

## Research Group of Forest Ecophysiology

### [Goal]

Analysis and understanding of the photosynthetic capacity of woody plants in changing environment, such as elevated CO<sub>2</sub> and increase in nitrogen deposition, in order to conserve forest ecosystem and to rehabilitate the degraded forests after the overuse by human activities.



A view of plantation of Sakhalin spruce after forest fires for four times from early 1900's at Teshio Exp. Forest, the northernmost university forest in Japan where serpentine soil is dominated. We had been planting about a half million seedlings with aid of Japan Ministry of Education, Science & Culture. However, harsh environment prevents its quick recovery in vegetation.

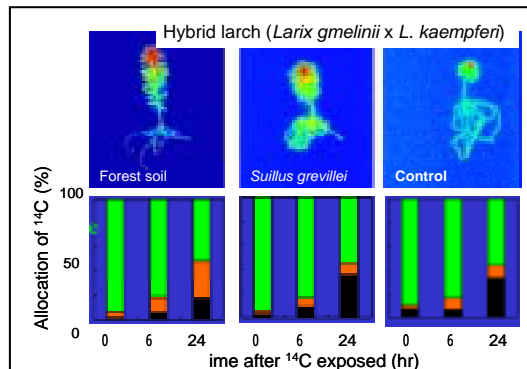
### [Current topics]

1. Photosynthesis and functional anatomy in relation to forest succession under the condition of global warming and soil acidification.

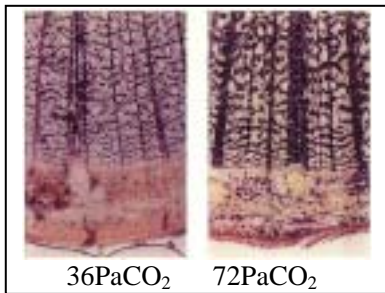


FACE experiment has been carried out with FSC staff and graduate students. We predict the change in stand structure composed of 11 deciduous tree species raised in the atmospheric CO<sub>2</sub> of 500ppm in FCAE (Free Air CO<sub>2</sub> Enrichment) with two soil types (volcanic ash vs. brown forest soil). This is the only one FCAE system for forest stands in Asia.

2. Analysis of allocation of photosynthates and growth characteristics (defense, symbiosis with ectomycorrhiza, propagation) of woody plants.



### 3. Wood formation as affected by global environmental changes



Xylem formation in beech (*Fagus crenata*) seedlings raised under elevated CO<sub>2</sub> and ambient CO<sub>2</sub>. With iodine-starch method, we can see extra-accumulation starch in xylem parenchyma of seedlings at high CO<sub>2</sub> as compared with that at ambient CO<sub>2</sub>.

( Kawagishi & Funada Unpublished data )

#### **-Research methods-**

Ecophysiological analysis on the environmental stresses on the growth and development of woody species. (Photosynthesis and allocation of photosynthates)

#### **[Staff]**

**Takayoshi KOIKE**

Professor of Forest Ecophysiology,

**Hokkaido University, Research Faculty of Agriculture**

(Laboratory of Silviculture and Forest Ecology Studies)

**Course in Environmental Resources, Graduate School of Agriculture,**

#### **-Membership-**

Japanese Society of Forest Society (senator in Hokkaido Branch), Japanese Botanical Society, British Ecological Society (Member 128272), Japanese Ecological Society, Plant Species Biology, American Biological Institute, Japanese Environment Society, Japanese Atmospheric Environment, Association of Northern Forestry, Association of Forest Tree Breeding, Association of Forest Tree Breeding in Hokkaido. Society of Forest Health (senator), Japanese Society of Root Research (senator)

#### **-Editorial Boards-**

Tree Physiology (1999, 2005-), Eurasian Journal of Forest Research (2000-), FOSNOLA (WSL: Switzerland: 2005-), Journal of Forest Research (2002-2003), Journal of Forest Health (2003-), Journal of Plant Research (1996-1999), Bulletin of Botanical Research (China: 2005-), Northern Forestry (1988-).

**Proofreading** is mainly connected with the SCITEXT in U.K. <http://www.scitext.com/>.

#### **-Awards-**

- Academic Award of the Japanese Forest Society in 2006,
- Academic Contribution Award to the Japanese Forest Technology Association in 2006,
- Contribution Award of International Congress on Air Pollution and Global Changes in 2004,
- Education Award for the Outstanding Chinese Students in 2004

#### **[Members of the group]**

**-Post Doctoral Fellow-**

**>FSC research fellow:**

Dr. Youko WATANABA (From Grad. School of Agr., Hokkaido University)

----Research topics: Functional anatomy of wood formation and plant growth

Dr. Takami SATOMURA (From Grad. School of Integrated Arts and Science, Hiroshima University)----Research topics: Functional root ecology under changing environment

**>JSPS research fellow:**

Dr. Satoshi KITAOKA (From Grad. School of Agr., Hokkaido University)

---- Research topics: Ecophysiology of deciduous broadleaved tree seedlings invading to unmanaged larch plantations at FFPRI (Hokkaido)

**-Graduate Students (research topics in 2007)-**

**>at Graduate School of Agriculture**

D3: Doughun JI (Forest rehabilitation in urban region to forest ecosystem under polluted environment)

D3: Norikazu EGUCHI (FACE study in deciduous trees native to northern Japan with special references to soil fertility; wood formation)

D1: Makoto KOBAYASHI (Biomass and regeneration of boreal forests under changing environment, Forest Fire Ecology)

PG: KIM Yonsok (Forest soil and analysis on the emission of CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O)

M2: Katsukiho MATSUI (Decomposition processes in FACE system and Spruce plantation with special references to soil macro-organisms)

M2: Tokihisa AGARI (Plant defense in alder species under changing environment)

M1: Shiro MATSUNAMI (Reproduction of an invasive species, Black locust with root sucker)

M1: Masaharu KANETOSHI (Photosynthetic traits of Black locust under changing environments)

B4: Kiyomi HINATA (Histochemistry of four summer green tree seedlings under changing environment)

B4: Takayuki KARAKI (Seed ecology on an invasive species, Black locust)

B4: Koharu RYU (Ectomycorrhizal study on larch and spruce in serpentine soil)

B4: Kohta KATO (Photosynthesis of deciduous broad-leaved trees grown in FACE) on leave from the Department of Bio-technology of Tokai University

**On going research projects:**

**Sponsored by Japan Society of Promotion of Science (JSPS)**

1) Prediction of forest dynamics and sustainability of mixed conifer-broadleaf forests based on a FACE study (2005-2008 March)

2) Histochemistry of plant defense chemicals in leaves at FACE (2006-2008 March)

**Sponsored by Ministry of Environment**

1) Estimation of carbon storage and growth rates of boreal forests in Russian Far East (2005-2008 March)

**Sponsored by Sumitomo Foundation**

1) Shift in light compensation point of deciduous broad-leaved trees under elevated CO<sub>2</sub> with FACE -Examination for Oikawa's prediction-(2007-2008 October)

## **Past Projects related to Forest Ecophysiology under changing environment**

>Sponsored by Ministry of Education (MEXT)

1) FACE (Free Air CO<sub>2</sub> Enrichment) experiment for mixed broadleaved tree species. Research Revolution 2002 (partnership between nature and humanity) Prediction of ecophysiological parameters for estimating of carbon budget of the terrestrial ecosystem (2002- 2007.March)

2) Measurement of transpiration of deciduous broadleaved trees raised under elevated CO<sub>2</sub> with a FACE (2004-2006 March)

>Sponsored by Ministry of Environment

1) Ecophysiological studies on matter flow in a larch ecosystem. (S1: Study on carbon management of terrestrial ecosystem of Asia in 21<sup>st</sup> century) (2003-2007 March)

## **[Again: Lectures by T.Koike]**

### **-Lectures for Master students-**

>at Graduate School of Agriculture

Forest Resources Ecology,

Topics in Global Warming

Advanced Bio-signal Chemistry under conducted by Prof. Y. Hashidoko

### **Past Part-time teacher:**

Environmental Biology (at Kyushu University) in 2007

Tree Ecophysiology (at The Univ. of Tokyo), 1996-2005

Ecology (Forest Ecology) (at The Univ. of Tsukuba) 1998-2004

Advanced course in Forest Bio-resources (at Mie University) 1996-2003

Advanced course in Biology (at Hokkaido Univ. of Education) in 2001

### **-Lectures for Undergraduate student-**

Silviculture and Forest Ecology, Forest Protection, Forest Space and Function and its Seminar, Forest Aesthetics, Forest Ecology for Regeneration

An Introduction to Field Science (Hokkaido University),

### **For overseas student:**

(HUSTEP; Short term course of overseas students in Hokkaido University),

1) Environmental Science of Biological Resources

2) An Introduction to Field Science (HUSTEP)

### **Part-time teacher:**

Plant Physiological Ecology (at Tokyo Univ. of Agriculture & Technology) until 2006

Environmental Resources (at Tokyo Univ. of Agriculture & Technology) in 2007

## **[again Members of the group]**

### **>PDF or PhD course, RONPAK Dr**

Dr. Tomoaki ICHIE (Associate Professor of Department of Forest Science, Kochi University; Tropical ecology, reproduction of woody species; Graduate School of Science, Kyoto University; JSPS fellow)

Dr. Ali M. QUORESHI (Researcher of Symbiotech. Alberta, Canada; Department of Forestry, University of Toronto, Canada; JSPS fellow)

## -----OB & OG-----

- Dr. Takatoshi NAKAMURA (Lecturer of Department of Plant Production Science, Tokyo University of Agriculture; Environmental Conservation in wetlands)
- Dr. Masazumi KAYAMA (Researcher at Kyushu Research Center, Forestry & Forest Products Research Institute; Tree Ecophysiology in nutrient ecology, Symbiotic micro-organisms)
- Dr. Sawako MATSUKI (Lecturer of Department of Forest Science, Iwate University; Plant defense of woody plants especially in Betulaceae)
- Dr. QU Laiye (Associate Professor of Eco-Environmental Research Center, Chinese Academy of Science, Beijing: Rhizosphere physiology in forest rehabilitation with special references to the existence of charcoal -- ectomycorrhizal ecology. (from China)
- Dr. WANG Wenjie (Associate Professor of Key Lab. of Forest Plant Ecology, Northeast Forestry University at Harbin, China; Production ecology, Respiration)
- Dr. Mahoko NOGUCHI (Researcher at Shikoku Research Center, Forestry & Forest Products Research Institute; Forest ecology in vegetation science)
- Dr. CHOI Dongsu (Associate Professor of Tokyo University of Agriculture & Technology; Soil acidification and CO<sub>2</sub> enrichment affecting growth of pine trees and symbiotic microorganisms in Korea and Japan. (from Korea)
- Dr. Yoshinori KITAHASHI (Researcher at Forest Products Research Institute of Hokkaido Government; Water relations in broadleaved trees in tropical regions and in shade trees in metropolis)

## [Previous engaged staff of the group]

### **Dr. Oxana MASYAGINA**

Associate Professor of Forest Ecophysiology Laboratory,  
(**Doctor, Russian Academy of Science**)

Engagement period: 2004 (July- Sept.), 2005 (June to Nov.).

**Specialty:** Ecophysiology of forest soil and rhizosphere environment,  
On leave from V.N. Sukachev Forest Research Institute, Krasnoyarsk, Russia English

### **Dr. Olga A. ZYRYANOVA**

Professor of Forest Ecology & Vegetation Science,  
(**Doctor, Russian Academy of Science**)

Engagement period: 2004 Oct. - March, 2005

**Specialty:** Vegetation science in permafrost region

On leave from V.N. Sukachev Forest Research Institute, Krasnoyarsk, Russia

## [Publications of Koike, T.]

### **-Selected articles by Koike, T.-**

- (1) Koike, T. (1987) Photosynthesis and expansion in leaves of the early, mid, and late successional tree species, birch, ash and maple. *Photosynthetica* 21:503-508.
- (2) Koike, T. (1988) Leaf structure and photosynthetic performance as related to the forest succession of deciduous broad-leaved trees. *Plant Species Biol.*, 3:77-87.
- (3) Koike, T. (1990) Autumn coloring, photosynthetic performance and leaf development of deciduous broad-leaved trees in relation to forest succession. *Tree Physiol.*, 7:21-32.
- (4) Koike, T. (1995) Effects of CO<sub>2</sub> in interaction with temperature and soil fertility on the

- foliar phenology of alder, birch, and maple seedlings. *Can. J. Bot.*, 73 :149-157.
- (5) Koike, T., Lei, T.T., Maximov, T.C., Tabuchi, R., Takahashi, K. and Ivanov, B.I (1996) Comparison of the photosynthetic capacity of Siberian and Japanese birch seedlings grown in elevated CO<sub>2</sub> and temperature. *Tree Physiol.*, 16:381-385.
- (6) Rousi, M., Mattson, W.J., Tahvanainen, J., Koike, T., and Uotila, I. (1996) Growth and hare resistance of birches: testing defense theories. *Oikos* 77:20-30.
- (7) Koike, T., Tabuchi, R., Mori, S., Takahashi, K. and Lei, T.T. (1998) Characteristics of the light response in seedlings and saplings of two mid successional species, ash and kalopanax, during the early stage of regeneration in a mature forest. *J. Sustainable For.*, 6: 73-84
- (8) Kitao, M., Lei, T.T., Koike, T., Tobita, H. and Maruyama, Y. (2000) Susceptibility to photoinhibition of three deciduous broadleaf tree species with different successional traits raised under various light regimes. *Plant Cell Environ.*, 23: 81-89.
- (9) Koike, T., Kitao, M., Maruyama, Y., Mori, S., and Lei, T.T. (2001) Leaf morphology and photosynthetic adjustments among deciduous broad-leaved trees within the vertical canopy profile. *Tree Physiol.*, 21: 951-958.
- (10) Kayama, M., Sasa, K. and Koike, T. (2002) Needle life span, photosynthetic rate, and nutrient concentration of *Picea glehnii*, *P. jezoensis*, and *P. abies* planted on serpentine soil in northern Japan. *Tree Physiol.*, 22: 707-716.
- (11) Matsuki, S., Sano, Y. and Koike, T. (2004) Chemical and physical defense in the early and late leaves in three heterophyllous birch species native to northern Japan. *Ann Bot.*, 93: 141-147.
- (12) Kitaoka, S. and Koike, T. (2004) Invasion of broadleaf tree species into a larch plantation: Seasonal light environment, photosynthesis, and nitrogen allocation. *Physiol. Plant.*, 121: 604-611.
- (13) Koike, T., Tobita, H., Shibata, T., Mastuki, S., Konno, K., Kitao, M., Yamashita, N. and Maruyama, Y. (2006) Defense characteristics of seral deciduous broad-leaved tree seedlings grown under differing levels of CO<sub>2</sub> and nitrogen. *Population Ecology* 48: 23-29.

### **-Chapter contributions of books (in English)-**

- (1) Koike, T. (1995) Physiological ecology of the growth characteristics of Japanese mountain birch in northern Japan: a comparison with Japanese mountain white birch. *In: E.O. Box et al. eds., Vegetation Science in Forestry: Global Perspective based on Forest, Ecosystems of East & Southeast Asia.*, Kluwer Academic Publishers, The Netherlands, 409-422.
- (2) Reich, P.B., Koike, T, Gower, S.T. and Schoettle, A (1995) Causes and consequences of variation in conifer leaf life-span. *In: W.K. Smith and T.M. Hinkley eds., Ecophysiology of coniferous forests.*, Academic Press, San Diego, 225-254.
- (3) Schulze, E-D., Bazzaz, F.A., Nadelhoffer, K., Koike, T. and Takatsuki, S. (1996) Biodiversity and ecosystem function of temperate deciduous broad-leaved forests., *In: Mooney, H.A., Cushman, J.H., Medina, E., eds., SCOPE Series. Functional roles of biodiversity: A global perspective.*, Jone Wiler & Sons, Chichester, New York, Shingapore., 71-98.
- (4) Koike, T. (2004) Autumn coloration, carbon acquisition, and leaf senescence. *In: L.D. Nooden ed., Plant Cell Death Processes.* Elsevier-Academic Press. Amsterdam, San Diego. 245-258.
- (5) Koike, T., Kitaoka, S., Ichie, T., Lei, T.T. and Kitao, M. (2004) Photosynthetic characteristics of mixed broadleaf forests from leaf to stand., *In: Shiomi, M. and Kawahata, H. eds. Global Environmental Change in the Ocean and on land.* TerraPub, Tokyo, 453-472.

## [Cooperative research groups]

1. Forest environment and Function group of Hokkaido University Forests
2. Forestry and Forest Products Research Institute (Hokkaido & Tsukuba)
3. Tokyo University of Agriculture and Technology (Plant Stress Physiology Lab., Wood formation regulation Lab.)
4. Center of Ecological Studies, Kyoto University (Prof. T. Ohgushi Lab.,)
5. Graduate School of Life Science, Tohoku University (Prof. T. Nakashizuka Lab.,)
6. Forest Resources Lab., Ehime University (Prof. I. Ninomiya La.)
7. National Institute of Industry (Dr. N. Saigusa)
8. Lab. of Forest Botany, Graduate School of Agriculture and Life Science, The University of Tokyo (Forest Pathology)

## [Graduated students]

### >Master course

Mrs. Yuko YANAGIHARA  
Ms. Machiko OOISHI  
Ms. Youko IGA  
Ms. Yuko SAKUMA  
Ms. Ikuko ENDO  
Mr. Takanori SHIBATA  
Mr. Takeshi HIDA  
Mr. Makoto KOBAYASHI  
Ms. Yuka OTSUKA  
Ms. Noriko MORII  
Mr. Kazuki Karatsu

### > Bachelor course

Mr. Takuma Shibutani  
Mr. Tomoharu Abe  
UG: Yuhki ISHII (Photosynthesis and methane emission) on leave from Tokai University in Hokkaido, Fac. Engineering. (Life science technology.)  
Ms. Sacie Naiki