



## Review

# The *Kobresia pygmaea* ecosystem of the Tibetan highlands – Origin, functioning and degradation of the world's largest pastoral alpine ecosystem

## *Kobresia* pastures of Tibet



Georg Miehe<sup>a</sup>, Per-Marten Schleuss<sup>b</sup>, Elke Seeber<sup>c</sup>, Wolfgang Babel<sup>d,e</sup>, Tobias Biermann<sup>f</sup>, Martin Braendle<sup>g</sup>, Fahu Chen<sup>h</sup>, Heinz Coners<sup>i</sup>, Thomas Foken<sup>e</sup>, Tobias Gerken<sup>j</sup>, Hans-F. Graf<sup>k</sup>, Georg Guggenberger<sup>l</sup>, Silke Hafner<sup>m</sup>, Maika Holzapfel<sup>n</sup>, Johannes Ingrisch<sup>o</sup>, Yakov Kuzyakov<sup>m,n,p,q</sup>, Zhongping Lai<sup>r</sup>, Lukas Lehnert<sup>a</sup>, Christoph Leuschner<sup>i</sup>, Xiaogang Li<sup>s</sup>, Jianquan Liu<sup>s</sup>, Shibin Liu<sup>m</sup>, Yaoming Ma<sup>t</sup>, Sabine Miehe<sup>a</sup>, Volker Mosbrugger<sup>u</sup>, Henry J. Noltie<sup>v</sup>, Joachim Schmidt<sup>w</sup>, Sandra Spielvogel<sup>x</sup>, Sebastian Unteregelsbacher<sup>y</sup>, Yun Wang<sup>n</sup>, Sandra Willinghöfer<sup>i</sup>, Xingliang Xu<sup>m,z</sup>, Yongping Yang<sup>aa</sup>, Shuren Zhang<sup>ab</sup>, Lars Opgenoorth<sup>g,\*</sup>, Karsten Wesche<sup>n,ac,ad</sup>

<sup>a</sup> Philipps-University of Marburg, Faculty of Geography, Marburg, Germany

<sup>b</sup> University of Bayreuth, Soil Biogeochemistry, Bayreuth, Germany

<sup>c</sup> University of Greifswald, Institute of Botany and Landscape Ecology, Greifswald, Germany

<sup>d</sup> University of Bayreuth, Micrometeorology Group, Bayreuth, Germany

<sup>e</sup> University of Bayreuth, Bayreuth Center of Ecology and Environmental Research, Bayreuth, Germany

<sup>f</sup> Lund University, Centre for Environmental and Climate Research, Lund, Sweden

<sup>g</sup> Philipps-University of Marburg, Department of Ecology, Marburg, Germany

<sup>h</sup> Lanzhou University, MOE Key Laboratory of West China's Environmental System, School of Earth and Environment Sciences, Lanzhou, China

<sup>i</sup> University of Göttingen, Department of Plant Ecology and Ecosystem Research, Göttingen, Germany

<sup>j</sup> Montana State University, Department of Land Resources and Environmental Sciences, Bozeman, MT, USA

<sup>k</sup> University of Cambridge, Department of Geography, Centre for Atmospheric Science, Cambridge, United Kingdom

<sup>l</sup> Leibniz Universität Hannover, Institute for Soil Science, Hannover, Germany

<sup>m</sup> University of Göttingen, Department of Soil Sciences of Temperate Ecosystems, Göttingen, Germany

<sup>n</sup> Senckenberg Museum Görlitz, Department of Botany, Görlitz, Germany

<sup>o</sup> University of Innsbruck, Institute of Ecology Research, Innsbruck, Austria

<sup>p</sup> University of Göttingen, Department of Agricultural Soil Science, Göttingen, Germany

<sup>q</sup> Institute of Environmental Sciences, Kazan Federal University, Kazan, Russia

<sup>r</sup> China University of Geosciences, State Key Lab of Biogeology and Environmental Geology, School of Earth Sciences, Wuhan, China

<sup>s</sup> Lanzhou University, State Key Laboratory of Grassland Agro-ecosystem, College of Life Science, Lanzhou, China

<sup>t</sup> Chinese Academy of Sciences, Institute of Tibetan Plateau Research, Key Laboratory of Tibetan Environment Changes and Land Surface Processes, Beijing, China

<sup>u</sup> Senckenberg Research Institute and Natural History Museum, Frankfurt am Main, Germany

<sup>v</sup> Royal Botanic Garden Edinburgh, Edinburgh, Scotland, United Kingdom

<sup>w</sup> University of Rostock, Institute of Biosciences, General and Systematic Zoology, Rostock, Germany

<sup>x</sup> University of Kiel, Dept. of Soil Science, Kiel, Germany

<sup>y</sup> Institute of Meteorology and Climate Research, Atmospheric Environmental Research (IMK-IFU), Karlsruhe Institute of Technology (KIT), Garmisch-Partenkirchen, Germany

<sup>z</sup> Key Laboratory of Ecosystem Network Observation and Modeling, Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, Beijing, China

<sup>aa</sup> Chinese Academy of Sciences, Institute of Tibetan Plateau Research, Laboratory of Alpine Ecology and Biodiversity, Beijing, China

<sup>ab</sup> Chinese Academy of Sciences, Laboratory of Systematic and Evolutionary Botany, Institute of Botany, Beijing, China

<sup>ac</sup> German Centre for Integrative Biodiversity Research (iDiv) Halle–Jena–Leipzig, Germany

<sup>ad</sup> International Institute Zittau, Technische Universität Dresden, Markt 23, 02763 Zittau, Germany

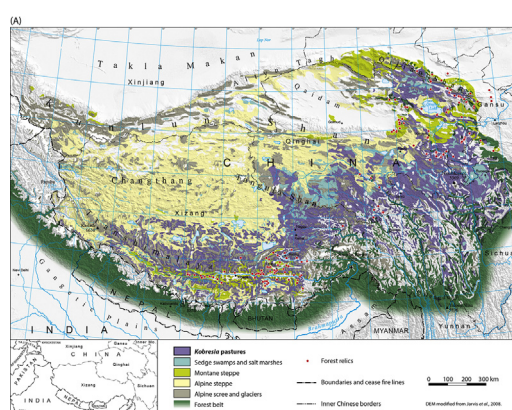
\* Corresponding author.

E-mail address: [opgenoorh@uni-marburg.de](mailto:opgenoorh@uni-marburg.de) (L. Opgenoorth).

## HIGHLIGHTS

- *Kobresia pygmaea* is co-limited by low rainfall, short growing season and livestock.
- Overstocking has caused pasture degradation and soil deterioration.
- Natural autocyclic processes of turf erosion are initiated by polygonal cracking.
- C & nutrient release, earlier diurnal cloud formation, surface temperature decrease.
- Traditional migratory rangeland management offers best strategy for conservation.

## GRAPHICAL ABSTRACT



## ARTICLE INFO

## Article history:

Received 24 April 2018

Received in revised form 10 August 2018

Accepted 12 August 2018

Available online 14 August 2018

Editor: Elena Paoletti

## Keywords:

Alpine meadow

Alpine plant ecology

Carbon cycle and sequestration

*Carex parvula*

Grazing ecology

Hydrological cycle

Nutrient cycles

Paleo-environment

Qinghai-Tibet Plateau

Rangeland management

## ABSTRACT

With 450,000 km<sup>2</sup> *Kobresia* (syn. *Carex*) *pygmaea* dominated pastures in the eastern Tibetan highlands are the world's largest pastoral alpine ecosystem forming a durable turf cover at 3000–6000 m a.s.l. *Kobresia*'s resilience and competitiveness is based on dwarf habit, predominantly below-ground allocation of photo assimilates, mixture of seed production and clonal growth, and high genetic diversity. *Kobresia* growth is co-limited by livestock-mediated nutrient withdrawal and, in the drier parts of the plateau, low rainfall during the short and cold growing season. Overstocking has caused pasture degradation and soil deterioration over most parts of the Tibetan highlands and is the basis for this man-made ecosystem. Natural autocyclic processes of turf destruction and soil erosion are initiated through polygonal turf cover cracking, and accelerated by soil-dwelling endemic small mammals in the absence of predators. The major consequences of vegetation cover deterioration include the release of large amounts of C, earlier diurnal formation of clouds, and decreased surface temperatures. These effects decrease the recovery potential of *Kobresia* pastures and make them more vulnerable to anthropogenic pressure and climate change. Traditional migratory rangeland management was sustainable over millennia, and possibly still offers the best strategy to conserve and possibly increase C stocks in the *Kobresia* turf.

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## 1. Introduction

The Tibetan highlands encompass 83% of the Earth's terrain above 4000 m and host the world's largest pastoral alpine ecosystem: the *Kobresia* pastures of the south-eastern highlands, with an area of 450,000 km<sup>2</sup> (Fig. 1). This ecosystem is globally unique as it is:

- (1) dominated by a single endemic sedge species of 1 to 4 cm in height – *Kobresia pygmaea*;
- (2) forms a golf-course like lawn, with a very durable turf cover anchored by a felty root mat;
- (3) extends over 3000 m elevation, stretching between 3000 m (in the north-eastern highlands) to nearly 6000 m (on the north slope of Mt. Everest; Miehe, 1989; Miehe et al., 2008b).

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