Factors controlling the spatial pattern of the forest vegetation in second growth forest on a steep mountainous hillslope in a warm-temperate region

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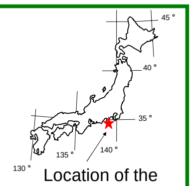
Introduction

Spatial patterns in forest vegetation in steep headwater and the factors that deriver those pattern is important information for the management of headwater.

We demonstrate spatial pattern of tree density, size and growth rate of second growth forest within a single valley-head and discuss the factors that deliver those spatial patterns. We hypothesized factors are associated with (1) spatial variability of soil moisture, nutrient, and light conditions and (2) geomorphic processes such as erosion and sedimentation patterns, that form landscape.

Study Site and Observation



Location of the Study Site

Location: Aono Experimental Forest in southern Izu Peninsula, LTER plot
Mean Annual Temp. : 15°C
Mena Annual Precip.： 2270mm
Geology：dacite, quartz porphyrite and fine-grained quartz diorite intruded to the Shirahama stratum of the Miocene
Mean slope Gradient： 31°
Vegetation：Evergreen broad-leaved secondary forest. It used be a coppice forest but almost clear cut around 1955. The *castanopsis seiboldii* consist almost 70% of basal area in the study plot.

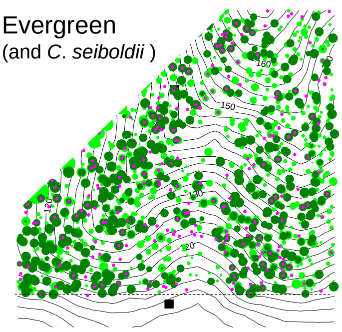
Tree species, diameter at breast height (DBH), height and location of each tree were measured for all the trees with DBH>4cm at 100✕100m plot in 1998 and 2003.

At monitoring location (22-25) we measured

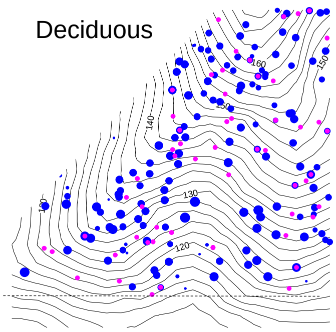
- **Soil stratification** and **depth** by knocking pole penetration test and hand auger with soil pit observation.
- **Volumetric water content** were periodically monitored through July 2005 to June 2006.
- **Soil carbon and nitrogen content** measured at the depth of 0-10 and 20-30cm.
- **Relative photosynthetic photon flux density (*rPPFD*)** at 50 cm above ground.

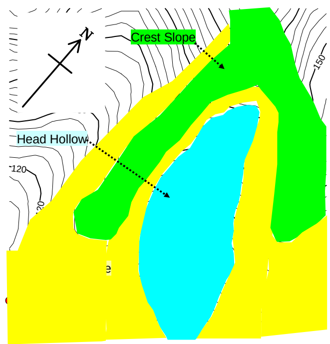
Spatial distribution of evergreen and deciduous trees and topography

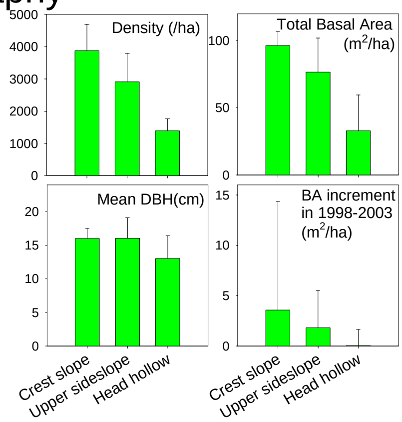
Evergreen (and *C. seiboldii*)



Deciduous





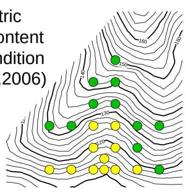


Micro-scale geomorphic units (e.g.Tamura 1969) seems to explain most of the spatial pattern. The density and height of the trees are greater at the crest slope and upper side slope than head hollow. Similar vegetation pattern corresponding with micro-scale geomorphic unit were also observed at other headwaters in Japan (e.g. Sakai & Ohsawa 1994). The results indicate that geomorphic processes give strong effect on the spatial pattern of trees.

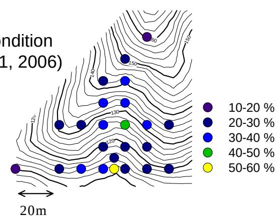
The data were assembled for each monitoring location and compared. Tree density, including total BA, tree size and growth rate were all greater at crest and upper side slope than head hollow

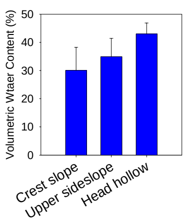
Soil Moisture

Volumetric water content Wet condition (May11,2006)



Dry condition (Oct.11, 2006)



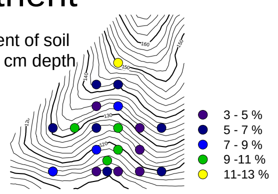


Mean and standard deviation for each geomorphic unit

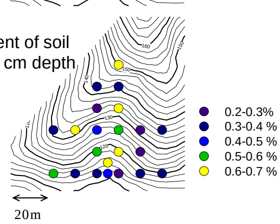
Head hollow is more monist than crest and upper side slope.

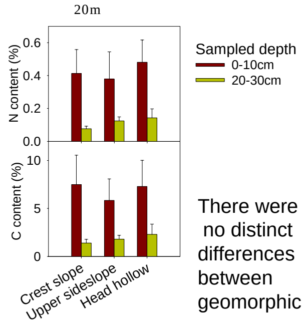
Nutrient

C content of soil at 0-10 cm depth



N content of soil at 0-10 cm depth

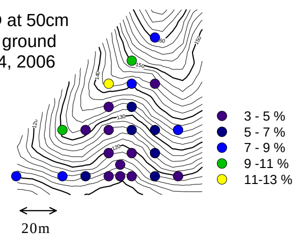


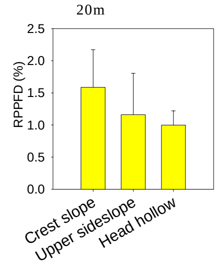


There were no distinct differences between geomorphic units.

Light at the floor

rPPFD at 50cm above ground May 24, 2006



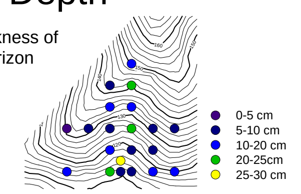


Observation conducted in May, June and October

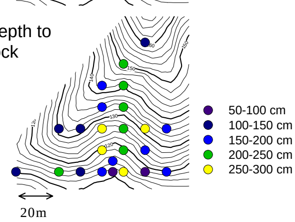
Forest floor of the studied site is generally very dark. This may restrict the regeneration by seedlings. Head hollow is slightly darker than crest and upper side slope.

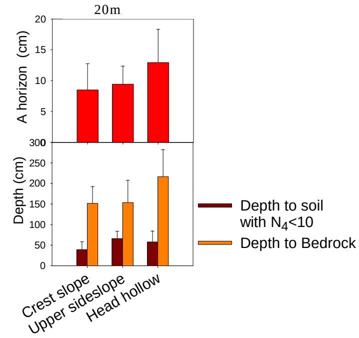
Soil Depth

Thickness of A horizon



Soil depth to Bedrock





A horizon is thicker and soil is deeper at head hollow indicating transport of material from upper slope. It is not clear "how" and "when" they moved.

Summary

We demonstrated spatial patterns of tree density, size and growth rate at the steep valley-head of warm-temperate climate. Spatial patters corresponded with micro-scale geomorphic units, indicating geomorphic processes give strong effect on spatial pattern of forest development.

We demonstrated spatial patterns of soil moisture, nutrient, soil depth and light availability at the forest floor. Soil moisture, soil depth and light condition differed between geomorphic units. Dark forest floor may also restrict the regeneration of trees at the head hollow, while spatial patterns in soil moisture and nutrient may give small effect for the forest development at this site.

Reference
•Kikuchi T. (2001) Vegetation and Landforms, University of Tokyo Press, (Japanese)
•Tamura T (1969) A series of micro-landform units composing valley heads in the hills near Sendai: Science Reports of Tohoku University, 7th Series (geography) 19, 111-127.
•Sakai A. & Ohsawa M. (1994) Topographical pattern of the forest vegetation on a river basin in a warm-temperate hilly region, central Japan, Ecological Research 9, 269-280.