Long-term ecological research (LTER) on desertification in Mongolia and the United States: Collaborative research support for rangeland monitoring

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The following framework for collaborative research was developed during a recent visit with Mongolian scientists, administrators, politicians from June 29-July 8 2007, supported in part by the LTER Network Office. The fundamental issue generating demand for long-term ecological science involves 1) the perception that rangeland degradation is affecting much of the land surface of Mongolia and much of the human population, 2) that recent demographic/socio-economic changes are interacting with climatic changes to drive increased degradation rates, 3) that some degradation may become permanent if not immediately addressed, and 4) that monitoring to document these changes alongside a) new federal laws and b) local outreach and training to alter herder perception are necessary to begin to mitigate degradation. We detected a broad consensus that a major impediment to solutions is a lack of coordination between the Mongolian Academy of Science (and component Institutes), government ministries, and international non-governmental organizations (NGOs) and academic groups. With regard to scientific support, lack of coordination results in methodologies that vary and are questioned, existing data that remain unsynthesized and un-used, and critical studies that need expansion or are not initiated. Below is an outline of suggested ideas/assertions to coordinate scientific support for desertification research applications within Mongolia under the broad umbrella of LTER concepts and international collaboration. We hope that this outline will serve as a basis for proposals to fund research. Next steps will be coordinated by our Mongolian partners.

Key background issues for Mongolia:

- Rangeland degradation significant but poorly quantified.
- Rangeland degradation mechanisms are not well understood (e.g., are Mongolian rangelands non-equilibrium persistent or threshold/irreversible ecosystems?)
- Rates and spatial variability of degradation unknown
- There is little research on sustainable animal carrying capacities
- Databasing and analysis of monitoring data not well developed
- Application of monitoring results at policy-making and local levels is weak
- **Increasing awareness that rangeland assessment and monitoring strategies should be coordinated among the Academy, Ministries, and NGOs**
- **Successful outcomes of national monitoring efforts require synergies basic ecosystem science (e.g., the Academy, international scientists), communication of research to government officials, and herder-based science applications (Land Agency, Research Institute for Animal Husbandry (RIAH), Swiss Agency for Development and Cooperation Green Gold Program, Mercy Corps Gobi Forage Program)**

Key international LTER issues

- Science-based design and interpretation of assessment and monitoring programs is a global problem
- Without science-based ecosystem frameworks, such as land classification and ecosystem models (state-and-transition models), even quantitative data are difficult to interpret and have limited application (e.g., accurate evaluation of what is "at risk" and "degraded")
- **International long-term ecological research is oriented towards discovering patterns and processes of ecosystem change that provide a basis for defensible interpretations of assessment and monitoring data**

Framework concepts for collaborative desertification research

- Key problem: what are the local and regional causes and consequences of reduced herbaceous ground cover associated with changing land use and climate change (Fig. 1)?

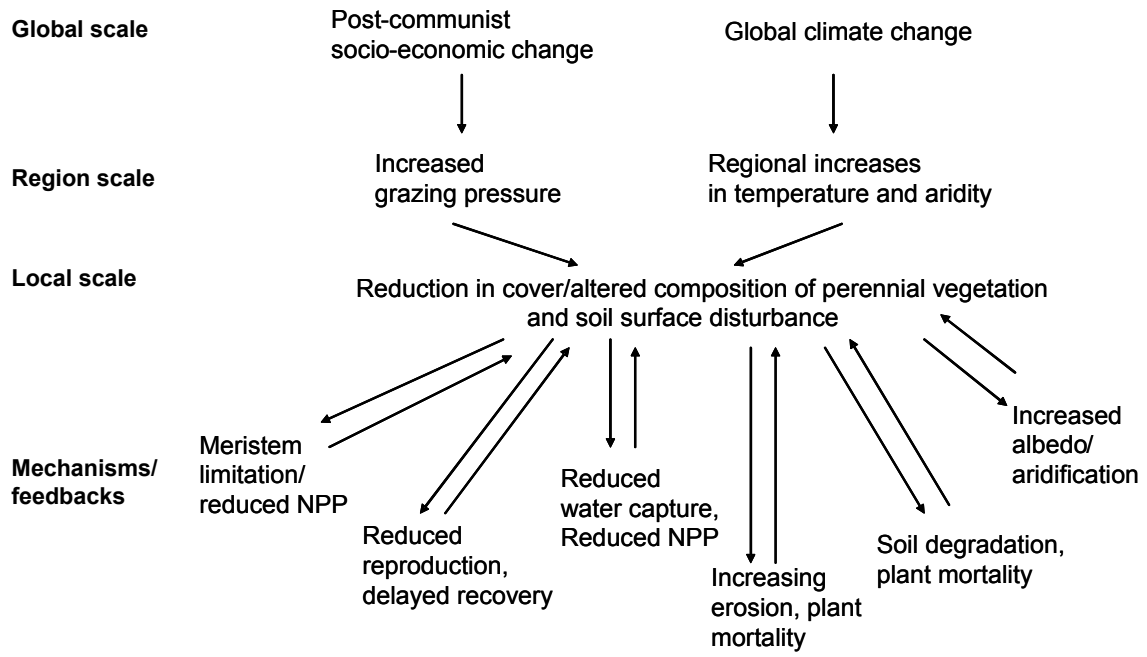

Figure 1. Conceptual model of drivers (downward arrows) and feedbacks (upward arrows) at different scales that were discussed based on experiences in the desert steppe and steppe ecosystems of central/southern Mongolia.

- Responses take decades to unfold and are difficult to detect in the near term
- **Five coordinated scientific efforts can help**

1) *Data synthesis and production of conceptual models*
    - Purpose: Synthesize what is known about patterns and mechanisms of rangeland degradation in Mongolia to provide an authoritative "best available science"-

based assessment that reflects consensus within Mongolia and is recognized y the international science and policy communities.

- Example projects (that LTER network could participate in):
  - An SDC Green Gold-sponsored "rapid assessment" workshop to bring together researchers, evaluate existing data, create conceptual models and preliminary assessments, and publish results. Longer-term outcome of the workshop would be the development of a database to store and manipulate existing data.

2) *National assessment and monitoring of rangeland ecosystems*
   - Purpose: Provide data and analyses that can be used to improve the design and interpretation of assessment and monitoring of current rangeland conditions, processes, and national trends in rangeland dynamics for national evaluations and herder decision-making.
   - Example projects (generating data that the LTER network could help analyze):
     - National Rangeland Condition Assessment (Land Agency). Recommended protocol is under development by RIAH, Green Gold, Geoecology, and Land Agency, and UNDP Sustainable Grassland Project
     - Gobi Forage Project monitoring (Mercy Corps). 300 monitoring points and NDVI maps in Tov, Dungobi, Omnogobi aimags, will be expanded and coordinated with rangeland health assessment.
     - Integrated land stratification and conceptual model development (Geography, Geoecology, RIAH, Botany; future proposal)
     - Remote-sensed monitoring (Meteorology, Netherlands)

3) *Long-term experiments on mechanisms of grazing impacts*
   - Purpose: Test hypotheses about the causes underlying current rangeland patterns and trends revealed from assessment and monitoring data (Fig. 2).
   - Example projects:
     - Exclosure Monitoring Network. Protocol under development, compare vegetation and soil erosion processes in reference and degraded areas. International groups (Japan) also have exclosure studies.

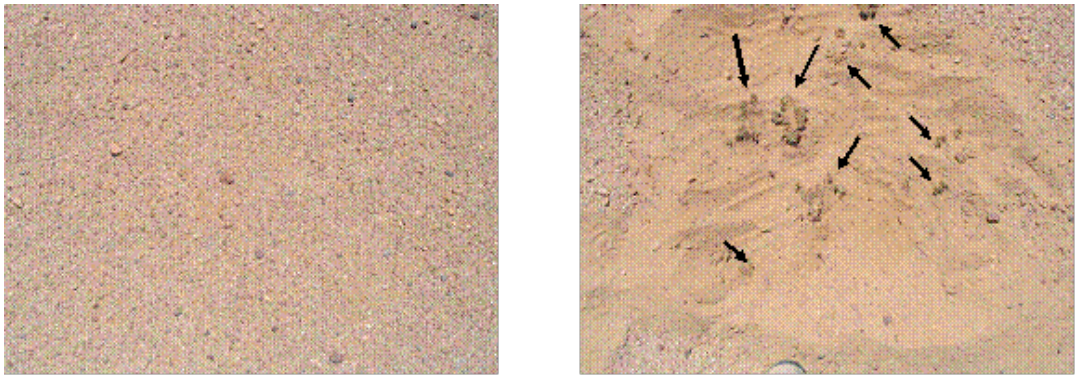

Figure 2. An example of the apparent resilience of Gobi Desert ecosystems. Apparent extensive bare ground (left) reveals several senescent but living plant bases below the surface soil (right). The degree to which perennial vegetation is recoverable with improved management is not understood.

4) *Landscape-scale experiments on alternative social-ecological systems*
   - Purpose: Test effects of alternative management scenarios on provision of multiple ecosystem services (ecosystem function/vegetation and soils, economics, cultural values)
   - Example projects:
     - Mongolia-China cross-border experiment (SDC Green Gold). Contrasting pasture-based and nomadic systems on southern border of Mongolia in steppe and desert steppe ecoregions.

5) *International connections for Mongolian students and pastoralists*
   - Purpose: Enhance scientific capacity and science application to slow desertification
   - Example projects:
     - Student training at Jornada Basin LTER/USDA/New Mexico State University
     - Herder training on international, science-derived concepts and data (Green Gold, RIAH, Land Agency, Mercy Corps Gobi Forage)

Proposed Jornada Experimental Range/Jornada LTER support

The USDA Agricultural Research Service and Jornada Experimental Range/Jornada Basin LTER are conducting a similar suite of studies and are national leaders in the study and prevention of land degradation. Our organization is prepared to support and collaborate with the Mongolian LTER and the Research Institute of Animal Husbandry, with which we have a formal agreement.

Specific activities could include:
- English (and Mongolian if desired) website development and hosting to describe collaborative activities
- Participation in synthesis workshops, data analysis, and writing activities
- Assistance with development of proposals to fund research
- Assistance with development of land classification systems and conceptual models to support National Rangeland Condition Assessment

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Appendix. Route taken by team in survey of rangeland conditions and study areas. Transportation was supported by SDC Green Gold and Mercy Corps Gobi Forage Programs.