NBR SUMMER WEATHER, NITROGEN & VEGETATION METADATA:

A. COLOR –

1) Gray = year of study
2) Olive = weather
3) Blue = HILL site (UTM 706453 EAST 5249980 NORTH)
4) Rose = TRIANGLE site (UTM 713570 EAST 5248100 NORTH)
5) Green = TRISKY site (UTM 711317 EAST 5242500 NORTH)
6) Light Blue = TOWER 2 – GRASSY site (UTM 708205 EAST 5244024 NORTH)
7) Orange = Misc. sites [HILL 2 (UTM 706407 EAST 5249831 NORTH), PAULINE (UTM 705717 EAST 5247255 NORTH), NORTH BOUNDARY (UTM 710177 EAST 5250023 NORTH), TOWER 2 – ROCKY (UTM 708212 EAST 5243906 NORTH)]

B. YEAR –

1) Study = began in 1978 and has continued every year.
2) Weather data from 1978 – 2000 was collected by the NBR staff at their original headquarters (latitude: 47 22 05; longitude: 114 15 03; elevation 795 m).
3) Weather data after 2000 (year marked with *) was not regularly recorded by the NBR staff and the weather station was moved to the new headquarters. Therefore, weather data was used from the AgriMet weather station at Round Butte, MT (distance from NBR: 18.9 km; latitude: 47 32 22; longitude: 114 16 50; elevation: 926 m; established: 5/23/89; http://www.usbr.gov/pn-bin/yearrpt.pl?StationName=RDBM&dataType=MM&START=1989&END=2000&head=no). From 1989 – 2000, June precipitation and temperature were highly correlated between these two weather stations (precipitation: $r = 0.94$, $N= 12$, constant $p < 0.59$, slope = 1.03 & $p < 0.000001$; temperature: $r = 0.94$, $N = 12$, constant $p < 0.58$, slope = 0.94 & $p < 0.000008$).

C. WEATHER –

1) June temperature = average of the maximum and minimum air temperature recorded for each day within June of each year.
2) June precipitation = sum of daily precipitation for each day within June of each year. If precipitation occurred during the night of May 31 - June 1, it was manually added to the total for June, even though the weather stations recorded this as May 31 precipitation.
3) Summer temperature = average of the maximum and minimum air temperature recorded for each day within July and August of each year.

D. WITHIN EACH SITE –

1) Elevation = meters above sea level measured using GPS and USGS topographic map.
2) Fall nitrate. At each site in May, 3 resin bags (Rexyn © Fisher Scientific, Binkley & Hart 1989) were randomly located, buried 15 cm. and collected in October. Resin bags were kept frozen after collection until analyzed, nitrogen was extracted using 2M KCl, and extract was analyzed for NO_3^- via spectrophotometer (©Latchat) (Robertson et al. 1999).
3) Fall ammonium. At each site in May, 3 resin bags (Rexyn © Fisher Scientific, Binkley & Hart 1989) were randomly located, buried 15 cm. and collected in October. Resin bags

were kept frozen after collection until analyzed, nitrogen was extracted using 2M KCl, and extract was analyzed for NH_4^+ via spectrophotometer (©Latchat) (Robertson et al. 1999).

4) Spring nitrate. At each site in October, 3 resin bags (Rexyn © Fisher Scientific, Binkley & Hart 1989) were randomly located, buried 15 cm. and collected in May. Resin bags were kept frozen after collection until analyzed, nitrogen was extracted using 2M KCl, and extract was analyzed for NO_3^- via spectrophotometer (©Latchat) (Robertson et al. 1999).
5) Spring ammonium. At each site in October, 3 resin bags (Rexyn © Fisher Scientific, Binkley & Hart 1989) were randomly located, buried 15 cm. and collected in May. Resin bags were kept frozen after collection until analyzed, nitrogen was extracted using 2M KCl, and extract was analyzed for NH_4^+ via spectrophotometer (©Latchat) (Robertson et al. 1999).
6) Total annual aboveground net primary production (ANPP): Two ANPP methods were employed over the study:
   a) For 1978 – 1993, live (green) vegetation was clipped on 10 – 12 randomly selected 0.1 m^2 plots at each site every two weeks from late May – mid-October. Clipped vegetation from each plot was dried for 48 hours at 60^o C, and then weighed.
   b) For 1994 – 2009, 10 – 12 permanent points were randomly selected at each site, and the abundance of live (green) vegetation was measured every two weeks by radiometer (Pearson et al. 1976, Milton 1987) from late May – mid-October. The radiometer was held at a height to measure a 0.10 m^2 area and 3 readings overlapping each point were made, providing an average value for ~0.25 m^2. Live plant biomass is computed from radiometer readings using a site and date specific regression. Each regression was based on radiometer readings of five 0.1 m^2 plots that were adjacent to the study site; plots were selected to range from very low to very high plant abundances. Green vegetation in each plot was clipped, dried for 48 hours at 60^o C, and weighed. Regressions averaged an r of 0.93 ($\pm$0.03 SE; range: 0.45 - 0.99).

   For either method, ANPP was the sum of all increases in live (green) plant biomass between consecutive periods from late May through mid-October. In 1994, clipping and radiometer measures were made and found to be highly correlated (r = 0.90, N = 4) and did not tend to over- or under-estimate ANPP (slope = 0.95 $\pm$ 0.17).
7) Grass annual aboveground net primary production. Clipped vegetation from each plot (#6 above) was separated between grass and dicot (forbs or leaves from woody vegetation), dried for 48 hours at 60^o C, and then weighed. Grass ANPP was calculated as described in #6 above.
8) Forb annual aboveground net primary production. Clipped vegetation from each plot (#6 above) was separated between grass and dicot (forbs or leaves from woody vegetation), dried for 48 hours at 60^o C, and then weighed. Forb ANPP was calculated as described in #6 above.
9) Proportion grass. Clipped vegetation from each plot (#6 above) was separated between grass and dicot (forbs or leaves from woody vegetation), dried for 48 hours at 60^o C, and then weighed. The weights were used to compute the relative abundance of grass.
10) Grass nitrogen content. The clipped vegetation in each plot (#6 above) since 1994 was separated into grass and forb, dried for 48 hours at 60^o C, and then the grass was analyzed for nitrogen content using micro-Kjeldahl methods in 1994 – 2000 (AOAC 1984) and combustion in an elemental analyzer (©Costech) after 2000 (Robertson et al. 1999).

11) Forb nitrogen content. The clipped vegetation in each plot (#6 above) since 1994 was separated into grass and forb, dried for 48 hours at 60^{o} C, and then the forb was analyzed for nitrogen content using micro-Kjeldahl methods in 1994 – 2000 (AOAC 1984) and combustion in an elemental analyzer (©Costech) after 2000 (Robertson et al. 1999).

12) Plant dormancy (%). Over the summer (July/August) after peak plant production (June), vegetation biomass declines as it becomes dormant or dies ("browns"). From the bimonthly ANPP measurements (#6 above), this decline in "green" (photosynthetically active) is measured as 1 – lowest observed summer biomass/peak observed biomass.

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