardship is exerted by central authorities in tribes, clans, bands etc. In socialist nations, all pastoral land became the property of the state. In principal, all members of the pastoral group clan have equal access to land of differing values within areas defined as belonging to the tribe, clan or state farm (Figure 1 A). In practice, access in time and space is negotiated between groups and arbitrated by social leaders.

Fragmentation introduces the possibility for individuals to excise parcels of rangeland and remove these from group access, either de facto or de jure. With fragmentation, the tendency is for individuals to seek control over the scarcest resources of the greatest value. These are the key resources. The process has two complementary effects that promote inequality: certain individuals from the original group gain exclusive control over more valuable land while the remainder of the group loses access to this land (Figure 1 B). Furthermore, individuals owning the excised portions often continue to move their livestock onto the residual communal land (Figure 1 C), thus increasing the pressure on these areas. As more valuable land is concentrated under the control/ownership of individuals, wealth disparities within the pre-existing land-use group become rigidified in fixed space.

Owners of privatised rangelands begin to break some of the reciprocal social bonds that formerly spread risk within the whole group by redistributing resources of livestock and labour, and ensured group access to key resources. With fragmentation, risk as well as wealth accumulation becomes attached to individual landed properties. As wealthier land owners shed their socio-economic obligations, the remainder of the group on communal rangelands lose access to the wider web of landed and socio-economic resources. Social stratification emerges, as inequality becomes institutionalised.

3. Research tasks:
Examine socio-economic inequality at all three SCALE sites in Kazakstan, Mongolia and Inner Mongolia, in relation to recent fragmentation and hetereogeneity. These three countries form a natural comparison as fragmentation and re-amalgamation has proceeded differently in the past several decades in each country, due to the waxing and waning of socialist policies towards pastoralist land use.

In Mongolia, sufficient secondary data probably exists to not require a full PHEWS survey. Background fieldwork will be required prior to designing a modified PHEWS survey, to determine the major lines of socio-economic stratification and patterns of land fragmentation. In Kazakstan and Inner Mongolia, modified PHEWS surveys will be carried out. The form and impact of land fragmentation will be examined in all three Asian SCALE case study sites.

4. Personnel:

Kathy Galvin, PI
Roy Behnke: characterise extent of landscape fragmentation at all 3 sites
Carol Kerven }
Aidos Smailov} Kazakstan PHEWS
Kathy's graduate student (PHEWS, Inner Mongolia)
Philip Thornton: PHEWS design and analysis

Figure 1: Effects of fragmentation on land access