YALE ENVIRONMENTAL NEWS

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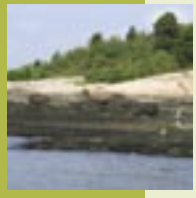
Karl Turekian, An Institution Within an Institute!

by Rose Rita Riccitelli
Administrator of the Yale Institute for Biospheric Studies

After serving for five years as the director of the Yale Institute for Biospheric Studies (YIBS), Karl Turekian steps down as of December 31, 2003. During his five year tenure, he has meticulously held true to the foundation and purpose of the Institute—to facilitate an intellectual and physical community of scholars addressing fundamental questions to inform the ability to generate solutions to the biosphere's most critical environmental problems. He has accomplished this by continuing to promote, foster and support environmental research and education at Yale, carrying the YIBS' mission forward into the 21st Century. So it is indeed fitting to dedicate this issue of the Yale Environmental News to Sterling Professor of Geology & Geophysics and YIBS Director Karl K. Turekian.

INSIDE THIS ISSUE



Karl Turekian assumed the role of YIBS Director in January of 1999, following his predecessor Elisabeth Vrba, and Leo W. Buss who served as the first director. During his term, he expanded the YIBS outreach beyond the Department of Ecology & Evolutionary Biology, the School of Forestry & Environmental Studies, the Department of Geology & Geophysics, and the Peabody Museum of Natural History, to include other areas such as the Department of Economics, the Faculty of Engineering—specifically Environmental Engineering, and the Department of Astronomy's Center for Solar & Space Research. He carefully considers each request for YIBS resources, and wisely and instinctively approves funding to support a new or existing initiative, or points the solicitor in the direction of more appropriate resources.

During the last five years I have realized the privilege it's been for me to work for this most unique individual—I've learned from his wisdom and guidance, and feel most fortunate to call him a friend, as he is a master teacher both within and outside the confines of the institution of Yale.

Even though his immutable presence as the leader of YIBS will be missed, he is sure to continue as an active member of the YIBS community, to offer his counsel, guidance and expertise to its new Director, Geology & Geophysics Professor Derek Briggs who assumes the position on January 1, 2004.

President Levin, and others working with Karl in his varied roles at the University, and most recently as YIBS Director, offered the following observations:

President Richard Levin

Five years ago Karl agreed to step in to the directorship of YIBS on what he believed to be an "interim" basis. Little did he know that a much longer commitment lay in store! Five hardworking years later he is departing, leaving the position marked by his scholarly commitment, fierce persistence, high energy, and—I can't help but add—his engaging gruff charm.

Everyone knows that Karl is a renowned scholar—to quote the citation when he was awarded the Maurice Ewing medal—one of the world's most productive, widely-known and best loved geochemists.

But it might be harder to guess that behind his scholarly excellence, his office overflowing with books and articles, and his witty comic asides, lies such a highly disciplined, organized, and savvy administrator. The world of YIBS, marked by its handsome new quarters, has been infused during Karl's tenure by his organizational powers and never-say-die commitment. He has brought to his directorship the sterling qualities one can define—and something even beyond those, an indefinable spirit that has allowed him to capture the imagination and marshal the capacities of those around him and to focus them productively. As he leaves his post as director, all of his admirers, including this one, salute him with pride, gratitude and affection.

Alison Richard
Former Provost of Yale University and Chancellor of Cambridge
A few decades ago, Karl led the way in "re-inventing" geology at Yale. It is not surprising, then, that under his leadership the "invention" of YIBS has proceeded apace. Karl is at once a distinguished scientist of great breadth and depth, a passionate citizen of the University, and (at moments) one of the most splendid bulldozers I've ever been privileged to know. All these qualities have served YIBS admirably. I'm not certain what "larger-than-life" really means, but if there were ever a person who fit the expression it's surely Karl. And YIBS, Yale and all of us are the beneficiaries.

Leo Buss
Professor of Ecology & Evolutionary Biology and the first Director of YIBS
I am pleased to salute Karl on his retirement as YIBS director, as he exemplifies the finest qualities one hopes to see in a scholar, educator and administrator. Karl's scholarly achievements are legion, recognized by prestigious awards from the Geological Society, the Geochemical Society, the National Academies, to his Sterling Professorship at Yale. His view of the earth as just a complex chemical mix left in a particular planetary setting for a particular length of time has not merely led to a lifetime of discovery, but rather more to an adoption of this view as effectively synonymous with the word geology. It is this same passion that makes him an educator of distinction. From his teas with his lab group, to his ceaseless badgering of seminar speakers, to the constant stream of visitors, Karl creates around him a climate of constant questioning that's essential to the training of a deliberate mind. Who else would stop you on the street and demand that you to tell him, immediately, how many gigatons of sediments are delivered via underground waterways to the worlds oceans because he simply must know this to assess the impact of the Himalayas on the Indian monsoons if he is to properly interpret the osmium data he is now thinking about collecting? Or something like that. Karl has combined this wizardry with a lifetime of service to Yale. As department chair, as YIBS director, and in many similar capacities over the years, Karl has brought a rare wisdom to process; he demands the best of Yale and, like few others amongst us, is physically sickened by any failure on our part of achieving it. Since, to Karl, what I just stated will be acknowledged as a mere statement of fact, I'll try now to warm his cold heart. Karl, you are an ambassador indeed you make a man want to meet more Armenians!

Elisabeth Vrba
Professor of Geology & Geophysics and former Director of YIBS
Ten of the many things I appreciate about my friend and colleague Karl Turekian:
(1) that he is a gentleman and a gentle man;
(2) his fierce and fearless loyalty towards anyone and anything he cares about, whether it be a friend, his Geology & Geophysics Department, Yale University, or other;
(3) his special kind of brainy mind which is superb at lateral thinking on everything from the most ordinary situations to science;
(4) his childlike curiosity ("childlike" here being meant as a high compliment) and unquenchable intellectual enthusiasm for all manner of knowledge, way beyond his special field;
(5) his ability to embrace new and fresh ideas—far greater than present in others of his age and, for that matter, in most of those who are younger; (Karl—do you remember how, long ago just after I arrived at Yale, I called you a "fuddy-duddy" during a heated disagreement? Well, anyone further removed from fuddiduddiness I cannot imagine!)
(6) his penchant for fierce exchange without holding grudges;
(7) his wisdom and quiet insight into people (yes—I mean "quiet", underneath the ebullience) and his kindness in dealing with people who are less strong and confident than he is;
(8) his ability to make us laugh at his quick wit every time we see him;
(9) his introductions of visitors and speakers (the likes—and occasional length—of which I have never encountered elsewhere);
(10) his visionary and straight-talking leadership, to which all of the above have contributed.
Karl—while you may have decided that in December you want to leave behind the directorship of the Yale Institute for Biospheric Studies, you had better stick around in our larger scheme of things, for a long time, and in a big way—we need you!

Richard Burger
Professor of Anthropology and past Director of the Peabody Museum of Natural History
During my eight years as Director of the Peabody, I sought Karl Turekian's advice often and tried to put him on as many committees as possible. This was not out of any special animus, quite the contrary. Whether considering the hiring of a staff member in public education or delineating a museum policy, he would always have unique insights into the question, and never be shy about expressing them. He is a zen master of the pointed question. The ones that he formulates always seem so simple but cut to the core without touching the bones on either side. He carries his eminence without pretense, brandishing his New York edge with glee. He was fascinated with global change long before it became fashionable and he retains he interest in archaeology with the same tenacity. He is, in short, a remarkable man and I remain deeply grateful for his assistance over the years.

Michael Donoghue
Current Director of the Peabody Museum of Natural History, and G. Evelyn Hutchinson Professor of Ecology & Evolutionary Biology
Curiously, I met Karl Turekian through YIBS—when I served on its External Advisory Board. 'Who IS that guy?', I remember asking the person next to me. I also remember thinking: hey, maybe Yale is full of people like Karl, and wouldn't that be fun. Now I know how silly that was—in fact, I'm positive there's no one like him at Yale, or anywhere—he's the universal outlier. Yale is, of course, definitely fun, and all the more so on the days I get to rub elbows with Karl. Why? Because he's committed to greatness and to great causes (the Peabody Museum, to name one) and he's nothing if not challenging—like exotic sushi, not for the faint of heart but very well worth the experience! Fearless leader of YIBS or not, it's a tremendous privilege just to have him nearby.

Jeffrey Park
Professor in Department of Geology & Geophysics, and current Chair of the Environmental Studies Program
Karl Turekian has been a tireless student of geo-environmental processes throughout his career. The central goal he sought as YIBS Director is the goal that he has largely achieved: the establishment at Yale of a first-rate facility for research and instruction in environmental science. Karl has applied YIBS resources at strategic points to encourage the Yale administration to invest heavily both in the new Environmental Science Center and in the refurbishment and refitting of existing labs throughout the YIBS-affiliated departments. It's been during his directorship that Yale designed and launched its Environmental Studies Program, a multidisciplinary major that exposes undergraduates to the scientific, political and cultural underpinnings of environmental issues. YIBS supported this move, in both logistical and spiritual senses.

Since I arrived at Yale in 1986, Karl has played the designated skeptic in environmental geology, probing the underbelly of conventional wisdom for evidence of soft thinking. Generations of graduate students have borne witness to Karl's insistence that scientific arguments be expressed in a simple narrative, using food analogies whenever possible. I recall well the oral exam in which Karl led a graduate student through the distinction between latent and manifest heat in Earth's atmosphere by asking the student why he blew on soup when it was too hot to swallow. In his famous "coffee room" discussions at 10:30 AM daily, Karl demands any newcomer to defend his or her competence in geochemical argument with a string of persistent questions. Job candidates, prospective graduate students, other Yale faculty—no one is immune from the challenge. At the same time, Karl has administered YIBS to fertilize the work of young researchers, assistant professors and post-docs, in a wide variety of fields.

Jared Cohon
Dean of the School of Forestry & Environmental Studies from 1992 to 1997, and now President, Carnegie Mellon University
Karl Turekian had much to do with my moving to Yale in 1992. While I was considering the Forestry School's good offer to become dean, I conferred with a trusted colleague at Johns Hopkins. He told me, "Better talk to Karl Turekian. He'll be able to tell you what the prospects are there. Oh, and another thing: You'll also have to be able to get along with him." I survived my first meeting with Karl, who was his usual direct self. Significantly, I came away with a good understanding of Yale's high standards, the importance of building better connections for F&ES to other parts of Yale, especially Yale College, and a sense of excitement about the opportunity to interact with scientists of Karl's caliber.

My very first meeting outside of F&ES was for the committee that oversaw the environmental studies program for undergraduates. Before the meeting convened, Karl got into an argument with another senior faculty member—my memory is fuzzy, but I think it might have been the dear, departed Robin Winks—about the content of a freshman course. For me, this was a fantastic spectacle: two great, senior faculty members arguing passionately about an undergraduate course. With no offense intended toward the other outstanding institutions with which I've been affiliated, this was something I had never witnessed, and it was an introduction to what makes Yale great.

And, of course, what has made Karl great is what has made Yale great. An outstanding scientist with the highest standards who cares deeply and passionately about Yale and its students, no one has done more to advance environmental research and education at Yale than Karl Turekian.

James Gustave Speth
present Dean of the School of Forestry & Environmental Studies
When I arrived here four years ago, I was told you were shy and reticent and I'd have to draw you out if I wanted to get your thoughts and advice. You can imagine my pleasant surprise, then, when I was able to do this so easily. During these four years, you have always been helpful to me and thoughtful in your suggestions, and I appreciate that. There have even been times when you have been right.

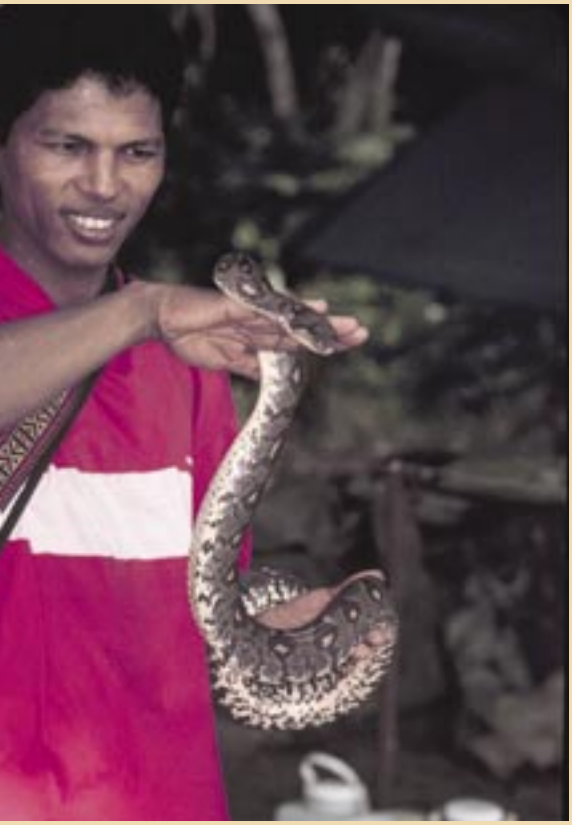
YIBS has done well under your leadership, and I will miss working with you and, especially, watching you chair meeting with your characteristic restraint. All the best!

Madagascar and India Reunite to Ensure the Survival of an Endangered Biota

Approximately 160 million years ago, Madagascar and India together slid away from the ancient supercontinent known as Gondwana. For the next 70 million years or so, the two conjoined landmasses formed the IndoMadagascar subcontinent, resting remotely side by side in the Indian Ocean. From there, India tore away from Madagascar (about 88 million years ago) to ultimately collide with Asia, leaving Madagascar in splendid isolation where its biota has evolved in a natural evolutionary laboratory that is celebrated for its unique flora and fauna. Now, after many millions of years of separation, the two landmasses are metaphorically reunited by virtue of a scientific collaboration between two scholars, one Malagasy and one Indian. Through support from a Biodiversity Leadership Award from the Bay and Paul Foundations to Anne Yoder, Associate Professor in the Department of Ecology and Evolutionary Biology, the two biodiversity scholars, Dr. Achille Raselimanana of Madagascar and Dr. Praveen Karanth of India, are collaborating on an investigation of the biogeography and evolutionary history of Malagasy plated lizards (family Gerrhosauridae). Given current taxonomy and classification, these animals are acknowledged to be among the most speciose lizards in Madagascar. Their distribution patterns are extremely complex, however, with some species broadly distributed throughout Madagascar, showing affiliation to a wide range of habitat types, while others show much more restricted distributions, with affinity for only highly-specialized habitats. Thus, one of the primary goals of the project is to employ molecular phylogenetic methods to determine if taxonomy actually reflects the evolutionary history and species boundaries among these lizards. Such considerations are increasingly playing a role in conservation management strategies for biota from all parts of the world.

Raselimanana (foreground) and Karanth (background) at a lab bench in the Environmental Sciences Center.

Beyond the biological interest of the project, much of its fascination comes from the cultural and intellectual synergy introduced by the two investigators. Raselimanana, who was born and raised in a small village to the north of Madagacar's capital city, has had a passion for natural diversity from the time that he was a young child. From very early ages, he recalls conducting natural experiments in predator/prey relationships and in avian behavior. With regard to the first, he recounts experiments wherein he would trap crickets as bait for frogs, which would then be fed to snakes, only to be subsequently dissected from the snake's stomach. In other experiments, he would use the long tail hairs from a cow to construct traps for capturing birds in primitive mark/recapture studies—and all of this long



Top: The holotype of Zonosaurus tsingy, a plated lizard species new to science when it was described by Raselimanana.

Bottom: Achille Raselimanana, holding an adult specimen of Sanzinia madagascariensis.

before receiving formal training as a biologist from the Université d'Antananarivo, where he received his Doctorate de Troisième cycle in 2000. While a student there, Raselimanana was told by advisors that he was "crazy" for wanting to study amphibians and reptiles. His mentors repeatedly tried to persuade him to study birds or mammals, suggesting that research on such charismatic animals would be more likely to gain him the recognition of the external research community. Fortunately, Raselimanana was undeterred, and herpetology has persisted as his research obsession, much to the benefit of the biological community. Karanth's fascination for biology has expressed itself a bit more traditionally, though no less fervently. Growing up in Udupi, a city of nearly 500,000 people on the west coast of India, Karanth's interest in biology was first inspired when he attended a nature camp in the sixth grade. From that point on, there was "no turning back" says Karanth, and by the tenth grade, he knew that a Ph.D. was in his future. As an undergraduate at the University of Agricultural Science in Bangalor, Karanth studied the cooperative breeding system of native birds called bee-eaters. From there, he attended graduate school at State University jof New York (SUNY)-Albany where he studied the evolutionary history of Old World monkeys called langurs, receiving his Ph.D. in 2000. Thus, he simultaneously expanded his organismal focus while confirming his tenth-grade ambitions.

Both scholars have continued to vigorously pursue their scientific goals. Since 1996, Raselimanana has served as Biodiversity Program Officer at World Wildlife Fund (WWF)—Madagascar. As such, he is uniquely placed to influence conservation policies in Madagascar. To his eyes, however, there is an essential component of the conservation management equation that is currently missing. "Evolution is part of life", says Raselimanana, and present-day conservation managers do not fully appreciate the historical perspective that is required for successful conservation strategy. His ultimate goal is to form a Center for Biodiversity Conservation in Madagascar where a phylogenetic perspective will be one of many important components for assuring the long-term survival of Madagascar's unique biota. Karanth, a Yale postdoctoral associate, who leads the ancient DNA project in Yoder's lab, ultimately wants to return to India to establish a molecular systematics laboratory at one of India's leading academic institutions. Like Raselimanana, Karanth believes that these techniques, and the intellectual framework that they feed, are critical for effective conservation biology.

Thanks to the generous award from the Bay and Paul Foundations, funding from YIBS ECOSAVE Center, and to the supportive atmosphere of the Environmental Sciences Center at Yale, both investigators are moving ever closer to the achievement of their goals. Raselimanana arrived at Yale in early July of 2003, with virtually no laboratory experience, but with a burning desire to master molecular phylogenetic techniques. The combination of Karanth's tutelage, and Raselimanana's dedication to the task, have in three months yielded a suite of lab skills that are "nothing short of remarkable", according to Karanth. By the time Raselimanana left Yale to return to Madagascar on October 16, 2003, he had generated DNA sequences for two genes from more than 80 lizard specimens. Even so, all parties involved consider this to be a project in its infancy. Raselimanana will be returning to the Yoder lab for at least the next two summers, as he completes his "punctuated postdoc". And, as a fulfillment of one of his lifelong goals, Karanth will be traveling in the spring of 2004 to work in Raselimanana's laboratory—the forests of Madagascar. There, the two researchers will be collecting DNA samples from the several species of plated lizards that are presently missing from the near-comprehensive taxonomic sample. Ultimately, Raselimanana and Karanth want to test a variety of biogeographic and evolutionary hypotheses that have been generated by studies of other Malagasy vertebrates. In so doing, they will be making a lasting contribution to the study of Madagascar's past, and will thus contribute much to the future of its threatened biota.

Life in Ice

Gaylord Donnelley Environmental Fellow Participates in Chinese Icebreaker Expedition to the Arctic Ocean

Top: Ice sampling with a motorized ice corer.

Bottom: A ship-based helicopter is used to transport scientists and equipment to the ice camp.

The present day intensity of interest in the role of the Arctic in Global Change has arisen nearly entirely from research in the physical sciences. Perhaps the most prominent and popularly understood organizing concept underlying this interest is the role of the global ice cover in ice/albedo feedback. It turns out that although the ice that forms from the polar oceans constitutes the thinnest component of the global ice cover—a mean thickness of three meters in the Arctic Ocean—it is by far the dominant contributor to the area; seasonal changes in the Arctic amounting to 8 million square kilometers and those in the Antarctic amounting to 18 million. Indeed, the much publicized Global Conveyer Belt, the stability of which owes itself to the amount of fresh water entering the North Atlantic Ocean, receives about 3000 cubic kilometers of fresh water in the form of sea ice each year—twice the combined outflow of North America's four largest rivers. Therefore, the central tenets of the large scale heat and mass balance of sea ice, and their influence on atmospheric and oceanic climatology, are all part of the present day language, thinking and lore of scientists working in the field.

An emerging and important aspect of the atmosphere/ice/ocean system in the polar regions concerns how the physics influence the biology and vice-versa. Indeed, sea ice is an essential structuring element of Arctic marine ecosystems. The first expeditions to the Arctic Ocean revealed the discoloration of sea ice that owed its origin to extremely high accumulations of unicellular algae. Modern research shows that sea ice provides a vast low-temperature habitat for many different organism groups including bacteria, micro-algae and

GAYLORD DONNELLEY ENVIRONMENTAL FELLOWS

Klaus Meiners taking a break during an ice station. The 500 ft long XUE LONG is in the background.

metazoans. Clearly such organisms cannot live within the solid ice matrix, but a quantitative understanding of just how they survive, motivates for the interdisciplinary studies of sea ice ecology. The organisms colonize throughout an interconnected network of brine-filled interstices between the solid ice crystals, which forms as a result of the crystallization of saline water. The organisms are adapted to the harsh environmental conditions in the sea ice, which is characterized by steep gradients of temperature and brine salinity. Winter temperatures in the upper parts of sea ice can be as low as -25 °C with corresponding brine salinities being seven times higher than that of open ocean sea water. Therefore, sea ice biological studies are not only essential for the basic understanding of the Arctic Ocean's ecology, but also provide a test bed for the study of extremophiles and astrobiology.

Due to the severe environmental conditions and restricted accessibility of the Arctic, data on the diversity and activity of biota in Arctic Ocean pack ice are still very sparse. Only relatively recently (the past 20 years) has modern ice-breaking capability allowed vessels to access the central Arctic Ocean year-round. However, there are only a handful of research vessels with ice breaking capabilities and international collaboration is necessary to perform scientific work in this remote part of the world's ocean.

During the summer of 2003, Gaylord Donnelley Post Doctoral Fellow Klaus Meiners joined a team of scientists from Canada, China, Finland, Japan, Korea and the United States participating in the 2nd Chinese National Arctic Research Expedition onboard the Chinese icebreaker XUE LONG. Meiners left Barrow, Alaska in the beginning of August and returned to Nome, Alaska in mid September. During the expedition, sea ice samples were taken along the cruise track in the Chukchi and Beaufort Seas. There was also a 2-week ice camp in the Canada Basin during which longer term studies were engaged. Collaborating in a National Oceanic and Atmospheric Administration (NOAA) funded project with Rolf Gradinger from the University of Alaska, Fairbanks the Yale researcher measured ice algal activity and production using stable isotope techniques. The data will help to tease out the biological linkages in Arctic marine ecosystems and their potential alteration, due to recent observations of the decrease in Arctic sea ice extent and thickness. They will also provide a baseline for future environmental change.

Algal samples were also transported back to New Haven and are now being cultivated in the Ice Physics Laboratory within the Department of Geology and Geophysics. The algae and especially extracellular "slime" produced by them will be used in an interdisciplinary project with ice-physicists John Wettlaufer (Yale) and visiting faculty member Larry Wilen (University of Ohio) studying the effects of algal secretions on ice crystals and ice grain boundaries. Recent studies indicate, that the "slime" may serve in the cryoprotection of the algae and may also alter the pore structure of the ice.

These studies form the springboard of more general questions concerning under just what conditions life can persist in the harsh pore spaces of naturally forming ice. The investigators hope to put quantitative constraints on the contemporary speculations concerning the origin of life on places like the icy moon of Jupiter, Europa.

Meyers

Dr. Stephen Meyers joined the Yale Institute for Biospheric Studies as a Gaylord Donnelley Postdoctoral Fellow from Northwestern University, where he recently completed a dissertation with Dr. Bradley Sageman on the integrated biogeochemical and cyclostratigraphic assessment of Oceanic Anoxic Event II, one of several episodes of exceptional organic matter burial during the Middle Cretaceous (~93 Ma). His research interests encompass paleoclimatology/paleoceanography, biogeochemistry, and numerical methods in paleoclimate analysis. Dr. Meyers was the recipient of the 2001 Outstanding Paper Award from the Journal of Sedimentary Research, for his manuscript "Integrated Quantitative Stratigraphy of the Cenomanian-Turonian Bridge Creek Limestone Member Using Evolutive Harmonic Analysis and Stratigraphic Modeling". As a Donnelley Postdoctoral Fellow, he will be conducting postdoctoral research with Geology & Geophysics Professor Mark Pagani on a project titled "Evaluating Temporal and Spatial Stability of the Holocene Hydrologic Cycle with Compound-Specific D/H Ratios of Higher-Plant and Algal Biomarkers". His research will focus on the development of a new geochemical proxy for reconstruction of paleo-evapotranspiration and aridity. The new proxy will be employed to assess the linkage between regional changes in the Holocene hydrologic cycle and global climatic episodes (e.g., the "Little Ice Age" and the "Dark Ages Cold Period"), as well as their relationships to records of major cultural events.

Twining

Russell

Left: Stephen Meyers, Gaylord Donnelley Post-Doctoral Fellow.

Middle: Ben Twining on a recent research cruise on the CCGS Limnos in Lake Erie. The purpose of the cruise was to study the interactions of trace metals with the microbial organisms of this lake. He performed experiments to measure the oxidation of the contaminant metal thallium by natural assemblages of aquatic bacteria.

Right: Amy Russell, Gaylord Donnelley Post-Doctoral Fellow.

Dr. Benjamin S. Twining arrived at Yale in August 2003 to begin working as a Gaylord Donnelley Environmental Postdoctoral Fellow with Gaboury Benoit, Professor of Environmental Chemistry at the School of Forestry & Environmental Studies. Dr. Twining received his Ph.D. in Coastal Oceanography from the State University of New York at Stony Brook, where he studied the role of aquatic protozoa, or single-celled animals, in the cycling and accumulation of trace metals. Certain trace metals, such as iron, are required by all organisms for proper growth. In some remote oceanic regions, however, there is not an adequate supply of iron to support the growth of the single-celled plants, or phytoplankton, that form the base of the oceanic food chain. In these areas, phytoplankton rely on iron recycled by protozoa for their growth. While phytoplankton are microscopic, they are responsible for nearly half of the world's photosynthesis, producing much of the oxygen we breathe. The phytoplankton in the Southern Ocean, which surrounds Antarctica, also plays an important role in regulating the carbon dioxide concentration of the earth's atmosphere. Therefore, their growth may play a role in mitigating global warming. As part of his dissertation research, Dr. Twining developed a new technique utilizing a synchrotron x-ray fluorescence microprobe to study the accumulation of iron by phytoplankton and protozoa in the Southern Ocean.

Dr. Twining also investigated the accumulation of pollutant metals such as silver, cadmium, and mercury by protozoa. These metals can occur at elevated concentrations in impacted systems such as the Hudson River Estuary. At certain times of the year, protozoa can be an important food source for zooplankton, small aquatic crustaceans consumed by fish. Dr. Twining studied the trophic transfer of silver, cadmium, and mercury from protozoa to zooplankton to determine if these metals are more likely to accumulate in protozoa-based aquatic food chains.

While at Yale, Dr. Twining plans to continue studying the accumulation of metals by aquatic protists. He will use voltammetric techniques to investigate the chemical forms of metals that are bioavailable to aquatic organisms. Additionally, he hopes to utilize fluorescently-labelled molecular probes to identify specific types of organisms, such as denitrifying bacteria, for analysis with the x-ray fluorescence microprobe. This research combines aspects of aquatic chemistry, microbial ecology, molecular biology, and geochemistry; such interdisciplinary work would be difficult to undertake without the support of the Gaylord Donnelley Environmental Fellowship.

Dr. Amy L. Russell joins the Department of Ecology and Evolutionary Biology as a Gaylord Donnelley Postdoctoral Fellow to work with Dr. Anne D. Yoder, Associate Professor in that department. Dr. Russell completed her Ph.D. in June of 2003 at the University of Tennessee with Dr. Gary McCracken. Using population genetic methods, she examined the population dynamics and phylogeography of Brazilian free-tailed bats, finding that these animals comprise a single panmictic population distributed over a vast geographic range in central and southern North America. Among other honors, her work earned her the Karl Koopman Award for best student paper from the 2002 North American Symposium on Bat Research. While at Yale, Dr. Russell will shift her geographic focus from the New World to the Old World by studying the bats and the chameleons of Madagascar. She will be examining the genetic and phylogeographic patterns within these two vertebrate groups that demonstrate vastly different dispersal abilities. In so doing, she will be able to address a number of evolutionary questions that, although specific to Madagascar, have relevance to the more general study of vertebrate biogeography. For example, how have idiosyncratic biological constraints of different vertebrate groups affected their respective ability to colonize and then flourish in Madagascar? Have climatic events had a prevailing effect on patterns of Malagasy vertebrate evolution? And, how are patterns of human disturbance affecting patterns of geographic distribution and genetic diversity among Malagasy vertebrates? The resolution of these questions will yield insight into the complex biogeographic processes that have shaped the Malagasy biota, and may one day prove essential for formulating realistic conservation strategies for these endangered animals.

PEABODY MUSEUM INFORMATION

- Open 10 am to 5 pm Monday through Saturday; noon to 5 pm on Sunday
- Admission is $7 (adults); $6 seniors 65+; $5 (children 3–18); free to Museum members, volunteers, Yale University I.D. holders, and children under 3. The museum is free to all every Thursday from 2–5 pm.
- Highlights tours are held every Saturday and Sunday at noon and 1 pm. Spanish highlights tours are held the first and third Saturday of every month at 11 am.
- The Museum is wheelchair accessible. A ramp and a handicapped parking space are adjacent to the Museum on Sachem Street.
- InfoTape at (203) 432-5050
- www.peabody.yale.edu

EVENTS

DR. KING'S LEGACY OF ENVIRONMENTAL & SOCIAL JUSTICE 2004
January 18 & 19

DINOSAUR DAYS
February 15–21

FIESTA LATINA
March 6

PALEO-KNOWLEDGE BOWL
March 13 & 14

Ornithological And

The sparsely-populated Rio Muni is densely covered with luxuriant rainforest quite similar to the ecosystem recently popularized by Michael Fay's Megatransect Project in Congo and Gabon. Its location within an important African biodiversity hotspot makes it one of the most exciting biological frontiers in the world.

by Kristof Zyskowski

New divisional staff and state-of-the-art collections facilities in the new Environmental Science Center have provided the impetus for several ambitious collecting expeditions by the Peabody Museum's Vertebrate Zoology Division. With consideration for the strengths and weaknesses of existing collections and the research interests of faculty and staff, sites were chosen where focused field collecting would generate a wealth of new specimens and data. In the last three years, destinations for the study and collection of native terrestrial vertebrates included New Caledonia, El Salvador, Uruguay, and Crete. The results of our most recent ornithological and herpetological explorations in Equatorial Guinea follow.

Equatorial Guinea is a small country in west-central Africa, not to be confused with two other similarly-named African countries further west: Guinea and Guinea-Bissau. The country comprises a continental part, sand-

EXHIBITS

JANUARY 24–JUNE 1, 2004

Hatching The Past: Dinosaur Eggs, Nests And Young

Presents new evidence to unlock the mysteries of dinosaur reproductive behavior.

MARCH 24, 2004

(New permanent exhibition)

Fossil Fragments: The Riddle of Human Origin

Traces the evolution of the human species as well as that of our closest relatives among the non-human primates.

Herpetological Explorations In Equatorial Guinea

wiched between Cameroon and Gabon, and five inhabited islands in the Gulf of Guinea. Although the largest island, Bioko (formerly Fernando Po) has received a fair amount of attention from biologists, the continental part, Rio Muni, has remained virtually unexplored.

The sparsely-populated Rio Muni is densely covered with luxuriant rainforest quite similar to the ecosystem recently popularized by Michael Fay's Megatransect Project in Congo and Gabon. Its location within an important African biodiversity hotspot makes it one of the most exciting biological frontiers in the world. However, emerging threats to this area's biodiversity from two sources—the recent discovery and exploitation of underwater oil resources and intensified commercial logging—add a certain urgency to biotic inventory projects such as ours.

continued on page 12

Kristof Zyskowski

This shaggy-crested Malachite Kingfisher (*Alcedo cristata*) documents the first record of this species in Equatorial Guinea and fills in an apparent gap in its range.

Kristof Zyskowski (3)

Top: Many West-African bird species possess brightly colored patches of skin, either prominently displayed, as in the Yellow-bellied Wattle-eye (Dyaphorophyia concreta). These colors are not pigment-based but are generated by constructive reflection of light from the microscopic hexagonal arrays of parallel collagen fibers. Skin samples collected in Equatorial Guinea are being analyzed by Richard Prum, who recently discovered this novel mechanism of structural color production, and who will be joining the Peabody Museum next year as a new ornithology curator.

Middle: This chameleon (Chamaeleo chapini) was extracted from the stomach of a colubrid snake that fell down from a tree into a camp's kitchen. It represents not only a new country record, but also the first adult male known to science, and the first sighting of the species since its discovery 40 years ago.

Bottom: Jorge de León and Kristof Zyskowski of the Peabody Museum (front) and colleagues from collaborating institutions minutes before departing for Monte Alen.

Opposite page: Afrixalus paradorsalis, frog from the Nsork highlands. Photo: Twan Leenders

Biogeographic considerations intensified our interest in continental Equatorial Guinea. The high number of species shared between the West and East African highlands, some 2000 kilometers apart, has led biogeographers to hypothesize the existence of connecting routes during colder and wetter climatic phases along the edges of the Congo Basin. The Niefang and Nsork highlands of Rio Muni are likely remnants of one such connecting route. A recent discovery in Rio Muni and neighboring Gabon of several bird species otherwise known to occur disjunctly in the mountains of Cameroon and East Africa lends further support to this hypothesis. Discoveries of isolated montane populations have important scientific and conservation implications, since such populations may represent undescribed taxa and often deserve protected status based on their restricted range.

We surveyed four localities within continental Equatorial Guinea: the base of Monte Alen; Monte Alen summit; the Nsork hills in the southeast; and the Rio Campo lowlands in the northwest. Abe Parrish of Sterling Memorial Library's Map Collection and Dr. Prasad Thenkabail of Yale's CERA project (Characterization of Eco Regions in Africa) were instrumental in providing us with current satellite images of the country and identifying unlogged primary forest fragments.

Despite relatively short aerial distances, getting to most study sites was a true challenge. The only paved road is the one connecting the mainland capital with the president's hometown, and the remaining roads quickly become impassable after rain, even to four-wheel drive vehicles. Monte Alen, the tallest mountain of the Niefang range in the interior, was accessible only by foot, necessitating reliance on human porters, due to the lack of horses or other cargo animals.

Ornithological highlights of the fieldwork included the discovery of six species new for Equatorial Guinea and the first-time documentation, with song recordings, specimens, and/or photographs, of eleven additional species previously known only from sight records. In contrast to the findings of previous visitors, we recorded a high diversity of hornbills, barbets, and other frugivorous birds, probably because we were fortunate to survey the area during the time of high fruit abundance.

Expedition photographs and recordings of bird vocalizations will be deposited in Philadelphia's VIREO (Visual Resources for Ornithology) collection and Cornell's Library of Natural Sounds respectively.

Until now, only eight percent of *ca.* 17,000 African bird specimens in the Yale Peabody Museum collections were from West Africa, our strengths being in the eastern and southern parts of the continent. Hence, it is not surprising that the Equatorial Guinea material included 22 taxa completely new for Yale and the first anatomical specimens (i.e., skeletons or whole birds preserved in alcohol) for 47 taxa. All nests and eggs were also new. Finally, we added nearly 750 samples to our still-young tissue collection. Voucher specimens and tissue samples representing isolated montane populations can now be used to evaluate the evolutionary distinctness of these populations.

Since the herpetofauna of West Africa is much less known than its birds, our field data and specimens from Equatorial Guinea are of great importance. At present, we know that we collected at least one snake species, two species of lizard and two frogs new for the country, but several specimens still defy identification. The fact that even experts on certain groups have difficulty assigning some specimens to known taxa may mean that they represent undescribed species! In contrast to birds, the strengths of Yale's African herpetological holdings lie in West Africa (especially Cameroon and Benin), yet almost all specimens from Equatorial Guinea are taxa new to the collection.

The expeditions have been a collaborative effort involving biologists at three institutions: Yale, the Academy of Natural Sciences of Philadelphia and the University of Kansas Natural History Museum. Two in-country organizations provided invaluable logistical support: INDEFOR, a government-funded forestry institute, and ECOFAC, a European Union-funded program promoting conservation and rational use of forest ecosystems.

Peabody's Biodiversity Education Program Expands

by Laura Fawcett

Since 1998 the Peabody Fellows Program, funded by the National Institutes of Health, has focused on the New Haven Public School district. This summer the program expanded into four new school districts: Bridgeport, Seymour, Waterbury and West Haven. In June, nineteen teachers from nine middle schools in these districts attended a Biodiversity and Human Health Institute focused on inquiry-based science education.

Middle school teachers statewide are clamoring to learn more engaging science content and interactive teaching techniques. The mandatory Connecticut science mastery test, previously administered only to 10th graders, will be extended into all middle schools over the next three years. By posing problems that students must solve experimentally, this test requires demonstrated competency with the scientific process. Middle school teachers are understandably eager to learn and practice new instructional techniques to strengthen their students' basic science literacy and inquiry skills.

L. Fawcett

Bridgeport teachers Walter Mayorga and Portia Scott examine plant specimen at the Summer Institute.

Ben and Birgit at a Peabody function.

Morse Endowment Fund Honors Ben Rouse

by Roger Colten

The Peabody Museum of Natural History (PM) is delighted to announce the establishment of the Birgit Faber Morse Endowment Fund in honor of Benjamin Irving Rouse, curator emeritus and C. S. MacCurdy Professor Emeritus in Anthropology at Yale. The fund will benefit the Division of Anthropology and its Caribbean Archaeology Collection. One of the world's largest and most important collections of archaeological material from the circum-Caribbean region, this collection contains the largest group of archaeological materials in the Peabody and was compiled during the extraordinary career of Professor Rouse. The endowment will provide perpetual financial support for the curation and study of the collection and the associated documentation.

Professor Rouse has been affiliated with the PM and Yale University for over 70 years, first as a volunteer and then as a student, professor, curator, and now as curator emeritus. A pioneer in the study of Caribbean archaeology, he is the author of dozens of articles and books on the Native Americans who occupied the many islands and surrounding mainland of the region.

Birgit Faber Morse is a curatorial affiliate in the Peabody's Division of Anthropology. She received her M.A. from the Yale University Department of Anthropology and has conducted research in North America as well as the Caribbean. Birgit has been a long-time research collaborator with Professor Rouse. Their 1999 publication Excavations at the Indian Creek Site, Antigua, West Indies, Yale University Publications in Anthropology No. 82, is available through the Peabody Museum publications office.

Peabody Museum Caught in HerpNET

by Gregory J. Watkins-Colwell and Reed S. Beaman

The Yale Peabody Museum of Natural History (PM), together with 36 partner institutions, is participating in an ambitious project to establish a collaborative network of herpetological (i.e., amphibian and reptile) collection databases throughout North America. Called HerpNet (www.herpnet.org), the project is funded by a grant from the Biological Databases and Informatics program of the National Science Foundation.

An estimated 4.7 million herpetological specimens are housed in North American collections of which 90% are databased on about 18 different software platforms. HerpNET will make it possible to access, retrieve, and integrate data from across these collections for biodiversity research on temporal and geographic phenomena in ecology, conservation, and evolution (e.g., changes in population numbers, species diversity, and ecological associations), bringing 300 years of accumulated knowledge from various collections into currency for science and society.

A third of North American herpetological specimens and their data are housed in small collections and are frequently overlooked. Among the HerpNET benefits is connecting large repositories of information with smaller collections that have regional specializations. In the fifth year of the project (September 2006-August 2007), the Peabody will receive a dedicated server that will function as a provider node for PM data to the HerpNET community.

The largest task for the HerpNET project is that of georeferencing collection localities, only a fraction of which is currently completed. Collection data must be georeferenced to serve the broader scientific community in biodiversity, ecology and related research. The availability of several million georeferenced localities will enable complex biogeographic analyses, modeling, and prediction of herpetological species distributions never before possible. Georeferencing in HerpNET is an altruistic collaborative effort; all collection locality data are pooled and contributors then claim a geographic area (e.g., Connecticut) for which they will georeference all HerpNET collections.

By collaborating in HerpNET, the PM will help further advance informatics tools available for biodiversity and environmental science, and will help educate the next generation of biodiversity scientists. HerpNET will bring together scientists from diverse institutions and offer the opportunity to cross train in information technology, natural history collections, systematics, and biological science in general.

Gregory Watkins-Colwell (3)

Top: The Jefferson Salamander is protected in Connecticut and often hybridizes with other salamander species in the wild. Knowing the distribution of each hybrid form relative to the pure forms is important to conservation biologists.

Middle: The smooth green snake, shown on a natural carpet of moss is thought to be a common species in the northeast, though it is rarely encountered. Combining the data from multiple collections could help shed light on the status of this seldom-seen species.

Bottom: Shown is one of two species of gray tree frog, which occur within North America and can be separated genetically and by vocalization only. Detailed geo-referencing can help scientists understand the distribution patterns of these two very similar species.

Climatic Change And Human Evolution

New Information From The Tugen Hills, Kenya

by Andrew Hill

John Kingston

Andrew Hill standing in front of a diatomite exposed in the Barsemoi River Valley, Tugen Hills, Kenya, which is dated at between 2.579 and 2.594 million years.

Why have we humans evolved as we have? Why did some ape get up on its back legs and become bipedal? Why did we develop large brains? Beginning with Croll, Darwin, Wallace, and contemporaries, a number of people—including Elizabeth Vrba in the Department of Geology & Geophysics at Yale—have suggested that astronomical cycles, linked to global climate and environmental change, have been fairly directly responsible for evolutionary shifts in terrestrial animals. This appealing idea has been applied to the origin of hominid lineages, such as the origin of bipeds and the origin of our own genus, Homo. But so far there has been little evidence to show that such astronomical forcing has a significant effect, or is even detectable, at the equator in the interior of continents.

The Baringo Paleontological Research Project (BPRP), directed by Andrew Hill, chair of the Anthropology Department and curator of anthropology in the Peabody Museum of Natural History (PM), has operated a research expedition to the Tugen Hills, in the Rift Valley of Kenya, since 1980. BPRP is based at Yale, run jointly with the National Museums of Kenya, and involves participants from several institutions in the United States and elsewhere.

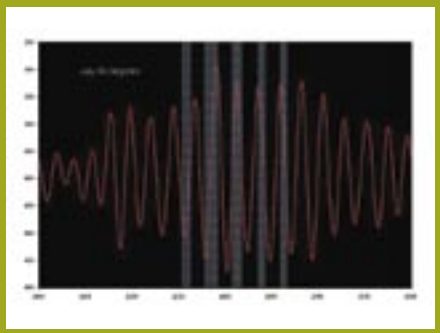
The Tugen Hills are particularly exciting in this context because they preserve a relatively unbroken succession of vertebrate faunas ranging in age from 16 million years to recent times, including time periods otherwise unrepresented in Africa. One of BPRP's current interests is the period between 3 million and 2 million, a time range of greatest significance for the origin and divergence of hominid lineages such as Homo and Paranthropus. In the Barsemoi River, west of Lake Baringo, the project has found exposures of five major diatomites. Diatomites are lake sediments formed from diatoms, which are unicellular algae with siliceous skeletons. They reflect increased lake levels responding to increased rainfall.

Major collaborators in this particular research are John Kingston, Assistant Professor of Anthropology at Emory University, formerly at Yale as a post-doc in Anthropology and a research associate in Geology & Geophysics, and Al Deino and Jonathon Glenn of the Berkeley Geochronology Laboratory.

BPRP has dated the rock sequence very precisely using single-crystal-laser-fusion argon methods, combined with detailed paleomagnetic stratigraphy and sedimentation rate interpolation. The diatomites fall between 2.66 and 2.56 million years and reflect a depositional periodicity of 24,000 and 28,000 years. This fits well with the 23,000 to 24,000 year Milankovitch precessional cycle. The effects of precession on the amount of solar energy reaching the earth at different places and times can be calculated using astronomical information. When the times of the Barsemoi diatomites are superimposed on the relevant curve they correspond very closely to the maximum peaks.

Over 35 fossil sites have been discovered by the project in this section, three with hominid fossils, including the earliest known member of genus Homo. So, do the climatic fluctuations now demonstrated in this sequence have an obvious evolutionary effect on the fauna? At first glance the fossil data suggest they don't, at least not at this scale; further research may change this initial impression. But at least we now know that the cycling of the solar system does indeed have an impact on the environment where our human ancestors were actually living, some 2.5 million years ago.

An overview of human evolution, from apes to Homo sapiens, including information about discovery and discoverers, is featured in a new Peabody Museum permanent exhibition, Fossil Fragments, curated by Andrew Hill and opening in spring 2004.



The ages of the Barsemoi diatomites plotted against the theoretical pattern of solar insolation through time calculated independently for July at 30° north. The diatomites, which coincide very well with the peaks of solar radiation, cluster overall in that range of time on the curve when solar insolation is at a maximum (horizontal axis is in thousands of years before present; vertical axis is an index of insolation). (Diagram: John Kingston).

Georeferencing: Finding A Place for Natural History Collections

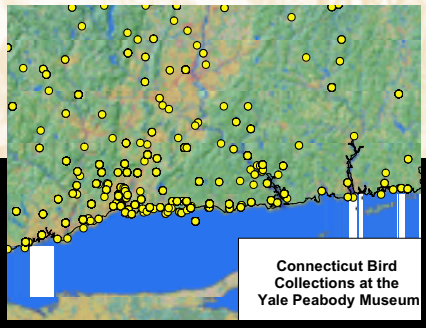
by Reed S. Beaman

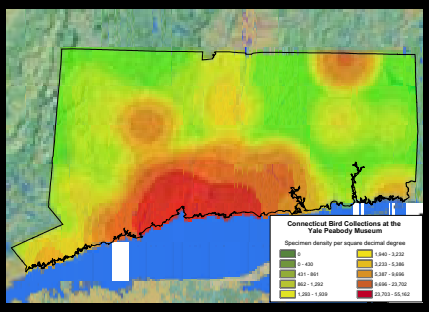
Natural history museums worldwide are estimated to house some 2.5 billion specimens, and the Yale Peabody Museum of Natural History (PM) curates about 11 million of these. Collections are the foundation of knowledge about the Earth's past and present biological diversity. Every museum specimen has a place from whence it came. The place of origin for a collection is an essential component of the information we have about specimens. Of the various classes of information linked to biological specimens, geographic coordinates used for mapping species distributions are among the most widely demanded by the scientific community and the general public. Providing these coordinates (georeferencing) has proven a significant challenge for researchers in biological informatics.

In mid-September, the PM hosted an international workshop to discuss development of georeferencing applications for natural history collections. The workshop, funded by the National Science Foundation (NSF) and the Global Biodiversity Information Facility (GBIF) brought together an interdisciplinary group of about 25 participants including curators, collection managers, application developers, digital library scientists, geographical information system specialists, and georeferencing project managers. The workshop provided the opportunity for discussion of specific biodiversity community needs for georeferencing and analysis of functional requirements to meet those needs. This will help establish an architectural framework for further development of georeferencing services, and will address providing technology tools for a number of national and international georeferencing projects.

Topics of the workshop included issues pertinent to providing automated and semi-automated georeferencing solutions for natural history collections in a distributed environment, formulation of strategies to promote interoperability between georeferencing applications, digital library gazetteers, and distributed biodiversity information retrieval protocols. Rapid capture of geographic data provides return on 250 years investment of global, biological inventory. Leveraging this remarkable investment requires significant planning across multiple disciplines.

In addition to the workshop support, GBIF has also recently funded an 18-month research and development grant to the Peabody Museum. The YPM's biodiversity informatics specialist, Reed Beaman, will be funded on this grant to develop interoperable georeferencing web services. Beaman is collaborating with community georeferencing projects such as the Mammal Networked Information System (MaNIS) and HerpNET to develop natural history collection georeferencing technologies. Research for this project involves natural language processing, developing interoperability with the Alexandria Digital Library Gazetteer, and providing estimates of uncertainty for georeferenced coordinates.





Top: Dot map showing distribution of georeferenced YPM Ornithology Division specimens from Connecticut. It appears that collections are well represented throughout the state.

Bottom: Density map based on YPM Ornithology Division specimens from Connecticut. A density analysisclearly shows the collection bias toward New Haven and coastal areas. Having a georeferenced collection helps determine where additional collecting efforts should be focused.

Maps by R. Beaman; data courtesy of K. Zyskowski, Peabody Museum Division of Vertebrate Zoology.

Standing in a huge bird's nest built by children at the Peabody's Biodiversity Day on May 10 are (L to R): Kellie Heckman, Monique Scott, Scott Teper, Leigh Baker and Esther Seibold.

Peabody Museum Offers NSF Graduate Teaching Fellowships

by Laura Fawcett

In May 2003, the Peabody Museum of Natural History (PM) offered its first teaching fellowships to five Yale graduate students through a grant from the National Science Foundation (NSF). The NSF Graduate Teaching Fellows in K-12 Education (GK-12) program awarded $879,174 to Museum Director Michael Donoghue and Associate Curator of Entomology Leonard Munstermann to enhance the Peabody's existing science literacy initiative in the New Haven Public School district by promoting collaboration between graduate students and teachers.

The PM's new GK 12 Fellows represent five disciplines relevant to the PM program's focus on biodiversity and human health: Anthropology (Monique Scott, PhD '04); Ecology & Evolutionary Biology (Kellie Heckman, PhD '05); Epidemiology & Public Health (Scott Teper, MPH '04); School of Forestry & Environmental Studies (Leigh Baker, MS '04); and Nursing (Esther Seibold, PhD '04).

The NSF program strives to improve communication and teaching skills of graduate students by linking them to pre-college education in their local communities. After an orientation led by PM curators and collections managers, the GK-12 Fellows began working in middle school classrooms in May. Their primary goal is to make apprehensive teachers more comfortable teaching science by providing expertise and access to PM resources. As dynamic young scientists, the GK-12 Fellows will also foster among young students a curiosity and enthusiasm for learning science. By communicating the excitement of scientific discovery, they hope to inspire a lifelong interest and sense of wonder about our place in the natural world.

The GK-12 Fellows' diverse perspectives are evident as they reflect on their new roles. Ms. Heckman attributes her inspiration for educating young students to her field research on lemurs in Madagascar. She believes that "introducing science early with an engaging, interactive approach encourages students to remain interested in it throughout their life. Science also provides a structure for critical thinking through hypothesis testing."

Ms. Scott's dissertation examines how the science of human evolution is communicated to diverse audiences in museums. She stresses "the importance for scientists to be continually conscious of the ways in which science and society are interconnected, and the ways in which scientists are connected to their communities at large. The web of life interconnected through biodiversity is an apt model for encouraging us all to think about the interconnections between science and society."

Ms. Siebold's doctoral research focuses on the relationship between health services and the public school setting. "Integrating health into the schools is an essential component of successful school reform. The Peabody Fellows program emphasizes the connection between the environment, science and health. Making children aware of the relationship between the environment and health at a young age increases the likelihood that they will develop respect for both."

The PM's orientation and training for the GK-12 Fellows included sessions on object-based learning and the history of museums led by Jane Pickering, assistant director for public programs; discussions on inquiry-based science with Terri Stern, curriculum specialist, and William Rando, director of teaching fellow development at the McDougal Center; and guided exposure to the PM's research collections led by Collections Managers Nico Cellinese (Botany), Eric Lazo-Wasem (Invertebrate Zoology), Kristof Zyskowski (Ornithology), and Ray Pupedis (Entomology).

For more information, visit peabody.yale.edu/education/fellows.

PETRIFIED WOOD:
Rainbows In Stone

by Linda Klise and Leo J. Hickey

Petrified Wood: Rainbows in Stone is a stunning new exhibit permanently gracing the Peabody Museum of Natural History's (PM) Great Hall. In addition to exploring the processes whereby plants become petrified, the exhibit documents the remarkable persistence of an ancient line of conifers that continues to dominate living remnants of a once flourishing Mesozoic ecosystem.

All of the specimens in the exhibit, whether fossil or recent, belong to a single long-lived family of giant conifers or cone bearing trees, known as the Araucariaceae or araucarians. The spectacularly colored logs and cross section that are the centerpiece of this exhibit were collected near the Petrified Forest National Park in east central Arizona and date to the Late Triassic Period, about 225 million years ago. At that time a great forest dominated by these towering trees extended from Texas into Utah.

Today, survivors of the araucarians are restricted to a portion of the warm-temperate to sub-tropical parts of the Southern Hemisphere, reaching into the Northern Hemisphere only in the Philippines. The fossil record shows that araucarians were abundant in moderate-to-warm climate areas of the Northern Hemisphere throughout the Mesozoic Era. However, they disappeared abruptly 65 million years ago, presumably as a result of the same catastrophe that caused the extinction of dinosaurs.

Judging from the size of their trunks and the stature of their descendents, araucarian trees grew upwards of 150 to 200 feet in height with trunks 4-5 feet in diameter. Some paleobotanists think that the characteristic umbrella silhouette that typifies older specimens of many modern araucarians may be a holdover from the time it served to protect the their foliage from grazing by gigantic sauropod dinosaurs such as Apatosaurus. Others maintain, however, that the constraints of blood-pressure physics would have prevented such giant sauropods from ever raising their heads so high.

Once these trees died they were transported by swollen streams from their original growth site to swampy lowland regions. As they tumbled or jostled one another, their branches, bark and small roots either broke off or were worn away. Over time they were buried in silt, mudstone or volcanic ash. This blanket of sediment sealed the logs away from oxygen, slowing their decay. At the same time, ground waters containing petrifying minerals seeped through the logs encasing much of the original cell wall.

Altogether, some 40 minerals have been associated with the process of petrification, but silica (silicon dioxide) in the form of quartz is the most abundant. As the cell walls filled with silica, more and more of the cellulose compounds and lignin were replaced, and the logs began to harden. During this process of petrification mineral impurities mixed with silica, producing the highly prized "rainbow wood" of this exhibit. The brilliant array of colors comes from manganese oxides (blues, black, purples), gypsum (white) and the iron oxides limonite (yellow) and hematite (red, rust). The scientific name of the Arizona specimens is Araucarioxylon arizonicum. The generic name used here relates to wood (Greek, xylon) of supposed affinity to the araucarian family.

One of the most extraordinary specimens in the exhibit is an exquisite slab of hardened volcanic ash (an especially good source of silica in highly soluble form) from the Jurassic Period of Argentina. Approximately 160 million years old, it contains over 40 araucarian cones, many still attached to the branches on which they grew. Cones of Araucaria typically disintegrate within a few weeks of ripening.

This specimen preserves a moment in geological time when a volcanic eruption tore down the forest canopy and buried the cones just as they had finished ripening. Because the parts of plants normally occur widely dispersed in the fossil record, with foliage, cone and tree specimens gathered from different localities and times, such an integral specimen is rare indeed.

Also displayed in the exhibit are individual petrified cones of Araucaria mirabilis from the same fossil forest of Argentina viewed next to a nearly identical modern cone of Araucaria angustifolia from southern Brazil. Support for Petrified Wood: Rainbows in Stone was provided by Ruth R. Lapides, Alex G. Nason Foundation, Inc., and Ralph Thompson.

David Heiser

Polished Trunk. Araucarioxylon arizonicum. Chinle Formation, Petrified Forest Member, late Triassic Period (aproximately 225 million years ago), near Petrified Forest National Park, AZ

Yale Celebrates 100th Birthday of G. Evelyn Hutchinson

On October 25, 2003, Yale celebrated the 100th birthday of G. Evelyn Hutchinson (1903–1991) with a day long speakers program and related exhibits highlighting Hutchinson's achievements in ecology and limnology, reflecting his interests in art and literature.

Hutchinson, born in England and educated at Cambridge, was famous for his study of the ecology of lakes and is known as the father of modern limnology, a mentor of many influential ecologists, a graceful prose stylist, an acute observer of natural history, and a contributor to the foundations of several other fields of science, especially biogeochemistry and evolutionary ecology. He arrived at Yale in 1928 and enjoyed a distinguished 43-year career, becoming the Sterling Professor of Zoology.

Speakers for the day were Sharon Kingsland, Professor of History, Science, Medicine & Technology at Johns Hopkins University; Earl Werner and Deborah Goldberg, Professors of Ecology & Evolutionary Biology at the University of Michigan; Lilian Randall, Curator of Manuscripts and Rare Books *Emerita*, The Walters Art Museum; Peter Vitousek, Professor of Population Biology at Stanford University; David Schindler, Professor of Biological Sciences at the University of Alberta; as well as Yale faculty Professors Oswald Schmitz and David Skelly, Yale School of Forestry & Environmental Studies; Chair and Edward P. Bass Professor Stephen Stearns and Professor David Post, Department Ecology & Evolutionary Biology (EEB); Sterling Professor Karl K. Turekian from the Department of Geology & Geophysics; and Michael Donoghue, Director of the Peabody Museum of Natural History and G. Evelyn Hutchinson Professor in EEB.

YIBS/ESC FRIDAY LUNCHEON SEMINAR SERIES

The Yale Institute for Biospheric Studies (YIBS) is again sponsoring a weekly seminar series held in the Class of 1954 Environmental Science Center (ESC), which promotes the intention of the building's use as a locus of interdisciplinary activities in environmental sciences. The YIBS/ESC Friday Luncheon Seminars are held during the Fall and Spring Semesters from 12 Noon to 1:15 PM, with topics relating to current research taking place in the various departments represented in the ESC. For a full schedule of seminars dates, speakers and topics, visit web site http://www.yale.edu/yibs/ESC_Seminar.html or call Peter Schrader at (203)432-9857.

Yale Graduate Students Trained as Forest Assessors

by Elizabeth Gordon and Barbara Bamberger

Last Spring, Yale's Program on Forest Certification, in collaboration with Rainforest Alliance/Smartwood, trained Yale graduate and professional students as forest assessors under the standards and criteria of the Forest Stewardship Council (FSC). Founded in 1993 by environmental groups, the timber industry, and foresters, the FSC provides a mechanism for tracking and monitoring timber production to meet a range of environmental criteria.

"By tracking wood from forest to final product, certification enables consumers to support responsible forestry and provides forest owners with an incentive to maintain and improve forest management practices," according to the FSC website. Growing recognition of forest certification regimes is hoped to provide a commercial incentive to industry and forest managers to use and purchase wood that is a result of sustainable forest management practices.

SmartWood, a program of the international non-profit the Rainforest Alliance, trained the 20 students and four professionals who participated in this three-day event. In addition to being accredited by the FSC, SmartWood is the oldest and one of the most extensive certifying bodies in the world. In advance of the trip, participants were asked to study management documents and an ecological, economic and social history of the land to be assessed during the training. Participants then examined FSC standards and criteria and their indicators in order to prepare for landowner and stakeholder interviews, a key component of the assessment.

During the training, students conducted stakeholders meetings with members of the community, and visited a sawmill to experience the chain of custody certification with an FSC-certified, wood-flooring manufacturer. Chain of custody certification helps to track certified wood through the complicated production stream—from timber managers to suppliers, wholesalers and manufacturers. This allows consumers to know where their wood came from and how it was produced.

Overall, the training was received enthusiastically by participants and program organizers alike. Participant and student organizer Abigail Weinberg noted, "The training was invaluable to understanding the complexities of the certification process and elucidated ways that certification can facilitate global sustainable forestry."

With the success of the program, the Yale Program on Forest Certification (YPFC) within Yale's School of Forestry & Environmental Studies (F&ES) hopes to include the assessor training as an ongoing practical tool for F&ES students and professional associates alike. Professor Benjamin Cashore, chair of the program, explains: "YPFC is very excited about the success of the assessor training and we hope to be able to offer it again in the future."

SmartWood has certified more than 800 operations and 25 million acres worldwide.

Smartwood officials commented that it was the best group of potential assessors they had ever trained.

Yale School of Forestry & Environmental Studies graduate student, Abigail Weinberg, studies a map of Connecticut land parcels in preparation for a mock interview with a stakeholder from the Nature Conservancy.

Top: The Guilford Coastal Station (Beattie House)

Middle: Horse Island

Bottom: The Richards Property

Yale's Natural Lands and the Guilford Coastal Station: Underutilized Resources Whose Time Has Come

by Stephen Stearns, Edward P. Bass Professor, and Chair,
Department of Ecology & Evolutionary Biology

No one can doubt Yale's contribution to ecology and conservation. From Gifford Pinchot and Aldo Leopold to Tom Lovejoy, Francis Beinecke, Ed Bass, Gus Speth, Strachan Donnelly, and many others, Yale has educated generations of national and international environmental leaders. Students arriving in New Haven with strong interests in the environment have found this a congenial and supportive university for more than a century.

They have, however, been a minority. It is still true that most Yale undergraduates grow up in cities and spend most of their time at Yale sitting in front of computers. Their field trips are made more frequently to Manhattan than to wilderness. Most of those interested in biology concentrate on molecular biology, spend their time in laboratories, and plan to attend medical school. Yale may be good at nurturing undergraduates who arrive here with environmental interests, but she is not yet doing a good job of showing large numbers of undergraduates how important, beautiful, and threatened the environment is, or how challenging and exciting the environmental sciences have become. There is considerable room for improvement.

It is not as though the problem has gone unnoticed. The greening of Yale, led by Yale's President Richard Levin and former Provost Alison Richard, has been a priority for at least a decade. The faculty under leadership of Deans Richard Brodhead and Gus Speth have created a new primary major in Environmental Studies. The new major got underway in 2002 with a curriculum including six new core courses, two in natural sciences and four in the social sciences and humanities. Recent appointments in the Departments of Ecology and Evolutionary Biology and Geology and Geophysics, in the School of Forestry & Environmental Studies, and in the School of Epidemiology & Public Health have added distinguished faculty doing environmental research. Many of them now want to expand and upgrade our offering of field courses, and some have been managing to do so for quite some time with very little infrastructure. Their arrival has triggered a new look at one of Yale's major under-utilized resources: its natural lands.

Yale's Natural Lands

Over the years, mostly through bequests, Yale has acquired ownership, and stewardship, of thousands of acres of natural land in New England. The Guilford properties are administered by Yale's Peabody Museum of Natural History (PM); the properties in New Haven and Branford by the Yale Natural Lands Committee (YNLC) appointed by the Provost; and the forests in northern Connecticut, Vermont, and New Hampshire by the School of Forestry & Environmental Studies ((F&ES, see Table). Several of these sites can be viewed at http://www.yale.edu/cfe/naturallands.html.

The site best suited to field research by undergraduate seniors and graduate students is the Yale-Myers Forest, an hour from New Haven in northeastern Connecticut. The site best suited to undergraduate teaching on weekdays is the collection of holdings in Guilford.

The Guilford Coastal Station

The Guilford Coastal Station, administered by Yale's Peabody Museum of Natural History (PM), can be reached by bus from central campus in less than half an hour. The center of the Station is the Beattie house and its outbuildings, situated on a lovely, quiet bay just inshore

Property	Location	Size	Governance
Yale Natural Preserve	New Haven, CT	200 acres	YNLC
Linsley Pond	Branford, CT	5 acres	YNLC
Linsley Lake	Branford, CT	< 1 acre	YNLC
Lydyhites Pond	Branford, CT	33 acres	YNLC
Yale Coastal Station	Guilford, CT	1.75 acres	PM
The Richards Property	Guilford, CT	41 acres	PM
The Emery Property	Guilford, CT	11 acres	PM
Horse Island	Guilford, CT	17 acres	PM
Yale-Myers Forest	Tolland & Windham Counties, CT	7,500 acres	F&ES
Keene Forest	Cheshire County, NH	1,400 acres	F&ES
Bowen Memorial Forest	Belknap County, VT	500 acres	F&ES
The Brett Pinetum	Fairfield, CT	5 acres	F&ES
Norfolk Forest (leased)	Litchfield County, CT	1374 acres	F&ES
Total		11,089 acres	

of the Thimble Islands. It is a superb site for scientists interested in launching research on Long Island Sound, where eutrophication is of practical concern and whose coastal and estuarine habitats offer a broad palette of basic research issues.

The largest of those islands, Horse Island (17 acres), belongs to Yale and can be reached by boat from the Station and by public ferry from Branford. It has beautiful rocky intertidal habitat as well as forests.

Near the station is the Richards Property, a bequest to Yale from one of its most distinguished biochemists, Fred Richards, and his wife Sally, who did important ecological work. With 41 acres of upland woods and salt marsh, it is an excellent site to teach both biodiversity and ecosystem ecology. On it also are Indian middens and the site from which the base of the Statue of Liberty was quarried.

Nearby lies Guilford Pond, surrounded by a hardwood forest on a plot totaling 11 acres. The ensemble of sites and habitats at Guilford is beautiful, rich in species, diverse in problems and projects, and easy to reach from New Haven.

The facilities, however, leave much to be desired. The Beattie house is badly in need of renovation; the outbuildings need to be completely replaced; and a classroom and lab are needed from which to stage the field courses that more and more faculty are offering.

Under the leadership of Michael Donoghue at the PM, a broadly representative group has been formed to recommend appropriate upgrades to the Guilford site. It draws on the enthusiasm and interest of faculty in the PM, the Departments of Ecology and Evolutionary Biology and Geology and Geophysics, the School of Forestry & Environmental Studies, and the Environmental Studies Program, all of which already use the site or plan to do so soon. Among the activities envisioned are undergraduate and graduate education, student and faculty research, and adult education and public outreach. The site also has the potential to serve as a residence for short-term visits by distinguished guests and as a center for small conferences.

Consensus must be reached, priorities set, money found—$2-5 million. All will take time, but within a few years, the Guilford Station could become one of the best sites for undergraduate and graduate education and coastal research in the environmental sciences on the East Coast. And it could convert Yale from a place where only the previously convinced strengthen their environmental competence to a place where many other students discover for the first time just how compelling environmental science can be.

F&ES BUYS WIND POWER

To encourage the development and use of alternative energy sources, the School of Forestry & Environmental Studies (F&ES) has purchased $3,500 of "renewable energy certificates," ensuring that 20 percent of the school's electricity is generated from wind power.

The purchase supports the "20 percent by 2010" campaign in Connecticut, initiated by Hartford-based nonprofit SmartPower Connecticut. The program encourages businesses and residences to commit to purchasing electricity from renewable sources.

"As an environment school, we should be setting a good example," said Dean Gus Speth. "Supporting the development and use of clean, wind energy is compatible with this goal."

F&ES purchased the certificates through the NewWind Energy program of Community Energy in Wayne, Penn., a company that markets and develops wind-generated power from the Fenner Wind Power Facility in Fenner, NY "By buying NewWind Energy certificates, F&ES ensures that more clean, renewable energy gets delivered into the system, and displaces conventional power generated from polluting sources such as coal or oil," said Jeffrey Keeler, the New England Director for Community Energy, Inc.

Keeler noted that F&ES is the first customer in Connecticut for Community Energy, and the purchase will generate more business throughout the state and region. "Supporting the new wind energy projects sets an example for other schools, businesses, governments and individuals in Connecticut and New England to follow."

Another aspect of F&ES' commitment to enhanced environmental performance is its plan for the construction of a complex that will include a "green" facility. The complex will be a model of energy conservation and efficiency, and it will employ systems for efficient waste management while restoring the surrounding area's ecology. The complex is at the center of the school's current $60 million capital campaign, for which $40 million has been raised.

Report Says Government Underestimates Cost of Wildfires

The cost of wildfires is vastly underestimated because federal and state agencies do not share or collect enough data on the impact of fires, according to a report released by the Global Institute of Sustainable Forestry at the Yale School of Forestry & Environmental Studies.

"During the past three fire seasons, 19 million acres of forest burned across the United States, from New Jersey to California, costing $3.4 billion for fire suppression," said Mary Tyrrell, director of the Program on Private Forests and co-author of the report. "This only begins to tell the story of wildfire impacts on communities."

Federal agencies keep records only on total acres burned, structures destroyed and fire suppression costs, which, according to the report, provide policy makers with an incomplete picture of the impacts of wildfires. The report, which is available at www.yale.edu/gisf, recommends that government agencies also calculate restoration costs, watershed impacts, lost tourism revenue, private-property losses and human health effects in order to reassess wildfire policies and forest management practices.

The report contains case studies of 10 of the most costly and damaging fires in recent years using data collected from national and state agencies over the past three years. Last year's Hayman Fire, the largest in Colorado's history, burned 137,760 acres of the Pike National Forest and private lands within 20 miles of the Denver and Colorado Springs metropolitan areas, home to nearly 3 million people. The estimated cost of suppressing the fire was $39 million. But, according to Tyrrell, the real cost was more likely triple that amount after factoring in the fire's impact on the Denver municipal water supply system and public health, and the cost of restoring private and federal lands.

Researchers found that eight of the 10 fires burned in areas where pre-fire forest conditions were significantly altered over many decades by fire suppression, timber harvesting, grazing, insects and disease and the introduction of exotic plant species. Tyrrell believes that increased funding for better forest management at the wildland/urban interface would help reduce the severity and cost of these wildfires.

The American Forest & Paper Association and the Global Institute of Sustainable Forestry funded the report, "Assessing the Environmental, Social, and Economic Impacts of Wildfire."

Study: Agricultural Lands May Store More Carbon Dioxide In Rivers Than Forests

A new study demonstrates a decades-long increase in the export of dissolved alkalinity from the Mississippi River, a process that removes the greenhouse gas carbon dioxide from the atmosphere and also suggests that agricultural lands may sequester more atmospheric carbon dioxide in rivers than forests.

The study, conducted by researchers at the Yale School of Forestry & Environmental Studies and the Institute of Ecosystem Studies in Milbrook, N.Y., appeared in the July 4 edition of Science.

Atmospheric carbon dioxide (CO_2) dissolved in rain and water in the soil acts as an acid, reacting with subterranean rocks to form dissolved carbonate alkalinity, which is then transported to the coastal ocean. Peter Raymond, assistant professor of ecosystem ecology at F&ES, and Jonathan Cole, an aquatic biologist at the Institute of Ecosystem Studies, show that dissolved carbonate alkalinity emanating from the Mississippi River, which is the largest river in North America, has increased dramatically over the past 47 years. They argue that the increase in dissolved alkalinity export is linked to increases in precipitation, which are documented for the Mississippi watershed. Scientists believe that the atmospheric buildup of carbon dioxide is contributing to climate change.

"These findings have two important implications," said Raymond. "First, they demonstrate the ability of a large watershed to sequester more atmospheric CO_2 in response to increases in rainfall, itself a projection of global warming. Second, previous researchers have argued that reconverting agricultural fields to forests increases the removal of atmospheric carbon dioxide by locking it away in living trees and soils. But we show that agricultural lands export more dissolved carbonate alkalinity than forested lands and, therefore, may sequester more atmospheric carbon dioxide than forests through this pathway."

Raymond and Cole are not arguing that agricultural fields are more valuable than forests with respect to atmospheric CO_2 concentrations, but are advocating the development of complete carbon budgets, including stream export, when determining the United States carbon balance.

Conservation Genetics of Giant Tortoises Project Featured in Science Magazine

YIBS ECOSAVE Conservation Genetics Laboratory (CGL) Director, Dr. Adalgisa Caccone, has been conducting an on-going study of the giant tortoises of the Galapagos Islands, and a paper resulting from this study is featured in the October 3, 2003 issue of Science Magazine.

Dr. Caccone, along with Yale Professor Jeffrey Powell in the Department of Ecology & Evolutionary Biology, and Dr. Luciano Beheregaray, a former Gaylord Donnelley Environmental Postdoctoral Fellow in the CGL, and now Assistant Professor of Biology at Macquaire University in Sydney Australia, collaborated on the study.

The paper suggests that giant tortoises that live on the slopes of Alcedo, a volcano on one of the islands, are far more inbred than those on nearby islands as a result of passing through a genetic bottleneck after an eruption there 100,000 years ago. It also suggests that Alcedo's ancient explosive past may have reduced the tortoise population at the time to just a few related individuals. Alcedo is an island located on Isabela, with five giant tortoise groups each occupying the slopes of its five major volcanoes. The group living in its vegetated areas is the most numerous in the archipelago, with between 3000 to 5000 individuals.

Beheregaray notes that their lack of genetic diversity was a real surprise, and that the study expected to find Alcedo to have the largest genetic diversity because it has the largest tortoise population. But just as human genetic studies have previously suggested that our own origins boast a similar bottleneck from a few founding females—the so-called "African Eve"—it turns out that Alcedo seems to have had its own tortoise equivalent, a Galapagos Eve.

Beheregaray was studying the tortoises to obtain insights into the process of island colonization and population history when a large-scale survey of their mitochondrial DNA —which is inherited along maternal lines surprisingly revealed that those on Alcedo had three to five times less matrilineal diversity than the other Isabela tortoises. This finding could indicate a relatively young population, despite the fact that Alcedo emerged above sea level at about the same time as the other Isabela volcanoes, about 500,000 years ago. Also, Alcedo probably was never exploited by whalers who hunted tortoise populations on more accessible islands. What does set Alcedo apart, however, is that it is unique among Galapagos volcanoes in having experienced a major explosive eruption in prehistoric times, 100,000 years ago (the rest are made up of basalt lavas that did not erupt explosively).

PROFESSOR JEFFREY POWELL
Elected President of The Society of Molecular Biology and Evolution

Jeffrey Powell, a Professor in the Department of Ecology and Evolutionary Biology and a member of the Yale Institute for Biospheric Studies (YIBS) community since its origin, has been elected President of the Society of Molecular Biology and Evolution. This international society exists to provide facilities for association and communication among molecular evolutionists. One of its primary goals is to increase communication between the fields of evolution and molecular biology. In order to accomplish those goals, the Society publishes the journal Molecular Biology and Evolution (MBE), the highest impact journal in the field and it sponsors an annual meeting. Yale, with the financial support of YIBS, hosted the annual meeting of this society in 2000.

EEB student Scott Glaberman and Dr. Adalgisa Caccone taking blood from Galapagos tortoises for genetic analysis.

The Yale Student Environmental Coalition: Working for a Sustainable Campus

by Maggie Dietrich, BK '05 (Current YSEC Co-Chair)

Members of the Yale Student Environmental Coalition (YSEC), the umbrella organization for all of the undergraduate environmental groups on campus, have already been hard at work this year (and in a few cases, over the summer), in their efforts to launch a broader-reaching set of projects than ever before. As large-scale environmental problems continue to threaten our global community, YSEC has developed a number of exciting initiatives geared toward sustainability on both a university-wide and a regional level. While the Sustainable Food Project's recent introduction of organic and locally-grown foods in the Berkeley College dining hall has certainly garnered the most media attention thus far, including an article in the Wall Street Journal last spring, YSEC's other central initiatives are equally ambitious and worthy of attention.

The Climate Campaign
A collaborative effort of the six major student environmental networks in the Northeast to make our schools and our states lead the way in the fight against global warming. Students will be working together to pressure governors to pass state climate action plans and to pressure our university administrations to make strong commitments to reduce greenhouse gas emissions. (Students have been working to arrange a regional student environmental network since last spring, when YSEC hosted a conference of northeastern student environmental groups at the Yale School of Forestry & Environmental Studies (F&ES). Many students continued to organize the network structure throughout this summer. This year's Climate Campaign is the first project launched by the newly formed regional coalition.)

The Energy Campaign
A student-led effort which is currently working with the Yale administration to reduce on-campus energy consumption. Students have been working to construct a detailed energy audit, which will then be used to determine how energy can be conserved most cost-effectively.

The Paper Project
A small group of students who have been working with all of the academic departments at Yale over the past semester in an effort to increase the purchase and use of 30% post-consumer recycled paper on campus.

SUMMER ENVIRONMENTAL INTERNSHIPS

The Environmental Studies Program in 2003 awarded 26 Environmental Summer Internships totaling $67,520 to Yale undergraduates. Funding for the internships was provided by the William Bingham and Montgomery Family Endowments that support Environmental Studies, as well as the Department of Ecology & Evolutionary Biology and the Yale Center for the Study of Globalization. The subject areas represented by our 2003 internship awardees ranged broadly, from studies of the HOX developmental gene in lower vertebrates to the integration of traditional sustainable farming techniques with new methods of agroecology in both Mexico and Tanzania. What is striking about the 2003 internships is their global scope. We see a strong interest in the environmental consequences of rapid economic development in a globalized marketplace. The problem of sustainable development, whether abroad or in the US, is a primary focus for many majors in the Environmental Studies program, Yale's newest standalone major. For these students, who represent 40% of the internship awardees, the summer work often develops into a senior independent project.

The following students received support for their summer projects:

Bhart-Anjan Bhullar, Biology (Ecology and Evolutionary Biology Track) '05
Investigation of the Functional Evolution of HoxA-11, a Transcription Factor Pivotal to Tetrapod Macroevolution

Livia DeMarchis, Environmental Studies '04
Surveying Frog Populations in Vermont and Connecticut

Joshua Fialkow, Biology (Ecology and Evolutionary Biology Track) '05
Joint Internship in Alaskan Fish Biology and Environmental Education at Wrangell—St. Elias National Park

Kent Gould and Lisa Rothman, Architecture '04
Environmental Design for Extreme Climates (Onsite Research in Iceland, Morocco, and Brazil)

Anna Gross, Environmental Studies '04
Feasibility of Adaptive Management as a Strategy for Conservation

Kathryn Henderson, Geology & Geophysics '04
Deformation and Fluid Flow During Metamorphism and Mountain Building in Crete, Greece

Emmy Hoy, Molecular, Cellular, and Developmental Biology '04
Environmental Consequences of the Use of Genetically Engineered Symbiotic Microbes as a Method of Disease Control

Peter Isaacson, Geology & Geophysics '05
Penn/Yellowstone-Bighorn Research Association Summer Course Geologic Field Methods in Red Lodge, Montana

Judith Joffe-Block, History '04
Facilitating Transitions in Mexican Agriculture: Rediscovery of Traditional Knowledge and New Findings in Agroecology

Daniel Keniston, Environmental Studies and Ethics, Politics, & Economics '04
Community Forest Management with USAID in Guinea

The Yale Food Project
A student and administrative project, which currently has three major components:

1) Bringing fresh, local, and organic food into the Yale dining halls, starting with a pilot project in the Berkeley College dining hall this year. By buying from local farmers with ecologically sustainable practices, we hope to positively influence the food system and landscape of New England and the greater US.

2) Composting Yale's organic waste, thereby reducing the University's disposal costs and creating a source of fertilizer for local agriculture.

3) Farming and educating members of the Yale and New Haven communities on the Yale Organic Garden plot (described in detail below).

Although the success of this project is due in large part to the Herculean efforts of the administration, it would not exist if not for the enthusiasm and interest of students. This year, students have formed the Sustainable Food Group, which will focus on education and outreach both at Yale and in the off-campus community.

The Yale Organic Garden
A one-acre garden plot, located on Edwards Street, organically growing an enormous variety of vegetables, including eggplant, bok-choy, pumpkins, sun-gold cherry tomatoes, and watermelon (to name just a few). The garden was created last May, with funding from Yale's Advisory Committee on Environmental Management and the generous help of about a dozen student interns, who worked through the summer. Students tend the farm, and harvested produce is sold at the Temple Street Farmers' Market or given to the Berkeley College dining hall. The primary goals of the garden are to serve as an educational resource for Yale students and members of the broader New Haven community, to model sustainable agriculture, and to provide student-harvested food to the students themselves.

In addition to these five major sustainability endeavors, YSEC continues to run its ongoing projects and campaigns, including environmental education in New Haven preschools, weekend service trips to local farms, and consumer and voter activism through such national organizations as Ecopledge and Students for and Environmentally Responsible President (SERP). The tremendous energy and talent that has been and continues to be poured into all of YSEC's latest initiatives is no less than inspiring. Indeed, we hope that the success of these projects may serve as a living testament to the group's favorite Margaret Mead quote, "Never doubt that a small group of thoughtful, committed citizens can change the world. Indeed, it is the only thing that ever has."

Sparsh Khandeshi, Environmental Studies '04
Alpine Meadow Management in Sequoia / Kings Canyon National Parks with the White Mountain Research Station REU Program

Amy Kohout, History '04
Internship with Friends of the Boundary Waters Wilderness in Minneapolis

Katherine Lo, Anthropology '05
Internship with the International Society for Ecology and Culture in Ladakh, India

Christopher McPhee, Environmental Studies '04
Dendrochronology and Dendroclimatology in the Southwestern United States

Todd Montgomery, Environmental Studies '04
Issues in Land Management and Development: The Canyon Club Project in Jackson, Wyoming

Christine Pham, Environmental Studies '04
The Nexus Between Environment and Development in Tanzania from a Food Security Perspective

Anya Raredon, Architecture '04
The Interaction of Environment and Vernacular Architecture in Mesoamerica

Michael Renda, Economics and Environmental Studies '04
Internship with the U.S. EPA in the Office of Policy, Economics and Innovation

Linda Shi, Environmental Studies and International Studies '04
Effect of Tourism in Sao Tome on Culture, Environment, and Economy of the Island

Katherine Sims, History of Art '04
Researching Clean Energy Alternatives with the Vermont Sierra Club

Marina Spitkovskaya, Environmental Studies and International Studies '04
Contamination, Health, and Injustice in Vieques, Puerto Rico

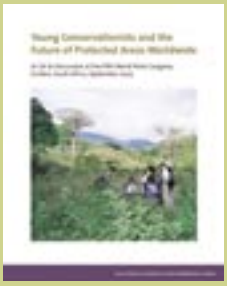
Elizabeth Turnell, Ecology and Evolutionary Biology Track '04
Internship at the Marine Resources Center at Woods Hole

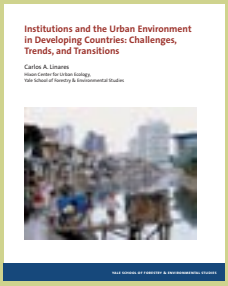
Rachel Wasser, Environmental Studies '04
Harnessing Capitalism: A Study of Women and the Community Based Natural Resources Management (CBNRM) Program in Botswana

Daniel Wei, Ecology and Evolutionary Biology '04
Genetic Examination of A. gambiae Species Complex: Understanding the Population Biology of the Main Vector of Malaria in Sub-Saharan Africa

Xizhou Zhou, Environmental Studies and International Studies '05
Internship with the World Wildlife Fund on the East Dongting Lake Wetland Conservation Project, China

PUBLICATIONS





TWO NEW F&ES WORKING PAPERS

Young Conservationists and the Future of Protected Areas Worldwide: A Call to Discussion at the Fifth World Parks Congress, Durban, South Africa, September 2003.

This paper is a product of a Spring '03 F&ES course on protected areas taught by Lisa Curran, Gordon Geballe, and Lisbet Kugler MEM '02. Twelve students and faculty from the course travelled to South Africa to attend the Congress and lead a special discussion based on the document. Supported with a grant from the Yale Center for the Study of Globalization.

Institutions and the Urban Environment in Developing Countries: Challenges, Trends, and Transitions

by Carlos Linares, an '03 graduate of the F&ES mid-career 1-year degree program for experienced professionals.

The paper highlights the important role that the "informal" sector plays in providing inexpensive water and sanitation to the poor in cities in developing countries around the world. Supported by the Hixon Center for Urban Ecology, the Leonard G. Carpenter Endowment Fund, and the Sperry Leavenworth Endowment Fund.

For free downloadable PDFs or to order printed copies of these and all other F&ES publications, go to our new OnLine Bookstore at www.yale.edu/environment/publications. For more information, contact Jane Coppock MEM '91, Editor, Yale F&ES Publications Series, at jane.coppock@yale.edu.

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Directors of the Environmental Partnership
Michael Donoghue
Director, Yale Peabody Museum of Natural History and Professor of Ecology & Evolutionary Biology
www.peabody.yale.edu

James Gustave Speth
Dean, Yale School of Forestry & Environmental Studies and Professor in the Practice of Environmental Policy and Sustainable Development
www.yale.edu/environment

Karl K. Turekian
Director, Yale Institute for Biospheric Studies and Silliman Professor of Geology & Geophysics
www.yale.edu/yibs
http://love.geology.yale.edu

We welcome submissions from faculty, staff, and students.

To submit an item, please contact:
Rose Rita Riccitelli, Editor.
Tel: 203.432.9856
Fax: 203.432.9927
E-mail: roserita.riccitelli@yale.edu

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