

Research Group of Forest Ecophysiology

[Goal]

Analysis and understanding of the photosynthetic capacity of woody plants in changing environment, such as elevated CO₂ 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. Combination effects of O₃ and CO₂ on the growth of representative tree species



A hand made chambers for fumigation study on birch species (16 chambers)



Recently, the atmospheric ozone (O₃) concentration usually reaches 60~120ppb in the mountain regions in Hokkaido. With this condition, mountain birch (*Betula ermanii*) shows declining symptoms. Thus, we started the effect of elevated CO₂ & O₃ on the growth of representative tree species.

2. Free air O₃ fumigation on beech, birch and oak

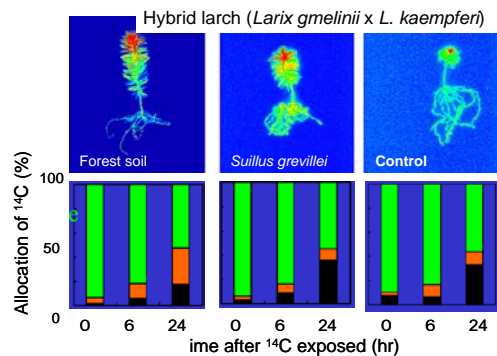


For evaluation of effects of ground surface ozone (O₃) on growth and absorption of O₃ in 3 kinds of deciduous broad-leaved tree saplings exposed to 60 ppb O₃ by a free air O₃ fumigation system.

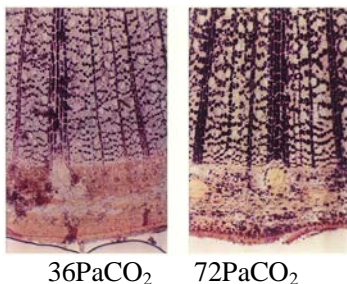
We found stomatal sluggishness in beech and monitor diameter growth in stem.

--- Jarvis model was applied for estimating O₃ absorption of saplings (Dr. Y. Hoshika studied)

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



4. Wood formation as affected by global environmental changes



Xylem formation in beech (*Fagus crenata*) seedlings raised under elevated CO_2 and ambient CO_2 . With iodine-starch method, we can see extra-accumulation starch in xylem parenchyma of seedlings at high CO_2 as compared with that at ambient CO_2 .

(Kawagishi & Funada Unpublished data)

Collaborate with Prof. R. Funada & his group.

Former main target: 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_2 of 500ppm in FCAE (Free Air CO_2 Enrichment) with two soil types (volcanic ash vs. brown forest soil). This is the only one FACE system for forest stands in Asia.

>We finished the second phase of FACE experiments by 2013 with the member of Dr. K. Takagi, Prof. K. Sasa and Prof. F. Satoh of Field Science Centre for Northern Biosphere (FSC) of Hokkaido University. We are synthesizing following topics:

- 1) Aerobic CH_4 efflux from tree species at elevated CO_2
- 2) Nitrogen allocation of hybrid larch F1 at elevated CO_2 and nitrogen levels.
- 3) Regeneration activities of deciduous broadleaf trees at elevated CO_2 simulated to conservation of SATOYAMA
- 4) Plant defense of deciduous broadleaf trees at elevated CO_2
- 5) Soil respiration characteristics after intensive disturbances.
- 6) Effect of elevated CO_2 on the growth of bio-fuel tree species

-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-).

Trees: structure & Function (2010~)

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

On going research projects:

- 1) Effects of high nitrogen loading on growth of larch species raised under elevated ozone (2014-2017 March)
- 2) Species richness of ectomycorrhiza in hybrid larch F1 grown under elevated O3 and CO2 (2014-2016 March)

Past Projects related to Forest Ecophysiology under changing environment

>Sponsored by Ministry of Education (MEXT), Sponsored by Japan Society of Promotion of Science (JSPS)

- 1) Parameterization of the growth and xylem formation of woody plants grown under FACE system (2009~2014 March: Innovation Research)
- 2) Effects of elevated O₃ and CO₂ on growth and photosynthesis of woody plants (2011-2014 March)
- 3) Carbon allocation of woody species grown in FACE and estimation of CO₂ efflux (2008~2011 March)
- 4) FACE (Free Air CO₂ 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)
- 6) Measurement of transpiration of deciduous broadleaved trees raised under elevated CO₂ with a FACE (2004-2006 March)
- 6) Prediction of forest dynamics and sustainability of mixed conifer-broadleaf forests based on a FACE study (2005-2008 March; Type A)
- 7) 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 the Sumitomo Foundation

- 1) Shift in light compensation point of deciduous broad-leaved trees under elevated CO₂ with FACE -Examination for Oikawa's prediction-(2007-2008 October)

>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 21st century) (2003-2007 March)

[Former 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)

Dr. Takami SATOMURA (From Grad. School of Integrated Arts and Science, Hiroshima University)---Research topics: Functional root ecology under changing environment, *Present address*: T. Kobayashi's Lab. (Plant Ecology), Faculty of Agriculture, Kagawa University, Takamatsu-City, Kagawa Prefecture, Japan

Dr. Makoto WATANABE (Associate Professor of Tokyo University of Agriculture and Technology; JSPS fellow)

Dr. Yasutomo HOSHIKA (JSPS researcher)

Dr. Yoko WATANABE (Researcher of Agriculture School of Hokkaido Univ.)

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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. Satoshi KITAOKA (Ecophysiology of deciduous broadleaved trees in a larch plantation)
- 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 CO₂ 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)
- Dr. JI Donghun (Regeneration of Korean white pine, Korean Forest Research Institute;) from Korea)
- Dr. Norikazu EGUCHI (FACE study in deciduous trees native to northern Japan with special references to soil fertility; wood formation; Forestry & Forest Research Center of Aichi Prefecture)
- Dr. KIM YongSuk (Emission of Greenhouse gass in various environments; Korean Forest Research Institute) (from Korea)
- Dr. Makoto KOBAYASHI (Fire disturbance in Siberia forests and analysis of ecological role of charcoal; Field Science Center for Northern Biosphere, Hokkaido Univ.)
- Dr. NOVRIYANTI Eka (Chemo-ecology of tropical plants under changing environment: Indonesian Institute of Fiber and Forest Products Research) (from Indonesia)
- Dr. MAO Qiaozhi (Growth and physiological responses of 3 kinds of larch grown under several environments, College of Resources and Environment, Southwest University, China)

[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