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Root Biomass Dataset of Alpine Meadow in Qinghai-Tibetan Plateau under the Artificial Climate Warming Experiment

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Abstract: Global warming has become an indisputable phenomenon and high-altitude ecosystems are more sensitive to climate change. In order to understand the change in root biomass of alpine meadows in a warming climate, typical plateau vegetation of alpine meadows was studied in the permafrost region of the Qinghai-Tibet Plateau (34°49′34″N–34°49′37″N, 92°55′57″E–92°56′06″E with an average elevation of 4,630 m). Infrared radiator (150 W/m^2) was used as the warming device in the experimental site to simulate temperature increase. Each sample area was 2 m×2 m, and the distance between adjacent samples was 4–5 m. In the growing season of 2012 and 2013 (May to September), root biomass of alpine meadow was sampled monthly with a soil auger (five typical plots were sampled in 2012 and three typical plots were sampled in 2013). Root samples were obtained from different soil layers by a soil auger with a diameter of 7 cm. Soil layers were 0–10 cm, 10–20 cm, 20–30 cm, 30–40 cm and 40–50 cm. The living roots were separated from the soil sample, and then dried at 75 °C before weighing. The dataset is archived in .xls data format with the data size of 47.5 KB.

Keywords: Qinghai-Tibetan Plateau; alpine meadow; root biomass; experimental warming

1 Introduction

Most ecologists have studied the aboveground parts of terrestrial ecosystems in depth, but there is little known about underground parts[1–2]. Roots are an important part of plants. The spatial distribution of roots and the complex relationships with the soil environment have an important impact on growth of the aboveground vegetation[3]. The underground distribution pattern of root biomass plays an important role in the maintenance and operation of the entire ecosystem, especially fine roots (diameter ≤ 2 mm) that obtain water and nutrients for

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plant growth[4]. Spatial structure of root biomass is not only influenced by the effects of root systems on underground resources, but also reflects the distribution of water and nutrients in the soil, and the response to different soil nutrients, water gradients and other characteristics of the soil[5].

As a sensitive area to global change, the Qinghai-Tibetan Plateau is an ideal place to study the mechanism of response of terrestrial ecosystems to global changes[6–7]. According to meteorological data from 1981 to 2010, the Qinghai-Tibetan Plateau is experiencing obvious warming[8–9]. Because the permafrost is widely found in the Qinghai Tibet Plateau, the alpine meadow systems in this area are very fragile[10]. Alpine meadows are extremely sensitive to the impacts of climate change and human activities[11–12]. Research on alpine meadow roots has been limited for the Qinghai-Tibetan Plateau, because climatic and environmental conditions are poor, root research methods are lacking and destructive in nature, and workloads are heavy[3].

2 Metadata of Dataset

The metadata for the root biomass alpine meadow[13] are summarized in Table 1.

Table 1 Metadata summary of the experimental warming dataset of alpine meadow root biomass in the Qinghai-Tibetan Plateau

Items	Description
Dataset full name	Root biomass dataset of alpine meadow in Qinghai-Tibetan Plateau under the artificial climate warming experiment
Dataset short name	RootBiomassAlpineMeadow
Author	Xu, M. H. F-8170-2017, Taiyuan Normal University, xumanhou@163.com
Geographical region	34°49′34″N–34°49′37″N, 92°55′57″E–92°56′06″E, average elevation of 4,630 m
Year	From May to September in 2012 and 2013
Data format	.xls
Data size	47.5 KB
Data files	One file: root biomass of 5 soil layers from 0 to 50cm in the artificial climate warming experiment from May to September in 2012 and 2013
Foundation(s)	National Natural Science Foundation of China (41501219)
Data publisher	Global Change Research Data Publishing & Repository, http://www.geodoi.ac.cn
Address	No. 11A, Datun Road, Chaoyang District, Beijing 100101, China
Data sharing policy	***Data*** from the Global Change Research Data Publishing & Repository includes metadata, datasets (data products), and publications (in this case, in the *Journal of Global Change Data & Discovery*). ***Data*** sharing policy includes: (1) ***Data*** are openly available and can be free downloaded via the Internet; (2) End users are encouraged to use ***Data*** subject to citation; (3) Users, who are by definition also value-added service providers, are welcome to redistribute ***Data*** subject to written permission from the GCdataPR Editorial Office and the issuance of a ***Data*** redistribution license; and (4) If ***Data*** are used to compile new datasets, the 'ten per cent principal' should be followed such that ***Data*** records utilized should not surpass 10% of the new dataset contents, while sources should be clearly noted in suitable places in the new dataset[14]

3 Methods

3.1 Experimental Design

The experiment was designed as a randomized block. There were five blocks in the experiment and each block had four treatments: control, warming (150 W/m^2, increasing the ground temperature 3 °C), clipping (the grasses were cut to a residual height of 1 cm) and warming and clipping combined[15–22]. There were 20 plots in total, each plot had an area of 2 m × 2 m and the distance between adjacent plots was 4–5 m. The data used in this study came from the control plots and warming plots. In the control plots, there was no warming and cutting treatment, and the natural state of the vegetation is maintained. In the warming plots, infrared radiators were used as heaters to simulate anthropogenic warming. The lamp body is a triangular prism with a length of 165 cm and a width of 15 cm, and the lamp tube is a cylinder with a length of 150 cm and a diameter of 8 mm. The reflector surface of the radiator was suspended at 1.5 m above the warmedplots. Since July in 2010, uninterrupted warming was applied throughout the year (Figure 1). The outer circumference of each group was surrounded by wire mesh to prevent damage.

3.2 Root Biomass Measurement

Root samples were obtained during the growing season, from May to September in 2012 and 2013, with the sampling time in the middle of each month and the sampling interval not exceeding 2–3 days[16–22]. The method of collection was soil drilling. We sampled root biomass using a soil auger with an inner diameter of 7 cm. Samples were collected from soil layers of 0–10 cm, 10–20 cm, 20–30 cm, 30–40 cm, and 40–50 cm. The number of drills was 1 in order to reduce damage to the ecosystem. After roots and soil were extracted, they were immediately placed in a cooler and transported to the laboratory. Then roots were separated from the soil samples and passed through a 60-mesh (0.28 mm aperture) sieve to retrieve fine roots. The root was washed with tap water and then put in a cool and ventilated place to dry. Then based on root color, flexibility and presence of attached fine roots, living roots were identified. Live roots were placed in an oven to dry to a constant weight at 75 °C, and then root biomass was weighed.

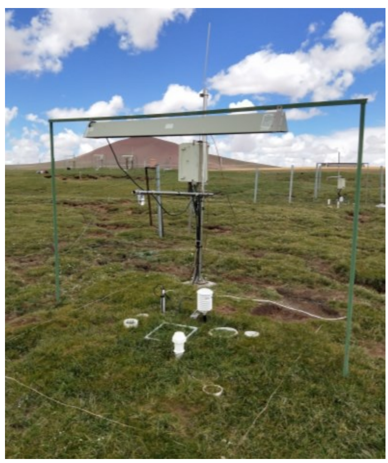

Figure 1 Warming device - infrared radiator (the Beiluhe Experimental Station)

3.3 Data Acquisition

The contour map of the root biomass was illustrated based on spatial and temporal distribution. The different months in the growing season were on the horizontal axis and different soil depths were on the vertical axis to investigate the variation in root biomass in different months and soil depths. In the graph, the depths of soil corresponded to root sampling soil layers, i.e., 0–50 cm soil layer corresponding to the depth of 0 cm, 0–10 cm soil layer corresponding to the depth of 10 cm, 10–20 cm soil layer corresponding to the depth of 20 cm, 20–30 cm soil layer corresponding to the depth of 30 cm, 30–40 cm soil layer corresponding to the depth of 40 cm, and 40–50 cm soil layer corresponding to the depth of 50 cm.

The total root biomass of 5 soil layers was used as the total root biomass, and histograms of total root biomass were created for different months, to analyze the variation of total root biomass in different months of the growing season. Then, the average value of root biomass was calculated for the same soil layer for 5 months, and the percentage of root biomass in each soil layer was calculated.

4 Data Results

In 2012 and 2013, the data for 5 sample points (0–10 cm, 10–20 cm, 20–30 cm, 30–40 cm, and 40–50 cm) in the growing season (May to September) were obtained. All sample data can be downloaded: RootBiomassAlpineMeadow.xls[13].

Table 2 Data of sampling point A from experimental plots in May, 2012

Month	Depth of soil (cm)	Root biomass (g/m^2)	
		Control	Warming
5	0–10	1,003.769,661	981.411,672,9
5	10–20	340.829,325,4	483.036,526,7
5	20–30	308.072,273,5	410.243,078,1
5	30–40	101.910,828	173.664,370,2
5	40–50	53.815,156,64	48.095,671,39

The results demonstrated that root biomass changed significantly in the warming treatment during the growing season, with differences by month and soil depth (Figure 2)[21].

Table 3 Data of sampling point A from experimental plots in June, 2012

Month	Depth of soil (cm)	Root biomass (g/m^2)	
		Control	Warming
6	0–10	1,212.270,896	1,161.055,505
6	10–20	709.476,147,1	1,082.282,595
6	20–30	393.344,599	1,044.326,011
6	30–40	279.474,847,3	785.389315
6	40–50	89.171,974,52	691.277,785

Table 4 Data of sampling point A from experimental plots in July, 2012

Month	Depth of soil (cm)	Root biomass (g/m^2)	
		Control	Warming
7	0–10	1,662.030,417	1,634.732,874
7	10–20	1,122.578,968	1,256.466,918
7	20–30	643.442,090,2	1,155.076,043
7	30–40	631.743,143,1	1,053.425,192
7	40–50	429.221,370,1	618.744,313

Table 5 Data of sampling point A from experimental plots in August, 2012

Month	Depth of soil (cm)	Root biomass (g/m^2)	
		Control	Warming
8	0–10	1,478.746,913	1,572.598,466
8	10–20	790.328,870,4	1,501.104,901
8	20–30	568.568,828,8	1,415.312,622
8	30–40	517.093,461,6	366.307,032,4
8	40–50	269.595,736,4	152.606,265,4

Table 6 Data of sampling point A from experimental plots in September, 2012

Month	Depth of soil (cm)	Root biomass (g/m^2)	
		Control	Warming
9	0–10	1,492.265,696	2,038.736,514
9	10–20	1,013.908,748	1,778.499,935
9	20–30	979.071,883,5	1,489.925,907
9	30–40	752.892,239,7	1,032.887,04
9	40–50	298.453,139,2	437.020,668,1

5 Discussions

The root biomass of this study was greater than that of Yang, *et al.*[23] and Wang, *et al.*[24]. The sampling location and sampling time were not completely consistent, which can lead to influences from the microenvironment. In our study, sample plots were in the same habitat, the impact of sampling scale, grazing disturbance and plant phenology cause uncertainties in biomass estimation. Our study is located in the permafrost region, where the vegetation was evenly distributed and a fence was used to prevent influence of grazing. Therefore, the influence of human activities was eliminated.

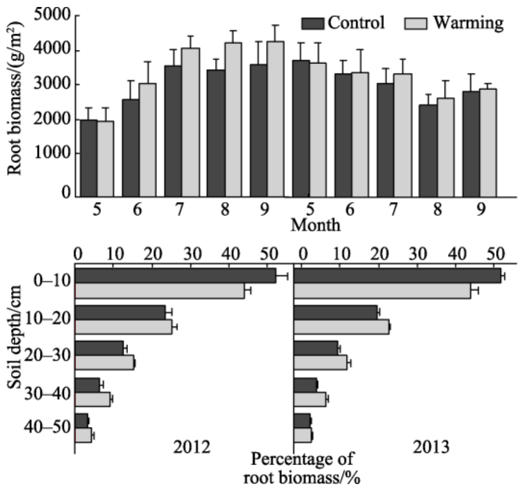

Figure 2 Distribution of root biomass in different months and different soil layers under experimental treatment[21]

Author Contributions

Xu, M. H. designed the algorithms of dataset. Xu, M. H. contributed to the data processing and analysis. Wen, J., Zhang, S. X., Yang, X. Y. wrote the data paper.

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