The Relationship between Water Environment, Microtopography and Vegetation in a Warm-Temperate, Volcanic Peat Mire in South-Western, Japan

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Introduction

The Tadewara mire have peat affected by volcanic activity (Nakazono *et al*. 2008), which located in Ohita prefecture, Japan. Distribution of peatlands in warm-temperate zoon is limited to some mountainous region in south-western Japan (Wolejko *et al*. 1986). The Tadewara mire and the Bougatsuru mire are located in the Aso volcanic area and these mires are the habitat of 51 endangered plant species (Arakane *et al* 2002). Hydrology and water chemistry of habitat are important factors for determining vegetation in peatlands (Wheeler et al. 2000, Asada 2002). However, relationship between vegetation and environmental condition has not been fully studied especially in the volcanic mires.

In this study, we investigated the correlation between vegetation and environmental condition in a volcanic mire. We specially noticed to the change in vegetation and environmental parameters in soil and discussed the direct effect of environmental change on mire vegetation.

Methods

Study site and transect

Latitude / longitude
33˚07'N /131˚14'E
Altitude range
1000~1100m (a.s.l)
Slope range
0.5˚ ~5.0˚
Area of mire
40ha
Annual temperature
Mean 9.5˚C
Maximum 21.0˚C (August)
Minimum 1.8˚C (January)
Annual precipitation
3000mm
Japan meteorological agency (2001, 2002)

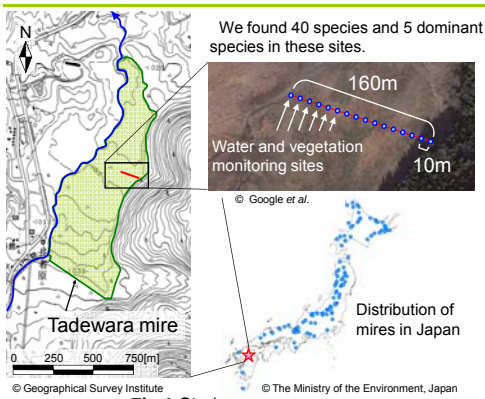

Fig.1 Study area

Vegetation, groundwater table, water chemistry and microtopography

Vegetation was recorded on 30 and 31 July 2007 and 10 and 11 July 2008. One hundred sixty quadrats of 1m × 1m were placed along transect line at 1m intervals. Coverage of all the species present in each quadrat was recorded.

At each of the pipe, groundwater table was measured 17 times from 10 August 2006 to 24 July 2008 at monthly. Water table depth was measured as the distance from the ground surface to groundwater table in each pipe.

On the same day of the water table depth measurement, water samples were collected from each of the pipe, and stored in 100ml polyethylene bottles. The pH and electrical conductivity of all water samples were measured within 12 h after collection.

Microtopography was measured on 13 June 2008 as elevation along transect at 1m interval relative to the level at western edge of the transect.

Parameters

Microtopography
Relative elevation

Water chemistry
Electrical conductivity
pH

Hydrology
Groundwater table

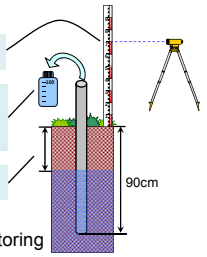

Fig.2 Method of monitoring

Data analyses

Vegetation was classified into four types by presence or absence of species in each quadrat in 2007 and 2008.

Vegetation classified

2007	2008	
presence	presence	3
absence	presence	2
presence	absence	1
absence	absence	0

Quadrats were grouped by TWINSPAN by using species number defined as above.

Quadrat grouped

Two-way indicator species analysis (TWINSPAN; Hill *et al.* 2005)

Cut level → 0.5,1.5,2.5
Other option → default

Averaged

The pH was converted to value of H^+ ion concentrations before the calculation of mean. Mean of electrical conductivity, pH, groundwater table depth and relative elevation measured at each quadrat during the study period were compared among groups classified by TWINSPAN.

Statistically analysis

Statistically significant difference in these environmental parameters were tested by using Tukey-Kramer Test ($p<0.05$).

Results & Discussion

Four groups (group A-D) of quadrats were recognized by the second division of TWINSPAN (Fig. 3). Mean total number of species in each quadrat in 2007 and 2008 was highest in group D (12.2 spp.), and was lowest in group B (3.77 spp., Fig.4-e). Mean number of immigrated species in each quadrat between 2007 and 2008 was highest in group D (5.40 spp.), and was lowest in group B (0.31 spp. , Fig.3). Mean number of distincted species in each quadrat between 2007 and 2008 was highest in group C (1.41 spp.), and was lowest in group B (0.14 spp. , Fig.3). Mean number of species those presented both in 2007 and 2008 was highest in group C and D (6.80 spp.), and was lowest in group B (3.46 spp. , Fig.3). Mean electric conductivity was highest at group B (32.3 mS/m), and was lowest at group C (14.2 mS/m, Fig.4-a). Mean pH was highest at group C (pH 5.65), and was lowest at group B (pH 4.25, Fig.4-b). Mean of water table depth was highest at group B (0.3 cm), and was lowest at group C (12.6 cm, Fig.4-c). Mean relative elevation was highest at group C (relative elevation 127.1cm), and was lowest at group D (relative elevation 69.7cm, Fig.4-d).

M. japonica, *S. palustre*, *S. fimbriatum*, *H. paniculata and P. australis* dominated in all of the groups especially in group B. Total number of species as well as immigrated species number were low in group B. Electrical conductivity and groundwater table in group B were high, and pH was low. In contrast, group D had high number of total species and immigrated species. *Carex thunbergii* Steud., *Persicaria* Miller spp., *Galium trifidum* L. var. *brevipedunculatum* Regel, *Sarothra laxa* (Blume) Y. Kimura immigrated to sites in group D in 2008. Electrical conductivity and groundwater table in group D were significantly lower, and pH was significantly higher than group B. Electrical conductivity, pH and groundwater table were thus the distinguishing environmental parameters between group B and D.

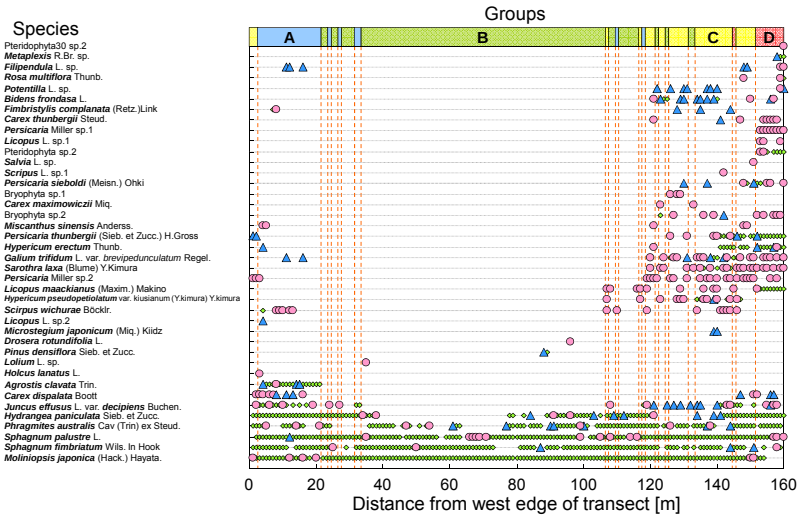

Fig.3 Distribution and appearance of species on the transect line. Quadrats were classified into groups (A-D) by TWINSPAN. Symbols: ◇, presented both in 2007 and 2008; ○, absent in 2007 and was presented in 2008; △, presented in 2007 and was absent in 2008;

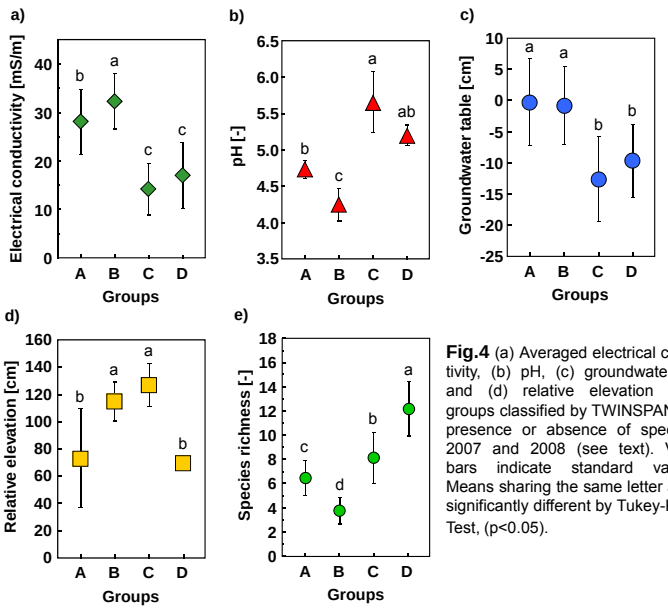

Fig.4 (a) Averaged electrical conductivity, (b) pH, (c) groundwater table and (d) relative elevation among groups classified by TWINSPAN using presence or absence of species in 2007 and 2008 (see text). Vertical bars indicate standard variation. Means sharing the same letter are not significantly different by Tukey-Kramer Test, ($p<0.05$).

Conclusion

1)High species richness of site related to low groundwater table, low electrical conductivity and high pH of the habitat. Vegetation change at sites with low pH, high groundwater table, and high electrical conductivity was small.
2)Hydrology and water chemistry were thus the distinguishing environmental parameters between each group in the Tadewara mire.

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