Abstract for the Core to Core symposium Objective of the international symposium on "Regeneration and dynamics of mixed conifer broad-leaved forests in East Asia after Natural and Man-made disturbances"

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Keywords: Carbon and nitrogen cycling, forest fire, Siberia Taiga,

We are conducting research project on "Up-scaling evaluation for symptom of environmental changes in permafrost-affected boreal forests" funded by JSPS Core-to-Core Program (FY 2005-2006). The objective of the research project is to establish coordination and cooperation among the scientists from Germany as well as Russia working in the field of nutrient cycling in terrestrial ecosystems to investigate and evaluate the influence of forest disturbance on the balance and cycle of carbon (C) and nitrogen (N) in a large scale in Siberian Taiga.

Boreal forests encircling the Earth above 48° N latitude occupy 21% (861 M ha) of the world's forested land surface. Siberia forested land stores about 447 Gt C, which accounts for 21% of the total amount of C stored in the terrestrial biosphere. Boreal forests have been damaged from forest fire frequently. In severe drought years, 15 to 20 M ha of forests is burnt. Carbon emission from burnt area of 17.9 Mha in 1998 boreal forest fire was estimated to be 290-383 Tg C, of which Russian forest fires accounted for 71%. It corresponds to Japanese total greenhouse gas emission of 355 Tg C occurred in 2000.

Carbon emission rate from boreal forest fire ranges from 8 to 21 t C ha⁻¹. The values are significantly larger than the net primary production (NPP), which is, for example, 1.23 Mg C ha⁻¹ y⁻¹ in average for Siberian forests estimated by Schulze et al. (1999), and soil respiration, which is 2.73 Mg C ha⁻¹ y⁻¹ on average for Taiga soils estimated by Raich and Schlesinger (1992). Carbon emission rates may depend on fire intensities. Estimation of carbon emissions with respect to fire intensities is necessary.

The recovery of forests generally requires about 20 years. Nitrogen and other nutrients release through organic matter decomposition, which is stimulated by forest disturbance. However, released N and nutrients can not be re-fixed in ecosystems due to lack of plants in destroyed forests, which may cause nitrate leaching and nitrous oxide (N₂O) emission from disturbed land surface. It is, therefore, necessary to clarify the effect of forest disturbance on N and nutrients in soil.

C budget in terrestrial ecosystems, which is determined by photosynthesis, respiration of vegetations, organic matter decomposition, and consumption of C by human and herbivorous animal, is influenced by climate change, and it also strongly influences the climate. Rise on surface air temperature and change in amount of precipitation alter plant productivity and decomposition of soil organic matter. It changes C budget in the ecosystem, then it influences atmospheric carbon dioxide (CO₂) concentration. Plant productivity depends on soil nutrient condition which is determined by soil biological, chemical, and physical processes such as N_2 fixation, denitrification, mineralization, immobilization, weathering, leaching, and so on.

Therefore, soil nutrient condition is also influenced by climate change. These indicate that the various factors relating to the interaction between ecosystem C budget and climate change are dependent on each other and they can not be described by single mechanistic model for each phenomenon. Therefore, a holistic approach to explain the whole phenomena is necessary to establish a strategy to protect and revive the ecosystem.

Objective of this symposium is to discuss about the forest management to conserve Siberian Taiga and its vicinity based on the status quo of its environment.

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Session 1: Regeneration and Stand dynamics *Keynote lecture*

Analysing and modelling Forest Stand Dynamics A European perspective

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Keywords: Model, Forest dynamics, yield, Simulator SILVA, Model BALANCE, European forests

Abstracts

The oldest forest growth and yield plots in Europe date back to 1860 and many of them are still under survey. More than 20 successive surveys provide unique time series of tree diameter, height, crown dimension, mortality etc. Different ways of thinning, fertilization, species mixing etc. were applied on the plots; so the tree's and stand's reactions on such factors were evaluated. This yielded a number of growth rules and laws and lead to growth and yield models: yield tables, individual tree models. Such models were and are of considerable value for forest management. They help foresters to foresee the consequences of their operations on stand level, estate or even on landscape level. In order to make maximum use of the valuable data pool from long-term observation, most of the approaches for analysing and modelling forest dynamics were understandably based on variables like e. g. tree diameter, height, site index. The forest simulator SILVA 2.0 is presented; it is a result of this conceptual approach and frequently used as decision support tool by forest managers.

However, climate change, air pollution, nutrients export and genetic engineering change growth conditions as well as tree and stand growth in an unprecedented way. As classical forest growth and yield models assume steady state conditions they lose in validity. More mechanistic based eco-physiological process models gain in importance. The model BALANCE is presented as an example of this approach. As such models explain dry matter production and other forest attributes explicitly in dependence on site factors (e.g. temperature) and resources (e.g. radiation, CO₂-concentration) they promise to be more appropriate to prognosticate system behaviour even under unstable and novel conditions.

Long tradition can promote, however, it also can tie down forest science. Due to the valuable data pool from long-term plots, the practicability of statistical approaches for analysing and modelling forest growth statistical approaches emerged and dominated in the past. On the other hand more forward looking eco-physiological approaches are still in the fledgling stage, far from being introduced into forest practice. However, promising research is under way to combine the potential of both approaches. Examples of overlap, completion and integration of statistical and eco-physiological process oriented approaches are presented. The common impetus of both approaches is to understand forest dynamics and to provide foresters and landscape planers with powerful and forward looking tools for sustainable forest management. That requires information about forest resources, forest ecosystem health and vitality, productive functions, biological diversity, protective functions and socio-economic functions of forest ecosystems.

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Forest structure and biodiversity after disturbance in Far East Russia

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Keywords: Priamurye, forest resources, biodiversity threats, sustainable use and management

Abstract

The forests of Priamurye, located in Amur State, the southwestern part of the Russian Far East, are of great environmental and social importance. They are diverse in space, time and species composition and have large wood stock, which was traditionally exploited for timber harvesting. They are also a source of medicinal, food and technical resources, as well as being a location for hunting. In recent decades the productivity of the forests has been decreasing. This is a result of forest policy based on profit-making from timber selling, and unsustainable methods of wood harvesting as well as on the disastrous impact of natural calamities such as forest fires, insect outbreaks and fungi infestations. In addition, the local forestry have faced a lack of co-ordination of federal and regional legislation, inadequate financing and the destruction of the forest management system during the period of reforms and the transition to a market-based economy. For sustainable use of the forest resources in Priamurye, a new system incorporating principles of practical forestry and forest management should be developed. The primary issues include: 1) the determination of the forms of forest ownership through the adoption of a new Forest Code of the Russian Federation; 2) the determination of sources and mechanisms for forestry financing, especially through forest resource lease; 3) the development of regional permanent forest surveying, fire protection and forest health monitoring systems.

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Regeneration and the recovery of aboveground biomass after forest fires in mixed conifer-broadleaf forests, Far Eastern Russia.

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Keywords: Fire intensity, Regeneration type, Aboveground biomass, Russian Far East

Abstract

Russian large forest (ca. 850'000'000 ha) is commonly expected to be a huge carbon sink. In some reports, however, Russian forests, as a whole, act as a carbon source because of the burning of biomass by recent frequent fires (e.g. IIASA. 1995). From the satellites, it could be detected that there are large number of forest fires in the mixed conifer-broadleaf forest, especially located in Amur region, Far East Russia. Therefore, to evaluate the accurate role of Russian forest in the carbon flux, it's necessary to know how frequent fires effect on the mixed forests in this region with occurrence of serious fires.

In the Amur region, Dahurican larch (*Larix gmelinii*) and white birch (*Betula platyphylla*) are the most dominant species. Zyryanova *et al.* (2005) reported that, in this region, two-third of the larch forests have changed to those of birch by the effects of recent frequent fires. In this region, if the fire intensity was not strong (strong surface fire or partial canopy fire), many *Larix gmelinii* trees can survive as mother trees. And then around remaining mother trees of larch, many seedlings regenerate, and form a patch-like larch stand in the early stage of regeneration after fires. But if the fire intensity would be strong (strong canopy fire or stand replacing fire), *Betula platyphylla* (an invader species) will be able to regenerate to the open area and form a monotonic stand. Therefore, with frequent forest fires, birch dominant forests will increase

How does vegetational change in recent years affect the carbon budget of the forests? To make it clear, we should firstly know the relations between this compositional change of woody species and their biomass. We estimated the aboveground biomass in two different types of forest. These forests were suffering from forest fires with different intensities because the number of remaining mother trees was markedly different.

In the present studies, birch has regenerated well in forests after severe fires and recovered its aboveground biomass to the level of lightly burnt forests in 35 years. Therefore, taking into the serious fire regime in this region (In fact, Yaborov (2000) reported that serious fires happen every 35 years in this region), CO_2 fixation capacity of these regions for 30-40 years may not be greatly changed by the vegetation change from larch forests to birch forests with the forest fires.

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Remote sensing of forest fire and vegetation recovery in a Siberian larch forest

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Keywords: Boreal forest fire, surface fire, forest floor vegetation cover, remote sensing

Abstract

Forest fire influences on forest dynamics and according carbon budget. In east Siberia, surface fire is more dominant than crown fire. We tested satellite detection of the surface fire and the recovery of the forest floor vegetation after the surface fire in a larch forest, east Siberia. The surface fire occurred from 1999 to 2005 were extracted on Landsat ETM+ data (185 km X 185 km area, 30 m resolution) by maximum likelihood method with reference to IKONOS satellite data and field reconnaissance. For the surface fire areas, yearly changes of forest-floor vegetation cover (FVC) and upper-canopy effective leaf area index (LAI_e) were estimated. FVC and LAI_e were indicators of net primary productivity (NPP) in the Siberian larch forest by considering forest biometric and CO₂ budget parameters. Through the relationships between FVC, LAI_e, and NPP, we estimated NPP changes induced by the surface fire in the region.

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Session 2: Nutrient cycling and soil characteristics

Keynote lecture

Biomass and nutrients of Korean pine seedlings invading oak and pine forests in Korea

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Keywords: Biomass, plant parts, nutrient cycling, oak, pine, central Korea

Abstract

A study was conducted to investigate biomass and nutrients of Korean pine (*Pinus koraiensis*) seedlings naturally invading a mixed oak (*Quercus mongolica* and *Q. variabilis*) forest and a Japanese red pine (*Pinus densiflora*) forest in central Korea. Average Korean pine seedling density (number of seedlings per ha) was 18,100 for the mixed oak forest and 4,550 for the pine forest. And the proportion of Korean pine seedling biomass to total above- and belowground biomass was 1.5% for the oak forest and 5.9% for the pine forest. Biomass of Korean pine seedlings was distributed in the order of foliage \geq stem > branch > root, and the Korean pine seedlings seemed to allocate more biomass to foliage to exploit the low light flux in shady conditions. In general nitrogen (N), phosphorus (P), and potassium (K) concentrations of Korean pine seedling were highest in foliage followed by branch, stem, and root for the two forests. Also foliage contained 56-61% of N, 43-48% of P, and 49-62% of K in the total above- and belowground nutrient contents in Korean pine seedlings.

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Effects of soil properties on the growth of Korean pine seedlings in mixed oak stands in central Korea.

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Keywords: Growth of Korean pine, soil properties, vegetation cover, mixed oak- pine forest, central Korea

Abstract

Korean pine (*Pinus koraiensis*) seedlings are naturally occurring from seeds carried by rodents in natural deciduous oak forests near mature Korean pine plantations. Twenty-three plots were located within oak forests at three regions (Chuncheon, Hongcheon, and Gapyeong) in central Korea, and ages, heights, and diameters at root collar of Korean pine seedlings were investigated and soil physical and chemical properties were examined. Densities of overstory oak species and understory Korean pine seedlings (number of trees/ha) were 500-2,500 and 1,400-13,800, respectively. No understory Korean pine seedlings showed mortality, and distribution patterns of age, height, and diameter were the reverse J shapes indicating typical shade tolerant increasing trends. Except for relatively low base saturation in the study area soil properties were similar to those of other common forest soils in the region. It was found that seedling densities increased while sums of total heights decreased with elevation from the CCA ordination analysis. However, densities and total heights were high at soils with low clay contents. There were highly positive correlations between basal area at root collar and soil water contents and soil porosity, however, basal area at root collar were negatively correlated with clay and Mg contents.

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Nutrient dynamics of boreal and temperate forests mixed conifer broad-leaved forests-Ionic flux of melting period in the mixed forest of snowy watersheds-

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Keywords: Ionic composition, snowmelt, mixed boreal forest, snowy watershed

Abstract

The ionic composition and flux of stream water during melting period were investigated in the mixed boreal forest watersheds of northern part of Hokkaido island, Japan. The winter climate of this area is characterized by heavy snow (the maximum depth of accumulated snow is more than 200cm) with cold air temperature (the lowest temperate is less than -30).

The samples of stream water were collected from four small neighboring watersheds (DE5 ~ De8: $3.9 \sim 13.7$ ha). The surface geological condition of the investigated area is the same (andesite). Mixed coniferous and broad leave forest (*Abies sachalinensis, Picea glehnii, Quercus mongolica* var. *grosseserata, Betura ermanii* etc.) is the main vegetation of the watersheds except DE8 whose vegetation is dwarf sasa bamboo (*Sasa kurilensis*). The interval of the water sampling is every 12 hours during the beginning of the snow melt (from 12^{th} April to 15^{th} May) and every 24 hours during the latter half of melting period (from 16^{th} May to 20^{th} June). The concentration of inorganic ions and organic substances (carbon and nitrogen) were analyzed by use of ion chromatography and C/N analyzer. The run off of the stream water was calculated on the basis of the water table which was situated in the weir of the watersheds.

From the comparison between mixed forest and sasa watersheds, following results were obtained for the elution of spring snowmelt. 1) The large fluctuation of daily outflow was observed in the sasa watershed. 2) The concentration of inorganic ions was relatively constant except the beginning of snow melt. 3) Snowmelt pushed out the groundwater in deeper part of the watersheds (old water) and caused the snowmelt out flow. 4) High concentration of bicarbonate ion in the old water accelerated the elution of cations from the watersheds in snowmelt period (wash out process). 5) The contribution of old water for the snowmelt outflow was estimated about 60% for the forest watershed and 40% for the sasa watershed.

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Session 3: Matter stock and flow

Keynote lecture

Effect of atmospheric nitrogen deposition on the budgets of greenhouse gases in semi-boreal forest ecosystems in Hokkaido, northern Japan

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Keywords: atmospheric DIN deposition, CH₄, CO₂, N₂O, net ecosystem production

Abstract

Nitrogen (N) is limited in forest ecosystem. Available mineral N in forest ecosystem is supplied by N_2 fixation and N deposition from the atmosphere and is controlled by the mineralization of soil organic matter. Tree is important sink of carbon dioxide (CO₂) and forest soil takes up methane (CH₄) from the atmosphere.

Recent researches show that increase of dissolved inorganic N (DIN) deposition into forest ecosystem increases nitrous oxide (N₂O) emission from soil (Butterbach-Bahl et al., 2002), and decreases CH₄ uptake by soil (Morishita et al., 2004). There are several reports showing DIN deposition accelerates soil organic matter deposition (Mo et al.2006). When CO_2 emission derived from soil organic matter decomposition is greater than plant CO_2 uptake, forest ecosystem is net source of CO_2 emission. On the other hand, increase of atmospheric DIN deposition stimulated tree growth (Kent and Fischer1988). Atmospheric DIN deposition increases with increase of anmonia (NH₃) and NO_x induced from agricultural activities, consumption of food and feed and consumption of fuel. Therefore, increase of human population increases atmospheric DIN deposition (Galloway and Cowling. 2002). It is important to start much more intensive research to clarify the effect of atmospheric DIN deposition into forest ecosystem on global warming.

In five *Larix leptolepis* dominated basins in Mt. Shirahata, Hokkaido, Japan (N42°56', E141°25'; 3 km × 4 km; annual temperature 8.2 ; annual precipitation 1130 mm), atmospheric DIN deposition associated with throughfall, net primary production of *Larix* (NPP), N₂O and CH₄ fluxes and soil organic matter decomposition (Ro) were measured. Atmospheric DIN deposition ranged from 2.96 to 5.68 kg N ha⁻¹ y⁻¹. Increase of the DIN deposition increased NPP and Ro significantly. Net ecosystem production (NEP = NPP – Ro) also increased with increase of the DIN deposition. However, NEP was negative in all Larix ecosystem other than one with highest DIN deposition. Increase of the DIN deposition increased N₂O emission and decreased CH₄ uptake significantly. Total global warming potential (GWP) which was CO₂ equivalent greenhouse gas emissions (IPCC, 2001) decreased with increase of the DIN deposition.

These results suggest that atmospheric DIN deposition can mitigate global warming by only increase tree growth, but may increase greenhouse gas emissions with reduction of soil organic matter pool.

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Wood resources and problems for their appropriate uses in the Amur region

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Keywords; wood resources, national forest policy, forest economy

Abstarct

На территории Амурской области сосредоточено 31,7 млн. га лесного фонда – это 17 % от площади лесов всего Дальнего Востока. Лесистость Амурской области составляет 64%. По этому показателю область занимает одно из первых мест в стране.

Общие запасы древесины в области составляют 1,9 млрд. м³, в том числе эксплуатационный запас древесины –788 млн. м³, из них хвойных пород – 695 млн. м³. На одного жителя области приходится 21,8 га леса и 1,9 тыс. м³ древесины. При общей вырубке около 2 млн. м³ в год ежегодный средний прирост составляет 28,89 млн. м³.

При таких общих показателях кажется, что запасы лесных ресурсов на территории Амурской области не только безграничны, но и ежегодно увеличиваются. Формально это так. Однако более детальный анализ позволяет сделать вывод о том, что процесс исчерпания затронул и эти ресурсы.

Сокращение запасов наиболее ценных пород древесины обусловлено следующими причинами:

- заготовка древесины за период с 2000-2005 г.г. возросла в 3,7 раза, преимущественно за счет роста экспорта древесины. При этом поставки обработанной древесины и изделий из нее резко снизилось и в 2005 году составила 1,6 % от общего объема;- в среднем за 5 лет лесными пожарами (75% - по вине человека), пройдено по 116 тыс.га, а лесовосстановительные работы за тот же период проведены только 27,8 % поврежденной площади;- используемые техника и технология заготовки леса приводит к большим потерям древесины (45-92 м³/га) и подроста (до 75%).

Сейчас необходим переход к ресурсосберегающим технологиям в лесном комплексе, что является единственным путем, который может обеспечить как потребности экономики, так и требования по охране природы. На это должны быть направлены все меры по изменению системы лесопользования, сохранению и воспроизводству лесных ресурсов.

Главное при этом – правовое обеспечение формирования национальной лесной политики: внесение изменений и дополнений в лесной, налоговый, гражданский, бюджетный и таможенный кодексы.

В налоговой политике для лесного хозяйства актуальна рециркуляция части налоговых сборов от производящих отраслей лесного комплекса. В отношении лесной и целлюлозно-бумажной промышленности главным будет: снижение роли налога на добавленную стоимость и повышение роли налога на прибыль, упрощение системы налогообложения за счет перехода на рентные платежи, налоговые льготы для предприятий, осуществляющих глубокую переработку древесины.

В области таможенной политики необходимо привести таможенные пошлины в соответствие с глубиной переработки экспортируемой лесной продукции, а также снизить их на импортируемые машины и оборудование для лесной, деревообрабатывающей и целлюлозно-бумажной промышленности.

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Recycling of sawdust to moderate environmental stress, an example of forest products utilization

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Keywords: GADE, BT, LMF, sawdust, artificial soil matrix, compost boards, planting pets, molding pellets, packing materials

Abstract

Biomass wastes such as garbage (food oriented wastes), excreta (human wastes), and live stock manure (feces and urine of cattle) were efficiently bio-converted into compost (organic fertilizer or soil conditioner) in sawdust, a biomass waste from forest products industry, used as an artificial soil matrix, without formation of odor.

GADE (garbage automatic degradation-extinguisher), BT (bio-toilet), and LMF (livestock manure fixer) systems were developed for garbage, excreta, and manure, respectively. The systems are well accepted by people in Japan for moderating the environmental stresses caused by these biomass wastes.

The used sawdust matrix, in which inorganic substances such as P, K, and N and organic substance such as humin are accumulated during the operation the systems, could be utilized as organic fertilizer or soil conditioner. The boards produced from the compost without addition of adhesive are strong enough to clear the JIS standard. Planting pots, molding pellets and packing materials are used as multifunctional recyclables.

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Session 4: Biodiversity conservation

Keynote lecture

Politics of wildlife management in forest ecosystems in Germany

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Keywords: Forest cover, Germany, wildlife damage, wildlife management

Abstract

For the Germans forests always have been and will be very important. The green third as forests often are called deliver precious services to environment and society. Without human impact, more than 90 % of Germany would be covered with forests. The needs of growing populations in the past caused the reduction of the forests to 32 % of the land area today. Despite a rising land use for settlements, industry, infrastructure etc. the loss of forests could be stopped and for about 30 years forest area has slowly been increasing again and probably will enlarge in future.

Most German forests are multi purpose forests and provide economic, ecological, environmental and social benefits for their owners and the population.

Wildlife management and hunting is practised on nearly every ha of the German forests. The main actors in the field of politics of wildlife management can be identified as the legislative, the hunting associations, the hunting administrations, the forest administrations, the land and forest owners with their associations and environmental associations.

Currently only 0,4 % (ca. 340 000) of all Germans are hunters. Due to the absence of predators in German forests the hunters have to control the populations of wildlife, especially of hoofed game.

In Germany every year for example more than 1 million roe deers (*Capreolus capreolus*) are shot. Nevertheless in many areas the hoofed game populations are still too high and cause severe damage especially in forest ecosystems. The effects of the damage are various e.g. reduction of increment, quality, value, diversity, stability or even destruction of the protective functions of the damaged forests. Particularly in mountain forests browsing and debarking by hoofed game is a danger for the whole forest which especially there has extreme important protective functions. In the last 20 years the State of Bavaria had to invest more than 56 Mill. \in for the restoration of alpine protective forests. These restoration measures have become necessary because of several reasons. One of the most important reasons probably was browsing damage by too big populations of hoofed game.

Because of different aims many hunters are in a struggle with forest owners and the forest administration. To solve some of the problems German hunting laws provide the right to claim compensation for wildlife damage to forests.

Successful wildlife management becomes more and more important, especially for the mountainous regions in Germany.

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The structure and distribution of crane roosting sites in "Muraviovka Park for Sustainable Land Use"

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Keywords: cranes, Muraviovka Park, roosting sites, stop over, habitat protection

Abstarct

The stop-over areas for the migrating birds are as important as nesting or roosting and over wintering sites. Muraviovka Park is one of rare sites in the world where huge multi-species gatherings of cranes which migrate in spring and autumn. The Park has conserved and improved the wetlands of the Amur river basin for the organic farming, preventing the wildfires, planting the lure crops, and provide the education programs for the students. The highest density of nest populations of red-crowned (*Grus japonesis*) and white-naped (*Grus vipio*) cranes in Russia was registered on the territory of "Muraviovka Park for sustainable land use".

One of the most important migration routes of cranes is located in this park. In autumn and spring, migrations of cranes in this park account for ca. 1500, and they stop over here. Among them, 30-50 are red-crowned cranes, 350-450 are white-naped cranes, 750-850 are Hooded cranes (*Grus monaha*). Common cranes (*Grus grus*), Demoiselle cranes (*Anthropoids virgo*), Siberian cranes (*Grus leucogeranus*) and hybrids of Common and Hooded cranes are also observed here. Usually, they stop over the Park for the period of 3 months from August to the beginning of November. Cranes gather for some smaller areas for their roostings. In this period, the crane-groups become bigger with the high density of birds.

After one of the cranes has come to use the roosting sites in this area, we started the census of this site in September 2006. Totally 5 roosting sites were found in the Park, but the census were run for the two of them. From the different watching points, we surveyed morning flyways, gatherings of the cranes in the evening, and also their flying away and coming back during the whole day. In the present studies, we defined the group dynamics and structures of these roosting sites.

The understanding of dynamics and distributions of the crane roosting sites in Muraviovka Park will lead to the best selection of the appropriate ways to protect and manage this core habitat of cranes.

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Poster session

Dynamics of nitrogen in leaves of deciduous broad-leaved trees and seedlings grown in unmanaged plantations in northern Japan

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Keywords: canopy photosynthesis, chlorophyll and nitrogen, year-to-year variation, CO₂ diffusion resistance, leaf anatomy

Abstract

Dynamics of nitrogen in leaves of trees and seedlings of deciduous broad-leaved forests had been studied with the aim of improving forest conservation. The photosynthetic traits of canopy leaves of deciduous broad-leaved trees were measured using a canopy tower. Leaf unfolding started from lower to higher of the each crown. As reflecting this pattern, leaf senescence began from the inner part of the crown in early successional species, but from within either the outer or top portion of the canopy in late successional species. The chlorophyll-to-nitrogen ratio in leaves increased with decreasing photon flux density. There is a clear positive correlation between nitrogen content in leaves and light saturated photosynthetic rate. Seasonal change in the allocation pattern of leaf nitrogen coincided with the changing of leaf phenology of upper canopy. In light limited condition, nitrogen was allocated to chlorophyll as light accumulation pigment while it allocated to more to photosynthetic carbon fixation, i.e. Rubisco in strong light condition, such as at forest gap. There was a significant year-to-year variation in photosynthetic rate at ambient CO₂ concentration. This variation may be due to the diffusion resistance in a leaf, since it disappeared under CO₂ saturation. Effect of nitrogen deposition and man-made disturbances on the photosynthetic rate of seedlings was performed through leaf structure.

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Changes in photosynthetic characteristics of alder and birch grown in a Free Air CO₂ Enrichment system in northern Japan

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Keywords: FACE (Free Air CO₂ Enrichment), Photosynthesis, Immature volcanic soil, water relations, birch, alder

Abstract

Physiological changes in plants exposed to elevated CO₂ concentrations ([CO₂]) differ from species to species. To determine the carbon sink capacity of forests in the future, it is therefore important to know the distinct photosynthetic traits of various woody species under elevated $[CO_2]$. For predicting early stage of forest succession in northern Japan under elevated CO_2 world, we focus on typical early successional species that are dominant there: two-year-old Alnus hirsuta Turcz, Betula platyphylla var. japonica Hara (in short B. platyphylla) and B. maximowicziana Regel. In these pioneer species, only A. hirsuta lives symbiotically with N₂-fixing Frankia sp. We grew these species for two growing seasons in a free air CO₂ enrichment (FACE; Hokkaido DALTON Co.Ltd. Japan) system (500 µmol mol⁻¹) in low nutrient volcanic ash soil which characterizes Japan. We also investigated the response in fertile brown forest soil, which extends all over Japan, to compare with volcanic ash soil. The N₂-fixing plant A. hirsuta and the non-N₂-fixing plants B. platyphylla and B. maximowicziana all reduced their photosynthetic capacity under elevated [CO₂]; this is known as photosynthetic down-regulation. The extent of down-regulation depends on soil fertility. For A. hirsuta, down-regulation occurred in brown forest soil, and was attributed to nitrogen deficiency and extra-accumulation of starch in foliage. In volcanic ash soil, however, A. hirsuta did not display reduced levels of nitrogen or accumulation of starch in leaves, and down-regulation did not occur. For *B. platyphylla* and *B. maximowicziana*, down-regulation was mainly found in volcanic ash soil, as a result of reduced nitrogen, lower Rubisco concentration in foliage and smaller leaf mass per area (LMA). These results suggest that A. hirsuta will be capable of significant effects on the carbon sink in CO₂ enriched forests in northern Japan; A. hirsuta had significantly higher photosynthetic rate than B. platyphylla or B. maximowicziana in volcanic ash soil.

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Effect of elevated carbon dioxide concentration on wood structure of hardwoods growing in Free Air CO₂ Enrichment (FACE) system

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Keywords: Elevated CO₂, FACE, wood structure, deciduous broadleaf trees, water relations

Abstract

It is predicted that increasing carbon dioxide (CO_2) concentration in atmosphere will result in change of forest dynamics. Many researchers have investigated effects of elevated CO_2 on tree physiology and forests. However, there are still very few studies on change in wood structure growing under high CO_2 concentrations. Under elevated CO_2 treatment, water conductivity in trees will change and may consequently modify wood structure, such as vessel lumen area and vessel frequency.

We have investigated changes in wood structure of boreal forest tree species in Free Air CO_2 Enrichment (FACE) system, which was established in Sapporo nursery of Hokkaido University Forests on June 2003. There are three replicates for FACE (500 ppmv) sites and control (370 ppmv) sites, respectively and seedlings of ten hardwoods in boreal forests were planted in those sites. Samples of four hardwoods including two ring-porous woods (*Quercus mongolica* and *Kalopanax septemlobus*) and two diffuse-porous woods (*Betula maximowicziana* and *Acer mono*) were obtained in August 2005. We cut about 15 µm thickness transverse sections from all blocks and measured vessel lumen area per a given area. Total vessel area, Mean vessel area, Vessel proportion and number of vessels per mm² were calculated in all samples. There were no significant differences on vessel morphology in all species. However, total vessel area, vessel proportion and number of vessels tended to decrease in *B. maximowicziana* seedlings under high CO₂ concentration. The response to elevated CO₂ on vessel morphology might dependent on species.

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Fine root demography in a cool-temperate deciduous forest in Japan

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Keywords: Fine roots, demography, Turnover rate, rhizosphere, cool-temperate forest,

Abstract

Production and mortality of fine roots (less than 1.0 mm in diameter) were estimated in a cool-temperate deciduous forest using a minirhizotron method during July 2000 to July 2001. Images at the transparent observation interfaces were taken, then digitized and stored on a computer. New, remaining and disappeared fine roots were manually discriminated at soil depths 0-20 cm at 5 cm intervals and each root length was calculated by a root image analysis. We calculated the fine root production turnover at each observation tube using the maximum root length density at all the observation date and year total root production. Likewise, fine root mortality turnover was also calculated. Year total fine root production and mortality decreased with increasing soil depth. At each depth, however, fine root production was chiefly higher than fine root mortality. For example, fine root production at 15-20 cm soil depth was 1.4 mm cm⁻² yr⁻¹, while fine root mortality was 0.3 mm cm⁻² yr⁻¹. Production turnover was not significantly different among soil depths, and average production turnover at all depths was 1.11 year⁻¹. In contrast, mortality turnover apparently decreased from 1.14 to 0.35 year⁻¹ with increasing soil depth. Our estimate, i.e., much higher turnover rates in surface soil horizons than at depth, is consistent with the hypothesis that the differences in the soil temperature and moisture along soil depths would reflect in the turnover. Decomposition rate would also reflect in our estimate because mortality turnover is based on all the fine roots (live and dead). Our results suggest that the importance of fine root survey with taking notice of soil depths.

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Dry toilet systems using sawdust as artificial soil matrix and their usefulness for preservation of water environment

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Keywords: Dry toilet, sawdust, aerobic conditions, evaporation of water, water preservation, safety sanitary, anaerobic conditions, anaerobic bacteria, urease,

Abstract

Dry closet systems named as "Bio-Toilets" in Japan will be introduced. The systems use sawdust as an artificial soil matrix in different sizes of machines. High porosities of the sawdust keep high air and moderate water retention. The aerobic conditions of the matrix allow aerobic bacteria increase their number and decompose the organic matters in the excretion into carbon dioxide and water without formation of odor. High surface ratios of the sawdust enable them to evaporate water efficiently out from the matrix, helping the matrix to keep aerobic conditions. Mixing of the sawdust without making any airless pockets in the matrixes is the key point of the systems. Control of the temperatures of the systems above 50 degrees in Centigrade is another point as providing safety sanitary conditions in the systems (no *E. coli* were detected).

The composts produced after the operation of systems could be utilized as organic fertilizers or soil conditioners in the farmlands or tree plantation sites.

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Effects of clear-cutting on nitrogen leaching and fine root dynamics in northern Japan

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Keywords: Disturbance, mixed confer-broadleaf forest, nitrogen, fine root dynamics, Coverage of *Sasa* (dwarf bamboo)

Abstract

Stream and soil solution chemistry, fine root biomass and soil nitrogen processing before and after clear-cutting of trees and subsequent strip-cutting of understory vegetation, dwarf bamboo (Sasa senanensis), were investigated to understand the effect of these disturbances on biogeochemical processes on forested watershed in northern Japan. Tree-cutting did not cause a significant increase of nitrate (NO_3^{-}) concentration in stream water during the growing season after the cutting. Subsequent Sasa-cutting caused significant increase of stream NO_3^{-1} concentration to ca. 15µmol L⁻¹. There was no significant change of stream pH following both cuttings. NO3⁻ concentration in soil solution increased after both cuttings, but the change of concentration was higher (>100 μ mol L⁻¹) after the Sasa-cutting than the tree-cutting. In a riparian conserved area, on the other hand, NO_3^- in soil solution remained low after tree-cutting, suggesting the riparian area acted as a NO₃⁻ sink after the tree-cutting. There was no significant change in total biomass of fine roots after the tree-cutting because of an increase in Sasa root biomass despite a decrease in tree roots. The subsequent Sasa-cutting caused a 50 % decrease of fine root biomass compared to that in the un-cut Sasa These results suggested that nitrogen uptake by Sasa was very important in preventing site. nitrogen leaching after tree-cutting, and decline of this nitrogen uptake after Sasa-cutting lead to marked NO_3^- leaching to the stream.

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