Mem. Natl Inst. Polar Res., Spec. Issue, 44, 254–256, 1986

TEMPERATURE AND ENERGY BUDGET OF *RHACOMITRIUM LANUGINOSUM* AND *GRIMMIA ELONGATA* AT THE TOP OF MT. FUJI (EXTENDED ABSTRACT)

Emiko MARUTA

Department of Botany, Faculty of Science, University of Tokyo, Hongo 3-chome, Tokyo 113

The vegetation of the high alpine region of Mt. Fuji consists of mosses and lichens. At the top of Mt. Fuji (3776 m, 35°21′N, 138°43′E), the average annual air temperature is −6.5°C and the soil is covered with snow from October to June. In order to evaluate the effects of microclimate at the top of Mt. Fuji on moss behavior during growing season, diurnal changes of the temperature in the moss mat were measured on sunny days in summer together with the microclimate of the habitat. *Rhacomitrium lanuginosum* BRID. and *Grimmia elongata* KAULF. were selected for measurements, because these species seemed to have opposite characteristics in respect of energy budget.

A rainless period continued from 13 to 29 August 1985. On August 14, 1985, the maximum temperature was 31° and 23°C at the surface of the community of *R. lanuginosum* and *G. elongata*, respectively (Fig. 1). On August 15 when drying process of the moss mat was proceeding, the maximum temperature at the surface of the *R. lanuginosum* mat rose as high as 40°C which was similar to the value of soil surface temperature. On the other hand, the maximum temperature of *G. elongata* remained at the same level as the one on the previous day. The minimum temperature at the predawn was −2°C and 0°C at the surface of *R. lanuginosum* and *G. elongata*, respectively. The range between the maximum and minimum temperatures in one day of *R. lanuginosum* was as much as 42°C in contrast with the smaller range of *G. elongata* (26°C).

Energy budget analysis was made in order to elucidate these differences. The energy budget of a moss mat can be given by

$$Q_{\text{net}} = C + E + G + J, \qquad (1)$$

where Q_{net} = net radiation absorbed by a moss mat, C = sensible heat, E = latent heat by evapotranspiration, G = conductive heat and J = storage heat within a moss mat, all in W m^{-2}. Using eq. (1) it was concluded that the strong solar radiation (1400 W m^{-2}) at a high elevation causes the high temperature of the moss mat despite of a relatively low air temperature (11°C).

Figure 2 shows the calculated values of heat dissipating from the moss mat energy balance using eq. (1). On August 14, conductive heat (G) and storage heat (J) of *R. lanuginosum* were smaller than those of *G. elongata*, although latent heat (E) of *R. lanuginosum* was the same as that of *G. elongata*. Conductive heat (G) of *R. lanuginosum* is smaller than that of *G. elongata*, because the density of the *R. lanuginosum* mat ($8.1 \times 10^{-3}\,\text{g cm}^{-3}$) is smaller than that of the *G. elongata* mat ($15.3 \times 10^{-3}\,\text{g cm}^{-3}$). The heat capacity of the *R. lanuginosum* mat is also smaller because of smaller density of the mat.

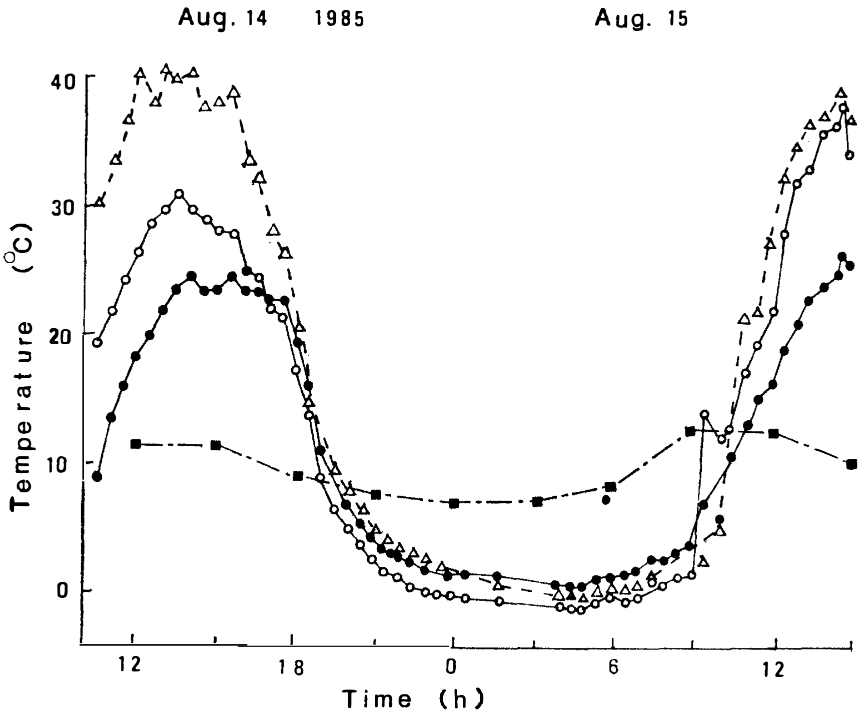

Fig. 1. Diurnal changes of the temperatures of mosses and environmental factors measured on Angust 14 and 15, 1985. ○—○*: surface temperature of the mat of* Rhacomitrium lanuginosum, ●—●*: surface temperature of the mat of* Grimmia elongata, △---△*: soil surface temperature. These temperatures were measured by 0.3 mm copper-constantan thermocouple and then care was taken in order to protect the junction of a thermocouple from the direct solar radiation.* ■-·-■*: air temperature measured by Mt. Fuji weather station which was 30 m apart from the mosses community.*

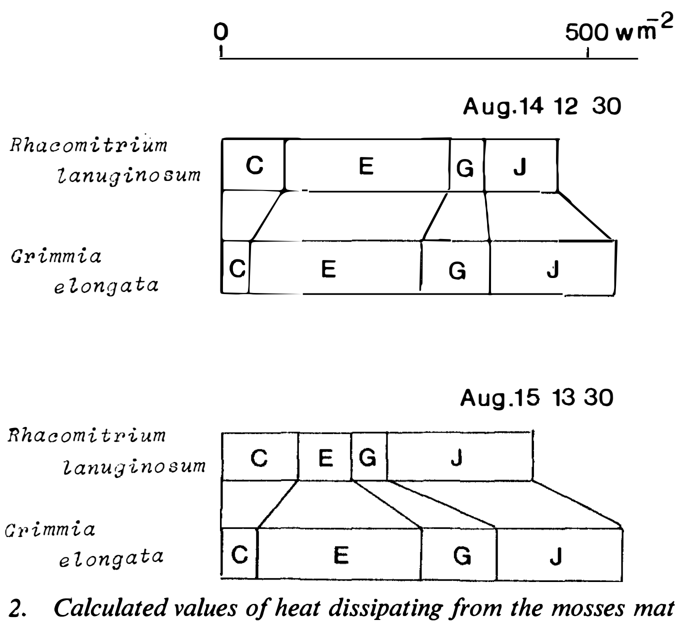

Fig. 2. Calculated values of heat dissipating from the mosses mat under energy balance using energy budget equation. C=sensible heat, E=latent heat by evapotranspiration, G=conductive heat and J=storage heat.

Therefore, a small increase in storage heat (J) resulted in a large increase in the temperature of the *R. lanuginosum* mat. Latent heat by evapotranspiration (E) from the dry surface of the *R. lanuginosum* mat decreased on August 15.

As a result, conductive heat (H) and storage heat (J) of the *R. lanuginosum* mat increased in contrast with no variation in the *G. elongata* mat (Fig. 2). I concluded that the small heat conductance and heat capacity resulting from the small density of the *R. lanuginosum* mat and easily drying characteristics caused the marked increase in the mat surface temperature during daytime.

(Received July 15, 1986; Revised manuscript received August 18, 1986)