NPP Grassland: Xilingol, China, 1980-1989, R1

Get Data

Summary:

This data set provides two data files in text format (.txt). One file contains bi-weekly measurements of above-ground live biomass recorded during the growing season (early May to early October) from 1980 through 1989 on a cold desert steppe at the Inner Mongolia Grassland Research Station of the Chinese Academy of Sciences within the Xilingol Biosphere Reserve. The second file contains monthly and annual climate data recorded at the study site from 1978 through 1989.

The study site contains grassland steppes of *Leymus chinense* and *Stipa grandis* which are the dominant vegetation types, respectively, in the Eastern Eurasian steppe zone (semi-arid and sub-humid) and the middle Eurasian steppe zone (semi-arid). Both steppes provide good livestock forage and are used mainly as natural grazing lands.

Above-ground net primary production (ANPP) was estimated by summing peak live biomass of each of 5 species categories. Peak live biomass of *L. chinense* steppe occurred between late July and late August and averaged 182.68 g/m2 between 1980 and 1988 while that of *S. grandis* steppe occurred in mid August to early September and averaged 144.43 g/m2 over the same time period. Mean ANPP for *L. chinense* steppe during 1980-1989 was 248.63 g/m2/yr. ANPP for *S. grandis* steppe was not calculated. Data are only provided for the *Leymus chinense* steppe in this data set.

Revision Notes: Only the documentation for this data set has been modified. The data files have been checked for accuracy and are identical to those originally published in 1996.

Figure 1. Lightly-grazed fenced plot in the foreground, with grazed lands in the background, near the Xilingol grassland site (Inner Mongolia Grassland Ecosystem Research Station), China. (The dominant grass is *Leymus chinense*. The man on horseback is holding a long herding stick. Photograph taken 7th August 1997 by L. Christensen, NREL, Colorado State University, USA).

Additional Documentation

The NPP data collection contains field measurements of biomass, estimated NPP, and climate data for terrestrial grassland, tropical forest, temperate forest, boreal forest, and tundra sites worldwide. Data were compiled from the published literature for intensively studied and well-documented individual field sites and from a number of previously compiled multi-site, multi-biome data sets of georeferenced NPP estimates. The principal compilation effort (Olson et al., 2001) was sponsored by the NASA Terrestrial Ecology Program. For more information, please visit the NPP web site at http://daac.ornl.gov/NPP/npp_home.shtml.

Data Citation:

Cite this data set as follows:

Xiao, X., and D. Ojima. 2015. NPP Grassland: Xilingol, China, 1980-1989, R1. Data set. Available on-line [http://daac.ornl.gov] from Oak Ridge National Laboratory Distributed Active Archive Center, Oak Ridge, Tennessee, USA. http://dx.doi.org/10.3334/ORNLDAAC/156

This data set was originally published as:

Xiao, X., and D. Ojima. 1996. NPP Grassland: Xilingol, China, 1980-1989. Data set. Available on-line [http://daac.ornl.gov] from Oak Ridge National Laboratory Distributed Active Archive Center, Oak Ridge, Tennessee, U.S.A.

Table of Contents:

1. Data Set Overview:

Project: Net Primary Production (NPP)

The one million hectare Xilingol Biosphere Reserve (also known as the Xilin Gol Biosphere Reserve) in the Xilin River basin is located in the Inner Mongolia Autonomous Region of China, about 60-km southeast of Xilinhaote City and about 600 km north of Beijing. It was established as China's first grassland

biosphere reserve in 1987 to protect the biodiversity of a typical steppe ecosystem and to develop models of sustainable grassland resource use for improved well-being of the local people. The area is extensively grazed by wild herbivores and domestic livestock managed mainly by sedentary herders. Before 1950, the area was used by nomadic Mongols as pasture land. Within the Reserve is the Baiyinxile Livestock Farm which is used for demonstrating traditional and alternative methods of raising animals such as horses, sheep and goats on the grassland and means of animal husbandry to local herders.

Two permanent experiment sites (25-ha each) with grazing exclosures were established at the Baiyinxile Livestock Farm in 1979, one for a *L. chinense* steppe and one for a *S. grandis* steppe. In this study, long-term dynamics of climate and above-ground biomass of the two steppes were studied with the objectives of: (1) quantifying temporal variability of biomass, primary production, water use efficiency, and rain use efficiency of the steppes; and (2) establishing quantitative relationships between these parameters and climatic variables. Only data for *L. chinense* steppe are provided in this data set.

Figure 2. A permanent exclosure near the Xilingol grassland site, China. (Typical steppe grassland dominated by *Leymus chinense*, Baiinxele Farm, Inner Mongolia; photograph taken 10th August 1997 by Lindsey Christensen, Colorado State University, USA).

2. Data Description:

Spatial Coverage

Site: Xilingol, China

Site Boundaries: (All latitude and longitude given in decimal degrees)

Site (Region)	Westernmost Longitude	Easternmost Longitude	Northernmost Latitude	Southernmost Latitude	Elevation (m)
Xilingol, Chin	116.63	116.63	43.72	43.72	1,200

Spatial Resolution

25-ha enclosed steppe with 1-m2 plots

Temporal Coverage

1980/07/29-1989/09/27

Temporal Resolution

Approximately every two weeks

Data File Information

Table 1. Data file descriptions

FILE NAME	TEMPORAL COVERAGE	FILE CONTENTS
xln_npp.txt	1980/07/29-1989/09/27	Above-ground live biomass data for the Leymus chinense cold desert steppe within the Xilingol Biosphere Reserve, Inner Mongolia
xln_cli.txt	1978/01/01-1989/12/31	Climate data from a weather station at the Xilingol study site

NPP Data. This data set contains one NPP data file (.txt format). The first 18 lines are metadata; data records begin on line 19. The variable values are delimited by semicolons. Biomass units are in g/m2 (dry matter weight). There are no missing values.

Table 2. Column headings in NPP files

COLUMN HEADING	DEFINITION	UNITS
Site	Site where data were gathered (code refers to site identification)	text
Treatmt	Long term management of site (code refers to treatment described in metadata in data file)	
Year	Year in which data were collected	yyyy
Mn	Month in which data were collected	mm
Dy	Day on which data were collected	dd
Tyear	Date in decimal year (year plus the Julian date divided by 365)	numeric
AGbiomass	Above-ground live biomass	g/m2

Sample NPP Data Record

```
Site;Treatmt;Year;Mn;Dy;Tyear; AGbiomass

xln;lngtrm;1980;07;29;1980.580; 70.9
xln;lngtrm;1980;08;27;1980.660; 74.0
xln;lngtrm;1980;09;26;1980.740; 85.4
xln;lngtrm;1981;05;29;1981.410; 55.4
xln;lngtrm;1981;07;01;1981.500; 106.9
xln;lngtrm;1981;07;30;1981.580; 227.8
xln;lngtrm;1981;08;28;1981.660; 210.9
xln;lngtrm;1981;09;30;1981.750; 36.5
...
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Climate Data. Climate data are provided in one text file (.txt format). The first 18 lines are metadata; data records begin on line 19. The variable values are delimited by semi-colons. There are no missing values.

Sample Climate Data Record

```
Site;Temp;Parm; Jan; Feb; Mar; Apr; May; Jun; Jul; Aug; Sep; Oct; Nov; Dec; Year

xln;mean;prec; 2.7; 4.3; 4.3; 14.8; 25.1; 62.9; 90.2; 81.9; 52.9; 12.3; 5.2; 4.0; 360.6
xln;mean;tmax;-13.5;-10.3; -1.3; 10.6; 19.2; 23.7; 25.7; 23.4; 17.7; 10.6; -1.4;-10.9; 26.1
xln;mean;tmin;-30.0;-27.7;-17.7; -4.8; 2.1; 7.9; 11.5; 10.0; 2.0; -6.2;-17.3;-26.1; -30.1
xln;numb;prec; 12.0; 12.0; 12.0; 12.0; 12.0; 12.0; 12.0; 12.0; 12.0; 12.0; 12.0; 12.0; 12.0
xln;numb;tmax; 12.0; 12.0; 12.0; 12.0; 12.0; 12.0; 12.0; 12.0; 12.0; 12.0; 12.0; 12.0; 12.0
xln;numb;tmin; 12.0; 12.0; 12.0; 12.0; 12.0; 12.0; 12.0; 12.0; 12.0; 12.0; 12.0; 12.0; 12.0
xln;stdv;prec; 1.4; 2.2; 2.7; 7.5; 12.0; 35.4; 51.4; 41.6; 42.4; 9.0; 4.5; 2.6; 125.6
xln;stdv;tmax; 2.9; 3.4; 2.4; 3.0; 1.2; 1.2; 2.2; 1.2; 0.9; 2.1; 3.4; 2.9; 1.7
xln;stdv;tmin; 2.6; 2.7; 2.7; 3.0; 1.5; 1.8; 1.7; 1.8; 1.6; 2.3; 2.8; 2.4; 2.5
xln;1978;prec; 4.0; 3.2; 7.5; 9.3; 43.7; 96.4;158.4;155.5;167.7; 5.7; 1.7; 2.5; 655.6
xln;1978;tmax;-15.9;-13.2; -2.2; 10.3; 19.1; 22.5; 25.1; 22.4; 19.5; 9.3; 1.5; -7.9; 25.1
xln;1978;tmin;-31.9;-31.2;-21.1; -6.5; 0.4; 6.9; 8.7; 7.9; -0.2;-11.0;-19.2;-28.2; -31.9
…

Where,
Temp (temporal) - specific year or long-term statistic:
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mean = mean based on all years
numb = number of years
stdv = standard deviation based on all years
Parm (parameter):
prec = precipitation for month or year (mm)
tmax = mean maximum temperature for month or year (C)
tmin = mean minimum temperature for month or year (C)

3. Data Application and Derivation:

The objectives of this study were to: (1) quantify temporal variability of biomass, primary production, water use efficiency, and rain use efficiency of the Xilingol steppes; and (2) establish quantitative relationships between these parameters and climatic variables.

4. Quality Assessment:

Field data show that there were large interannual variations in seasonal dynamics and magnitude of above-ground biomass of the *L. chinense* steppe during 1980-1989. The date on which community peak above-ground live biomass occurred shifted every year, although seasonal community above-ground live biomass followed a unimodal growth pattern. Peak above-ground live biomass was used as a crude estimate of ANPP.

On the average, ANPP of the *L. chinense* steppe (248.63 g/m2/yr) at the study site is much higher than ANPP of shortgrass steppe (97 g/m2/yr) in the Central Plain Experiment Range in Colorado, USA, where annual precipitation is similar (Lauenroth and Sala, 1992). It is slightly higher than or close to ANPP of northern mixed prairie of northern American grasslands where annual precipitation is higher, ranging from 400 mm to 600 mm (Sims and Singh, 1978). The relatively high ANPP of *L. chinense* steppe may be attributed partially to (1) optimum monthly and seasonal distribution of precipitation and temperature (Xiao et al. 1995) and (2) coarser soil texture in Inner Mongolia grasslands. Comparatively high biological N-fixation could be another factor.

5. Data Acquisition Materials and Methods:

Site Information

Two permanent experiment sites (25-ha each) were established at the Baiyinxile Livestock Farm in 1979, one for *L. chinense* steppe one for a *S. grandis* steppe. The *S. grandis* site is about 6 km west of the *L. chinense* site. The study sites are representative of "typical steppe" grasslands with a warm, wet growing season from the end of April to early October. The steppes were very lightly grazed by sheep and cattle before enclosures were established in 1979 because they are far away from drinking water spots and residential villages. There was little difference in species composition and plant biomass between the inside and outside enclosure areas, due to very light degree of livestock grazing, according to the field survey in July-August 1987 (Hayashi et al., 1988).

The Xilin River basin has a continental mid-temperate semi-arid climate. Winter is usually cold and dry, while summer is generally warm and wet (Chen, 1988). The average annual mean temperature and annual precipitation in the period of 1980-1989 were 0.02 degrees C and 313.3 mm, respectively. Stable snow cover exists from the end of November to March. The non-frost period lasts about 102-136 days. Grass plants initiate growth at the end of April and continue growing until September, a growing season of about 150 days (Jiang, 1985).

The *L. chinense* site is located in a smooth wide plain with low hills on a 2nd-level basalt platform, approximately 1,200-m in altitude. Low hills occur with a relative height of 20-30 m with <5 degree slope. Of 86 species of flowering plants that belong to 28 families and 67 genera at the site, there are 11 grass species (Jiang, 1985). Community cover is about 30-40% and may reach 60-70% in wet years. The soil is dark chestnut (Mollisol) and the soil depth is usually over 100 to 150 cm (Wang and Cai, 1988). The A horizon reaches 20-30 cm deep. Soil textures average 21% clay, 19% silt and 60% sand. Litter covers the soil surface and no soil erosion occurs.

The *S. grandis* site with 52 species of flowering plants is located in a open high plain on a 1st-level basalt platform, approximately 1,130-m in altitude. Community cover is usually about 25%, and may reach 50% on wet years (Xiao et al., 1995). Soil is typically chestnut (Mollisol) and soil depth is less than 1 m (Wang and Cai, 1988). The A horizon is about 20-cm deep. On average, soil texture is 21% clay, 30% silt and 49% sand.

The study area has been described by Jiang (1985; 1988) and the soils by Wang and Cai (1988). Grassland productivity has been studied by Hayashi et al. (1988) and more recently by Xiao et al. (1995; 1996). Only data for *L. chinense* steppe is provided in this data set.

Figure 3. Another view of a permanent exclosure near the Xilingol grassland site, China. (Typical steppe grassland dominated by Leymus chinense, Baiinxele Farm, Inner Mongolia, 43.55 N 116.68 E; photograph taken 10th August 1997 by Lindsey Christensen, Colorado State University, USA).

Table 3. Site characteristics

Description	Values
mean annual precipitation	360 mm
mean monthly minimum temperature	-30.0 degrees C (Jan)
mean monthly maximum temperature	25.7 degrees C (July)
vegetation type	steppe
dominant species	*Leymus chinense* and *Stipa grandis* (both C3)
historical long-term management regime	light grazing
peak above-ground live biomass (typical month)	*Leymus chinense* 183 g/m2 (mean) *Stipa grandis* 144 g/m2 (mean)
soil type	dark chestnut, coarse texture
soil pH	data not available
soil texture (sand/ silt/ clay)	*Leymus chinense* 0.60 / 0.19 / 0.21 *Stipa grandis* 0.49 / 0.30 / 0.21
soil carbon content	*Leymus chinense* 5,405 g/m2 (0-20 cm)
soil nitrogen content	*Leymus chinense* 414 g/m2 (0-20 cm)

Table 4. ANPP, BNPP, and TNPP values for the Xilingol *Leymus chinense* steppe reported by various published data sources

Source	Units	ANPP	BNPP	TNPP
Xiao et al. (1995)	$g/m^2/yr$	248.63	na	na
GPPDI Class B Site #983 (MI 1532) in Olson et al. (2013a)	gC/m2/yr	110		
EMDI Class B Site #983 in Olson et al. (2013b)				

Notes: MI = Measurement identification number. na = not available.

Methods

Field sampling began in the enclosed steppe in early May and ended in mid-October of each year, 1980-1989. Measurements were made at intervals of about 2 weeks. Five 1-m2 quadrats were randomly placed at each sampling date. Cover, density, growth height and phenological phases of each species were recorded. Above-ground biomass of individual species was measured by the harvest technique. Plant materials were clipped to the ground surface, and litter on the harvested quadrats was collected. At the laboratory, the clipped plant material was separated into live and standing-dead parts, which were weighed as the fresh weight of live biomass and standing dead, respectively. These plant materials were then oven-dried at 65 degrees C and dry weights of live biomass and standing dead were measured. In 1987-1989, only measurements of above-ground live biomass was made. Peak above-ground live biomass was used as a crude estimate of ANPP.

Figure 4. Measurements in progress near the Xilingol grassland site, China. (Lindsey Christensen, Colorado State University, and Han Yuan Hong, Institute of Botany, Beijing, are detemining ground cover by species at a typical steppe grassland dominated by *Leymus chinense* on the Baiinxele Farm in Inner Mongolia, 43.82 N 116.68 E; photograph taken August 1997 by Dr. M.B. Coughenour, Colorado State University, USA).

6. Data Access:

This data set is available through the Oak Ridge National Laboratory (ORNL) Distributed Active Archive Center (DAAC).

Data Archive:

Web Site: http://daac.ornl.gov

Contact for Data Center Access Information:

E-mail: uso@daac.ornl.gov
Telephone: +1 (865) 241-3952

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