Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

ACG35-P01 Room:Convention Hall Time:May 22 18:15-19:30

Chemical dynamics of snow layers in the Norikura Highlands

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Precipitation includes various chemical substances. Chemical substances within precipitation were preserved in the snowpack during winter. These substances flushed out during the snowmelt season. It exerts great impact on the environment. Therefore, it is very important to examine its deposit and melt. In this study, we aim to clarify the chemical dynamics of snow layers during winter in the Norikura Highlands, Japanese Alps.

We conducted the regularly snow pit study during winter in the Norikura Highlands. The snow pits were dug through flat and open space. We observed the profile of the snow pit to make clear snow conditions, which are snow stratigraphy, snow temperature, and snow density. Then, we collected the snow samples. The snow samples were melted in the clean room. The pH and electric conductivity were measured after filtration. Concentrations of major ions were measured by ion chromatographs. The total ion leads in the snowpack were decreased in snowmelt season.

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The chemical characteristics of spring water in Kamikochi at the Japanese Alps

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There are much spring waters in the Azusa River which flows through Kamikochi. These spring waters form the branch of the Azusa River. Spring water shows the characteristics reflecting an underground water flow. Therefore, in order to understand the water cycle of Kamikochi, it is important to understand the formation mechanism of spring water. The purpose of this study is to clarify the characteristics of spring water which forms the branch of Azusa River in Kamikochi. We set up the thermometer in five places of a basin for the measuring of spring and river water temperature. The water samples were collected in water temperature measuring site and Azusa River from July 2011. The pH, electric conductivity, major ions, and stable isotope of water were analyzed with the pH meter, conductivity meter, ion chromatographs, and isotope mass spectrometer, respectively. In addition, HCO_3^- concentration was measured using the sulfuric acid titration method. At many observation points, the temperatures of spring water showed seasonal change. However, only one site did not have change of water temperature through a whole year.

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Snow Depth Measurement using GPS on Karasawa Cirque, Japanese Northern Alps

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In the mountainous area, snow depth is known to increases so as to become of high altitudes. However, the snow depth distribution are hardly measured in the high mountain. It is significant to clarify the snow depth distribution based on actual measurement of snow depth in order to calculate the water equivalent of snow in its hydrographic basin. The measurement using GPS is attracted to attentions because the method of the GPS measurement is simple and high resolution. Especially, the Kinematic GPS measurement using two GPS receivers make possible to the measurement a wide area in a short time. We aim to measure the snow depth based on the Kinematic GPS measurement in Karasawa Cirque where is one of the biggest cirque in Japan,during snowmelt season in 2012.

Keywords: GPS, Kinematic Survey, Snow depth, Karasawa Cirque

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Perennial snow patch distribution in Japanese Alps Region by aerial photograph interpretation

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Variations in glaciers are visible indicators of climate change, especially in mountain region. In Japan, snow patch can be an alternate indicator since glaciers, long years, were not recognized in the Japanese Alps. One characteristic of the Japanese Alps is their extensive distribution of perennial snow patch. A snow patch inventory for this mountain is urgently required, not only for monitoring snow patch variations but also to evaluate water reservoir in the region. Limited number of studies has attempted to complete snow patch atlas in Japan. As a step in this direction, the authors have produced a snow patch inventory of 1976/77. This study addresses the results of snow patch mapping. The status of snow patch distribution may indicate snowfall character in winter and also future possibilities of snow patch change.

The work of compiling a perennial snow patch inventory for the Japanese Alps initially involved preparing a detailed map using aerial photographs. First, vertical aerial photographs at scales of about 1:16 000 were interpreted for the entire study area using a stereoscope. The photographs were taken by the Geographical Survey of Japan in fall seasons of 1966 and 1967. In addition, aerial photographs taken by the Forest Agency of Japan in 2009/2010 and 1968/1969 were applied. Then the compilation of these perennial snow patch maps may identify snow patch variations during the past 43 years. The planimetric outline of each perennial snow patch of fall was carefully delimited and drawn on 1:25 000 scale topographical maps. Interpretation of stereopairs of aerial photographs was employed to determine the exact three-dimensional position of snow patch with reference to the surrounding topography. Moreover, stereo interpretation was used to discriminate snow patch from other associated assemblages around a snow patch could be misconstrued to be snow patch forms. Debris flow, landslide portion, and gully erosion can be clearly clarified, while an orthoimagery cannot discriminate them from small-sized snow patch. Once satellite images were applied for the compilation of inventories, the spatial resolution of the imagery limited the accuracy of mapping. However, when stereopair of aerial photographs are used, mapping resolution depend not on the scale of the aerial photographs but on the scale of the base map. This study used 1: 25 000 scale topographical maps. 1 mm at this scale corresponds 25 m of actual distance on the ground; hence this is regard as the limit of resolution for the snow patch map produced by this study.

Snow patch maps from around the study area illustrate successful aerial photograph interpretation in the Northern Japanese Alps and Mt. Norikura. Even very tiny snow masses, smaller than 0.005 ha, were identified. Then manual delineation from aerial photograph interpretation is reliable method of producing complete, accurate perennial snow patch maps. The inventory of 1976/77 thus compiled reveals 226 perennial snow patches with a total surface area of 244.41 ha (2.44 km^2). Major distribution concentrated in Mts. Tsurugi and Tateyama, whereas highest mountains, the Yari-hotaka Mountains, the southern part of the Northern Japanese Alps have quite limited number of snow patches. In addition, almost of all snow patches distribute the eastern flank of the mountains, in contrast, rare snow patches at the western flank of the mountains. The biggest snow patch appeared at Tsurugi-sawa valley with the area of 14.94 ha and length of 1410 m. Basically Mt. Tsurugi has 62 perennial snow patches with the total surface area of 90.69 ha. Distribution changes of these perennial snow patches during the past 34 years are not so remarkable. However minor change in the size and distribution are significant.

Keywords: Snow patch, Japanese Alps Region, aerial photograph

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Impacts of forest harvesting on micro-climate and sediment transport in a mountain area

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Most of knowledge on the sediment transport in forests has been obtained by many field studies conducted in low mountain areas. In contrast, only few studies on the sediment transport have been conducted in deep mountain areas, because of the difficulties in monitoring. Mountain areas can be characterized as colder climate as well as steeper topography. Effect of these characteristics on types and timing of sediment transport is not sufficiently clarified. Therefore, we have conducted field observations on the sediment transport and the micro-climate in Ikawa University Forest, Akaishi Mountain Range, central Japan. We also harvested part of trees in our study site and observed changes in the sediment transport and the micro-climate to discuss impact of forest harvesting on them. The study site is located in 38-year-old hinoki (Chamaecyparis obtusa) artificial forest. In June 2011, six sediment traps were set up to investigate spatial distribution of sediment transport in the forest. We collected and weighed sediment captured by traps once in a month. We also monitored micro-climate (e.g., temperature, amount of radiation, soil moisture) near sediment traps. Clear cutting of trees was conducted around three sediment traps from March 2012 to September 2012. Our observation results show that the sediment transport rate is largely different among sediment traps. Spatial variability of slope morphology and grain size may result in wide range of the sediment transport rate. In autumn (non-freezing season), sediment transport rate was high in the periods with larger rainfall events (i.e., daily rainfall $>$ 50 mm). Sediment transport was also observed in the winter when freeze-thawing occurs. Daily variation of the ground temperature and amount of soil moisture became larger after clear cutting of trees. However, the sediment transport rate did not change clearly (or decreased) by the cutting. By field surveys, we found that sediment coming from upper slopes was captured by leaves and brunches of harvested trees left on the ground surface. Thus, sediment transport rate is influenced by combination of various factors (i.e., changes in micro-climate and covering of ground surface) resulting from clear cutting of trees.

Keywords: forest harvesting, sediment trasport, micro-climate, mountain area

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Carbon cycling in an old-growth beech-oak forest of cool-temperate region, Mt. Hakusan

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Old-growth temperate deciduous forests were grown in a middle slope (840-1600 m) of Mt Hakusan, Gifu, central Japan. Mt Hakusan has erupted in the middle of 16 century, and no human disturbance occurred in these areas up to the middle of 20 century. The carbon balance of a forest varies dramatically at different successional stages. In general, a forest stand is expected to be a C source for several years at the beginning of secondary succession. Even-aged forests, such as coppiced forests or plantations, reach the peak of net ecosystem production (NEP) in a middle age (ca. 40-50 years) after disturbance in turn NEP declines as forest mature and finally reach to GPP/RE ratio = 1 (NEP=0). In contrast, old-growth natural forests with gap dynamics might have different pattern compared to even-aged mature forests. However, few studies of carbon cycling were conducted in old-growth forests especially in Japan. We set up a 1 ha permanent quadrat in an beech-oak old growth forest on Mt. Hakusan (1330 m) in 2011 to study carbon cycling and to estimate biometric-based NEP. Here, we introduced the preliminary study of soil respiration measurement and biometric-based annual NPP in the old growth beech-oak forest during 2012.

Above-ground net stand increment of the old-growth forest was 3.3 t ha^{-1} yr^{-1}, and annual biomass increment is 3.1 t ha^{-1} yr^{-1} with a few dead trees during 2012 (dry weight basis). Annual fine litter that produced during 2012 was 4.0 t ha^{-1} yr^{-1}, and thus annual aboveground NPP was estimated as 7.3 t ha^{-1} yr^{-1}. Aboveground biomass in the old-growth forest was extremely large (479 t ha^{-1}), and beech and oak contributed more than 95% biomass almost equally (beech: 236 t ha^{-1}, oak: 220 t ha^{-1}) in 2011. However, annual total beech growth (2.3 t ha^{-1} yr^{-1}) contributed 70% to the total annual stand increment of 2012 in the forest against to total oak growth (0.6 t ha^{-1} yr^{-1}) contributed 18%. Aboveground NPP in the old-growth forest fell with in the data of Japanese cool-temperate deciduous forest stands (8.74 $^{+}_{-}$ 3.47 t ha^{-1} yr^{-1}), and thus, growth of beech is rather high even in old-aged (may be more than 400 yrs) with large biomass.

Moreover, daily soil respiration (RS) was measured using soda lime method: 100- closed chambers (23.5 cm in diameter, ca. 16 cm in height) were used in each 10 by 10 m subquadrat in every month during growing season (June to November) in 2012. Daily soil respiration was exponentially correlated with soil temperature at 1 cm depth, and the Q10 value was 1.67. Annual RS was calculated based on the soil temperature monitoring in the field. Total annual RS (only in growing season) was 3.19 tC ha^{-1} yr^{-1}, which was rather small compared to the other temperate forests (ranged from 4.5 to 9.1 tC ha^{-1} yr^{-1}). These data (high NPP and low RS) suggested that rather large C sinks in the beech-oak old-growth forest under study although we need to separate RS to autotrophic and heterotrophic respiration to estimate biometric-based NEP.

Keywords: Mt. Hakusan, Caron cycling, Net ecosystem production, Net primary production, Soil respiration, Beech forest

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Comparison of quantity and quality of soil organic carbon between matured and gap areas in an old-growth beech forest

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We performed this study to further understand the effect of canopy gap stands on surface soil carbon dynamics in cool-temperate deciduous broad-leaved old-growth forests. We investigated the annual aboveground litter production, soil organic matter content, and soil humic acids (soil organic matter) quality in several matured (n=7) and gap (n=3) areas (each area was 20 m times 20 m) in a Japanese old-growth beech forest. The annual fine litter (foliage) production from 2005 to 2011 in the matured area was totally higher than that in the gap area; however, those of annual coarse litter production were not so different. The gravimetric soil carbon content in the matured area was significantly higher than that in the gap. In addition, the C:N ratios in the matured area were significantly higher than those in the gap. The estimated compositions of carbonyl C and aromatic C and those of O-alkyl C and alkyl C in total C of soil humic acids in the matured area were higher and lower, respectively, dependent on higher A600/C values, than their respective compositions in the gap area. Furthermore, the ratio of alkyl C to O-alkyl C in the matured area was significantly lower than those of the gap. Our data strongly suggests that, compared to the closed canopy stands, canopy gap stands in this study site can be a carbon source, which is particularly dependent on labile carbon dynamics.

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Influence of soil formation on spreading process of Abies mariesii : Case study in the Hachimantai area

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Coniferous forest composed of Abies mariesii and Abies veitchii commonly covers subalpine zone of Tohoku and Japanese Alps, although its extent and maturity vary even in adjacent areas corresponding to some local factors such as landform and snow cover. In case of Hachimantai, Abies mariesii forest is well distributed in its northern part in contrast with the southern part where the coniferous forest is scanty. This study investigate the spreading processes of Abies mariesii forest in Hachimantai in terms of soil formation.

The results suggest that the matured Abies forest widely covers the areas in which black soils are well developed. The Abies forest on places where black soils are less developed is scattered or immatured. The past palynological studies also support this correspondence. It is estimated that spreading processes of Abies forest is closely related to soil development.

Keywords: Abies mariesii, Soil formation, Pseudo-Alpine Zone, Vegetation changes

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Repeated migration of *Dasiphora fruticosa* during the Pleistocene revealed by comparison between Japan and Tibetan

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Alpine plants would experience several cycles of range contractions and expansions in response to the Pleistocene climate fluctuations. Such range and demographic changes affects the geographical patterns of genetic variation within and among populations. Such genetic variation indicates where species survived and how species colonized their present-day distribution using the molecular approaches

Dasiphora fruticosa L. (Rosaceae), an alpine shrub, is widely distributed in Northern hemisphere. In this study, phylogeographic analysis was conducted using samples from Qinghai-Tibetan Plateau and Japanese archipelago to reveal that the Japanese populations have been migrated to Japan in several times.

Leaf materials of *D. fruticosa* were collected from 23 populations from inner to northeast across the Qinghai-Tibetan Plateau and five populations from Japan. The sequence variation and geographical distribution of the chloroplast *matK* region were analyzed. 33 and 23 haplotypes were detected from the Qinghai-Tibetan plateau and Japan, respectively.

Two Japanese haplotypes were closely related to haplotypes detected in the inner plateau. These were belonging to different clades. One clade indicated deep divergence and included relatively ancestral haplotypes. The other clade included relatively derived haplotypes. These results suggested that *D. fruticosa* has been migrated to Japanese Archipelago at least two times. Although just one of the two clades was detected in central Japan, two clades were detected in Northern Japan.

The population of Hokkaido mountain showed high levels of genetic diversity and had unique haplotypes that were restricted to this area. The Hokkaido mountain maintains longer history of *D. fruticosa* and/or enough population size avoiding bottleneck from past to present than other regions.

Keywords: alpine plant, genetic diversity, phylogeography, refugia

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Open field warming experiments for forest carbon cycling in Takayama, Japan

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Experimental evaluation of the effects of rising temperature on carbon cycling processes in forest ecosystems is one of the central interests in ecosystem science under climate change. We have established open field warming experiments in a cool-temperate deciduous broadleaf forest in Takayama site, central Japan, to investigate the responses of foliage photosynthesis in a canopy tree (*Quercus crispula*) and soil carbon dynamics to artificial warming treatment. Warming treatment for canopy tree (+5degreeC) was made by installing an Open-Top Canopy Chamber (OTCC) to three branches at the top of tree crown by an aid of canopy-access tower (18m height), and for soil (+3degreeC) it was made by installing heating cables to a depth of 3-5cm. Air temperature in the OTCC and soil temperature in the warming plots are monitored by temperature probes, respectively.

We monitored foliage phenology by automated digital camera system, and leaf-level ecophysiological characteristics by periodical measurements of chlorophyll content (biochemical assay and SPAD meter), photosynthetic and respiratory CO2 gas exchange (LI-6400, Li-Cor, Inc.) and leaf mass per area. Rising air temperature of the branches resulted in earlier leaf expansion (ca 5 days) and delayed leaf senescence (ca 5 days), and about 10% higher photosynthetic capacity in early summer, while leaf morphological characteristics were not influenced by the temperature treatments.

We examined the diurnal and seasonal patterns of soil respiration in warmed and control plots by using automatic measurement system (LI-8100, Li-Cor, Inc.) and portable non-dispersive infrared gas CO2 sensors (GMP343, Vaisala CARBOCAP, Finland). Soil warming treatment decreased soil moisture by about 6.4% and enhanced annual soil respiration by about 10% during growing season without snow cover. Temperature sensitivity (Q10) was different between control (3.06) and warmed (2.75) plots. The diurnal and seasonal variations in soil respiration might reflect the changes in physiological activities of plant roots and microbial organisms with increasing temperature.

Keywords: carbon cycle, global warming, forest ecosystem, photosynthesis, soil respiration

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Monitoring leaf-out day of forests in Gifu, Japan using Terra/MODIS data

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Carbon dioxide concentration in the atmosphere would accelerate global warming. Therefore climate change would have strong effects on terrestrial ecosystems, and analyzing the impacts on terrestrial ecosystems is required. Growth stages of vegetation are controlled by air temperature in the humid temperate zone. The seasons from spring to autumn under high air temperature are growth period by photosynthesis. Winter under cold air temperature is dormant season. Global warming would make the growth period longer. If photosynthesis becomes possible through a year due to air temperature rise, deciduous trees are left out of their own habitat. Monitoring phenology would be important to evaluate effects by global warming. However, observing phenology is difficult in large forests on the ground.

MODIS sensors on Terra and Aqua satellites observe the same point on the earth every day, although their ground resolution is coarse. MODISs observe red and near infrared bands, which are effective for vegetation analysis, with 250m resolution, and their reflectance images after atmospheric and geometric corrections are open to public. Even MODISs observe the same point every day, MODISs cannot observe the ground quite often due to cloud over Japan in the humid temperate with frequent cloud covers. Therefore cloud free images are produces by mosaicking 8 days' or 32 days' images, and phenology is analyzed by curve fittings using the normalized difference vegetation index (NDVI) images with smoothing. The smoothing and curve fittings would reduce accuracy of analysis, since they change seasonal trends of NDVI slightly.

We produced a leaf-out day analysis method using a linear regression model which showed a trend of NDVI change at each pixel. We applied the linear model to daily MODIS NDVI of each year in the leafing period and estimated leaf-out days over forests in Gifu prefecture. The process is as follows. 1) Moving averages of NDVI during 3 days in some years and their moving median during 7 days were computed on each pixel according to the day of year (DOY) from the New Year's day. 2) A linear regression line was estimated selecting DOY as an independent and NDVI as the dependent variables in each pixel during the leafing period. 3) A threshold value at the time of leafing start was determined by searching NDVI after dropping leaves in autumn. 4) The leaf-out date was estimated using the linear regression line and the threshold value in each pixel using daily NDVI data.

Advantages of this method are as follows. 1) Leaf-out day can be determined daily basis in each pixel. 2) Since any smoothing and curve fittings are not applied, the method analyzes NDVI change trends in detail. 3) Mixed pixels with different forest types can be analyzed by the same method. Although the method is not suffered by noises by clouds, noises of increasing NDVI by atmospheric correction errors reduce accuracy.

The method estimated leaf-out days quite accurately in deciduous forests with great seasonal NDVI changes in snowy areas. On the other hand, leaf-out day was not estimated in evergreen forest, since coefficients of determination were not high enough in the regression analysis due to small seasonal changes and the linear equations were not reliable. Inter-annual changes in pixels of evergreen forests where leaf-out day was estimated appeared greater than those in deciduous forests. It suggested that additive noises on NDVI reduced accuracy. Accurate leaf-out day estimation was also difficult in mixed pixels with urban areas, farm lands and forests. We concluded that mapping of inter-annual changes of leaf-out days was possible in deciduous forest, however, effects of global warming were not validated yet due to the short period of MODIS images available.

This research was executed in the research project " Development of mitigation and adaptation techniques to global warming in the sectors of agriculture, forestry, and fisheries" by MAFFIN.

Keywords: phenology, leaf-out day, MODIS, NDVI

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Successional changes in vegetation and soil microbial community in a volcanic desert on Mount Fuji, Japan

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Lava flows and ash deposits from volcanic eruptions create virgin land surfaces on which ecosystem development processes such as plant colonization and soil formation begin. Such areas affected by volcanic activity are referred to as ”volcanic deserts”. Volcanic deserts are nutrient-poor ecosystems, and therefore the soil microorganisms function as drivers of carbon and nutrient cycles and soil formation through their role in the decomposition of soil organic matter, and their roles as sources of, and sinks for, labile carbon and nutrients are of great importance. This suggests that successional changes in the microbial community will greatly affect soil C and N pools and cycling in volcanic deserts.

In subalpine volcanic deserts such as those in Japan, we can find isolated island-like plant communities at different developmental stages. The presence of these island-like communities at different successional stages in a small area with the same altitudinal location and initial conditions therefore provides a good opportunity to investigate successional changes in the plant community, soil characteristics, and soil microbial community after a volcanic eruption. However, there is little information about the relationships between the shifts in microbial properties and the development of island-like communities.

In this study, to study the relationship between vegetation development and changes in the soil microbial community during primary succession in a volcanic desert, we examined successional changes in microbial respiration, biomass, and community structure in a volcanic desert on Mount Fuji, Japan.

The study was conducted on the southeastern slope of Mount Fuji between 1500 and 1550 m above sea level. Soil samples were collected from six successional stages, including isolated island-like plant communities. We measured microbial respiration in our laboratory and performed community-level physiological profile (CLPP) analysis, phospholipid fatty acid (PLFA) analysis, and denaturing gradient gel electrophoresis (DGGE) analysis of 16S rDNA amplified by polymerase chain reaction (PCR) to determine the microbial community composition from functional, taxonomic, and genetic perspectives, respectively. Combining these methods should provide a better understanding of soil microbial communities from multiple (functional, taxonomic, and genetic) perspectives.

Microbial biomass (total PLFA content) increased during plant succession and was positively correlated with soil properties including soil water and soil organic matter (SOM) contents. The microbial respiration rate per unit biomass decreased during succession. Nonmetric multidimensional scaling based on the PLFA, DGGE, and CLPP analyses showed a substantial shift in microbial community structure as a result of initial colonization by the pioneer herb *Polygonum cuspidatum* and subsequent colonization by *Larix kaempferi* into central areas of island-like communities. These shifts in microbial community structure probably reflect differences in SOM quality.

Microbial succession in the volcanic desert of Mt. Fuji was initially strongly affected by colonization of the pioneer herbaceous plant (*P. cuspidatum*) associated with substantial changes in the soil environment. Subsequent changes in vegetation, including the invasion of shrubs such as *L. kaempferi*, also affected the microbial community structure.

Keywords: Island-like plant community, Microbial biomass, Microbial community structure, Primary succession, Volcanic desert

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Vertical distribution and Seasonal change of Shilphidae community in the Central Alps

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The burying beetle is an insect belonging to Coleoptera (Silphidae). It eats the dead body of animals. Since the body length of the burying beetle is comparatively large and the species identification is easy, it is suitable as a bio-indicator. In recent years, change of biota has broken out on the earth by global warming.

It is possible to monitor global warming using the burying beetles. In this study, the seasonal change and the vertical distribution of the community structure of the burying beetles were investigated in the Central Alps of Nagano Prefecture, and the results were reported.

Keywords: Shilphidae, Vertical distribution, Seasonal change, Nagano Prefecture