

atability. In 17 of 30 feeding trials (57%) herbivores significantly preferred plants from one or the other end of a stress gradient. Four of 7 significant trials across elevational gradients indicated a preference for plants growing at the low-stress end of the gradient. Seven of 10 significant trials across salinity gradients indicated a preference for plants growing at the high salinity end of the gradient. Results were dependent on the plant and herbivore species studied, suggesting that different plants respond differently to stress, and/or that different herbivore species measure plant quality in different ways. The variability in these results cautions against the utility of simple models of how plant stress affects palatability to herbivores. The causes and consequences of variation in plant palatability across stress gradients are important issues deserving further attention.

GORDON, WENDY S.,<sup>1</sup>\* JAMES S. FAMIGLIETTI,<sup>1</sup> NORMA L. FOWLER,<sup>1</sup> KATHY A. HIBBARD,<sup>2</sup> TIMOTHY G.F. KITTEL<sup>3</sup> and VEMAP MEMBERS.<sup>4</sup> <sup>1</sup> University of Texas at Austin; <sup>2</sup> University of New Hampshire; <sup>3</sup> National Center for Atmospheric Research; <sup>4</sup> Various. **The validation of VEMAP Phase 2 model experiments using hydrologic data.**

The Vegetation/Ecosystem Modeling and Analysis Project (VEMAP) Phase 2 model experiments investigate the response of biogeochemical and biogeographical models to variability in climate over the conterminous United States using historical and projected transient scenarios of climate and atmospheric CO<sub>2</sub>. Here we evaluate the behavior of six models by comparing simulated runoff to gauged streamflow from the USGS Hydro-Climatic Data Network (HCDN). These records cover much of the 20th century providing a lengthy record of monthly flows against which to validate the models. GIS software is used to manipulate the two distinct types of spatial data: VEMAP grid cells and USGS watersheds. Using time-series analysis, we present the average, monthly, under- or over-estimate of runoff by the models. While the errors are large, the time-series analysis demonstrates the ability of the models to simulate seasonal patterns that are qualitatively similar to those seen in the observed data. We also present the correlation between each of the models and the observed data set for 13 selected watersheds. We find that generally the performance of the models is quite similar. The greatest variability in model performance occurs across watersheds. The correlations between simulated and observed runoff range between 0.12 and 0.94. Within a single watershed, those correlation coefficients differ by as much as 0.43 and as little as 0.05. This validation exercise increases our understanding of the strengths and shortcomings of these models.

GRANT, BRUCE W.,\* CATHERINE C. L'ARMAND, ITZICK VATNICK and ROBERT NEVELN. Widener University. **Effects of chamber activity on estimates of digestive performance of lizards.**

Research on individual energy budgets has contributed greatly to our understanding of a wide range of ecological phenomena from life history evolution to ecological energetics. Modeling energy budgets of animals requires a detailed understanding of the physiological processes of energy assimilation during digestion, which includes estimating the cost of digestion. However, a common method to measure the cost of digestion (by integrating the difference between digesting and standard metabolic rates over the time between feeding and defecation) assumes that the animals are resting or at least equally active while fed and fasted, which is not always true. Thus, activity metabolism can lead to inaccurate estimate of digestive costs. We have developed a novel method to measure the cost of digestion of the Eastern Fence Lizard (*Sceloporus undulatus*) that removes the effects of lizard activity during metabolic measurements. We used infrared time-lapse video imaging and a Sable Systems oxygen analyzer to simultaneously measure the rates of activity and metabolism. Using a Scalex Plan Wheel and our own device driver, we analyzed the videos to assess lizard movement rates during their metabolic rate measurements. Data indicate that even slight chamber activity (e.g. lizards moving 1m/24 min) can significantly elevate metabolism. Our results over a range of temperatures show significant improvement in estimating the cost of digestion by removing the effects of activity metabolism.

GRANT, BRUCE W.,<sup>1</sup>\* CHARLENE D'AVANZO,<sup>2</sup> SUSAN A. MUSAN, TE<sup>1,4</sup> and DANIEL UDOVIC.<sup>5</sup> <sup>1</sup> Widener University, Chester PA 19013; <sup>2</sup> Hampshire College, Amherst MA 01002; <sup>3</sup> Ecological Society of America; <sup>4</sup> presently: American Society for Microbiology; <sup>5</sup> University of Oregon, Eugene OR 97403-1210. **Teaching Issues and Experiments in Ecology (TIEE): A web site and CD-ROM for undergraduate ecological education.**

We report on the goals, structure, and current successes of a web and CD-ROM based project to improve ecological education in undergraduate courses: Teaching Issues and Experiments in Ecology (TIEE). This is an NSF-funded, ESA-sponsored, peer-reviewed, and classroom/ field tested collection of teaching materials (1) to facilitate inquiry-based Experiments to Teach Ecology in laboratory courses, and (2) that uses active-learning methods and current controversial Issues to Teach Ecology for lecture classes (particularly for large class sizes). The TIEE resource collection is not merely a static site of labs or topics for lecture discussion, it is an interactive set of new materials that are both scientifically sound and pedagogically innovative. Our goal is to have each new peer-reviewed unit meet standards-based learning objectives and use innovative strategies for teaching, assessing growth among the full diversity of student learners, and improving teaching through formative and summative evaluation. In addition, the peer review aspect of TIEE submissions and ESA's publication of the accepted educational materials will hopefully stimulate greater participation in ecological educational improvement by faculty who teach ecology. The poster will describe the pedagogical and classroom materials, as well as annotated links offsite, that are directly linked through keywords from the "Experiments" and "Issues" sections of the site. The resources provide background explanations and references to the pedagogy and enable faculty to use and evaluate new innovations in education in their classrooms and participate in rigorous research in ecological education to learn what works and why.

GRAY, ANDREW N.,<sup>1</sup>\* THOMAS A. SPIES<sup>2</sup> and ROBERT J. PABST<sup>3</sup> <sup>1</sup> PNW Research Station, USDA Forest Service, Portland, OR 97205; <sup>2</sup> PNW Research Station, USDA Forest Service, Corvallis, OR 97331; <sup>3</sup> Oregon State University, Corvallis, OR 97331. **Response of overstory and understory conifers to gap size and resource levels.**

This study examined the long-term response of overstory and understory trees to creation of canopy gaps in mature *Pseudotsuga-Tsuga* forests in the Cascade Range. Four circular gap sizes (diameters 0.2, 0.4, 0.6 and 1.0 times canopy height) and controls were established in four stands in 1990. Overstory trees in controls and within 10-20 m of gap edges were mapped and diameters measured prior to gap creation and 7 years later. A subsample of trees were cored to quantify growth before and after gap creation. Overstory tree mortality was evaluated annually. The tallest saplings of each species in each 4 x 4 m cell across the gaps were mapped and measured in 1998 and 2000. Results of the core analysis indicated that old-growth trees had a greater growth response to gap formation (137% of pre-gap growth rates) than mature trees (114%). However, diameter measurements of large trees were not accurate enough to detect a growth response. Growth of intermediate-stature, shade-tolerant trees tended to be greater on north sides than on south sides of small (0.2 and 0.4) gaps; the reverse was true for large (0.4 and 1.0) gaps. Overstory tree mortality did not vary with gap size. Sapling growth across gaps suggested trade-offs between optimal levels of solar radiation and soil moisture, with radiation being relatively more important than soil moisture for *Pseudotsuga menziesii* than for *Tsuga heterophylla* and *Abies amabilis*.

GRAY, STEPHEN T.,<sup>1</sup>\* CHRISTOPHER L. FASTIE,<sup>2</sup> STEPHEN T. JACKSON,<sup>1</sup> JULIO L. BETANCOURT<sup>3</sup> and KENTON TAYLOR.<sup>1</sup> <sup>1</sup> University of Wyoming, Laramie, WY 82071; <sup>2</sup> Middlebury College, Middlebury, VT 05753; <sup>3</sup> USGS Desert Laboratory, 1675 West Anklam Road, Tucson, AZ 85745. **1000 year drought records from tree-rings in the Bighorn Basin, Wyoming.**

Understanding how climate can vary over time is an integral part of natural areas management in the Western United States. With its vast areas of public land and agricultural economy, drought related information is particularly important in the Bighorn Basin of Wyoming. Ring-width chro-



Keeping All the Parts:  
Preserving, Restoring  
& Sustaining Complex  
Ecosystems

THE ECOLOGICAL  
SOCIETY OF AMERICA  
86th ANNUAL MEETING  
MONONA TERRACE, MADISON, WISCONSIN  
AUGUST 5-10, 2001

**The Ecological Society of America**

1707 H Street, N.W., Suite 400

Washington, D.C. 20006

Web: <http://esa.sdsc.edu>