

## Journal Publications

### Tree species richness and the logging of natural forests: A meta-analysis

**Authors:** Jason Clark and Kristofer Covey

**Published:** 2012, *Forest Ecology and Management* 276, p. 146-153

**DOI:** 10.1016/j.foreco.2012.04.001

**Abstract:** Forests cover much of the earth's surface and are regularly logged. Well established ecological theory predicts, and the results of extensive silvicultural studies demonstrate the role of disturbance in maintaining species richness in forests; however, logging and other human initiated disturbance is often credited with the degradation of forest ecosystems throughout the world. Presented here are the results of a meta-analysis of 19 published studies investigating 25 distinct paired human-disturbed and primary forests in the tropical and temperate biomes. Regardless of whether studies were grouped across biomes or considered independently, the current literature indicates a significant reduction in tree species richness following logging. While the reasons for this reduction in richness are as diverse as the forests considered here, some common themes are clear. Although logging may increase the richness of early successional tree species, it also tends to reduce the richness of late successional trees. This occurs both through the altering biotic and abiotic processes regulating resource availability and through size-class and species based selection biases common in logging. Logging also makes primary forests more accessible, setting the stage for a chronic human disturbance cycle.

### Exposure to airborne particulate matter in Kathmandu Valley, Nepal

**Authors:** Anobha Gurung and Michelle Bell

**Published:** 2012, *Journal of Exposure Science and Environmental Epidemiology* 22(3), p. 235-242

**DOI:** 10.1038/jes.2012.14

**Abstract:** Kathmandu Valley, Nepal, has severe air pollution, although few studies examine air pollution and health in this region. To the best of our knowledge, no previous studies in Nepal used time-activity diaries or conducted personal monitoring of individuals' exposures. We investigated personal exposure of particulate matter (PM) with aerodynamic diameter  $\leq 2.5 \mu\text{m}$  ( $\text{PM}_{2.5}$ ) by location, occupation, and proximity to roadways.  $\text{PM}_{2.5}$  monitoring, time-activity diary, respiratory health questionnaire, and spirometer testing were performed from 28 June 2009 to 7 August 2009 for 36 subjects, including traffic police (TP), indoor officer workers next to main road (IOWs\_NMR) and away from main road (IOWs\_AMR), in urban area (UA), urban residential area, and semi-UA (SUA). TP had the highest exposure of all the occupations (average  $51.2 \mu\text{g}/\text{m}^3$ , hourly maximum  $>500 \mu\text{g}/\text{m}^3$ ). TP levels were higher at the UA than other locations. IOW\_NMR levels (averaged  $46.9 \mu\text{g}/\text{m}^3$ ) were higher than those of IOW\_AMR ( $26.2 \mu\text{g}/\text{m}^3$ ). Exposure was generally higher during morning rush hours (0800–1100 hours) than evening rush hours (1500–1800 hours) for all occupations and areas (78% of days for TP and 84% for urban IOW).  $\text{PM}_{2.5}$  personal exposures for each occupation at each location exceeded the World Health Organization ambient  $\text{PM}_{2.5}$  guideline ( $25 \mu\text{g}/\text{m}^3$ ). Findings suggest potential substantial health impacts of air pollution on this region, especially for TP.

### Susceptibility to air pollution effects on mortality in Seoul, Korea: A case-crossover analysis of individual-level effect modifiers

**Authors:** Jiyoung Son, Jong-Tae Lee, Ho Kim, Okhee Yi, and Michelle Bell

**Published:** 2012, *Journal of Exposure Science and Environmental Epidemiology* 22(3), p. 227-234

**DOI:** 10.1038/jes.2012.6

**Abstract:** Air pollution's mortality effects may differ by subpopulation; however, few studies have investigated this issue in Asia. We investigated susceptibility to air pollutants on total, cardiovascular, and respiratory mortality

in Seoul, Korea for the period 2000-2007. We applied time-stratified case-crossover analysis, which allows direct modeling of interaction terms, to estimate susceptibility based on sex, age, education, marital status, and occupation. An interquartile range increase in pollution was associated with odds ratios of 0.94 (95% confidence interval, 0.25-1.62), 2.27 (1.03-3.53), 1.94 (0.80-3.09), and 2.21 (1.00-3.43) for total mortality and 1.95 (0.64-3.27), 4.82 (2.18-7.54), 3.64 (1.46-5.87), and 4.32 (1.77-6.92) for cardiovascular mortality for PM<sub>10</sub>, nitrogen dioxide (NO<sub>2</sub>), sulfur dioxide (SO<sub>2</sub>), and carbon monoxide (CO), respectively. Ozone effect estimates were positive, but not statistically significant. Results indicate that some populations are more susceptible than others. For total or cardiovascular mortality, associations were higher for males, those 65-74 years, and those with no education or manual occupation for some pollutants. For example, the odds ratio for SO<sub>2</sub> and cardiovascular mortality was 1.19 (1.03-1.37) times higher for those with manual occupations than professional occupations. Our findings provide evidence that some populations are more susceptible to the effects of air pollution than others, which has implications for public policy and risk assessment for susceptible subpopulations.

## Advances in disaster modeling, simulation, and visualization for sandstorm risk management in North China

**Authors:** Lin Z, Levy JK, Lei H, Bell ML

**Published:** 2012, Remote Sensing 4(5), p. 1337-1354

**DOI:** 10.3390/rs4051337

**Abstract:** Dust storms in North China result in high concentrations of airborne dust particles, which cause detrimental effects on human health as well as social and economic losses and environmental degradation. To investigate the impact of land surface processes on dust storms, we simulate two dust storm events in North China during spring 2002 using two versions of a dust storm prediction system developed by the Institute for Atmospheric Physics (IAP) in Beijing, China. The primary difference between the IAP Sandstorm Prediction System (IAPS 1.0) and more recent version (IAPS 2.0) is the land surface modeling. IAPS 1.0 is based on the Oregon State University (OSU) land surface model, whereas the latest version of the dust storm prediction (IAPS 2.0) uses NOAA land surface schemes for land surface modeling within a meteorological model, MM5. This work investigates whether the improved land surface modeling affects modeling of sandstorms. It is shown that an integrated sandstorm management system can be used to aid the following tasks: ensure sandstorm monitoring and warning; incorporate weather forecasts; ascertain the risk of a sandstorm disaster; integrate multiple technologies (for example, GIS, remote sensing, and information processing technology); track the progress of the storm in real-time; exhibit flexibility, accuracy and reliability (by using multiple sources of data, including in-situ meteorological observations); and monitor PM<sub>10</sub> and PM<sub>2.5</sub> dust concentrations in airborne dustfalls. The results indicate that with the new land surface scheme, the simulation of soil moisture is greatly improved, leading to a better estimate of the threshold frictional velocity, a key parameter for the estimating surface dust emissions. In this study, we also discuss specific mechanisms by which land surface processes affect dust storm modeling and make recommendations for further improvements to numerical dust storm simulations.

## Differential stress tolerance of four pines (Pinaceae) across the elevation gradient of the San Bernardino Mountains, Southern California, USA

**Authors:** Helen M. Poulos, Graeme P. Berlyn, and Sara A. Mills

**Published:** 2012, The Journal of the Torrey Botanical Society 139(1), p. 96-108

**DOI:** 10.3159/TORREY-D-11-00038.1

**Abstract:** Ecophysiological studies that investigate species sorting across environmental gradients provide insights into the mechanisms underscoring tree distribution patterns. We examined pine functional traits by measuring a suite of physiological parameters including needle water content, spectral reflectance, transpiration decline, and leaf morphology to explore pine stratification patterns across the elevation gradient of the San Bernardino Mountains in southern California. The high and low elevation species demonstrated moisture and solar radiation tolerance. The lowest elevation species, *Pinus attenuata* Lem., maintained low transpiration rates under drought stress and had high concentrations of photosynthetic pigments indicating high photosynthetic capacity. *Pinus coulteri* Don was the most stress intolerant pine as demonstrated by high transpiration rates. Although *Pinus lambertiana* Doug. dominated cooler north-facing slopes, its

lower transpiration rates suggested that it was well adapted to moisture stress. *Pinus contorta* Dougl. was a typical high elevation stress tolerant tree growing under high incident solar radiation, heavy snow pack, and severe winds. Our results suggest that water availability and solar radiation intensity are the major factors influencing southern California pine distributions.

### **New Directions: Enduring Ozone**

**Authors:** Nadine Unger and Joshua L Pan

**Published:** 2012, Atmospheric Environment 55, p. 456-458

**DOI:** 10.1016/j.atmosenv.2012.03.036

**Abstract:** Ozone damages plants and reduces terrestrial productivity leading to increased anthropogenic carbon dioxide in the atmosphere that is an equivalent emission and thus provides an indirect radiative forcing. Through this perturbation of the carbon cycle, anthropogenic increases in ozone affect the climate system on considerably longer timescales than the ozone atmospheric lifetime of only a few weeks. The indirect global warming impact may be irreversible depending upon the uncertain ability of the land carbon sink to reabsorb the carbon dioxide excess after removal of the ozone damage.

### **Predator occupancy rates in a thinned ponderosa pine forest, Arizona: a pilot study**

**Authors:** Kevin J. Barrett, Elizabeth L. Kalies, Carol L. Chambers

**Published:** 2012, Wildlife Society Bulletin, *in press*

**DOI:** 10.1002/wsb.124

**Abstract:** Throughout northern Arizona, USA, forest thinning in ponderosa pine (*Pinus ponderosa*) forests has become a common practice to reduce the threat of stand-replacing wildfire and to increase plant and animal diversity across the landscape. To determine how thinning affects predator occurrence, we assessed relationships between predator occupancy and the density of small mammals (prey) across a range of tree stocking levels (basal area of 10–65 m<sup>2</sup>/ha). Predators were detected using 2 techniques: baited track plates and motion-sensitive cameras. We sampled 33 sites for 2 weeks each in order to detect presence of predators, and estimated occupancy using occupancy models and multimodel inference. We modeled occupancy rates for gray fox (*Urocyon cinereoargenteus*), coyote (*Canis latrans*), and raccoon (*Procyon lotor*). Our results suggest that thinning may have a positive influence on gray fox and coyote abundance, but a negative influence on raccoon abundance. However, our inability to develop strong models that predicted predator occupancy indicates that higher sample sizes and more habitat covariates are needed. Our simulations indicated that, given our occupancy and detection rates, a sample size of 75 sites would allow us to better model occupancy covariates. Overall, we found that predator occupancy can be assessed at large spatial scales using occupancy approaches, particularly using motion-sensitive cameras, which were the most time- and cost-efficient of the methods we analyzed.

### **Identification and correction of spectral contamination in <sup>2</sup>H/<sup>1</sup>H and <sup>18</sup>O/<sup>16</sup>O measured in leaf, stem, and soil water**

**Authors:** Schultz NM, TJ Griffis, X Lee, JM Baker

**Published:** 2011, Rapid Communications in Mass Spectrometry 25(21), p. 3360-3368

**DOI:** 10.1002/rcm.5236

**Abstract:** Plant water extracts typically contain organic materials that may cause spectral interference when using isotope ratio infrared spectroscopy (IRIS), resulting in errors in the measured isotope ratios. Manufacturers of IRIS instruments have developed post-processing software to identify the degree of contamination in water samples, and potentially correct the isotope ratios of water with known contaminants. Here, the correction method proposed by an IRIS manufacturer, Los Gatos Research, Inc., was employed and the results were compared with those obtained from isotope ratio mass spectrometry (IRMS). Deionized water was spiked with methanol and ethanol to create correction curves for  $\delta^{18}\text{O}$  and  $\delta^2\text{H}$ . The contamination effects of different sample types (leaf, stem, soil) and different species from agricultural fields, grasslands, and forests were compared. The average corrections in leaf samples ranged from 0.35 to 15.73‰ for  $\delta^2\text{H}$  and 0.28 to 9.27‰ for  $\delta^{18}\text{O}$ . The average corrections in stem samples ranged from 1.17 to 13.70‰ for  $\delta^2\text{H}$  and 0.47 to 7.97‰

for  $\delta^{18}\text{O}$ . There was no contamination observed in soil water. Cleaning plant samples with activated charcoal had minimal effects on the degree of spectral contamination, reducing the corrections, by on average, 0.44‰ for  $\delta^2\text{H}$  and 0.25‰ for  $\delta^{18}\text{O}$ . The correction method eliminated the discrepancies between IRMS and IRIS for  $\delta^{18}\text{O}$ , and greatly reduced the discrepancies for  $\delta^2\text{H}$ . The mean differences in isotope ratios between IRMS and the corrected IRIS method were 0.18‰ for  $\delta^{18}\text{O}$ , and -3.39‰ for  $\delta^2\text{H}$ . The inability to create an ethanol correction curve for  $\delta^2\text{H}$  probably caused the larger discrepancies. We conclude that ethanol and methanol are the primary compounds causing interference in IRIS analyzers, and that each individual analyzer will probably require customized correction curves.

## Remotely sensing the cooling effects of city-scale efforts to reduce urban heat island

**Authors:** Mackey CW, X Lee, RB Smith

**Published:** 2012, Building and Environment 49, p. 348-358

**DOI:** 10.1016/j.buildenv.2011.08.004

**Abstract:** While recent years have seen many analyses of techniques to reduce urban heat island, nearly all of these studies have either been evaluations of real small scale applications or attempts to model the effects of large scale applications. This study is an attempt to analyze a real large scale application by observing recent vegetated and reflective surfaces in LANDSAT images of Chicago, a city which has deployed a variety of heat island combative methods over the last 15 years. Results show that Chicago's new reflective surfaces since 1995 produced a noticeable impact on the citywide albedo, raising it by about 0.016, while citywide NDVI increase is around 0.007. This finding along with counts of pixels with increased albedo and NDVI suggest that the reflective strategies influenced a larger area of the city than the vegetative methods. Additionally, plots between albedo increase and corresponding LANDSAT temperature change over the test period have linear regressions with steeper slopes (-15.7) and stronger linear correlations (-0.33) than plots between NDVI increase and temperature change (-8.9 slope, -0.17 correlation). This indicates that the albedo increases produced greater LANDSAT cooling than the NDVI increases. Observation of aerial images confirmed that typical instances of efforts to increase albedo, such as reflective roofs, produced stronger LANDSAT cooling than common instances of NDVI efforts, such as green roofs, street trees and green spaces. Accordingly, the reflective strategies were likely much more effective at cooling Chicago's LANDSAT heat island and may signify a generally more effective strategy for similar cities.

## Inter-comparison of four commercial analyzers for water vapor isotope measurement

**Authors:** Wen XF, X Lee, XM Sun, JL Wang, SG Li, GR Yu

**Published:** 2012, Journal of Atmospheric and Oceanic Technology 29, p. 235-247

**DOI:** 10.1175/JTECH-D-10-05037.1

**Abstract:** The  $\delta^{18}\text{O}$  and  $\delta\text{D}$  of atmospheric water vapor are important tracers in hydrological and ecological studies. Isotope ratio infrared spectroscopy (IRIS) provides an in situ technology for measuring  $\delta^{18}\text{O}$  and  $\delta\text{D}$  in ambient conditions. An intercomparison experiment was carried out with four commercial IRIS analyzers to characterize their performance and transferability of calibration methods. Over a 15-day atmospheric measurement, during which the water vapor concentration ranged from 14 to 27 mol mol<sup>-1</sup> and the isotopic ratios spanned about 90‰ and 13‰ for  $\delta\text{D}$  and  $\delta^{18}\text{O}$ , respectively, these analyzers tracked the natural variability in ambient conditions very well and achieved an average difference between one another within 2‰ for  $\delta\text{D}$  and within 0.1‰ for  $\delta^{18}\text{O}$  after calibration at appropriate frequencies. Two of the calibration methods (discrete liquid water injection and continuous dripping) agreed with each other within the tolerance thresholds of 2‰ for  $\delta\text{D}$  and 0.1‰ for  $\delta^{18}\text{O}$ . The Rayleigh distillation technique appeared to be acceptable as a calibration standard for  $\delta\text{D}$  but not for  $\delta^{18}\text{O}$ . The  $\delta\text{D}$  measurements were less prone to concentration dependence errors than the  $\delta^{18}\text{O}$  measurements. The concentration dependence underscores the importance of using a calibration procedure at multiple mixing ratios to bracket the range of natural variability.

## Dew water isotopic ratios and their relations to ecosystem water pools and fluxes in a cropland and a grassland in China

**Authors:** Wen XF, X Lee, XM Sun, JL Wang, SG Li, GR Yu

**Published:** 2012, *Oecologia* 168, p. 549-561

**DOI:** 10.1007/s00442-011-2091-0

**Abstract:** Dew formation has the potential to modulate the spatial and temporal variations of isotopic contents of atmospheric water vapor, oxygen and carbon dioxide. The goal of this paper is to improve our understanding of the isotopic interactions between dew water and ecosystem water pools and fluxes through two field experiments in a wheat/maize cropland and in a short steppe grassland in China. Measurements were made during 94 dew events of the D and  $^{18}\text{O}$  compositions of dew, atmospheric vapor, leaf, xylem and soil water, and the whole ecosystem water flux. Our results demonstrate that the equilibrium fractionation played a dominant role over the kinetic fractionation in controlling the dew water isotopic compositions. A significant correlation between the isotopic compositions of leaf water and dew water suggests a large role of top-down exchange with atmospheric vapor controlling the leaf water turnover at night. According to the isotopic labeling, dew water consisted of a downward flux of water vapor from above the canopy (98%) and upward fluxes originated from soil evaporation and transpiration of the leaves in the lower canopy (2%).

## **A large-eddy simulation study of water vapour and carbon dioxide isotopes in the atmospheric boundary layer**

**Authors:** Lee X, J Huang, EG Patton

**Published:** 2012, *Boundary-Layer Meteorology*, *in press*

**DOI:** 10.1007/s10546-011-9631-3

**Abstract:** A large-eddy simulation model developed at the National Center for Atmospheric Research (NCAR) is extended to simulate the transport and diffusion of  $\text{C}^{18}\text{OO}$ ,  $\text{H}_2^{18}\text{O}$  and  $^{13}\text{CO}_2$  in the atmospheric boundary layer (ABL). The simulation results show that the  $^{18}\text{O}$  compositions of leaf water and the ABL  $\text{CO}_2$  are moderately sensitive to wind speed. The variations in the  $^{18}\text{O}$  composition of water vapour are an order of magnitude greater than those in the  $^{13}\text{C}$  and  $^{18}\text{O}$  compositions of  $\text{CO}_2$  both at turbulent eddy scales and across the capping inversion. In a fully-developed convective ABL, these isotopic compositions are well mixed as with other conserved atmospheric quantities. The Keeling intercepts determined with the simulated high-frequency turbulence time series do not give a reliable estimate of the  $^{18}\text{O}$  composition of the surface water vapour flux and may be a reasonable approximation to the  $^{13}\text{C}$  and  $^{18}\text{O}$  compositions of the surface  $\text{CO}_2$  flux in the late afternoon only after a deep convective ABL has developed. We suggest that our isotopic large-eddy simulation (ISOLES) model should be a useful tool for testing and formulating research hypotheses on land-air isotopic exchanges.

## **Modeling biophysical controls on canopy foliage water $^{18}\text{O}$ enrichment in wheat and corn**

**Authors:** Xiao W, X Lee, X Wen, X Sun, S Zhang

**Published:** 2012, *Global Change Biology* 18(5), p. 1769-1780

**DOI:** 10.1111/j.1365-2486.2012.02648.x

**Abstract:** Leaf water  $^{18}\text{O}$  enrichment is an important factor controlling the  $\text{H}_2^{18}\text{O}$ ,  $\text{C}^{18}\text{OO}$ , and  $\text{O}^{18}\text{O}$  exchanges between the biosphere and the atmosphere. At present, there is limited capacity to explain the enrichment mechanisms in field conditions. In this study, three models of varying complexity were used to simulate the leaf water  $^{18}\text{O}$  enrichment at the canopy scale. Comparisons were made among the models and with high-frequency isotopic measurements of ecosystem water pools in wheat and corn. The results show that the steady state assumption was a better approximation for ecosystems with lower canopy resistance, that it is important to consider the effect of leaf water turnover in modeling the enrichment and not necessary to deal with time changes in leaf water content, and that the leaf-scale Péclet effect was incompatible with the big-leaf modeling framework for canopy-air interactions. After turbulent diffusion has been accounted for in an apparent kinetic factor parameterization, the mean  $^{18}\text{O}$  composition of the canopy foliage water was a well-behaved property predictable according to the principles established by leaf-scale studies, despite substantial variations in the leaf water enrichment with leaf and canopy positions. In the online supplement we provided a discussion on the observed variability of leaf water  $^{18}\text{O}$  composition with leaf and canopy positions and on the procedure for correcting isotopic measurements for organic contamination.

## Publication Update

### Environmental Research Letters: Best of the Year (2011)

The following publication was selected as one of the best of the year (2011) for the journal *Environmental Research Letters*, and will be republished in a special issue:

**Meng Ji (FES alum)**, Daniel S Cohan, and **Michelle L. Bell**. 2011. Meta-analysis of the association between short-term exposure to ambient ozone and respiratory hospital admissions. *Environmental Research Letters* 6(2), Art. No. 024006. doi: 10.1088/1748-9326/6/2/024006

## Awards

### EPA New England 2012 Environmental Merit Award

**Awardee:** Anthony Leiserowitz

### Walter L. Huber Civil Engineering Research Prize

**Awardee:** Julie Zimmerman

### Yale Graduate School of Arts and Sciences – Public Scholar Award

**Awardee:** Sébastien Jodoin, PhD student (Advisor: Ben Cashore)

## Grant Awards

### The Quiet Corner Woodland Partnership: engaging a landowner community through an adaptive learning and outreach program

**Sponsor:** USDA Forest Service

**PI:** Mark Ashton and Brad Gentry

**Total Amount:** \$230,283

Many private landowners in southern New England desire the knowledge and the resources to sustainably manage their forests, and to generate acceptable levels of income from the resource. Our experimental woodland partnership proposes a collaborative approach to private forestland management, bringing together landowners with Yale University, the State of Connecticut, NGOs, and local forest products industry. We seek to write and implement scale-appropriate conservation and landowner management plans, implement silvicultural prescriptions, provide guidance and assistance creating conservation easements, develop new sources of income through FSC certification and payments for ecosystem services, and hold workshops addressing land management and conservation issues that specifically concern small landowners. We intend for this to be a learning experience for all involved, whereby we systematically gather information, monitor changes, and report and discuss our successes and failures, learn, adapt, and continue. We seek funding to continue a process that we initially started in 2010 and to fully develop and expand a program intended to be long-term and of potentially great educational and demonstration benefit to the community and region.

### Domesticating the Ocean: The Work of Conservation in Southwestern Okinawa

**Sponsor:** NSF Doctoral Dissertation Research Improvement Grant

**PI:** Annie Claus (Advisor: Michael Dove)

Annie's research seeks to understand 1) how the use of using biodiversity enhancing technologies

(restoration, ecosystem engineering) by conservationists in the Okinawan islands are shaping conceptualizations of the seascape; 2) how marine conservation in the region has influenced public understanding of the environment more generally, and 3) how international conservation in Japan today reflects a new paradigm of environmental management that represents a break with the pristine, wilderness model of natural systems. Her research will be approached from the perspective of environmental anthropology, and will involve ethnographic methods, historical inquiry, and media research. Annie's research is also supported by Fulbright.

### **Yale Institute for Biospheric Studies (YIBS) – F&ES Recipients**

**Small Pilot Grant Recipients:** Meredith Atwood, Anobha Gurung, and Nikki Springer

**MS Grant Recipients:** Cara Mae Cirignano, Geoff Giller, and Max Lambert

### **Hixon Center Research Fellowships**

**Molly Greene:** Fresh Kills: Waste-scapes, Life-scapes and the Reinvention of Place

**Anobha Gurung:** Understanding Exposure to Traffic-Related Air Pollution in Kathmandu, Nepal

**Max Lambert:** Effects of Land Use on Endocrine Disruption Among Amphibian Species

**Dexter Locke:** Neighborhoods as Urban Socio-ecological Patches: Building A Community  
Forestry Typology

**Christopher Shughrue:** Delhi Urbanization as a Dynamical System: Pattern Instabilities and Opportunities

**Lisa Weber:** Examining the Efficacy of Connecticut Constructed Wetlands as an Urban Stormwater Best Management Practice