NPP Grassland: Kurukshetra, India, 1970-1971, R1

Get Data

Revision Date: November 4, 2014

Summary:

This data set contains two ASCII files (.txt format). One file contains above- and below-ground biomass (including standing dead material and litter) and productivity data for a tropical grassland at Kurukshetra University (29.97 N, 76.85 E, Elevation 247 m) in northern India, about 150-km north-northwest of Delhi. The second file contains climate data from a weather station located at the study site.

Biomass measurements were made monthly by harvest methods from mid-May 1970 to mid-May 1971. Annual net primary productivity (NPP) was calculated for the grassland according to several methods, with preference shown for the estimate given by summing positive increases in biomass and accounting for mortality. Total NPP was estimated at 3,538 g/m2/yr, with above-ground net primary productivity (ANPP) of 2,407 g/m2/yr and below-ground net primary productivity (BNPP) of 1,131 g/m2/yr.

Seasonal changes in the vegetation were studied through tiller analysis. Examination of vertical distribution of above-ground biomass showed that different layers of vegetation were dominated by different species in different months. ANPP was maximum during the rainy season (1,706 g/m2) and BNPP was maximum during the dry winter season (785 g/m2). Production was more directed above ground during the rainy season and below ground during the dry season. Apparent efficiency of energy conversion was calculated at 1.66% on the basis of 50% total solar radiation.

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 1997.

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 NASA's Terrestrial Ecology Program. For more information, please visit the NPP web site at http://daac.ornl.gov/NPP/npp_home.html.

Data Citation:

Cite this data set as follows:

Singh, J.S., and P.S. Yadava. 2014. NPP Grassland: Kurukshetra, India, 1970-1971, R1. Data set. Available on-line [http://daac.ornl.gov] from Oak Ridge National Laboratory Distributed Active Archive Center, Oak Ridge, Tennessee, USA. doi:10.3334/ORNLDAAC/193

This data set was originally published as:

Singh, J.S., and P.S. Yadava. 1997. NPP Grassland: Kurukshetra, India, 1970-1971. 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 Productivity (NPP)

NPP was determined for a tropical grassland at Kurukshetra University in northern India, from 1970 to 1971, under the auspices of the Indian International Biological Program (IBP). NPP was calculated according to several methods, with preference shown for the estimate given by summing positive increases in biomass and accounting for mortality. Total NPP was estimated at 3,538 g/m2/yr, with above-ground net primary productivity (ANPP) of 2,407 g/m2/yr and below-ground net primary productivity (BNPP) of 1,131 g/m2/yr based on Method 4 in Singh and Yadava (1974). These values are also reported by Esser (2013) and Olson et al. (2013), the latter converting values to grams of carbon per square meter using a conversion factor of 0.475.

NPP was calculated by Scurlock and Olson (2013) using a different methodology. Total NPP in Scurlock and Olson (2012) agrees with Singh and Yadava (1974); however, NPP component estimates differ (i.e., 1,706 g/m2/yr for ANPP and 1,832 g/m2/yr for BNPP). See Scurlock and Olson (2002) for a description of the method (Method 5) used to calculate components of NPP.

The 2-hectare Kurukshetra study site (29.97 N, 76.85 E, Elevation 247 m) is situated on the university campus in the district of Karnal, Haryana state, about 150-km north-northwest of Delhi. It has been maintained as a grassland since 1950, with little biotic interference apart from insect and small mammal herbivory. In general, the area is low-lying with little relief but a hummocky topography. The grasslands in this region originated from abandonment of areas previously cleared for cultivation, and are maintained by grazing and annual burning. The climate is tropical monsoonal, with a rainy season (July-September), cool dry season (October-February), and hot dry season (March-May).

Detailed monthly data are available on above-ground biomass dynamics (based on 14 species categories reported in the literature), standing dead and litter, and total below-ground matter. Climate data are available from a weather station located at the Kurukshetra grassland study site. Additional data on solar radiation, canopy stratification, root distribution, and estimated energy flows are reported in the literature.

2. Data Description:

Site: Kurukshetra, India

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

Site (Region)	Westernmost Longitude	Easternmost Longitude	Northernmost Latitude	Southernmost Latitude	Elevation (m)
Kurukshetra, India	76.85	76.85	29.97	29.97	247

Spatial Resolution

The study area was 2-hectare in size. Above-ground harvest plots were 30 x 30 cm. Below-ground samples were 15 x 15 x 30-cm monoliths.

Temporal Coverage

Biomass measurements were made from 1970/05/15 through 1971/05/15. Climate data are available from 1876/01/01 through 1971/12/31.

Temporal Resolution

Biomass measurements were made monthly. All biomass estimates are based on plant dry matter accumulation, expressed as g/m2. Climate data are expressed as monthly and annual precipitation amounts (mm) and monthly and annual average maximum/minimum temperature (C). Monthly and annual climatic means are provided for the 1876-1971 period.

FILE NAME	TEMPORAL COVERAGE	FILE CONTENTS
krk1_npp.txt	1970/05/15 - 1971/05/15	Above- and below-ground biomass and productivity data for a tropical grassland at Kurukshetra, India
krk_cli.txt	1876/01/01 - 1971/12/31	Monthly and annual climate data from a weather station at Kurukshetra, India

NPP data: Biomass and productivity estimates for the Kurukshetra site are provided in one ASCII file (.txt format). The first 18 lines are metadata; data records begin on line 19. The variable values are delimited by semi-colons. The value -999.9 is used to denote missing values. All biomass units arereported as g/m2 (dry matter weight).

Table 2. Column headings in NPP file

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)	Text
Year	Year in which data were collected	Numeric
Mn	Month in which data were collected	
Day	Day on which data were collected	

Jdate	Date in Julian year	
Tyear	Date in decimal year (year plus the Julian date divided by 365)	
AGbiomass	Monthly above-ground living biomass	g/m^2
Stdead	Monthly above-ground standing dead biomass	
litter	Monthly above-ground litter	
AGtotmatter	Monthly total above-ground standing biomass (living + dead material + litter)	
BGtotmatter	Below-ground total biomass (0-20 cm)	

Notes: All values are from Singh and Yadava (1974). Monthly biomass estimates are the average of 10 plots for each sampling date.

Sample NPP Data Record:

```
Site;Treatmt;Year;Mn;Dy;Tyear;AGbiomass;Stdead;litter;AGtotmatter;BGtotmatter
krk;lngtrm ;1970;05;15;1970.370; 437.0; 155.0; 133.0; 725.0;-999.9
krk;lngtrm ;1970;06;15;1970.455; 773.0; 203.0; 123.0;1099.0; 874.0
krk;lngtrm ;1970;07;15;1970.537;1103.0; 196.0; 116.0;1415.0; 845.0 ...
```

Climate Data. The climate data set is an ASCII file (.txt format). The 18 lines are metadata; data records begin on line 19. The variable values are delimited by semicolons. There are no missing values.

COLUMN HEADINGS	DEFINITION
Site	Unique 3-character code for each site based on the first three consonants in the site name (e.g., KRK for Kurukshetra)
Temp (Temporal)	Indicates whether the values in that row are either long-term (i.e, mulit-year) or annual data for the specified parameter. For multi-year, the values are: mean=mean values (monthly and annual) calculated for the years of data as noted in the documentation numb=number of years of data included in a reported mean value stdv=standard deviation of a mean value Annual data: 19XX=monthly and annual parameter values for the specified year (e.g., 1972)
Parm	Parameter, indicates the meteorological data reported in that row. prec-total precipitation for the month or year tmax=maximum temperature for the month or year reported in degrees C tmin=minimum temperature for the month or year reported in degrees C

Description of specific Temp and Parm data values:

Long-term data:

site;mean;prec;
Multi-year mean of total precipitation for each month [Jan, Feb, Mar, …, Dec] and mean of total annual precipitation across all years [Year] (mm)

site;mean;tmax;
Multi-year mean of maximum temperature for each month [Jan, Feb, Mar, …, Dec] and mean of annual maximum temperature across all years [Year] (C)

site;mean;tmin;
Multi-year mean of minimum temperature for each month [Jan, Feb, Mar, …, Dec] and mean of annual minimum temperature across all years [Year] (C)

… site; numb and stdv; repeat for prec, tmax, and tmin;

Annual data:

site;19XX;prec;
Total precipitation for each month [Jan, Feb, Mar,.....Dec] and total precipitation for the year 19XX [Year] (mm)

site;19XX;tmax;
Maximum temperature for each month [Jan, Feb, Mar,.....Dec] and maximum for the year 19XX [Year] (C)

site;19XX;tmin;
Minimum temperature for each month [Jan, Feb, Mar,.....Dec] and minimum for the year 19XX [Year] (C)

... site;19XX;(prec, tmax, and tmin); repeat for reported years.

Annual data missing value note: If a monthly parm value is missing, the parm value for [Year] is also set to missing (-999.9).

Sample Climate Data Record need to replace the data

Site;Temp;Parm; Jan; Feb; Mar; Apr; May; Jun; Jul; Aug; Sep; Oct; Nov; Dec; Year
KRK;mean;prec; 35.6; 32.8; 26.8; 15.7; 14.8; 57.9;209.1;174.6;102.0; 18.7; 3.5; 16.0; 707.3
KRK;mean;tmax; 19.4; 21.8; 28.6; 35.3; 39.9; 40.6; 36.1; 34.9; 35.0; 33.6; 27.4; 21.8; 41.2
KRK;mean;tmin; 6.6; 9.0; 13.6; 19.1; 24.3; 27.2; 26.6; 26.0; 23.8; 17.4; 10.8; 6.8; 6.0
...
KRK;1876;prec; 4.0; 14.0; 60.0; 4.0; 31.0; 0.0;174.0; 69.0; 22.0; 18.0; 0.0; 0.0; 396.0
KRK;1876;tmax; 19.5; 21.2; 27.4; 34.2; 39.5; 41.6; 36.1; 34.7; 34.5; 31.7; 26.9; 21.0; 41.6
KRK;1876;tmin; 6.7; 8.4; 12.4; 18.0; 23.9; 28.2; 26.7; 25.9; 23.3; 15.5; 10.3; 6.0; 6.0
...
Where,
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 accumulation of biomass, or NPP, is the net gain of carbon by photosynthesis that remains after plant respiration. While there are many fates for this carbon, this study considered increases in above-ground biomass (based on 14 species categories reported in the literature), in standing dead, in litter, and in total below-ground matter to be NPP.

This work was carried out under the auspices of the Indian International Biological Program (IBP). At the time of this research, relatively few studies on primary productivity and energetics of tropical grassland ecosystems had been reported.

The grassland monthly biomass dynamics data for the Kurukshetra site are provided for comparison with models and estimation of NPP. Climate data are provided for use in driving ecosystem/NPP models.

4. Quality Assessment:

None provided.

5. Data Acquisition Materials and Methods:

Site Information

The study site is located within the Kurukshetra University campus at 29.97 N latitude and 76.85 E longitude in the district of Karnal, Haryana, at approximately 247-m above the mean sea level. The area, in general, exhibits hummocky topography and is low lying with little relief. Soil is loamy in texture and slightly calcareous in nature, with a pH of 8.5.

This study deals with the composition, structure, and productivity of a tropical grassland vegetation (modified Bailey ecoregion savanna, #412) in north India. A study of life forms indicated predominance of therocryptophytic flora. Detailed phytosociological values of constituent species of the vegetation were studied at monthly intervals (May 1970 to May 1971) through tiller analysis. Most of the species were found to be contagiously distributed. The grasslands in this area owe their origin to abandoned cultivation.

The grassland was approximately 20 years old at the time of this study. The dominant species at Kurukshetra is Panicum miliare (C4). Long-term management of the site includes grazing and annual burning.

Climate data are available from a weather station located at the Kurukshetra grassland study site. The data record for the 1876-1971 period shows mean annual precipitation of 707.3 mm and mean maximum and minimum temperatures of 41.2 degres C and 6.0 degrees C, respectively. Climate is tropical monsoonal, with a rainy season (July-September), cool dry season (October-February) and hot dry season (March-May).

Methods

Seasonal changes in the vegetation were studied through tiller analysis. This method was adopted because it is impossible to decide where an individual plant begins and ends with this type of vegetation, especially with perennial grasses like Dichanthium annulatum and Panicum miliare, and forbs like Alhagi camelorum. In this work, each annual erect shoot was considered to be a plant tiller. In the case of sod-forming grasses, any portion of the plant possessing an independent shoot and root that can be separated from others was regarded as one tiller. In this context, the term "plant" is synonymous with erect independent shoots in forbs, and tillers in grasses.

Above-ground plant biomass was evaluated through 30 x 30-cm harvest plots. The field was divided into 50 equal areas, and these were numbered and staked. On each sampling date 10 areas were selected with the help of a random table. From within each of these 10 areas, one plot of 30 x 30-cm size was harvested at random. Thus a total of 10 plots were harvested on each sampling date. The sampling was done at monthly intervals from May 15, 1970 to May 15, 1971. Sampling was performed manually with the help of a flat sharp instrument. In order to obtain a valid estimate of the herbage, all vegetation was harvested at ground level. Before the harvesting, however, all the standing dead material was collected separately; and litter was gathered after the plot had been harvested for live vegetation. The litter samples from each harvest plot were washed through flotation, dried, and weighed. Standing dead material was also dried and weighed.

The live vegetation from each harvest plot was separated into species in the laboratory, and clipped at 10-cm intervals. These 10-cm segments were dried and weighed separately. All drying was done at 80 degrees C until constant weight. For the estimation of below-ground plant material, 15 x 15 x 30-cm monoliths were dug out from the field on each sampling date, one from each harvest plot. A 30-cm depth was chosen because of the labor and time involved, and because 93% of root material was found to be concentrated in the top 30-cm soil layer. These monoliths were brought to the laboratory, cut into 10-cm segments, soaked in water for 24 hr, and then washed with a fine jet of water using a 32-mesh screen. The below-ground plant material was dried at 80 degrees C. Each segment was weighed separately.

Climate data

Climate data are available from Monthly and annual measurements reported include precipitation amount, maximum temperature, and minimum temperature. Long-term means are also reported.

The climate data accompanying this NPP data set was compiled from daily observations of Tmax, Tmin, and precip amount. The data are from the weather station located at the Kurukshetra grassland study site for the period 1876-1971. Additional data on solar radiation, canopy stratification, root distribution, and estimated energy flows are reported in the literature (Singh and Yadave, 1974).

For a given month, the maximum value of the daily Tmax for that month and the minimum value of the Tmin for that month is provided. For the year, the maximum value of the monthly Tmax is the annual Tmax and for the year the minimum value of the monthly Tmin values is the annual Tmin. Daily precipitation amount is summed to yield a monthly precipitation amount and the monthly precipitation is summed to provide an annual precipitation amount.

The multi-year mean monthly Tmax is the average of the Tmax values for that month for each year of the record. For example the mean monthly Tmax for April is the mean of each April's Tmax for the observation period of record. Mean monthly Tmin and Mean monthly precip amount are calculated similarly.

6. Data Access:

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

Data Archive Center:

Contact for Data Center Access Information:
E-mail: uso@daac.ornl.gov
Telephone: +1 (865) 241-3952

7. References:

Olson, R.J., K.R. Johnson, D.L. Zheng, and J.M.O. Scurlock. 2001. Global and Regional Ecosystem Modeling: Databases of Model Drivers and Validation Measurements. ORNL Technical Memorandum TM-2001/196. Oak Ridge National Laboratory, Oak Ridge, Tennessee, U.S.A.

Singh, J.S., and P.S. Yadava. 1974. Seasonal variation in composition, plant biomass and net primary productivity of a tropical grassland at Kurukshetra, India. Ecological Monographs, 44: 351-376.

Additional Sources of Information:

Esser, G. 2013. NPP Multi-Biome: Global Osnabruck Data, 1937-1981. Data set. Available on-line [http://daac.ornl.gov] from Oak Ridge National Laboratory Distributed Active Archive Center, Oak Ridge, Tennessee, USA. doi:10.3334/ORNLDAAC/214

Olson, R.J., J.M.O. Scurlock, S.D. Prince, D.L. Zheng, and K.R. Johnson (eds.). 2013a. NPP Multi-Biome: Global Primary Production Data Initiative Products, R2. Data set. Available on-line [http://daac.ornl.gov] from the Oak Ridge National Laboratory Distributed Active Archive Center, Oak Ridge, Tennessee, USA. doi:10.3334/ORNLDAAC/617

Rajvanshi, R., and S.R. Gupta. 1985. Biomass, productivity and litterfall in a tropical Dalbergia sissoo forest. J. Tree Science, 4: 73-78.

Scurlock, J.M.O., and R.J. Olson. 2002. Terrestrial net primary productivity – A brief history and a new worldwide database. Environ. Rev. 10(2): 91-109. doi:10.1139/a02-002

Scurlock, J.M.O., and R.J. Olson. 2013. NPP Multi-Biome: Grassland, Boreal Forest, and Tropical Forest Sites, 1939-1996, R1. Data set. Available on-line [http://daac.ornl.gov] from Oak Ridge National Laboratory Distributed Active Archive Center, Oak Ridge, Tennessee, USA. doi:10.3334/ORNLDAAC/653

Scurlock, J.M.O., K. Johnson, and R.J. Olson. 2002. Estimating net primary productivity from grassland biomass dynamics measurements. Global Change

Biology 8(8): 736-753. DOI: 10.1046/j.1365-2486.2002.00512.x