Mongolian rangelands have a great potential for natural recovery

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Abstract

Mongolians are aware that rangeland degradation is accelerating due to the combination of unsustainable use and drought events, but the natural recovery of degraded rangeland and timelines for recovery are less well studied. In this paper, we describe the use of "recovery class" concepts in rangeland classification that are being used to evaluate rangeland condition and management impacts across Mongolia. Recovery classes are analogous to degradation classes already used in Mongolia, but are based on ecological site descriptions (ESDs) and provide information about expected recovery rates based on quantitative measurements. While the degradation levels communicate the severity of plant community departure from reference conditions, the recovery classes communicate the management needs and timelines for recovery. According to the national report of Mongolian rangeland health, as of 2015, 65 percent of Mongolian rangelands was altered to some degree. Plant community composition, however, indicates that in more than half of sampled areas, changes to grazing management could result in recovery, or progress toward recovery, within ten years. Fifteen percent of nationwide rangeland health monitoring plots had evidence of recovery within 2 years between 2014-2016 and shifted to a more desirable state of their respective State and Transition models.

Introduction

As one of the few remaining countries with a robust, nomadic pastoral culture supported by extensive natural rangelands, Mongolia is well positioned to offer sustainable, rangeland-based goods and services to its citizens and global consumers who place a premium on sustainable products. In order to create a national assessment of rangeland health and certification of responsible management that incorporates variations in ecological potential across Mongolia, standardized "recovery classes" were developed (Densambuu *et al.,* 2015). The recovery class hypothesizes timelines to recovery of the reference (healthy) state based on vegetation cover and composition data interpreted according to expert knowledge and existing studies when available, captured in state and transition models (Bestelmeyer *et al.,* 2017). For example, the presence of remnant perennial grasses suggests that recovery of a reference state can occur within several years. The recovery classes allow standardized interpretations across multiple state and transition models to allow for reporting and visualization of rangeland restoration needs.

One of the key products produced by the nationwide rangeland health monitoring system is the recovery class map that is used for decision makers and practitioners as an efficient tool to plan appropriate management and interventions.

Materials and methods

Recovery class concept development efforts started with training for core research team on methods to develop ESDs in the US in early 2009, followed by data collection co-occurring with trainings in Mongolia.

Following recommendations adopted by US agencies, inventory of vegetation and soils was conducted at over 600 sites across Mongolia, coupled to workshops aimed at eliciting local knowledge about reference conditions, the presumed causes of vegetation change, and to identify informative sites for inventory. The recovery class concept has 5 levels from a highly productive reference state (I) to an irreversibly degraded level with severely reduced ecosystem service provision (V). Classes in between (II-IV) hypothesize timelines to recovery of the reference state based on vegetation cover and composition data interpreted via state and transition models developed for 23 land classes across Mongolia (Densambuu *et al.,* 2018b). Depending on the cover of key species, soil surface characteristics, and grazing management natural recovery rates vary from 1-3 (Class I), 3-5 (Class II), 5-10 (Class III), and > 10 years (Class IV) or it is unlikely that the reference state can be recovered over any timeframe (Class V; often regarded as true desertification).

Results

According to the latest national report on Mongolian rangeland health (Densambuu *et al.,* 2018a) and the recovery class map for Mongolian rangelands, 43 % of 1516 monitoring sites were in Class I (healthy reference state); 29 % in Class II; 16 % in Class III; and 12 % in Class IV. Thus, a majority of sites were altered from a reference state, but all have potential for natural recovery. Most monitoring sites in High mountainous and Desert ecological zones are at reference condition or could recover rapidly (Class I). A high percentage of sites requiring more than 3 years of management for recovery (Class II-IV) were observed in forest steppe, steppe and desert steppe zones.

Comparing the recovery classes of 2014 and 2016, 51% of the monitoring sites have not changed over the past 2 years with respect to the expected timeline to recovery, while 15% of sites are on a path to more rapid recovery and 34% will now take even longer to recover.

Sandy loam soils in steppe and desert steppe zones respond quickly to favorable conditions because i) sandy loam soils in Mongolia generally have a high amount of organic matter in the surface horizon that supports recovery in years with average to above average precipitation amounts; ii) most sites have a relatively rich seedbank to promote plant recruitment once the grazing pressure is moderated; iii) herders in this area move large distances, especially in dry years, that allows for some rest from grazing. The potential recovery rate slows in areas that have undergone transitions from perennial grasses with strong tap roots to rhizomatous species such as sedges (Carex) and subshrubs (Artemisia). A high cover of these unpalatable species produces low quality litter that slows down nutrient cycling and recovery of productivity (Ritchie *et al.,* 1998).

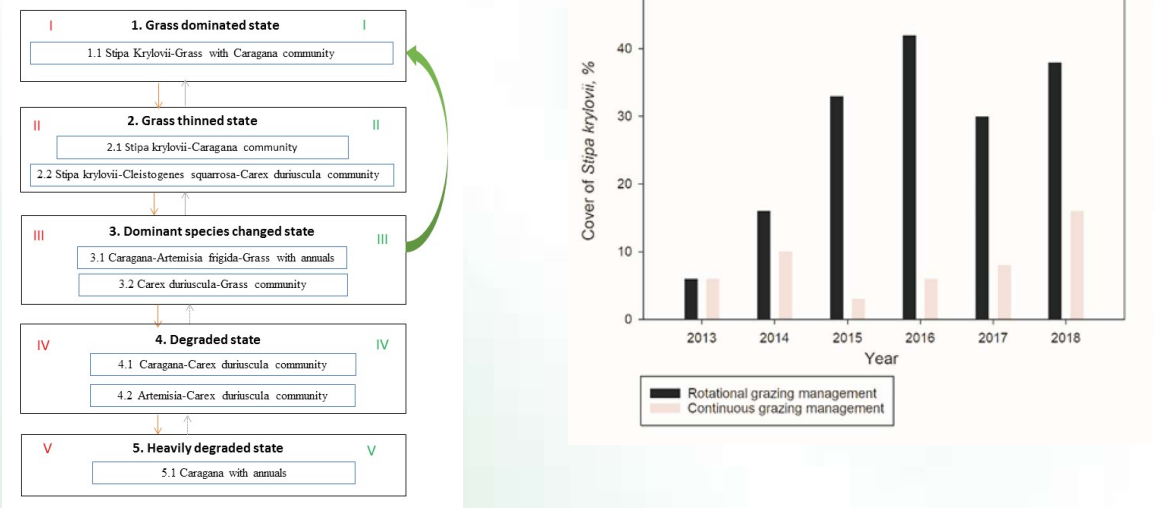

Figure 1: a) State and Transition model for Stipa krylovii-Grass with Caragana steppe rangeland; b) Perennial grass dynamics under contrasting management indicate the potential rate of recovery from State III to State 1.

Stipa krylovii-Grass with Caragana steppe rangeland (Figure 1a) is the one of the most common rangeland types on deep sandy alluvial plain in Mongolia that has a high potential for natural recovery (Chognii 2001). As a result of rotational grazing management the heavily degraded *Stipa krylovii-Grass with Caragana* steppe rangeland, which was dominated by *Carex* and *Artemisia spp*, has recovered and shifted from the alternative state 3 (Dominant species changed state) to the grass-dominated healthy state 1 in 3 years (2013-2016) (Fig 1b.). Cover of perennial grasses, mainly *Stipa spp*. has increased by 5.5 times in 3 years and stabilized.

Discussion and Conclusion

The recovery class concept is an important tool for interpreting the current state of rangeland health and for planning the appropriate management and restoration measures. Government agencies such as Agency for Land Management, Geodesy and Cartography and National Agency for Meteorology and Environmental Monitoring have adopted this concept for interpretation of vegetation monitoring data.

The timing required for natural recovery varies depending on the ecological site. Sites with sandy and sandy loam soil are more sensitive to continuous grazing but respond to grazing management changes very well, especially when combined with sufficient precipitation. The pathway to recovery also varies; in most cases communities shift to adjacent, better condition states following the proposed timelines but sometimes recovery to a reference state can be rapid. Recovery of *Tripteris sinuata* DC., for example, was significantly slower in plots with a history of heavy grazing that endured ongoing grazing by sheep, compared with plots with a history of moderate grazing and the equivalent treatment. This is probably because once the vegetation is in a state of low biomass, the grazing pressure needed to subsequently suppress vegetation re-growth is far lower than that needed to cause the collapse in the first place (Colleen *et al.,* 2010).

Restoring the full suite of palatable species over practical management timeframes will require more complex interventions such as reseeding or selective clearing (Colleen *et al.,* 2010).

Nonetheless, even when most grasses are lost and communities are dominated by rhizomatous species and forbs, there are ample opportunities for changes in management and policy that support the recovery of rangelands in Mongolia because soils are seldom severely or permanently degraded (at least in our monitoring record). It is important, however, to act decisively and promptly before recovery opportunities are lost.

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