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A field warming experiment with OTC in a cold region, Sugadaira: changes in biomass, species richness, and snow depth

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Aim: Acceleration of snow melt with accompanying global warming may cause the change during a vegetable growing period, and may have serious influence on the vegetation of a snowfall zone.

Then, this research investigated the influence which the acceleration of snow melt with accompanying warming has on development and species diversity of vegetation by field warming experiment for the Japanese-pampas-grass dominated grassland in the Sugadaira plateau of a cold region.

Method: The experiment was conducted in the grassland site of Sugadaira Montane Research Center, University of Tsukuba. Every autumn, the facilities managers remove all of the aboveground plant parts in the grassland to prevent the vegetative succession from grassland to forest.

The annual mean temperature at the site was 6.5 ?C and the average monthly temperature ranged from 19.4 ?C in August to ?5.6?C in February, while the mean annual rainfall was 1,226 mm and the annual mean of maximum snow depth was 102 cm for the years 1971?2006. The first snow in the site is usually observed in the beginning of November. All snow melt in mid-April.

Five warming experiment plots and five control plots each of 1 m x 1 m were placed in the grassland.

The four lateral sides of the warming experiment plots were covered by the transparent panel about 2 m high, and the upper part was open (Open top chamber, OTC).

Snow depth and temperature at 1 m above ground in ten plots were recorded. Moreover, species composition and the degree of plant cover from immediately after snow melt were recorded at intervals of one month from one week. In September when plant biomass becomes the maximum, all above-ground plant parts were collected in each plot, and weight of these samples were measured after drying.

Result: Compared with the control plots, an average of 1.4 ?C temperature was higher in the OTC plots throughout the experimental period. Snow dept was 33 cm lower and the snow melt day which was defined as the day when all snow in an plot disappeared was 22 days earlier in the OTC plots.

These differences in temperature and snow melt affected the vegetation development. Since vegetable growth was started immediately after snow melt, the length of vegetable growing period was prolonged in the OTC plots. On the other hand, in the control plots, the plant cover increased rapidly during a short period. As a result, two months after from snow melt, the degree of plant cover and the number of species emerged had no significant differences between OTC and control. However, the OTC plots had higher final biomass and species richness than the control plots in September.

Discussion: Temperature increased and the snow melt was accelerated in the warming plot. Consequently, vegetable growth was also increased, and thus the final plant biomass and the number of species per area were tended to be high in warming plots. However, the vegetation tended to grow rapidly after snow melt in the control plots. Our study suggests that when snow melt accelerated with accompanying warming, vegetable growth is not simply accelerated, but shows the delay in reaction to warming.

Keywords: Field warming experiment, Biodiversity, Biomass, Grassland, Snow depth