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NPP Boreal Forest: Canal Flats, Canada, 1984, R1

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Revision date: July 15, 2013

Summary:

This data set contains two files (.txt). One file contains stand characteristics, soil characteristics, biomass distribution, and production allocation data measured during the 1984 growing season in four lodgepole pine stands (*Pinus contorta* var. *latifolia*) located near Canal Flats, British Columbia, Canada (50.2 N -115.5 W Elevation 1,300-1,380 m). The second file contains climate data from a nearby weather station at Kananaskis Boundary, Alberta (50.98 N -115.12 W Elevation 1,463 m).

Two lodgepole pine stands were growing on xeric sites and two stands were growing on mesic sites. The stands were 70-78 years old, were unmanaged, and had regenerated naturally following wildfire. They were studied to determine the influence of soil water content on resource allocation to above-ground versus below-ground plant components.

Above-ground NPP of the two xeric stands was 350 and 330 g/m^2/yr, and below-ground NPP was 430 and 630 g/m^2/yr, respectively, giving a range of total NPP from 780 to 960 g/m^2/yr. ANPP of the two mesic stands was 640 and 740 g/m^2/yr, and BNPP was 550 and 450 g/m2/yr, respectively, giving total NPP of 1,190 g/m^2/yr in each case. Although the ANPP of the mesic stands was approximately double that of the two xeric stands, total NPP was only 36% greater for the mesic stands than for the xeric stands. Production allocation was in the following order: fine and small roots > stems > foliage > coarse roots > branches, for all but the wettest site, where stem production exceeded fine and small root production.

Revision Notes: This data set has been revised to correct the sampling date (month) when above-ground biomass samples were collected. Please see the Data Set Revisions section of this document for detailed information.

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.html.

Data Citation:

Cite this data set as follows:

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This data set was originally published as:

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Table of Contents:

1. Data Set Overview:

Project: Net Primary Productivity (NPP)

This data set contains estimates of the accumulation of above- and below-ground biomass by plants for a given year (1984). Four lodgepole pine stands were studied -- two growing on xeric sites and two growing on mesic sites -- to determine the influence of soil water content on resource allocation to above-ground versus below-ground plant components.

Above and below-ground biomass and productivity of four lodgepole pine stands (*Pinus contorta* var. *latifolia*) were determined near Canal Flats, Canada, during the 1984 growing season. Two stands growing on xeric sites and two stands growing on mesic sites were studied to determine the influence of soil water content on resource allocation to above-ground versus below-ground plant components. The stands were 70-78 years old, unmanaged, and had regenerated naturally following wildfire.

The study sites are located in the Rocky Mountains of southeastern British Columbia, just east of the town of Canal Flats (50.2 N -115.5 W), approximately 75 km north of Cranbrook, British Columbia, and 150 km southwest of Calgary, Alberta. Three of the four study sites are located near the junction of the White River and the North Fork of the White River (50.1 N -115.25 W) and one study site is located south of Whiteswan Lake (50.1 N -115.5 W).

Climate data were recorded from a weather station at Kananaskis Boundary Research Station, Alberta (50.98 N -115.12 W Elevation 1,463 m). This area experiences a mean annual temperature of about 1.4 C and annual precipitation of around 630 mm.

Biomass and productivity were estimated from regression equations developed from several local lodgepole pine stands, together with data from angle-count sampling of the stands. Foliage production was estimated as the biomass of 2-year-old needles. Fine and small root biomass and productivity were estimated from soil cores taken from the lower organic and upper mineral soil horizons, with productivity estimated as the sum of increases in biomass for the organic horizon and maximum-minus-minimum biomass for the mineral soil.

Stem biomass represented 68 and 73% of total tree biomass on the xeric and mesic sites, respectively. Total root biomass represented between 20 and 28% of total lodgepole pine biomass. Fine and small roots (< 5 mm diameter) represented 4 and 1.5% of total tree biomass on the xeric and mesic sites, respectively.

Above-ground NPP of the two xeric stands was 350 and 330 g/m^2/yr, and below-ground NPP was 430 and 630 g/m^2/yr, respectively, giving a range of total NPP from 780 to 960 g/m^2/yr. The two mesic stands had above-ground NPP of 640 and 740 g/m^2/yr, and the respective below-ground NPP of these stands was 550 and 450 g/m^2/yr, giving total NPP of 1,190 g/m,/yr in each case. Although the above-ground NPP of the mesic stands was approximately double that of the two xeric stands, total NPP was only 36% greater for the mesic stands than for the xeric stands.

Stemwood production represented 20 and 27% of total net primary production on the xeric sites and 35% on both mesic sites. Below-ground production represented 38 and 46% of total net primary production on the two mesic sites (450 and 550 g/m^2/yr, respectively) and 55 and 66% on the two xeric sites (430 and 630 g/m^2/yr, respectively). Fine and small roots represented 82-94% of below-ground production. Production allocation was in the following order: fine and small roots > stems > foliage> coarse roots > branches, for all but the wettest site, where stem production exceeded fine and small root production.

ANPP, BNPP, and TNPP estimates are also reported in Olson et al. (2012a, b) and Scurlock and Olson (2012). These values are comparable to the average of the values reported by Comeau and Kimmins (1989) for the mesic sites (Table 1).

Table 1. ANPP, BNPP, and TNPP values reported by various published data sources

File Name or Description	Data Source(s)	Sub-Site	ANPP	BNPP	TNPP
			gC/m^2/year		
cnl_npp_r1.txt	Comeau and Kimmins (1989)[1]	cnl xeric1	166	204	375
		cnl xeric2	157	299	456
		cnl mesic1	304	261	565
		cnl mesic2	223	214	565
NPP_Multibiome_EnvReview _Table_A1_R1.xls	Scurlock and Olson (2012) based on Comeau and Kimmins (1989)	cnl (average of the two mesic sub-sites)	328	238	565

GPPDI_ClassA_NPP_162_R2.csv	Olson et al. (2012a)based on Scurlock and Olson (2012) calculation	Class A 115 (MI 102) (average of the two mesic sub-sites)	328	238	565
EMDI_ClassA_NPP_81_R2.csv	Olson et al. (2012b)based on Scurlock and Olson (2012) calculation	Class A 115 (average of the two mesic sub-sites)	328	238	565

Notes: NA = Not available. MI = Measurement identification number. The differences in NPP values reported in this table are mainly due to differences in calculation methods, as explained in these notes.

Please consult original references for details.

Please see the Data Set Revisions section of this document for detailed information on the revised data sets (R1, R2, etc.)

[1]For this table, NPP data from the original data source were converted from grams of dry weight per meter square per year to grams of carbon per meter square per year using a conversion factor of 0.475. The ANPP estimate is based on field measurement and calculation of foliage production + branch biomass increment + stem wood increment. The BNPP estimate is based on fine and small root production. TNPP = ANPP + BNPP.

2. Data Description:

Spatial Coverage

Site: Canal Flats, Canada

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

Site (Region)	Westernmost Longitude	Easternmost Longitude	Northernmost Latitude	Southernmost Latitude	Elevation (m)
Canal Flats, Canada	-115.5	-115.5	50.2	50.2	1,300 - 1,380

Site Information

The NPP study sites are located in the Rocky Mountains of southeastern British Columbia, just east of the town of Canal Flats (50.2 N 115.5 W), approximately 75 km north of Cranbrook, British Columbia, and 150 km southwest of Calgary, Alberta. Three of the four study sites are located near the junction of the White River and the North Fork of the White River (50.1 N 115.25 W) and one study site is located south of Whiteswan Lake (50.1 N 115.5 W). The study sites span an elevation gradient from 1,300 to 1,380 m.

The weather station is located at the Kananaskis Boundary Research Station, Alberta, Canada (Latitude 50.98 N, Longitude 115.12 W) at an elevation of 1,463 m. Mean annual precipitation at the weather station for the period 1962-1986 was 630 mm. Annual average temperature for this time period was 1.4 C.

The lodgepole stands are classified as western montane forest (modified Bailey ecoregion forest/alpine meadow, #M331). The dominant tree species is *Pinus contorta* var. *latifolia*. The four lodgepole stands selected for study were unmanaged stands had regenerated naturally following wildfire. Soil types are loamy sand (xeric sub-sites) and loam and silty clay loam (mesic sub-sites). Site characteristics of each of the four stands are outlined in Table 2.

Table 2. Characteristics of the four lodgepole pine stands studied

Soil moisture regime and plot	Elevation (m)	Soil drainage	F & H horizons (cm)	Stand density (per ha)	Age (yr)	Mean annual increment (MAI) (g/m^2/yr)
Xeric 1	1,300	Rapid	3.4	1,900	70	154
Xeric 2	1,300	Rapid	3.5	3,580	70	164
Mesic 1	1,370	Well	6.5	1,770	70	305
Mesic 2	1,380	Moderately well	5.1	1,900	80	353

Spatial Resolution

Stand size is not available. Fine and small root production was estimated from soil cores. Mineral soil samples were obtained with a 10-cm diameter steel tube corer driven to 40-cm depth. A 5-cm diameter steel tube corer was used to collect samples of forest floor organic horizons (F and H) beside each mineral soil core. Soil temperature was measured at 30-cm depth in randomly selected fresh core holes. Aluminum access tubes were also installed for probe readings at 35 cm below the soil surface. Gravimetric samples of mineral soil were taken from 30- to 40-cm depths 2 m from each access tube in each plot.

Temporal Coverage

All measurements were made from 1984/01/01 to 1984/12/31.

Temporal Resolution

Biomass measurements were made in August. Soil measurements were made in June, July, August, and November. All NPP measurements are expressed on a annual basis (g/m^2/yr).

Data File Information:

Table 3. Data files in this data set archive

FILE NAME	FILE CONTENTS
cnl_npp_r1.txt	Stand characteristics, soil parameter, above- and below-ground biomass, and productivity data for four lodgepole pine stands located near Canal Flats in the Rocky Mountains of southeastern British Columbia, Canada
cnl_cli.txt	Monthly and annual precipitation amount and average temperature data from a weather station near the Canal Flats sites at Kananaskis Boundary Research Station, Alberta, Canada

NPP Data. NPP estimates for the Canal Flats sites are provided in one file (Table 3). The data sets are text files (.txt format). The variable values are delimited by semi-colons. The first 18 lines are metadata; data records begin on line 19. The value -999.9 is used to denote missing values. All NPP units are in g/m^2/yr (dry matter weight).

Table 4. Column headings in NPP file

COLUMN HEADING	DEFINITION	UNITS
Site	Site where data were gathered (code refers to site identification)	Text
Treatmt	Study area where measurements were made; treatment of study plots are described in metadata in data files	Text
Year	Year in which data were collected	Numeric
Month	Month in which data were collected	
Day	Day on which data were collected	
parameter	Parameters measured (see definitions in Table 3)	Text
amount	Data values	Numeric
units	Unit of measure	Text
References / comments	Primary references plus explanatory comments	Text

Table 5. Parameter definitions in NPP file

PARAMETER	DEFINITION	UNITS	SOURCE[1]
numdensity	Tree density per hectare	trees/ha	Table 2
age	Stand age	years	
height	Mean tree height	m	Personal communication from PIs[2]
mean_annual_increment	Mean annual increment	g/m^2/yr	Personal communication from PIs[3]
needles	Needle biomass determined by harvest methods	g/m^2	Table 4
branches	Branch biomass determined by harvest methods		
trunks	Trunk biomass determined by harvest methods		
AGbiomass	Above-ground biomass (needle + branch + truck)		
roots>5mm	Biomass of small roots (> 5 mm diameter)		

	determined from soil cores	g/m^2	
roots<5mm	Biomass of fine roots (< 5 mm diameter) determined from soil cores		
BGbiomass	Below-ground biomass (fine + small roots)		
needle_NPP	Foliage production (estimated as the biomass of 2-year-old needles)	g/m2/yr	Table 5
branch_NPP	Branch production (based on regression equations)		
trunk_NPP	Trunk production (based on measurements of radial increment over the recent 5-year period and of sapwood width obtained from two increment cores plus height increment estimated using published site index equations for lodgepole pine and measured tree height)		
ANPP	Above-ground net primary production (calculated for each stand as the sum of calculated values for each sampled tree multiplied by the sampling probability for each tree)		
root>5mm_NPP	Coarse root production	g/m2/yr	
root<5mm_NPP	Fine plus small root production		
BNPP	Below-ground net primary production production (calculated as the sum of all increments in fine and small + coarse root biomass over the sampling period)		
NPP	Total net primary production (stand total)	g/m2/yr	
F&H_horizon_depth	Depth of F & H horizons	cm	Table 1
soil_temperature	Seasonal soil temperature at 30-cm depth	C	Figure 2
soil_moisture	Seasonal soil moisture at 35-cm depth	percent	

Notes: [1]All data are from Comeau and Kimmins (1989) unless otherwise noted.

[2]A different value is given in Table 2 in Comeau and Kimmins (1989) based on a site index (m at 100 years).

[3]A different value is given in Table 2 in Comeau and Kimmins (1989).

Sample NPP Data Record

```
Site; Treatmt; Year; Month; Day; parameter; amount; units; Reference/comments

cnl ; xeric1; 1984; -999.9; -999.9; numdensity; 1900; trees/ha; All data from
cnl ; xeric1; 1984; -999.9; -999.9; age; 70; years; Comeau and Kimmins (1989)
cnl ; xeric1; 1984; -999.9; -999.9; height; 13.9; m;
cnl ; xeric1; 1984; -999.9; -999.9; mean_annual_increment; 153; g/m2/yr;
cnl ; xeric1; 1984; 8; -999.9; needles; 490; g/m2;
cnl ; xeric1; 1984; 8; -999.9; branches; 710; g/m2;
cnl ; xeric1; 1984; 8; -999.9; trunks; 10740; g/m2;
cnl ; xeric1; 1984; 8; -999.9; AGbiomass; 11940; g/m2;
cnl ; xeric1; 1984; 8; -999.9; roots>5mm; 3030; g/m2;
cnl ; xeric1; 1984; 8; -999.9; roots<5mm; 640; g/m2;
cnl ; xeric1; 1984; 8; -999.9; BGbiomass; 3660; g/m2;
cnl ; xeric1; 1984; -999.9; -999.9; needle_NPP; 120; g/m2/yr;
cnl ; xeric1; 1984; -999.9; -999.9; branch_NPP; 20; g/m2/yr;
cnl ; xeric1; 1984; -999.9; -999.9; trunk_NPP; 210; g/m2/yr;
cnl ; xeric1; 1984; -999.9; -999.9; ANPP; 350; g/m2/yr;
cnl ; xeric1; 1984; -999.9; -999.9; roots>5mm_NPP; 40; g/m2/yr;
cnl ; xeric1; 1984; -999.9; -999.9; roots<5mm_NPP; 390; g/m2/yr;
cnl ; xeric1; 1984; -999.9; -999.9; BNPP; 430; g/m2/yr;
cnl ; xeric1; 1984; -999.9; -999.9; NPP; 790; g/m2/yr; ...
```

Climate Data. The climate data for the Canal Flats sites are provided in one file (Table 3). The data set is a text file (.txt format). The variable values are delimited by semi-colons. The first 18 lines are metadata; data records begin on line 19. The value -999.9 is used to denote missing values. Mean monthly and annual climate data for the period 1962-1986 are from the weather station at the Kananaskis Boundary Research Station, Alberta, Canada.

Sample Climate Data Record

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

cnl ;mean;prec; 59.2; 47.8; 35.6; 52.0; 79.9; 92.6; 45.0; 44.4; 45.1; 34.8; 38.2; 51.9; 634.5
cnl ;mean;tavg; -13.5; -8.2; -5.7; 0.6; 6.5; 10.5; 13.2; 13.4; 8.7; 4.3; -4.1; -10.0; 1.4
cnl ;numb;prec; 10; 10; 10; 13; 19; 21; 21; 18; 17; 12; 10; 10; 6
cnl ;numb;tavg; 10; 10; 10; 13; 16; 19; 20; 18; 16; 10; 10; 10; 6
cnl ;stdv;prec; 41.4; 48.2; 21.7; 31.7; 59.5; 59.3; 27.8; 29.1; 27.2; 19.7; 29.4; 41.5; 154.5
cnl ;stdv;tavg; 4.2; 3.5; 2.8; 2.5; 1.4; 1.1; 1.0; 1.7; 2.7; 2.6; 2.8; 4.3; 0.4
cnl ;1962;prec; -999.9; -999.9; -999.9; 22.9; 65.0; 47.8; 51.6; -999.9; 51.1; 17.5; -999.9; -999.9; -999.9
cnl ;1963;prec; -999.9; -999.9; -999.9; -999.9; 35.3; 274.6; 90.9; 29.2; 42.7; 56.6; -999.9; -999.9; -999.9
cnl ;1964;prec; -999.9; -999.9; -999.9; -999.9; 141.5; 114.8; 27.4; 16.8; 63.5; 26.4; 27.9; 48.3; -999.9
cnl ;1965;prec; 41.9; 133.4; 26.7; 31.0; 44.7; 189.7; 39.9; 112.5; 110.0; 31.8; 41.9; 119.9; 923.4
cnl ;1966;prec; 43.2; 5.1; 26.7; 30.5; 88.9; 62.0; 42.9; 58.4; 26.2; 82.3; 114.3; 11.7; 592.2
cnl ;1967;prec; 40.6; 48.3; 48.3; 88.9; 83.8; 54.1; 10.2; 47.2; 3.8; 43.4; 15.2; 49.5; 533.3
cnl ;1968;prec; 21.6; 2.5; 53.3; 45.7; 89.2; 99.6; 35.6; 48.5; 63.2; 30.2; 17.8; 99.1; 606.3
cnl ;1969;prec; 39.4; 15.2; 5.1; 110.2; 29.2; 131.1; 41.7; 7.6; 28.7; 46.0; 20.3; 11.4; 485.9
cnl ;1970;prec; 58.4; 25.4; 16.5; 94.5; 24.4; 163.3; 15.7; 7.6; 23.4; -999.9; 54.6; 25.4; -999.9
cnl ;1971;prec; 64.8; 25.4; 68.6; 54.6; 88.9; 108.0; 20.6; 15.0; 55.1; 30.5; 27.9; 106.7; 666.1
cnl ;1972;prec; 105.4; 127.0; 63.5; 21.6; 27.2; 54.1; 69.3; 40.4; 68.3; -999.9; -999.9; -999.9; -999.9
cnl ;1973;prec; -999.9; -999.9; -999.9; -999.9; 69.6; 47.8; 30.7; 72.1; 41.9; 14.0; 39.4; 19.1; -999.9
cnl ;1974;prec; 154.9; 21.6; 31.8; 85.9; 89.2; 35.6; 17.0; 57.4; 34.8; -999.9; 22.9; 27.9; -999.9
cnl ;1975;prec; 21.6; 73.7; 15.2; -999.9; 64.0; 78.5; 70.4; -999.9; -999.9; -999.9; -999.9; -999.9; -999.9 …


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)
  tavg = mean average 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 data set accounts for above-ground growth (i.e., needle, branch, and trunk NPP) and below-ground growth (i.e., NPP of roots > 5 mm and NPP of roots < 5 mm). These are considered the major components of NPP.

This study of biomass distribution and production allocation in four stands of lodgepole pine (*Pinus contorta* var. *latifolia*) was conducted to test the hypothesis that a larger proportion of production is invested in root systems on sites with xeric (very dry to dry) soil moisture regimes than on sites with mesic (fresh) soil moisture regimes.

Above- and below-ground biomass and productivity of four lodgepole pine stands are provided for comparison with model output and estimates of NPP for other forest biomes. Climate data are provided for use in driving ecosystem/NPP models.

4. Quality Assessment:

Given that the measurements are presented on an annual basis, the amount of observation time (span of 1 year) is relatively short, although typical of many NPP studies.

Above-ground values for stem biomass are larger than those reported for stands of similar age by Pearson et al. (1984), Johnstone (1971), and Moir (1972), branch biomass is within the range of values reported by these authors, and foliage biomass is within or below the reported range.

The large differences in production allocation between lodgepole pine stands growing on xeric and mesic sites are similar to those reported by Keyes and Grier (1981) for Douglas-fir stands.

The estimates of below-ground production presented in this study are probably conservative, because short-term fluctuations in below-ground biomass were not measured and the synchronous occurrence of production and mortality was not considered.The method used to calculate below-ground production also assumes that the data represent actual seasonal maximum and minimum values. However, the results of this study can be compared with those of most other studies in which similar methods have been employed. Further studies of soil carbon budgets are required to evaluate the consequences and validity of these assumptions.

The production of fine and small roots varied with both site and stand characteristics, ranging from 370 to 590 g/m /yr. Evidence from other studies (Pearson et al. 1984; P.G. Comeau, unpublished data) suggests that the proportion of production allocated to roots may also increase with increasing stand density in lodgepole pine stands. The mechanisms involved in this shift in production allocation with changing stand density require further study.

Sources of Error

Acquiring and processing a sufficiently large number of samples to provide statistically reliable estimates of belowground biomass has been a major problem in studies of belowground production. Data from this study indicate that 20 mineral soil samples taken with a 10 cm diameter corer would provide estimates of mean fine and small root biomass with an allowable error of 20% (= 0.10) in all but 3 of the 16 cases. For soil organic horizons, 40 samples collected with a 5 cm diameter corer would be needed to achieve these levels of precision for all but 3 of the 16 cases. Such large numbers of samples, particularly from organic horizons, would have required larger investments in sample processing than were possible in this study.

5. Data Acquisition Materials and Methods:

The biomass and productivity data are from Comeau and Kimmins (1989).

Biomass and productivity were estimated from regression equations developed from several local lodgepole pine stands. The regression equations were developed in conjunction with this study and a second study of variation in aboveground production in 30 stands. A total of 68 trees was harvested from 13 stands representing a range of sites (xeric to mesic), stand densities (400 - 10,000 trees/ha), tree diameters (5-45 cm DBH), and ages (20-150 years).

Variables tested for predicting aboveground component biomass were sapwood basal area, basal area, age, sapwood area x height to base of live crown, sapwood area x height, basal area x height, and basal area x height to base of live crown. The variable (basal area x height)^2 was added to deal with the curvilinear nature of the relationship between stem biomass and basal area x height. Variables were selected using backwards selection (= 0.05).

Foliage production was estimated as the biomass of 2-year-old needles. Observations of the age-class distribution of needle biomass indicated a continuous gain in the weight of individual needles with age and very little loss of needles less than 3 years of age to litter fall.

Above-ground biomass and production of each stand were estimated using data from angle-count sampling (Bitterlich, 1984) and the regression equations. Diameter, height, and height to crown base of each sampled tree were measured. Measurements of radial increment over the recent 5-year period and of sapwood width were obtained from two increment cores collected from opposite sides of each tree at breast height (1.3 m). Height increment was estimated using published site index equations for lodgepole pine (Hegyi et al., 1979) and measured tree height. Stand biomass and production were calculated as the sum of calculated values for each sampled tree multiplied by the sampling probability for each tree.

Fine and small root production was estimated from soil cores taken from the forest floor and mineral soil in each stand on four occasions. During mid-June, mid-July, and late August of 1984, 20 mineral soil samples were collected using a 10-cm diameter steel tube corer driven to 40-cm depth. A 5-cm diameter steel tube corer was used to collect 20 samples of forest floor organic horizons (F and H) beside each mineral soil core. During late November, 10 samples each of mineral soil and forest floor were collected using the same corers. On each sampling occasion, soil temperature was measured at 30-cm depth in five randomly selected fresh core holes. Soil moisture content was measured during July and August 1985, using a Troxler Depth Moisture Gauge. Aluminum access tubes were installed during June 1984 at five points in each stand. Readings were taken with the probe lowered to 35 cm below the soil surface. Because reliable readings could not be obtained immediately following installation of access tubes, soil moisture during June was estimated from five gravimetric samples of mineral soil taken from 30- to 40-cm depths 2 m from each access tube in each plot. During November 1984, access tubes were blocked with ice and soil moisture values were obtained by measuring five gravimetric samples.

Following collection, samples of mineral soil plus roots were washed over 0.5-mm sieves to separate root material from mineral soil. After initial separation, the partially cleaned root samples were stored frozen at - 2 C for later processing in the laboratory. Samples of forest floor plus roots were stored frozen at - 2 C until they were processed.

Roots of lodgepole pine were manually separated in water from those of other species, and then separated into live and dead components, and into fine plus small (<5 mm diameter) and coarse (> 5 mm diameter) size classes. Live lodgepole pine roots were intact, flexible, and reddish-colored, and showed no signs of decomposition. Dead roots were discolored and brittle, often consisting of a hollow ectomycorrhizal sheath. Following separation, samples were oven-dried at 70 C for 72 h. Although lodgepole pine fine roots were predominantly ectomycorrhizal, no attempt was made to separate mycorrhizae from root material.

Fine and small root production in forest floor horizons was calculated as the sum of all increments in biomass over the sampling period. In mineral soil horizons, seasonal patterns of fine and small root biomass showed only one annual maximum and one annual minimum value. Consequently, production of fine and small roots in mineral soil horizons was estimated using the "maximum-minimum" technique of McClaugherty et al. (1982), minimum summer values being subtracted from maximum fall or spring values.

Climate data were recorded from a weather station at Kananaskis Boundary Research Station, Alberta (50.98 N -115.12 W Elevation 1,463 m). Monthly and annual precipitation amount and average air temperature are provided for the period 1962-1986, although the climatological record is rather patchy.

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:

Comeau P.G. and J.P. Kimmins. 1989. Above-ground and below-ground biomass and production of lodgepole pine on sites with differing soil-moisture regimes. Canadian J. Forest Research 19: 447-454.

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8. Data Set Revisions:

Revision Summary:

This data file (**cnl_npp_r1.txt**) has been revised to correct the sampling date (month) when above-ground biomass samples were collected.

Data File Changes:

The sampling date (month) when above-ground foliage, branch, and stem biomass samples were collected at each site has been corrected to agree with Table 4 in Comeau and Kimmins (1989). The data values in **cnl_npp_r1.txt** are now correct.

Parameter Field* (with above-ground biomass variable)	Uncorrected in cnl_npp.txt	Corrected in cnl_npp_r1.txt
Month (needles)	-999.9	8
Month (branches)	-999.9	8
Month (trunks)	-999.9	8
Month (AGbiomass)	-999.9	8

* = Column heading. See data set Guide document for parameter definitions.

Data User Action: If you downloaded the referenced data set from the ORNL DAAC on-line archive before July 15, 2013, you should download it again from the ORNL DAAC.

Revision History:

Original Citation:

Comeau, P. G., and J. P. Kimmins. 1999. NPP Boreal Forest: Canal Flats, Canada, 1984. Data set. Available on-line [http://daac.ornl.gov] from Oak Ridge National Laboratory Distributed Active Archive Center, Oak Ridge, Tennessee, USA

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