



FACING THE FUTURE

The FACTS II (Aspen FACE) Newsletter

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David F. Karnosky and Janet M. Pikkarainen, Editors

CFS Management Visits Aspen FACE

Mr. Bruce Pendrel (far left), Science Director, Forest Health and Biodiversity at the Natural Resources Canada, Canadian Forest Service's Atlantic Forestry Centre (CFS-AFC) in Fredericton, New Brunswick and Dr. Kevin Percy (center), CFS-AFC Senior Scientist and member of the Aspen FACE Steering Committee, visited the Aspen FACE project on October 4 and 5, 2004. Representing the US Forest Service at the meeting were Dr. Rob Doudrick (far right), Assistant Director of the North Central Research Station, and USFS NC Project Leader Dr. Neil Nelson (second from right). After a brief presentation on Aspen FACE by Project Director Dave Karnosky (Michigan Tech), ongoing and potential collaborative efforts were discussed at the site and later at the USFS Forestry Sciences Laboratory.



Wisconsin Public Radio Visits Aspen FACE

Mike Simonson, Wisconsin Public Radio, recently visited the Aspen FACE site. In the photo on the left, Mike interviews Aspen FACE scientist Dr. Mark Kubiske (USFS). Mike's wife, Jennifer, taped several common sounds of the Aspen FACE site, including the sound of the CO₂ truck disengaging from our CO₂ tanks (right). The story aired on Wisconsin Public Radio, October 1, 2004 and can be listened to on line at <http://www.wpr.org/news/newsstories.cfm>. The story was also aired worldwide on Voice of America radio on October 16 and 17, and may be translated into as many as 44 languages. The story also aired November 1 on the Great Lakes Radio Consortium http://www.glrc.org/story.php3?story_id=2447 which has 150 stations in the United States and Canada.





Jim Trochta, WDNR, Continues Ozone Calibration

Jim Trochta, an Air Management Environmental Specialist with the Air Quality Division of the Wisconsin Department of Natural Resources, recently completed another season of calibration and monitoring of ozone at the Harshaw Farm site. Jim makes monthly visits to the Aspen FACE site each summer to calibrate the O₃ monitor in our control shed. Each spring and autumn, we also calibrate our own site's 10 monitors against Jim's EPA-equivalency primary O₃ standard photometer. Jim was instrumental in operating our fence line O₃ monitors during our full first year of operation and has maintained the control shed monitoring program for the past 11 years, first with Dave Karnosky (MTU) and Ed Jepsen (WDNR)'s bioindicator project at the Harshaw Farm and then with the Aspen FACE project since 1997. Thanks much, Jim!

Anu Sober Completes Another Summer at Aspen FACE

Dr. Anu Sober (left), Ecophysiologicalist with Tartu University in Tartu, Estonia, is shown in the photo to the left. Anu recently completed her 7th summer at the Aspen FACE site. Working with Drs. Dave Karnosky (Michigan Tech), Mark Kubiske (USFS), and Neil Nelson (USFS), Anu coordinated the summer's diurnal photosynthesis campaign. Assisting Anu were graduate students Katre Kets (Tartu University) and Joseph Darbah (Michigan Tech), shown in the photo on the right. Anu's husband Jaak Sober is the head operator of the Aspen FACE project. Anu first came to the U.S. in the summer of 1993 when she collaborated with Dave Karnosky's open-top chamber project at the Ford Forestry Center in Alberta, Michigan. Anu's gas exchange data has been featured in the Noormets *et al.* (2001) *Trees and Plant Cell Environment* papers, in the Sharma *et al.* (2003) *Ekologia* paper, and in a Sober *et al.* paper in revision for *Trees*.



Stora Enso Visit

USFS Project Leader Neil Nelson (far left) and USFS scientists Mark Kubiske (back row-far right) and Vanessa Quinn (next to Neil) recently gave a tour of the Aspen FACE site to 10 local and international representatives of Stora Enso Company's corporate forestry environmental management group. Stora Enso participants were from all the company operations including North America, Europe and Brazil. Headquartered in Finland, Stora Enso is one of the world's largest forest products companies.



Other Aspen FACE tours this summer and fall included the Rhinelander Charter School Science class and Nicolet College Weather and Climate and Ecology classes.



Free-lance Photographer Photographs Aspen FACE

David Hay Jones (left), a free-lance photographer who provides photos of global change experiments to textbook printers in the United Kingdom, visited Aspen FACE on October 4, 2004 to photograph our site. David also visited several other USFS and DOE facilities this summer. According to David, "This is a fantastic place for photographs, much more photogenic than the typical indoor labs I visit."

Mondor and Lindroth's Research Receives Great Press

Ed Mondor and Rick Lindroth (both from the University of Wisconsin-Madison) have had some excellent press on their pioneering aphid research at Aspen FACE. Their recent Global Change Biology paper on phenotypic plasticity of goldenrod aphids being mediated by global atmospheric change was featured in the Editor's Choice "Highlights of the Recent Literature" section of Science (Science 306:199). Then shortly thereafter their recent Ecology Letters paper on aspen aphids was featured in the "Dispatches" section of the Ecological Society of America's Frontiers in Ecology. Their work was also written up in the University of Wisconsin CALS News and can be viewed at <http://news.cals.wisc.edu/newsDisplay.asp?id=1116>. Congratulations to Ed, Rick and their UW colleagues for work exceptionally well done!

Argonne Crew Samples Mycorrhizal Fungi

Vicki Allison (right), postdoctoral fellow with Dr. Mike Miller (Argonne National Lab), prepared to label an Aspen FACE location where she collected 50 μ m diameter mesh hyphal in-growth bags filled with clean sand that were buried the previous fall beneath a tree's fine roots for quantifying the amount of mycorrhizal fungus that grows into the soil (as compared to the amount of fungus associated with roots). Vicki was joined by technicians Zhanna Yermakov and David Loehlin.



John Hom Heads Stem Respiration Campaign

John Hom (below), Assistant Director of the USFS Northern Station's Global Change Program, led



an extended campaign to measure stem respiration at Aspen FACE this past summer. The small trailer housed John's monitoring equipment which read continuous respiration values for diurnal curves. The respiration chambers and associated tubing are shown below. John was joined in this effort with Vanessa Quinn (USFS postdoctoral fellow in Neil Nelson's project at Rhinelander), Steve Roberts (San Diego State University), Joanne Lund (USFS), and Matt Patterson (USFS).

New Study of Understory Nutritive Value

Dr. Art Chappelka (right), Auburn University, and his technician Efre Roberts visited Aspen FACE on August 9-10, 2004 to collect understory vegetation to examine the effects of elevated CO₂ and O₃ on nutritive quality. Art is cooperating on the project with Dr. Russ Muntifering, also at Auburn University. According to Art, "We have previously seen substantial changes in forage quality of grasses exposed to O₃. Because of the well-known effects of elevated CO₂ on nitrogen dynamics of plants, we are anxious to see how forage quality of various plants is affected by elevated CO₂ and by the interaction of elevated CO₂ and O₃. This study also will be a good comparison for our previous O₃ work which was done in open-top chambers."



Washington Post Features Aspen FACE Story

Aspen FACE was featured in a story entitled "Group of Trees in Wisconsin Forced into the Future" in the August 22, 2004 issue of the Washington Post (<http://www.washingtonpost.com/wp-dyn/articles/A24738-2004Aug22.html>). To develop the story, Washington Post reporter Kari Lydersen (shown on the left with USFS Project Leader Dr. Neil Nelson) visited Aspen FACE in early July, 2004. Kari interviewed Neil and Aspen FACE Director Dr. David Karnosky (Michigan Tech). The story was later picked up by newspapers across the country including the St. Paul Pioneer Press, The Boston Globe, and the Seattle Times. The original story included our aerial overview photo showing the 12 FACE rings, an aerial photo of one ring, and a photo of Angela Johansen (MTU) doing soil sampling.

Duluth News Tribune Does Followup on Aspen FACE

Aspen FACE was featured in an August 22, 2004 Duluth News Tribune story entitled “Scientist study trees to get to root of pollution debate”, as a followup to a story run shortly after we began operating. John Myers (shown in the photo interviewing Aspen FACE and Canadian Forest Service Senior Scientist Dr. Kevin Percy) interviewed Kevin, Dr. David Karnosky (Aspen FACE Project Director, Michigan Tech), Dr. Neil Nelson (USFS Project Leader), Dr. Mark Kubiske (USFS), and Dr. Vanessa Quinn (right) on July 14-15, 2004. Myers was accompanied by a photographer who took many photos of the site, including several from our aerial lift vehicle operated by Jaak Sober (right). The story can be viewed at <http://www.duluthsuperior.com/mld/duluthsuperior/9463233.htm?temp>.



Aspen FACE Featured on Local Television

Rhinelander’s Channel 12 television ran a news story in early September, 2004 on Aspen FACE. A Channel 12 reporter (photo on left) interviewed USFS Project Leader Dr. Neil Nelson and USFS Scientist Dr. Mark Kubiske (right), and Dr. David Karnosky, Project Director, and took a number of video clips of the various treatments rings.



New CFS Study of Canopy Architecture

Dr. Joanne MacDonald, Canadian Forest Service’s Atlantic Forestry Centre (CFS-AFC) in Fredericton, New Brunswick, and technician Gary Henderson (CFS-AFC) visited the Aspen FACE project on November 2-4, 2004 to organize a new study in which they are examining the effects of

greenhouse gases on crown architecture (photo on right). The study, in collaboration with Aspen FACE Director Dr. David Karnosky and Dr. Kevin Percy (CFS-AFC and FACE Steering Committee member), builds on previous research in open-top chambers suggesting that crown architecture may be subtly altered by elevated CO₂ and O₃ (Dickson *et al.* 2001. Environ. Pollut. 115:319-334).



Aspen FACE Featured at McIntire-Stennis Biennial Meeting

Dr. David Karnosky (MTU), Director of Aspen FACE, presented an invited talk at the Second Biennial McIntire-Stennis Biennial Meeting at the CSREES building in Washington, D.C on October 27, 2004. Speaking on behalf of Michigan Technological University, Dave discussed how McIntire-Stennis research support is being used for research at Aspen FACE. Dave’s McIntire-Stennis support is being used for modeling research at Aspen FACE. Don Zak (University of Michigan) also has McIntire-Stennis support supplementing his DOE-sponsored studies of belowground community dynamics.



New Gates Being Installed for Use with Rabbit Fences

New gates (left) are being installed along the rabbit fences this autumn on the west side of each ring. The gates are meant to accommodate access to the rings without stepping over (or on) the rabbit fence. Rabbit damage continues to be a problem, especially on maple as shown on the right from Ring 1.2 in April, 2004. *We ask all Aspen FACE users to use these gates for accessing the rings once the fences are up.* Thanks to Wendy Jones (MTU), Aspen FACE site operator, and Tribin Holbrook (MTU) for organizing this effort.

Local Papers Feature Aspen FACE Stories

Aspen FACE was featured in two local papers this autumn. Sarah John wrote an article entitled "Local scientists lead the way in air pollution study" that appeared in the August 29, 2004, North Star Journal. Sarah interviewed Aspen FACE scientists Dr. David Karnosky (MTU) and Drs. Neil Nelson and Mark Kubiske (USFS). Then, Sandy Lotto wrote an article entitled "Getting the facts on FACE and other aspen research" in the fall issue of the Trees for Tomorrow newsletter, Northbound, Vol. 24, Number 3, page 5. Sandy interviewed Dr. Vanessa Quinn (USFS).

POPGENICS Update

POPGENICS is a DOE-sponsored consortium of scientists examining ways to increase carbon sequestration potential of trees and is focusing on trees growing at Aspen FACE and POPFACE (in Italy). Foliar samples were taken at three time points during the 2004 growing season for both aspen and birch for study of gene expression. Dr. Ramesh Thakur (right) and Aspen FACE Project Director Dr. David Karnosky collected 5-10 leaves per each of three genotypes of each species; the leaves were wrapped in aluminum foil and then placed in liquid N. Aspen samples will be run on microarrays by Dr. Gopi Podila (University of Alabama-Huntsville) and the birch samples will be examined by Dr. Elina Vapaavuori (METLA-Finland).

POPGENICS Scientists Drs. Gail Taylor, Gopi Podila, David Karnosky, Ramesh Thakur, Chung-Jui Tsai and Francis Martin attended the recent "Functional Genomics of Environmental Adaptation in Populus" Symposium on October 10-13, 2004 in Gatlinburg, Tennessee. Drs. Taylor and Martin made oral presentations, while Dr. Podila chaired a discussion session. Four posters including POPGENICS research were presented by Drs. Podila, Taylor (2) and Karnosky.



Aspen FACE New Publications

Journal Articles

- Awmack, C.S., R. Harrington, and R.L. Lindroth. 2004. Individual performance does not predict aphid population responses to elevated atmospheric CO₂ or O₃. *Global Change Biology* 10:1414-1423.
- Ellsworth, D.S., P.B. Reich, E.S. Naumburg, G.W. Koch, M.E. Kubiske, and S.D. Smith. 2004. Photosynthesis, carboxylation and leaf nitrogen responses of 16 species to elevated pCO₂ across from free-air CO₂ enrichment experiments in forest, grassland and desert. *Global Change Biology* 10:1-18.
- Kaakinen, S., Katri Kostianen, 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* 10:1513-1525.
- Karberg, N., K.S. Pregitzer, J.S. King, A.L. Friend, and J.R. Wood. 2004. Soil carbon dioxide partial pressure and dissolved inorganic carbonate chemistry under elevated carbon dioxide and ozone. *Oecologia* (In Press).
- Karnosky, D.F. 2004. Ozone effects on forest ecosystems under a changing environment. *J. Agricultural Meteorology*, Vol. 60, Special Issue (In Press).
- King, J.S., P.J. Hanson, E. Bernhardt, P. DeAngelis, R.J. Norby, and K.S. Pregitzer. 2004a. A multi-year synthesis of soil respiration responses to elevated atmospheric CO₂ from four forest FACE experiments. *Global Change Biology* 10:1027-1042.
- Loranger, G.I., K.S. Pregitzer, and J.S. King. 2004. Elevated CO₂ and O₃ concentrations differentially affect selected groups of the fauna in temperate forest soils. *Soil Biol. & Biochem.* 36:1521-1524.
- Mattson, W.J., K. Kuokkanen, P. Niemela, R. Julkunen-Tiitto, S. Kellomaki, and J. Tahvanainen. 2004. Elevated CO₂ alters birch resistance to lagomorpha herbivores. *Global Change Biology* 10:1402-1413.
- Mondor, E.B., M.N. Tremblay, M.N., C.S. Awmack, and R.L. Lindroth. 2004. Divergent pheromone-mediated insect behaviour under global atmospheric change. *Global Change Biology* 10:1820-1824.
- Mondor, E.B., M.N. Tremblay, and R.L. Lindroth. 2004. Transgenerational phenotypic plasticity under future atmospheric conditions. *Ecology Letters* 7:941-946.
- Parsons, W.F.J., R.L. Lindroth, and J.G. Bockheim. 2004. Decomposition of *Betula papyrifera* leaf litter under the independent and interactive effects of elevated CO₂ and O₃. *Global Change Biology* 10:1666-1677.

Other Publications

- Chapman, J.A., J.S. King, K.S. Pregitzer, and D.R. Zak. 2004. Decomposition of fine roots grown in an enriched CO₂ and O₃ environment: Relationships of soil microbial respiration and fine root biochemistry. *Proc. 18th North American Forest Biology Workshop*, July 12-15, 2004, Houghton, Michigan (Abstract, p. 45).
- Giardina, C.P., E. McDonald, P. Gupta, B. Parsons, M. Kubiske, R. Lindroth, D. Karnosky, K. Pregitzer, and W. Loya. 2004. Interactions effects of elevated CO₂ and O₃ on forest canopies at the Aspen FACE experiment in northern Wisconsin. *Proc. 36th Air Pollution Workshop*, April 26-29, 2004, Rhinelander, Wisconsin. (Abstract, p. 2).
- Giardina, C., E. McDonald, M. Kubiske, W. Parsons, R. Lindroth, J. King, W. Loya, K. Pregitzer, and D. Karnosky. 2004. The effects of elevated CO₂ and O₃ on litterfall in mixed aspen and birch stands at the Rhinelander FACE facility. *Proc. 18th North American Forest Biology Workshop*, July 12-15, 2004, Houghton, Michigan (Abstract, p. 70).
- Heilman, W.E. 2004. Trends in elevated CO₂ and O₃: Past and Present. *Proc. 36th Air Pollution Workshop*, April 26-29, 2004, Rhinelander, Wisconsin. (Abstract, p. 3).

- Heilman, W., R. Teclaw, J. Isebrands, D. Karnosky, G. Hendrey, and K. Pregitzer. 2000. Impacts of elevated CO₂ and O₃ concentrations on forest microclimates: Initial observations from the FACTS II Aspen FACE facility. Proc. Air Pollution, Global Change and Forests in the New Millennium. The 19th International Meeting for Specialists in Air Pollution Effects on Forest Ecosystems, Houghton, Michigan USA (Abstract, p. 36).
- Kaakinen, S., K. Kostianen, M.E. Kubiske, J. Sober, D.F. Karnosky, and E. Vapaavuori. 2004. Are changes in wood chemical properties maintained over five years of exposure to elevated CO₂ and O₃ in aspen clones? Proc. 36th Air Pollution Workshop, April 26-29, 2004, Rhinelander, Wisconsin. (Abstract, p. 23).
- Kaakinen, S., K. Kostianen, F. Ek, P. Saranpää, M.E. Kubiske, J. Sober, D.F. Karnosky, and E. Vapaavuori. 2004. Stem wood properties of *Populus tremuloides*, *Betula papyrifera* and *Acer saccharum* after three years of exposure to elevated CO₂ and O₃. Proc. 36th Air Pollution Workshop, April 26-29, 2004, Rhinelander, Wisconsin. (Abstract, p. 4).
- Karnosky, D.F., P. Gupta, J. Darbah, W.S. Jones, M. Kubiske, J. Pikkariainen, and D.B. Karnosky. 2004. Impacts of elevated atmospheric CO₂ and O₃ on canopy dynamics of aggregating northern forest ecosystems. Proc. 36th Air Pollution Workshop, April 26-29, 2004, Rhinelander, Wisconsin. (Abstract, p. 25).
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- Karnosky, D., B. Gielen, R. Ceulemans, W.H. Schlesinger, R.J. Norby, E. Oksanen, R. Matyssek, and G.R. Hendrey. 2000. Facing the future: Free air exposure systems for studying the impacts of greenhouse gases on forest ecosystems. Proc. Air Pollution, Global Change and Forests in the New Millennium. The 19th International Meeting for Specialists in Air Pollution Effects on Forest Ecosystems, Houghton, Michigan USA (Abstract, p. 96).
- 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 CO₂ from four forest FACE experiments. Proc. 18th North American Forest Biology Workshop, July 12-15, 2004, Houghton, Michigan (Abstract, p. 45).
- Kubiske, M.E., E. McDonald, V. Quinn, P. Marquardt, and D.F. Karnosky. 2004. Growth dynamics of tree communities exposed to elevated atmospheric CO₂ and O₃ for six years in the Aspen FACE experiment. 2004. Proc. 36th Air Pollution Workshop, April 26-29, 2004, Rhinelander, Wisconsin. (Abstract, p. 5).
- Lilleskov, E.A. 2004. Carbon dioxide and ozone affect sporocarp production and community structure of ectomycorrhizal fungal communities in the Aspen FACE experiment. Proc. 18th North American Forest Biology Workshop, July 12-15, 2004, Houghton, Michigan (Abstract, p. 79).
- Lindroth, R.L., B.J. Kopper and E.B. Mondor. 2004. Impacts of interacting CO₂ and O₃ on forest insects. Proc. 36th Air Pollution Workshop, April 26-29, 2004, Rhinelander, Wisconsin. (Abstract, p. 6).
- Liu, L., J.S. King, and C. Giardina. 2004. Fluxes, decay rates, and mean residence times of carbon and nutrients in leaf litter of northern forests under elevated atmospheric CO₂ and tropospheric O₃. 2004. Proc. 18th North American Forest Biology Workshop, July 12-15, 2004, Houghton, Michigan (Abstract, p. 80).
- Oksanen, E. 2004. Interactions of O₃, CO₂ and nitrogen deposition in Finnish forest trees. Proc. 36th Air Pollution Workshop, April 26-29, 2004, Rhinelander, Wisconsin. (Abstract, p. 7).
- Oksanen, E., T. Holopainen, S. Kaakinen, D.F. Karnosky, J. Riikonen and E. Vapaavuori. 2004. Changes in anatomical and chemical structure of leaves in deciduous trees at elevated CO₂. Proc. 36th Air Pollution Workshop, April 26-29, 2004, Rhinelander, Wisconsin. (Abstract, p. 35).
- Oksanen, E., T. Holopainen, D.F. Karnosky, J. Riikonen, and E. Vapaavuori. 2004. Ozone-caused H₂O₂ accumulation in mesophyll cells is linked to functional structure of leaves. Proc. 36th Air Pollution Workshop, April 26-29, 2004, Rhinelander, Wisconsin. (Abstract, p. 36).
- Percy, K. 2004. Implications of rising CO₂ and O₃ for forest health. Proc. 36th Air Pollution Workshop, April 26-29, 2004, Rhinelander, Wisconsin. (Abstract, p. 8).
- Vigue, L. and R. Lindroth. 2004. Effects of enhanced CO₂ and O₃ on aspen leaf beetle (*Chrysomela crotchii*) performance in a northern deciduous forest ecosystem. Proc. 36th Air Pollution Workshop, April 26-29, 2004, Rhinelander, Wisconsin. (Abstract, p. 42).



People at the Aspen FACE Project

Joanne Lund, Technician-USFS

Editors: How did you get started at Aspen FACE?

Joanne: My brother lived in Harshaw (still does) and thus I was familiar with the area and its overwhelming natural beauty. I had completed a master's degree in the spring of 1998 in insect ecology and applied for a forestry position at the Forestry Sciences Laboratory in Rhinelander, for which I was not selected. However, Jud Isebrands called me in response to my application and explained that there would be opportunities in the near future for someone with a background in plant-insect interactions. He asked if I would be interested in working as an operator at the FACE Site beginning immediately, and I agreed. I initially was unaware of the wonderful complexity and uniqueness of the project.

Editors: How long have you been involved in the Aspen FACE project?

Joanne: I began as a FACE Site operator in August of 1998 during the first treatment season. In

December 1998 I began working for the Forest Service as a Biological Science Technician for Jud Isebrands and Bill Mattson.

Editors: What are your current activities at the FACE Site?

Joanne: These are various and many. Every spring I work with a team assessing insect damage on stems and branches from the previous season. I have been monitoring insect populations using passive sticky traps for the past 3 years, and assist visiting scientists in installing and maintaining specialized equipment such as the sap flow meters and the multi-cuvette respirometry system. I conduct tours of the FACE Site by groups of scientists and students. I participate in the processing of trees during the destructive harvests, and in measuring tree heights and diameters each year at season's end. In the laboratory I analyze FACE samples for total carbon and nitrogen and for energy density. I am always on the lookout for newly-arriving insect species that colonize the treated trees, so that we can prepare to monitor these populations the following spring and/or develop manipulative studies.

Editors: You have no doubt seen a lot of changes at the Aspen FACE Site over the years. What is your impression of the project now and as compared to when it started?

Joanne: The most striking difference on the surface is that the trees in each ring have grown from skinny saplings to become a forest! This has in turn led to all kinds of logistical problems. But looking deeper, we are getting to a point where cumulative and longer term effects are manifest, and this is very exciting.

Editors: Have there been any surprises in your research project at Aspen FACE or have things gone pretty much as expected?

Joanne: I must say that the differences in tree growth and physiology between the carbon dioxide and ozone treatments are striking and more dramatic than I had expected. I had no real preconception of the effects of treatments on the trees, phytophagous insects, and their parasitoids because I had only studied such interactions under ambient conditions. One unforgettable surprise was the Forest Tent Caterpillar outbreak, which peaked in 2001. I had not previously witnessed an outbreak of such magnitude, but it led to some interesting studies on egg mass distribution, hatch rate, and patterns and levels of parasitism.



Ed Mondor, Postdoctoral Fellow, University of Wisconsin

Editors: Ed, what was your background before coming to Aspen FACE?

Ed: It really has been a long and winding road. I have a B.Sc. degree in psychology from Brandon University and a M.Sc. in zoology from the University of Alberta. I then completed a Ph.D. at Simon Fraser University in Burnaby, BC. For my thesis research, I studied the ecology and evolution of aphid alarm pheromone production and emission. Specifically, I wanted to find out why aphids evolved unique anatomical structures, cornicles, for alarm signaling.

Editors: How did you end up here at Aspen FACE?

Ed: Rick Lindroth's group at UW-Madison posted an ad in the Entomological Society of America Bulletin for a postdoc to work on aphid genotype by environment interactions. Having worked previously on aphid phenotypic plasticity, it looked like a perfect fit.

Editors: How did you get started with aphids?

Ed: Aphids have always seemed like interesting little creatures. Most of the year they reproduce asexually forming clones, yet when environmental conditions change these same individuals produce sexual morphs. Aphids are also great for fitness studies as they are easy to rear, have short generation times, lots of offspring, and high levels of phenotypic variation.

Editors: We have seen you out here at Aspen FACE very often the last two summers. How do you like working at Aspen FACE?

Ed: Aspen FACE is an incredible place. Compared to greenhouse studies, open top chambers, etc., Aspen FACE offers a unique and realistic environment in which to study changes in the genotypic and phenotypic structure of insect populations under future atmospheric conditions. It's truly a "world class" place to work!



Editors: Ed, what are your future goals?

Ed: I'd love to get a faculty position where I could combine both teaching and research. I'd like to continue my research to better understand how global atmospheric change will alter the abundance and diversity of insect populations, and trophic functioning.

Editors: Ed, your presentation this past spring at the Air Pollution Workshop was truly outstanding. It seems now you are starting to get quite a lot of recognition for this pioneering research.

Ed: Yes, we've been fortunate with the two FACE papers we've recently published. Our Ecology Letters paper, on how greenhouse gases alter aphid transgenerational phenotypic responses, was featured in the Editor's Choice section of Science earlier this month. Then, our Global Change Biology paper, on atmospheric effects altering aphid alarm pheromone responses, will be covered next month in the Dispatches section of Frontiers in Ecology and the Environment.
