YALE ENVIRONMENTAL NEWS

The Peabody Museum of Natural History, the School of Forestry & Environmental Studies, and the Yale Institute for Biospheric Studies

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Yale Takes Leadership Role to Respond to Energy Challenge

The following statement was issued October 11 by President Richard C. Levin, Provost Andrew D. Hamilton and John E. Pepper, Vice President for Finance and Administration.

In his recent book, *Red Sky at Morning*, Gus Speth, Dean of the Yale School of Forestry & Environmental Studies (F&ES), states that in the face of disturbing polar ice loss and the startling consequences of global warming, addressing CO_2 emissions from fossil fuels must be the bedrock of a successful climate strategy. This concern has been strongly reinforced by the Advisory Committee on Environmental Management under the leadership of F&ES Professor Thomas Graedel, and by a number of student groups around the university. Yale recognizes the need to respond to and prepare for the unprecedented circumstances that we face with respect to energy production, consumption and related carbon emissions. As an institution, Yale is committed to becoming a model university that prepares its students for facing the pressing environmental conditions and taking a leadership role among higher education institutions to respond to the energy challenge.

Achieving Yale's goal will require real commitment from all of us—including cultural change here on campus. We've all got to become far more energy conscious.

GUS SPETH

In the fall of 2004, Yale Energy Task Force, a University-wide committee with staff, faculty and student representation, convened to respond to the challenge of increasing energy costs and greenhouse gas emissions. The task force was charged with making recommendations on Yale's approach to energy production—from conventional to renewable, procurement, demand, greenhouse gas emission reduction and conservation.

Following a thorough review and analysis, the officers have adopted the key recommendation from the report presented by the Energy Task Force and announced the following campus-wide goal, which will become effective immediately:

"Yale is committed to a level of investment in energy conservation and alternate energy sources that will lead, based on current projections, to a reduction in its greenhouse gas emissions 10% below our 1990 levels by the year 2020. This is consistent with a similar commitment by the Connecticut State Legislature and the New England Governors and Eastern Canadian Premiers Climate Action Plan."

By adopting this goal, Yale is one of the first universities in the country to commit to a 15-year strategic energy plan. We intend to reach our goal through a combination of a strong energy conservation program, invest-

continued on next page

INSIDE THIS ISSUE

ENERGY CHALLENGE

continued from page 1

ing in alternative energy sources, purchasing Renewable Energy Certificates, and implementing on-site renewable and clean energy demonstration projects.

Every one of us on campus has a role to play in helping achieve this goal, by conserving energy and by reducing the greenhouse gas emissions that flow from its use. Effective conservation programs can further free up funds within the University budget that will in turn be invested in renewable and non-CO_2-emitting forms of energy. Specifically, we are setting out to achieve the following conservation targets:

15% reduction at residential colleges over a three-year period;

10% reduction at all other facilities.

Two student groups—New Haven Action and the Student Task Force for Environmental Partnership—will take the lead in engaging and educating students on how to participate in advancing our goals for energy conservation. For every 5% of reduction at residential colleges, the University will allocate renewable energy certificates to offset one-third of the electrical energy used by residential colleges.

Yale has taken a bold and very important initiative. I'm extraordinarily pleased with President Levin's leadership on this issue. I hope that universities and colleges throughout our country will make similar commitments. That would not only show the path for others, but would also represent meaningful greenhouse gas reduction of international importance.

GUS SPETH

There will be a great deal of learning to be gained, both here at Yale and outside the campus community, on how to best meet our energy conservation and greenhouse gas reduction goals. We will share this learning internally and externally as it is gained in the months and years ahead.

To learn more about Yale's 15-year Greenhouse Gas Reduction and Renewable Energy strategic plan, go to *www.yale.edu/sustainability.*

Jennifer Briggs (2)

Tree Planting Honors Ed Bass's Contributions to Yale

At the close of the Fall 2005 Yale Institute for Biospheric Studies (YIBS) External Advisory Board meeting on October 21, 2005, Mr. Edward P. Bass '67 was honored for his commitment and continued support to environmental science at Yale—by having a tree planted in his honor.

President Richard C. Levin offered a champagne toast, commending Ed Bass for his ongoing support to environmental sciences at Yale, and for the active roles he plays on various University committees—most recently serving as the chair of the Yale Campaign Executive Committee.

When Leo Hickey, Professor of Geology & Geophysics and Biology, and Curator of Paleobotany for the Peabody Museum of Natural History, was asked by YIBS Director Derek Briggs and Museum Director Michael Donoghue to help with the selection of the tree to be planted in honor of Ed Bass, he was delighted to suggest a perfect and most appropriate species—the *Tilias americana*—also know as the Basswood Tree, for this special recognition.

The tree is located on the Sachem Street side of the Class of 1954 Environmental Science Center (ESC), and is marked with a plaque inscribed: *In honor of Edward P. Bass '67, in recognition of his contributions to the development of environmental science at Yale.*

TOP LEFT YIBS Director Derek Briggs, Edward P. Bass, Yale President Richard C. Levin, and Peabody Museum of Natural History Director Michael Donoghue stand in front of the Basswood Tree—*Tilia americana*.

BOTTOM LEFT President Levin and group toast Ed Bass.

H. C. Conklin

Hal Conklin inspecting the maturing rice that has begun to head, in a mountain pond-field terrace near Banaue, Ifugao, Philippines.

Professor Harold C. Conklin Named 2005 Distinguished Economic Botanist

Professor Emeritus of Anthropology Harold Conklin has received the 2005 Distinguished Economic Botanist award from the Society for Economic Botany, given in recognition of his outstanding contributions to ecological anthropology, which have inspired several generations of scholars, and for his studies of the Hanunóo and Ifugao of the Philippines, which remain the standards against which other research is measured. He is the first ethnographer to receive this honor.

In his concluding address at the Society's annual meeting in Fort Worth, Texas, in June, Conklin spoke of his many years of work in Southeast Asia, exemplifying his kind of ethnobotany by focusing on the hundreds of uses of wild canegrass (*Miscanthus floridulus*) among the Ifugao. This amazing plant provides essential materials for fencing, walling, flooring, sleeping mats, weaving frames, drainage conduits, weapons, lures, combs and building thatch, all of which are represented at the Yale Peabody Museum of Natural History by the many examples from Conklin's 18 expeditions to this region.

Professor Conklin is also Curator Emeritus of Anthropology in the Peabody Museum of Natural History, and the Franklin Muzzy Crosby Professor Emeritus of the Human Environment. He received his Ph.D. from Yale in 1955, taught for eight years at Columbia University, and joined the Yale anthropology faculty in 1962. Elected a member of the National Academy of Sciences in 1976, he is considered a world expert on the ethnography and linguistics of insular Southeast Asia. Along with his pioneering ethnoecological works, Professor Conklin has studied intensively the languages of the Luzon Cordillera, showing, for example, that there are over 245 ways to say *rice* in Ifugao alone, all related to the structure of the plant, subsistence methods and also to religious practices.

He has built up an ethnobiological laboratory at the Peabody, donating his ethnographic field collections not only to the Division of Anthropology, but also to the Yale Herbarium in the Museum's Division of Botany. He did not start off as a botanist or ethnobiologist but realized early on the importance of studying peoples' life ways and products in context.

Professor Conklin has written scores of scholarly articles and books on the cultures of Southeast Asia and other topics, including his most comprehensive publication, the *Ethnographic Atlas of Ifugao*.

Long-Sought Maya City Site Q–Found in Guatemala

A team of scientists including Marcello Canuto, Professor of Anthropology at Yale, has found incontrovertible proof of Site Q, a long-speculated Maya city, during a mission to the northwest Peten region of Guatemala.

The proof—an insitu panel carved with over 140 hieroglyphs that fill in a key 30-year chapter in classic Maya history—was found in a little-known ancient royal center called La Corona.

Roughly 40 years ago, the antiquities market was flooded with many exquisitely carved monuments of apparent Mayan origin. Many were purchased for private and museum collections despite a lack of provenance. Because of their similar style and shared subject matter, it was suggested that they came from some still unknown site located somewhere in the Peten lowlands. This site, called Site Q—an abbreviation of the Spanish "¿que?" or "which?"—has been the target of many expeditions.

The expedition to Guatemala this past April was to set up camp for an in-depth study later this year. On their last day in camp, Canuto and his team happened upon what they believe to be one of the monuments of Site Q.

"This panel exactly mirrors the style, size, subject matter and historical chronology of the Site Q texts," said Canuto. "This discovery, therefore, concludes one of the longest and widest hunts for a Maya city in the history of the discipline."

In addition to confirming the existence and location of Site Q, the find is one of the longest hieroglyphic texts discovered in Guatemala in the past several decades. Canuto also noted that the two blocks making up the panel appeared to be in their original location in a temple platform and were in no way damaged or looted.

"The discovery reinforces the existence of a 'royal road,' a strategic overland route that links the Maya capital to its vassal kingdoms in the southern lowlands," said team member David Freidel, professor of anthropology at Southern Methodist University. "For this reason, the forested enclave of Laguna del Tigre should receive serious consideration as a World Heritage Region."

The group will be returning to Guatemala to continue the study, which was supported in part by the National Geographic Society, the El Perú-Waka' Archaeological Project directed by David Freidel and Héctor Escobedo, and the Wildlife Conservation Society.

Other researchers included a mapping team of Damien Marken and Lia Tsesmeli, and an epigrapher, Stanley Guenter, all from Southern Methodist University. Logistics for the expedition were carried out by Roan McNabb of the Wildlife Conservation Society and Salvador Lopez, head of the department of Monumentos Prehispánicos of the Guatemalan Instituto de Antropologia e Historia (IDAEH).

Marcello Canuto with hieroglyph panel from Site Q—La Corona, Guatemala.

ELIMELECH

RAYMOND

CLARKE PRIZE FOR WATER SCIENCE AND TECHNOLOGY TO YALE'S ELIMELECH

The 2005 Athalie Richardson Irvine Clarke Prize for outstanding achievement in water science and technology was presented to Yale Professor Menachem Elimelech on July 7 in a ceremony in Dana Point, California, by the National Water Research Institute (NWRI).

This distinguished award is one of only a dozen water prizes worldwide, and is awarded annually to an outstanding individual who has demonstrated significant contributions in one of the following areas: the discovery, development, improvement and/or understanding of the issues associated with water quality, quantity, technology or public policy. The award includes a gold medallion, a $50,000 honorarium and an invitation to deliver the 2005 Clarke Lecture.

The NWRI, established in 1991, is renowned for facilitating and funding water-related research projects in the U.S. and abroad. Some of its critical research topics and interests in the world of water include ultraviolet disinfection, membranes, salinity management and desalination, riverbank filtration and education.

Elimelech, the Roberto C. Goizueta Professor of Chemical and Environmental Engineering, is a specialist in the physiochemical processes in natural water and in engineered aquatic systems. He directs the Yale Environmental Engineering Program, emphasizing a multidisciplinary approach to solving environmental problems. His research focuses on three areas: transport and fate of microbial pathogens in aquatic environments; fundamentals and applications of membrane

separation processes for water quality control and dynamics of colloidal particles and biocolloids in aquatic systems.

A native of Israel, Elimelech served in the Israeli Air Force before earning his B.S. and M.Sc. at the Hebrew University in Jerusalem and his Ph.D. at Johns Hopkins University (1989). He taught 1989–1998 at the University of California at Los Angeles, where he was professor and vice chair in the Department of Civil and Environmental Engineering before coming to Yale as Professor of Environmental Engineering. He has written over 90 articles and is principal author of the book *Particle Deposition and Aggregation*. Elimelech has held visiting posts at the California Institute of Technology, the Swiss Federal Institute of Technology and the Gwangju Institute of Science and Technology in Korea. In summer of 2002, he was the ExxonMobil Professor at the National University of Singapore.

"We are delighted at the very significant honor that the Clarke Prize gives to Professor Elimelech," said Paul Fleury, Dean of the Faculty of Engineering and Frederick W. Beinecke Professor of Engineering at Yale. "It is gratifying to see that the worldwide water research community already recognizes his extraordinary energy, creativity and leadership as do all of his Yale colleagues. We bask in his reflected glory."

His numerous honors include the W. M. Keck Foundation Engineering Teaching Excellence Award, the Walter L. Huber Civil Engineering Research Prize of the American Society of Civil Engineers, the Outstanding Paper Award of the Association of Environmental Engineering and Science Professors and the Excellence in Review Award of the journal *Environmental Science & Technology*. In May 2004 he received Yale's Graduate Mentor Award.

Further information about the NWRI is available on the Web at *www.nwri-usa.org/* or from Gina Melin at 714.280.5709, gmelin@nwri-usa.org.

F&ES PROFESSOR RECEIVES RESEARCH AWARD

Pete Raymond, assistant professor of ecosystem ecology at the School of Forestry & Environmental Studies (F&ES), has received the Estuarine Research Federation's 2005 Cronin Award for Early Achievement for significant career accomplishments.

"The Cronin Award is awarded to an estuarine scientist who has shown great promise in his or her work that is carried out six years after obtaining a doctorate," said Linda Schaffner, president of the Estuarine Research Federation. "We are pleased to recognize and honor the breadth and interdisciplinary nature of Professor Raymond's research interests, the quality of his publications, his teaching accomplishments and the impact he has had on the field of coastal ecology."

Raymond's research examines how climate and land-use change affect the amount of carbon transferred to rivers from the continents. This work will be an important step toward allowing researchers to close the carbon budget in rivers, estuaries and the coastal ocean worldwide. He currently works on East Coast and Arctic rivers and estuaries, and is funded by the Hudson River Foundation and the National Science Foundation.

Raymond has been involved in many studies designed to establish the role of rivers and estuaries in the carbon budget of coastal ecosystems. His Ph.D. and postdoctoral work on the York River in Virginia and the Parker River in Massachusetts was some of the first to use C14, which is a radioactive isotope used for carbon dating, to determine the major flows of carbon in East Coast estuaries.

Since arriving at Yale, he has been working to determine how old river carbon is and if there is a relationship between the age of carbon and its availability to riverine bacteria. He has also been collaborating with researchers at the Lamont Doherty Earth Observatory at Columbia University to develop methods to accurately measure the air-water exchange of carbon dioxide in rivers and estuaries.

Raymond has authored or co-authored 16 papers, with one published in *Science*, one in *Nature* and three in *Estuaries*. A 2003 study, conducted by Raymond and researchers at the Institute for Ecosystem Studies in Millbrook, N.Y., and published in *Science*, suggested that inorganic carbon export from agricultural lands might offset some of the proposed carbon sequestration due to reforestation.

Raymond holds a doctorate from the School of Marine Science, College of William and Mary. After completing postdoctoral fellowships at the Marine Biological Laboratory's Ecosystems Center and the Woods Hole Oceanographic Institution in 2002, Raymond joined the faculty of the Yale School of Forestry & Environmental Studies.

Anthropologist Burger Is Designated MacCurdy Professor

Richard L. Burger, an authority on ancient Andean civilization and former director of the Yale Peabody Museum of Natural History (YPM), has been named the C. J. MacCurdy Professor of Anthropology. The professorship was established from a bequest of Evelyn MacCurdy Salisbury as a memorial to her father, Charles J. MacCurdy, B.A. 1817, LL.D. 1868, for a professorship in anthropology.

Burger has carried out archaeological research in Peru for over two decades, directing excavations at Chavin de Huantar and Huaricoto in the northern highlands and at Cardal, Mina Perdida and Manchay Bajo on Peru's central coast, resulting in the books *Chavín and the Origins of Andean Civilization* and *Machu Picchu: Unveiling the Mystery of the Incas*, as well as several others he co-edited: *Social and Economic Organization in the Prehistoric Andes, Formative Ecuador* and *Variations in the Expression of Inka Power*. His most recent work, *The Life and Writings of Julio C. Tello*, is forthcoming. Burger has also authored or co-authored a number of monographs, as well as numerous articles and reviews.

A 1972 graduate of Yale College, Burger earned his M.A. and Ph.D. in anthropology from the University of California at Berkeley. He joined the Yale faculty in 1981 and was named a full professor in 1989. Since 1983 he has been Curator of the Division of Anthropology at the YPM and served as the Museum's Director from 1995 to 2002. Under his leadership, the Museum expanded its programs with the New Haven community by introducing a science literacy initiative for New Haven elementary and middle school

Anthropologist Hill Is Designated Stephenson Professor

Andrew Hill has been appointed the Clayton Stephenson Class of 1954 Professor of Anthropology. The professorship was established in June 2004 by J. Clayton Stephenson, Class of 1954—"to provide support for a faculty scholar who exhibits outstanding and distinctive achievement in his or her field of research within the Department of Anthropology."

Professor Hill's teaching and research focuses on human evolution, with particular emphasis on the environmental and ecological context in which it occurred. He also serves as the Chair of the Department of Anthropology (since 2000) and is Curator of Anthropology at the Yale Peabody Museum of Natural History (since 1992).

Hill has conducted fieldwork in eastern Africa, Pakistan and the United Arab Emirates, and for many years he has been director of the Baringo Paleontological Research Project, a multidisciplinary research program operating in the Tugen Hills, Kenya, that explores hominoid evolution in environments in the late Neogene of Africa.

In 1992, Hill and his colleagues identified the oldest known skull in the human family and established its age to be about 2.4 million years. The skull fragment had been unearthed decades earlier in Kenya near Lake Baringo and was kept in the National Museum of Kenya. Hill and his team established its age by analyzing the rocks in the strata where the fossil was originally found. From 1984 to 1995, he took part in yearly expeditions in Abu Dhabi, United Arab Emirates, to investigate fossils there and compare them with fossils in Pakistan and Kenya for clues about whether species evolved in response to major global climate change.

Hill has written numerous articles and abstracts and has co-edited several scientific publications, including *Fossil Vertebrates of*

teachers, establishing an events department at the Museum, and beginning its annual Fiesta Latina, a celebration of Latin American cultures in New Haven, among other endeavors.

Since 2005, Burger has been Chair and Director of Graduate Studies for the Council on Archaeological Studies.

Burger and his wife, archaeologist Lucy C. Salazar, are co-curators of *Machu Picchu: Unveiling the Mystery of the Incas*, the largest exhibition on the Incas ever assembled in the United States. The exhibition opened at the YPM in 2003 and then traveled to other venues before its recent return to the Museum, where it is on view through July 3, 2006. The exhibition was funded in part by a grant from the National Science Foundation. Burger has also been the recipient of numerous other grants and fellowships. In addition to Yale, he has taught at Pontificia Universidad Católica in Lima, Peru, and at the Universidad Nacional Mayor de San Marcos.

The Yale archaeologist served as chair of the advisory board of the Senior Fellows of Pre-Columbian Studies at Dumbarton Oaks in Washington, D.C., and has been a member of several editorial boards for archaeological journals. He has been a consultant to numerous institutions, including the American Museum of Natural History and the National Geographic Society.

F&ES PROFESSOR GETS STATE RESEARCH GRANT

Connecticut Governor Jodi Rell presented Gaboury Benoit, right, Professor of Environmental Chemistry at Yale's School of Forestry & Environmental Studies, with a $25,000 check to conduct research on nitrogen emissions from sewage treatment plants, which cause hypoxia in Long Island Sound every summer. The governor presented $347,206 in grants this year from the Long Island Sound Fund for statewide projects.

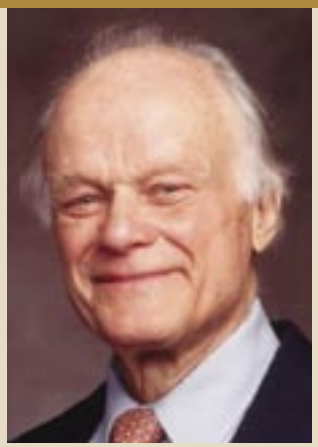
Arabia and *Fossils in the Making: Taphonomy and Vertebrate Paleoecology*. In 2002, he was guest editor of a special two-volume issue of the *Journal of Human Evolution* dedicated to the work of his Kenyan expeditions.

A native of England, Hill earned his B.S. from the University of Reading and his Ph.D. from Bedford College, University of London. After graduating, he was a research officer for the National Museums of Kenya and later a research fellow, then administrative director of The International Louis Leakey Memorial Institute for African Prehistory in Nairobi, Kenya. He was a postdoctoral research fellow in anthropology at Harvard University and a research associate in Harvard's Peabody Museum before coming to Yale in 1985 as an assistant professor. He was named a full professor in 1992.

This year Hill was also named head of the Anthropology Division at the Yale Peabody Museum of Natural Hisotory. He was Curator-in-Charge of the Museum's permanent exhibition on human evolution titled *Fossil Fragments*.

Hill has served on the editorial board of Oxford University Press's Human Evolution Series since 1999, has been a consultant and reviewer for publishers of various popular and academic publications, and was a participant in the A&E/Granada television series on human evolution hosted by Walter Cronkite in 1994.

In recognition of his undergraduate teaching, Hill received the Yale College–Lex Hixon '63 Prize for Teaching Excellence in the Social Sciences in 1994.



F. HERBERT BORMANN HONORED

F. Herbert Bormann, Oastler Professor Emeritus of Forest Ecology at the School of Forestry & Environmental Studies, became a lifetime honorary member of the International Association for Ecology in appreciation for his long and dedicated service and for having been a founding member, secretary-general and president of the organization.

PEABODY MUSEUM OF NATURAL HISTORY

William Sacco

EVENTS

MACHU PICCHU: UNVEILING THE MYSTERY OF THE INCAS
Ongoing until July 3, 2006

After its spectacularly successful nationwide tour, the largest exhibition on the Incas ever assembled in the U.S. is back. On display are objects excavated by the Yale Peruvian Expedition of 1912.

10TH ANNUAL CELEBRATION OF MARTIN LUTHER KING, JR., DAY
January 15 & 16, 2006

The Yale Peabody Museum's renowned two-day festival in honor of Dr. Martin Luther King, Jr., and his efforts to ensure environmental and social justice among all people.

FIESTA LATINA
March 11, 2006

Our annual celebration of Latin American cultures! This daylong fiesta features performances of traditional and contemporary Latin American music and dances, along with storytelling, face painting and mask making for kids.

For information and updates visit *www.peabody.yale.edu*.

The Peabody Museum Ichthyology Collections: History and Discovery

By Gregory Watkins-Colwell
Museum Assistant, Division of Vertebrate Zoology

Michael Vecchione

Jon Moore holding the fish *Gephyroberyx darwini* from the F/V Flicka.

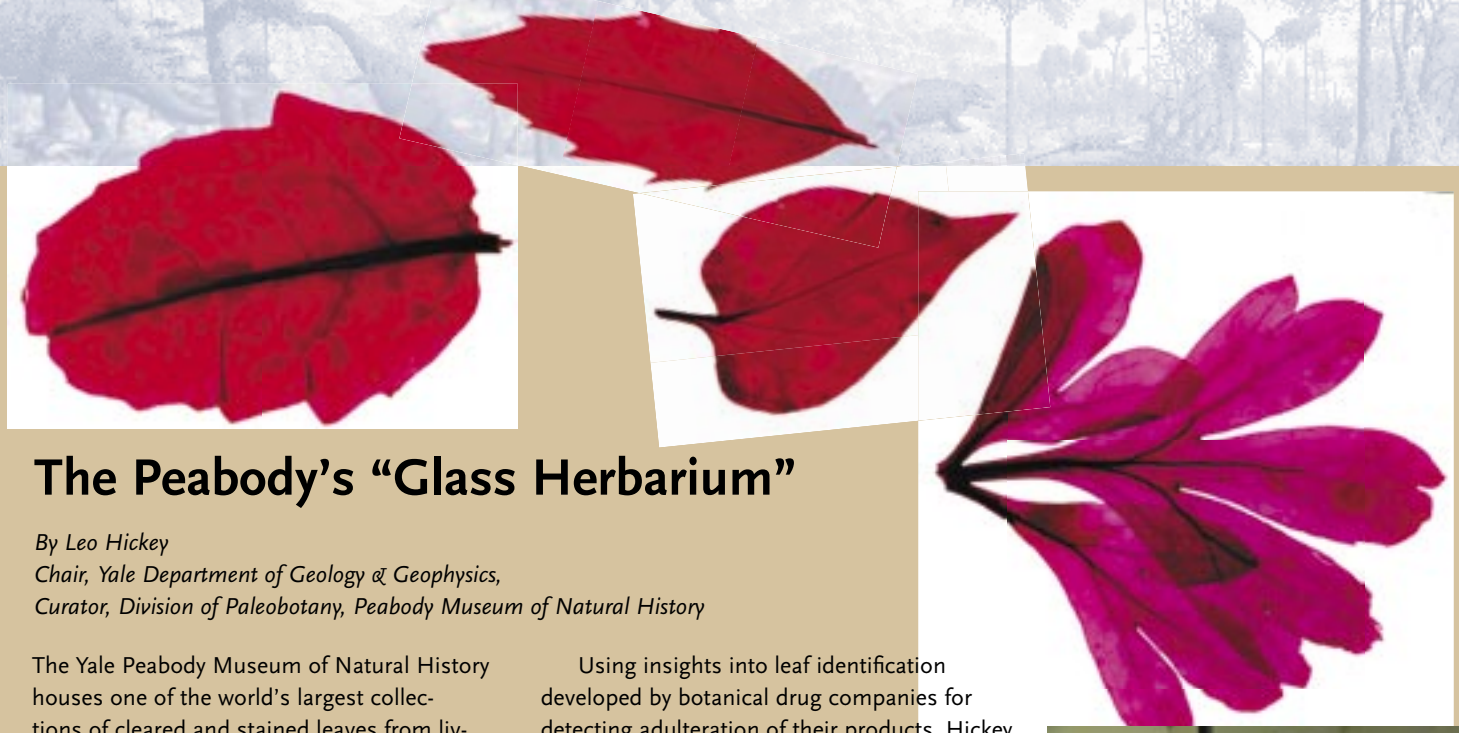
In July and early August the Division of Vertebrate Zoology at Yale Peabody Museum hosted ichthyologist Jon Moore, currently assistant professor of biology at Florida Atlantic University and a curatorial affiliate in the Division. Moore, who received his doctorate from Yale University in 1993, researches the ecology of deep-sea fishes and has participated in several expeditions to study seamounts in the Atlantic (see "Peabody Acquires Deep Sea Fauna from New England Seamounts," *Yale Environmental News,* Spring 2004, 9(2):10–13).

During his visit to the Museum, Moore examined the uncatalogued materials housed within the Division of Vertebrate Zoology, specimens accumulated from courses and independent research by Yale faculty and students over the past 130 years. While significant progress has been made toward identifying and cataloguing these materials (over 3,000 fish specimen lots have been catalogued within the last two years), roughly 1,500 remained uncatalogued. Moore sorted these materials, recognizing those with significant historic value as well as scientific value. Additionally, he identified to genus or species more than 350 specimen lots. Included were a few very rare specimens: *Menidia conchorum,* the federally protected Keys Silverside; *Sonoda megalophthalma,* a very rare deep-sea sternoptychid (less than 30 specimens are known); and *Photostylus pycnopterus,* a rare deep-sea slickhead (alepocephalid).

Among the historically significant findings within the uncatalogued materials were many fish specimens from the U.S. Fish Commission explorations off the eastern seaboard in the 1870s and 1880s, fishes from Bermuda collected by A. E. Verrill in 1898, a collection of blennies from the Dominican Republic, and specimens from A. E. Parr's cruises in the 1930s with the Woods Hole Oceanographic Institution's ship *Atlantis.*

Moore also sorted and separated more than 500 lots of early life stage specimens, to be set aside as a new collection within the Division's ichthyology holdings (early life stages are often poorly represented in collections). During his stay Moore donated fish specimens from Belize and the Red Sea to the Museum, including taxa new to the Peabody collections.

The ichthyology collection at the Yale Peabody Museum includes over 15,000 catalogued specimen lots totaling more than 141,000 individual fish. The Division houses type specimens of 190 taxa, as well as many specimens of historical and scientific value, such as those from the Gray Museum and Bingham Oceanographic Foundation collections. Significant collections also include fishes from the Atlantic seamounts, the Seychelles, and the African Rift Lakes. To learn more about the Peabody's Division of Vertebrate Zoology and its fish collections, visit *www.peabody.yale.edu/collections/vz/*.



The Peabody's "Glass Herbarium"

By Leo Hickey
Chair, Yale Department of Geology & Geophysics,
Curator, Division of Paleobotany, Peabody Museum of Natural History

The Yale Peabody Museum of Natural History houses one of the world's largest collections of cleared and stained leaves from living angiosperms. Like fingerprints, the vein patterns in leaves, combined with features such as leaf shape and the presence of lobes, marginal teeth and glands, are unique to individual genera and species of flowering plants. The approximately 7,000 specimens in the National Cleared Leaf Collection on loan from the National Cleared Leaf Collection, Department of Paleobiology, National Museum of Natural History, Smithsonian Institution, are housed in the Peabody's Division of Paleobotany. Study of this collection resulted in a method, known as leaf architectural analysis, of describing and identifying vein patterns. Although originally conceived as a technique for identifying fossil angiosperm leaves, leaf architectural analysis has been widely applied to living floras, especially those in the tropics. Another very active research application for this collection has been as a source of information on angiosperm relationships and ecological settings during the course of their evolution.

Patterns Under Glass

Curator Leo Hickey began this collection at the Smithsonian Institution in 1967 as part of his research on the systematic distribution of the leaf characters of the flowering plants. The impetus for doing so came when, during the course of his dissertation, he realized that most of the identifications of fossil angiosperm leaves more than about 20 million years old were incorrect.

Using insights into leaf identification developed by botanical drug companies for detecting adulteration of their products, Hickey realized that many of the features needed to determine the identities of leaves could be seen only in cleared and stained specimens. These are taken mainly from pressed leaves in herbarium collections, with some collected in the field. Preparation involves clearing in caustic and bleaching solutions, and staining, followed by mounting in resin between sheets of optical glass. Typical mounts range from 2x3" inches to 4x6" inches, but the largest slide in this "glass herbarium," a leaf from Thailand, measures a whopping two feet square! The whole process of clearing and mounting the leaves can take six to eight weeks for a single specimen. The collection came to Yale when Hickey came to the Peabody Museum as its director in 1982.

Beauty in the Service of Science

Although the great beauty of the cleared leaf mounts never ceases to impress first-time visitors, the real significance of the collection is as a powerful tool for identifying unknown leaves and for working out the evolutionary and ecological history of the flowering plants. With over a quarter of a million species, the angiosperms are without question the most diverse and successful group of plants. Needless to say, similar patterns of venation have arisen several times within angiosperm evolutionary history, and teasing them apart requires a well-documented database. Thus, each specimen in the collection is vouchered to an authoritatively identified herbarium sheet. During its relatively short history the glass herbarium has been a resource for many scientific papers, monographs and manuals, and even for a few customs seizures and inquiries from drug enforcement agencies.

Linda Klise

Current research applications using the National Cleared Leaf Collection involve analysis of leaf architectural characters for National Science Foundation projects on angiosperm phylogeny and a numerical comparison of the leaf architecture of modern and fossil forests. Ongoing studies of at least six fossil floras are using its data, in addition to a long-term project to develop an integrated pictorial database of the leaf architecture of modern and fossil angiosperm leaves. For more on the Peabody collections in botany and paleobotany, see *www.peabody.yale.edu/collections/*.

LEFT TO RIGHT Cleared leaf of ***Amborella trichopoda;*** cleared leaf of ***Atherosperma moschatum;*** cleared leaf of ***Houtuynia cordata;*** cleared leaf of ***Paeonia brownii.*** From the National Cleared Leaf Collection, Department of Paleobiology, National Museum of Natural History, Smithsonian Institution. Photograph © Peabody Museum of Natural History, Yale University.
BELOW Division of Paleobotany Museum Assistant Sandra Preston repairs a cleared leaf slide.

Raising Alligators: Researching Vertebrate Development

By John Vanden Brooks

Ruth Elsey

Understanding an environment's effect on vertebrate evolution and development is essential to the study of ecology, paleontology and evolution. Oxygen is the most important environmental component for all vertebrate groups. Although much attention has been paid to the rise of oxygen during the Precambrian, little has been given to its continued evolution throughout the Phanerozoic. Interestingly, the Berner oxygen curve indicates a marked increase in the partial pressure of oxygen (pO_2) during the Permian–Carboniferous, with an upper value of approximately 31%, and a sharp decline at the Permian–Triassic boundary (about 248 million years ago) to below today's level of 21%. Large-scale changes in pO_2 in the atmosphere would have had wide-ranging effects on vertebrate evolution and development.

A newborn alligator emerges from its egg.

The Evolution of Color in Birds

By Mary Caswell Stoddard (Yale '08)

Birds are among the most colorful creatures in the animal kingdom, but how well do we really understand the true richness of a bird's color? Until quite recently, not very well at all. It wasn't until the 1970s and 1980s that Yale biologist Professor Timothy Goldsmith and other scientists discovered that avian and human visual systems are quite different.

Bird vision is tetrachromatic; humans have a more limited trichromatic visual system. Like humans, birds have the three color cones that are sensitive to short, medium and long wavelengths in the visible spectrum (400 nm to 700 nm), but birds also have an additional color cone that detects wavelengths in the near-ultraviolet range (300 nm to 400 nm). Not only can birds see these shorter wavelengths, their plumage reflects considerable amounts of UV light. Because humans cannot perceive these shorter UV wavelengths, we are blind to a whole range of colors birds can see. Thus, it is essential that we reevaluate previously held beliefs about avian color and modify the way we study color in birds.

During the summer I worked in Professor Richard Prum's lab, examining the complexity of bird vision and plumage coloration and the nature of color evolution in one clade of birds. The focus was on developing a descriptive, phylogenetic natural history of color evolution in *Cyanocompsa* and *Passerina* (Cardinalidae). Birds in these sister genera include blue grosbeaks and especially striking buntings such as the Indigo Bunting and the Painted Bunting. These birds have undeniably vivid color patterns, but an evaluation of these colors based on human vision would be incomplete. So, what do these colors look like to other birds?

To answer this, colors in the plumage patterns of each species were measured and an estimate made of how these colors would be perceived by the avian retina. Skins in the Yale Peabody Museum of Natural History's ornithology collections were used to obtain the reflectance spectra of plumage patches on representatives of each species in these genera. The reflectance spectra showed that humans are indeed missing key aspects of bird coloration. For example, the bright green patch on the back of the Painted Bunting reflected almost as much UV light as it did green light, implying that the patch, which looks green to humans, appears to birds as a UV-green color combination quite inconceivable to humans. In birds, color processing is based on the relative stimulation of color cones. For each color patch in a plumage pattern, the spectra were used to predict relative stimulation of the four avian color cones in response to that patch. Ultimately, the color patterns of all species in *Cyanocompsa* and *Passerina* were described by

To better understand the effects of changes in pO_2 in the past, it is crucial to understand the effects of varying pO_2 on the development of modern vertebrate groups. As a doctoral student in Yale's Department of Geology & Geophysics advised by Professor Elisabeth Vrba and Professor Robert Berner, my project involves raising the eggs of *Alligator mississippiensis* (the American alligator) under varying pO_2 levels to examine its effects on vertebrate development. I have traveled to the Rockefeller Wildlife Refuge in southwestern Louisiana each of the last two summers to collect alligator eggs with the help of Ruth Elsey, a wildlife biologist at the refuge. The nests, which are located on the edge of islands of vegetation in the swamps, are made of rotting vegetation that keeps the eggs warm and humid. Each clutch or group of eggs laid by a single mother contains about 30 to 50 eggs. The eggs are collected, placed in mesh containers with nesting material for insulation and then driven back to the laboratory at Yale University.

In the lab, I have constructed incubators in a temperature- and humidity-controlled room. Using the settings within the room in conjunction with underwater heaters and preset gas mixtures, the temperature (89°F), humidity (about 100%) and carbon dioxide concentration (350 ppm) of each incubator are kept constant. The only variable is pO_2, which ranges between 16% and 35%.

The most obvious result of this experiment is that with increased pO_2 the alligators grow and develop faster. This means that they have a higher birth weight and larger size when they approach hatching, and also hatch at an earlier age. This trend can be seen from a level of 16% oxygen through 21% (the control) up to approximately 27%, beyond which high oxygen levels are deleterious to the organisms (from increased ozone and oxide radicals, which can lead to cell destruction). At these higher concentrations, the mortality rate increases and the growth and developmental rates drop. Preliminarily, some other observations are that variations in both the chemical composition and density of the long bones correlate with oxygen level, as does the timing of developmental events. All the embryos are preserved and will be deposited in the vertebrate zoology collections at the Peabody Museum of Natural History, where they can be available for future examination.

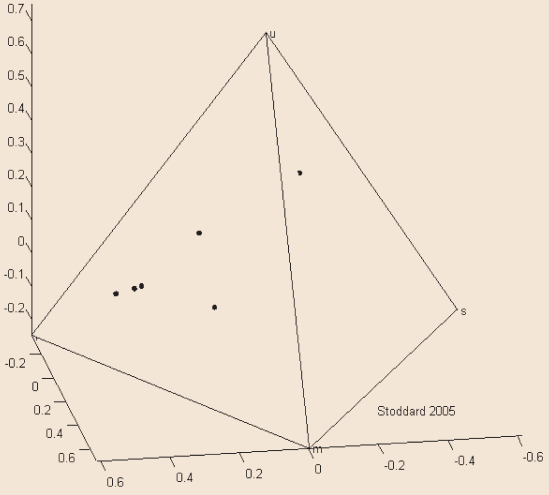
The data from these experiments can be used to examine changes in the fossil record. I look at temnospondyls, possible ancestors of modern-day amphibians, some of which are housed in the collections at the Peabody. Some of the same trends seen in this experiment are also observed in the fossils. It is important to keep in mind that this experiment does not say anything about evolutionary processes, but just shows the potential for changes in pO_2 through time to have affected vertebrate physiology and ecology. This work is an important first step in understanding the complex interaction between vertebrate development and environmental oxygen levels.

a set of color patches, with each color patch defined by its corresponding relative cone stimulation values.

The next phase of this research involved analyzing the color patterns and comparing them between species, and a computer program was developed to evaluate the color patterns. The program plots the colors of a plumage pattern in a virtual color space tetrahedron, the current model of avian color space. Because birds have a tetrachromatic visual system, avian color space can be represented as a three-dimensional tetrahedron. The four vertices correspond to the near ultraviolet-sensitive, short-wavelength-sensitive, medium-wavelength-sensitive and long-wavelength-sensitive photoreceptors. Each color in a plumage pattern, then, can be mapped as a point in the tetrahedron; its position is related to the relative stimulation of the four color cones, located at the vertices. The tetrahedron aptly depicts tetrachromatic color space as an extension of the human color space, which comprises the short-, medium- and long-wavelength-sensitive cones and can be projected on the base of the tetrahedron. Compared with this two-dimensional, triangular color space, the avian tetrahedral color space suggests that birds experience color in another whole dimension.

Using a verified, molecular-based phylogeny for this clade, I am currently examining trends in UV color, hue, chromaticity and contrast in the color patterns of each species. By exploring modifications of color with respect to the known genetic changes in this group, a better understanding of the life history of these varied and vibrant birds should be achievable. For truly, in the world of bird color, there is more than meets the human eye.

Colors in the plumage pattern of *Passerina ciris* (Painted Bunting) plotted in the tetrahedral color space. The vertices of the tetrahedron represent the near ultraviolet-sensitive (u), short-wavelength-sensitive (s), medium-wavelength-sensitive (m) and long-wavelength-sensitive (l) avian photoreceptors.



Eric Lazo-Wasem

Artist George Rennie Brings Natural History Up Close

By Eric A. Lazo-Wasem
Senior Collections Manager, Division of Invertebrate Zoology

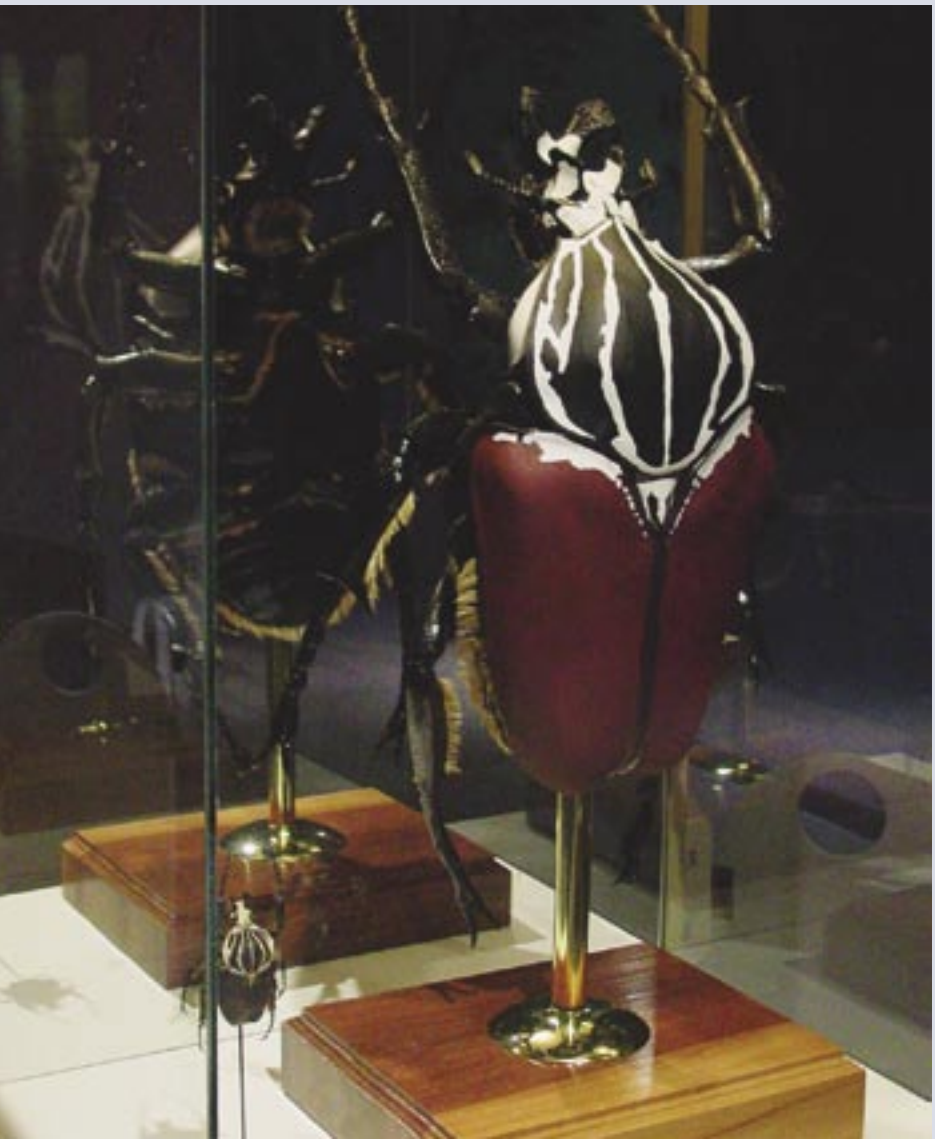
George S. Rennie III recently completed his most detailed and challenging project to date—a six-times-life-size replica of the mantis shrimp, *Squilla empusa*, a reclusive marine crustacean that inhabits sand and mud burrows in Long Island Sound.

George Rennie has had a long association with the Yale Peabody Museum. As a research preparator for the Division of Vertebrate Paleontology in the 1960s, he made casts and molds of important fossils such as *Deinonychus* and *Moeratherium*. He was also part of the team that crafted the giant squid model that now hangs above the Museum's lobby.

After leaving the Museum in 1970, George pursued freelance work in modeling, sculpting and painting. Unlike many artists and modelers that focus on scientific themes, George has specialized training in science, earning his bachelor's degree in geology from Dickinson College. Several of his highly detailed natural history paintings have graced the walls of both the Museum and the Class of 1954 Environmental Science Center. Recently he combined this scientific background with his artistic talent to undertake a series of highly accurate enlarged replicas of various fossil and living invertebrates. Some of these have been displayed at the Museum: an *Anomalocaris* and an *Ottoia* in the 2003 exhibition *Burgess Shale: Evolution's Big Bang,* and a Goliath beetle (*Goliathus goliathus*) currently on view on the Museum's third floor. In addition, a newly installed exhibit in Yale's Kline Geology Laboratory features a larger-than-life trilobite.

To ensure the accuracy of his models, George typically consults with curators or other specialists repeatedly throughout the construction phase of his projects. The *Squilla* model is meticulously crafted of epoxy resin, with natural materials such as boar bristles to represent the hair-like setae of the appendages, and marabou feathers to mimic the foliaceous abdominal gills. Almost one meter long, it required nearly 400 hours to complete.

George has generously donated this outstanding *Squilla* model to the Peabody's Division of Invertebrate Zoology, and the Division is planning to use it in public displays, classroom demonstrations and other teaching opportunities.



K. Zolvik

TOP George Rennie with his model of the mantis shrimp.

BOTTOM The Goliath beetle model, six times actual size, is an exact replica of a specimen from the Peabody's collections (visible in the lower left of the display case).

Peabody Fellows Program Expands to Include Biodiversity and Global Change

By Jane Pickering
Assistant Director for Public Programs

E. Willett (3)

The Yale Peabody Museum has been awarded a grant to extend its highly successful Peabody Fellows Program in Biodiversity and Human Health from the Institute of Museum and Library Services, an independent federal agency that supports the nation's 15,000 museums and 122,000 libraries. This new grant will expand the scientific scope of the Peabody Fellows Program to cover biodiversity and global change, and also complements the Museum's global change program funded by the Bay and Paul Foundations to produce curriculum materials on this theme (see "Peabody Global Change Education Program," *Yale Environmental News,* Spring 2005, 10(2):20). Materials produced by the global change program will be tested by teachers in the IMLS-funded program. Both programs are rooted in the unique resources of the Yale environmental community, and will use the Peabody's extensive collections.

Until 2004 Connecticut schools taught specific science content areas in each grade. However, the new Connecticut science standards now mandate the teaching of integrated science for all grade levels. Understanding the interrelationship between global change and biological diversity requires an integrated knowledge of the earth and life sciences. This project will promote such interdisciplinary teaching, along with intensive instruction and practice in inquiry-based techniques. Topics will include habitat destruction, invasive species, climate dynamics, and the effects of globalization on wild and domesticated plants. Within these themes locally relevant examples will be identified since teachers have specified that such material is a priority need.

The program will work with middle school teachers from five Connecticut public school districts: New Haven, Bridgeport, Hamden, Waterbury and West Haven. School principals and science supervisors will nominate teachers to attend an intensive summer institute in 2006 and several workshops during the following academic year. The districts will also host a one-month visit by the Museum's BioAction Lab, which is equipped with over 300 natural history specimens, microscopes and other resources for inquiry-based teaching. The program's advisory council, chaired by Professors and Peabody Curators Derek Briggs and Michael Donoghue, includes other faculty from Yale and school administrators from the partner school districts.

L. Fawcett

LEFT Vertebrate Zoology Museum Assistant Greg Watkins-Colwell discusses the natural history of the American toad.

TOP Curriculum consultant Francesca Grifo (left) discusses a lobster dissection with teachers Marjorie Drucker, Evelyn Willett and Jennifer Esty.

MIDDLE Botanist Lauren Brown discusses plant diversity with teachers.

BOTTOM Project Director Jim Sirch shows teacher Marjorie Drucker an egret roost found by ornithologist Celia Lewis (left).

The *Biozone!* II group spent the afternoon collecting specimens and exploring Horse Island.

D. Heiser (2)

At Horse Island, Invertebrate Zoology Senior Collections Manager Eric Lazo-Wasem teaches a camper how to collect marine invertebrates.

The Fun Just Gets Better for the Peabody's Summer Youth Programs

By David Heiser
Events Coordinator, Yale Peabody Museum of Natural History

D. Heiser (2)

J. Alonzo (2)




The Yale Peabody Museum of Natural History Events Office expanded this year's *Biozone!* summer camp programs to four weeks, up from two weeks in 2004, and from three grade levels (4th to 6th) to six (3rd to 8th). During the first *Biozone!* session the younger campers learned about the creation of the Peabody's dioramas from Museum Preparator Michael Anderson, and then spent the week designing and creating their own diorama with specimens collected during their field trips. The second *Biozone!* session, for older children, was designed to teach kids about making collections (including identifying and preparing specimens), and was as successful as last year's camp. Thanks to the collections staff in the Division of Invertebrate Zoology, we were able to add a marine invertebrates track, while botany and geology were equally popular. Two full-day field trips included an afternoon on Horse Island in the Thimble Islands of Long Island Sound, and a visit to an old pegmatite quarry near Middletown, Connecticut.

The other two weeks were devoted to anthropology and archaeology in our new *Bones & Stones* program. Each day of this camp included a field trip, such as a closer look at the Peabody's own anthropology collections and a journey to the Institute for American Indian Studies in Washington, Connecticut. The highlight for these kids was the chance to participate in a real archaeological dig at the Cove River Site in West Haven. One camper even found a very nice projectile point tip.

Also offered this summer was *Expeditions!*, a two-week, field-based summer academic program for 7th- to 9th-grade students developed by the Peabody's Education Special Projects Coordinator Jamie Alonzo. Among the 16 participants was a student from Taiwan, and 4.5 full scholarships were awarded for this program alone. These students conducted research at three different field sites (Yale-Myers Forest, the West Woods Natural Area and the Peabody Museum Natural Area) to compare and contrast the following:

- The percentage of forest canopy and groundcover, using densiometers they made themselves;
- The type of canopy and ground vegetation;
- The heights of dominant and co-dominant trees, using their own clinometers, tested on the dinosaurs in the Peabody's Great Hall;
- The insects in leaf litter, trapped with a Berlese funnel; and
- The pH and fertility of soil (by measuring its nitrogen, phosphorous and potassium content).

Fun field trips also included tours of habitat exploration at Hammonasset State Park, a visit to the laboratory at the National Marine Fisheries Service in Milford, a behind-the-scenes look at the Beardsley Zoo, intertidal investigations at Outer Island, and a kayak trip to Horse Island for the session finale.

The success of this year's Peabody summer programs paves the way for an even greater effort in 2006, when we hope to serve an even broader range of children.

LEFT TO RIGHT
Bones & Stones **camper Rebekah Meredith found this projectile point tip at the Cove River site in West Haven.**

Lily Engbith, a returning camper, seemed to have a knack for the artistry involved in preparing herbarium specimens. This is a *Viburnum* that she also correctly identified.

Students test their clinometers by measuring dinosaurs in the Great Hall.

Sampling the intertidal zone at Outer Island.

Peabody Division of Invertebrate Paleontology Acquires the Ciurca Eurypterid Collection

By Derek E. G. Briggs
Director, Yale Institute for Biospheric Studies, Professor of Geology & Geophysics, Curator-in-Charge, Division of Invertebrate Paleontology, and Susan Butts, Collections Manager, Division of Invertebrate Paleontology, Peabody Museum of Natural History

The Yale Peabody Museum of Natural History has acquired the largest collection of eurypterids ever assembled, collected over nearly 50 years.

Eurypterids are an extinct group of chelicerates, arthropods whose modern relatives include the horseshoe crabs, scorpions, spiders, mites and ticks. Most common in rocks of Silurian age (444 to 416 million years ago), they ranged from the Ordovician Period (approximately 480 Mya) to the end of the Permian (approximately 250 Mya), when they died out. They are aptly described by their common name, sea scorpions, because they look like swimming versions of these living land animals. Yet, apart from living almost exclusively in water, they differ from scorpions in several important respects, most striking being their tendency to evolve forms up to six feet long, the largest arthropods known! Eurypterids were the top predators in the environments where they lived. The pterygotids, for example, had formidable clawed head appendages for catching prey.

The Yale Peabody Museum of Natural History has acquired the largest collection of eurypterids ever assembled, collected over nearly 50 years by Samuel J. Ciurca Jr. of Rochester, New York, a former organic chemist. The Ciurca Collection of eurypterids comprises an estimated 10,000 specimens and includes large slabs from over 100 collecting localities in New York, Pennsylvania, Indiana, Ohio, and Ontario, over 35,000 pounds of rock in all. Sam Ciurca's meticulous documentation of the collection localities will enable a greater understanding of the geologic history of New York. The collection's many examples of associated fossils, including other arthropods, brachiopods, bivalves and plants, as well as sedimentary structures, will also provide important clues to the environment and lifestyle of eurypterids. The Ciurca Collection will allow many aspects of the paleobiology of eurypterids to be investigated, including changes in their biodiversity, ecology and habitat preferences through time.

For the next three years the primary researcher on the collection will be Erik Tetlie. Tetlie obtained his doctorate from the University of Bristol in the United Kingdom earlier this year, and is already a leading expert on the diversity and relationships of eurypterids. He will spend three years in Derek Briggs's laboratory at Yale, funded by the Norwegian Research Council. The Ciurca Collection has

already been found to contain many new genera and species, as well as beautifully preserved examples of several eurypterids previously known only from partial specimens. An exhibition of eurypterid specimens at the Yale Peabody Museum is planned for the future.

Eurypterid fossils from the collection of Samuel J. Ciurca, recently acquired by the Peabody Museum. Photographs by O. Erik Tetlie and Susan Butts. Two contrasting specimens of *Eurypterus remipes lacustris* (left and above) from the Buffalo, New York area. Note the large swimming paddles at the rear of the prosoma (the head shield). The eurypterid with much of the body missing represents a molted specimen (the body was carried away by water during burial in the sediment) with the telson (tail spine) displaced so that it lies closer to the head than in the complete specimen. Sam Ciurca calls this specimen "Nobody!" The specimen illustrated immediately above preserves the head and anterior body of *Pterygotus ventricosus* from the Silurian of Indiana.

CONFERENCES, SEMINARS, SYMPOSIA

YIBS/ESC FRIDAY LUNCHEON SEMINARS

The Yale Institute for Biopsheric Studies (YIBS) continues to present the YIBS/ESC Friday Luncheon Seminars. The fall 2005 seminars drew enthusiastic audiences of faculty, students and other interested guests. The talks are held each week during the fall and spring semesters in the Class of 1954 Environmental Science Center (ESC). Fall 2005 seminars featured the following list of speakers and topics:

Roland Geerken, Associate Research Scientist, Department of Geology & Geophysics, *Ecological Changes in South-West Asia: Causes and Trends*; Jordan Peccia, Assistant Professor, Environmental Engineering, *What Is Wrong with Applying Processed Sewage Sludge to Agricultural Land?*; Stephanie Anestis, Postdoctoral Associate and Lecturer, Department of Anthropology, *Dominance, Relationships, Personality, and Hormones in Young Chimpanzees*; Gary Aronsen, Research Associate, Department of Anthropology, *Tropical Forest Canopy Architecture and Primate Positional Behavior, Support;* Whitey Hagadorn, Visiting Professor, Department of Geology & Geophysics; Assistant Professor, Department of Geology, Amherst College, *Surfing Late Cambrian Beaches: A Neoproterozoic Flashback?*; Timothy Reluga, Postdoctoral Fellow, Department of Epidemiology & Public Health, *Modelling Ecological Invasions*; Dr. Dorceta Taylor, Edward P. Bass Distinguished Visiting Scholar; Associate Professor of Environmental Sociology, School of Natural Resources and Environment, and Associate Professor of Afroamerican and African Studies, College of Literature, Science, and the Arts, University of Michigan, *The Status of Diversity in Environmental Institutions in the 21st Century: Results from Three National Studies*; Gisella Caccone, Senior Research Scientist and Lecturer, Department of Ecology & Evolutionary Biology; Director, YIBS ECOSAVE Molecular Systematics and Conservation Genetics Lab, *DNA from Museum Samples: Their Use to Address Issues in Systematics, Biogeography, Conservation, and Vector Biology*; Nikolai Pedentchouk, Postdoctoral Fellow, Department of Geology & Geophysics, *Hydrogen Isotopes in Tree Leaves: Modern Environmental Controls and Applications in the Geological Record*; Helen Nguyen, Gaylord Donnelley Postdoctoral Environmental Fellow, Environmental Engineering, *Sorption of Nonionic Organic Chemicals to Organic Matter and Black Carbons*; Thomas Graedel, Clifton R. Musser Professor of Industrial Ecology, Yale School of Forestry & Environmental Studies, *How Humans Use and Lose Materials*; Michael Russello, Postdoctoral Associate, Department of Ecology & Evolutionary Biology, *Multi-Scaled Genetic Approaches in Ecology and Conservation.*

The seminars will continue in the spring 2006 semester. For information and the list of speakers, please visit the YIBS Web site at *www.yale.edu/yibs.*

ENVIRONMENTAL MANAGEMENT

Bringing the Human Enterprise into Harmony with Nature

By James Gustave Speth
Dean of the School of Forestry & Environmental Studies

Central to the mission of America's environmental schools is the development of professional environmental managers. The majority of our graduate students at Yale are enrolled in our master of environmental management program. But what exactly is environmental management?

When I am asked this question, I reply that environmental management is the new business of bringing our human enterprise into harmony with the natural world of which we are a part. And I add: It's the most important thing in the world.

I know this may sound exaggerated, but I think the truth of this statement will become clear in the years ahead. The enormous expansion of the human enterprise in recent decades has brought us to the threshold of a fundamentally new era in which environmental management must quickly emerge as the top priority of governments and peoples everywhere.

Consider first that environmental losses are already great. Half the world's tropical and temperate forests are gone. Half the wetlands and a third of the mangroves are gone. Ninety percent of the large predator fish are gone, and 75 percent of marine fisheries are now overfished or fished to capacity. Twenty percent of the corals are gone, and another 20 percent severely threatened. Species are disappearing at rates 100 to 1,000 times faster than normal. Most agricultural land in drier regions suffers from serious deterioration. Persistent toxic chemicals can now be found by the dozens in essentially each and every one of us.

Consider also that human activities are now large relative to natural systems. We severely depleted the Earth's stratospheric ozone layer without knowing it. We have pushed atmospheric carbon dioxide up by one-third, and started the dangerous process of warming the planet and disrupting climate. Everywhere Earth's ice fields are melting. We are fixing nitrogen at a rate equal to nature's; one result is the development of at least 150 dead zones in the oceans due to overfertilization. We already consume or destroy each year about 40 percent of nature's photosynthetic output, leaving too little for other species. Freshwater withdrawals doubled globally between 1960 and 2000, and are now approaching a quarter of all river flow. The following rivers no longer reach the oceans in the dry season: the Colorado, Yellow, Ganges and Nile, among others. We live in a full world, dramatically unlike the world of 1900, or even that of 1950.

Consider also that all we have to do to destroy the planet's climate and its biota is to keep doing exactly what we are doing today, even with no growth in the human population or the world economy. But human activities are growing—dramatically. It took all of history to build the $7 trillion world economy of 1950, and today we add that amount of economic activity every 5 to 10 years. The world economy is poised to double and then double again by mid-century. This economic growth cannot resemble the growth of the past; it requires new designs and new technologies. Everything must be different—construction, manufacturing, energy production, transportation, forestry and agriculture—all very different.

Finally, consider that political, technological and social changes take time. We are now in the most important race in human history—the race to change our politics, our technology and our personal consumption choices much faster than the world economy grows. Only unprecedented action taken with a profound sense of urgency can forestall an appalling deterioration of our natural assets. This is the challenge of environmental management.

To prepare for this race, we are building a new academic field, an interdiscipline called "environment." It is the rigorous scientific study of the interactions between human societies and the natural world of the biosphere. Knowledge generated in this new field becomes the basis for environmental management. We need a new generation of professionals trained in environmental management, and we also need the knowledge of environment to infuse the traditional professions—business, law, science and engineering, medicine and so on—and to motivate a revolution in personal choice as each of us carries out daily life as consumer, family member, investor, joiner, worshipper, worker and voter. Environmental management thus becomes a civic responsibility of the first order.

In 1970, we created a separate environmental sector; today, we must make every economic sector an environmental sector. Every government agency must be an environmental protection agency.

It is good that we are now in the midst of a necessary and timely paradigm shift in our thinking about environmental management. In 1970, when the modern era of environmental concern was born, the environmental style was confrontational; business was the enemy. Today, we must try to put collaboration ahead of confrontation. Business must be on board, not overboard. We must all be environmentalists now.

Peter Ortis

Gus Speth

In 1970, it was "put the polluters in a straightjacket." Today, it is let them out of the regulatory tangle if they can show they have a solution that is better. Then, our approach was command and control; today, it must also be goals and incentives.

In 1970, we were *against*; today, we must be *for*. Then, we defined problems; today, we must design solutions. Then, we responded; today we must anticipate.

In 1970, technology was the devil that got us into this mess. Today, we know that technology—soft and hard—must get us out of this mess. In 1970 it was end-of-pipe; today we must end the pipe.

In 1970, we saw an unguided market taking us over the cliff. Now, we know that the market can be guided for environmental as well as economic goals. But that guidance requires government action to get the prices right—environmentally honest prices. Antigovernment ideologues would rob us of the power of collective action for our common future.

In 1970, it was environmental protection; today, it is sustainable development—sustainable development in the poorer countries, for we will never sustain the biosphere unless the poorer countries are realizing their development and antipoverty objectives, and sustainable development for the rich, for success at the triple bottom line of environment-economy-society is a more worthy goal than achieving another 3 percent growth in GDP.

In 1970, it was national; today, it is "global." Pollution has gone global, species have gone global—and so must environmental management. Global governance must come to the environment. We need a World Environment Organization as strong as the World Trade Organization. Environmental diplomacy is not a sideshow; it's the main event. But, in the end, we know that all action is local. Our lives are local lives. The struggle begins locally.

In 1970, we took a top-down approach; now, we must encourage innovative bottom-up, grassroots approaches—green jazz that is unscripted, improvisational and creative.

In 1970, we were too elitist. Now we must stress justice and equity: equity among nations, equity within nations, equity between the sexes, all in addition to equity to future generations. We have created wonderful protected areas but sometimes neglected the poor, the minorities, the victims, the indigenous peoples. Let their environmental rights now be asserted.

In 1970, it was species; today it is ecosystems. We should have always known this: Human societies are utterly dependent on provisioning by nature's ecosystems. But we forgot it.

We must at long last take Aldo Leopold and his land ethic seriously. "A thing is right," he said, "when it tends to preserve the integrity, stability and beauty of the biotic community." Just as we have rights, the land community does also.

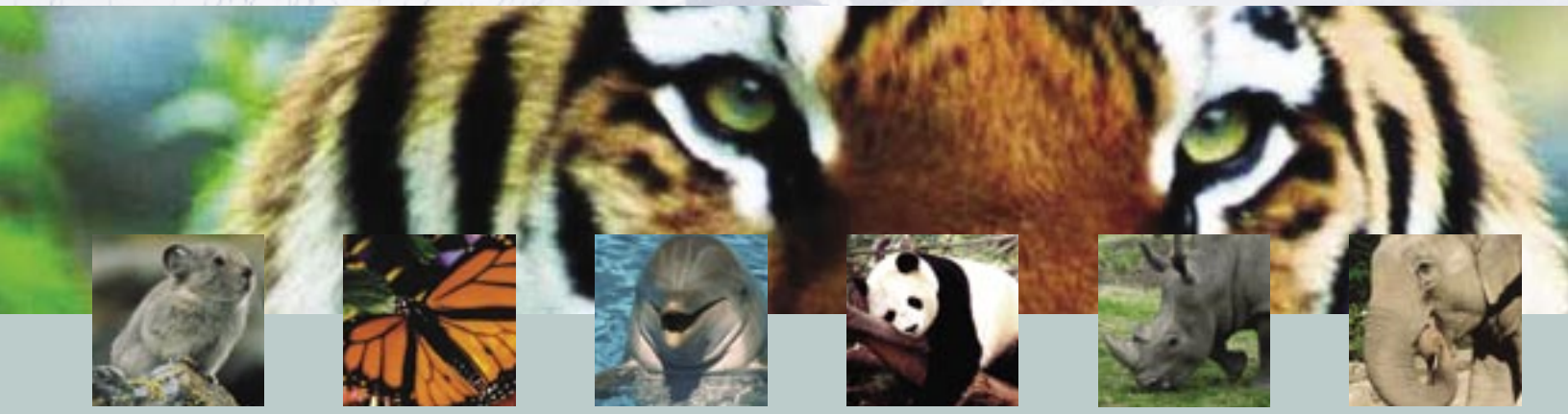
In 1970, we looked for government leadership. Today, we must often do it ourselves, with or without government. Business is often ahead of government; scientists are often ahead of government; consumers and environmentalists are often ahead of government. We should not wait for government. We must push it forward with us. Politicians ride the waves, as everyone knows. Citizens make waves.

In 1970, we were from Mars; today, we must be from Venus. Then, we broke things down to the component parts and laid out rational plans of attack. Now we know the most important resource is human motivation—hope, caring, our feelings about nature and our fellow humans. Today we need the preachers, the philosophers, the psychologists and the poets! In one poem, W. S. Merwin said: "On the last day of the world, I would want to plant a tree." And in another: "I want to tell you what the forests were like / I will have to speak a forgotten language."

"After the final no," Wallace Stevens wrote, "there comes a yes / And on that yes the future world depends." Despite the daunting projections of environmental decline, we affirm that we will win this struggle for the future. Yes.

And here we come full circle, for there is something vital from 1970 that we need to rekindle and rebuild, rather than move beyond, and that is the extraordinary spirit of that moment and the widespread popular demand for far-reaching change. One can hear that demand plainly in the words citizens of Santa Barbara sent to the U.S. Congress in 1970 shortly after the devastating oil spill there: "We, therefore, resolve to act. We propose a revolution in conduct toward the environment. ... Today is the first day of the rest of our life on this planet. We will begin anew."

It can seem that we are now a long way from the prosaic subject of environmental management, but we are actually at the heart of the matter.



The Endangered Species Act in Need of Reform

By Stephen Kellert
Tweedy/Ordway Professor of Social Ecology, Yale School of Forestry & Environmental Studies

Before any misunderstanding develops, I am in favor of reauthorizing the Endangered Species Act (ESA). Yet, I believe the ESA is in serious need of reform to correct a number of fundamental deficiencies that significantly impair its effectiveness. The ESA has arguably ceased to be a safety net preventing extinction. More species awaiting listing have gone extinct than have been recovered, and the pace of candidate species listing remains in the thousands despite mandates to eliminate this backlog. More important, recovery of listed species has been elusive, with efforts on behalf of most endangered species being more a matter of protection on paper than practical activities aimed at removing species from the brink of extinction. Meanwhile, the ESA has been mired in political confrontation, legal battle, extensive resource user and landowner opposition and associated ideological clashes over property rights and governmental control. The general public also remains woefully ignorant of the importance of endangered-species protection and, more fundamentally, the meaning and value of biological diversity. The ESA for most people connotes single-species conservation of charismatic megavertebrates like grizzly bears and blue whales rather than conservation of invertebrate species or maintenance of ecosystem functions and dynamics. This situation has been exacerbated by the bulk of ESA funding being expended on a relatively small number of high-profile species.

These problems will not be resolved by simply reauthorizing the ESA, allocating it more funding or bestowing on the administering agencies greater power. Indeed, if these options occurred, I predict they would result in far greater costs, increased ineffectiveness and greater conflict rather than improvement in endangered-species protection. The basic problem in my estimation is that the ESA remains fundamentally flawed and, thus, in need of radical reform.

A major problem of the ESA is its reliance on top-down federal control, bureaucratic administration and Washington-centered politics. I believe significant improvements depend on a more "bottom-up" approach emphasizing decentralized control and more regional, local and community-oriented action, such as has been the case with the relatively successful habitat conservation planning approach, which allows private landowners to manage their land while providing for the conservation of at-risk species of plants and animals. Also, because the ultimate basis for endangered-species recovery and biodiversity conservation is the will of the people, there is a critical need for a far greater focus on individual and group motivation, values, behavior and sustainable-development options.

Serious and long-term educational and sustainable-design strategies will be as important to endangered-species recovery as more scientific study, new species management technologies or enhanced regulatory control. This change would shift the federal role more to one of setting priorities, generating performance standards, providing meaningful oversight and offering material support and financial incentives.

Through a competitive-award system, state, regional and local governmental *and* nongovernmental organizations would be responsible for implementing most management, recovery and educational programs. These competitive awards would need to be periodically evaluated and renewed based on clearly delineated performance standards emphasizing progress toward species recovery goals and enhanced public awareness of the benefits of endangered-species and biodiversity conservation.

Could this approach of devolving authority and enhancing educational and sustainable-development strategies mitigate the prevailing climate of political confrontation and administrative ineptitude? Might it produce major improvements in endangered-species recovery and greater public understanding of how biodiversity contributes to human well-being? Politics is a scrap heap of such predictions. Yet, the current situation is clearly untenable, acrimonious and wasteful. It is time to try something different. The suggested approach may have a chance of reversing the current tide of environmental destruction and political polarization.

Yale Study Examines Criteria Used to Set Global Conservation Agenda

A study that examines the scientific criteria used by conservation organizations to set global forest conservation priorities has been published by researchers at the Yale Global Institute of Sustainable Forestry at the School of Forestry & Environmental Studies (F&ES).

The report, "Protecting Biodiversity: A Guide to Criteria Used by Global Conservation Organizations," examines the global conservation planning approaches utilized by five conservation organizations, including Conservation International, the World Wildlife Fund and The Nature Conservancy. Its aim is to enable industry, policy makers, environmental nongovernmental organizations, scientists and others to work together with greater understanding, and to guide decisions about which areas to prioritize for conservation.

"This report is going to serve as an excellent resource for land managers as they develop local strategies to conserve biodiversity on their land," said F&ES Dean Gus Speth. "The fact that we were asked to conduct the study suggests that industry is interested in working collaboratively with the conservation community. It is encouraging from the standpoint of sustainability."

The F&ES researchers found that while the various approaches are distinct, they share many scientific underpinnings, techniques and recommendations, such as the need to focus on vulnerable and unique areas. Furthermore, a significant level of collaboration exists among the organizations, resulting in many of the same global regions being identified as high priority: the Tropical Andes, the Atlantic forest region of eastern Brazil, Mesoamerican forests, the Philippines, Madagascar and most of Indonesia.

In response to high worldwide deforestation rates and dramatic species decline, conservationists have been joined by a broad array of stakeholders in stressing the importance of protecting habitats, including forests, to maintain biological diversity, preserve ecological functions and ensure sustainable forest management. "The forest products industry, in particular, has taken a growing interest in integrating ecological factors into management decisions and placing increasing emphasis on scientifically based and ecologically sensitive forest management," according to the report's authors, Mary Tyrrell, Executive Director of the Global Institute of Sustainable Forestry, Elizabeth Gordon, Program Director for the Yale Program on Forest Certification, and Oscar Franco, a candidate for a master's degree in environmental management.

The study was commissioned by the American Forest & Paper Association, the National Council for Air and Stream Improvement and the Forest Products Association of Canada. The full report is part of the F&ES Publication Series, which is edited by Assistant Dean Jane Coppock, and is available at *www.yale.edu/forestry/publications*, as well as *www.yale.edu/gisf*.

Yale Survey Showed Public Desire for New Energy Policy

A research survey conducted last May showed that while Americans are deeply divided on many issues, they overwhelmingly believe that the United States is too dependent on imported oil. The survey of 1,000 adults nationwide found that a vast majority of the public also wants to see government action to develop new "clean" energy sources, including solar and wind power as well as hydrogen cars.

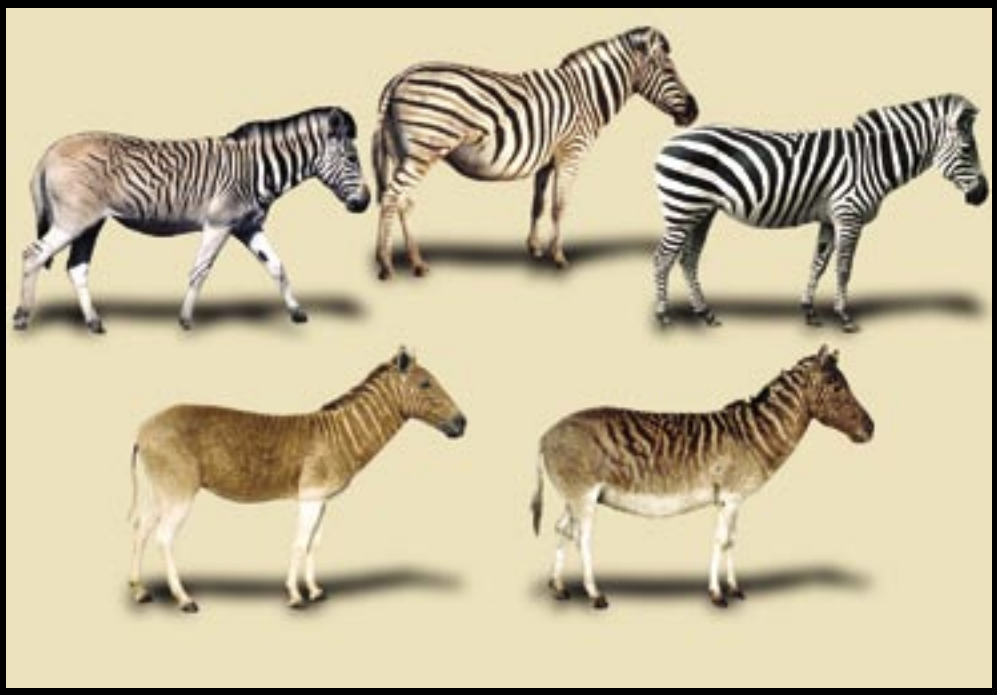
The results underscored Americans' deep concerns about the country's current energy policies, particularly the nation's dependence on imported oil. Fully 92 percent of respondents said this dependence is a serious problem, while 68 percent said it is a "very serious" problem.

Across all regions of the country and every demographic group, there was broad support for a new emphasis on finding alternative energy sources. Building more solar power facilities was considered a "good idea" by 90 percent of respondents; 87 percent supported expanded wind farms; and 86 percent wanted increased funding for renewable energy research.

Ninety-three percent of respondents said that requiring the auto industry to make cars that get better gas mileage was a good idea. Just 6 percent said it was a bad idea. This sentiment varied little by political leaning, with 96 percent of Democrats and Independents and 85 percent of Republicans supporting the call for more fuel-efficient vehicles. These findings came on the heels of Congress's rejection of a proposal to require sport utility vehicles and minivans to become more fuel-efficient and achieve the same gasoline mileage as passenger cars.

The survey also revealed broad support for action to improve air and water quality, but growing discomfort with "environmentalists."

This survey, conducted by Global Strategy Group, was one element of a broader research project at the Yale School of Forestry & Environmental Studies (F&ES) focused on environmental attitudes and behavior. Funding for this project, directed by Dan Abbasi, Associate Dean for Public Affairs and Strategic Initiatives, is being provided by the Betsy and Jesse Fink Foundation and Hartford-based United Technologies Corporation, which has been ranked as *Fortune* magazine's "Most Admired" aerospace company based on criteria including social responsibility. The survey questions and full results can be found on the Web site of the Yale Center for Environmental Law and Policy: *www.yale.edu/envirocenter.*



The quagga,* Equus quagga*, a South African relative of horses and zebras, having a front half with zebra-like stripes and a back section like a horse with no marking, became extinct about 100 years ago.

How the Zebra Lost Its Stripes: Rapid Evolution of the Quagga

DNA from museum samples of extinct animals is providing unexpected information on the extent and effect of the Ice Age as well as the path of species evolution, according to a report by scientists from Yale University, the Smithsonian Institute and the Max Planck Institute for Evolutionary Anthropology.

The quagga, *Equus quagga*, a South African relative of horses and zebras, having a front half with zebra-like stripes and a back section like a horse with no marking, became extinct about 100 years ago. The pelt from a museum specimen was the subject of tissue sampling that launched the field of ancient DNA analysis.

"Twenty years ago this exact species opened the field of ancient DNA studies on extinct animals," said one of the authors, Gisella Caccone, senior research scientist in the Department of Ecology & Evolutionary Biology and Director of the Yale Institute for Biospheric Studies (YIBS) Molecular Systematics and Conservation Genetic Lab at Yale. "Now, thanks to technological advances in the field, we revisited the story and used a population level approach to this question by analyzing a larger fragment of DNA and multiple specimens."

In the past, the quagga has alternatively been described as a species and a subspecies of the Plains zebra. These researchers asked how and when the quagga diverged from all the remaining related horses, zebras, and asses. They compared the genetics, coat color and habitats of existing zebras with related extinct species.

The mitochondrial DNA markers from 13 museum specimens, including the only skeleton in museum collections, which is at Yale's Peabody Museum of Natural History, showed that quagga likely diverged from Plains zebra about 120,000 to 290,000 years ago during the Ice Age. These results suggest that the quagga descended from a population of Plains zebras that became isolated and the distinct quagga body type and coloring evolved rapidly.

This study reveals that the Ice Age was important not just in Europe and North America, but also in Africa.

"The rapid evolution of coat color in the quagga could be explained by disrupted gene flow because of geographical isolation, an adaptive response to a drier habitat, or a combination of both of the two forces," said Caccone.

The research team also included Scott Glaberman at Yale, Jennifer A. Leonard and Robert C. Fleischer from the Smithsonian Institution, Michael Hofreiter and Nadin Rohland from the Max Planck Institute for Evolutionary Anthropology.

Moore Foundation Grant to Develop Environmental Leadership in Amazon

The Gordon and Betty Moore Foundation has awarded the Yale Environment Management Center a $1.5 million grant to support the joint master's degree program between the Yale School of Management and the Yale School of Forestry & Environmental Studies.

The joint master's degree is a three-year program through which students earn both an M.B.A. and a master of environmental management degree. The program prepares students to be adept at working in the increasingly interconnected realms of business and environment by combining training in environmental science with traditional leadership and management skills. Established in 1982, it is the oldest program of its kind in the country.

The Gordon and Betty Moore Foundation funds organizations whose work supports global environmental conservation, science and the San Francisco Bay area. The grant received by the Yale Environment Management Center is part of the foundation's Andes-Amazon Initiative within its environment program. The initiative finances and coordinates activities that contribute to biodiversity conservation in the Andes-Amazon region.

The grant will fund tuition, fees, stipends and summer fellowships for six joint-degree students. Students who receive these scholarships will commit to working in the biodiversity conservation field in South America for at least three years following graduation. The grant will also support visiting scholars or practitioners from the Andes-Amazon region who are engaged in environment or biodiversity conservation issues. Their work at Yale will help them develop short courses and joint-degree programs in environmental management when they return home.

"The students and faculty who benefit from this grant will leave Yale with the skills to make a difference in a region that contains some of the most critical ecosystems in the world," said Garry Brewer, Director of the Yale Environment Management Center and the Frederick K. Weyerhaeuser Professor of Resource Policy and Management. "Whether they conduct scientific research in protected habitats, manage an area nongovernmental organization or create a local education program, their efforts will have a global impact."

The grant will be administered over five years beginning in the 2006–07 academic year. For more information on the joint master's degree program, visit *emc.som.yale.edu/description.html*. For information about the Gordon and Betty Moore Foundation and its Andes-Amazon Initiative, visit *www.moore.org*.

DR. STEPHANIE ANESTIS JOINS ANTHROPOLOGY AS A SCHWARTZ FOUNDATION POSTDOCTORAL RESEARCH ASSOCIATE AND CHaPRE RESEARCH ASSOCIATE

Dr. Stephanie Anestis is a newly minted Ph.D. in anthropology from Yale University, having earned her degree in the spring of 2005. As of July 1, 2005, she is a Schwartz Family Foundation Postdoctoral Research Associate and YIBS Center for Human & Primate Reproductive Ecology (CHaPRE) Research Associate.

Dr. Anestis is the author of several peer-reviewed scientific articles and is serving as lecturer in the Department of Anthropology for the academic year 2005–06, teaching introductory undergraduate courses in biological anthropology and the evolutionary physiology of human life histories. Her research has focused on hormonal correlates of stress, development and behavioral style among captive chimpanzees *(Pan troglodytes)*. Dr. Anestis discusses her future research at CHaPRE.

Many reproductive ecology laboratories focus only on humans or nonhuman primates. There is great value in creating an academic community where researchers of both fields can share ideas, especially when expanding our understanding of comparative life histories is the ultimate goal. I am thrilled to be a part of CHaPRE, where I will be continuing my research on chimpanzee social behavior and its endocrine correlates. For my dissertation research I collected behavioral data and several thousand urine samples from young chimpanzees at the New Iberia Research Center in Louisiana to test hypotheses about the relationship between dominance rank, behavioral style and the hormones cortisol and testosterone. The hormone analyses were conducted at Yale's Reproductive Ecology Laboratory. This large dataset, spanning four years during the chimpanzees' transition to adolescence, allows me to explore a variety of as yet unanswered questions, especially those pertaining to the physiological development of captive chimpanzees. During my tenure at CHaPRE, I hope to answer questions such as: how is the development of mating behavior related to changes in testosterone level in both males and females? Are behavioral indicators of anxiety (such as self-scratching) correlated with physiological measures

continued on page 24

continued from page 23

of stress, specifically baseline urinary cortisol, and does this relationship change as individuals mature? Is cortisol purely an indicator of negative stress events, or is it elevated in response to unusual (and from the chimpanzees' perspective, exciting) positive events as well? The answers to these questions are particularly relevant to captive animal care, as they may give insight into the management and enrichment of chimpanzees in captivity. However, they can also be a valuable starting point for investigations of wild chimpanzee behavior/hormone relationships. For example, although chimpanzees in captivity mature earlier than their wild counterparts, the relationship between testosterone and mating behavior in adolescents may be similar. Wild and captive chimpanzees may display behavioral indicators of anxiety with different frequencies, but knowing whether self-scratching is an indicator of physiological arousal as reflected by urinary cortisol would be useful for researchers in both settings. Ultimately, I hope to add to the longitudinal database on the New Iberia chimpanzees by setting up long-term data collection protocols there, while also collaborating with researchers at Ngogo to test similar hypotheses in wild chimpanzees.

To read more on Dr. Anestis's research, see:

Anestis, SF (in press). Behavioral style, dominance rank, and stress in young chimpanzees *(Pan troglodytes). Behaviour.*

Anestis, SF, and Bribiescas RG (2004). Rapid changes in chimpanzee *(Pan troglodytes)* urinary cortisol excretion. *Hormones and Behavior* 45(3):209-13.

Anestis, SF (2004). Genito-genital rubbing in a group of captive chimpanzees. *International Journal of Primatology* 25(2):477-88.

Firos, S (2001). Absence of intragroup coalitionary behavior in adult male red colobus *(Colobus badius tephrosceles)* in the Kibale National Park, Uganda. *Folia Primatologica* 72(1):54-6.

A 105-year-old plantation in Grand Rapids, Minnesota established by Prof. H. H. Chapman before he came to Yale, is an extraordinary example of long-term follow-through in forest research. Photos are courtesy of Brian Palik, USFS, NCRS.

Long-term Forest Research Underappreciated and Underfunded

By Lloyd Irland and Ann Camp

Our current understanding of the ways that managed and unmanaged forests develop comes from detailed forest and ecological measurements in dedicated research plots over periods of many decades. If foresters, biologists and land managers are to understand how to manage forests sustainably, there is no substitute for long-term studies that can verify predictions underlying management choices.

In long-term studies, selected plots or stands of trees are thoroughly measured, tallying species, diameter and condition of trees and shrubs, often including ground cover and young seedlings. The data are carefully recorded and the individual plants and trees may be mapped. Plot centers and individual trees are marked so technicians revisiting the sites in five to ten years can quickly relocate them for re-measurement. Over time, scientists use results of such repeated measurements to understand the effects of drought, insect outbreaks, air pollution and cutting practices on forest growth, regeneration and health. These studies can help us learn whether forest growth and ecological health are being affected by acid rain, nitrogen overloading and even overgrazing by deer. Such questions cannot be resolved by single studies lasting just a year or two.

Several major long-term forest research programs are having anniversaries during this decade. Hubbard Brook Experimental Forest in New Hampshire celebrates its 50th anniversary this year. The project, originally designed to measure the hydrologic and biogeochemical effects of harvesting in northern hardwoods, has become even more famous for its insights into acid rain, nutrient cycling and other long-term ecological processes. The Yale School of Forestry & Environmental Studies played a prominent role in this work, led by Herb Bormann, Oastler Professor Emeritus of Forest Ecology, teaming with U.S. Forest Service

workers and Gene Likens, then of Cornell. The Harvard Forest in Petersham, Massachusetts, turns 100 in 2007.

But changing scientific interests and budget cuts by federal agencies and state universities have made it difficult to sustain some of these programs. For example, the U.S. Forest Service's Experimental Forests and Ranges began shortly after 1900 as the agency created its research branch. Its purpose at the time was to learn the best methods of growing timber and regenerating forests and to understand "forest influences"—how forests affect water flow and growth conditions for nearby farm fields. Other experiments were undertaken over the years to study long-term changes in wildlife habitat. Over the years, the Forest Service has been the nation's leading forest science agency.

With changing future climates and the potential for altered weather and storm intensities, it is vital that long-term studies such as these be continued. They form a baseline against which to compare effects of forest cutting practices and of practices to reduce or offset the effects of air pollution and other stresses.

But the number of these sites managed by the Forest Service shrank from 110 in 1990 to only 77 today. And not all of those remain active. Concerned with the uncertainty of maintaining and continuing these long-term studies, we teamed up with Forest Service scientist John Brissette to convene a one-day program at a recent regional forestry conference. The session was well attended and well received; many of those in attendance encouraged us to seek papers from researchers across North America that highlighted some important findings that resulted from long-term re-measurements. This fall, Yale's Global Institute of Sustainable Forestry will publish a research paper containing essays describing the importance of selected long-term forest studies.

Some of the lessons learned include:

Long-term measurements can detect effects of management treatments that only occur with a lag. As an example, an experiment in Pennsylvania attempted to see if offsetting soil acidity by using lime would improve tree growth. In the first few years, nothing happened. A short-term study would conclude that liming had no effect. But the measurements were continued, and in just a few more years, the trees began to respond.

Studies originally established with narrowly focused objectives have enabled scientists to shed light on new problems. For instance, scientists in Wisconsin used long-term plots to test different harvesting methods for timber production. These plots were measured for this purpose for over 50 years. There has been concern about how forest-cutting affects vulnerable understory plants. So, scientists studied these stands to assess understory plant responses to these treatments. They found little difference in plant composition between the treatments, indicating that harvesting by these methods does not significantly change plant composition in the understory.

Long-term studies by federal research agencies are only the tip of the iceberg. In Connecticut, for example, the Agriculture Experiment Station, located in New Haven, has undertaken periodic re-measurements in unmanaged forest stands since the 1920s, yielding important ecological insights. By periodically re-measuring the same stands, they showed how the stands were affected in composition and growth by infestations of the gypsy moth and, in one instance, how the stand was affected by a wildfire.

"The scientific asset represented by these projects is incredibly valuable," noted Chad Oliver, Pinchot Professor of Forestry and Environmental Studies. "Yet, in too many instances, decisions about their future are being made on the basis of momentary budget or personnel issues. The U.S. Forest Service has upgraded its management focus on its 77 experimental forests and rangelands. But nobody is keeping track, in a systematic way, of the needs of hundreds of little-known long-term studies by states, companies and nonprofit organizations. We need better ways to fund these long-term re-measurements that are not funded by the typical two- to three-year project-funding approaches."

David M. Smith, Morris K. Jesup Professor Emeritus of Silviculture, noted: "The time scale of the necessary repeated observations is longer than the active career of one observer. This means that such investigations generally require the commitment of continuing entities such as research agencies, corporations or professional groups with an interest in learning about responses to silvicultural treatments or natural disturbances. One critical ingredient is retention of old plot records that sometimes fall victim to overzealous housecleaning!"

The current generation of forest scientists and research administrators must develop new sources of support and show the wider science community why these long-term studies are important. If we fail to do so, more and more of these studies will fall by the wayside, and our ability to respond to new questions and concerns in the future will be compromised.

We would very much appreciate hearing from YEN readers who know of re-measured forestry or ecological plot experiments around the world that have been in place for 50 years or more.

Lloyd Irland (lloyd.irland@yale.edu) is a lecturer and senior scientist, and Ann Camp (ann.camp@yale.edu) is a lecturer and associate research scientist at the Yale School of Forestry & Environmental Studies.

STUDENT NEWS

Environmental Internships Encourage Students to Explore Broad Perspectives

For over a decade, Environmental Studies has supported summer internships for students in Yale College who are interested in working on environmental questions in either developed or developing countries. This year, 39 students applied and 27 received awards totaling $73,055. The program is open to students seeking practical environmental experience. This year's interns include majors in English, History, Literature, Anthropology, Biology, Geology & Geophysics, Biomedical Engineering, and Environmental Engineering.

Interns worked on research projects with academic institutions, NGOs, national governments, the U.N. or the E.U. Five students undertook projects in Connecticut with Yale

LEFT Laura Schewel leading a discussion about ways to defeat germs with the women of the Miwaleni Hamlet Mosque congregation in Uchira Village, Tanzania.

TOP A public water tap in Uchira Village, Tanzania. While the pipeline connected to this tap has improved life in the village, problems such as allowing animals to contaminate the tap areas have hindered health improvements.

profile

Laura Schewel '06, Literature/Environmental Engineering
Water Quality and Public Health in the Pangani Basin, Tanzania

Laura Schewel interviews a villager about health practices and beliefs. This man crippled by polio as a child supports his family by fixing odds and ends brought to his house by friends.

Two school girls carrying 20L buckets of water to the Uchira school in Uchira Village, Tanzania.

faculty and staff, seven others worked in the United States, including Alaska and Vieques, and fifteen in Europe, Central and South America, Asia and Africa. The following examples illustrate the variety of places and projects that our interns pursued: in Washington, D.C. with Save America's Forests; in Italy at the University of Florence on the use of environmental indicators by the European Union to monitor agricultural sustainability; in Paris and Athens on a comparison of transportation and urban sprawl; in South Africa on a small reserve using biotelemetry to monitor large predators; in Tanzania on the effect of a water pipeline on the public health of a rural village; in coastal Ecuador with a grassroots conservation organization restoring mangrove forests, composting hotel and restaurant wastes for agriculture and furthering environmental education among the citizens of all ages; in the Philippines with the International Rice Research Institute on improving efficiency of water use in cultivating rice; in India with the Energy and Resources Institute on providing renewable energy in rural areas.

A committee of faculty chaired by Professor Mary Helen Goldsmith administers the environmental internships. During the spring semester, students consult their Yale faculty advisers in planning their internships. The committee ensures that wherever students work they will have mentors on site so that their projects will be productive. Juniors initiating a project that they intend to pursue for their senior research and essay receive highest priority. First- and second-year students are encouraged to further their understanding of different ecosystems, habitat conservation, natural history, agriculture and public health. The internship program is generously supported by the Gaylord and Dorothy Donnelley Foundation, the William Bingham Foundation, the Montgomery Family Fund and by the Department of Ecology & Evolutionary Biology.

Informative short reports by this and previous years' interns as well as information on opportunities for internships are posted on the Environmental Studies website: *www.yale.edu/evst.*

profile

Molly Montes '06, Biomedical Engineering
Large Carnivore Research and Telemetry Work at Karonwe Ecological Research Institute, Edeni Reserve, South Africa

Molly and Kitima, a young cheetah, rescued and hand-raised as a cub at Edeni Reserve, South Africa.

profile

Ariane Lotti '06, Environmental Studies
Indicators of Agricultural Sustainability in Tuscany, Italy

Olive grove on "I Renai," a conventional farm in the Val d'Elsa region outside of Florence, Italy.

ENVIRONMENTAL INTERNS SUMMER 2005

Brandon Berkeley '06, Environmental Studies
A Tale of Two Cities: Comparative Study of Landscape in Paris and Athens

Caitlin Clarke '07, Environmental Studies
Saving Forests in Ecuador and the United States; Save America's Forests in Washington, D.C.

Christopher Dalton '06, Biology (Ecology & Evolutionary Biology)
Role of Alewives in the Diet of Cormorants Breeding in Coastal Connecticut

Rachel Doud '07, Biology (Ecology & Evolutionary Biology)
Investigating the Ecological Impacts of Restoration of Anadromous Alewifes in Connecticut

Sara Enders '06, Geology & Geophysics
Community-Based Irrigation System Management and Technology Transfer for Water Savings in Rice Production in the Philippines

Miles Farmer '07, Biology (Ecology & Evolutionary Biology)
Identifying the Origin of Captive Galapagos Tortoises: Implications for Conservation Management

Shani Harmon '06, Environmental Studies/ Anthropology
American Indian and Colonial Human Ecology in Tidewater Virginia

Caroline Howe '07, Environmental Engineering
Alternative Strategies for Sustaining Tropical Ecosystems; School for Field Studies in Costa Rica and at the Cloud Forest School

Charles Iaconangelo '07, History
Environment, Economics, and Ecuador; Cerro Seco a Grassroots Conservation Organization

Dawn Lippert '06, Environmental Studies
Study of Ecology of Leatherback Turtles and Monitoring Predation of Their Nests by Mongeese; the Sea Turtle Conservation Group on Vieques

Charlie Liu '06, Biology (Ecology & Evolutionary Biology)
Mouthpart Variation Amongst Generalist Grasshopper (M. femurrubrum) *Populations in Yale-Myers Forest*

Ariane Lotti '06, Environmental Studies
Indicators of Agricultural Sustainability in Tuscany, Italy

Jasmine Low '06, Environmental Studies
Developing Survey Techniques: Research on Understanding Peoples' Attitude and Behavior toward the Environment; Urban Resources Initiative and PACE at Yale

John Mittermeier '08, Biology (Ecology & Evolutionary Biology)
Unearthing Samoa's Mysterious Moorhen: Survey of Birds in the Upland Forests of Savai'I, Samoa

Molly Montes '06, Biomedical Engineering
Large Carnivore Research and Telemetry Work at Karonwe Ecological Research Institute, Edeni Reserve, South Africa

Charles Munford '06, English
Investigation of Agroecology at Centro de Investigacion Agropecuaria, Universidad Central de Las Villas in Cienfuegos, Cuba

Michelle Quibell '06, Environmental Studies
Tropical Biology, Field Course in Costa Rica, Organization for Tropical Studies



profile

Dawn Lippert '06, Environmental Studies
Study of Ecology of Leatherback Turtles and Monitoring Predation of Their Nests by Mongeese; the Sea Turtle Conservation Group on Vieques

LEFT TO RIGHT Four leatherback hatchlings streaking to the ocean. Relocating the eggs from a leatherback turtle's nest out of harm's way on the beach in Vieques. Five leatherback hatchlings emerging from nest on the beach in Vieques.

Victor Ramos '07, Biology (Ecology & Evolutionary Biology)
Tropical Biology, Field Course in Costa Rica; Organization for Tropical Studies

Randall Rubinstein '06, Environmental Engineering
Changing Climate, Changing Tactics: Understanding the Media as an Essential Tool for Environmental Campaign Success; Environmental Media Services in Washington, D.C.

Laura Schewel '06, Literature/Environmental Engineering
Water Quality and Public Health in the Pangani Basin, Tanzania

Sarah Jane Selig '06, Environmental Studies
Environmental Effects of Tobacco Growth, Manufacture, and Disposal; Institute for Global Health in San Francisco

Mirko Serkovic '07, Environmental Studies
Marketing Renewable Energy Use in India; Energy and Resources Institute (TERI), New Delhi

Karen Stamieszkin '06, Environmental Studies
Oyster Aquaculture on the Damariscotta River, Maine: An Investigation of Carrying Capacity

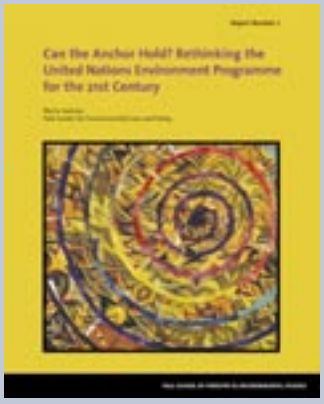
Leanna Sudhof '06, Environmental Studies
A Comparative Evaluation of Strategies: Study of Environmental Management of Malaria, World Health Organization in Geneva

Teresa Tapia '06, Environmental Engineering
Renewable Energies within an Emissions Trading Scheme; Energy Environmental Forecast and Analysis in Muenster, Germany

Vicente Undurraga Perl '06, Biology (Molecular, Cellular & Developmental Biology)
Multi-Drug Resistant Tuberculosis in Southern Mexico; Instituto Nacional de Salud Publica in Cuernavaca, Mexico

Scott Zhu '06, undeclared
Field Study; Wrangell Mountains Program in Alaska

PUBLICATIONS



THREE NEW REPORTS ISSUED BY F&ES PUBLICATION SERIES

Breaking Ground: Planning and Building in Priority Growth Districts
A Guide for Local Leaders

Jeremy Stone, Joshua Rinesmith, Sue Holt, John R. Nolon and Jessica A. Bacher, Editors
Land Use Law Center, Pace University School of Law

The need to control sprawl, encourage Smart Growth and create more livable neighborhoods that instill a sense of community through traditional neighborhood design are topics in the forefront of discussions about community planning and development. An innovative land use technique—Priority Growth Districts—can be used by communities to manage and define future growth in a way that creates more livable places that are environmentally, socially and fiscally sound. This report provides the necessary tools and describes the steps that a community may take to designate Priority Growth Districts and reap their many benefits. Yale F&ES Report Number 5.

Protecting Biodiversity: A Guide to Criteria Used by Global Conservation Organizations

Elizabeth A. Gordon, Oscar E. Franco and Mary Tyrrell, Yale Global Institute for Sustainable Forestry

This report examines the global conservation planning approaches utilized by eight conservation organizations, including Conservation International, the World Wildlife Fund and The Nature Conservancy. Its aim is to enable industry, policy makers, environmental non-governmental organizations, scientists and others to work together with greater understanding, and to guide decisions about which areas to prioritize for conservation. The study was commissioned by the American Forest & Paper Association, the National Council for Air and Stream Improvement and the Forest Products Association of Canada. Yale F&ES Report Number 6.

Can the Anchor Hold? Rethinking the United Nations Environment Programme for the 21st Century

Maria Ivanova
Yale Center for Environmental Law and Policy

The performance of the United Nations Environment Programme (UNEP) as the mandated anchor institution for the global environment is assessed in this report. Focusing on strengthening the global environmental governance system, it takes a look at UNEP's performance with regard to key functions that are necessary for an effective international environmental organization and offers policy recommendations for governments, UNEP, and the U.N. Secretary-General on steps for reform for the 21st century. Yale F&ES Report Number 7.

To see a complete listing of reports, working papers, reports, books and bulletins issued by the Yale School of Forestry & Environmental Studies Publication Series since 1995, go to our Web store at *www.yale.edu/environment/publications*. All publications are available there for order as bound copies or as free downloadable chapter PDFs. For further information or inquiries, contact Jane Coppock, Editor of the Series, at jane.coppock@yale.edu.

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Yale School of Forestry & Environmental Studies Publication Series

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We welcome submissions from faculty, staff and students.

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