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Center for Biodiversity and Conservation

SPRING SYMPOSIUM

April 17 and 18, 1997

HUMANS AND OTHER CATASTROPHES: EXPLAINING PAST EXTINCTIONS AND THE EXTINCTION PROCESS

April 17, 1997

PREVENTING EXTINCTION: ADVANCES IN BIODIVERSITY CONSERVATION

April 18, 1997

American Museum of Natural History

Thursday, April 17, 1997

SPRING SYMPOSIUM

Extinction is a natural process. Indeed, it is as much a part of the total pattern of life on earth as is evolution. However, this does not mean that all extinctions have a common cause. For many reasons, it is vital that we understand better how extinctions occur.

The overwhelming majority of species losses have occurred within mass extinction events. Five major events, and a host of smaller ones, have occurred in the last 500 million years. Some appear to have been caused by worldwide environmental changes induced by extraterrestrial bolide impacts or colossal releases of volcanic materials. Others do not yet have an established cause.

Many scientists believe that we are witnessing the onset of a sixth major extinction event. They argue that this one differs from the others in three ways: the rapidity with which species are being lost—at one-hundred times the rate predicted by the fossil record; the diversity of taxa being affected; and the cause — human activities.

To properly understand human involvement in extinction, we have to look at the past as well as the present and the future. A dreadful syncopation appears to link the earliest human migrations across the continents to the sudden and severe loss of species. Today, population levels and patterns of consumption exert their own devastating effect, threatening not only species but entire ecosystems.

We have the capacity to control and alter ecosystems to suit and support our own species in every region of the planet. By placing undiminished demands on the planet's natural resources, habitats, and environment, we entertain the naive and dangerous notion that we are a species set apart.

In order to make appropriate decisions to ensure the future for all species, we must meet the challenge of comprehending the mechanisms at work in extinctions, and determine the most effective course of action to maintain and sustain earth's precious biological diversity.

CENTER FOR BIODIVERSITY AND CONSERVATION

SPRING SYMPOSIUM SCHEDULE

Thursday, April 17, 1997

HUMANS AND OTHER CATASTROPHES: EXPLAINING PAST EXTINCTIONS AND THE EXTINCTION PROCESS

7:30 a.m.	REGISTRATION (for attendees)
8:30 a.m.	INTRODUCTORY REMARKS Michael J. Novacek Senior Vice-President and Provost, AMNH Ross D.E. MacPhee Curator and Chairman of Mammalogy, AMNH
8:45 a.m.	Paul S. Martin, University of Arizona *Prehistoric Overkill: Four Decades of Discovery and Debate*
9:15 a.m.	Norman Owen-Smith, University of the Witwatersrand *The Interaction of Humans, Megaherbivores, and Habitats in the Late Pleistocene Extinction Event*
9:45 a.m.	John Alroy, Smithsonian Institution *Reorganization of Late Quaternary Mammal Faunas and Causes of Mass Extinction*
10:15 - 10:30 a.m.	**Coffee/Tea Break**
10:30 a.m.	A.J. Stuart, Norfolk Museum Services/Castle Museum *The Role of Humans in Late Pleistocene Megafaunal Extinction, with Particular Reference to Northern Eurasia and North America*
11:00 a.m.	Gary Haynes and B. Sunday Eiselt, University of Nevada *The Power of Pleistocene Hunter-gatherers: A Forward and Backward Search for the Evidence about Mammoth Extinction*
11:30 a.m.	Russell W. Graham, Denver Museum of Natural History Thomas W. Stafford, Jr., University of Colorado Holmes A. Semken, Jr., University of Iowa *Pleistocene Extinctions: Chronology, Non-analog Communities, and Environmental Change*
12:00-12:30 p.m.	Discussion – Past Extinctions and the Extinction Process: Some Lessons from the Pleistocene Moderator: David Hurst Thomas, AMNH

American Museum of Natural History

SPRING SYMPOSIUM SCHEDULE

12:30 - 1:30 p.m.	**Lunch**
1:30 p.m.	Tim F. Flannery, Australian Museum *Emerging Patterns in Australasian Quaternary Extinctions*
2:00 p.m.	Richard N. Holdaway, Palaecol Research *Differential Vulnerability in the New Zealand Vertebrate Fauna*
2:30 p.m.	Melanie L.J. Stiassny and Ian J. Harrison, AMNH *Vanishing from Freshwater: Species Decline and the Machinery of Extinction*
3:00 p.m.	David A. Burney, Fordham University *Rates, Patterns, and Processes of Landscape Transformation and Extinction: Madagascar as an Experiment in Human Ecology*
3:30 - 3:45 p.m.	**Coffee/Tea Break**
3:45 p.m.	Helen F. James, Smithsonian Institution Douglas Siegel-Causey, National Science Foundation *Prehistoric Extinctions in Hawaii: The Search for Causes*
4:15 p.m.	Ross D.E. MacPhee, AMNH Preston A. Marx, Aaron Diamond AIDS Research Center *Lightning Strikes Twice: Blitzkrieg, Hyperdisease, and Global Explanations of Late Quaternary Catastrophic Extinctions*
4:45 p.m.	Niles Eldredge, AMNH *Cretaceous Meteor Showers, the Human Ecological "Niche," and the Sixth Extinction*
5:15 - 5:45 p.m.	Discussion—Past Extinctions and the Extinction Process: Explaining Faunal Collapses on Islands and Elsewhere Moderator: Joel L. Cracraft, AMNH
7:00 p.m.	**PLENARY ADDRESS** Stuart L. Pimm, University of Tennessee *Extinctions, Geographic Ranges, and Patterns of Loss*
7:45 p.m.	**RECEPTION**

American Museum of Natural History

Reorganization of Late Quaternary Mammal Faunas and Causes of Mass Extinction

John Alroy
Smithsonian Institution

Research on end-Pleistocene mass extinction of large-bodied North American mammals has focused on relatively short time scales like that of the extinction episode itself, and on relatively minor ecological phenomena like the geographic distributions of individual species. Here, I discuss two general lines of research intended to correct these problems. The first involves my database of Cenozoic North American mammalian paleofaunas, which provides a backdrop for understanding Pleistocene extinction rates. The second project involves the FAUNMAP database, graciously made available on-line by the FAUNMAP Working Group.

The results of these analyses have interesting ecological implications. The biogeographic coherence of mammalian faunas challenges climate- or vegetation-driven mechanisms for mass extinction. If small mammal communities survived unscathed, how could environmental change have suddenly and almost totally destroyed the continent's large mammal communities? Together with the intense, rapid, and selective nature of the extinction in comparison to any other event in the Cenozoic, the results add to the already weighty evidence against non-anthropogenic models for mass extinction.

Rates, Patterns, and Processes of Landscape Transformation and Extinction: Madagascar as an Experiment in Human Ecology

David A. Burney
Fordham University

Bridging the gap between methodological limits and theoretical expectations is most likely to be possible in the most isolated natural systems, such as those found on remote islands. With their severe biogeographical constraints and generally shallow human time-depth, it is sometimes possible to address questions of global relevance regarding background-level versus human-era disturbance, biotic invasion, and extinction. A series of examples from recent research in Madagascar demonstrates how explicit tests may be applied to hypotheses of landscape transformation and extinction causation that have been proposed for the late Quaternary.

A preliminary comparison between the empirical evidence and the predictions of five hypotheses suggests that all available evidence is consistent with the notions that 1) each major ecological region of Madagascar shows a different composite history in terms of landscape transformation and perhaps extinction chronologies; and 2) each region studied contains some variation on the same mix of human ecological depredations (overkill, change of fire regime, exotic species introduction, deforestation, accelerated erosion). These factors, as well as the "natural" background-level climatic variations of the late Holocene, have good potential for synergistic interactions.

Cretaceous Meteor Showers, the Human Ecological "Niche," and the Sixth Extinction

Niles Eldredge
American Museum of Natural History

The geological time scale is a telegraphic precis of biotic turnovers during the Phanerozoic and thus constitutes, in summary form, the empirical basis of the reality of mass extinctions and subsequent evolutionary rebounds. Mass extinctions are real and have been caused, in the main, by 1) global climate change; 2) a combination of climate change and other physical events, such as anoxic turnovers; and 3) at least in one instance, extraterrestrial bolide impact and/or massive volcanism. It is equally well established that the earth is currently undergoing yet another mass extinction event — sometimes called the "Sixth Extinction." And it is clear that the major agent for this current event is Homo sapiens *— primarily through direct habitat destruction and degradation, over-utilization of "natural resources," and direct and inadvertent introduction of exotic species.*

What is the "ecosystem" in which Homo sapiens *has established an interactive presence? It is the global system, sometimes called "Gaia." If this general line of thought is correct, we can no longer think and act as if we were outside of nature — an attitude that understandably arose with our altered ecological position starting 10,000 years ago. We must realize that we are still very much a part of the global system — and that our future is completely locked in with the state of the rest of the living world.*

Emerging Patterns in Australasian Quaternary Extinctions

Tim F. Flannery
Australian Museum

The body of data examined here is divided into three geographic/temporal units: Australian Pleistocene; New Guinean Pleistocene; and the Holocene of Australia, New Guinea, the Moluccas, and the Melanesian island arcs. Three major phases of extinction are identified: Pleistocene, mid-late Holocene, and historic. Each of these is temporally associated with the arrival of a new wave of humans or their commensal animal companions.

The first phase of extinction affected large terrestrial reptiles and mammals as well as flightless birds in Australia, and mammals in New Guinea. These extinctions occurred more than 35,000 years ago. The second phase, which began less than 4,000 years ago, affected large terrestrial carnivores and some terrestrial herbivores in Australia, New Guinea, and the Melanesian islands, but not in Tasmania. It coincided with the introduction of Canis familiaris *into the region; and in the Melanesian island arcs, with the introduction of exotic murids. Recent extinctions have been a mixture of a continuation of Holocene extinction trends and an "aftershock" event ultimately resulting from Pleistocene extinction, possibly accentuated by introduction of the fox.*

Pleistocene Extinctions: Chronology, Non-analog Communities, and Environmental Change

Russell W. Graham
Denver Museum of Natural History
Thomas W. Stafford, Jr.
University of Colorado
Holmes A. Semken, Jr.
University of Iowa

A host of models has been proposed under the broad umbrella of environmental change to explain the terminal Pleistocene extinction event. Most of these models have focused on a few taxa, and they are frequently not applicable to the wide range of mammals that became extinct. More generalized models have invoked the interactions of mammals with changing vegetational communities. However, even these models have been criticized because they presumably did not completely satisfy certain criteria. Specifically, environmental models can be refuted if they do not conform to the following: 1) The extinction event occurred circa 11,000 years ago; 2) large mammals (>100 kg) were preferentially affected by the event; and 3) extinctions did not occur in earlier glacial/interglacial fluctuations.

A new model involving the reduction in geographic ranges with a threshold effect at the terminal Pleistocene does meet these criteria and is broadly applicable. Data on the distribution of mammal species document a continuous trend for mammal range reductions throughout the late Quaternary. These changes were underway well before modern Homo sapiens *evolved and significantly in advance of human entry into the New World. In essence, the terminal Pleistocene extinction can be explained by climate-driven habitat reduction.*

The Power of Pleistocene Hunter-gatherers: A Forward and Backward Search for the Evidence about Mammoth Extinction

Gary Haynes and B. Sunday Eiselt
University of Nevada

In this paper, we will explore the possibility that human foragers were ultimately responsible for the extinction of mammoths. For years, debate about the cause of late Pleistocene extinctions has not been able to provide proof that either climate change or hunting by humans was the driving force behind the disappearance of so many mammalian species. One of us (GH) has examined the ways in which climatic events and trends that kill large mammals may leave unambiguous traces in preserved bone assemblages. Emerging from his actualistic and behavioral studies of free-ranging African elephants has been inferential support for the argument that climate change caused the extinctions.

We will compare the density and distribution of elephant-bone and mammoth-bone sites throughout the world. Study of mammoth-bone collections and modern elephant-bone assemblages provides evidence that certain overlooked characteristics of sites are found only when humans killed animals, and other characteristics are found only when non-cultural mortality processes killed them. We will compare the fossil sites of the late Pleistocene to the numerous modern sites studied in Africa and propose some explanations for the similarities and differences. We will then develop our argument that Clovis foragers were the main agent in mammoth extinction.

Differential Vulnerability in the New Zealand Vertebrate Fauna

Richard N. Holdaway
Palaecol Research

Late Holocene vertebrate extinctions in New Zealand included small and large taxa. Extensive surveys of Quaternary sites in the South Island have shown that vertebrate faunas changed in distribution and composition from Otiran glacial to the Holocene, but that there was no extinction event at the Pleistocene-Holocene boundary. The New Zealand event occurred within the last 2,000 years. Introductions of alien predators as well as periods of habitat destruction, but not climate change, can be matched to some extinctions. The record of differential vulnerability is a key to the factors precipitating extinction.

The lack of extinctions at the end of the Otiran glaciation (14,000-10,000 years BP) indicates that major environmental change does not necessarily result in an extinction event so long as it is gradual and involves movement rather than extinction of vegetation types. Introduced predators do, however, effect extinctions. Small ecological factors can predispose taxa to extinction. The vulnerability to predators differs with the prey and with predators for the same prey species. An extinction "event" is the sum of individual extinctions: barring global catastrophe, each species extinction is an individual event. The identification of introduced mammalian predators as the major cause of vertebrate extinctions in New Zealand has proven useful for conservation scientists working on endangered birds, lizards, and frogs, and may have wider applications for study of previous events.

Prehistoric Extinctions in Hawaii: The Search for Causes

Helen F. James
Smithsonian Institution

Douglas Siegel-Causey
National Science Foundation

The Hawaiian Islands, first colonized by Polynesians only about 1,400-1,600 years ago, experienced extinction of two-thirds of its native vertebrate species after human arrival. The primary causes of extinction and the history of ecological collapse are poorly understood, but the extinctions are very recent in geologic terms and the relevant paleontological, paleoecological, and archaeological records are fairly complete.

This evidence is reviewed in relation to a number of factors commonly thought to have played a role in Quaternary extinctions: 1) Climatic forcing; 2) a blitzkrieg of over-harvesting soon after initial human contact with the native fauna; 3) gradual overharvesting by humans; 4) predation by animals that arrived with prehistoric humans; 5) resource competition from animals that arrived with prehistoric humans; 6) cascading extinctions after the disappearance of key species; 7) introduced infectious diseases; and 8) destruction and degradation of habitat.

Archaeologists' reconstructions of population growth, settlement patterns, and land use suggest that the aboriginal human population eventually reached and may have exceeded the carrying capacity of the islands, thus raising the possibility that this human population expansion, rather than mere human presence, was the key to ecological collapse.

Lightning Strikes Twice: Blitzkrieg, Hyperdisease, and Global Explanations of Late Quaternary Catastrophic Extinctions

Ross D.E. MacPhee
American Museum of Natural History

Preston A. Marx
Aaron Diamond AIDS Research Center

There is a recurring pattern to large-scale mammalian extinctions that have occurred within the last 40,000-60,000 years. With certain exceptions, 1) losses have occurred in temporally and geographically discrete clusters; 2) geographical areas that suffered a major extinction within this period did not experience large-scale losses thereafter; and 3) extinctions have closely tracked the human diaspora, in both time and space. On present evidence, this dreadful syncopation — humans arrive, animals disappear — seems to have occurred to a greater or lesser degree on every land mass except the continents of earliest human evolution, Africa and Eurasia. But after the period of first contact and initial substantial loss, the pattern changes markedly: the rate of loss drops precipitously and stays depressed until the present era (i.e., the last 500 years).

We propose that the dominant features of at least some first-contact extinctions can be explained by inferring that the principal agency of loss was not overhunting or environmental degradation, but hypervirulent, hyperlethal diseases ("hyperdiseases") introduced into immunologically naive populations by colonizing humans and/or their commensals and synanthropics. This hypothesis potentially 1) explains differential losses in K-selected versus r-selected taxa; 2) requires no ad hoc *explanations for the absence of mass kill sites in affected areas; and 3) accounts for pattern change in the character of anthropogenic extinction after first-contact losses.*

Prehistoric Overkill: Four Decades of Discovery and Debate

Paul S. Martin
University of Arizona

The discovery of prehistoric overkill has triggered a major breakthrough in natural and cultural history. In the last 40,000 years our species, Homo sapiens, *spread out of our Afro-Asian homeland into other parts of the globe. In the process, desirable and vulnerable prey declined or vanished. The fossil record on some islands suggests "hit and run" wipe-outs or "commando raids" in which the more vulnerable and desirable species, including rookeries of nesting pelagic seabirds, were obliterated hundreds of years before settlement and horticulture. While not a mass extinction by geological standards, since marine phyla were immune, the continental losses involved "flagship species," large land mammals whose absence profoundly biases our understanding of biogeography, global change, conservation, and range management.*

Beyond the debate on prehistoric extinctions is an even more significant matter, that is their meaning. Radical new ideas of land use are at stake. The last ice age of some 1.7 million years is no longer regarded as too remote to be worth considering in "negotiations with nature." Paleontological and archaeological data are critical in managerial choices for national parks; these data bear on the potential replacement of livestock on the western range and on the restoration of "wildness." An extinct megafauna ranged the continent when it last displayed its wildness, its evolutionary potential. The biotic potential of the land must be considered.

The Interaction of Humans, Megaherbivores, and Habitats in the Late Pleistocene Extinction Event

Norman Owen-Smith
University of the Witwatersrand

The extinction event at the end of the Pleistocene differed from preceding extinction episodes in two peculiar features: 1) Extinction likelihood rose sharply with increasing body size; and 2) certain continents, specifically Africa and tropical Asia, escaped the extinctions. It resulted in the demise of all megaherbivores throughout the Americas, northern Eurasia, and Australia. It was associated in time not only with a period of climate shift, but also with a large-scale expansion in the geographic range occupied by humans.

Mechanisms leading to extinction may entail habitat deterioration, competitive replacement, unsustainable levels of predation, or disease outbreaks. Whatever the process, populations must become non-viable throughout the geographic range of the species. The crucial feature distinguishing the change to interglacial conditions at the end of the Pleistocene was the almost worldwide presence of humans. Human elimination of megaherbivores, and hence of their consumptive and engineering effects on habitats, adversely transformed habitats that were beneficial for the coexistence of many other large herbivores, creating fragmented localized islands with deteriorating vegetation conditions. A sequence of local extinctions led inevitably to global demise of these herbivote species, perhaps assisted by human predation.

Extinctions, Geographic Ranges, and Patterns of Loss

Stuart L. Pimm
University of Tennessee

Over the last few centuries the loss of species in well-known groups of plants, invertebrates, and vertebrates exceeds by one-hundred fold the rate expected from the fossil record. In all instances, these extinctions are dominated by special cases: birds on Pacific islands, fish in African lakes, mollusks in North American rivers, mammals in Australia, and so on. The feature that unites these widely divergent systems and groups is that all contain large numbers of geographically restricted species. A second observation is that existing technologies — indeed, in the Pacific, only Stone Age technologies — are capable of causing double-digit percentages of species extinctions.

The lessons for the future are that our technologies are more than adequate to continue to eliminate large number of species. Moreover, many areas remain where habitat destruction, on a scale no larger than the forest losses in 19th-century eastern North America, could rapidly eliminate 20 percent or more of the world's species.

Vanishing from Freshwater: Species Decline and the Machinery of Extinction

Melanie L.J. Stiassny and
Ian J. Harrison
American Museum of Natural History

Throughout most of human history, freshwater resources have been more than adequate to serve human needs while maintaining the integrity and biological diversity of the earth's ecosystems. But today's stark reality is that massive habitat modification and the widespread introduction of exotic species are straining sustainability to its limit as global freshwater resources are consumed and degraded, and aquatic biodiversity is decimated. Globally, the true degree of aquatic impoverishment is largely unknown, yet there can be no doubt that the losses are already great. In the United States, the Nationwide Rivers Inventory estimates that of the 5.2 million km of streams in the nation, most have been so dramatically altered that only 2 percent have sufficient high quality to be worthy of federal protection status. In the former Soviet Union, long-term diversion of the Aral Sea for cotton irrigation has resulted in a volume decrease of 65 percent, salinity has more than tripled, and the endemic biota is decimated.

Widespread extinction is a pervasive theme in freshwater systems throughout the world; and while best documented in lake ecosystems, the losses in rivers and other wetlands are also profound. The reasons for the particular vulnerability of freshwater habitats will be explored and the frightful roster of extinction among selected fish faunas will be described.

The Role of Humans in Late Pleistocene Megafaunal Extinction, with Particular Reference to Northern Eurasia and North America

A. J. Stuart
Norfolk Museum Services/Castle Museum

This paper focuses on the accelerated extinctions that occurred within the late Pleistocene, with some reference to earlier and later events. Although a global phenomenon, late Pleistocene extinctions of terrestrial megafauna were very variable in their severity between different zoogeographical regions. Patterns and timing were also different. Losses were highest in North America, South America, and Australia, moderate in Europe, and lowest in sub-Saharan Africa, where all four late Pleistocene mammals of 1,000 kg or over (elephant, white rhino, black rhino, hippopotamus) survive today.

Any extinction hypothesis must be able to explain why extinctions were severe and sudden in North America, but moderate and staggered in northern Eurasia. Since Late Glacial environmental changes in North America were broadly similar to those in northern Eurasia, why should the extinction patterns have been so different? Moreover, very similar environmental changes occurred several times previously but did not cause major megafaunal extinctions. The one new factor in the Late Glacial not present at the end of previous cold stages was the presence of modern Homo sapiens. *However, the arrival of advanced humans took place tens of thousands of years before many of the megafaunal extinctions. Hunting pressure on megafauna that were severely reduced in population size and geographical area by climatic changes may prove to be the key to late Pleistocene extinctions on a global scale.*

John Alroy

John Alroy is a post-doctoral fellow in the Department of Paleobiology at the Smithsonian Institution. He received his Ph.D. at the University of Chicago. He completed a year-long internship with the Evolution of Terrestrial Ecosystems group at the Smithsonian Institution, and a two-year post-doctoral position with the Research Training Group in the Analysis of Biological Diversification in Tucson, Arizona.

RELEVANT PUBLICATIONS

Alroy, J. 1997. Equilibrial diversity dynamics in North American mammals. In: *Biodiversity Dynamics: Turnover of Populations, Taxa and Communities*, M. L. McKinney (ed.), in press.

Alroy, J. 1996. Constant extinction, constrained diversification, and uncoordinated stasis in North American mammals. *Paleogeography, Paleoclimatology, Paleoecology* 127:285-311.

David A. Burney

David A. Burney is Associate Professor in the Department of Biological Sciences at Fordham University; an associated scientist of the Louis Calder Conservation and Ecology Center and the Université d'Antananarivo, Madagascar; and an instructor in the Education Department of the New York Botanical Garden. He received an M.Sc. in conservation biology from the University of Nairobi, writing his thesis on the effects of human activities on cheetahs. He received his Ph.D. in zoology, with a minor in botany, from Duke University, and wrote his dissertation on late Quaternary environmental dynamics of Madagascar. His research has focused on endangered species, paleoenvironmental studies, and causes of extinction. He has used paleoecological techniques such as palynology, paleolimnology, and multidisciplinary stratigraphic analyses to study late Quaternary environmental changes and extinctions in Hawaii, Madagascar, the West Indies, Africa, and North America. Recent research efforts have included applications of paleoecological techniques to cave research, fire ecology, and dietary reconstructions for extinct animals.

RELEVANT PUBLICATIONS

Burney, D.A. 1996. Historical perspectives on human-assisted biological invasions. *Evolutionary Anthropology* 4(6):216-221.

Burney, D.A. 1993. Recent animal extinctions: Recipes for disaster. *American Scientist* 81:530-541.

Joel L. Cracraft

Joel L. Cracraft is Curator in the Department of Ornithology at the American Museum of Natural History and Adjunct Professor at Columbia University and the City University of New York. His research interests include systematic theory, speciation analysis, biological diversification, avian higher-level relationships, historical biogeography, and molecular systematics and evolution. Using DNA sequence information, Dr. Cracraft and his students are investigating the phylogenetic relationships of a variety of avian groups. They have also undertaken studies on the conservation genetics of tigers. Dr. Cracraft is co-chairman of Systematics Agenda 2000 International, a program of the International Union of Biological Sciences endeavoring to promote basic research and training in biodiversity and systematics science. He is also a participating curator for the Museum's upcoming permanent exhibition devoted to biodiversity (opening in 1998). Dr. Cracraft received his Ph.D. in biology from Columbia University in 1969.

RELEVANT PUBLICATIONS

Wheeler, Q.D. and J. Cracraft. 1997. Taxonomic preparedness: Are we ready to meet the biodiversity challenge? Pp. 435-446. In: *Biodiversity II*, M.L. Reaka-Kudla, D.E. Wilson, and E.O. Wilson (eds.). Washington, D.C.: Joseph Henry Press.

Cracraft, J. 1992. Explaining patterns of biological diversity: Integrating causation at different spatial and temporal scales. Pp.59-76. In: *Systematics, Ecology and the Biodiversity Crisis*, N. Eldredge (ed.). New York: Columbia University Press.

B. Sunday Eiselt

B. Sunday Eiselt is a graduate student in Anthropology at the University of Nevada, with interests in archaeology and paleobiology. In her research, foraging theory has provided a productive framework for exploring the interpretive potential of paleoenvironmental and archaeological data. An important concern is with the differences between male and female foraging decisions. She has extensive experience in zooarchaeology, macrobotanical analyses, and palynology. Ms. Eiselt is also interested in material culture and variability, especially as seen in basketry, architecture, and ornamentation. She has recently completed analyses of fish bones from a 9,400 year-old human paleofecal sample recovered in central Nevada.

RELEVANT PUBLICATIONS

Eiselt, B.S. Spirit Cave paleofecal materials: 9,400 year-old evidence for Great Basin indigenous use of small fish. *Nevada Historical Quarterly*, in press.

Eiselt, B.S. Investigating the Klamath signature: A comparison of Klamath and Paiute Indian material culture. University of Nevada, Reno, *Anthropology Department Research Reports*, in press.

Niles Eldredge

Niles Eldredge is Curator in the Department of Invertebrates at the American Museum of Natural History, and Adjunct Professor at the City University of New York. A specialist in mid-Paleozoic phacopid trilobites, his focus is on achieving a better "fit" between historical patterns of stasis and change in the fossil record and evolutionary theory. He has also analyzed the relationship between global extinctions of the geologic past and the present-day biodiversity crisis, as well as the general relationship between extinction and evolution. His ongoing concern is with delineating the differences between gene-centered reductionist evolutionary theory of the "ultradarwinians" and those who hold evolutionary theory accountable to patterns of historical data. A further aim is to specify the physical, environmental, and large-scale biological systems context of statis and change in evolutionary history. He has embarked on a new project examining the nature of pattern perception and analysis in the "historical" sciences, and the relative merits of hierarchy versus reductionism in approaching complexity.

RELEVANT PUBLICATIONS

Eldredge, N. 1995. *Dominion*. New York: Henry Holt and Co.

Eldredge, N. 1991. *The Miner's Canary: Unraveling the Mysteries of Extinction*. Princeton, N.J.: Princeton University Press.

Tim F. Flannery

Tim F. Flannery is Principal Research Scientist at the Australian Museum. His leading research interests concern the fossil and modern mammals of the Australasian region. He has particular expertise in the mammals of the Melanesian rainforests. His interests in extinction and endangerment concern the following: 1) The nature, timing, and aftershock of megafaunal extinctions in Australasia; and 2) the nature and extent of Holocene extinctions, especially the nature and causes of modern mammal extinctions in Australasia. He is also interested in the conservation of endangered species, such as tree-kangaroos, in Melanesia.

RELEVANT PUBLICATIONS

Flannery, T.F. 1995. *Mammals of the South West Pacific and Moluccan Islands*. Sydney: Reed.

Flannery, T.F. 1994. *The Future Eaters: An Ecological History of the Australasian Lands and People*. Sydney: Reed.

Russell W. Graham

Russell W. Graham is Curator and Head of Earth Sciences at the Denver Museum of Natural History. He has a B.S. in Zoology and a M.S. in Geology from the University of Iowa, and received his Ph.D. in Geology from the University of Texas at Austin. His dissertation focused on the analysis of a late Pleistocene mammal fauna from a cave in central Texas. Dr. Graham spent a year at the Smithsonian Institution as a postdoctoral fellow in systematic and evolutionary biology, and studied Pleistocene mammals from archaeological sites in Mexico and Colorado. His research focuses on the evolution and biogeography of Quaternary mammal communities. He has edited three books and published more than 50 professional papers on these topics. He was elected a Fellow of the American Association for the Advancement of Science in 1996 for his studies of the spatial response of mammals to environmental change.

RELEVANT PUBLICATIONS

Graham, R.W. and E.L. Lundelius, Jr. 1984. Coevolutionary disequilibrium. Pp. 223-249. In: *Quaternary Extinctions: A Prehistoric Revolution*; P.S. Martin and R.G. Klein (eds.). Tuscon: University of Arizona Press.

Graham, R.W. and J.I. Mead. 1987. Environmental fluctuations and evolution of mammalian faunas during the last deglaciation in North America. Pp. 371-402. In: *North America and Adjacent Oceans During the Last Deglaciation*, W.F. Ruddiman and H.E. Wright, Jr. (eds.), The Geology of North America, Geological Society of America, Volume K-3.

Gary Haynes

Gary Haynes is Professor of Anthropology at the University of Nevada, and directs the small-scale Hwange Research Trust in Zimbabwe. His research interests center on southern African prehistory and paleoenvironments, North America's late Pleistocene extinctions, and the various roles that humans have played in shaping modern ecosystems. He has studied the behavior and biology of African elephants for 15 years, and continues looking for new analytical methods to understand fossil mammoth and mastodont sites. He is also increasingly involved in issues of conservation and sustainable development in southern Africa.

RELEVANT PUBLICATIONS

Haynes, G. 1991. *Mammoths, Mastodonts, and Elephants: Biology, Behavior, and the Fossil Record*. New York: Cambridge University Press.

Haynes, G. *The Forest with a Desert Heart: Human Fortunes in an African Wilderness*. Washington, D.C.: Smithsonian Institution Press, in press.

Richard N. Holdaway

Richard N. Holdaway is a private researcher, and an Honorary Research Associate in the Department of Zoology, University of Canterbury, New Zealand. His research interests include the paleoecology and systematics of New Zealand birds. He is especially interested in the effects of introduced predators on indigenous faunas, and the causes of New Zealand's late Holocene extinctions. For the past five years he has been engaged in a major survey of the distributions of New Zealand vertebrates during the late Pleistocene and Holocene, before humans arrived. Presently, he is investigating the time of arrival and rate of spread of the first introduced predator to reach New Zealand, the Pacific rat (*Rattus exulans*).

RELEVANT PUBLICATIONS

Holdaway, R.N. 1996. Arrival of rats in New Zealand. *Nature* 384:225-226.

Holdaway, R.N. 1989. New Zealand's pre-human avifauna and its vulnerability. *New Zealand Journal of Ecology* 12 (supplement): 11-25.

Helen F. James

Helen F. James is Museum Specialist in the Department of Vertebrate Zoology at the National Museum of Natural History, Smithsonian Institution. Her research focus is on evolution and extinction in island avifaunas. She has 20 years of paleontological field experience in Hawaii and on other islands, including Madagascar. With Storrs Olson, in 1991, she published two monographs describing 32 extinct species of fossil birds from the Hawaiian Islands. She continues to study island paleontological records and the causes of prehistoric island extinctions, particularly in Hawaii. Other current projects include a morphological phylogeny of the Hawaiian finches (Fringillidae: Drepanidini), and studies of "ancient DNA" and the genetic relationships of extinct Hawaiian birds (with Robert Fleischer and colleagues).

RELEVANT PUBLICATIONS

James, H.F. 1995. Prehistoric extinctions and ecological changes on oceanic islands. *Ecological Studies* 115:88-102.

James, H.F. and S.L. Olson. 1991. Descriptions of thirty-two new species of Hawaiian birds. Part II. Passeriformes. *Ornithological Monographs* 46:1-88.

Ross D.E. MacPhee

Ross D.E. MacPhee is Chairman and Curator in the Department of Mammalogy at the American Museum of Natural History, and Adjunct Professor at Columbia University, the State University of New York at Stony Brook, and the City University of New York. His major interest is extinction — in particular, mammalian extinctions believed to have been caused or indirectly forced by humans within the last 40,000 years. His recent work has revolved around the possibility that diseases introduced by humans or their commensals have been proximate causes of extinction in many parts of the world. He conducts most of his field research on islands, because island faunas have been greatly affected by anthropogenic losses. Another major focus of Dr. MacPhee's research is historical biogeography, with particular reference to the mammalian colonization of islands. At present, using paleontological methods, he is interested in determining when and how mammals first reached the islands comprising the Greater Antilles, where recent fossil recovery has pushed back the chronicle of mammalian colonization to almost 30 million years. Other research interests include primate and insectivore evolution.

RELEVANT PUBLICATIONS

MacPhee, R.D.E. and P.A. Marx. 1997. The 40,000-year plague: Humans, hyperdisease, and first-contact extinctions. Pp. 169-217. In: *Natural Change and Human Impact in Madagascar*, S. Goodman and B. Patterson (eds.). Washington, D.C.: Smithsonian Institution Press.

MacPhee, R.D.E. and C.E. Flemming. Mammalian extinctions since AD 1500: A preliminary census. In: *The Biodiversity Crisis: Science, Policy, and Society*. J.L. Cracraft and F. Grifo (eds.). New York: Columbia University Press, in press.

Paul S. Martin

Paul S. Martin is Emeritus Professor of Geosciences at the University of Arizona's Desert Laboratory, where he has taught paleoecology and investigated late Quaternary environmental change since 1957. He studied vertebrate zoology at Cornell University and at the University of Michigan, where he received his Ph.D. in 1956. He did postdoctoral training at Yale University and the University of Montreal. Dr. Martin is best known for his theory of prehistoric overkill, a pattern of global extinction over the last 40,000 years apparently coinciding with human colonizations spreading out of Africa and Asia. The theory has helped rejuvenate interest in prehistoric extinctions, leading to dramatic new fossil discoveries, especially on oceanic islands.

RELEVANT PUBLICATIONS

Martin, P.S. 1990. 40,000 Years of Extinctions on the "Planet of Doom." In: *Paleogeography, Paleoclimatology, and Paleoecology* 82:187-201.

Martin, P.S. and R. Klein (eds.). 1984. *Quaternary Extinctions: A Prehistoric Revolution*. Tucson: University of Arizona Press.

Preston A. Marx

Preston A. Marx is Senior Scientist at the Aaron Diamond AIDS Research Center and Professor at New York University. In 1992, as Director of the New Mexico Primate Center, he oversaw the design and construction of a $10-million chimpanzee facility which included 24 outdoor areas for AIDS-carrying chimpanzees. In a recent study, Dr. Marx found that, in monkeys, the female hormone progesterone enhanced vaginal transmission of simian AIDS. The study linked progesterone to possible increases in the risk of HIV infection in West Africa in the region where simian AIDS viruses are naturally found.

RELEVANT PUBLICATIONS

Marx, P.A. 1996. Progesterone implants enhance SIV vaginal transmission and early virus load. *Nature Medicine*: 2: 1084-1089.

Marx, P.A. 1997. Human immunodeficiency virus type 2 (HIV-2) seroprevalence and characterization of a distinct HIV-2 genetic subtype from the natural range of simian immunodeficiency virus-infected sooty mangabeys. *Journal of Virology*, 71.

Michael J. Novacek

Michael J. Novacek is Senior Vice-President and Provost of the American Museum of Natural History and Curator in the Department of Vertebrate Paleontology. As Senior Vice-President and Provost, Dr. Novacek provides leadership to the curatorial staff and advises the president on the direction of scientific research at the Museum. He is a chief spokesperson in enunciating the Museum's scientific programs. As a curator in the Department of Vertebrate Paleontology, Dr. Novacek has conducted extensive research on the evolutionary relationships of extinct and living mammals. His examination of broad-based problems in systematics and evolution draws upon evidence from the fossil record and molecular biology. He is one of the team leaders of the joint American Museum-Mongolian Academy of Sciences ongoing expedition to the Gobi Desert to search for fossils, and in 1993 was one of the discoverers of Ukhaa Tolgod, the richest Cretaceous fossil site in the world. Dr. Novacek was instrumental in establishing the Museum's Center for Biodiversity and Conservation, and is a co-chair of the steering committee of Systematics Agenda 2000, an international scientific initiative to discover, describe, and classify the world's species. He is a member of the National Science Foundation Advisory Board and was recently elected to the Board of the American Association for the Advancement of Science. Dr. Novacek earned his Ph.D. in paleontology at the University of California, Berkeley, in 1978.

RELEVANT PUBLICATIONS

Novacek, M.J. 1996. *Dinosaurs of the Flaming Cliffs*. New York: Anchor/Doubleday.

Novacek, M.J. 1992. The meaning of systematics and the biodiversity crisis. Pp. 101-108. In: *Systematics, Ecology, and the Biodiversity Crisis*, N. Eldredge (ed.). New York: Columbia University Press.

Norman Owen-Smith

Norman Owen-Smith is Reader in African Ecology in the Department of Zoology, University of the Witwatersrand, South Africa, and Director of the Centre for African Ecology there. His special interests lie in the ecology of African large herbivores, their interactions with vegetation, and theoretical modeling of consumer-resource systems. For his Ph.D. he studied the ecology and behavior of the white rhinoceros, and subsequently carried out research on the population and feeding ecology of kudus. He has supervised studies on elephant impacts on vegetation in Botswana and South Africa. From these modern studies he became interested in potential causes of the late Pleistocene extinctions of large mammals. This led him to propose the "keystone herbivore" hypothesis, suggesting that the extermination of megaherbivores by human hunters led to habitat changes which precipitated extinctions of other large herbivores.

RELEVANT PUBLICATIONS

Owen-Smith, N. 1989. Megafaunal extinctions: The conservation message from 11,000 years BP. *Conservation Biology* 3:405-412.

Owen-Smith, N. 1988. *Megaherbivores: The Influence of Very Large Body Size on Ecology*. Cambridge: Cambridge University Press.

Stuart L. Pimm

Stuart L. Pimm is Professor of Ecology in the Department of Ecology and Evolutionary Biology at the University of Tennessee. His research focuses on the question: How fast are species becoming extinct worldwide? He argues that high rates of extinction on Pacific islands also typify a wide range of mainland situations that share equally high levels of endemism. The second argument addresses how long individual species last. He has explored how species numbers vary from year to year — a critical component of this question — and documented the empirical patterns of time-to-extinction of small populations on islands. Finally, he has considered how useful the species-area relationship is in predicting how many endemic species are lost following habitat fragmentation. Applied to areas of high endemism in Brazil and insular Southeast Asia, his predictions based on deforestation closely match the numbers of species known to be on the brink of extinction.

RELEVANT PUBLICATIONS

Pimm, S.L., G.J. Russell, J.L. Gittleman, and T.M. Brooks. 1995. The future of biodiversity. *Science* 269:347-350.

Pimm, S.L., M.P. Moulton, and J. Justice. 1994. Bird extinctions in the central Pacific. *Philosophical Transactions of the Royal Society* 344:27-33.

Holmes A. Semken, Jr.

Holmes A. Semken, Jr. is Professor of Geology at the University of Iowa. He received a B.S. and M.S. in Geology from the University of Texas at Austin, and his Ph.D. in Geology from the University of Michigan. His primary research interests are interpreting late Pleistocene and Holocene community structure and paleoecology via micromammal remains. Because archaeological sites, when waterscreened, have proven to be reservoirs for micromammal skeletal elements, recent projects involve comparison of paleoecological interpretations derived from contemporaneous cultural and non-cultural sites, the taphonomy of rodent and insectivore remains in archaeological sites, and the changing biogeography of small mammals during the Wisconsinan-Holocene extinction event, as well as through the Holocene. Most of his work has been associated with the Northern Great Plains.

RELEVANT PUBLICATIONS

Semken, H.A., Jr. and R.W. Graham. 1996. Paleoecological and taphonomic patterns derived from correspondence analysis of zooarchaeological and paleontological faunal samples. *Acta Zoologica Cracova* 39:1-17.

Croft, D.A. and H.A. Semken, Jr. 1994. Distribution of mammalian osteological elements recovered from waterscreened features, house fill, and overburden at the Wall Ridge Earth Lodge (13ML176), Mills County, Iowa. *Current Research in the Pleistocene* 11:65-67.

Douglas Siegel-Causey

Douglas Siegel-Causey is Program Director for the Arctic Sciences program of the National Science Foundation Office of Polar Programs, and Research Professor of Biology at the University of Nebraska. His research is focused on the biology and ecology of polar waterbirds, and he is currently studying the biogeography and genetics of Bering Sea waterfowl. Working in collaboration with an international team of archaeologists, molecular biologists, paleobiologists, and native Alaskan elders, Dr. Siegel-Causey is working to construct the historical patterns of animal distributions and human ecology of Beringian marine environments since the end of the Ice Age. Current research includes molecular-based studies of the role of waterfowl as vectors of viral and bacterial diseases, including influenza and Newcastle disease, and the epidemiology of avian zoonotic disease. He has authored over 100 research articles and books, and his work is currently the focus of a documentary series on Arctic research.

RELEVANT PUBLICATIONS

Siegel-Causey, D., C. Lefèvre, and A.B. Savinetskii. 1991. Historical patterns of cormorants on Amchitka Island, Alaska. *Condor* 93:840-852.

Siegel-Causey, D. and S.P. Kharitonov. The evolution of coloniality in waterbirds. In: *Colonial Breeding in Waterbirds*, F. Cezilly, H. Hafner, D.N. Nettleship (eds.). Oxford: Oxford University Press, in press.

Thomas W. Stafford, Jr.

Thomas W. Stafford, Jr. is Director of the Laboratory for AMS-Radiocarbon Research-INSTAAR at the University of Colorado-Boulder. He has B.S. and M.S. degrees in geology, and a Ph.D. in geosciences from the University of Arizona. His research specialtiés include AMS radiocarbon dating, Quaternary stratigraphy, stable isotope geochemistry, cave paleontology, geoarchaeology, and paleobiology.

Dr. Stafford's present research is on the chronology of vertebrate faunal change during the late Pleistocene, the timing of human migrations, the dating chemistry of sediments, cave paleontology, database development for mammalian osteology, and automation of chemical and vacuum instrumentation.

RELEVANT PUBLICATIONS:

Stafford, T.W., Jr. and H.A. Semken, Jr. 1990. Accelerator 14C dating of two micromammal species representative of the late Pleistocene disharmonious fauna from Peccary Cave, Newton County, Arkansas. *Current Research in the Pleistocene* 7:129-132.

Steadman, D.W., T.W. Stafford, Jr., and R.E. Funk. 1997. Nonassociation of paleoindians with AMS-dated late Pleistocene mammals from the Dutchess Quarry Caves, New York. *Quaternary Research* 47:105-116.

Melanie L.J. Stiassny

Melanie L.J. Stiassny is Associate Curator in the Department of Herpetology and Ichthyology at the American Museum of Natural History, and Associate Professor at the City University of New York. Her research concerns systematics, evolutionary morphology, and conservation biology of fishes. Most recently, her research has focused on conservation issues in freshwater habitats in the Old World tropics, including an exploration of the roles of phylogenetic systematics in informing conservation programs. More than half the world's vertebrates are fishes and nearly half of these live in freshwater; fish play a central role in freshwater ecosystems, and as a source of food they are of considerable social and economic importance. Stiassny's taxonomic research concentrates on the systematics and morphological evolution of members of the family Cichlidae, a paradigm group for evolutionary study; and on a variety of studies of high-level euteleostean interrelationships. Taxonomic revisional studies are also ongoing.

RELEVANT PUBLICATIONS

Stiassny, M.L.J. 1996. An overview of biodiversity: With some lessons from African fishes. *Fisheries* 21(9):7-13.

Stiassny, M.L.J. and M.C.C. DePinna 1994. Basal taxa and the role of cladistic patterns in the evaluation of conservation priorities: A view from freshwater. In: *Systematics and Conservation Evaluation*, Systematics Association Special Volume, P. Forey et al. (eds.). London: Oxford University Press.

A.J. Stuart

A. J. Stuart, Ph.D., D.Sc., is Geologist for the Norfolk Museums Service, Norwich, England, and Honorary Lecturer in Earth Sciences at the University of Manchester. His research interests are Quaternary vertebrates, especially interglacial faunas from northwest Europe (including directing excavation of and research on a 600,000-year-old *Mammuthus trogontherii* skeleton from the Cromerian type locality), and late Quaternary megafaunal extinctions. Dr. Stuart has synthesized relevant information on extinctions from Europe, and contrasted the very different extinction patterns in northern Eurasia and North America.

RELEVANT PUBLICATIONS

Stuart, A.J. 1993. The failure of evolution: Late Quaternary mammalian extinctions in the Holarctic. *Quaternary International* 19:101-107.

Stuart, A.J. 1991. Mammalian extinctions in the late Pleistocene of northern Eurasia and North America. *Biological Reviews* 66:453-562.

David Hurst Thomas

David Hurst Thomas is Curator in the Department of Anthropology at the American Museum of Natural History and Adjunct Professor at Columbia University and the City University of New York. Over the past 25 years, his research interests have focused on aspects of Americanist archaeology. He has worked to understand human adaptations to the relatively harsh Great Basin area of the Western U.S., concentrating geographically on the state of Nevada and temporally on the Holocene post-glacial period. In addition, over the past two decades, Dr. Thomas and his colleagues have conducted extensive environmental archaeology studies on St. Catherines Island, Georgia. Recently, he has been exploring the implications of new paleoenvironmental evidence suggesting that two major droughts struck the western U.S. within the last millennium.

RELEVANT PUBLICATIONS

Thomas, D.H. 1997. *Archaeology*, 3rd edition. Fort Worth: Harcourt Brace & Company College Publishers.

Thomas, D.H. 1994. *Exploring Ancient Native America: An Archaeological Guide*. New York: Macmillan.

CENTER FOR BIODIVERSITY AND CONSERVATION

SPRING SYMPOSIUM SCHEDULE

Friday, April 18, 1997

PREVENTING EXTINCTION: ADVANCES IN BIODIVERSITY CONSERVATION

8:30 a.m.	REGISTRATION
9:00 a.m.	INTRODUCTORY REMARKS Ellen V. Futter President, American Museum of Natural History Francesca T. Grifo Director, Center for Biodiversity and Conservation
	EXPLAINING PAST EXTINCTIONS AND THE EXTINCTION PROCESS
9:30 a.m.	Tim F. Flannery Principal Research Scientist, Australian Museum *The Timing, Nature, and Aftershock of Pleistocene Extinctions in Australia*
10:00 a.m.	Ross D.E. MacPhee Chairman and Curator, Department of Mammalogy, AMNH *Extinctions in Deep Time, Near Time, and Future Time: What We Think We Know*
10:30 a.m.	Discussion
10:45 a.m.	**Coffee/Tea Break**
	THE ROLE OF SCIENCE
11:00 a.m.	David Ehrenfeld Professor of Biology, Department of Ecology, Evolution and Natural Resources, Cook College, Rutgers University *Conservation Biology in the 21st Century*
11:30 a.m.	Michael J. Novacek Senior Vice-President and Provost, AMNH *Mapping the Ebb and Flow of Life*
12:00 - 12:15 p.m.	Discussion
12:15 - 1:45 p.m.	**Lunch**

American Museum of Natural History

CENTER FOR BIODIVERSITY AND CONSERVATION

SPRING SYMPOSIUM SCHEDULE

MANAGING NATURAL RESOURCES FOR DIVERSITY

1:45 p.m. Gary Hartshorn
Executive Director, Organization for Tropical Studies
Integrating Sustainable Forestry and Biodiversity Conservation in Tropical Forests

2:15 p.m. Marianne Cramer
Central Park Planner, Central Park Conservancy
Central Park's Woodlands: A Case Study in Restoring and Managing an Urban Natural Resource

2:45 p.m. **Coffee/Tea Break**

THE CONTRIBUTIONS OF ENVIRONMENTAL EDUCATION

3:00 p.m. Judy Braus
Director of Environmental Education, World Wildlife Fund
Windows on the Wild: A National Biodiversity Education Program

3:30 p.m. Carol J. Fialkowski
Environmental Educator, Department of Environmental and Conservation Programs, The Field Museum
Chicago Wilderness: A Regional Biodiversity Initiative or an Oxymoron?

4:00 p.m. THE IMPACT OF CONSERVATION POLICY

Panel Discussion
Gail Benjamin
Director, Land Use Division, New York City Council
Eric Goldstein
Senior Attorney, Natural Resources Defense Council
Franklin C. Moore
Senior Policy Advisor, USAID Environment Center
Moderator: Francesca T. Grifo, Director, CBC

THE IMPORTANCE OF THE INDIVIDUAL

4:45 p.m. Paul W. Johnson
Chief, Natural Resources Conservation Service
America's Private Land: A Geography of Hope

5:30 p.m. Symposium Adjourns

American Museum of Natural History

Windows on the Wild: A National Biodiversity Education Program

Judy Braus
World Wildlife Fund

How do we educate a nation about biodiversity? What are the key concepts, skills, attitudes, and actions that will help slow the loss of biodiversity worldwide and create a more sustainable future? This overview of "Windows on the Wild" explains the approach that World Wildlife Fund is taking to reach students, teachers, and non-formal educators, and why WWF places so much value on local, state, national, and global partnerships.

Central Park's Woodlands: A Case Study in Restoring and Managing an Urban Natural Resource

Marianne Cramer
Central Park Conservancy

Ten years ago, the Central Park Conservancy, in partnership with the New York City Department of Parks and Recreation, embarked on a program to manage and restore Central Park's 130 acres of woodland landscapes. Although the goal of the original designers of the Park, Frederick Law Olmsted and Calvert Vaux, was to create picturesque woodlands imitating the scenic beauty of the Adirondacks, the new mission proposes the restoration of the diversity of the ecosystems originally present on the site — the eastern deciduous forest and affiliated natural habitats — which are increasingly endangered in our region by urban and suburban sprawl. Beset by problems typical of most large-scale parks in densely populated urban areas, Central Park's woodlands have become a laboratory for examining whether decline in health and diversity can be reversed and, equally important, for determining whether urban dwellers who view the Park as their own backyard can be engaged in its ongoing stewardship. This presentation documents the analytical work, incremental management projects, and public outreach that are the foundation for a long-term management and restoration program.

Conservation Biology in the 21st Century

David Ehrenfeld
Rutgers University

The next quarter century is likely to be very different from the last, with changes that include a diminished public awareness of nature and many fewer biologists with a working knowledge of systematics and natural history, against a background of global economic breakdown and frequent, local military conflicts. Conservation biologists can prepare for these changes.

Chicago Wilderness: A Regional Biodiversity Initiative or an Oxymoron?

Carol J. Fialkowski
The Field Museum

Chicago Wilderness is a first-of-its-kind collaboration of 34 diverse organizations working together to preserve and restore the biodiversity of the Chicago region. Focus will be on the goals of Chicago Wilderness, the role that research is playing in informing program development, and the development of the project's educational direction to reach diverse audiences at multiple entry points.

Integrating Sustainable Forestry and Biodiversity Conservation in Tropical Forests

Gary Hartshorn
Organization for Tropical Studies

Tropical forests contain a disproportionately high percentage of the world's terrestrial biodiversity. In forest-rich tropical countries, most of the forests are unprotected, hence available for development or conversion. Unless tropical forests are brought into sustainable production, very few of these unprotected forests will survive well into the next century. The integration of sustainable forestry and biodiversity conservation must become an urgent priority.

America's Private Land: A Geography of Hope

Paul W. Johnson
Natural Resources Conservation Service

In America, 70 percent of our land is made up of farms, ranches, and private forests. That land need not be just food and fiber factories. It can and must protect and enhance biological diversity. Only then will we truly have a "Geography of Hope."

Mapping the Ebb and Flow of Life

Michael J. Novacek
American Museum of Natural History

The living world is a delicate web of connections, a network of species reproducing, growing, feeding on one another, competing for the same resources, evolving, and going extinct at an alarming rate. The building blocks of these finely tuned and, as we are increasingly aware, highly vulnerable systems, are the species themselves. Systematics is the science that is central to the problem of understanding the diversity of these species and the impact of their current and projected extinction on the well-being of the planet.

Gail Benjamin

Gail Benjamin is Director of the Land Use Division of the New York City Council. Her duties involve formulation of programs and policies for the City Council with respect to land use, including policy planning and individual applications. She advises the Speaker of the Council and other senior members on land use issues, and manages a team of architects, planners, lawyers, and urban designers who conduct research and provide the technical expertise necessary for formulating positions. Previously, Ms. Benjamin was Director of the Office of Environmental Impact of New York City, and Special Assistant to the President of the New York City Health and Hospitals Corporation. She has a B.A. in Urban History from Princeton University.

Judy Braus

Judy Braus is Director of Environmental Education for World Wildlife Fund (WWF), where she oversees the Fund's educational initiatives, including management of its national biodiversity education program, "Windows on the Wild." In addition, she provides technical assistance to regional programs in Africa, Asia, Latin America, and the U.S., and works to strengthen environmental education throughout the WWF network, which includes more than 40 national programs working in more than 100 countries worldwide. She has been actively involved in national and international environmental education efforts for more than 20 years. Prior to joining WWF, Ms. Braus coordinated environmental education activities and conducted workshops for the Peace Corps. She was also Director of School Programs at the National Wildlife Federation.

Marianne Cramer

Marianne Cramer is Central Park Planner for the Central Park Conservancy and one of the authors of *Rebuilding Central Park: A Management and Restoration Plan*, the blueprint currently guiding a multi-million-dollar public-private restoration of the Park's entire 843 acres. She was responsible for initiating the woodlands management and restoration program in 1987 and continues to oversee and guide its development.

RELEVANT PUBLICATIONS

Cramer, M. 1993. Urban Renewal. *Restoration & Management Notes* 11 (2): 106-116.

Rogers, E.B., M. Cramer, J. Heiritz, B. Kelly, and P. Winslow. 1987. *Rebuilding Central Park: A Management and Restoration Plan*. Cambridge, MA: The MIT Press.

David Ehrenfeld

David Ehrenfeld is Professor of Biology in the Department of Ecology, Evolution and Natural Resources of Cook College at Rutgers University. He received his M.D. from Harvard Medical School in 1963 and his Ph.D. in zoology from the University of Florida in 1967. He has studied the behavior and sensory physiology of animal orientation and navigation in sea turtles and was a scientific organizer of the first World Conference on Sea Turtle Conservation. He is presently a member of the Marine Turtle Specialist Group of the International Union for the Conservation of Nature in Switzerland. He was the founding editor, and is now consulting editor, of the international journal *Conservation Biology*. He was elected a Fellow of the American Association for the Advancement of Science and received, in 1993, the annual award of the Society for Conservation Biology.

RELEVANT PUBLICATIONS

Ehrenfeld, D. (ed.) 1995. *Readings from Conservation Biology* (six volumes). Boston, MA.: Blackwell Science.

Ehrenfeld, D. 1993. *Beginning Again: People and Nature in the New Millennium*. New York: Oxford University Press.

Carol J. Fialkowski

Carol J. Fialkowski is Environmental Educator in the Department of Environmental and Conservation Programs at the Field Museum. She is also on the Adjunct Faculty of National-Louis University College of Education, Chicago State University, and Northeastern Illinois University. She is Chair of the Illinois Environmental Education Advocacy Consortium and of the Steering Committee for Environmental Literacy for Illinois, 2000. She is the co-chair of the National Commission on Urban and Multicultural Environmental Education. She has a B.A. in Social Science from St. Xavier College, and a M.Ed. in Environmental Science from the National College of Education.

RELEVANT PUBLICATIONS

Fialkowski, C.J. 1994. Evaluation informs good practice. *Journal of Museum Education* 19(3).

Fialkowski, C.J. 1994. Service/action approach—ecological citizenship, urban EE programs: Four examples. *The Environmental Education Toolbox*, Workshop Resource Manual, National Consortium for Environmental Education and Training.

Tim F. Flannery

Tim F. Flannery is Principal Research Scientist at the Australian Museum. His leading research interests concern the fossil and modern mammals of the Australasian region. He has particular expertise in the mammals of the Melanesian rainforests. His interests in extinction and endangerment concern the following: 1) The nature, timing, and aftershock of megafaunal extinctions in Australasia; and 2) the nature and extent of Holocene extinctions, especially the nature and causes of modern mammal extinctions in Australasia. He is also interested in the conservation of endangered species, such as tree-kangaroos, in Melanesia.

RELEVANT PUBLICATIONS

Flannery, T.F. 1995. *Mammals of the South West Pacific and Moluccan Islands*. Sydney: Reed.

Flannery, T.F. 1994. *The Future Eaters: An Ecological History of the Australasian Lands and People*. Sydney: Reed.

Ellen V. Futter

Ellen.V. Futter has been President of the American Museum of Natural History since November 1993. She previously served for 13 years as president of Barnard College. She is director of a number of organizations and has a strong record of public service, including having served as chairman of the Federal Reserve Bank of New York. Ms. Futter is also a fellow of the American Academy of Arts and Sciences, and a member of the Council on Foreign Relations. She is widely recognized as a dynamic voice for higher education and is an active supporter of women's issues. She has been awarded numerous honorary degrees, and is the recipient of the National Institute of Social Science's Gold Medal Award and the National Organization of Women's Eleanor Roosevelt Leadership Award. Ms. Futter was graduated Phi Beta Kappa, magna cum laude, from Barnard College in 1971. She earned her J.D. degree from Columbia University Law School in 1974.

Francesca T. Grifo

Francesca T. Grifo is Director of the Center for Biodiversity and Conservation (CBC) at the American Museum of Natural History, and Adjunct Professor at Columbia University. She oversees all CBC operations, including projects demonstrating how scientific results are integrated into conservation, policy, and education. Among Dr. Grifo's research interests is seeking solutions to the biodiversity crisis that integrate the competing needs of people and the environment. Her most recent work has focused on the relationships between biodiversity and human health. Earlier work has included national-level biodiversity management and planning in Eastern Europe, and intellectual property rights and benefits sharing, issues related to the commercialization of biodiversity. This work included how policy issues relevant to scientists are interpreted through the Convention on Biological Diversity. Her botanical research focuses on the evolution and systematics of neotropical cloudforest Myrtaceae, incorporating anatomical, morphological, and phylogenetic analysis to address biogeographical questions. Dr. Grifo serves on many boards and advisory committees and is on steering committees of two exhibitions at the AMNH.

RELEVANT PUBLICATIONS

Grifo, F.T. and J. Rosenthal (eds.). 1997. *Biodiversity and Human Health*. Washington, D.C.: Island Press.

Grifo, F.T. and D. Downes. 1995. Valuing intellectual property rights and indigenous knowledge: The International Cooperative Biodiversity Groups' Experience. In: *Valuing Local Knowledge*, S.B. Brush and D. Stabinsky (eds.) Washington, D.C.: Island Press.

Eric Goldstein

Eric Goldstein is a senior attorney at the Natural Resources Defense Council where, for nearly two decades, he has worked exclusively on urban environmental issues, including air pollution, solid waste, drinking water, and environmental justice. He gained national attention during the early 1980s as a leader in the public campaign to reduce levels of toxic lead in gasoline. Mr. Goldstein is also co-instructor of the Environmental Law Clinic at New York University School of Law.

RELEVANT PUBLICATIONS

Goldstein, E. and M. Izeman. 1990. *The New York Environment Book*. Washington, D.C.: Island Press.

Gary Hartshorn

Gary Hartshorn is Executive Director of the Organization for Tropical Studies and Professor at the Nicholas School of the Environment, Duke University. Formerly, he was Vice President and Chief Scientist for World Wildlife Fund (WWF) and previous to that, served as Director of the Biodiversity Support Program, a consortium of WWF, The Nature Conservancy, and the World Resources Institute. Dr. Hartshorn received a Presidential appointment to the Joint Commission on the Environment in 1991 and again in 1995, and served as that group's elected chairman from 1993 to 1994. He also serves on the Board of Directors of several organizations concerned with global tropical-forest issues. He received his Ph.D. in Forest Resources from the University of Washington.

RELEVANT PUBLICATIONS

Lieberman, D., M. Lieberman, and G.S. Hartshorn. 1996. Tropical forest structure and composition on a large-scale altitudinal gradient in Costa Rica. *The Journal of Ecology* 84(2): 137.

McDade, L., K. Bawa, H. Hespenheide, and G.S. Hartshorn (eds.) 1994. La Selva biological station, pp. 6-14; and Tree-fall gap environments and forest dynamic processes, pp. 120-127. In: *La Selva: Ecology and Natural History of a Neotropical Rainforest*. University of Chicago Press.

Paul W. Johnson

Paul W. Johnson is Chief of the Natural Resources Conservation Service in the U.S. Department of Agriculture. The NRCS is the agency concerned with conservation on private lands. The guiding principle of his leadership is to assure that NRCS works in partnership with farmers and ranchers to meet conservation goals based on local and regional priorities and environmental needs. Prior to his appointment in 1994, he was an Iowa farmer and state legislator. As a representative in the Iowa General Assembly from 1984 to 1990, he was a major architect of Iowa's Groundwater Protection Act, a model used nationwide for its emphasis on research, education, and voluntary approaches to water quality. He is a graduate of the University of Michigan where he received B.S. and M.S. degrees in forestry.

Ross D.E. MacPhee

Ross D.E. MacPhee is Chairman and Curator in the Department of Mammalogy at the American Museum of Natural History, and Adjunct Professor at Columbia University, the State University of New York at Stony Brook, and the City University of New York. His major interest is extinction — in particular, mammalian extinctions believed to have been caused or indirectly forced by humans within the last 40,000 years. His recent work revolves around the possibility that diseases introduced by humans or their commensals have been proximate causes of extinction in many parts of the world. He conducts most of his field research on islands, because island faunas have been greatly affected by anthropogenic losses. Another major focus of Dr. MacPhee's research is historical biogeography, with particular reference to the mammalian colonization of islands. At present, using paleontological methods, he is interested in determining when and how mammals first reached the islands comprising the Greater Antilles, where recent fossil recovery has pushed back the chronicle of mammalian colonization to almost 30 million years. Other research interests include primate and insectivore evolution.

RELEVANT PUBLICATIONS

MacPhee, R.D.E. and P.A. Marx. 1997. The 40,000-year plague: Humans, hyperdisease, and first-contact extinctions. Pp. 169-217. In: *Natural Change and Human Impact in Madagascar*, S. Goodman and B. Patterson (eds.). Washington, D.C.: Smithsonian Institution Press.

MacPhee, R.D.E. and C.E. Flemming. Mammalian extinctions since AD 1500: A preliminary census. In: *The Biodiversity Crisis: Science, Policy, and Society*, J.L. Cracraft and F. Grifo (eds.). New York: Columbia University Press, in press.

Michael J. Novacek

Michael J. Novacek is Senior Vice-President and Provost of the American Museum of Natural History and Curator in the Department of Vertebrate Paleontology. As Senior Vice-President and Provost, Dr. Novacek provides leadership to the curatorial staff and advises the president on the direction of scientific research at the Museum. He is a chief spokesperson in enunciating the Museum's scientific programs. As a curator in the Department of Vertebrate Paleontology, Dr. Novacek has conducted extensive research on the evolutionary relationships of extinct and living mammals. His examination of broad-based problems in systematics and evolution draws upon evidence from the fossil record and molecular biology. He is one of the team leaders of the joint American Museum-Mongolian Academy of Sciences ongoing expedition to the Gobi Desert to search for fossils, and in 1993 was one of the discoverers of Ukhaa Tolgod, the richest Cretaceous fossil site in the world. Dr. Novacek was instrumental in establishing the Museum's Center for Biodiversity and Conservation, and is a co-chair of the steering committee of Systematics Agenda 2000, an international scientific initiative to discover, describe, and classify the world's species. He is a member of the National Science Foundation Advisory Board and was recently elected to the Board of the American Association for the Advancement of Science. Dr. Novacek earned his Ph.D. in paleontology at the University of California, Berkeley, in 1978.

RELEVANT PUBLICATIONS

Novacek, M.J. 1996. *Dinosaurs of the Flaming Cliffs*. New York: Anchor/Doubleday.

Novacek, M.J. 1992. The meaning of systematics and the biodiversity crisis. Pp. 101-108. In: *Systematics, Ecology, and the Biodiversity Crisis*, N. Eldredge (ed.). New York: Columbia University Press.

SUGGESTED READING AND REFERENCE LIST

Board on Science and Technology for International Development, U.S. National Research Council. *Conserving Biodiversity: A Research Agenda for Development Agencies*, 1992, National Academy Press, Washington, D.C.

Caufield, Catherine. *In the Rainforest: Report from a Strange, Beautiful, Imperiled World*, 1984, University of Chicago Press.

Flannery, Tim F. *The Future Eaters*, 1994, George Braziller; New York, N.Y.

Grifo, Francesca and Joshua Rosenthal (eds.). *Biodiversity and Human Health*, 1997, Island Press, Washington, D.C.

Grumbine, R. Edward. *Ghost Bears: Exploring the Biodiversity Crisis*, 1992, Island Press, Washington, D.C.

Kohm, K.A. (ed.). *Balancing on the Brink of Extinction: The Endangered Species Act and Lessons for the Future*, 1991, Island Press, Washington, D.C.

Kricher, John C. *A Neotropical Companion: An Introduction to the Animals, Plants and Ecosystems of the New World Tropics*, 1989, Princeton University Press.

Mann, Charles and Mark Plummer. *Noah's Choice: The Future of Endangered Species*, 1995, Alfred A. Knopf, New York, N.Y.

Martin, P.S., and R.G. Klein (eds.). *Quaternary Extinctions: A Prehistoric Revolution*, 1984, University of Arizona Press, Tucson.

McClung, Robert. *Lost Wild America: The Story of Our Extinct and Vanishing Wildlife*, 1993, The Shoe String Press, Hamden, CT.

Myers, Norman. *The Primary Source: Tropical Forests and Our Future*, 1992, W.W. Norton & Company, New York, N.Y.

Noss, Reed F. and Allen Y. Cooperrider. *Saving Nature's Legacy: Protecting and Restoring Biodiversity*, 1994, Island Press, Washington, D.C.

Pimm, Stuart L., G.J. Russell, J.L. Gittleman, and T.M. Brooks. The future of biodiversity, 1995, *Science* 269:347-350.

Quammen, David. *The Song of the Dodo: Island Biogeography in an Age of Extinctions*, 1996, Charles Scribner's Sons, New York, N.Y.

Reaka-Kudla, Marjorie L., Don E. Wilson, and Edward O. Wilson (eds.). *Biodiversity II*, 1996, Joseph Henry Press, Washington, D.C.

Reid, W.W., and K.R. Miller. *Keeping Options Alive: The Scientific Basis for Conserving Biodiversity*, 1989, World Resources Institute, Washington, D.C.

Schaller, George. *The Last Panda*, 1993, University of Chicago Press.

Steadman, D.W. Prehistoric extinctions of Pacific island birds: Biodiversity meets zooarchaeology, 1995, *Science* 267:1123-1131.

Thorne-Miller, Boyce and John Catena. *The Living Ocean: Understanding and Protecting Marine Biodiversity*, 1991, Island Press, Washington, D.C.

Tudge, Colin. *Last Animals at the Zoo: How Mass Extinctions Can Be Stopped*, 1992, Island Press, Washington, D.C.

Wilson, E.O. *Biodiversity*, 1988, National Academy Press, Washington, D.C.

Wilson, E.O. *The Diversity of Life*, 1992, W.W. Norton & Company, New York, N.Y.

World Resources Institute (WRI), International Union for the Conservation of Nature (IUCN) and the United Nations Environment Programme (UNEP). *Global Biodiversity Strategy: Guidelines for Actions to Save, Study, and Use Earth's Biotic Wealth Sustainably and Equitably*, 1992, World Resources Institute, Washington, D.C.

Many of these titles are available in the Museum Book Shop.

The Center for Biodiversity and Conservation

The American Museum of Natural History (AMNH) has been a leader in expanding general scientific understanding of the natural world for over 125 years. The Center for Biodiversity and Conservation (CBC), established by the Museum as a multi-departmental facility in 1993, is dedicated to enhancing the use of rigorous scientific data to mitigate critical threats to global biodiversity. Drawing on the combined strengths of the Museum's scientific, education, and exhibition departments, as well as its extensive collections and library, the CBC strives to disseminate scientific information to a wide audience and to develop viable, science-based solutions to biodiversity conservation problems.

The CBC sponsors programs in research, training, and outreach to scientists, students, and organizations worldwide.

Research Programs

The CBC seeks to build global collaborations that integrate the AMNH's extensive resources with the diverse strengths of sister institutions, conservation organizations, environmental NGOs, and educators. A series of field-based projects is being developed in regions of the world with high concentrations of biological diversity. A priority of these projects is to ensure that resulting data is disseminated efficiently, and in readily accessible terms, to resource managers, decision-makers, and the general public.

The CBC's Research Grants Program provides research support to AMNH curators whose work addresses questions of direct relevance to conservation. Recent projects include:

- An inventory of ants, bees, wasps, and termites in Brazil that will enable scientists to use these insects as bioindicators
- An assessment of diversity and endemism patterns among Africa's birds and mammals
- A study of the status of humpback whales and other marine mammals off northeastern Madagascar
- The use of DNA sequence variation to determine the migration patterns, relationships, and interactions of distinct populations
- A project to determine the actual status of mammals thought to be recently extinct on Hispaniola

Graduate Training Program

The Graduate Training Program offers course- and fieldwork in systematics and biodiversity science to students from around the world. Currently, the program enrollment includes students from Ethiopia, Indonesia, Madagascar, Peru, and the U.S., conducting research in entomology, ichthyology, mammalogy, and ornithology.

Outreach

The CBC is committed to integrating scientific research findings into education and communication about biodiversity conservation through training workshops for international environmental educators; conferences that convey important topics to both the scientific community and the general public; and fostering relationships with other institutions.

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