NPP Grassland: Osage, USA, 1970-1972, R1

Get Data

Revision date: October 14, 2014

Summary:

This data set contains three ASCII files (.txt format). Two files contain above- and below-ground biomass and productivity data for the Osage tallgrass prairie study site (36.95 N, -96.55 W, Elevation 392 m) in the U.S. Central Lowlands. There is one file for each treatment area (ungrazed and lightly grazed). The third file contains monthly and annual climate data from weather station at Pawhuska, Oklahoma (36.67 N, -96.35 W, Elevation of 255 m) near Osage.

Dynamics of above- and below-ground plant biomass were monitored by harvest technique at roughly 2-week intervals during the growing season for the years 1970-1972. Data on above-ground live biomass, standing dead matter, and litter are available for two replications each at recently grazed and an "ungrazed" (relatively undisturbed) grassland sites at Osage. Below-ground biomass was sampled at 0-30 cm and 0-90 cm depths. The data were collected as part of a coordinated study over 1-3 years at ten grassland sites of the central and western United States, under the US Grassland Biome Project of the International Biological Program (IBP).

Annual above-ground net primary production (ANPP) was estimated conservatively by summing peak biomass of individual species (346 $g/m^2/yr$), and annual below-ground net primary production (BNPP) was estimated as the sum of positive increments in root biomass (including crown biomass) (542 $g/m^2/yr$).

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 1998.

Additional Documentation:

The Net Primary Productivity (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.html.

Figure 1. "Quick Trap" for sampling insect populations at the Osage grassland site, Oklahoma, USA. (Photograph taken in May 1972 by Dr. W.J. Parton, Colorado State University).

Data Citation:

Cite this data set as follows:

Risser, P.G. 2014. NPP Grassland: Osage, USA, 1970-1972, R1. Data set. Available on-line [http://daac.ornl.gov] from Oak Ridge National Laboratory Distributed Active Archive Center, Oak Ridge, Tennessee, USAdoi:10.3334/ORNLDAAC/211

This data set was originally published as:

Risser, P.G. 1998. NPP Grassland: Osage, USA, 1970-1972. Data set. Available on-line [http://daac.ornl.gov] from Oak Ridge National Laboratory Distributed Active Archive Center, Oak Ridge, Tennessee, U.S.A.

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1. Data Set Overview:

Project: Net Primary Productivity (NPP)

The Osage study site (36.95 N, -96.55 W, Elevation 392 m) is situated in the U.S. Central Lowlands, about 60-km northwest of the city of Tulsa, Oklahoma. Osage is located on the K. S. Adams Ranch, a rangeland of 14,000 ha located at the southern end of the Flint Hills, the largest expanse of

unbroken tallgrass prairie in the USA. The "ungrazed" treatment area had not been grazed between 1950 and 1970, although it may have been mowed for hay as late as 1968. The grazed treatment was relatively lightly grazed, primarily in early spring and late fall (autumn).

Productivity of the tallgrass prairie was monitored from 1970 to 1972. Dynamics of above-ground plant biomass were monitored at roughly 2-week intervals during the growing season. Data on above-ground live biomass, standing dead matter and litter are available for two replications each of grazed and "ungrazed" (relatively undisturbed) treatments. Total below-ground biomass was also sampled. ANPP was estimated conservatively by summing peak biomass of individual species, and annual BNPP was estimated as the sum of positive increments in root biomass (including crown biomass).

Table 1. Annual above-ground net primary production at Osage, 1970-1972 (g/m^2/year)

YEAR	UNGRAZED	GRAZED
1970	331	434
1971	416	523
1972	290	370

Source: Sims and Singh (1978b), Table 2, p. 578.Three-year annual average ANPP for the ungrazed grassland is also reported in Esser (2013) and in Scurlock and Olson (2013).

Table 2. Annual below-ground net primary production at Osage, 1970-1972 (g/m^2/year)

YEAR	UNGRAZED	GRAZED
1970	602	502
1971	431	421
1972	592	983

Source: Sims and Singh (1978b), Table 4, p. 583. Three-year annual average BNPP for the ungrazed grassland is also reported in Esser (2013) and in Scurlock and Olson (2013).

Note: Productivity values are also reported Olson et al. (2013a; b) but do not agree with the values given above because different calculation methods and conversion factors were used.

Monthly and annual climate data from the weather station at Pawhuska, Oklahoma (36.67 N, -96.35 W, Elevation of 255 m) are available for the period 1898-1994.

2. Data Description:

Spatial Coverage

Site: Osage, Oklahoma, USA

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

Site (Region)	Westernmost Longitude	Easternmost Longitude	Northernmost Latitude	Southernmost Latitude	Elevation (m)
Osage, Oklahoma, USA	-96.55	-96.55	36.95	36.95	392

Spatial Resolution

The harvest plots were 0.5-m^2 square quadrats in 1970 and 1972 and 0.5-m^2 circular quadrats in 1971. In addition, 2.0-m^2 quadrats were used at Osage in 1970.

Temporal Coverage

Biomass measurements were made from 1970/03/27 through 1972/11/15. Climate data are available from 1898/01/01 through 1994/12/31.

Temporal Resolution

Biomass measurements were made at roughly 2-week intervals during the growing season. All biomass estimates are based on plant dry matter accumulation, expressed as g/m^2. Climate data are expressed as monthly and annual precipitation amounts (mm) and monthly and annual average maximum/minimum temperature (degrees C). Monthly and annual climatic means are provided for the 1898-1994 period.

Data File Information

Table 3. File names and descriptions

FILE NAME	TEMPORAL COVERAGE	FILE CONTENTS
osg1_npp.txt	1970/03/27 - 1972/11/15	Above- and below-ground biomass data for an ungrazed grassland at Osage, Oklahoma, USA
osg2_npp.txt	1970/04/11 - 1972/11/15	Above- and below-ground biomass data for a grazed grassland at Osage, Oklahoma, USA
osg_cli.txt	1898/01/01 - 1994/12/31	Monthly and annual climate data from a weather station near Osage, Oklahoma, USA

NPP Data. Biomass estimates for the Osage site are provided in two files, one for each treatment (Table 3). The data sets are ASCII files (.txt format). The first 18 lines are metadata; data records begin on line 19. The variable values are delimited by semicolons. The values -9, -99, -99.9, and -999.9 are used to denote missing values. All biomass units are in g/m^2. Below-ground depth is reported in cm.

Table 4. Column headings in NPP files

COLUMN HEADINGS	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	Numeric
Mn	Month in which data were collected	
Dy	Day on which data were collected	
Jdate	Date in Julian year	
Tyear	Date in decimal year (year plus the Julian date divided by 365)	
nrep	Number of replicates	
nplots	Number of sampling plots	
AGbiomass	Mean above-ground standing crop of living biomass; each value is the mean of two replicates	g/m^2
AGbm_SE	Standard error for above-ground living biomass measurement	
Olddead	Mean above-ground standing crop of old dead biomass (i.e., carry-over material from the previous year); each value is the mean of two replicates	
Oldd_SE	Standard error for above-ground old dead biomass measurement	
Newdead	Mean above-ground standing crop of new dead biomass (i.e., material produced and senesced during the current growing season); each value is the mean of two replicates	
Newd_SE	Standard error for above-ground new dead biomass measurement	
AGTotclip	Mean total above-ground standing crop biomass (living + dead); each value is the mean of two replicates	
Total_SE	Standard error for total above-ground biomass measurement	
BGtop30	Mean below-ground standing crop biomass in top 30 cm sample; each value is the mean of two replicates	

BGtotal	Mean total below-ground standing crop biomass; each value is the mean of two replicates	
BGdepth	Maximum below-ground sampling depth	cm

Sample NPP Data Record <**osg1_npp.txt>**

```
Site;Treatmnt;Year;Mo;Dy;Jdate;Tyear;nrep;nplots;AGbiomass;AGbm_SE;Olddead;Oldd_SE;Newdead;
Newd_SE;AGTotclip;Totcl_SE;nrep_BG;nplot_BG;BGtop30;BGtotal;BGdepth
osg;ungrazed;1970;03;27; 86;1970.236; 2; 10; 0.2; 0.2; 289.5; 22.0; 0.0; 0.0; 289.7; 21.9; -9;-99;-
999.9;-999.9; -99.9
osg;ungrazed;1970;05;01;121;1970.332; 2; 6; 19.6; 5.1; 255.3; 40.5; 0.0; 0.0; 274.9; 36.4; -9;-99;-
999.9;-999.9; -99.9
osg;ungrazed;1970;06;01;152;1970.416; 2; 6; 145.4; 13.9; 298.7; 56.2; 0.0; 0.0; 444.1; 64.6; -9;-99;-
999.9;-999.9; -99.9
...
```

Sample NPP Data Record <**osg2_npp.txt**>

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Site;Treatmnt;Year;Mo;Dy;Jdate;Tyear;nrep;nplots;AGbiomass;AGbm_SE;Olddead;Oldd_SE;Newdead;
Newd_SE;AGTotclip;Totcl_SE;nrep_BG;nplot_BG;BGtop30;BGtotal;BGdepth
osg;rcntgrzd;1970;04;11;101;1970.277; 2; 10; 0.0; 0.0; 74.5; 8.7; 0.0; 0.0; 74.5; 8.7; -9;-99;-999.9;-
999.9; -99.9
osg;rcntgrzd;1970;05;02;122;1970.334; 2; 10; 27.2; 3.2; 29.9; 16.5; 0.0; 0.0; 57.1; 18.8; -9;-99;-
999.9;-999.9; -99.9
osg;rcntgrzd;1970;06;02;153;1970.419; 2; 14; 181.3; 23.7; 37.9; 24.8; 0.0; 0.0; 219.2; 47.4; -9;-99;-
999.9;-999.9; -99.9
...
```

Climate Data. The data set is an ASCII file (.txt format). The first 18 lines are metadata; data records begin on line 19. The variable values are delimited by semicolons. Monthly and annual precipitation and temperature data are provided for each year 1898 through 1994. Monthly and annual means are provided for the 1898-1994 period. 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., osg for Osage)
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

```
Site;Temp;Parm; Jan; Feb; Mar; Apr; May; Jun; Jul; Aug; Sep; Oct; Nov; Dec; Year
osg;mean;prec; 33.72; 37.98; 67.84; 93.87; 130.83; 114.37; 88.72; 78.63; 99.39; 75.31; 58.40; 37.40; 916.47
osg;mean;tmax; 7.73; 10.58; 16.03; 21.57; 25.78; 30.45; 33.69; 33.59; 29.20; 23.23; 15.47; 9.06; 34.50
osg;mean;tmin; -6.19; -4.17; 1.60; 7.78; 12.88; 17.61; 19.76; 19.12; 14.75; 8.08; 0.98; -4.37; -7.20
osg;numb;prec; 97; 97; 97; 97; 97; 97; 97; 97; 97; 97; 97; 97; 97
osg;numb;tmax; 97; 97; 97; 97; 97; 97; 97; 97; 97; 97; 97; 97; 97
osg;numb;tmin; 97; 97; 97; 97; 97; 97; 97; 97; 97; 97; 97; 97; 97
osg;stdv;prec; 27.59; 32.12; 45.60; 57.23; 72.45; 68.69; 62.63; 57.80; 76.69; 57.73; 48.20; 30.93; 225.67
osg;stdv;tmax; 3.16; 3.48; 3.15; 1.94; 1.61; 1.97; 2.10; 2.29; 2.04; 2.19; 2.16; 2.56; 2.08
osg;stdv;tmin; 2.61; 2.64; 2.33; 1.79; 1.61; 1.38; 1.35; 1.39; 1.83; 1.77; 2.03; 2.37; 2.38
osg;1898;prec; 75.90; 12.05; 172.56; 67.18; 212.82; 107.69; 192.82; 52.31; 105.13; 67.69; 41.03; 34.36;1141.54
osg;1898;tmax; 8.57; 11.52; 15.48; 20.63; 25.54; 30.72; 32.49; 32.99; 29.92; 20.83; 13.23; 4.62; 32.99
osg;1898;tmin; -3.97; -3.71; 1.16; 5.96; 12.57; 18.48; 18.61; 18.46; 15.43; 6.73; -2.47; -7.17; -7.17 …
Where,
Temp (temporal) - specific year or long-term statistic:
  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:

Grassland monthly biomass dynamics data are provided for comparison with model output and estimation of NPP. Monthly and annual climate data are provided for use in driving ecosystem/NPP models.

Data at Osage were collected as part of a coordinated study over 1-3 years at ten grassland sites of the central and western United States, under the US Grassland Biome Project of the International Biological Program (IBP). The aim of the US/IBP Grassland Biome program was to study the whole US grassland system, particularly the seasonal biomass and energy dynamics of grasslands across multiple trophic levels (Sims et al., 1978). The ten sites for which net primary productivity (NPP) data are reported encompassed six major grassland types, ranging from latitude 30 to 48 N and longitude -96 to -123 W. The elevation ranged from 390 m to 2,340 m. Mean annual precipitation for the ten sites ranged from 228 mm to 930 mm, and mean annual temperature from 2.7 degrees C to 15.2 degrees C.

4. Quality Assessment:

Under the US Grassland Biome Project, above- and below-ground net productivity at the participating grassland sites was measured and calculated using comparable methods.

Sources of Error

Annual ANPP determined by the summation of peak live weights of individual species, as in this study, can yield a conservative estimate because material produced, senesced and detached before the peak live weight of a given species occurs is unaccounted for. The presence of different growth forms in the variety of vegetation types grasslands complicates the study of crowns and estimation of crown biomass production. Difficulties and inaccuracies involved in the estimation of root production arise primarily because of insufficient information on the periods of greatest root growth and decomposition, and the unaccounted losses of organic root secretions, sloughing of root hairs, root caps, and cortical layers, translocation of organic

material to the soil and to the fungal components of mycorrhizal roots, death and decay of fine roots, and consumption of fine roots by soil. Estimates of root production should therefore be viewed with the constraints imposed by the procedures used.

5. Data Acquisition Materials and Methods:

Site Information

The Osage study site (36.95 N, -96.55 W, Elevation 392 m) is situated in the U.S. Central Lowlands, about 60 km northwest of the city of Tulsa, Oklahoma, on the K. S. Adams Ranch, a rangeland of 14,000 ha. It is located at the southern end of the Flint Hills, the largest expanse of unbroken tallgrass prairie in the United States. The terrain is level to undulating, and the soil-texture at the study site is silty clay Mollisol.

Osage is classified as a tallgrass prairie (modified Bailey ecoregion humid temperate/sub-tropical prairie, #255) and is dominated by warm-season plants. *Andropogon scoparius* (Little Bluestem) and *Sorghastrum nutans* (Indiangrass) are the abundant species at Osage. The midgrass *Sporobolus asper* (Tall Dropseed) is an important constituent of the tallgrass prairie, especially under grazed conditions. It should be noted that in this study herbage samples were not separated except for the major species. Thus, the total number of vegetation species recorded in this study (13) may underestimate Osage flora.

The experimental design at the Osage site included an ungrazed and a recently-grazed treatment, with two replications of each. The ungrazed treatment refers to long-term absence of grazing by large domestic herbivores by exclosure. The ungrazed treatment area had not been grazed between 1950 and 1970, although it may have been mowed for hay as late as 1968. In the opinion of the investigators, there had been sufficient time of ungrazed treatment for these areas to become successionally stable. The grazed treatment refers to grazing during the previous growing seasons, since no domestic animals were allowed on the areas sampled during the study years. The grazed treatment had been relatively lightly grazed, primarily in early spring and late fall (autumn).

Climate data are available from the weather station at Pawhuska, Oklahoma (36.67 N, -96.35 W) at an elevation of 255 m for the period 1898-1994. Mean annual precipitation for the period was 916.47 mm. Approximately 75% of the annual rainfall occurs between April and September for this grassland. Mean maximum temperature was 34.50 degrees C and mean minimum temperature -7.20 degrees C. At Osage, the length of thermal potential growing season (defined as the number of consecutive days with a 15-day running-mean air temperature at or above 4.4 degrees C) averaged 272 days during the study. The growing season begins, in general, between late February and late March.

Intra-seasonal dynamics of the various above-ground and below-ground primary producer compartments were studied at Osage. The experimental design included two replications of ungrazed (i.e., long-term absence of grazing by large domestic herbivores by enclosure) and recently-grazed treatments. Structural characteristics studied included quantities of cool- and warm-season plants at each plot, and magnitude and seasonality of primary producer compartments. These latter measurements included seasonal above-ground live biomass, above-ground dead matter (recent plus old dead), total above-ground standing crop (living plus dead biomass), below-ground biomass by depth (root and crown inclusive), and total below-ground biomass. Litter decomposition and below-ground root turnover were measured but the data are not included in this data set.

Above-ground biomass was measured by the harvest technique, over successive 2-week intervals during the growing season. The aerial plant material was clipped at the soil surface from 0.5-m^2 square harvest plots in 1970 and 1972 and 0.5-m^2 circular quadrats in 1971. In 1970, Osage used 2.0-m^2 quadrats in addition to the 0.5-m^2 quadrats. Above-ground plant biomass was separated into several compartments, including perennial live, current (annual) live, recent dead, and old dead. Recent and old dead were primarily determined on the basis of color and the experience of the field and laboratory workers; recent dead was the material produced and senesced during the current growing season, while old dead was carry-over material from the previous year. Live and dead compartment material was further separated by species. Litter material was hand-picked from the harvest plots in 1970 and removed by a vacuum device in 1971 and 1972. All material was oven-dried at 60 degrees C. Aerial materials were presented on a dry matter basis while litter weights were converted to an ash-free basis. Perennial and current live were summed to obtain total live material, and likewise recent dead and old dead were summed to give total dead material.

Below-ground biomass was sampled by coring within the harvested plots to a depth sufficient to include at least 90% of the root mass. At Osage, that was 90 cm. Root crown sampling was limited to one-quarter of the above-ground sampling quadrat. Soil cores were obtained by hydraulic coring. Soil cores containing root samples were separated into 10-cm increments, and the increments washed over a 32-mesh screen. In 1971 and 1972, an additional fine screen was used during the washing process. Root material obtained was dried at 60 degrees C, weighed, and then ashed. Further details for specific sampling procedures for Osage appear in Risser (1971), Risser and Kennedy (1972), and Sims et al. (1978).

Intra-seasonal biomass dynamics data are provided in this data set. Annual ANPP or shoot production was determined by summing peak live weights of individual species. Net root production was estimated by summing significant positive increases in root biomass by depth. Annual BNPP was estimated as the sum of total root biomass (including crown biomass). Data analysis and results are discussed by Sims and Singh (1978b).

Climate data from the weather station at Pawhuska, Oklahoma (36.67 N, - 96.35 W, Elevation of 255 m) are available for the 1898-1994 period. Reported measurements included precipitation, minimum temperature, and maximum temperature.

The climate data accompanying this NPP data set was compiled from daily observations of Tmax, Tmin, and precip amount.

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.

Figure 2. Litter collection using a "D-Vac" motorized vacuum system on the ungrazed treatment at the Osage grassland site, Oklahoma, USA (Photograph taken in 1972 by Dr. W.J. Parton, Colorado State University).

Figure 3. Litter bag for decomposition studies at the Osage grassland site, Oklahoma, USA (Photograph taken in July 1971).

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:

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Additional Sources of Information:

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Sims, P.L., and J.S. Singh. 1978b. The structure and function of ten western North American grasslands. III. Net primary production, turnover and efficiencies of energy capture and water use. Journal of Ecology 66: 573-597.