



# FACING THE FUTURE

## The FACTS II (Aspen FACE) Newsletter

### Volume 3, No. 1, June 2004

**David F. Karnosky and Janet M. Pikkarainen, Editors**



### 36<sup>th</sup> Air Pollution Workshop Visits Aspen FACE

Approximately 70 participants of the 36<sup>th</sup> Air Pollution Workshop visited the Aspen FACE site on April 28, 2004 as part of their 3-day workshop activities. USFS North Central Research Station Assistant Director Rob Doudrick (right) welcomed the participants to the site. After lunch, the group toured the facilities including the CO<sub>2</sub> and O<sub>3</sub> generation system, a demonstration of the self-propelled boom lift by Jaak Sober (Michigan Tech) and then walking to three rings (the north replicate (CO<sub>2</sub>, O<sub>3</sub>, and CO<sub>2</sub>+O<sub>3</sub>).



Aspen FACE scientists Mark Kubiske, Bill Mattson and Vanessa Quinn (USFS, Rhinelander), Ed Mondor (University of Wisconsin, Madison), Kevin Percy (Canadian Forest Service, Fredericton, New Brunswick, Canada), and Dave Karnosky (Michigan Tech) made presentations in the rings. Retired USFS and distinguished scientist FACE investigator Richard Dickson was a surprise participant in the meeting. Richard briefed participants on the logistics of dispensing CO<sub>2</sub> and O<sub>3</sub> across our 20-hectare experiment. A story of the field trip was written up in the April 29, 2004 Rhinelander *Daily News*.

The local hosts for the Workshop were Dave Karnosky (Michigan Tech) and Mark Kubiske (USFS-Rhinelander). Aspen FACE research was featured in several presentations during the 3-day Workshop including

those by Elina Vapaavuori (METLA, Finland), Elina Oksanen (University of Kuopio, Finland), Ed Mondor (University of Wisconsin-Madison), and Leanne Vigue (University of Wisconsin-Madison). Participants with Aspen FACE posters included Dave Karnosky (Michigan Tech), Anu Sober (University of Tartu, Estonia), and Dave Ellsworth (University of Michigan). The Workshop was sponsored by the USFS Northern Station Global Change Program, the USFS North Central Research Station, the US EPA, and Michigan Tech's Ecosystem Science Center.



Scientists look into the future to fight pollution



*Daily News, Rhinelander  
April 29, 2004*

### Symposium Features Aspen FACE

On Monday, April 26, 2004 Aspen FACE scientists Dave Karnosky (Michigan Tech) and Mark Kubiske (USFS-Rhineland) chaired a Pre-Workshop Symposium entitled “Interactions of Elevated CO<sub>2</sub> and O<sub>3</sub>” at the Holiday Inn Express Hotel in Rhineland, Wisconsin. Aspen FACE research was highlighted in presentations by Elina Oksanen (University of Kuopio, Finland), Kevin Percy (Canadian Forest Service, Fredericton, New Brunswick, Canada), Mark Kubiske (USFS-Rhineland, WI), Seija Kaakinen (METLA, Finland), Christian Giardina (USFS-Houghton, MI), Rick Lindroth (University of Wisconsin, Madison, WI) and Warren Heilman (USFS-East Lansing, MI). About 70 participants took part in the symposium.



Kevin Percy



Rick Lindroth



Christian Giardina



Warren Heilman

### Dr. Neil Nelson Joins USFS

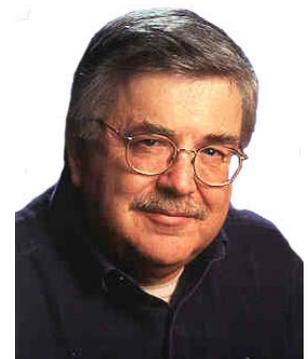
Dr. Neil Nelson joined the USFS on May 2, 2004 as a Scientist and Project Leader for RWU 4152 in Rhineland, Wisconsin. He brings more than 30 years of research expertise in plant physiology. He is coming to the Station from the Natural Resources Research Institute, University of Minnesota Duluth, where he served over six years as the Director of the Forestry/Forest Products Division, Center for Applied Research and Technology Development (CARTD). In that position, Dr. Nelson conducted research in plant physiology and biotechnology and provided leadership to five programs—forestry, biotechnology, chemical extractives, wood materials and engineering, and secondary wood products. Prior to his work at the Institute, he was President, CEO, and Director of Forgene, Inc., a forest biotechnology company that developed and commercialized genetically improved trees and new genetic technologies for tree crops. Earlier in his career, he worked as a forest products technologist for the Forest Products Lab and later as a research plant physiologist, project leader, and program manager for North Central in Rhineland, WI.

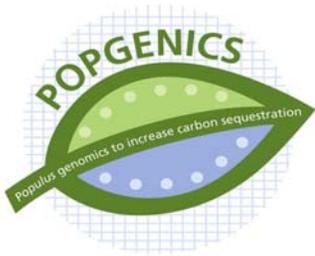


Throughout his career, Dr. Nelson has been successful in securing research grants and has published more than 50 papers. He serves as an Adjunct Professor for the University of Minnesota Duluth and has served at Michigan State University and the University of Minnesota St. Paul. Neil will assume the USFS role in the Aspen FACE Steering Committee and Mark Kubiske will remain on the Steering Committee as an ex-officio member.

### Book Dedicated to the late Dr. David Shriner

The recent Elsevier Press book by Aspen FACE investigators David Karnosky (MTU), Kevin Percy (Canadian Forest Service—Fredericton, New Brunswick), and Janet Pikkarainen (MTU), and Art Chappelka and Caroline Simpson entitled “Air Pollution, Global Change and Forests in the New Millennium” was dedicated to former USFS North Central Station Assistant Director Dr. David Shriner who died on July 26, 2003. The dedication reads “Dr. David Shriner had a lifelong interest in the effects of air pollution and climate change on forest ecosystems. While at Oak Ridge National Lab, David was one of the principal authors of the U.S. National Acid Precipitation Assessment Program State of Science Report, and he served as a member of the National Science and Technology Council under President Clinton. While serving as Assistant Director of the USDA Forest Service’s North Central Research Station from 1998-2003, David was an enthusiastic and tireless promoter of the Aspen FACE project. He presented the lead keynote address at the May, 2000 IUFRO meeting leading to this book’s development.”





### POPGENICS Consortium Established

The *Populus* genomics to increase carbon sequestration (POPGENICS) consortium was established with support from the Office of Science (BER), U.S. Department of Energy. The new consortium, headed by Aspen FACE Director Dave Karnosky (MTU), Gopi Podila (University of Alabama-Huntsville), and Gail Taylor (University of Southampton, UK). Other investigators on the project include Chung-Jui Tsai (MTU), Alistair Rogers (Brookhaven National Lab), Don Riemenschneider (USFS), and Ramesh Thakur (MTU). The project is focusing on functional genomics using microarray gene expression and QTL of growth

characteristics under elevated CO<sub>2</sub> at the Aspen FACE and companion POPFACE in Italy. Engineering of Don Riemenschneider's high-yielding backcrosses of (*Populus deltoides* x *P. trichocarpa*) x *P. deltoides* is planned to increase their ability to sequester carbon. The consortium's first meeting was held on April 25, 2004 in Rhinelander, Wisconsin. The project includes a 3-year, \$916,231 grant to Michigan Tech with subcontracts to the University of Southampton and University of Alabama-Huntsville. Aspen FACE investigator, Alistair Rogers, was also awarded a separate DOE contract for physiological studies in the consortium. POPGENICS investigators Ramesh Thakur, Chung-Jui Tsai, Alistair Rogers, Gail Taylor, and Dave Karnosky are shown in the photo.



### Ecosystem Science Center Established at Michigan Tech

The Ecosystem Science Center (ESC) was recently established at Michigan Technological University. Housed in the School of Forest Resources and Environmental Science, ESC is directed by Aspen FACE Steering Committee member Dr. Kurt S. Pregitzer. According to Kurt, "The Ecosystem Science Center (ESC) is designed to advance our understanding of how ecosystems function and how human activities influence ecosystem processes. The Center's two main objectives are to: (1) foster ecosystem research through the acquisition of extramural support; and (2) improve Michigan Tech's ability to educate graduate and undergraduate students in the area of ecosystem science."

ESC consolidates a large set of ecosystem studies ongoing at Michigan Tech including the Aspen FACE project. "We would like to particularly expand the educational opportunities of large ecological studies such as Aspen FACE", says Kurt.



### Venturia Rears Up Again

*Venturia* shoot blight has flared up again at the Aspen FACE site. This disease has been present since the start of our experiment but had been in relatively low occurrence for the past few years. Unusually wet spring conditions have caused the disease to have a flare up this year. Classic symptoms include the shepherd's crooks branches in the upper canopy (far left) and blackened leaves in the lower canopy (left). Dr. Tony Hopkin and Chuck Davis (Canadian Forest Service—Sault Ste. Marie, Ontario) are scheduled to continue their rating of *Venturia* this summer. According to Dr. Hopkin, "we may see a second flare up of the disease later this summer, depending on the weather." The disease incidence is strongly clonal in nature with Aspen FACE clone 216 being particularly susceptible. The good news is the disease is not life-threatening and poplars usually outgrow it.





### Additional Walkways Added

In an attempt to reduce foot traffic in the Aspen FACE rings, additional boardwalks were added this spring (right). These were placed in the opposite direction of our original walkways to allow easier movement between the walkways across each ring. This project was coordinated by Dr. Erik Lilleskov (USFS-Houghton) who encourages all Aspen FACE researchers and workers to **“Please stay on the boardwalks in the rings”**. Many studies of the forest floor and forest soils, such as those of mycorrhizal fungi, can be damaged by off-walkway travel.

### Rabbit Damage Continues

Despite our best efforts to fence the rings during the winter to keep out rabbits, we incurred significant rabbit damage in a few rings this past winter. We will continue to live trap and conduct rabbit hunts this year to reduce numbers and Wendy Jones (MTU) says we will reconfigure our protective fencing by constructing a gate for human access that will be less likely to be pressed down by foot traffic as has happened in the past.



### New Aspen FACE Student Operators

Suresh Shenoy (left) and Alok Sabherwal (right) are working as student operators this summer at Aspen FACE. Both Suresh and Alok are Michigan Tech Electrical Engineering graduate students. Suresh completed his B.S. degree in Engineering Electronics and Communications from the J.S.S. Academy of Technical Education in Bangalore, India. He has extensive computer programming skills. Alok graduated in Electronics from Maharshi Dayanand University in Haryana, India. He is working on mobile networks and robotics for his masters project.

### Water Balance Study Supported by USDA/NRI

Drs. John King (MTU- right) and Mark Kubiske (USFS) recently received word that this proposal entitled “Forest ecophysiological responses will influence regional water supplies due to altered atmospheric conditions in the near future” was supported by the USDA NRICGP Water

Resources and Watershed Processes Program for \$450,000.

This project will characterize how water cycling in aggrading north temperate forests is influenced by concentrations of atmospheric CO<sub>2</sub> and tropospheric O<sub>3</sub> predicted for the year 2050. We will examine how the interaction of stomatal physiology, development and duration of leaf area (canopy-atmosphere coupling), plant hydraulic conductance, root growth and depth-distribution affect the biotic and abiotic controls on the forest hydrologic cycle. Standard water balance methodology and monitoring of micrometeorological conditions in all FACE rings will allow development of statistically robust stand water balances as function of the atmospheric treatments. This project will provide data needed to validate ecosystem hydrologic models for nested modeling activities of the USGCRP to reduce uncertainty in managing future water supplies, and protect ecosystem function and health from human-induced environmental change.

*Congratulations John and Mark!*



### Lindroth Group News

Rick Lindroth (UW) tells us he has a new graduate student, Mike Hillstrom, who will investigate the impacts of elevated CO<sub>2</sub> and O<sub>3</sub> on biodiversity of canopy insects. Also, Rick has another new graduate student Leanne Vigue (photo) who will evaluate the impacts of elevated CO<sub>2</sub> and O<sub>3</sub> on litter arthropod diversity. Leanne recently received a 3-year National Academy of Science-Ford Foundation predoctoral fellowship for her work.



### Host Group News

George Host (Natural Resources Research Institute) tells us he and Kathryn Lenz have recently attended the "4<sup>th</sup> International Workshop on Functional-Structural Plant Models" in Montpellier, France on June 7-11, 2004. They presented the following papers:

Kathryn Lenz, Harlan Stech and George Host – Phenological process models based on carbon productivity at the leaf and branch levels, and their effects on aspen tree architecture.

George Host, Kathryn Lenz and Harlan Stech – Mechanistically-based functional-structural tree models for simulating forest patch response to interacting environmental stresses.

Harlan Stech, Kathryn Lenz and George Host – Elementary mage techniques for calibrating and testing canopy light interception models.



### Karnosky Group News

Joseph Darbah (left), a new Ph.D. student in Dr. David Karnosky's (MTU) lab will be examining diurnal photosynthesis curves this summer at the Aspen FACE site. Joseph is also examining canopy depth. Joseph is funded by a graduate research assistantship from Michigan Tech.

Anu Sober, University of Tartu-Estonia, will return this summer to coordinate gas exchange studies in various portions of the Aspen FACE canopies. She will train Joseph Darbah and her graduate student, Katre Kets, on the LiCor 6400. Anu is also interested in acclimation and water conductance issues at the Aspen FACE site. Anu has been spending her summers at our site for the past 10 years. Her husband, Jaak Sober, is our lead site operator.

Wendy Jones (MTU) continues to take the series of digital photos to characterize LAI.

Dave Karnosky (MTU) continues his research on spring and autumn phenology, canopy development, and gene expression under elevated CO<sub>2</sub> and O<sub>3</sub>.

### Pregitzer Group News

Kurt Pregitzer's group continues to monitor the belowground processes. The crew makes biweekly trips to Rhinelander to take a suite of measurements including soil respiration and pCO<sub>2</sub>, root growth and turnover, dissolved organic and inorganic carbon, soil and canopy temperatures, and soil moisture. A comprehensive sampling program is also in place for characterizing the 13C signature of both above and belowground components and the ring atmosphere, including a sample archive. In addition, Pregitzer's group will be collaborating with Don Zak's group in July to assess the fate of the 15N tracer applied to plots in June 2003.

Angela Johansen (below right) is the field supervisor for the crew this year, which also includes three undergraduates from MTU: Brian Hunter (Applied Ecology), David Bandlow (Environmental Engineering), and Hilary Sherzer (Biology). Wendy Loya continues her post-doctoral research on soil C at the site. Robin Johnson is a new MS student that is designing a research project on characterization of root exudates. We also welcome an MTU REU, Janet Aerts (Applied Ecology), who will be investigating the 15N and 13C signature of the understory vegetation to compliment measurements taken on the trees.





### **University of Wisconsin Ecology Class Visit**

On May 1, University of Wisconsin-Madison professors Carol Barford and Chris Kucharik brought their popular “Ecology and a Changing Planet” class to a 3-hour visit of the Aspen FACE project. Aspen FACE Director Dave Karnosky led the tour of the Aspen FACE facility including stops at the CO<sub>2</sub> and O<sub>3</sub> generation facility and several experimental rings. Discussions between Karnosky, Barford and Kucharik were to make this an annual event and to possibly extend the Aspen FACE time in the course to 2-3 days during the summer and to involve other Aspen FACE investigators.



### **Options Explored for Dealing with Taller Trees**

Wisconsin Public Service Engineer Richard Reitz (center in photo) visited the Aspen FACE project on June 15, 2004 to discuss options for dealing with the infrastructure changes needed to continue elevated CO<sub>2</sub> and O<sub>3</sub> exposures at the Aspen FACE site. Reitz met with Dave Karnosky, Michigan Tech, Ron Teclaw, USFS-Rhineland (left in photo) and Jaak Sober, Michigan Tech (right in photo). Wisconsin Public Service set the original poles for the center monitoring and the 16 poles per ring to hold up the vertical vent pipes. Rich is working up estimates for several options for extending or replacing the support poles. Rich has also helped us develop our lightning protection system and has been a frequent visitor to the Aspen FACE project over the years.

### **Housekeeping Reminders for the Aspen FACE site**

- 1) Please sign in each day (full name) so we can keep track of daily users at our facility. This is important information for our sponsors!
- 2) Respirator use (see photo of Leanne Vigue who carries her respirator with her at all times while going from ring to ring) is mandatory inside ozone rings while ozone dispensing is occurring -- see Site Operators for these. Please see Wendy Jones for details on medical exams necessary for respirator use.
- 3) Please stay off the elevated walkways and towers unless you have had the proper training on their use. Training sessions can be arranged via Wendy Jones. Climbing harnesses are mandatory for climbs to the elevated walkways.
- 4) Please drive carefully and slowly on the Aspen FACE site roads!
- 5) Please alert Site Operators of any hornet or wasp problems so they can use proper eradication techniques.
- 6) A first-aid kit is available in the main control building.



## Aspen FACE New Publications

### Journal Articles:

- Karnosky, D.F.** and **R.C. Thakur**. 2004. Genetic aspects of air pollution and climate change. In: J. Burley, J. Evans, and J. Youngquist (Eds.), *Genetics and Genetic Resources, Encyclopedia of Forest Sciences*. Academic Press. London, pp. 223-229.
- Oksanen, E.**, **E. Häikiö**, **J. Sober**, and **D.F. Karnosky**. 2003. Ozone-induced H<sub>2</sub>O<sub>2</sub> accumulation in field-grown aspen and birch is linked to foliar ultrastructure and peroxisomal activity. *New Phytologist* 161:791-799.
- Davey, P.A.**, **S. Hunt**, **G.J. Hymus**, **E.H. DeLucia**, **B.G. Drake**, **D.F. Karnosky**, and **S.P. Long**. 2004. Respiratory oxygen uptake is not decreased by an instantaneous elevation of [CO<sub>2</sub>], but is increased with long-term growth in the field at elevated [CO<sub>2</sub>]. *Plant Physiology* 134:520-527.
- Awmack, C.S.**, **R. Harrington**, and **R.L. Lindroth**. 2004. Individual performance does not predict aphid population responses to elevated atmospheric CO<sub>2</sub> or O<sub>3</sub>. *Global Change Biology* (In Press).
- Kaakinen, S.**, **Katri Kostiaainen**, **Fredrik Ek**, **Pekka Saranpää**, **Mark E. Kubiske**, **Jaak Sober**, **David F. Karnosky** and **Elina Vapaavuori**. 2004. Stem wood properties of *Populus tremuloides*, *Betula papyrifera* and *Acer saccharum* saplings after three years of treatments to elevated carbon dioxide and ozone. *Global Change Biology* (In Press)
- King, J.S.**, **P.J. Hanson**, **E. Bernhardt**, **P. DeAngelis**, **R.J. Norby**, and **K.S. Pregitzer**. 2004. A multi-year synthesis of soil respiration responses to elevated atmospheric CO<sub>2</sub> from four forest FACE experiments. *Global Change Biology* (in press).

### Books and Book Chapters:

- Karnosky, D.F.**, **K.E. Percy**, **A.H. Chappelka**, **C. Simpson**, and **J.M. Pikkariainen** (Eds.). 2003. *Air Pollution, Global Change and Forests in the New Millennium*. Elsevier Press, Amsterdam. 469 pp.
- Karnosky, D.F.**, **K.E. Percy**, **R.C. Thakur**, and **R.E. Honrath Jr.** 2003. Air pollution and global change: A double challenge to forest ecosystems. In: **D.F. Karnosky**, **K.E. Percy**, **A.H. Chappelka**, **C. Simpson**, and **J.M. Pikkariainen** (Eds.), *Air Pollution, Global Change and Forests in the New Millennium*. Elsevier Press, Amsterdam. pp. 1-41.
- Shriner, D.S.** and **D.F. Karnosky**. 2003. What is the role of demographic factors in air pollution and forests? In: **D.F. Karnosky**, **K.E. Percy**, **A.H. Chappelka**, **C. Simpson**, and **J.M. Pikkariainen** (Eds.), *Air Pollution, Global Change and Forests in the New Millennium*. Elsevier Press, Amsterdam. pp. 43-55.
- Karnosky, D.F.**, **P. Sharma**, **R.C. Thakur**, **M. Kinouchi**, **J. King**, **M.E. Kubiske**, and **R.A. Birdsey**. 2003. Changing atmospheric carbon dioxide: A threat or benefit? In: **D.F. Karnosky**, **K.E. Percy**, **A.H. Chappelka**, **C. Simpson**, and **J.M. Pikkariainen** (Eds.), *Air Pollution, Global Change and Forests in the New Millennium*. Elsevier Press, Amsterdam. pp. 57-84.
- Percy, K.E.**, **A.H. Legge**, and **S.V. Krupa**. 2003. Tropospheric ozone: A continuing threat to global forests? In: **D.F. Karnosky**, **K.E. Percy**, **A.H. Chappelka**, **C. Simpson**, and **J.M. Pikkariainen** (Eds.), *Air Pollution, Global Change and Forests in the New Millennium*. Elsevier Press, Amsterdam. pp. 85-118.
- Martin, M.J.**, **G.E. Host**, **K.E. Lenz**, and **J.G. Isebrands**. 2003. Simulating the growth response of aspen to elevated ozone: a mechanistic approach from leaf-level photosynthesis to complex architecture. In: **D.F. Karnosky**, **K.E. Percy**, **A.H. Chappelka**, **C. Simpson**, and **J.M. Pikkariainen** (Eds.), *Air Pollution, Global Change and Forests in the New Millennium*. Elsevier Press, Amsterdam. pp. 175-197.
- Karnosky, D.F.**, **K. Percy**, **B. Mankovska**, **T. Prichard**, **A. Noormets**, **R.E. Dickson**, **E. Jepsen**, and **J.G. Isebrands**. 2003. Ozone affects the fitness of trembling aspen. In: **D.F. Karnosky**, **K.E. Percy**, **A.H. Chappelka**, **C. Simpson**, and **J.M. Pikkariainen** (Eds.), *Air Pollution, Global Change and Forests in the New Millennium*. Elsevier Press, Amsterdam. pp. 199-209.
- Percy, K.E.**, **B. Mankovska**, **A. Hopkin**, **B. Callan**, and **D.F. Karnosky**. 2003. Ozone affects leaf surface pest interactions. In: **D.F. Karnosky**, **K.E. Percy**, **A.H. Chappelka**, **C. Simpson**, and **J.M. Pikkariainen** (Eds.), *Air Pollution, Global Change and Forests in the New Millennium*. Elsevier Press, Amsterdam. pp. 247-258.
- Wustman, B.**, **E. Oksanen**, **D.F. Karnosky**, **A. Noormets**, **J. Isebrands**, **K. Pregitzer**, **G. Hendrey**, **J. Sober**, and **G.K. Podila**. 2003. Effects of elevated CO<sub>2</sub> and O<sub>3</sub> on aspen clones of varying O<sub>3</sub> sensitivity: Can CO<sub>2</sub> ameliorate the harmful effects of O<sub>3</sub>? In: **D.F. Karnosky**, **K.E. Percy**, **A.H. Chappelka**, **C. Simpson**, and **J.M. Pikkariainen** (Eds.), *Air Pollution, Global Change and Forests in the New Millennium*. Elsevier Press, Amsterdam. pp. 391-409.
- Isebrands, J.G.**, **E.P. McDonald**, **E. Kruger**, **G. Hendrey**, **K. Percy**, **K. Pregitzer**, **J. Sober**, and **D.F. Karnosky**. 2003. Growth responses of aspen clones to elevated carbon dioxide and ozone. In: **D.F. Karnosky**, **K.E. Percy**, **A.H. Chappelka**, **C. Simpson**, and **J.M. Pikkariainen** (Eds.), *Air Pollution, Global Change and Forests in the New Millennium*. Elsevier Press, Amsterdam. pp. 411-435.
- Ferretti, M.**, **J. Bucher**, **A. Bytnerowicz**, **W. Prus-Glowacki**, **D. Karnosky**, and **K. Percy**. 2003. State of science and gaps in our knowledge to relation to air pollution. In: **D.F. Karnosky**, **K.E. Percy**, **A.H. Chappelka**, **C. Simpson**, and **J.M. Pikkariainen** (Eds.), *Air Pollution, Global Change and Forests in the New Millennium*. Elsevier Press, Amsterdam. pp. 437-446.
- Karnosky, D.F.**, **K.E. Percy**, **A.H. Chappelka**, and **S.V. Krupa**. 2003. Air pollution and global change impacts on forest ecosystems: Monitoring and research needs. In: **D.F. Karnosky**, **K.E. Percy**, **A.H. Chappelka**, **C. Simpson**, and **J.M. Pikkariainen** (Eds.), *Air Pollution, Global Change and Forests in the New Millennium*. Elsevier Press, Amsterdam. pp. 447-459.

## People at the Aspen FACE Project



### Paula Marquardt, Technician

USFS RWU 4152, Rhinelander, WI

In 2000, Paula Marquardt joined the USFS Physiology project, Rhinelander, WI. For the past several years, she has been examining the photosynthetic response of aspen leaves to multiple stressors including CO<sub>2</sub>, O<sub>3</sub>, and insects.

**Editors:** Paula, what are your main interests at Aspen FACE?

**Paula:** My main question is whether the loss of functional leaf area to insect damage affects the leaf's ability to capture carbon under the various gas treatments.

**Editors:** Anyone who studies aspen knows they are hosts to numerous insect pests. For the past few years Paula has been focusing on the aspen leaf miners (*Phyllonorycter tremuloidiella* and *P. salicifoliella*) which have been variable in occurrence at the Aspen FACE site ranging from a few mines per tree in some years to multiple mines per every leaf on every tree in



other years.

**Paula:** Thus far, only in the lower canopy under ambient conditions have we seen evidence that photosynthesis was higher for the healthy portion of leaves damaged by leaf miner than for the control leaves without insect damage. We are still evaluating gas exchange data collected from the upper canopy.

**Editors:** What are you planning for 2004?

**Paula:** This year, I plan to run Rubisco extractions from insect-affected and nonaffected leaves and to begin modeling of gas exchange based on the previous years' research. But, I also plan to be out in the upper canopy again this year with the LiCor for several new campaigns. In addition to gas exchange, we will be measuring leaf fluorescence. I really enjoy the opportunity to take part in this Aspen FACE experiment. Eventually, I would like to be involved in gene expression studies to better understand the mechanisms of responses



### Ron Teclaw, Technician

USFS RWU 4152, Rhinelander, WI

Ron Teclaw has been involved with Aspen FACE Project from nearly day one as he and Warren Heilman (USFS, East Lansing) designed and installed the micrometeorological network for the site. The system monitors wind speed and direction, air temperature and humidity, photosynthetically active radiation, net radiation, soil temperature and moisture and precipitation. These parameters are being monitored at one ring of each fumigation treatment and also at the ambient conditions tower at the north end of the experiment. The primary objective of the monitoring is to document how meteorological conditions change as the tree canopies develop within the rings of the various fumigation treatments. This can help scientists predict how the forests of the future will affect climate change. The data are also used by the tree physiologists and other scientists and experimenters in the studies they conduct on the site.



**Editors:** We understand you are upgrading the micromet system this year.

**Ron:** Yes, we have suffered from lack of replication across the various fumigation treatments at the site. We are installing sensors for most parameters in the rings that did not previously have micromet stations so we'll have the entire experiment monitored.

**Editors:** You have seen a lot of things happen over the years of this study. What events stick out in your mind?

**Ron:** Actually, there have been a few events that really come to mind. First and foremost, the lightning strikes at the site which have taken out our sensors and burned down two sheds have probably been the most significant problems we've had to deal with. We've learned a lot about lightning protection and now have our whole site pretty well protected with a Faraday-type grounding system, lightning rods, and deep grounds. Second, we connected all of our data loggers to the control computer in the main building via the fiber optic system. Prior to that we had to visit each data logger to check for potential problems and to collect data. It is great now to be able to view and troubleshoot our whole micromet system from the control computer.

**Editors:** What do you think of this study in comparison to others you've worked on?

**Ron:** This is an amazing study. It is absolutely fascinating to see the year-to-year changes and dramatic treatment effects. It doesn't take much imagination to see the differences in the general condition and size of the trees relative to the fumigation treatments. It's quite obvious without even looking at the allometry or micromet data that the conditions within the rings of different treatments are significantly different.

**Editors:** Any new activities for you this year?

**Ron:** Yes, I have taken over partial responsibility for the sap flow monitoring this year from Evan McDonald and am working with Dave Ellsworth and his team. We employ a system where we monitor heat dispersion within the stems of the trees. It is actually the sap flow in the tree that conducts the heat away from sensors we inserted in the stems of the trees. This all gives us information about tree canopy hydrology.

**Editors:** Do you have responsibilities outside the Aspen FACE experiment?

**Ron:** Oh sure, I have several northern red oak regeneration studies where we are tracking growth and performance of planted oak seedlings relative to different overstory and understory treatments. I also participate in the Chequamegon Ecosystem/ Atmospheric Study (ChEAS) where a team of researchers is studying biosphere/atmosphere interactions within a northern mixed forest in northern Wisconsin. A primary goal is to understand the processes controlling forest-atmosphere exchange of CO<sub>2</sub> and the response of these processes to climate change. We conduct this work from a tall 400-meter tower near Park Falls, WI that captures air that is representative of several types of ecosystems (mature upland hardwood forest, conifer forest, immature regenerating aspen forest and lowland or wetland ecosystems). We compare this to data we collect from smaller monitoring stations within each of the individual ecosystems mentioned above. This provides information for us to compare how each ecosystem is contributing either to the production of atmospheric CO<sub>2</sub> or the assimilation of CO<sub>2</sub>.

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