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Smithsonian Institution

CLIMATE CHANGE AND BIODIVERSITY IN THE AMERICAS

PANAMA ▪ February 25-29, 2008

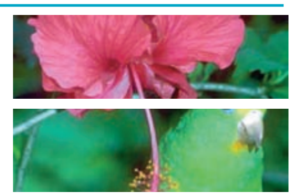
www.climatechangeandbiodiversity.ca

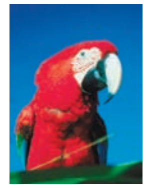
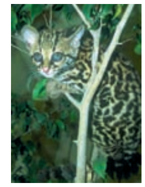
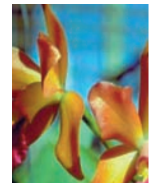
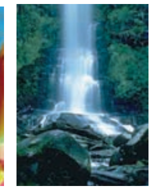
Acknowledgement

It is gratefully acknowledged that the Canadian International Development Agency has provided substantial resources to ensure participation from countries in the Americas.

Canadian International Development Agency

Agence canadienne de développement international



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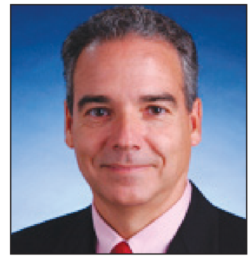
Message from co-chairs

Don MacIver
Director



Francisco Dallmeier
Director

During this century, human-induced climate change may lead to loss of biodiversity on a global scale. In particular, climate change could cause dramatic shifts in species' distributions, and species' extinctions, particularly across fragmented or vulnerable ecosystems. The impacts of climate change on biodiversity are of major concern to the Convention on Biological Diversity (CBD) as well as the work of the Intergovernmental Panel on Climate Change (IPCC) as it supports the United Nations' Framework Convention on Climate Change (UNFCCC). The risks have been highlighted to coral reefs and forest ecosystems, and have drawn attention to the serious impacts of loss of biodiversity on people's livelihoods. More recently, the CBD's Conference of the Parties has turned its attention to the potential impacts on biodiversity and ecosystems of the various options for mitigating or adapting to climate change and requested the Convention's Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA) to develop scientific advice on these issues.

SBSTTA established an ad hoc technical expert group to carry out an assessment of the inter-linkages between biodiversity and climate change - the results of which draw upon the best available scientific knowledge, including that provided by the Intergovernmental Panel on Climate Change. The report concludes that there are significant opportunities for mitigating climate change, and for adapting to climate change while enhancing the conservation of biodiversity.

However, these synergies will not happen without a conscious attention to biodiversity concerns, and without knowledge of likely future climatic changes. This symposium brings together over 100 scientists and environmental managers from over 20 countries to report on their individual research activities, and contribute to providing an overall understanding that will help decision makers assess the likely impacts of climate change on biodiversity and make informed choices. This symposium is designed to highlight the scientific basis for the development of recommendations, as appropriate, for setting priorities for future research on climate change and biodiversity throughout the Americas. We hope that it will also be useful to countries as they seek to implement policies, programmes and activities under the Convention on Biological Diversity and the United Nations Framework Convention on Climate Change.

We trust that you will find this symposium both informative and rewarding. Our full program of speakers and activities will keep you busy over the length of the symposium. We will be publishing papers from this symposium in the peer-reviewed literature as a continuing contribution to our attempts collectively to understand the inter-linkages and synergies between climate change and biodiversity.

We wish to acknowledge the hard work of our staff in organizing and running this symposium; the sponsors of the symposium; the scientific advisory committee to the symposium; the paper and poster presenters; our welcoming addresses; and our distinguished keynote speaker, Dr. Thomas Lovejoy.

And last, we thank you as a participant for taking part is this valuable symposium. We trust that you will find it useful and inspiring.

SYMPOSIUM CO-CHAIRS

Don MacIver, *Director*
Adaptation and Impacts Research Division
Environment Canada

Francisco Dallmeier, *Director*
Center for Conservation Education and Sustainability,
Smithsonian Institution, National Zoological Park

Symposium Overview

The focus of the symposium is to provide a forum for leading scientists to present the results of research and monitoring activities of climate change and forest biodiversity throughout the Americas. The aim is to establish a co-operative science, research and monitoring network of activities that interlink biodiversity conservation and sustainability, policy responses, and adaptation to climate change throughout the Americas.

The changing climate is a significant driver of biodiversity and is already affecting many ecosystems throughout the Americas. It is necessary to mitigate and prevent these changes to preserve the biodiversity and ecological integrity of these regions. Increasingly, governments, organizations, industries, and communities need to consider adaptation to impacts of current and future changes in forest biodiversity in their planning, infrastructure and operations.

The goals of the symposium are to: 1. Review the baseline data and systematic observation networks to assess biodiversity conservation, sustainability options and policy responses to global climate change; 2. Integrate our knowledge of likely future changes on forest biodiversity, from a changing climate, reflecting both scientific and traditional knowledge; 3. Report on predictive models and decision support tools to guide the design and selection of adaptation strategies from local to regional scales; and 4. Establish a framework for future collaborative research on climate change, biodiversity and sustainable development.

The Symposium brings together top researchers, industry representatives and managers of climate change and forest biodiversity research and monitoring activities from North, Central and South America and the Caribbean. It will provide an opportunity for researchers and decision makers from a wide range of disciplines to share results and information throughout this pan-American event. The symposium program includes invited keynote and plenary presentations, panel presentations, poster sessions, and study tours.

The focus of the symposium is structured to address regional themes on climate change and biodiversity as well as approaches, techniques and integrated studies. This symposium allows participants to collaborate with other managers of climate and forest biodiversity monitoring networks, compare data from across the Americas, share local strategies, learn latest advances in adaptation and gain an understanding of threats and impacts to biodiversity as a result of a changing climate.

Symposium Themes Include:

1 Current status of climate change and forest biodiversity monitoring throughout the Americas: case studies and comparative research.

2 Impacts to forest biodiversity from global climate change including El Niño events, infectious disease, invasive species, hurricanes, forest fires, land degradation, periodic drought and desertification.

3 Adaptation and sustainability options, interactions and synergies between global climate change and forest biodiversity.

4 Future networks, research collaborations, and the establishment of an Americas wide network of climate change and of biodiversity sites across climate, chemical and ecological gradients.

Venue

The Smithsonian Tropical Research Institute (STRI), one of the best known tropical research organizations, aims to increase understanding of the past, present, and future of tropical biodiversity and its relevance to human welfare. STRI offers an ideal setting with offices, laboratories, and a major library in Panama City, facilities in Gamboa, near the 22,000-hectare Soberania National Park, a field station in western Panama at Fortuna, providing access to tropical montane forests, and a resident international staff of over 40 scientists. For more information on STRI visit www.stri.org

International Science Symposium
CLIMATE CHANGE AND BIODIVERSITY
25 to 29 February 2008 Panama City, Panama

MONDAY ■ February 25, 2008

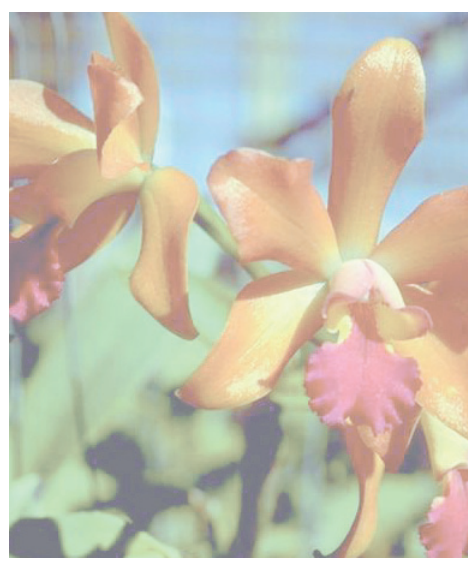
OPENING PLENARY

Welcoming Addresses
Chair: Don MacIver, Environment Canada

1400 to 1420	Eldredge Bermingham, Acting Director, Smithsonian Tropical Research Institute, Panama
1420 to 1440	Jose Herran-Lima, Canadian Ambassador to Panama
1440 to 1500	Dani Kuzniecky, Minister for Canal Affairs, Panama
1500 to 1520	Ligia Castro de Doens, General Administrator, Panama's National Environmental Authority (ANAM)
1520 to 1600	Break

Distinguished Address
Chair: Francisco Dallmeier, Smithsonian Institution

1600 to 1700	Climate Change and Biodiversity Thomas Lovejoy, President, John Heinz Center for Science, Economics and the Environment, USA
1730 to 2000	Evening Reception STRI Facility



TUESDAY ■ February 26, 2008

PLENARY SESSION 2

Climate Change and Biodiversity: A Sponsor's View

Chair: Adam Fenech, Environment Canada

0830 to 0850	Integrating biodiversity conservation into energy development: Experiences from Gabon and Peru Francisco Dallmeier, Smithsonian Institution, USA
0850 to 0910	Environment = Management x Climate^2 Don MacIver, Environment Canada
0910 to 0930	Biodiversity, global change and development – a dialogue? Holm Thiessen, InterAmerican Institute for Global Change Research, Brazil
0930 to 0950	Perspectives on climate change from the convention on biological diversity Ahmed Djoghlaf, Convention on Biological Diversity, Canada
0950 to 1010	Climate change impacts on forest biodiversity Buruhani Nyenzi, World Meteorological Organization, Switzerland
1010 to 1030	Break
1030 to 1050	Climate change and biodiversity challenges at UNESCO Biosphere Reserves Natarajan Ishwaran, United Nations' Education, Science and Cultural Organization, France
1050 to 1110	Climate change and biodiversity in the Caribbean Kenrick Leslie, Caribbean Community Climate Change Centre, Belize
1110 to 1130	Global Forest Observatories: Monitoring the health of tropical forests Stuart Davies, Smithsonian Tropical Research Institute, Panama
1130 to 1150	Climate, oceans, infectious diseases, and human health Rita Colwell, University of Maryland and Johns Hopkins School of Public Health, USA
1150 to 1210	Climate change and biodiversity in high latitudes and high altitudes Fred Roots, Canada MAB Programme
1210 to 1230	Environmental prediction, biodiversity and the changing climate Heather Auld, Environment Canada
1230 to 1400	**LUNCH AND POSTER SESSIONS**

PLENARY SESSION 3

Current Status of Monitoring and Future Modelling of Climate and Biodiversity

Chair: Holm Tiessen, InterAmerican Institute for Global Change Research

1400 to 1420	A new Smithsonian initiative on carbon dynamics and impacts of global change in tropical and temperate forests Helene Muller-Landau, Smithsonian Tropical Research Institute, Panama
1420 to 1440	Climate change and biodiversity in St.Vincent and the Grenadines Ruth Knights, SVG Ministry of Agriculture, Forestry and Fisheries
1440 to 1500	Modelling future climates: From GCMs to statistical downscaling approaches Bill Gough, University of Toronto at Scarborough, Canada
1500 to 1520	Climate scenarios for the Caribbean: Limitations and needs for biodiversity studies Anthony Chen, University of the West Indies, Jamaica

1520 to 1540	The warming of the Americas: A detailed analysis of future climate change scenarios Shannon Allen, University of Toronto, Canada
1540 to 1600	Changing climate and hydrologic variability in the Cordillera of the Americas Brian Luckman, University of Western Ontario, Canada
1600 to 1630	Break
1630 to 1650	Status and future direction of the SI/MAB network of permanent plots Alfonso Alonso, Smithsonian Institution, USA
1650 to 1710	Neutral-plus models as a tool for exploring impacts of climate change on tropical forests Rick Condit, Smithsonian Tropical Research Institute, Panama
1710 to 1730	Tropical tree plantations with native species: linking carbon storage with concerns for biodiversity Catherine Potvin, McGill University, Canada
1730 to 1750	TEAM: A global framework for monitoring, understanding and conserving biodiversity in a changing world Sandy J. Andelman, Conservation International, USA
1750 to 1810	Impacts of climate extremes on biodiversity in the Americas Marianne Karsh, Environment Canada
1810 to 1830	Priorities and pitfalls for assessing the responses of tropical forests to global climatic and atmospheric change: lessons from research to date Deborah Clark, University of Missouri-St. Louis, USA
1830 to 1850	The Canadian Climate Change Scenarios Network (CCCSN) Neil Comer, Environment Canada
1850 to 1910	Potential effects of climate change on the sex ratio of crocodiles Armando H. Escobedo-Galván, Ciudad Universitaria, Mexico

WEDNESDAY ■ February 27, 2008

RESEARCH/STUDY TOURS

1. Barro Colorado

2. Canopy Crane

3. Gamboa and Pipeline Road

4. Miraflores Locks

THURSDAY ■ February 28, 2008

PLENARY SESSION 4

Impacts of Climate Change on Biodiversity

Chair: Ahmed Djoghlaf, Convention on Biological Diversity

0830 to 0850	How will global change affect tropical forests? Recent findings and debates William F. Laurance, Smithsonian Tropical Research Institute, Panama
0850 to 0910	Changes on ecosystem growth due to climate change in tropical dry forests in the Americas Arturo Sanchez-Azofeifa, University of Alberta, Canada
0910 to 0930	Climate and global change will induce the development of new forests Ariel Lugo, International Institute of Tropical Forestry, Puerto Rico
0930 to 0950	Biodiversity not as a victim: atmosphere control in Amazonia Antonio Nobre, Instituto Nacional de Pesquisas da Amazônia-INPA, Brazil
0950 to 1010	Climate change impacts on coastal biodiversity Virginia Burkett, US Geological Society
1010 to 1030	Break
1030 to 1050	Rapid change in Amazonian forest dynamics: effects of climate change? Susan Laurance, Smithsonian Tropical Research Institute, Panama
1050 to 1110	The vulnerability of tropical species to global warming Joseph Wright, Smithsonian Tropical Research Institute, Panama
1110 to 1130	Renewable natural resources and climate change Raquel Soto, Instituto Nacional de Recursos Naturales (INRENA), Peru
1130 to 1150	Long term leafing changes in Amazon forest trees and climate change Patricia Morellato, Universidade Estadual Paulista (UNESP), Brazil
1150 to 1210	Global warming and rainforest: a geological perspective Carlos Jaramillo, Smithsonian Tropical Research Institute, Panama
1210 to 1230	Influence of niche properties on distance for habitat tracking in response to future climate change by highland grasses endemic to Mesoamerica Iván Jiménez, Missouri Botanical Garden, USA
1230 to 1400	**LUNCH AND POSTER SESSIONS**

PLENARY SESSION 5

Impacts of Climate Change on Biodiversity

Chair: Buruhani Nyenzi, World Meteorological Organization

1400 to 1420	The effects of functional biodiversity on ecosystem processes, ecosystem services and sustainability: an interdisciplinary approach Natalia Pérez-Harguindeguy, Universidad Nacional de Córdoba, Argentina
1420 to 1440	Biodiversity consequences of long-term snow climate change Michael E. Loik, University of California, USA
1440 to 1500	Increase in the dominance of galls across the Americas as a result of climate change. Geraldo Wilson Fernandes, Universidade Federale de Minas Gerais, Brazil

1500 to 1520	Bridging the gap: Neotropical endangered species and climate changes Denise Rambaldi, Associação Mico-Leão-Dourado, Brazil
1520 to 1540	Tropospheric ozone and climatic changes: Effects on the main agronomic species Jesus Ramirez, Instituto de Meteorología de Cuba
1540 to 1600	Avian response to climate change in British Columbia, Canada – towards a general model Fred Bunnell, University of British Columbia, Canada
1600 to 1630	Break
1630 to 1650	Can 40-years natural restoration give us a clue about climatic change effects in transition zones between two Brazilian hot spots? Luiz Carlos Busato, Signus Vitae Environmental Projects, Brazil
1650 to 1710	Phenological changes of Mammillaria mathildae in a deciduous tropical forest as a bio-indicator of climatic change Oscar Rubio, Universidad Autónoma de Querétaro, Mexico
1710 to 1730	Modelación espacial del efecto del cambio climático sobre la distribución de Quercus emoryi Torr. (Fagaceae) en México María de Jesús Torres Meza, Instituto Nacional de Investigaciones Forestales, Agrícolas y Pecuarias, Mexico
1730 to 1750	Population trends of montane birds in southwestern Puerto Rico eight years after the passage of Hurricane Georges Adrianne Tossas, Puerto Rico
1750 to 1810	Regional bird monitoring as a tool for predicting the effects of climate change on biodiversity Maria Zaccagnini, Instituto Nacional de Tecnología Agropecuaria, Argentina
1900 to 2200	Evening Reception Miraflores Locks

FRIDAY ■ February 29, 2008

PLENARY SESSION 6

Adaptation Strategies and Solutions
Chair: Natarajan Ishwaran, United Nations' Education, Science and Cultural Organization, France

0830 to 0850	Mainstreaming adaptation in national protected areas systems in Central America by scaling up biological corridors and forest landscape restoration Pascal O. Girot, IUCN Mesoamerica, Costa Rica
0850 to 0910	Adapting management strategies under changing climate scenarios Robert Szaro, US Geological Survey
0910 to 0930	Climate change and adaptive resource management in the Southwest Nova Biosphere Reserve Cliff Drysdale, Mersey Tobeatic Research Institution, Nova Scotia, Canada
0930 to 0950	Biomass and carbon accumulation in secondary forests and forestry plantations used as restoration tools in the Caribbean region of Costa Rica Frederico Alice, Instituto de Investigación y Servicios Forestales (INISEFOR), Universidad Nacional, Costa Rica
0950 to 1010	Climate change, biodiversity conservation, deforestation and their policy responses in Bolivia under the current political context: What scope for synergies and interactions? Bernardo Peredov, Oxford University Centre for the Environment (Bolivia)
1010 to 1030	The status and rate of adaptation policymaking for biodiversity conservation Kelly Levin, USA
1030 to 1050	A Mata Atlântica e o aquecimento global Monika Naumann, Consultant, Brazil
1050 to 1110	Break

PANEL SESSION

Chair: Don MacIver

1110 to 1210	Building a Network on Climate Change and Biodiversity in the Americas Panel members: Dallmeier, Djoghlaf, Fenech, Ishwaran, Leslie, Nyenzi, Thiessen
1230 to 1400	**LUNCH AND POSTER SESSIONS**

SYMPOSIUM DECLARATION

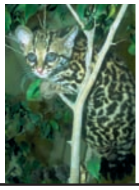
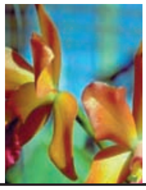
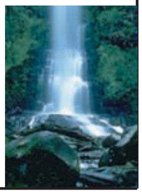
Presented by Francisco Dallmeier

TRAINING SESSIONS

Forest Biodiversity Monitoring Plots: Tools for Measuring Forest Changes
February 29 (afternoon) to March 2, 2008

Models of Future Climate Changes
March 3 to 4, 2008

Short Biographies for the opening day

ELDREDGE BERMINGHAM, *Acting Director, Smithsonian Tropical Research Institute*

Eldredge Bermingham is acting director of the Smithsonian Tropical Research Institute a unit of the Smithsonian Institution headquartered in Panama City, Panama, since March 2007. He joined the institute's scientific staff in 1989 and has served as deputy director since 2003. He replaces Ira Rubinoff, who is on leave from his position as STRI's director while he serves as the Smithsonian's acting Under Secretary for Science. As STRI's acting director, Bermingham oversees the world's premier tropical biology research institute, dedicated to increasing the understanding of the past, present and future of tropical biodiversity and its relevance to human welfare. The institute furthers the understanding of tropical nature and its importance to human welfare, trains students to conduct research in the tropics and promotes conservation by increasing public awareness of the beauty and importance of tropical ecosystems. Bermingham's research has advanced knowledge of the movement of organisms across the land bridge formed as the Isthmus of Panama rose to connect North and South America 3 million years ago and sheds light on processes of contemporary biological invasions. His analyses of bird populations on the islands of the Lesser Antilles contribute to the understanding of extinction. He has been a strong proponent of cross-unit collaborations at the Smithsonian, encouraging the development of projects through the Smithsonian Marine Science Network and the Smithsonian Barcode of Life Initiative. Bermingham earned a bachelor's degree in biology from Cornell University in 1977 and a doctorate degree in genetics from the University of Georgia in 1986.

JOSE HERRAN-LIMA, *Canadian Ambassador to Panama*

Jose Herran-Lima grew up in Bogota, Colombia, the son of a Brazilian mother and a Colombian father working in his country's foreign service. When he was 16, the family moved to New York City where he completed an MBA at Columbia University (1973). The bits of news that Mr. Herran-Lima read about Canada in the newspapers there intrigued him and he decided to move to Toronto in 1974, becoming a citizen three years later. Attending Osgoode Hall Law School in 1980, Mr. Herran-Lima became interested in the Canadian foreign service. With his legal training and Spanish, his first assignment was a three-month stint in 1981 helping consular officers in Lima, Peru, deal with a large number of cases of Canadians charged with drug offences. At the embassy in Lima, he met a Canadian secretary, Susan Magee, who would, upon her return to Canada, become his wife. In Ottawa he has worked as a senior analyst for the Canada-U.S. Trade Negotiations Office, a desk officer for the Economic Relations with Developing Countries Division, Deputy Director of the UN Legal Operations Division, and Deputy Director of the Inter-American Relations, South America and Inter-American Division. Mr. Herran-Lima has since been posted to Indonesia, Zimbabwe, Guatemala and Brazil. In Panama, his first assignment as ambassador, Mr. Herran-Lima is working to build on existing ties.

DANI KUZNIECKY, *Minister for Canal Affairs, Panama*

Dani Kuzniecky officially assumed the position as chairman of the Panama Canal Authority (ACP) Board of Directors in April 2007 and concurrently holds the rank of Minister for Canal Affairs. A partner at Kuzniecky & Levy Co., Mr. Kuzniecky received his M.S. in comparative jurisprudence from New York University. He conducted post-graduate work at Harvard Law School and earned a degree in law and political science from the Universidad Santa Maria La Antigua - Panama. During his service to the government, the National Assembly of Panama appointed Mr. Kuzniecky as Comptroller General of Panama, a position he held from January 2005 until April 2007. In this role, he presided over the Central American and Caribbean Superior Comptroller Entities (OCCEFS) and acted as Executive Secretary of the Latin American and Caribbean Superior Comptroller Entities (OLACEFS). Moreover, he is a member of various professional organizations including the International Association of Attorneys, International Association of Hebrew Attorneys and Jurors and the National College of Attorneys. In 2006 he received the “Complete Attorney of the Year” Award by the Universidad Santa María la Antigua. Mr. Kuzniecky sits on the Nutrehogar Board of Directors and has served as professor of philosophy and law at the Universidad Santa María La Antigua. A published author of children’s books, he is married and the father of three children.

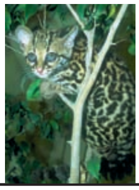
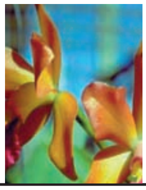
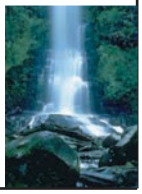
THOMAS LOVEJOY, *President, Heinz Center for Science, Economics, and the Environment*

Dr. Thomas Eugene Lovejoy III is chief biodiversity adviser to the president of the World Bank, senior adviser to the president of the United Nations Foundation, and president of the Heinz Center for Science, Economics, and the Environment. He coined the term biological diversity in 1980. Lovejoy, a tropical biologist and conservation biologist, has worked in the Amazon of Brazil since 1965. He received his B.S. and Ph.D. in biology from Yale University. From 1973 to 1987 he directed the World Wildlife Fund-U.S., and from 1987 to 1998 he served as Assistant Secretary for Environmental and External Affairs for the Smithsonian Institution in Washington, D.C., and in 1994 became Counselor to the Secretary for Biodiversity and Environmental Affairs. He is chair of the Yale Institute for Biospheric Studies, and is past president of the American Institute of Biological Sciences, past chairman of the United States Man and Biosphere Program, and past president of the Society for Conservation Biology. Thomas Lovejoy developed the debt-for-nature swaps, in which environmental groups purchase shaky foreign debt on the secondary market at the market rate, which is considerably discounted, and then convert this debt at its face value into the local currency to purchase biologically sensitive tracts of land in the debtor nation for purposes of environmental protection. Thomas Lovejoy has also supported the Forests Now Declaration, which calls for new market based mechanisms to protect tropical forests. Lovejoy serves on many scientific and conservation boards and advisory groups, is the author of numerous articles and books, and is the founder of the public television series Nature.

Plenary 1

Distinguished Address

- *Climate Change and Biodiversity - Thomas Lovejoy*

Climate Change and Biodiversity

THOMAS LOVEJOY, *President, John Heinz Center for Science, Economics and the Environment, USA and M. B. Karsh, Environment Canada*

Biodiversity in the Americas is being transformed by human induced climate change. There have already been many noted changes among numerous species in times of nesting and flowering as well as changes in geographical distributions, population dynamics and genetics. Increased CO_2 in the atmosphere has made oceans 0.1 pH unit more acid, negatively affecting tens of thousands of species that depend on calcium carbonate to build skeletons. On land, the alteration of the hydrological cycle has increased the probability of wildfire, which is devastating to biodiversity in regions with no previous adaptation to fire. Besides climate change, human activities are also accelerating loss in biodiversity. Exotic species are being introduced far beyond their natural biogeographical boundaries. Native and non-native species alike must contend with pollutants for which they are unable to adapt. In the tropics, the widespread clearing and burning of forests is not only increasing CO_2 levels but also reducing biodiversity. Ironically, some of the destruction is due to the increased demand for ethanol and biodiesel (soybean and palm oil) by countries seeking to wean themselves off of oil. The habitats that do remain are becoming increasingly fragmented and isolated. Habitat fragmentation leads to genetic impoverishment and eventual extinction, as species can no longer adjust their ranges to climate change. Driven by habitat loss in tropical moist forests and ensured by fragmented habitats and climate change, the current rate of extinction is 100 times faster than expected. If greenhouse gas emissions continue to run unchecked until 2050, future rates could be 1,000 times faster than expected. The impacts on biodiversity will be disastrous. Habitat fragmentations and climate change is the new challenge for biodiversity conservation. The current protected area system used in much of the Americas is insufficient given the realities of climate change. To ensure that biodiversity is protected, multiple large reserves are required, tens to hundreds of thousands of square kilometers in size, stratified along major environmental gradients to capture regional biota. All regional reserve networks and landscape connectivity must be wed with effective modeling of future climate change. To implement the changes necessary for sustainable ecosystems that are biologically healthy, functional and diverse, humanity needs hope and the ability to dream of a glorious coexistence with a planet teeming with life. Part of the solution lies in the natural world and its ability to instill wonder. Awakening the biophilia inherent in humanity can improve the outlook for biodiversity if everyone has more contact with life on earth and becomes more aware of the negative trends that threaten it.

Plenary 2

Climate Change and Biodiversty: A Sponsor's View

- Integrating biodiversity conservation into energy development: Experiences from Gabon and Peru - Francisco Dallmeier
- Environment = Management x Climate^2 - Don MacIver
- Biodiversity, global change and development – a dialogue? - Holm Thiessen
- Perspectives on climate change from the convention on biological diversity - Ahmed Djoghlaf
- Climate change impacts on forest biodiversity - Buruhani Nyenzi
- Climate change and biodiversity challenges at UNESCO Biosphere Reserves - Natarajan Ishwaran
- Climate change and biodiversity in the Caribbean - Kenrick Leslie
- Global Forest Observatories: Monitoring the health of tropical forests - Stuart Davies
- Climate, oceans, infectious diseases, and human health - Rita Colwell
- Climate change and biodiversity in high latitudes and high altitudes - Fred Roots
- Environmental prediction, biodiversity and the changing climate - Heather Auld

Integrating biodiversity conservation into energy development: Experiences from Gabon and Peru

FRANCISCO DALLMEIER, *and Alfonso Alonso, Center for Biodiversity Conservation Education and Sustainability, Smithsonian Institution, National Zoological Park, USA*

Increasingly, areas of interest for biodiversity conservation are also being identified by the oil and gas development industry by their energy resources. While energy development is not the main threat to biodiversity, it can cause significant primary and secondary impacts on ecosystems. In some cases, careful planning and implementation of biodiversity actions plans and associated monitoring programs may also make a positive contribution to biodiversity conservation. With the projected increase on global energy demands, the risk to biodiversity from oil and gas development is also expected to increase. For the energy industry the challenge is to find a way to meet the public demand expectations, low cost of oil and gas products, and societal environmental responsibility. Several leading companies have identified strategic, operational, reputational, and financial benefits to including biodiversity conservation in their decision making policies and operational processes. For conservation and environmental organizations, the key is to find the balance between the challenge of working with the industry and the opportunity for harnessing the influence, expertise and resources of energy companies for conservation efforts. For the last ten years, the Smithsonian Institution's Monitoring and Assessment of Biodiversity Program joined several energy companies to integrate biodiversity conservation into energy development. The emphasis of this partnership has been on the long term societal and environmental benefits of species and habitat conservation while adding value to company operations. The Smithsonian team has conducted biodiversity research and monitoring activities in sensitive areas of Peru and Gabon. Some of the biodiversity research questions focused on the connectivity of forest ecosystems to maintain the integrity of sensitive species and habitats, the impact and management of invasive species, the effects of forest fragmentation due to roads and pipelines routes, the impacts of "black spots" on species and habitats, and the monitoring of sensitive species over time. The outcome of the research, the stakeholder consultation process and the input from management has contributed to the development of site specific biodiversity action plans. Critical operational decisions such as location of infrastructure, building of roads and pipeline routes have considered the results of the research and conservation priorities.

Environment = Management x Climate^2

DON MacIVER, *Environment Canada*

Einstein discovered a deep connection between energy and mass and represented it by the now famous equation $E=mc^2$. In this equation, the final variable is a very large number, the square of the speed of light. Moving beyond the physics, there appears to be a similar magnitude and speed analogy when we now look at the Environment where the final variable in this equation is the square of the climate or in other words, natural climate times human-induced climate. As we know, climate exerts a large influence on biodiversity and we need to consider the multiplier effect of natural and human-induced climate, instead of simple additive impacts. In this context, we know that biodiversity thresholds change radically when the impact of the multiplier climate is further accelerated by the lack of management actions. We have made significant progress in our understanding of the current and future changes in the climate system, but have we implemented biodiversity management actions at the same magnitude and rate to maintain a sustainable environment?

Biodiversity, global change and development – a dialogue?

HOLM THIESSEN, *InterAmerican Institute for Global Change Research, Brazil*

We need to promote "development policies that simultaneously preserve biodiversity and enrich the livelihoods of those societies in close contact with it" said a representative of an establishment for the increase and diffusion of knowledge. "They hold up progress for the sake of a catfish" said a president of a country undergoing rapid development. How can we communicate across the divide? Biodiversity loss is a concern, but to whom? A dialogue is needed on the value and valuation of biodiversity. The meaning of biodiversity and the relevance of biodiversity to the discourse on global change must become clearer. In what ways do global change, mitigation and adaptation affect biodiversity and vice versa? Mitigation by expansion of palm oil and sugar cane will cause biodiversity loss, yet a doubling in atmospheric carbon dioxide could strip biodiversity-rich regions of many species. Climate change and habitat loss interact in landscapes, and regional landscapes rather than individual ecosystems may have to be managed in the future. Sanctuaries may no longer work under climate change. More integrated approaches will be needed and, most importantly, justified to those who will foot the bill.

Perspectives on climate change from the convention on biological diversity

AHMED DJOGHLAF, *Convention on Biological Diversity, Canada*

The Millennium Ecosystem Assessment as well as recent reports from the Intergovernmental Panel on Climate Change have made us all aware that climate change negatively impacts natural resources and that it is one of the main drivers of biodiversity loss. From the dramatic decline in amphibian populations in Central and South America, to the decreased fitness of polar bears in the Arctic, and the spread of the pine beetle in North America's forests, impacts have been felt across the Americas. It is important, as we work to achieve the 2010 Biodiversity Target to significantly reduce the rate of biodiversity loss, that we both consider biodiversity in climate change adaptation and enhance the ability of biodiversity to resist and respond to this rapidly emerging challenge. Furthermore, the conservation and sustainable use of biodiversity can contribute to both climate change mitigation and adaptation activities. Therefore, the vital link between two of the most pressing environmental issues facing our planet – biodiversity loss and climate change - needs to be better understood. Some important emerging links between biodiversity and climate change can be found in ongoing discussions on avoided emissions from deforestation, adaptation and vulnerability, traditional and indigenous knowledge and the conservation and sustainable use of critical ecosystems such as wetlands, coastal zones, mountains, and dry and sub-humid lands. The role of protected areas and natural corridors in climate change mitigation and adaptation are also emerging issues for discussion. The Convention on Biological Diversity (CBD) set the international framework regarding biodiversity and very early on looked into the relationship between biodiversity and climate change. The CBD, through its cross-cutting issue on climate change, integrated climate change components within all of the programmes of work of the Convention, with the exception of technology transfer and cooperation. The Convention has also built synergies with the United Nations Framework Convention on Climate Change and convened an Ad Hoc Technical Expert Group on climate change and biodiversity. There remains, however, a number of challenges and opportunities for the further development of interlinkages between biodiversity and climate change, many of which will need to be addressed through national implementation. These include capacity building, mainstreaming, communication and awareness raising and research and technology.

Climate change impacts on forest biodiversity

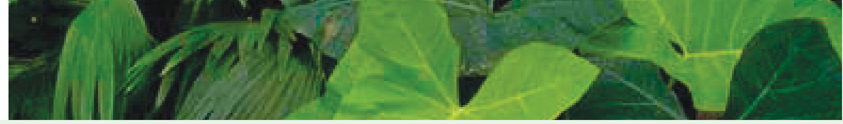
BURUHANI NYENZI, *and Robert Stefanski, World Climate Programme*
World Meteorological Organization, Switzerland

Forest ecosystems will be under severe stress over the next century by an unprecedented combination of climate change including increased threats of drought, wildfire, and pests and other issues such as land use change and over exploitation of resources. The assessment made by the Intergovernmental Panel on Climate Change (IPCC) shows that there will be major changes in the structure of forest ecosystems, the interactions between species, and the geographic range of many species resulting in mostly negative consequences for biodiversity and ecosystem resources. However, much is still unknown about the current year-to-year climate variability and its impact on forest ecosystems. For example, the relationships between physical mechanisms such as the El Nino/La Nina, Southern Oscillation and the North Atlantic Oscillation and the productivity of forest ecosystems are still being investigated and further research into these relationships is needed. Therefore, in order to sustainably manage current forest resources with respect to impacts of climate variability (droughts, wildfire) and to adequately address likely future climate change impacts, decision-makers at all levels need to be aware of all aspects of the climate system. WMO, in collaboration with its Members comprising of a global network of National Meteorological and Hydrological Services (NMHSs) and other partners, plays an important role in weather and climate observation, monitoring, scientific understanding of climate processes, and the development of clear, precise and user-targeted information and climate predictions. It furthermore provides sector-specific climate services, including advice, tools and expertise, to meet the needs and requirements of climate-related adaptation strategies as well as decision-making. The climate system is so complex that the global network of scientific observations and research need to be strengthened.

Climate change and biodiversity challenges at UNESCO Biosphere Reserves

NATARAJAN ISHWARAN, *United Nations' Education, Science and Cultural Organization, France*

The 529 biosphere reserves in 105 countries to-date have been proposed by UNESCO Member States and recognized by the UNESCO Man and the Biosphere (MAB) Programme. While sites nominated prior to 1995 are mostly protected areas with buffer zones and, at times, transition areas, post-1995 designations are true land/seascape units with a mix of natural and rural, and some times urban, ecosystems. In the more than 200 post-1995 sites protected area core zones make up only 11% of the total area; the rest of the 89% is spread across buffer zones and transition areas that have multiple resource use and regulatory regimes and where trade-offs between biodiversity conservation and socio-economic development need to be worked out with the participation of stakeholders. Climate change mitigation presents challenges as well as opportunities in buffer zones and transition areas with potential to link mitigation tactics with adaptation scenarios for biodiversity extending beyond the legally protected core zones. A six year Plan agreed upon at the 3rd World Congress of Biosphere Reserves held in Madrid, Spain, from 4 to 9 February 2008 presents opportunities to use biosphere reserves as learning laboratories for sustainable development; i.e. deriving context specific mix of climate change mitigation, biodiversity conservation and human well-being enhancement measures that could attract sustainable investments into these UNESCO recognized places.



Climate change and biodiversity in the Caribbean

KENRICK LESLIE, *Caribbean Community Climate Change Centre, Belize*

The effects of climate change are expected to cause shifts in species and/or loss in species in the Caribbean due to changes in the normal patterns of temperature, rainfall, and other climatic parameters. To better understand and monitor the inter-relationship between the anticipated changes in the climate and likely impacts on the ecosystems, the Centre under various GEF sponsored projects, is in the process of installing various types of monitoring systems at specific locations in the Caribbean. This presentation will discuss the various monitoring systems and the climate modeling being done. *Climate modeling – Glimpses of future Caribbean Climate.* In this section a discussion of the modeling work being done will be discussed. Both dynamical and statistical downscaling models are being utilized in the studies. Two dynamical downscaling models are currently being used - the UK Hadley PRECIS model and the Japanese Earth Simulator. Three grid size resolutions are utilized- The 50 km and 25 km of the PRECIS model and 20 km of the Earth Simulator. The model scenarios are the A2 and B2 with the PRECIS and A1B2 with the Earth Simulator. Results of key climate parameters from these models will be presented and implications on the biodiversity discussed. *The Marine Monitoring system.* The Marine monitoring system comprises a Coral Reef Early Warning System (CREWS) in the Northwestern region of the Caribbean Sea and Coral reef monitoring in the Eastern Caribbean. *The CREWS Monitoring System.* The Coral Reef Early Warning System (CREWS) uses equipment in monitoring on a continuous basis different sea parameters such as temperature, biological oxygen load, etc. Analysis of the data from the system will indicate the conditions the corals are being subjected. Conditions that lead to degradation of the coral can be measured and used to give warning and plan/implement corrective actions. Early results from this system will be presented. *The Coral Reef Monitoring System.* The Coral Reef Monitoring Program in the OECS and Tobago uses a protocol developed under an earlier project (CPACC) to do the monitoring. Video images are captured of coral reefs on an annual basis and these are then uploaded and transformed using appropriate computer software. Using an agreed video monitoring protocol, images are then analyzed and results interpreted to provide the data and information on the state of the coral reef at the time of monitoring. *The Climate Monitoring System.* A network comprising of eleven climate and five sea level stations are being established to monitor atmospheric and sea conditions in the Caribbean. A detailed description and functioning of these stations will be presented in the paper. *The Terrestrial Monitoring Programm.* The detailed design of pilot adaptation programs to reduce expected negative impacts of climate change on coastal biodiversity and land degradation will be presented.

Global Forest Observatories: Monitoring the health of tropical forests

STUART DAVIES, *Smithsonian Tropical Research Institute, Panama*

Tropical deforestation continues at around 13 million hectares per year. This and other land-use change in the tropics contributes greenhouse gases to the atmosphere, reduces the ability of forests to regulate climates, and threatens the many species that are only known from tropical rain forests. Regrettably, there is a tremendous gap in our understanding of the role of tropical forests in the global carbon cycle, in regulating hydrological cycles, and the likely impact of these changing global conditions. The Center for Tropical Forest Science developed methods to understand how deforestation and climate change are affecting tropical forests. CTFS coordinates research activities using standardized methods on forest plots ranging from 16-148 hectares in 20 sites in 15 tropical forest countries in Latin America, Africa, and Asia. The CTFS plots involve hundreds of scientists from more dozens of institutions. Over the past 25 years, the CTFS network has created the first actuarial table for tropical trees around the world, thus providing a basis for determining quantitatively how trees and forest ecosystems are responding to Earth's changing climate. This international collaboration is now monitoring the growth and survival of 3.5 million trees in over 6,500 species – over 12% of all known tropical tree species - to investigate key indicators of global environmental health. In this talk, I will discuss some of the key findings of this global network of tropical forest research.

Climate, oceans, infectious diseases, and human health

RITA COLWELL, *University of Maryland and Johns Hopkins School of Public Health, USA*

Recent studies have shown that vector borne infectious diseases, i.e., malaria, dengue, and other insect transmitted diseases, are related to climate in their distribution and seasonality. Similarly, infectious disease agents transmitted by waterborne hosts, namely cholera, caused by the bacterium, Vibrio cholerae, demonstrate pandemicity influenced by climate. Sea surface temperature, sea surface height, and chlorophyll concentration measured via satellite have proven useful predictors of cholera epidemics. Studies carried out in the Bay of Bengal have shown strong correlation of climate predictors with seasonal epidemics of cholera in Mathbaria and Bakerganj, Bangladesh, and in Kolkata, India. Additional studies in Ghana, Africa, and in Lima, Peru, have similarly shown climate driven outbreaks of cholera. More recently, a related species, Vibrio parahaemolyticus, the causative agent of gastroenteritis, has caused outbreaks of illness in the Pacific Northwest and Alaska, as well as in the Gulf of Mexico, in the United States, that are related to warming temperatures of the coastal waters. Clearly, the more subtle influences of climate on infectious diseases need to be understood and predictive models established for this aspect of climate change that has not been given attention.

Climate change and biodiversity in high latitudes and high altitudes

FRED ROOTS, *Canada MAB Programme*

Present knowledge of environmental processes and climate modeling predict that the effects of changes in planetary surface heat flux that appear to be in store will be greatest in high northern latitudes and in the sub-Antarctic. These effects can be expected to be further exacerbated in rugged mountainous districts in such areas, where the combination of low sun angle, great seasonal differences in solar energy received during winter and summer, and very uneven distribution of precipitation result in extreme local contrasts in environmental conditions. Ecosystems that have developed in polar, sub-polar and high alpine conditions are typically low-energy systems, with relatively few species at each trophic level, and comparatively simple food chains. Individuals of the constituent species must have the ability to become dormant when conditions are unfavorable, or to migrate, sometimes over great distances. Such systems, highly stressed by physical factors, commonly simple in organizations but with great complexity of pattern, are inherently particularly vulnerable to rapid change in climate. They typically have evolved a delicate and complex intertrophic interdependence in which plant germination and growth, development and distribution of insects and other invertebrates including parasites and microfauna, and the life cycles of the vertebrates, each with a different and distinctive response and maturation period are marvelously interlinked. Any rapid and persistent change in climate is likely to disrupt this interlocking system. A warming climate will also likely introduce new species from lower latitudes and altitudes, further disrupting the ecosystem. Some of these problems are being studied through the UNESCO MAB GLOCHAMORE (GLObal CHAnge in MOuntain REgions) program; others are topics in the current International Polar Year program.

Environmental prediction, biodiversity and the changing climate

HEATHER AULD, *Environment Canada*

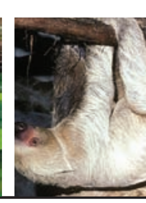
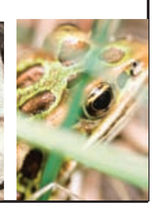
Climate change has been described as one of the major challenges of the 21st century to conserving biodiversity and to ensuring the sustainable use of natural resources. Responses to deal with the threats to biodiversity from the changing climate and its new extremes will require improved scientific understanding of the linkages among the issues as well as an improved "environmental prediction" capability to predict the potential biodiversity and land use changes that may result from the changes. Environmental predictions of ecological conditions attempt to forecast or project the impacts of changing physical, chemical and human-induced changes on ecosystems and their components. In dealing with changing weather and climate conditions, environmental prediction tools will be needed that can project the effects or directions of climate-induced changes on ecosystems and their components. These tools will become increasingly critical for the decisions that will need to be taken to deal with the impacts from changing climates and to meet the goals of international Conventions. In particular, it will be the ability to understand and to predict the occurrence of extreme climate events and their ecosystem impacts that will become most important for planning and implementing response actions that can minimize damages and enhance ecosystem resilience. In some cases, extreme climate events may open the door for cumulative impacts on many species. Building the ability to predict the cumulative impacts of climate impacts on biodiversity will become one of ecology's most significant challenges in dealing with future changes. The development of environmental prediction capacity and tools will need to build from expert judgment, traditional ecological knowledge, extensive analysis, incorporation of new types of observations, and assessments, in addition to numerical simulation and prediction models.

Plenary 3

Current Status of Monitoring and Future Modelling of Climate and Biodiversity

- A new Smithsonian initiative on carbon dynamics and impacts of global change in tropical and temperate forests - Helene Muller-Landau
- Climate change and biodiversity in St.Vincent and the Grenadines - Ruth Knights
- Modelling future climates: From GCMs to statistical downscaling approaches - Bill Gough
- Climate scenarios for the Caribbean: Limitations and needs for biodiversity studies - Anthony Chen
- The warming of the Americas: A detailed analysis of future climate change scenarios - Shannon Allen
- Changing climate and hydrologic variability in the Cordillera of the Americas - Brian Luckman
- Status and future direction of the SI/MAB network of permanent plots - Alfonso Alonso
- Neutral-plus models as a tool for exploring impacts of climate change on tropical forests - Rick Condit
- Tropical tree plantations with native species: linking carbon storage with concerns for biodiversity - Catherine Potvin
- TEAM: A global framework for monitoring, understanding and conserving biodiversity in a changing world - Sandy J. Andelman
- Impacts of climate extremes on biodiversity in the Americas - Marianne Karsh
- Priorities and pitfalls for assessing the responses of tropical forests to global climatic and atmospheric change: lessons from research to date - Deborah Clark
- The Canadian Climate Change Scenarios Network (CCCSN) - Neil Comer
- Potential effects of climate change on the sex ratio of the crocodiles - Armando H. Escobedo-Galván



A new Smithsonian initiative on carbon dynamics and impacts of global change in tropical and temperate forests

HELENE MULLER-LANDAU, *Smithsonian Tropical Research Institute, Panama*

Tropical and temperate forests together encompass an estimated 38% of terrestrial carbon pools and 48% of terrestrial net primary production, and thus, knowledge of their carbon dynamics and of how these dynamics respond to natural and anthropogenic global change is key to understanding the global carbon budget today and in the future. Yet we remain tremendously ignorant of how forests are responding and will respond to changing climates and other atmospheric drivers, and for tropical forests in particular even data on past and current pools and fluxes are scarce. The Center for Tropical Forest Science of the Smithsonian Tropical Research Institute is embarking on a new long-term program to quantify and monitor carbon stores and fluxes at large plots (15-50 ha each) in twelve old-growth tropical and temperate forests. In the next four years, we will assess carbon stores in soil, coarse woody debris, and lianas at each site for the first time; we will annually measure tree growth, tree mortality, litterfall, and decomposition rates; and we will refine current estimates of above-ground tree biomass. We will thereby estimate total carbon stocks at each site and investigate how interannual variation in carbon fluxes relates to interannual variation in climate. We will collaborate with partners to link our detailed on-the-ground measurements to remote sensing for extrapolation to larger landscapes, and provide small grants for complementary studies of other aspects of carbon dynamics and the underlying mechanisms. We are eager to maximize the gain from this new research program by making data publicly available and by linking our work to other monitoring efforts and studies. Because the CTFS plots encompass 3 million trees identified to 6000 species whose locations are precisely mapped within large plots around the world, they are a tremendous resource for examining the roles of species differences and local interactions in driving carbon dynamics, and the global consistency of these patterns. I will summarize past findings from the CTFS plots on changes in aboveground tree carbon and the roles of climate variation, species composition, and local disturbance dynamics in these changes, and preview future research directions.

Climate change and biodiversity in St.Vincent and the Grenadines

RUTH KNIGHTS, *SVG Ministry of Agriculture, Forestry and Fisheries*

The paper will attempt to show the current status of climate change and biological diversity along with identifying the present and potential impacts to the forest biodiversity in St. Vincent and the Grenadines from global climate change including ENSO phenomenon, invasive species, hurricanes, forest fires and land degradation. The paper defines climate change and biodiversity in addition to linking their relationships and effects on St. Vincent and the Grenadines. Furthermore, the current status of climate change and forest biodiversity monitoring by including a list of endemic species in St. Vincent and the Grenadines is provided. The Paper will: (1) identify the impacts to forest biodiversity from global climate change by indicating (a) key issues of the recent Knowledge, Attitude, Practices (KAP) Survey 2007 conducted at Union Island, Bequia and Spring Village (communities in SVG); (b) state current and potential adverse impacts of climate change on biodiversity such as changes in flowering of forest species; migration/succession of forest types, vegetation and fauna; damage/destruction of habitat due to change in temperature and rainfall; and changes in predator/prey relationship, which in turn will affect agriculture and human health; (2) identify research areas that will provide pertinent information (this is due to the lack of scientific evidence for

implementing adaptation strategies aimed at providing environmental and socio-economic sustainability. Such research will focus on options, interactions and synergies between global climate change and forest biodiversity); (3) list present and future networks including the Second National Communications Project to the UNFCCC, launched in October 2006, to conduct vulnerability and adaptation assessments of major productive sectors inclusive of forest biodiversity; and existing regional agencies focusing on climate change and its adverse effects that will assist in giving technical and other support to regional countries on addressing climate change issues along with providing assistance to research projects.

Modelling future climates: From GCMs to statistical downscaling approaches

BILL GOUGH, *University of Toronto at Scarborough, Canada*

Climate change impact assessments utilize projections of climate change to assess impacts of a wide variety of human and natural systems. The projections can come from a variety of sources including synthetic scenarios, climate transpositions and climate models. Synthetic scenarios project climate change in a relatively simply fashion such as a 3°C increase in temperature or a 20% reduction of precipitation. It is widely used to assess the sensitivity of an area of interest to climate change. Climate transposition uses climate data that is displaced either temporally or spatially to provide self consistent scenarios of future climates. However, the methodology of choice is the use of projections from coupled atmosphere-ocean models. These models (GCMs) provide a variety of useful scenarios for the evolution of the earth's climate for the next century. These models however have relatively coarse resolution both temporally and spatially. This, thus, makes the application of the data to local and regional studies or studies in which finer temporal scales, such as diurnality, problematic. One example, day to day temperature variability, is explored using data from a climate station and the corresponding output from a GCM. It is shown that the GCM fails to capture the nuances of this variation. Downscaling techniques are proposed to ameliorate this problem.

Climate scenarios for the Caribbean: Limitations and needs for biodiversity studies

ANTHONY CHEN, *and Michael Taylor, University of the West Indies, Jamaica; David Farrell, Caribbean Institute of Meteorology and Hydrology, Barbados; and Abel Centella, Instituto de Meteorologia, Cuba*

The extent of climate baseline data, climate information and climate scenarios which are readily available for related biodiversity studies and the capacity for undertaking these studies in the Caribbean were investigated. A list of the databases available is given. Although adequate capacity and some information exist, there are gaps to be filled. Information is inadequate because of the limited baseline data, the course resolution of the global and even the regional models. Steps to fill the gaps are discussed. Information for biodiversity studies includes knowledge of climate threshold values and geographical distribution. Some of this information can be provided by statistical downscaling but the process requires daily data of good quality and long duration. These, however, are infrequently collected. The material for this paper comes from the Implementation of the Climate Change and Biodiversity in the Insular Caribbean (CCBIC) Project which is being conducted by the Caribbean Natural Resources Institute (CANARI).

The warming of the Americas: A detailed analysis of future climate change scenarios

SHANNON ALLEN, *University of Toronto at Scarborough, Canada; and Adam Fenech, Environment Canada*

Climate change is a problem affecting nearly every environment in the world. The ability to predict what areas of the world will undergo the most drastic changes can be useful to biologists in the protection and conservation of organisms living in these altered environments. The purpose of this presentation is to determine what areas of the Americas will be most greatly affected by changing temperatures and precipitation in the near future. The data necessary for such a task was taken from the Canadian Climate Change Scenarios Network (CCCSN) which allows the user to download model outputs drawn from the Intergovernmental Panel on Climate Change's (IPCC) Fourth Assessment Report (AR4). The three periods in which scenarios of future climate change are made are for the 2020s, 2050s and 2080s. Baseline maps were created for a 30 year period between 1961 and 1990, and compared with observational data taken from the Global Climate Observing System (GCOS). By calculating the differences between the two maps and the observed GCOS data, the degree of uncertainty created was calculated. Data taken from the CCCSN site was then used with the baseline maps to create the projected climate anaomalies for the 2020s, 2050s and 2080s. Two maps were created for each time frame, one representing temperature increases, and the other changes in precipitation levels. These maps were produced by averaging the three IPCC scenarios known as A2, A1B, and B1 into an ensemble approach. In total, six future scenario maps were created using the third generation Canadian Global Climate Model (CGCM3). From these maps, the paper concludes focusing on the areas of the Americas most affected by climate changes.

Changing climate and hydrologic variability in the Cordillera of the Americas

BRIAN LUCKMAN, *University of Western Ontario, Canada*

This presentation will provide results from investigations of climate and hydrological variability in the Cordillera of the Americas using available instrumental data and proxy records reconstructed using tree-rings. Significant changes in hydrological variability that result from climate warming occur in basins where a major component of annual (usually summer) flow is controlled by snow or glacier melt in the headwaters of the basin. Warmer winters may result in lower snowpack and or winter accumulation on glaciers that ultimately lead to lower summer flows. These changes in regime have important implications for downstream water management in many lowland areas adjacent to the cordillera in both hemispheres. In addition the reduction of snow/glacier melt inputs and lower summer flows may significantly influence water temperatures resulting in changes in aquatic habitats and freshwater ecology. In regions with strong interannual (e.g. ENSO) or multidecadal (e.g. PDO) flow variability it is important to determine low frequency changes in these regimes to establish the representativeness of the available instrumental records and possible long term interactions between these phenomena. Climate variability may also have significant effects on the magnitude and frequency of major disturbance regimes in forest vegetation e.g. through changes in the periodicities or intensity of fire, insect outbreaks, drought, hurricanes or ice storms. Changing frequency of these events, superimposed on long term trends may result in changes in the nature and pattern of regeneration following disturbance. As climates change, environmental conditions may pass significant biological thresholds resulting in a drastic landscape response e.g. forest mortality due to drought stress. Finally, the effects of climate changes may be most strongly felt at ecotonal boundaries or for organisms with a very narrow range of tolerance for change. Examples of these effects will be discussed based on work undertaken in the cordillera by researchers of IAI CRN 03 and 2047.

Status and future direction of the SI/MAB network of permanent plots

Francisco Dallmeier and ALFONSO ALONSO, *Smithsonian Institution, USA; and Marianne Karsh, Adam Fenech and Don MacIver, Environment Canada*

Since 1986, with a mandate to promote the conservation of biodiversity, the Smithsonian Institution's Monitoring and Assessment of Biodiversity Program (SI/MAB) has been developing an international network of SI/MAB research and monitoring plots to monitor the status of forests and changes over time. The SI/MAB protocol emphasizes 3 main objectives: (1) to gather baseline information about forest structure, composition and diversity within a vegetation plot (a snapshot); (2) to assess changes in these forest components over time (snapshots to build a film of changes over time); and (3) to use the information to link forest vegetation parameters with multi-taxa monitoring (link forest vegetation to understanding other parts of the environment including birds, fungi, soils, etc.). The tool for establishing these plots is the Smithsonian Institution/MAB Biodiversity Monitoring Plot Protocol, published by the UNESCO Man and the Biosphere program as MAB 11 titled "Long-Term Monitoring of Biological Diversity in Tropical Forest Areas: Methods for Establishment and Inventory of Permanent Plots". The protocol calls for a 1 hectare plot (that is 100 meters by 100 meters) divided into 25 contiguous quadrats (20 by 20 meters). The initial tree measurements are straightforward for establishing an inventory plot: tree tagging and location, tree species identification, tree dbh (diameter at breast height), and tree height. The data is recorded in common field note formats, and then entered into a common database software, developed by the Smithsonian Institution, called BIOMON. From the data, maps are generated for each quadrat, and are used to validate the measurements in the field. Once the 1 hectare plot is established, and the major vegetation habitat is surveyed, then the SI/MAB plot sets the framework for other associated environmental measurements to be taken such as forest health surveys, ground-cover vegetation, earthworms, soils, birds, etc. in and around the plot. There are at least 388 SI/MAB plots established around the world in 32 countries. Most of these plots (about 80 percent) are in the Americas. There are SI/MAB plots in Canada, the United States of America, Argentina, Bolivia, Brazil, Chile, Columbia, Costa Rica, Cuba, El Salvador, Guatemala, Guyana, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru and Venezuela. Plots are established for research, conservation, education, training and ecotourism. The immediate data available from the plots are species lists for trees above 4 or 10 cm dbh, total trees, total species, total families as well as other statistics such as abundance, basal area, frequency, relative abundance, relative basal area, relative frequency, Importance Value Index, total basal area, total abundance, average dbh, relative density, and relative dominance. This presentation will provide the basics of the SI/MAB Protocol; GIS-produced maps of the world and regionally for the locations of the SI/MAB plots; tables of the number of plots, countries, stems, species, etc. that are represented in the SI/MAB plot international database; and then examples will be shown on the current and potential research uses of the plots throughout the Americas.

Neutral-plus models as a tool for exploring impacts of climate change on tropical forests

Lee Hannah, Conservation International and RICK CONDIT, *Smithsonian Tropical Research Institute, Panama*

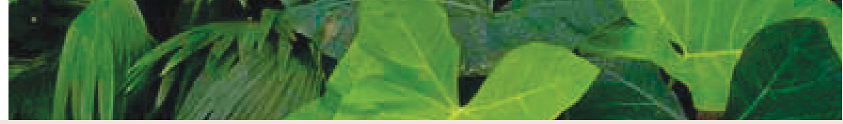
Assessing the impacts of past and future climate change on tropical forests faces several unique barriers. Information about life-history and even taxonomic identity may be quite limited for large numbers of tropical forest species. Paleoecological studies are often denominated at the generic, rather than species level. How then do we learn from the past and anticipate the future for conservation of species-rich, information-poor tropical forests? One approach is to use

neutral models, which make the assumption that all individuals of all species are ecologically equivalent. The power of neutral theory is that it is sufficient to describe many observed patterns in biodiversity, allowing data collection and hypothesis testing to focus on questions that cannot be explained by the assumption of ecological equivalence. A related class of models, that we term "Neutral-plus", is models that violate the assumption of ecological equivalence incrementally, and only where it can be empirically demonstrated that this violation contributes to model explanatory power. Neutral-plus models are powerful in assessing impacts of climate change because response to climate by definition violates the assumption of ecological equivalence. Here we present results for a Neutral-plus model operating on a small, 50ha domain and preliminary results for trials of the model on larger domains. We use a Neutral-plus model that has been developed for tropical forests at the Smithsonian Tropical Research Institute, add a climatic ecological response, and a climatic gradient. The model is then run for a shift in climatic gradient alone, and for a shift in climatic gradient combined with different levels and patterns of landscape fragmentation (random, fractal and directional). The results of the 50ha trials are relevant to site-level conservation management and to providing insight into sub-gridscale processes operational in other types of biological models, such as species distribution models of climate change, that are typically run at spatial resolutions of 1km or coarser. The 50ha results are of further use in providing insights into interactions that may operate at larger spatial scales. The larger domain preliminary results support several interactions identified in the 50ha runs, but also reveal emergent properties that may be unique to larger spatial scales.

Tropical tree plantations with native species: linking carbon storage with concerns for biodiversity

Malena Sarlo, The Nature Conservancy, Panamá, Republica de Panamá; Chrystal Healey, Quebecor World, Canada; and CATHERINE POTVIN*, Department of Biology, McGill University, Canada*

Increased concern for climate change coupled with a willingness of some developed countries to developed mitigation strategies has raised the interest for tropical tree plantations. Yet the expansion of monocultures has raised significant concern for biodiversity. Here, we examined the extent to which tree diversity affects plot productivity, carbon storage and, in turn, earthworm numbers and soil and litter arthropod diversity. The study was carried out in a tropical tree plantation located in Sardinilla, Panama, where six native trees have been planted in different diversity treatments to test for the effects of biodiversity on ecosystem functioning. ANOVAR unveiled that the tree biomass of the three-species plots was significantly higher than that of the other diversity levels and this effect increased through time. A. excelsum had the smallest average biomass while C. odorata was the most productive species in the three- and six-species mixtures. The additive partitioning method used to compare the basal area of mixtures with monocultures demonstrated a significant positive effect of complementarity (t=2.64, p =0.023) and a significant negative effect of selection (t=-2.21, p= 0.049). The highest carbon storage (5.87 tC ha^{-1}) after four years of growth corresponded to a three-species plot planted with C. odorata, H. crepitans and L. seemanii, whereas, the lowest value was that of the A. excelsum monocultures (< 1 tC ha^{-1}). The effect of mixture (monoculture vs. mixed species pairs) on the number of litter arthropods was statistically significant (Pillai Trace value = 0.130, p=0.040), less arthropods were found below trees growing in monocultures than in mixed species pairs. Shannon's and Simpson's indices of diversity revealed that mixed-species pairs sustain less diverse arthropod communities than monoculture pairs. MANOVA unveiled a significant effect of tree species (Pillai Trace value = 0.647, p=0.014) on the numbers of the litter arthropods. Two taxa, Araneae and Coleoptera, drove the significant response to tree species identity (respectively F5, 108=5.317, p=.0001; F5, 108 = 2.324, p=.048). The tree species main effect was statistically significant (F5,91= 3.28, p =0.009) and explained 27.55% of the variation in earthworm numbers. Over all, our study suggest that reforestation strategies with tree native species plantations translated in significant biodiversity benefits with correlated impacts on ecosystem carbon cycling.



TEAM: A global framework for monitoring, understanding and conserving biodiversity in a changing world

SANDY J. ANDELMAN, *USA, Conservation International*

Global change and direct human actions threaten biodiversity at local to global scales and compromise the essential services that human societies derive from nature. Although biodiversity is one of our planet's most precious assets, we do not have a consistent way of measuring biodiversity change that allows us to make comparisons among different geographic scales and among different taxonomic and trophic levels in a way that is statistically robust. The Convention on Biological Diversity set a target to reduce current rates of biodiversity loss by 2010. This creates the need for a monitoring program that not only produces detailed and reliable information about rates of biodiversity loss, but that also will provide insights into the underlying mechanisms of change at the relevant scales. The Tropical Ecology, Assessment and Monitoring Network provides the first systematically designed framework for a global network of sites and a set of consistent methods that will enable us to quantify and forecast changes in biodiversity in response to climate change and land cover change. This unprecedented effort fills a critical data gap in conservation science by providing the first public domain, reliable time series data on a range of biodiversity attributes at local, regional and global scales.

Impacts of climate extremes on biodiversity in the Americas

MARIANNE KARSH, *and D.C.MacIver, Environment Canada*

Since 1970, climate extremes have been impacting biodiversity in the Americas with greater frequency, duration and severity than ever previously recorded. There is widespread evidence of longer droughts, more frequent wildfires, higher temperatures and more intense storms, hurricanes and precipitation events. As well as greater variability of El Niño Southern Oscillation events, the total area impacted by flooding, glacier retreat and permafrost melt, desertification, landslides and avalanches has grown. Further, concurrent extreme events – such as flooding and high temperatures, droughts and high winds, and droughts and flooding – are becoming increasingly common. Extreme events are not only emerging as a critical factor in climate change: they also have a greater correlation to predicted changes in biodiversity than climate change alone. Although ecosystems show high resilience to hurricanes, ice-storms and other extreme events, significant impacts on biodiversity may occur once certain thresholds in duration, intensity and severity are exceeded. The resulting losses in biodiversity can reduce ecological resilience and adaptive capacity to climate change. To manage for potential biodiversity loss and to provide adaptation options for ecosystems to become more resilient to climate hazards, researchers and policymakers require a baseline monitoring database. The current database, the forest biodiversity observing network, consists of more than 500 individual observing sites that allow for transact studies to interlink climate and biodiversity information. Canadian case studies are featured to illustrate the benefits of using transact studies to analyze the impacts of climate hazards and their associated risks for biodiversity. To strengthen the existing database of biodiversity observing sites in the Americas, future sites located in areas of critical biodiversity, across climate, chemical and physical gradients, are discussed. Strategies for risk assessment and the analysis of impacts on biodiversity are shown for sites with hurricane, ice-storm and heavy browsing damage.

Priorities and pitfalls for assessing the responses of tropical forests to global climatic and atmospheric change: lessons from research to date

DEBORAH CLARK, *University of Missouri-St. Louis, USA*

At the La Selva Biological Station, Costa Rica, findings from long-term monitoring of annual tree growth (25 years) and forest carbon cycling (10 yr) suggest dramatic forest responses to climatic variation. However, experiences associated with this research and with other recent studies underscore a series of caveats and information gaps that will continue to make it especially challenging to detect climate-change effects on tropical forests. A fundamental constraint for such investigations is the need for sufficient time-series of observations. With only a few successive census intervals completed for most tropical-forest monitoring sites, the power to detect correlations between environmental factors and forest performance will remain low for a considerable time, and climatic relationships that appear to exist early on can disappear as a short time-series is extended. A critical limitation for nearly all long-term tropical-forest study sites is the lack of high-quality multi-decade records of most climatic and atmospheric factors. Another important outstanding need is to make the data underlying recent findings in this field freely available to the scientific community. Multiple issues arise in the analysis of temporal series of forest growth measurements; cohort data and stand-level data require different approaches, and inappropriate analyses can distort the findings. More robust indicators will come when monitoring in small, unreplicated plots is extended to the larger landscape. Special challenges for detecting tropical-forest responses to environmental change are: incomplete and changing taxonomies (the requirement for vouchers); the potentially large role of site history; the rarity of long-term data on plant reproduction; and the still limited understanding of the ecophysiology underlying forest performance. In this paper I illustrate these issues with examples from recent studies and conclude with a set of priorities for going forward.

The Canadian Climate Change Scenarios Network (CCCSN)

NEIL COMER, *Environment Canada*

The CCCSN is Environment Canada's updated interface for distributing climate change scenarios and adaptation research. The CCCSN was originally launched in February 2005 with support from Environment Canada, the Climate Change Adaptation Fund (CCAF) and the University of Regina. Since April of 2005, it has been wholly supported by Environment Canada and the Adaptation and Impacts Research Division (AIRD), along with university and other partners. The CCCSN was initially developed to assist AIRD researchers with ongoing research at various AIRD nodes, but the site available to the internet. The CCCSN contains the most recent new science to help practitioners of climate change impacts and adaptation and the general public who wish to know more about climate change projections across Canada and the world. The goals of the CCCSN are: Support climate change impact and adaptation research in Canada and other countries; Support stakeholders requiring scenario information for decision making and policy development; Provide access to the work of AIRD, an Environment Canada research division; and Provide access to Canadian and International work on the development of scenarios and adaptation research The CCCSN continues to support climate change impact and adaptation research in Canada and other partner countries through the provision of Global Climate Model (GCM) scenarios, Regional Climate Model (RCM) scenarios, data, and downscaling tools. Climate change scenarios are provided from numerous international research centres, in support of the Intergovernmental Panel for Climate Change (IPCC) assessments. Results from the second (SAR), third (TAR), and fourth (AR4, 2007) assessments are available. In addition, the CCCSN can provide high level technical support for downscaling and impacts and adaptation research, access to existing research, access to new research tools as they are developed at the AIRD nodes and training in the use of these tools. The CCCSN supports academic researchers as well as other stakeholders outside of academia who require scenario information for decision-making. The CCCSN has a wealth of information including climate change model maps, data download, scatterplots, downscaling methodologies/data, and bioclimate profiles to support impacts and adaptation science. The CCCSN will maintain Canada's reputation for preserving a leading-edge scenarios facility that will become one of the premier sources for Canadians and international researchers seeking information on climate change scenarios and impacts and adaptation research.

Potential effects of climate change on the sex ratio of the crocodiles

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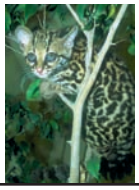
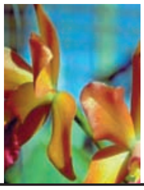
Recent raise of global temperature has affected the phenology, performance, survival and reproduction of a wide range of plants and animals. However, projections of climatic changes for the next 100 years show that not all regions will experience equal alterations. In species that exhibit temperature-dependant sexual determination, climate change may alter offspring sex ratios. In the case of crocodilians, understanding the effect of climate on sex determination represents a key aspect to conserve these species in the long-term. Herein, we reviewed the sex ratios of Crocodylus acutus and C. moreletii in different localities across their geographic range, characterizing the local climate and evaluating the potential impact in the next 50 years. With the localities where sex ratio has and has not been altered and using genetic and maximum entropy algorithms, we generated ecological niche models and projected them onto current and future climate scenarios to produce potential distribution maps for the two species in the two time periods. Our results include spatially-explicit models detecting the areas where we can expect sex ratio alterations due to climate change.

Plenary 4

Impacts of Climate Change on Biodiversity

- How will global change affect tropical forests? Recent findings and debates - William Laurance
- Changes on ecosystem growth due to climate change in tropical dry forests in the Americas - Arturo Sanchez-Azofeifa
- Climate and global change will induce the development of new forests - Ariel Lugo
- Biodiversity not as a victim: atmosphere control in Amazonia - Antonio Nobre
- Climate change Impacts on coastal biodiversity - Virginia Burkett
- Rapid change in Amazonian forest dynamics: effects of climate change? - Susan Laurance
- The vulnerability of tropical species to global warming - Joseph Wright
- Renewable natural resources and climate change - Raquel Soto
- Long term leafing changes in Amazon forest trees and climate change - Patricia Morellato
- Global warming and rainforest: a geological perspective - Carlos Jaramillo
- Influence of niche properties on distance for habitat tracking in response to future climate change by highland grasses endemic to Mesoamerica - Iván Jiménez


How will global change affect tropical forests? Recent findings and debates

WILLIAM LAURANCE, *Smithsonian Tropical Research Institute, Panama*

Global climatic and atmospheric changes could potentially have wide-ranging effects on tropical ecosystems and their biota. Some possible changes are relatively well understood, others are not, and many are subjects of active debate. I will highlight the various kinds of global-scale changes that have been hypothesized or putatively demonstrated for tropical forests. These include deleterious impacts of global warming on cool-adapted biotas at higher elevations, increasing effects of pathogens, and declining primary productivity in lowland forests as a result of higher plant-respiration rates. Another potential category of changes, which might arise from increasing atmospheric CO_2 concentrations, involves increasing forest productivity from CO_2 fertilization, elevated forest dynamics, and nonrandom changes in plant-species composition. A third category of change, around which there is great uncertainty, concerns the effects of global warming on rainfall regimes and storm intensity in the tropics. Any of these changes could potentially interact with, and exacerbate, the effects of rapid forest loss and disruption in the tropics.

Changes on ecosystem growth due to climate change in tropical dry forests in the Americas

ARTURO SANCHEZ-AZOFEIFA, *Benoit Rivard and Andrew Bush, Earth and Atmospheric Sciences Department, University of Alberta, Canada*

Our understanding of how tropical dry forests will respond to increases in temperature and reductions on precipitation in the America's is unknown since most of current research, in terms of tropical forest's responses to climate change, is biased towards tropical rainforests. In this paper we analyze the potential impacts of climate change in tropical dry forests in the Americas using an integration of temperature and precipitation data sets coupled with observations from Global Circulation Models; plus forest phenology based on the use of the Normalized Difference Vegetation Index (NDVI), the Enhance Vegetation Index (EVI) and Leaf Area Index (LAI) observations derived from NASA's Moderate Resolution Spectro-Radiometer (MODIS). Observed changes on phenological patterns in Mexico's tropical dry forests present the possibility of using this fragile ecosystem as a barometer to quantify early manifestations of ecological systems to climate change in the Americas. We conduct our analyses at two different levels: single time series analysis and large-scale level analysis. Our results indicate a significant and important sensitivity of Mexico's tropical dry forests to climate change with less significant responses in terms of phenological dynamics for tropical dry forests in Costa Rica and Brazil. We explore the possibility that future tropical dry forests will have an increase on the dominance of drought resistant species and a notorious increase in tree mortality, as growing seasons become sorter. Our Mexican results pose an important question about the future of this tropical ecosystem and how local biodiversity will response under future climate change scenarios.

Climate and global change will induce the development of new forests

ARIEL LUGO, *International Institute of Tropical Forestry, Puerto Rico*

Climate change sensu stricto will affect the rates of ecological processes and contribute to geographical shifts in species distribution. However, climate change is not the only large scale phenomenon affecting the structuring and functioning of future forests, and might not be the most significant. Anthropogenic changes, collectively identified as global change, might have a greater effect on future forests than climate change. Among the many anthropogenic changes, I will focus on land use and land cover changes. Experience in Puerto Rico suggests that these anthropogenic changes modify species compositions of forests, and that hurricanes and other environmental factors do not erase this legacy of effects. A challenge facing us as ecologists is to anticipate the effects of the synergy between global climate change and global change. I will suggest that this synergy will result in new forest types with different species composition or different combinations of species and different rates of ecological processes than those of today.

Biodiversity not as a victim: atmosphere control in Amazonia

ANTONIO NOBRE, *Instituto Nacional de Pesquisas da Amazônia (INPA), Brazil*

After the release of the series of IPCC reports in the last few months it became clear that massive alterations in the climate system are already happening, and on a fast pace. But biodiversity is still seen for the most part as a sitting duck for climate change to strike. Nevertheless a number of works exploring the biosphere-atmosphere interactions have indicated that the myriad of organisms in natural systems might have much bigger resilience and more than a passive role in climate regulation. In order to explore this possibility on a better known, and less spoiled, massive terrestrial system, I will focus on South America and its impacts on the regional climate. There is much evidence indicating that South America east of the Andes might have had a sufficiently stable climate for at least 25 thousand years, and possibly for much longer. The extraordinary diversity of life forms found in its three most extensive biomes – Amazon, Atlantic forests and the savannas – supports the indication of long term climate stability. However, whether South America enjoyed a continuous forest cover over millions of years or if it was subjected to periods of partial or total aridity has not been established beyond a certainty. Extensive forests, covering most of the continent, requires wet climates or, at least, a less seasonal rainfall distribution. Long dry seasons create a role for fire in opening up forest areas that can be colonized by savannas. Conversely, short or absent dry seasons will favor forest over savannas. The historical vegetation cover in South America is thus rather relevant as proxy for the understanding of the complex biome-atmosphere interactions and control mechanisms. Over thousands or likely millions of years the rainforest of South America has evolved its luxuriant biota without signs of having been shut-down by climate extremes, like aridity or freezing. Over the same span of time, however, it is very unlikely that external climate forcing remained equally benign, especially considering orbital and other known drivers for planetary-scale climate changes. The lingering question then is how on the face of formidable external adversity has this magnificent biome resisted extinction? This question then elicits another one: how will the system respond to the new forcing on climate, given that there is an unprecedented annihilation pressure on forests? Some potential scenarios for impacts on human livelihoods, both within and outside the great domain of Amazonia, have been explored by coupled climate modeling exercises. Uncertainty of these exercises still does not warrant full confidence on the projections. Nevertheless, the destruction of the long standing climate-forest regulating systems has the potential to adversely impact agriculture, reduce or damage hydro energy production, alter frequency and intensity of extreme events both on land and over seas, among many other damages.

Climate Change Impacts on Coastal Biodiversity

VIRGINIA BURKETT, *US Geological Society*

Impacts on coastal systems are among the most costly and most certain consequences of climate change. As temperature increases and rainfall patterns change, soil moisture and runoff to the coast are likely to be altered. As sea level rises, coastal shorelines will retreat and low-lying areas will tend to be inundated more frequently, if not permanently, by the advancing sea. The salinity of estuaries, coastal wetlands, and tidal rivers will increase, thereby restructuring coastal ecosystems and displacing them further inland. If tropical cyclones in the Atlantic and Gulf of Mexico intensify, as projected by many studies, shoreline retreat and wetland loss along the eastern coastal margins of North, Central, and South America will accelerate. Coastal areas comprise some of the most heavily developed landscapes in the Americas. The autonomous adaptive capacity and sustainability of coastal ecosystems could be challenged due to a combination of stressors at the ocean/land interface. Coastal deltas, such as the Mississippi and Paraná, are particularly vulnerable due to their high sensitivity to relatively small changes in mean sea level and riverine sediment delivery. Many coastal states, provinces, and nations are planning coastal adaptation strategies but much of the current emphasis is on protection of the built environment. Some adaptation options, such as flood protection levees and sea walls, can exacerbate the effects of climate change and sea level rise on coastal flora and fauna. By incorporating biodiversity considerations into adaptation planning, native fish, wildlife, and plant populations are more likely to be preserved as climate change intensifies in the 21st century.

Rapid change in Amazonian forest dynamics: effects of climate change?

SUSAN G. W. LAURANCE, *Henrique E. M. Nascimento, William F. Laurance, Ana Andrade, Phillip M. Fearnside, Expedito R. G. Rebello and Richard Condit*

Recent studies suggest that the dynamics of tropical forests are changing, with potentially important implications for ecosystem functioning, carbon storage, and biodiversity. We examined stand-level changes in Amazon forest dynamics over a 23-year period (1981-2003), based on five repeated censuses of trees (≥10 cm diameter-at-breast-height) within 20 1-ha plots in intact forest. Tree recruitment rose significantly over time but lagged behind mortality, suggesting that mortality increases led to subsequent increases in tree recruitment and turnover. Tree growth generally increased during our study but varied considerably among census intervals, and was lowest when mortality was highest. Tree basal area also rose over time, increasing by 4% overall, but stem numbers exhibited no clear directional change. Increasing forest dynamics, growth, and basal area in our plots are consistent with the expected effects of rising atmospheric CO_2 concentrations, but climatic vicissitudes may underlie marked short-term variability in stand dynamics. In particular, tree mortality appears to have peaked, and tree recruitment and growth declined, during periods of atypically wet weather, whereas tree growth was fastest during dry periods, when reduced cloudiness probably increased available solar radiation. Temperature and rainfall seasonality has increased in central Amazonia over the past 50 years, in concert with stronger ENSO events, and this could potentially have long-term effects on forest dynamics and carbon storage.

The vulnerability of tropical species to global warming

JOSEPH WRIGHT, *Smithsonian Tropical Research Institute, Panama*

The vulnerability of wild species to global warming is likely to vary with latitude for at least two reasons. The first is widely recognized – temperatures are increasing fastest at higher latitudes particularly in the Northern Hemisphere. Many temperate and boreal species have already responded to longer growing seasons through earlier migration, earlier reproduction and range extensions to higher latitudes and altitudes. The second reason that vulnerability to global warming is likely to vary with latitude is perhaps less widely appreciated, involves latitudinal differences among species rather than climate, and acts in the opposite direction. Tropical species were exposed to a sharply curtailed range of temperatures before global warming began. Mean annual temperatures in the lowlands range from just 24 to 30 °C over 47 degrees of latitude between the Tropics of Cancer and Capricorn, and a classic definition limits the tropics to areas where the seasonal temperature range is smaller than the diurnal temperature range. Thus, most tropical species are exposed to a limited range of temperatures both seasonally and throughout their geographic ranges. As a consequence, their physiologies might have evolved to function optimally within narrow temperature ranges. With physiologies finely tuned to a narrow temperature range, tropical species might be particularly sensitive to global warming. I will further refine the potential vulnerability of tropical species to global warming by evaluating the range of temperatures occupied by different vegetation types. The data used include global vegetation cover from the Global Land Cover 2000 project and global temperatures from the International Panel on Climate Change. The results are alarming. For example, in the 1970s lowland evergreen tropical forests occurred only where mean annual temperatures (MATs) were between 24 and 27 °C, the area in evergreen tropical forest declined precipitously above MATs of 27 °C, and only open scrub or herbaceous vegetation types occurred where MATs exceeded 27 °C. Tropical temperatures have increased by 0.2 °C decade^{-1} since the 1970s. Precipitation increases might permit evergreen tropical forests to persist at higher temperatures if moisture availability now contributes to the upper temperature limit. Tropical precipitation has increased by 0.006 mm day^{-1} decade^{-1} over the oceans but decreased by 0.001 mm day^{-1} decade^{-1} over land since 1979. For these reasons, tropical evergreen forests are particularly vulnerable to global warming today.

Renewable natural resources and climate change

RAQUEL SOTO, *Instituto Nacional de Recursos Naturales (INRENA), Peru*

To achieve the sustainable use of the renewable natural resources has been and is a challenge for the developing countries. In Peru, the investment projects, principally of mining and energy sectors, have generated the most important significant impacts in the environmental, economic, social and cultural aspects. Nevertheless, in the last few years, climate change has been identified as a problem that will affect the availability and quality of renewable natural resources in a short term. Lately, climate change is a component that has been considered as a strong factor of analysis in the national system of environmental management, constructed to control the degradation and pollution of the renewable natural resources generated by investment projects. It has been necessary to initiate a process of capacity building (at involved institutions in the topic and general population) to implement new instruments and methodologies that allow us to evaluate the condition of renewable natural resources and their relations with the trends of climate change. Bearing in mind that the principal sources of greenhouse gases emissions are changes in land use (deforestation) and agriculture, the National Institute of Natural Resources (INRENA) conformed a multidisciplinary group to take part in the elaboration of the Inventory of Greenhouse Gases for the agrarian and land use sectors whose objective was to determine the greenhouse gases emitted by these activities to 2000, generating among other kinds of information the deforested surfaces by land use change in the Amazonian basin. The deforested surface accumulated to year 2000 for the Peruvian Amazon was calculated at 7 172 553,97 hectares, which represents 9,25 % of the Peruvian Amazonian surface and 5,58 % of the national territory. These results are being used to propose mitigation measures that not only reduce greenhouse gases but establish actions orientated to reduce the process of deforestation and develop a sustainable agriculture. It hopes that the products of this study and other related ones could be used by national, regional and local government in order to consider this topic as a priority component, inside their policies and development strategies, deriving the necessary budget to plan and implement mitigation and adaptation measures as part of the sustainable managing of the renewable natural resources in their territorial area.

Long term leafing changes in Amazon forest trees and climate change

PATRICIA MORELLATO, *Departamento de Botânica, UNESP – Universidade Estadual Paulista, Brazil; Antonio Moçambite Pinto, Centro de Pesquisas em Silvicultura Tropical, INPA – Instituto Nacional de Pesquisas da Amazônia, Brazil; and Arturo Sanchez-Azofeifa, Earth and Atmospheric Sciences Department, University of Alberta, Canada*

Our understanding of long term phenological changes and responses of Amazonian tropical rainforest to climate change is limited by the lack of long term records that account for changes on leafing, fruiting and flowering. In addition, patterns derived from short term records based on sole remote sensing observations, suggest large seasonal swings in leaf area during the dry season timed to the seasonality of solar radiation. In this paper we assess the former suggestion by first evaluating a record of 40 years of phenological observations of 200 tropical rainforest tree species from lowland forest in central Amazon, Brazil. Afterward, we link the last seven years of ground observations with Leaf Area Index, Normalized Difference Vegetation Index and Enhanced Vegetation Index measurements via the Moderate Resolution Imaging Spectro-radiometer (MODIS) satellite to explore if seasonal swings in leaf area index can be considered true or satellite artifacts and if the patterns match the land leafing observations. Long term records of phenological observations provide a unique opportunity for quantifying the inter-dynamics of Amazonian forests to climate change and our results suggest that ground observations provide a more powerful and accurate estimate of ecosystem response than those observed via uncalibrated remote sensing platforms.

Global warming and rainforest: a geological perspective

CARLOS JARAMILLO, *Smithsonian Tropical Research Institute, Panama*

The consequences of global warming on tropical vegetation are unknown. We can use empirical examples in earth history to understand the behavior of tropical biota during past climate changes. During the onset of the Paleocene Eocene Thermal Maximum (PETM, 55.5 Million years ago) worldwide temperature increased by 6-8°C in ~10,000 years. Temperatures in tropical regions reached 33-34°C, rising at a rate of 0.05°C per century. This is similar to the temperature rise during the 20th century (0.6 °C). Modern ecological studies suggest that high temperatures could be deleterious to tropical rainforest plants. We studied the pollen record of several sites in Colombia and Venezuela to understand the effects of the PETM on vegetation. The pollen record suggests a major floristic turnover, with many new species arising rapidly in the Eocene. The shift in pollen flora is unrelated to lithofacies change. Uppermost

Paleocene palynofloras have a low alpha diversity and are widespread across the region, while lowermost Eocene palynofloras have a higher alpha diversity and are more restricted geographically with a higher degree of change across the landscape. Plants extinction levels increased during the onset of the PETM, and are followed by a very rapid diversification during the middle and late stages of the PETM. Results suggest that rapid climate change has had major impacts on tropical rainforests in geological history.

Influence of niche properties on distance for habitat tracking in response to future climate change by highland grasses endemic to Mesoamerica

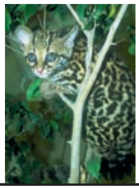
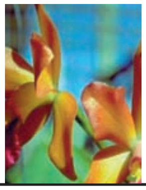
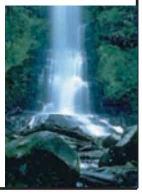
Jill C. Preston, Department of Biology, University of Missouri, USA; Trisha Consiglio, Center for Conservation and Sustainable Development, Missouri Botanical Garden, USA; Gerrit Davidse, Research Division, Missouri Botanical Garden; and **IVAN JIMENEZ,** *Center for Conservation and Sustainable Development, Missouri Botanical Garden, USA*

Global climate change plays a central role in shaping the distribution of biological diversity. Studies of plant population responses to environmental change suggest that the ability to habitat track will be a major determinant of future species survival. In turn, the ability of a species to habitat track depends partly on the distances for habitat tracking (DHT): the distances between current populations and future suitable habitat. Here we examined how ecological niche properties, through their effects on current geographic range size (CGRS) and extent of future suitable habitat (EFH), can determine DHT. Specifically, we tested hypotheses that niche breadth (a measure of the variation of environmental conditions in which a species is able to survive and reproduce) and niche position (a measure of the spatial frequency of the environmental conditions in which a species is able to survive and reproduce) determine CGRS, that niche breadth determines EFH, and that, in turn, CGRS and EFH determine DHT. We used two types of models (Domain and Maxent) to estimate EFH for 54 highland grass species endemic to Mesoamerica under the CCM3 doubling of CO_2 model for 2050. Our analyses showed that EFH, as estimated by Domain models, is negatively related to DHT. However, when EFH was estimated by Maxent models, CGRS and not EFH was negatively related to DHT. This dependence on model type highlights the importance of establishing the accuracy of different methods for estimating EFH. Yet, regardless of model type, EFH was positively related to niche breadth. CGRS was also positively related to niche breadth. In contrast niche position was not a consistent predictor of CGRS. Thus, this study shows how ecological niche properties, particularly niche breadth, can determine the distance that populations of different species will have to travel to habitat track.

Plenary 5

Impact of Climate Change on Biodiversity - con't

- The effects of functional biodiversity on ecosystem processes, ecosystem services and sustainability: an interdisciplinary approach - Natalia Pérez-Harguindeguy
- Biodiversity consequences of long-term snow climate change - Michael E. Loik
- Increase in the dominance of galls across the Americas as a result of climate change - Geraldo Wilson Fernandes
- Bridging the gap: Neotropical endangered species and climate changes - Denise Rambaldi
- Tropospheric ozone and climatic changes: Effects on the main agronomic species - Jesus Ramirez
- Avian response to climate change in British Columbia, Canada – towards a general model - Fred Bunnell
- Can 40-years natural restoration give us a clue about climatic change effects in transition zones between two Brazilian hot spots? - Luiz Carlos Busato
- Phenological changes of Mammillaria mathildae in a deciduous tropical forest as a bio-indicator of climatic change - Oscar Rubio
- Modelación espacial del efecto del cambio climático sobre la distribución de Quercus emoryi Torr. (Fagaceae) en México - María de Jesús Torres Mez
- Population trends of montane birds in southwestern Puerto Rico eight years after the passage of Hurricane Georges - Adrianne Tossas
- Regional bird monitoring as a tool for predicting the effects of climate change on biodiversity - Maria Zaccagnini

The effects of functional biodiversity on ecosystem processes, ecosystem services and sustainability: an interdisciplinary approach

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Global environmental change is threatening the sustainability of socio-ecological systems all over the world. This is a particularly critical problem in areas of high socio-economic vulnerability and low degree of ecosystem artificialization, such as most of Latin America. In this process, biodiversity is not only a response variable in the face of changes in climate and land use, but also a driving factor affecting human well-being through its effects on ecosystem processes and their derived ecosystem services. Within this framework, DiverSus is an IAI Collaborative Research Network that uses an interdisciplinary approach to integrate functional biodiversity effects on ecosystem properties with social evaluations of ecosystem services and their sustainability. We have developed a framework centered in the concept of functional diversity, or the value, range, and relative abundance of functional traits in a given community. There is growing evidence that it is functional diversity, rather than species diversity what matters the most for the ecosystem processes at the base of human subsistence and well-being. Standard protocols to quantify functional traits and their diversity are now available, especially for plants. We are carrying out the first large-scale comparison of vascular plant functional diversity under different land use regimes and different degrees of climatic control (stronger in cold/arid systems, weaker in moist tropical systems) in the Americas, from tundra to dry forests and rainforests. Through interdisciplinary work with social scientists, we will link functional diversity with ecosystem processes and services perceived by different social actors. This is particularly relevant because the provision of an ecosystem service for one social group often means the loss of ecosystem services highly valued by other groups. This may lead to social conflict, alliances, and unequal impacts of land use change on different sectors of society. We claim that our general approach represents a promising way to understand how changes in functional biodiversity impact different bundles of ecosystem services, and how this can modify the sustainability of socio-ecological systems in the region, and the power balance within and among them.

Biodiversity consequences of long-term snow climate change

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Changes in the cryosphere are a bellwether of a warming climate, but what will be the consequences for biodiversity? Current computer simulations do not have the spatial or temporal resolution to tell how uncertain snow changes will affect biodiversity, habitat quality, ecosystem processes, and the availability of freshwater for downstream needs. Most climate change experiments are small in spatial scale and of a short duration, and few capture the uncertainty of computer climate simulations. This study examines linkages between long-term snow depth forcing, soil water content, species richness, cover, and recruitment for two opposing GCM scenarios that envision increased and decreased snowfall. Research was conducted at the ecotone between the Great Basin Desert shrubland and Sierra Nevada conifer forest. Snow depth was manipulated using eight long-term snow fences along a 50-km transect; impacts on physical and biological characteristics were measured from 2003 to 2007. Snow depth on +snow plots was about twice that of ambient-depth plots, and about 2.2 times of that for -snow plots. Snow melted about two weeks earlier on -snow plots compared to ambient-depth plots. Soils at 50 cm depth were wetter on +snow compared to ambient and -snow plots. Snow depth treatments did not affect species richness, yet increased snow depth led to a decrease in cover of the co-dominant, N-fixing shrub Purshia tridentata (Rosaceae, Antelope Bitterbrush) and an increase in the grass Achnatherum occidentalis (Poaceae, Western Needlegrass) Recruitment of the two conifer tree species depends on snow depth and microhabitat; Pinus jeffreyi (Pinaceae, Jeffrey Pine) recruits maximally on –snow sites whereas P. contorta (Lodgepole Pine) establishes in open sites rather than under nurse shrubs. Changes in recruitment, growth, cover, and reproductive output respond to snow depth, melt date, and microhabitat in a complex and interactive manner, yet they portend shifts in the position of this widespread western North American forest-shrub ecotone.

Increase in the dominance of galls across the Americas as a result of climate change

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In the vein of discovering pattern within environmentally defined boundaries, we explored the relationships between gall inducing insects and their host plants for the past 20 yr and their relationship to potential climate change scenarios. We compiled data on the distribution of several climatic variables in the Americas and correlate then with the diversity of galling insects in an attempt to test our predictions on gall distribution under climate change. Our results first suggest that galling species richness increases with decreasing elevation in North and South America; and second it suggest that within localities, at the same elevation, galling species richness is higher in dry and nutrient-deficient habitats. Our results also suggest that a global scale, galling species richness reaches a strong peak in harsh regions dominated by sclerophyllous vegetation. Furthermore, we suggest that the major mechanism by which plants locate and kill cells potentially tumoral, plant hypersensitivity, are diminished or hampered at higher temperatures. In this way, gallers find in hot and harsher habitats an ideal environment in which they are able to circumvent plant defenses and manipulate their tissue to obtain a rich, nontoxic food source and protection against environmental harshness. Secondary data on fossil records during the Cenozoic supports our contention of a higher number of galling species in warmer environments, where sclerophyllous plants succeeded. The former can be used as a proxy indicator of potential gall distribution and behavior during potential climate change scenarios in the Americas.

Bridging the gap: Neotropical endangered species and climate changes

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The Atlantic Forest of South America is one of the world's 34 threatened biodiversity "Hotspots", with 90% of this forest being found in Brazil. A total of 1,200,000 km^2 of the Brazilian territory was originally covered by the Atlantic Forest. To date, only 7.3% of this expanse remains, with only 2% remaining along the southeastern coast. This region contains 80% of Brazil's 168 million people including two of the world's largest metropolitan areas. The Atlantic

Forest has high levels of biodiversity, sheltering 5% of the world's fauna and 7% of its flora. Many species are endemic to this region including 2% of all non-fish vertebrates and 2.7% of terrestrial plants (6,000 species). Deforestation has led to an inadequate water supply, floods, mangrove destruction and a high threat of extinction. Twenty percent of the world's most endangered primates live in this "Hotspot", including the golden lion tamarin (Leontopithecus rosalia). In the 60's this endemic species of Lowland Atlantic Forest in Rio de Janeiro State (core area: S 220 30' 129"; W 420 16' 071") was on the brink of extinction, and the wild population estimated at less than 200 individuals. The main threats to the species conservation are deforestation, fragmentation and invasive species. The Golden Lion Tamarin Association, since 1983, initiated an intensive and long term conservation cooperative effort, including research and management on the tamarins population and its habitat, a captive-breeding program, reintroduction program, support to the creation and management of public and private protected areas, environmental education, local capacity building and influencing public policies at all levels. This strategy allowed the use of Population and Habitat Viability Assessment and the establishment of goals for species conservation through a minimum viable population of 2,000 wild tamarins naturally evolving on 25,000 hectares of protected and connected habitat by the year 2025. Nowadays the protected habitat – Poço das Antas and União Federal Reserves and dozens private reserves – comprehends around 12,000 hectares of forest, that shelter 1,500 golden lion tamarins. The six viable population currently existing are isolated one from each other. To be managed as a metapopulation these fragmented population and habitat must to be reconnected in order to restore the gene flow. To accomplish its goals, the Associação Mico-Leão-Dourado created the Forestry Corridors Project to restore the connectivity and increase the habitat resilience and, at the same time involving landowners and improving rural livelihoods at the São João watershed. Corridors has been planned to the entire watershed based on landscape analysis and priority areas for conservation. So far, the strategic restoration of 20 hectares has provided 9.600 hectares of available and connected habitat, suitable not only for the tamarins but to a countless species.

Tropospheric ozone and climatic changes: Effects on the main agronomic species

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Víctor Gutiérrez, Centro Nacional de Investigación y Capacitación Ambiental, Cuba; Rafael Ramos, Sistema de Monitoreo Atmosférico, Cuba; and Don Mckenzie, College of Forest Resources Climate Impacts Group, University of Washington, USA

Ozone is an air pollutant that causes damage to forests, agricultural crops and vegetation in general. It has a strong influence in the appearance of plagues and disease in agricultural crops and forests. Ozone is the third leading pollutant that causes global warming of the planet as a result of the greenhouse effect. For all of these reasons, ozone has a direct incidence in climatic changes. Investigations were carried out in agricultural areas of Mexico and Cuba with the purpose of checking the link between meteorological phenomenon of a synoptic scale with the transport of ozone from urban areas, and the variations that take place as a result of this phenomenon. The noxious effect that this pollutant causes on agricultural crops, forests and vegetation was observed. The necessity to use a system of early alerts for rural areas was demonstrated to allow the alleviation of damages from ozone, like a means of adaptation to the current climatic changes to local and regional scale.

Avian response to climate change in British Columbia, Canada – towards a general model

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We report changes in climate variables and measures of bird occurrence and distribution within British Columbia, Canada. Measures of avian response include relative abundance, distribution, arrival and departure dates and breeding parameters for birds resident and migrating into British Columbia. These responses are correlated with changes in climate variables in a fashion suggesting cause and effect. British Columbia currently hosts 496 bird species, of which 312 breed. All could respond somewhat differently to changes in climate variables. There is need for some general model of expected response to allow agencies sufficient time to evaluate mitigative actions. Using a data base of >5 million detections spanning 120 years, we describe a general model for bird species based primarily on migratory patterns, body size, food habits and breeding habitat. We summarize test predictions derived from the model for a subset of species and provide examples of how these predictions could guide management actions.

Can 40-years natural restoration give us a clue about climatic change effects in transition zones between two Brazilian hot spots?

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The Paranapiacaba river watershed, Central Eastern Brazil, is a region of natural occurrence of Semi Deciduous forest, part of the Atlantic Rain Forest biome. Nevertheless, it is surrounded by the Cerrado biome. During the last decades, the region has been heavily occupied by agricultural fields, and only sparse forest fragments remain preserved, where it is still possible to find some relevant fauna species associated to the natural resources, like the bird Crax fasciolata and the mammal Puma yagouaroundi. Due to the construction of an hydroelectric reservoir in the 1970-80, top soil was removed from more than 400 ha, and until now natural processes had not evolved in the area. Thus, intervention for ecological restoration was needed and the region started to be studied. Floristic investigatons of forest fragments in the surroundings showed markedly distinct structures: “ever-green” Semi Deciduous forest and “dry” deciduous forest, closer to Cerrado-like (savannah) structure. From the sampled areas till now, about 30% of the species occurred only in one of the structures – this number should decrease with the addition of more sampling effort. An image of the area from the year 1968 was obtained, and in comparison to the today’s image showed that “dry forest” occurs mostly in areas where natural restoration processes occurred along the last four decades. Two hypothesis raised from that: (1) differences between “older than 40 years forest” and “younger naturally regenerated forest” are explained as an effect of climatic changes; or (2) differences between “older than 40 years forest” and “younger naturally regenerated forest” means that a transitional stepwise regeneration process through “Cerrado” till “ever-green forest” occurs. First results indicated that to monitor the natural and man-made restoration processes can help us to identify whether floristic composition of an area is already under effects of climatic change or not. It is also essential to drive restoration efforts. Floristic analysis of natural regeneration, seed dispersion, man-made restoration performance and phenology patterns of leaf, flower and fruit can help us to identify possible effects of climate change at early stages. Long term monitoring is essential to come out with robust results.

Phenological changes of Mammillaria mathildae in a deciduous tropical forest as a bio-indicator of climatic change

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Phenological phases of the endemic cactus Mammillaria matlidae were recorded as part of the long term monitoring program for natural protected areas in a deciduous tropical forest near to Querétaro City. Commonly this cactus blooms and fructify from late May to August. However the blooming period in 2005 and 2006 occurred 1.5 months earlier. Since phenophases depend on seasonal meteorological trends, we explored their association with a temperature increase. Non significant differences were found between 2003, 2005 and 2006. In contrast, rainfall patterns were different and the rainy season was atypical in 2003: it began later, was shorter and extreme. In the first 9 days of October precipitation registered 432 mm, accumulating more water than 2005 total precipitation (405mm). Therefore it was the highest precipitation in the last 70 years. This impacted negatively both the number of Mammillaria matlidae individuals (decreasing from 209 to 111) and the cactus' annual recruitment. Meanwhile, during 2005 and 2006 rainfall patterns were homogeneously distributed throughout the year. In both years M. mathildae fruit yield was increased, and plant population was increased in 2006, with 31 seedlings registered. It is possible that one of the key factors for the plant population recovery was the homogeneous distribution of the rainfall. These observations contribute to a better understanding of climatic change repercussions on individual species; and further on, they could facilitate the improvement for the construction of prediction models to estimate potential distribution of species after climatic change event.

Modelación espacial del efecto del cambio climático sobre la distribución de Quercus emoryi Torr. (Fagaceae) en México

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La mayor concentración de especies de encino en el mundo posiblemente se encuentra en el Centro y Sur de México. Al tener México una de las más altas tasas de deforestación en América, se coloca en una situación de alto riesgo ante el cambio climático global, para la persistencia de su biodiversidad y supervivencia de su población. De acuerdo con el tercer informe de evaluación sobre cambio climático presentado por el Panel Intergubernamental de Expertos sobre Cambio Climático en 2001, las características del cambio climático más importantes en la vulnerabilidad y la adaptación, tienen que ver con la variabilidad y los extremos y no solamente con las nuevas condiciones medias del clima. Un acercamiento al conocimiento de los posibles efectos del cambio climático en las especies puede obtenerse a través de modelaje espacial. En el presente trabajo se desarrollaron escenarios de impacto sobre poblaciones de Quercus emoryi Torr., a partir de un modelo de la distribución geográfica de la especie en México y de una aproximación a su nicho realizado. Ambos obtenidos a través de la caracterización de sitios de colecta de ejemplares botánicos con geo-referencia, en función de factores climáticos, edáficos, de vegetación y de relieve. Los escenarios se basaron en análisis de regresión lineal con el cual se detectaron en 53 de 67 estaciones meteorológicas ubicadas dentro del área representada

en el modelo, tendencias significativas en anomalías climáticas que pueden influir en la distribución geográfica de la especie. Por ejemplo, se detectaron tendencias positivas en temperatura mínima de enero y temperatura media de junio así como tendencias negativas en precipitación media anual, número de días con temperaturas menores a 0 ºC, rango de temperaturas extremas, número de días con precipitación mayor o igual a 10 mm d-1 y en el índice de intensidad diaria de precipitación. Los cuatro últimos pertenecen a los 10 indicadores propuestos por Frich et al. en 2002, para monitorear cambios en extremos climáticos. Los resultados permitieron conocer áreas susceptibles de afectación a las poblaciones de Q. emoryi Torr. o de modificación en su distribución.

Population trends of montane birds in southwestern Puerto Rico eight years after the passage of Hurricane Georges

ADRIANNE TOSSAS, *Puerto Rico*

Puerto Rico, part of the Caribbean biodiversity hotspot, is frequently hit by hurricanes that affect birds directly by decreasing their survival or indirectly when the resources on which they depend for foraging, roosting and nesting are destroyed. Georges, a moderate hurricane (category 3) according to Saffir-Simpson scale of 5, crossed the island from east to west on 21-22 September 1998. It affected the forest structure of Maricao State Forest, a montane reserve in southwestern Puerto Rico spared by hurricanes for approximately 60 years, by destroying the canopy through defoliation and uprooting trees. The effects to resident bird abundance were assessed by comparing baseline point counts from 1998 with data from 1999, 2000 and 2007. Twenty-two species were detected in surveys throughout the length of the study, although the total number of species varied among years. A species typical of open lowland forests, the White-winged Dove (Zenaida asiatica) was first reported from the forest after the hurricane when new microclimatic conditions facilitated its colonization. Meanwhile, the Ruddy Quail-Dove (Geotrygon montana), which requires a dense and close canopy coverage, was not reported again in post-hurricane surveys. Most species (15/17) showed declines in abundance in 1999, but half of those started showing gradual increases in 2000. In general, all species showed fluctuations in the mean number of individuals detected per count from year to year, but eight species, including initially common insectivores like the Puerto Rican (PR) Tody (Todus mexicanus), PR Woodpecker (Melanerpes portoricensis), and PR Vireo (Vireo latimeri), still had lower abundance in 2007 than previous to the hurricane. In contrast, species that were restricted to particular habitats within the forest, like the Adelaide's Warbler (Dendroica adelaidae), Antillean Euphonia (Euphonia musica), and Black-faced Grassquit (Tiaris bicolor), were able to expand their distribution after the hurricane. The resulting fluctuations in bird abundance, still occurring eight years after the hurricane, suggest a slow recovery of the forest structure or long-lasting damage to prey populations. Thus, long-term monitoring focusing on how population trends relate to habitat changes and resource availability, particularly since more severe and frequent hurricanes are expected with climate changes, is recommended.

Regional bird monitoring as a tool for predicting the effects of climate change on biodiversity

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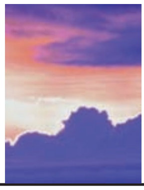
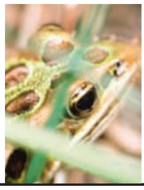
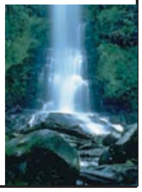
Large-scale processes, such as climate and land-use change, drive patterns of biodiversity worldwide. While these processes impact ecosystem structure and function individually, climate and land use are also interrelated, thus exacerbating their effects (Dale 1997). Increasing demand for food and fuel by a burgeoning world population is one of the primary factors leading to an unprecedented rate of land-use change, in the form of converting native vegetation to agricultural landscapes (Ojima 1994). Therefore, changes in land use and climate, and their accompanying ecological impacts, are important focal areas in the conservation of biodiversity worldwide. The success of biodiversity conservation is dependent upon the availability of baseline data that describes the distribution and abundance of species across spatial and temporal scales (Noss 1990). Regional-scale, long-term monitoring programs are a key component in providing the types of data upon which the status and trends of species can be determined. Few long-term ecological monitoring programs are currently ongoing in Latin America; yet, conversion of land in these countries has been increasing as they attempt to establish themselves as leaders in the world economy (Grau et al. 2005). Thus, it is imperative to establish these programs and to secure long-term support and funding. Birds are commonly chosen as indicator species in long-term monitoring programs due to their sensitivity to environmental change and migratory behavior, which leads local-scale changes to have global impacts (Blair 1999, Gregory et al. 2003). In 2003, the Grupo de Biodiversidad at the Instituto Nacional de Tecnología Agropecuaria (INTA) started a regional-scale, long-term program that focuses on monitoring indicators of avian biodiversity in central Argentina. The emphasis of this program is to examine the effects of land-use change and associated threats (e.g., increased pesticide use) on metrics of avian populations, such as bird species richness, composition, relative abundance and density. The goal of the monitoring program is to analyze the status and trends of landbird populations at a regional scale using point-count methods. In addition, data on percent cover of land-use types is collected. Together, numerous metrics of bird population dynamics, including species richness, composition, relative abundance and density can be calculated. Preliminary evaluation of these data suggests that spatial and temporal variations in landbird populations exist and that these variations may be due to land-use type. Given these preliminary results, we developed a model to examine the impacts of large-scale drivers on bird species richness at a regional scale. Due to the focus of the monitoring program on land-use change, we then also analyzed the impact of land-use types on species composition. We began by building a generalized linear model (GLM) that describes bird species richness in relation to climate variables (maximum temperature, minimum temperature and annual precipitation), land-use variables (the percent cover of each of five land-use types) and the normalized difference vegetation index (NDVI—a measure of primary productivity and vegetation biomass). We then analyzed the impact of land-use gradients on species composition using canonical correspondence analysis (CCA), a constrained ordination technique. Evaluation of trend data suggests that spatial and temporal variation in bird population dynamics in this ecosystem exists. Because of these patterns, we chose to build a model to help explain this variation using large-scale drivers as predictor variables. This model explained 76% of the variation in the bird species richness data, suggesting that ecosystem drivers indeed are impacting bird populations in this region. In addition, we found that species richness is positively correlated ($r=0.77$) with cover of native vegetation and negatively correlated ($r=-0.61$) with cover of annual cultivars, such as soybeans. Furthermore, multivariate analysis of species composition along land-use gradients suggests that distinct groups of species are selecting optimal habitat along the existing land-use gradients. These results suggest that overall species richness is higher in habitats dominated by native vegetation and lower in habitats that have been converted to crop monocultures. In addition, the results

suggest that birds are sensitive indicators of changes in land use and that they are responding to large-scale drivers, such as climate and land-use change, at the regional scale of this study. Future changes in these drivers, and their interactive effects, may be expected to lead to overall decreases in species richness and changes in species composition of avifauna in central Argentina. A long-term, regional-scale monitoring program, such as the one described here, provides essential baseline information for assessing the status and trends of birds as biodiversity indicators in agroecosystems. It is important to establish such programs in developing countries and support them politically and monetarily through secured, permanent funding. Data from these programs will allow countries to provide information to address the status of the 2010 biodiversity indicators and, hopefully, contribute to decision making to reduce the loss of biodiversity worldwide.

Plenary 6

Adaptation Strategies and Solutions

- *Mainstreaming adaptation in national protected areas systems in Central America by scaling up biological corridors and forest landscape restoration - Pascal O. Girot*
- *Adapting management strategies under changing climate scenarios - Robert Szaro*
- Climate change and adaptive resource management in the Southwest Nova Biosphere Reserve - Cliff Drysdale, Mersey Tobeatic
- Biomass and carbon accumulation in secondary forests and forestry plantations used as restoration tools in the Caribbean region of Costa Rica - Frederico Alice, Instituto de Investigación y Servicios Forestales (INISEFOR), Universidad Nacional
- Climate change, biodiversity conservation, deforestation and their policy responses in Bolivia under the current political context: What scope for synergies and interactions? - Bernardo Peredov
- The status and rate of adaptation policymaking for biodiversity conservation - Kelly Levin
- A Mata Atlântica e o aquecimento global - Monika Naumann

Mainstreaming adaptation in national protected areas systems in Central America by scaling up biological corridors and forest landscape restoration

PASCAL O. GIROT, *and Alberto Salas, IUCN Mesoamerica*

This paper addresses the adaptation options facing the National Protected Areas Systems in Central America to stave off the impacts of climate change on critical ecosystems. It builds on the premise that well designed national protected areas system should be a key part of any adaptation strategies. At the same time, the impacts of climate change of rainfall patterns, temperature distribution and extreme weather events are bound to affect ecosystems and species alike. Among the critical impacts of climate change on coastal and terrestrial ecosystems in Central America, will include coral bleaching, coastal erosion, saltwater intrusion, loss of habitat, higher incidence of forest fires and floods, with the resulting changes in the geographical distribution of species, spread of invasive species and new disease vectors, among others. Particularly sensitive to shifts in climate, are some of the high mountain páramo, sub-alpine and cloud forest ecosystems. Similarly, freshwater and coastal ecosystems are particularly at risk especially in the low lying areas of the Caribbean coast. A brief review of existing literature and lessons drawn from IUCN Mesoamerica's field experience enables the identification critical issues in ecosystem management and biodiversity conservation in the face of climate change. Addressing both existing, non-climatic threats, and future compounded effects of climate on hydrological and biological systems is fraught with uncertainties and surprises. There are however, critical "no regrets" measures which contribute both to biodiversity objectives and adaptation to climate change, in particular, those measures which contribute to reduce forest fragmentation and increased connectivity. Central America has an interesting track record in developing approaches to biological corridors, through the Mesoamerican Biological Corridor. However, this paper provides an assessment of the shortcomings of this approach geared essentially to biodiversity conservation, and proposes to augment and strengthen the biological corridor approach to encompass larger biogeographical scales, define greater flexibility in the definition buffer zones and land use planning, provide stepping stones to protect future climatic refugia are among some of the proposed adaptation tools in the framework of the region's protected areas system. The implementation of a adapted approach to biological corridors and forest landscape management also implies new institutional and governance arrangements. Lessons from regional initiatives could provide a key sounding board for new adaptation approaches combining traditional in situ conservation with landscape level corridor planning and sustainable livelihoods approaches. The paper concludes with recommendations on mainstreaming adaptation into national conservation and forest plans aimed at regional and national decision makers and conservation practitioners.

Adapting management strategies under changing climate scenarios

ROBERT SZARO, *US Geological Survey*

Species, natural communities, and ecological systems have evolved over time in response to changing and dynamic environments. The natural variation of the physical environment and biotic interactions within that environment create a dynamic template that shapes how species evolve and what species may (or may not) be able to persist in any given area. Rapidly changing climate has potentially profound implications for nature conservation and threatened and endangered species management. Predictions include dramatic shifts in species populations and their distributions with potentially increased extinction risk for those species with small ranges, limited distribution, or mobility. For example, the rate of future climate change will likely exceed the migration rates of most plant species. Given likely future climate scenarios, conservation planners need to use and develop strategies that incorporate management with an adaptive framework at multiple scales.

Climate change and adaptive resource management in the Southwest Nova Biosphere Reserve

CLIFF DRYSDALE, *Mersey Tobeatic Research Institution, Nova Scotia, Canada*

Recognition of the global phenomenon of climate change is stimulating government legislative response at a national and regional level. However there is a need to better understand local climate change dynamics, and subsequently develop strategies to enhance biological and socioeconomic resilience at the community level. This discussion paper will describe several relevant study and educational activities being carried out in southwestern Nova Scotia, Canada, and some strategies being developed to increase socioeconomic and ecological resilience to potential climate change impact. Projects described will include monitoring and research by national and provincial agencies and institutions in the Southwest Nova Biosphere Reserve region including plot based biodiversity monitoring studies in Kejimkujik National Park and National Historic Site; analysis of Blandings turtles growth rings as indicators of climate dynamics associated with species at risk recovery (Richard 2007); monitoring of fire weather trends by provincial and federal agencies (Heathcot 2007); monitoring of microclimate and sea level change modeling using LIDAR technology (Colville et al 2007); and assessment of wetland (Spooner 2007) and aquatic system (Brylinsky 2002) changes. In context with the concept of Adaptation through Learning discussed by Fenech (2007), climate change response initiatives described will include the application of weather data provided by the Applied Geomatics Research Group to assess grape production(Colville et al 2007); training initiatives by the Bridgewater campus of the Nova Scotia Community Colleges (NSCC) to implement silviculture practices to advance forest resiliency in cooperation with provincial and municipal governments (Ross, Pitman et al., 2007, Nickerson et al 2007); collaborative community based public education and study initiatives facilitated by the Mersey Tobeatic Research Institution (Lavers et al 2007); and methodology refinement for plot based monitoring in collaboration with Environment Canada and the Smithsonian Institution (Drysdale et al 2007).

Biomass and carbon accumulation in secondary forests and forestry plantations used as restoration tools in the Caribbean region of Costa Rica

IWilliam Fonseca G., **FEDERICO E. ALICE,** *Johan Montero, Henry Toruño, Instituto de Investigación y Servicios Forestales (INISEFOR), Universidad Nacional, Costa Rica; and Humberto Leblanc, Universidad EARTH*

Biomass and carbon accumulation were studied in secondary forests (5, 8 and 18 years old) and forestry plantations of Vochysia guatemalensis Donn. and Hyeronyma alchorneoides Allemào at the EARTH University, located in the Caribbean zone of Costa Rica. Sampling plots, each of 500 m^2, were established in both forest ecosystems. The above and belowground biomass, the necromass (litter and dead woody material) and the soil organic carbon were estimated in all plots. The carbon content in biomass was quantified by component. The highest carbon storage was found in plantations of H. alchorneoides, followed by plantations of V. guatemalensis and, lastly, secondary forests. The above and belowground biomass and the necromass increased with age in the secondary forests and plantations. In contrast, the herbaceous biomass decreased with age in both ecosystems. The aboveground biomass stored between 11 and 17% of total carbon. Soil, at a depth of 30 cm, was the main carbon pool, accounting for 82.5-86.3% of the total ecosystem carbon.

Climate change, biodiversity conservation, deforestation and their policy responses in Bolivia under the current political context: What scope for synergies and interactions?

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Biodiversity conservation is an economic, environmental and social process. It's also a political and cultural process in developing nations, characterized by being the richest regions in biodiversity but also the poorest economically. Paradoxically, whilst biodiversity and forest management provide substantial socio-economic and environmental benefits, local people have not often received benefits resulting from these processes. Thus ecosystem degradation and deforestation has increased. This would be the case of Bolivia, considered amongst the richest countries in biodiversity, especially within the Tropical Andes Hotspot, recognised as the global epicentre of biodiversity. However, the country is one of the poorest nations in Latin America with indigenous communities amongst the most vulnerable groups. Despite some progress and advances during the last decade in biodiversity conservation and climate change, these efforts have been mainly promoted by international cooperation. Therefore, political arguments and economic policies are asking new questions on the effectiveness of these initiatives for conservation and sustainable development, including climate change and the discussion of emerging trade-offs as part of new development approaches to reduce poverty. Furthermore, new threats arise to the sustainability of these processes related to increasing deforestation rates. Hence, the current national agenda is recognising the need for improved roles and synergies in the management and ownership of renewable natural resources, including recent legal and policy frameworks that are integrated into the national development plans.

The status and rate of adaptation policymaking for biodiversity conservation

KELLY LEVIN, *USA*

Significant headway has been made by managers and conservation biologists on adaptation options for increasing the resiliency of biodiversity in a changing climate. However, these measures have yet to be adopted by policymakers in many jurisdictions, and only a limited number of nations have embraced adaptation plans for biodiversity. This paper will first describe the current state of adaptation policies for biodiversity conservation in nations throughout the world, as well as the state of global policies, such as the climate and biodiversity conventions, governing the issue. In addition, the paper will classify policies according to their progression along the policy cycle, differentiating those that have only recently emerged on an institutional agenda from those that have advanced through the policy cycle. This exercise will reveal variation of the rate of policy change, which is a critical first step in explaining why adaptation policymaking for biodiversity conservation has emerged and advanced at different rates in various jurisdictions.

A Mata Atlântica e o aquecimento global

MONIKA NAUMANN, *Consultant, Brazil*

A Mata Atlântica - As formações florestais do Brasil podem ser divididas em dois grupos básicos - as formações amazônicas e as formações atlânticas. Estas, ao longo do tempo geológico, deram origem a Mata Atlântica sensu lato. As formações florestais da costa Atlântica, especialmente as da Serra do Mar, estão entre as mais antigas do Brasil, pois sua origem remonta ao período Cretáceo. As famílias de parte das espécies arbóreas que recobrem estas escarpas cristalinas a milhões de anos são tão antigas que Martius, em sua extraordinária Flora Brasiliensis, as considera gondwanicas. O mesmo não se aplica às plantas herbáceas e, muito menos, às epífitas, cujo processo de especiação é muito mais recente. A estimativa do número de espécies na Mata Atlântica está entre os maiores do planeta. Aproximadamente, temos 250 espécies de mamíferos; 1.023 de aves; 197 de répteis; 340 de anfíbios; 350 de peixes e 20.000 de plantas vasculares. Estima-se que pelo menos 40% das espécies de Mata Atlântica são endêmicas, isto é, ali ocorrem exclusivamente. A Mata Atlântica possui três características - 93% da área originalmente ocupada já foi devastada, alta riqueza de espécies e alto grau de endemismos, que a caracterizam como um hotsptot (Miers et al 2000. A pressão antrópica - A Mata Atlântica está tão fortemente vinculada com a história do Brasil, que até o nome do país tem como origem uma espécie arbórea endêmica desta formação, o pau-brasil (Caesalpinea echinata). A exploração do pau-brasil foi o primeiro de uma série de ciclos econômicos - como o ciclo da cana-de-açúcar, o ciclo da mineração e o ciclo do café - que, ao longo de 500 anos, reduziram os 1.300.000 km2 de Mata Atlântica aos cerca de 100.000 km^2 que restam hoje. Além de representarem apenas 7% da área originalmente ocupada, os remanescentes de Mata Atlântica encontram-se altamente fragmentados e sob uma forte pressão antrópica, pois 120 milhões de brasileiros vivem na região. Considerando o conjunto de Unidades de Conservação federais, estaduais e municipais hoje existente, apenas 1% das áreas que ainda conservam a vegetação nativa está protegido. Diversos autores têm demonstrado que a distribuição de espécies arbóreas de Mata Atlântica está diretamente correlacionada com características climáticas, especialmente a temperatura e a precipitação. Portanto, mudanças climáticas afetam não só o limite de biomas, mas também a distribuição de espécies dentro destes. O clima do planeta Terra oscilou significativamente nos últimos 65 milhões de anos, em processos que duravam de 10 mil a 1 milhão de anos. Este padrão de flutuações alterou-se, significativamente, desde a revolução industrial do século XIX, quando a Terra entrou em um processo de aquecimento em função do crescente acúmulo de gases, especialmente CO_2, na atmosfera do planeta. Este processo está provocando mudanças climáticas em uma velocidade sem precedentes, pois a temperatura média da Terra já subiu pelo menos 0,5° C no último século e diversos cenários sugerem que deverá subir mais 2 ou 3° C até o fim deste século. Junto com o aumento da temperatura temos, pelo menos para a região da Mata Atlântica, a previsão de uma diminuição significativa nos índices pluviométricos. Ou seja, dentro de 100 anos a área ocupada hoje pela Mata Atlântica será mais quente e mais seca. Conseqüências das mudanças climáticas - A pergunta que fazemos é: haverá tempo para uma redistribuição espacial das espécies de Mata Atlântica? Seremos capazes de definir hoje onde criar Unidades de Conservação e corredores migratórios, para assegurar que dentro de 100 anos as áreas ocupadas por remanescentes de Mata Atlântica estejam protegidas e conectadas? O que vai acontecer com as espécies hoje restritas às regiões mais frias? Para enfrentar estes desafios e implementar os projetos que serão necessários para vencê-los, propomos a criação de um órgão gestor e de um fundo financeiro supranacional. Como projeto específico, propomos que árvores matrizes de espécies consideradas vulneráveis sejam identificadas e colocadas sob proteção especial, e que suas sementes sejam utilizadas para a produção de mudas que possam ser introduzidas ou reintroduzidas nas áreas mais adequadas já considerando-se as futuras mudanças climáticas.

Poster Sessions




Planning Ecological Corridors For The Araucaria Forest In Southern Brazil: Seeking Biodiversity Conservation And Local Development

GISELE GARCIA ALARCON, *Biologist, Brazil*

The Araucária Forest is part of the Atlantic Forest Biome, known as the third of the top five richest and most endangered biomes of the world. Originally, the Araucaria Forest occupied 42,5% of Santa Catarina State, in Brazil, corresponding to an area of 40.800 km^2. According to researches developed in 2003 by the National Ministry of Environment, the remaining Araucaria Forest occupies less than 2% of its original extension. The forest loss is associated to the economical cycles of wood exploitation by national and international paper industries, and currently by illegal exploitation. The Araucaria Forest constitutes a rich and complex regional ecosystem with many species, some of them endemic of this forest. According to a study developed by the Synthesis Institute in 2002, the Chapecó basin congregates the main Araucaria Forest fragments of Santa Catarina State. As an effort to preserve these fragments and avoid biodiversity loss, the State Environmental Foundation (FATMA), with support of the World Bank, started together with a consulting enterprise a project to plan and implement an Ecological Corridor in the Chapecó basin. The area congregates three Protected Areas and three Indigenous Lands, which are surrounded by more than 60 landless families' settlements, important national paper enterprises growing homogenous forest plantation (Pinus sp), cattle raising farms and soy plantations. The Chapecó Ecological Corridor aims to raise the landscape matrix permeability in order to maintain and reestablish gene exchange between the wildlife populations. The project started in May 2007 and its first phase will last until May 2008. The goal of the first phase is to develop a management plan to the Ecological Corridor implementation. The second phase, which still depends on funding, will focus on its implementation itself. The methodology used in the first phase comprises a complete and objective diagnosis of the area, including social, economical, biological and physical aspects. Regarding the biological aspects, an adapted version of the Ecological Rapid Assessment, developed by The Nature Conservancy (TNC), is being used to evaluate in 70 points the presence and absence of indicator species for the different groups analyzed (mammals, birds, amphibians and vegetation). The economical diagnosis will focus on tendencies analysis and also on opportunities and threats for the Ecological Corridor implementation. After the diagnosis completed for each theme, the project will define the zoning and the management plan for the Chapecó Ecological Corridor implementation. The main challenge of the project in this first phase is to involve the majority of the social sectors of the area, identify the level of threat of the forest fragments and develop a proposal that will improve the landscape matrix permeability, increasing biodiversity conservation, and identify economical benefits that stimulates the land owners to conserve the remaining Araucaria Forest on private lands.

Case Study on the Upper Essequibo Conservation Concession - as an innovative legal mechanism for biodiversity conservation and a viable option for avoiding deforestation

EUSTACE ALEXANDER, *Guyana*

Deforestation due to logging and agricultural clearing is one of the main causes of increased emissions of atmospheric carbon. Many developing countries (including Guyana) are traditionally dependent on commercial timber production for national economic development. As such, these countries skim their forests of its timber resources but without generating any significant economic benefits. Until recently, few alternatives have existed that would allow countries to benefit from their forests other than through destructive development. One such alternative is the conservation concession an approach that offers that offers a model that is a sustainable and cost effective alternative for developing countries to achieve forest based economic development without incurring forest degradation. The Upper Essequibo Conservation Concession (UECC) is approximately 200,000 acres of pristine tropical rainforests in a watershed area of the Upper Essequibo River within Guyana's Forestry Zone. The site is being managed by CI-Guyana for biodiversity conservation rather than timber production. Though this innovative mechanism of forestry management operates under the principles of a standard timber concession, the difference is rather than log the trees, CI-Guyana pays the Government of Guyana (GOG) royalty and fees equivalent to those of a logging concession to keep the trees intact. Additionally, a Voluntary Community Investment Fund was established to ensure nearby stakeholder communities receive tangible socio-economic benefits for choosing to forego logging of their forests for the achievement of biodiversity conservation and the prevention of forest degradation. Successful implementation of the UECC was due to a well structured stakeholder management strategy that combined conservation education and awareness programmes with consultation meetings. This transparent and total participation approach provided all stakeholders (particularly the stakeholder communities) a direct stake in conservation management of the site. The UECC has successfully proven that there are markets for conservation and it provides an excellent strategy for achieving biodiversity conservation, to reduce emissions of carbon, avoid deforestation, promote economic development at both national and local levels without the need for new legislations or giving up of national sovereignty and ultimately mitigate against climate change.

Floristic composition, local forest diversity and soils in non-flooded forests in the state of Amazonas, Venezuela

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For the purpose of comparing and relating the floristic composition as well as soil structure, drainage and geomorphology of different non-flooded forest types located in the Amazonian region of Venezuela, a practical sampling proceedure, the 0.10 ha transect method, was utilised. From the 42 transects, 1153 species were inventoried within the 12493 individules sampled. By means of the analytic methods of grouping and TWINSPAN, and ordenation (DCA, CCA), the forests were separated into two major groups: Group 1: black-water forests of the Negro and Casiquiare Rivers, which are made up of transitional forests of medium stature with emergents; the Amazonian caatinga, and medium-high forests with abundant emergents. The Groups 2 forests are located in the white-water regions of the Orinoco River complex, and include the medium-high and high forests. The forests studied are evergreen with emergent trees of diameters greater than 50 cm. Their density ranged from medium to dense and structurally contained three to four height stratifications. The highest leve lis comprised of emergent species up to 30-35 m in height, which presents an irregular aspect at crown level. The second stratification (20-25 m) was variable in tree diameter and height. As opposed to the second stratification, the third and fourth strata (from 10 to 20 m) show a high level of spatial homogeneity amongst all the species sampled, areas with extensive colonies of palms. The forest understory is very dense and made up of a large number of shrub and herb species. Comments regarding species diversity, phytogeographic aspects in relation to adjacent regions to Amazonia and the Venezuelan Guayana, as well as information regarding conservation of vegetation communities are presented. Floristic lists by family of the species inventoried in the study areas are presented.

Modelacion de la distribucion espacial de cactáceas en peligro de extinción en Aguascalientes, Mexico

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La definición de la distribución espacial de especies es esencial para los programas de conservación de la biodiversidad. El objetivo del trabajo fue caracterizar las poblaciones de cinco cactáceas en peligro de extinción y definir su distribución potencial. El estudio se enfocó a las siguientes especies reportadas en Aguascalientes, México, y catalogadas por NOM, CITES y UICN en peligro de extinción: Echinocereus pulchellus, Stenocactus coptonogonus, Mammillaria zephyranthoides, Mammillaria perezdelarosa, Lophophora williamsii. Para la caracterización se utilizó una base de datos digitalizados a escala 1:50,000 referente a las características climáticas (temperatura, precipitación, evaporación, radiación y unidades calor) y físicas (altitud, pendiente, exposición, tipo y profundidad de suelo, roca madre, erosión potencial y tipo de vegetación) del Estado. La caracterización se efectuó considerando poblaciones reportadas en estudios previos las cuales fueron proyectadas a través del SIG sobre cada imagen digital, obteniendo para cada población georeferenciado su dato correspondiente de los aspectos físicos y climáticos. En base a esto se generó una matriz de doble entrada con los parametros que caracterizan cada poblacion. Estos parametros fueron integrados en un modelo espacial generado en el SIG IDRISI con el fin de detectar el patrón de distribución predictiva de cada especie el cual fue validado a traves de un muestreo dirigido. Se análizo la información mediante la prueba Cramer's V y el indice de Asociación de Kappa (KIA), asi como, una prueba de Chi 2 . Los mapas de distribución de la especie permitieron conocer la ubicación así como la superficie (km2) que contiene las caracteristicas escenciales para su establecimiento en Aguascalientes. La Echinocereus pulchellus presenta una superficie potencial de 1,922 has, la Lophopora williamsii de 113 has, la Mammillaria perezdelarosae 1498.0 has, Mammillaria zephyranthoides 152.0 has y el Stenocactus coptonogonus solo presento 57 has. La precisión del modelo vario de acuerdo a la especie. El modelo para Lophophora williamsii fue el que no mostró diferencia significativa ($P>0.05$) entre lo predicho y lo observado en campo. Lo anterior indica que el modelo contiene el rango correcto de parametros que determinan la distribución de esta especie.

Ontario's Niagara Escarpment (ONE) Monitoring Programme

ANNE MARIE BRAID, *Niagara Escarpment Commission, Canada*

The SI/MAB protocols have been adopted by the ONE monitoring programme to track long-term biodiversity changes along the Niagara Escarpment. Five plots were established from 1996 to 2000 in various areas along the Niagara escarpment. Hilton Falls is a transitional zone between the Carolinian Region and the Southern Deciduous-Coniferous Forest Region which remained relatively undisturbed during human settlement (poor soil for cultivation). Conifer plantations and road construction as well as recreational use (Bruce Trail) and selective logging have impacted the area. Hockley Valley is a large, contiguous forest block that stretches for 16 km north-east of Orangeville. Approximately 80% of the Valley was cleared of mature trees by the late 1900s. Many of these areas were later reforested. The western end of the Valley is designated a Class 1 “Strict Nature Reserve/Scientific Reserve” by the International Union for Conservation of Nature. Cabot Head was used as a logging and mill site in the late 1800 and early 1900s. There is a trail adjacent to the plot, most likely a logging tote road to take logs away from the bush to Wingfield Basin. Cabot Head is also designated as a Class 1 Nature Reserve. A sizeable portion of the Hope Bay Forest Area of Natural and Scientific Interest (ANSI) is intermediate to semi-mature in age and is gradually approaching an older, undisturbed condition. Several land-use impacts noted within the ANSI include: selective logging, light to moderate grazing, logging roads and light use of trails. The fifth plot, in the Skinner's Bluff Management Area, is located in Grey County. The escarpment plain was selectively logged 20 to 30 years ago and is situated near a little used portion of the Bruce Trail. The plots were set up for long-term monitoring and it is hoped that comparisons of monitoring variables (e.g. native floristic quality, species richness, biomass, canopy height, etc.) can be made between “control” plots and “pressure” plots (that are subjected to higher rates of human disturbance). Monitoring is carried out by students from the University of Waterloo, providing them with theoretical and practical knowledge of environmental monitoring. Because the monitoring of sites will occur over the long term, it will help increase understanding of forest dynamics and ecosystem processes that can be used to assess the impact of disturbance and predict change. SI/MAB plot monitoring on the Escarpment is part of a larger monitoring programme (Ontario's Niagara Escarpment Monitoring Programme), which was established to determine whether the policies of the Niagara Escarpment Plan (Canada's first large-scale environmental land use plan) are adequate to protect the Niagara Escarpment. A variety of site reports (describing the areas) and resource materials (background information on monitoring, data analysis, protocol reference manual) have been written with respect to these plots.

SI/MAB Paired Forest Monitoring Plots in Canada

ALICE CASSELMAN, *Association for Canadian Educational Resources*

Over the past ten years, the Association for Canadian Educational Resources (ACER) has developed the capacity to provide complete support for the establishment of new SI/MAB sites along the Niagara Escarpment - from land surveys, such as those done at Brock University and Dufferin County forest sites, to training, community involvement and data collection by community members at Outdoor Education Centres. Each site includes a pair of surveyed plots – one that serves both for demonstration and training, while the other is surveyed, staked and set aside for future research. The research plots, in theory, provide the model and support for the community-based plot. Established in the northern, central and southern areas of the Niagara Escarpment in southcentral Canada, the plots provide a natural gradient of biodiversity and climatic conditions for studies of comparative monitoring on a regional scale. These plots are part of an integrated, long-term environmental education and monitoring network and are community-based, serving to link educators, residents and researchers. The community-based monitoring programme was built on the premise that laypersons could become accurate data gatherers of forest biodiversity information.

Long Point Biosphere Reserve, Canada

BRIAN CRAIG, *Environment Canada and Christine Rikley, University of Waterloo, Canada*

The Long Point Biosphere Reserve adopted the SI/MAB protocol as part of a long-term forest biodiversity monitoring initiative. In 1994 and 1995, four plots were established in three areas of the Long Point Biosphere Reserve (LPBR): Backus Woods, an old growth Carolinian forest composed primarily of oak and maple species; Wilson Tract, a managed Carolinian forest which has been subjected to periodic timber extraction; and Turkey Point Provincial Park, with plots in disturbed and natural Oak Parkland. In addition to tree, shrub and ground vegetation inventories, data on salamanders, soil health and aquatic invertebrates (mayflies and caddis flies) was collected. Local students (elementary and high school) and volunteers have been instrumental in data collection becoming familiar with the various SI/MAB protocols, research methods and environmental ethics. A number of students who have participated in the Long Point Student Monitoring Camp have assisted in writing reports on the plots, have given presentations at conferences and are now pursuing careers in science and environmental studies. Results produced information on the cause of decreases in Eastern Flowering Dogwood trees.

SI/MAB Plot use in Kejimkujik National Park, Canada

CLIFF DRYSDALE, *Ecosystem Science Manager Kejimkujik National Park, Canada*

Five SI/MAB plots were established in Kejimkujik from 1994 to 1997 for training and experiment purposes, evaluating the protocol on its input into long-range air pollutant impact on Acadian forest ecology. Associated protocols for data collection and management have facilitated data comparisons with other commonly used forestry plots in Nova Scotia. Kejimkujik National Park is representative of the Atlantic Coastal Uplands Natural Region of Nova Scotia, covering an area of 381 km2. Kejimkujik National Park, established in 1974, typifies the glaciated, rolling drumlin topography of southwestern Nova Scotia, interspersed with lakes and streams. Several monitoring plots have been established outside Kejimkujik Naitonal Park through cooperative efforts with private companies and provincial parks. In most cases, students and adult trainees were used to collect data in these monitoring plots. The Bowater Mersey Paper Company installed a plot in 1997 in order to evaluate silviculture techniques and the role of forest gaps in red spruce regeneration. The NF Douglas Lumber Company set up one full plot and eight replicate quadrats in 1996 to evaluate sylviculture techniques to support managed white pine regeneration in a mixed forest environment. Harry Freeman and Sons Lumber Company installed a monitoring plot in 1998 to test the effects of liming on the survival and growth of softwood species. Finally, a plot was established in T. H. Randall Provincial Park in 1999 in order to document the biodiversity and growth of tree species in a coastal environment. The SI/MAB plot appears to be an excellent tool for educational purposes, which can simultaneously address monitoring needs. Kejimkujik has used students extensively for plot installation. Their results appear to be at least as accurate as those of adults in this endeavour. Also, the use of SI/MAB plot based monitoring, as part of a partnership with other land users, offers an excellent opportunity to advance cooperation and dialogue among parties who may not normally collaborate.

SI/MAB in the Yukon, Canada: Adapting the protocols for the North

JOAN EAMER, *Environment Canada*

Two SI/MAB plots were established (starting in 1997) in the Wolf Creek Research Basin, in the Boreal Cordillera ecozone, near Whitehorse, Yukon. These plots form part of a developing forest biodiversity monitoring programme for the Research Basin to: track changes in the Boreal Cordillera forest ecosystem; develop an inventory of species and habitats; establish a framework for integrated research; and contribute to community education on ecosystem and biodiversity issues. Most of the hard work in establishing the plots goes to youth crews, especially through the Yukon Youth Conservation Corps (Y2C2). Applying a methodology designed for tropical rain forests to northern coniferous forests poses some interesting challenges. Forests around Whitehorse are patchy, dense and slow-growing. Some accommodations are listed that were made to adapt the SI/MAB methodology to these conditions.

Drought shapes species distribution in tropical forests - consequences of climate change for biodiversity

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Shifts in rainfall patterns together with an increase in the frequency of El Niño events are expected for the tropics, and these may have profound impacts on forest composition, structure and ecosystem function. Correlative approaches have been taken to extrapolate consequences of global climate change on tropical forest communities. However, sound predictions rely on an understanding of the mechanisms underlying species distributions, because many areas will experience novel climates. By combining extensive experimental data on species responses to drought with quantitative assessments of species occurrence across the pronounced rainfall gradient across the Isthmus of Panama, we show that species' differential drought sensitivity shapes plant distributions in tropical forests at both regional and local scales. Our results suggest that niche differentiation with respect to soil water availability is a direct determinant of both local and regional scale distributions of tropical trees. Changes in soil moisture availability caused by global climate change are therefore likely to alter tropical species distributions, community composition and diversity.

Floristic and phytosociological comparison of the Cerrado sensu stricto in the Xavantina Physiographic Unit in Mato Grosso State

PAULO ERNANE NOGUEIRA, *Universidade de Brasília, Brazil*

Floristic and phytosociological surveys were conducted under a standardized methodology in the cerrado sensu stricto in three land systems within the Central Brazilian physiographic unit named Xavantina complex (n. 28, 31 and 33) according to a Cochran´s land system zoning. In each land system a sample consisting of ten (20x50m) plots were surveyed. All woody individuals from 5 cm diameter at the stem base were identified and measured in the plots. The floristics and phytosociology of each area were analyzed and, SØrensen and Czekanowski similarity indices were used for the comparisons. Composite soil samples (0-20 cm) were taken for physico-chemical analyses. TWINSPAN classification placed most plots of the system 31 and four plots of the system 33 together in one side of the first division (eigen-value 0.329). DCCA showed that there is an environmental gradient underlying the division in land systems. P, K and Ca+Mg concentrations in the soils were the main determinants.

Two decades of monitoring of permamente plots in Central Brazilian savanna (Cerrado sensu strito) and gallery forests

JEANINE MARIA FELFILI, *and José Roberto Rodrigues Pinto, Departamento de Engenharia Florestal, Universidade de Brasília*

Savanna, locally known as Cerrado, is the dominant vegetation the Central Brazilian plateaux. The main physiognomy is cerrado sensu stricto, a savanna woodland vegetation while the gallery forests are strips of topical forests that follow the watercourses. A continuous inventory system based on permanent plots was established at the University of Brasilia Experimental Station, the Fazenda Água Limpa from 1983. Fazenda Água Limpa, at the core area of the Cerrado Region in the Federal District of Brazil, is a nuclear zone of the Cerrado Biosphere Reserve, program MAB-UNESCO. Two gallery forests, Capetinga (1983) and Gama (1985) and a cerrado sensu stricto area (1985) have been measured since the establishment of the plots, see dates in brackets. The sampling design covered the gradients along each studied vegetation using a set of plots in each one, totaling one ha in Capetinga, 3,02 ha in Gama and 2,1 ha in Cerrado. These are the most long term plots in cerrado and gallery forests under continuous monitoring and inspired the guidelines for the establishment of permanent plots in the Brazilian network of permanent plots. Parameters of dynamics such as growth, recruitmente and mortality, dynamics at species and family levels, natural regeneration patterns and processes, biophysical factors such as light and soils have been studied over time by a team involving researchers and students from undergraduate to doctorate levels from the Forestry, Ecology and Biology courses at the University of Brasília. The Brazilian Research Council have been providing grants for students and included the plots in the PELD (Long Term Ecological Research Program) RECOR site. Growth rates in undisturbed gallery forest, median increments around 0.2 cm.yr^{-1} was in the range of tropical humid forests but mortality and recruitment rates were more intense probably due to the disturbances and to edge effects. The strips of gallery forests are narrow, surrounded by an open vegetation, a savanna grasslands matrix, and surrounds streams suffering floods at the riverbanks. Light regime is also similar to rainforests. The gallery forests disturbed by fire presented more heterogeneity of growth and higher rates of mortality and recruitment also compatible with disturbed rainforest sites. savanna vegetation, the cerrado sensu stricto, presented lower growth rates, half of that found in gallery forests. Both vegetations showed stability and resilience to occasional fires and climatic phenomena such as El Niño and La Niña. Fire acted as an intermediate disturbance reducing the woody layer in the Cerrado. High rainfall provoked intense tree falls accelerating the already intense dynamics of gallery forests. Microsites linked to humidity and light are clearly defined in gallery forests with the Cerrado presenting a more homogeneous environment. Another set of permanent plots, totalling a 1,08 ha sample, have been monitored since 1996 in a gallery forest at the northern border of the cerrado in Mato Grosso State at the National Park of Chapada dos Guimarães in the Véu da Nova valley. A high stability (stability time 5.42 years) with a high turnover time (27.88) suggest a dynamic but stable community, similar to that monitored at the core area.

Ecosystems vulnerability to the impact of the climatic change in Argentina

LEANDRO CARLOS FERNANDEZ, *Secretaría de Ambiente y Desarrollo Sustentable, Argentina*

Ecosystem vulnerability to the impact of the climatic change in Argentina was evaluated across three main axes. Projected climate changes for the period 2020/2040 were analyzed utilizing results from numerical experiments carried out at the Center for Ocean Atmospheric Research (CIMA). Critical provinces where the impact of climate change will probably be more important was identified based on this information. The Cuyo and Patagonian region were the zones where the impact will be probably more severe. A detailed analysis of the northwestern Patagonia in the Andean area was performed because this region presents strong and negative past precipitation trends that seem to continue in the future according to the projections of climate scenarios. Almost all water resources in the region depend on the Adean glacier systems including some rich biodiversity wetlands that are actually threatened. The performance of a simplified version of the model CPTEC-PVM and of the model BIOME4 to simulate the distribution of the vegetation was used to evaluate the impacts of the climatic change on net primary productivity (NPP) and foliar area index (FAI) in Argentina. The models run using a current climatology and the exit was compared with a map of existing vegetation an agreement being obtained: regular for CPTEC and down for BIOME4: kcptec=0,40 and kbiome4=0,32. NPP values and FAI100 simulated for BIOME4 were coherent but they need to be validated. After some parameters fitted in both models, a very good representation was achieved of the distribution of the existing vegetation: kcptec=0,75 and kbiome4=0,63. Sensitivity experiments (temperature, rainfall and CO_2) and climatic change were carried out. In the latter case the models of vegetation run fit using climatic future scenarios (2081-2090) of the region generated for regional climatic model MM5-CIMA. Both models simulate scenarios A2 and B2 of the IPCC and lead to increased areas occupied by woody type vegetation. The Ecoregions where the bigger quantity of changes is registered in the type of biome are: Dry Chaco and Mount of plains in CPTEC and Mount of plains and Steppe in BIOME4. The NPP increase practically in the whole territory, with the exception of the Chaco ecoregion and FAI100 shows increases and declines depending of which ecoregion were analyzed. Representation of the ecotones between the ecoregions in the system of protected areas, was evaluated utilizing a Geographic Information System (GIS).

Parcelas permanentes de medicion y monitoreo de la biodiversidad en las rvas. biol. itabo y limoy – Itaipu Binacional, Paraguay

RUBEN DARIO CABALLERO GONZALEZ

El análisis de los datos de campo de las mediciones de las Parcelas Permanentes de Medición y Monitoreo de la Biodiversidad realizados desde octubre del 2005 a enero del 2006, arrojaron interesantes resultados sobre los cambios que ocurren en la estructura horizontal como vertical del bosque nativo de las Reservas Biológicas de Limoy e Itabo. En la Reserva Biológica de Itabo se volvieron a medir y analizar cuatro de las cinco parcelas permanentes instaladas en lugares estratégicos, tres de las cuales se encuentran situadas en la formación de bosque alto y una en bosque bajo. En la Reserva Biológica Limoy, se midieron las dos parcelas permanentes, analizándose una de ellas, la misma se encuentra en una formación del bosque alto semidecidual alterado en proceso de recuperación. Las dos unidades de conservación se encuentran situadas en la formación que actualmente se conoce como Bosque Atlántico del Alto Paraná, ecosistema considerado por la Unión Internacional para la Conservación de la Naturaleza (UICN) como uno de los más importantes del planeta por la alta biodiversidad y por su rápida perdida debido al cambio en el uso de la tierra generado por actividad antrópica.

Forest Biodiversity Plots on Galiano Island, Canada

ANGELA JEAN-LOUIS, *Galiano Conservation Association, Canada*

Galiano Island is home to one of Canada's most limited biogeoclimatic zones: the coastal Douglas-fir ecosystem which is designated as an "Ecosystem at Risk" by the British Columbia Conservation Data Centre. The Pebble Beach Reserve (322 acres) encompasses three parcels of land: the central one owned by the Galiano Conservancy (1998), and a Crown Land parcel on either side. The area is ecologically significant, home to many diverse and healthy ecosystems: a freshwater lake and creek, remnant old-growth coastal Douglas-fir forest, naturally regenerated forest and a healthy, younger Douglas fir plantation. This plot was established in a naturally regenerated forest in 1999, and there is the potential to establish comparison plots in plantation and old-growth forests. Information on protecting the biodiversity of this system is being assessed through the use of SI/MAB protocol for forests as these inventories offer a framework for biodiversity research.

Biological threats to biodiversity

MARIANNE KARSH, *D.C. MacIver and Heather Auld, Environment Canada; and Alice Casselman and S. Fung, Association of Canadian Educational Resources*

The pressures of urban development impact small remaining areas of the Carolinian Forest in Southern Ontario. The Carolinian Forest contains some of the highest biodiversity in Canada and losses in green areas and the diversity of species can be identified from the local or municipal level to a global scale. Changes in climate and disease patterns put additional pressure on these areas. The Association for Canadian Educational Resources (ACER), Humber Arboretum, Arborvitae (non-profit) and the Atmospheric Science and Technology Directorate, Adaptation and Impacts Division (government), developed a climate change experimental site at the Toronto Humber Arboretum in northwest Toronto, in the heart of the Carolinian forest, to monitor the impacts of biological threats on urban forest biodiversity. The goal was to investigate the benefits of forest planting design and the selection of species to optimize greater species biodiversity and ensure increased climatic resilience of species under current and changed climate conditions, particularly for urban forests. Approximately 2,157 trees and shrubs were planted in 2002-03 in a standard one-hectare biodiversity site with 25 quadrats, each 20 metres by 20 metres in size. There are 76 different species of trees and shrubs planted, an unprecedented number of species for a community planting project. As well as planting for biodiversity and climatic warming, the site was also designed to bolster disease resistance: no more than 5-10% of any one species; no more than 20% of species in the same genus; and no more than 30% in the same family. The Toronto urban location proved particularly beneficial for this study. The heart of Toronto is home to 2.5 million people, with some one-third of Canada's population living within a 160 km radius of Toronto itself. The Toronto core has a well-documented warming bias relative to surrounding rural sites. This "Toronto warming effect" of nearly 4.0°C in minimum temperatures relative to rural sites includes thermal influences from the city's location on the shoreline of the Great Lakes, as well as urban heat island effects. The degree of warming in the Toronto core relative to nearby rural areas is consistent and within the range of anticipated future warming. It is hypothesized that this degree of temperature change in the city presents itself as a possible “learning laboratory.” The current observed differences in minimum temperatures serve as an important indicator to better assess the responses of vegetation to the warming through a comparison to rural sites outside of the city. Climate warming in urban habitats is associated with increased frequency and outbreaks of pests, as well as the expansion of populations of deer and rabbits, which benefit from the warmer springs. Despite protecting the trees with tree collars, browsing damage in the Humber Arboretum site was considerable, with 20-80% mortality of the newly planted seedlings in the sampled quadrats after five years. All of the trees still living, with the exception of white spruce, showed signs of heavy or severe browsing that may affect future growth, survival, reproductive success and competitive ability. The take-home message for managers is to plant larger-sized trees and trees more resilient to deer browsing in the urban landscape.

Bioregional Mapping on Toronto Island’s Biodiversity Plot

MARIANNE KARSH, *Executive Director, Arborvitae, Canada*

Bioregional maps are community-based and communicate a story both in images and in words. Once a bioregional map is complete, it becomes the foundation of knowledge from which planning scenarios can be prepared. In 2000, as part of Arborvitae’s Cosmic Camp For Kids and Youth Training Program, youth completed a Bioregional Map of the Toronto Island SI/MAB Biodiversity Plot. The concept of Bioregionalism, or “living a life dedicated towards the reintegration of human and non human relationships in place”, includes four main components: (1) Knowing the land, gaining familiarity with the landscape by creating a wildlife species list, a record of rainfall, waterflows, monthly climate conditions, historical events, native settlements, potentials for using clean energy, etc.; (2) Learning the lore - gaining an understanding about the history of one’s life place from libraries, city archives, museums and area residents; (3)Developing the potential. Discovering how well resources are used in the bioregion with the understanding that “A bioregion used to its potential will encourage and demand full development from its human and non-human inhabitants” (Sale, 1985); and (4) Liberating the self - seeking opportunities in the bioregion to live closer to the land and becoming less dependent on global economic/political forces. Bioregional maps communicate a story both in images and in words; spatial information such as the location of special things or events are labelled on the land while information about events is written in a story format. Whenever people look at maps they are reminded of stories about certain places. For example, people might have stories about a particular stand of trees and what it means to the community, which they would record on the map. The map could show natural features such as soils, landscapes, vegetation and wildlife, as well as ways that people in the community use the land. The community learns about itself in the process of making decisions about its future. The experience of creating a bioregional map for Toronto Island, Canada, is presented.

National Comparisons of SI/MAB Plots in Canada

MARIANNE KARSH, *Executive Director, Arborvitae, Canada*

The Canadian SI/MAB baseline operates within the context of a global biodiversity program to better understand the state of biodiversity using the same standardized monitoring protocols. Unique to this program is the recognition and usability of information collected throughout Canada from numerous participants with various levels of scientific knowledge and experience. This means that quality assurance, redundancy, auditing and certification has been incorporated into the program to support the evolving Canadian baseline. The Canadian SI/MAB baseline is represented by observation sites from coast to coast with the predominance of sites in Ontario and Quebec. A total of 88 sites are in the Canadian SI/MAB baseline with Ontario and Quebec representing 60%, the Maritime Provinces representing 16% and Western Canada, the Prairies and the North representing 24%. These sites are analyzed showing a high predominance of sites with sugar maple (Acer saccharum). The baseline ranges from 339 stems/ha in the prescribed burn plot at Turkey Point, Ontario, to 2,521 stems/ha at Charlevoix, Quebec. As a comparison, the sites in Limbe, Africa, and Dinghusham, Asia, have an average of 1,223 and 3,960 stems/ha respectively. The average diameter/stem ranges from 11.1 cm/stem in Charlevoix to 52.3 cm/stem in CARE, Ontario (Plot 1). The greatest basal areas were found at the two CARE plots, approximately 300-400 m^2/ha. Most of the sites have between 23 - 86 m^2/ha. This poster examines the baseline in detail.

Preliminary Report on Ice Storm Damage to Forest Trees in Quebec, Canada

MARTIN LECHOWICZ, *Department of Biology, McGill University, Canada*

In January 1998, the area from around Kingston, Ontario east to the Maritime provinces was struck by the worst glaze ice storm of the century. Prior to the devastating ice storm, two plots were established in the Mont St.-Hilaire Biosphere Reserve at Lake Hill and Botany Bay. Originally established to study long-term forest dynamics in an area of old growth forest uncut since European colonization, the plots now serve as study sites for monitoring the recovery and mortality of trees affected by the ice storm. Quantitative assessment of the damage to the 1-ha plots at Mont St. Hilaire Biosphere was made by sampling 117 circular quadrats (6-m radius) placed randomly over the entire mountain. Trees were scored for damage using a scale employed by the Quebec Ministry of Natural Resources in their province-wide estimates of the effect of the ice storm. In terms of the damage to individual trees, most of the common canopy species were, on average, equally damaged at a given site. The damage caused to the trees by the ice storm was ranked on a scale of 1 (not or almost not affected) to 5 (severely affected to fatal). The majority fell between "25-50% loss of canopy branches" and "more than 50% branch loss but less than total loss of canopy form". This was an indication that many trees were very badly damaged and subsequently may not be able to recover from the storm. There is little quantitative data in the literature, but indications are that canopy damage, in excess of 50%, will lead to the death of many species. It will be interesting to track individual stems in these to establish reliable data on the fate of stems and species with different amounts of branch loss.

Atmospheric Change and Biodiversity: Using SI/MAB Plots for Understanding the Impacts of Atmospheric Change

DON MACIVER, *Environment Canada*

The atmosphere is dynamic, changing and extreme. The atmosphere influences processes at all levels of biodiversity and their many interrelated populations. It is difficult to think of a biodiversity process that is not directly or indirectly adapting to a changing atmosphere. Many components of biodiversity are naturally adapted to a certain degree of atmospheric variability (i.e. climate variability) and will migrate or go extinct depending upon the rates of atmospheric change (i.e. climate change). As changes in biodiversity have now been linked to changes in atmosphere, forest

biodiversity monitoring plots can provide baseline data on atmospheric related variation in ecosystems. SI/MAB plots can be evaluated based on a heat unit from family diversity models which identify whether biodiversity within plots correspond with the expected biodiversity of the current climate. Heat is a powerful trigger. Changes of 1 or 2 degrees Celsius translate into significant biological impacts, adaptations and vulnerabilities. The heat unit by family diversity model for forests, suggested by Rochefort and Woodward (1992), provides a useful global baseline against which to examine and evaluate SI/MAB plots (i.e. expected versus observed). The heat unit is the accumulation of heat above the base temperature of 5 degrees Celsius commonly referred to as growing degree days (GDD). In addition, this basic relationship serves as an effective diagnostic tool to identify plots where the biodiversity was or was not in equilibrium with the present climate. Further, this baseline relationship also serves as an essential transfer function when merged with the longterm bioclimate maps for Ontario. The spatial variability of climate-based biodiversity was mapped and then subjected to a 2xCO_2 atmosphere, using climate change scenarios to calibrate and again map, the anticipated and future changes in biodiversity. This mapping technique helped to identify areas in southern Ontario that will require enhanced conservation practices for the adaptability of native species, including areas that will be vulnerable to invasive exotic species which will serve as critical early-warning sites for detecting the presence of invasive exotic species. The SI/MAB plots provided initial verification of the family diversity baseline nationally, but more importantly, allowed for the construction and calibration of the biodiversity baseline for mixedwood forest species due to the abundance of the SI/MAB plots located across ecological, climate and chemical gradients in southern Ontario. Figures depict this gradient analysis approach and the relative linearity of the basic heat by family biodiversity relationship for mixedwood forest sites from Long Point on Lake Erie to Tiffin Conservation Area on Georgian Bay. In addition to climate variability and change, there are many atmospheric processes that directly affect the structure and functioning of ecosystems and hence, the changing state of biodiversity, including weather extremes; increased UV-B; acid deposition; increased levels of ground-level ozone and other photochemical pollutants; and suspended particulate matter and hazardous air pollutants. The SI/MAB plots, using global protocols, perform many integrating tasks and have proven useful in identifying the effects of atmospheric variability and change. It is recommended that more SI/MAB plots be established across ecological, chemical and climate gradients in highly altered landscapes in Canada to detect change and adaptation responses.

Centre for Atmospheric Research Experiments (CARE)

DON MACIVER *and Marianne Karsh, Environment Canada*

The Centre for Atmospheric Research Experiments (CARE) was established in 1988 and is Canada's national experimental site for testing new atmospheric instrumentation as well as for detecting long-term atmospheric change. Instrumented towers for temperature, humidity, wind and radiation were established to monitor the horizontal and vertical profiles of heat, moisture and wind. Towers were located in standard open site locations, openings in the forest, forest edges and closed forest environments. In 1995, as part of an SI/MAB training initiative, two plots were established at the CARE site. Two instrumented meteorological towers were located in the closed forest, planted red pine SI/MAB plot; and a second SI/MAB paired plot was established in the unmanaged mixed hardwood forest. Using increment cores of the forest, a history of forest growth at the two plots is provided. Influences of snow cover and invasive species is also provided. A forest climate monitoring programme in highly altered landscapes needs to be co-located in the SI/MAB plots to understand the biometeorological exchanges and processes that affect biodiversity.

Analysing and Applying Collected Data: The Biodiversity Issue

DON MACIVER, *Environment Canada*

At the United Nations Conference on Environment and Development (UNCED) in 1992, more than 156 countries and the European Union signed the Convention on Biological Diversity. The Framework Convention on Climate Change and the Statement of Forest Principles were also part of the Rio Declaration, Agenda 21. Canada, in the same year, ratified its commitment to the Convention on Biological Diversity through the production of two key documents: The Canadian Biodiversity Strategy and The Science Assessment on Biodiversity. This poster details these two key documents.

Biodiversity Framework

DON MACIVER, *Environment Canada*

The Canadian Biodiversity SI/MAB network continues to expand at an unprecedented rate. Numerous agencies, using the SI/MAB protocols, have established the one hectare plots in forest environments or smaller biodiversity plots in grassland and tundra locations. The goals and objectives of each group are different, hence making it difficult to communicate respective methodologies and results in a common room in spite of the common topic – biodiversity. For this reason, a framework was established to emphasize the diversity of goals and objectives faced by different groups using the same biodiversity plot. This poster illustrates this framework.

Biodiversidad y cambio climático en el estado de Veracruz

M.C. Griselda Benítez Badillo, Biól. Arturo Hernández Huerta, Dr. Miguel E. Equihua Zamora, **ALEXANDRO MEDINA CHENA,** *José Luis Álvarez Palacios, Dr. Sergio Ibáñez Bernal, M.C. Christian Delfin Alfonso, Dr. Adalberto Tejeda Mtz, Depto. de Ecología Aplicada. Km 2.5 carr. antigua a Coatepec No. 351. Congr. El Haya. Xalapa, Veracruz 91070. MX.*

Contribución del Inecol en el Marco del Plan Estatal de Acción Climática del estado de Veracruz, forma parte de la iniciativa del Instituto Nacional de Ecología y el Consejo Británico a través del fondo de oportunidades globales del Reino Unido. Se evaluaron las implicaciones del cambio climático para la biodiversidad de Veracruz utilizando "árboles de clasificación" para modelar escenarios de vegetación, ajustados con S-Plus (Insightful) StatMod. Como clasificación base se usó la carta de vegetación potencial de Rzedowski (1978), utilizando la temperatura y precipitación como predictores de los tipos de vegetación. El árbol resultante se consideró representativo de criterios causales fijos, que se aplicaron a los distintos escenarios climatológicos. Se valoraron las condiciones ideales para la existencia de los distintos tipos de vegetación (vegetación potencial), a partir la temperatura media y precipitación total. Los resultados sugieren la disminución, en la década 2020, de las condiciones para la existencia de vegetación xerófila, lo que implicaría la extirpación en Veracruz de las especies más sensibles de esta comunidad. Se espera un aumento de condiciones propicias para la existencia de bosques tropicales perennifolios en la década 2020, para dar lugar en el 2050 a condiciones que favorecerán al bosque tropical caducifolio. Se ampliarán las zonas propicias para el bosque espinoso al norte de la entidad. Los bosques mesófilos avanzarán sobre los bosques de coníferas y de encino, resultado que requiere de un análisis más cuidadoso en el futuro. En general hay una ampliación de las condiciones propicias para la existencia de vegetación acuática y subacuática. En lo particular, es probable que algunas especies terrestres como Quercus oleoides desaparezcan de ciertas partes de su distribución actual. Se espera que la fauna modifique sus áreas de distribución actuales. Las aves pueden colonizar nuevas áreas, hacia partes altas del estado; su capacidad de desplazamiento les permitiría evitar extinciones locales, y solo las especies endémicas de las porciones montañosas aisladas enfrentarían ese riesgo. Los mamíferos también podrían desplazarse hacia partes altas del estado, aunque su panorama es más difícil que el de las aves debido a que tienen menor capacidad de desplazamiento (sin considerar murciélagos) y tendrán que franquear áreas desprovistas actualmente de hábitat natural. Los mamíferos más vulnerables al cambio son las especies endémicas que habitan zonas montañosas, como la región de Los Tuxtlas y las asociadas al matorral xerófilo que existe en las inmediaciones del Cofre de Perote. Los reptiles enfrentan un panorama similar al de los mamíferos, con especies vulnerables en las zonas montañosas del estado; su limitada capacidad de desplazamiento y la discontinuidad de cobertura vegetal representan fuertes obstáculos para colonizar nuevas áreas. Los anfibios son aún más vulnerables debido a que su ciclo reproductivo está muy vinculado a la humedad del ambiente y dependen de la disponibilidad de cuerpos de agua para asegurar su supervivencia. Las posibilidades de adaptación dependen de que puedan sortear las barreras humanas, y que el desplazamiento sea sincrónico con la disponibilidad de recursos como alimento, sitios de refugio y reproducción. El cambio climático también puede favorecer el establecimiento de especies consideradas como nocivas para el ser humano, como sería el caso de los insectos transmisores de organismos patógenos causantes de enfermedades como dengue, malaria y la enfermedad de Chagas. Gran parte de la vegetación natural ha desaparecido del estado, y el reacomodo de especies dependerá de las condiciones actuales del paisaje. Evitar la fragmentación del hábitat, y restablecer ecosistemas nativos puede aumentar la resistencia al impacto del cambio climático. La pérdida de especies representa la pérdida del sustento de poblaciones rurales, como los productos no maderables de los bosques. Además, los parientes silvestres de los cultivos de alimento se consideran pólizas de seguro para el futuro, y pueden utilizarse para generar nuevas variedades resistentes a condiciones cambiantes.

Here today, gone tomorrow? Targeting conservation investment in the face of climate change

Ceif Olson and KATHRYN FREEMARK LINDSAY, *Geomatics and Landscape Ecology Research Lab, Carleton University, Canada*

To optimize the use of scarce resources, it is imperative to target conservation investment wisely. We evaluate the impact of potential climate-driven shifts in species distributions on the future conservation utility of a present-day reserve design, using Breeding Bird Survey data for 150 species in the conterminous USA east of the 100th meridian and two predicted future species distributions models (generated by others, using modelled tree species information and two global circulation climate models). Using present-day distributions, we select sets of sites meeting a range of conservation targets; from 10 to 100 occurrences of each species in the reserve network. These sites cover 68 – 79 % of bird species in the two future scenarios. Underrepresented species fall into two principal groups, those associated with more northern tree species (Balsam Fir Tsuga canadensis or Paper Birch Betula papyrifera) and those linked to temperature variables. Changes in the geography of conservation priority are highlighted by an interpolated 'conservation priority surface', informing strategies for adaptive conservation management in response to climate change and encouraging the geographic targeting of conservation investment.

Faunistic survey of the crickets (Orthoptera: Gryllidae) of the West Indies

DANIEL E. PEREZ-GELABERT, *Smithsonian Institution, USA*

The total faunal diversity of Gryllidae in the islands of the West Indies (Greater Antilles, Lesser Antilles and Bahamas) is assessed for the first time through a comprehensive taxonomic survey. Here we present a summary of our research on the West Indian cricket fauna, giving updated data on the total number of species recorded per island and per cricket subfamily groups. This work includes the description of nearly 400 new species based on the taxonomic study of approximately 5,000 specimens obtained through recent collecting in several islands and other materials from several United States museum collections. Relevant morphological features of all new species are depicted through photographs and line illustrations. The number of cricket species known from the Caribbean islands is quadrupled from the previously known to about 530 species. Then this makes the crickets of the West Indies about 13% of the nearly 4,000 known cricket species in the world. It is significant that over 85% of these species may be exclusive to the West Indies and most of them appear to be confined to single islands. Ten subfamilies of Gryllidae are represented, being the Podoscirtinae (~200 species) and the Phalangopsinae (145 species) the most diverse. This base-line inventory should enhance further taxonomic and conservational studies on this ecologically significant group of insects in the Caribbean area.

Lianas in the Yasuni Forest Dynamics Plot: monitoring demographic dynamics and functional traits

HUGO ROMERO-SALTOS, *and Leonel Sternberg, Department of Biology, University of Miami, USA; Nataly Charpantier, Esteban Gortaire and Renato Valencia, Escuela de Ciencias Biológicas, Pontificia Universidad Católica del Ecuador; Stefan Schnitzer, Department of Biological Sciences, University of Wisconsin-Milwaukee, USA ; Robyn Burnham, Department of Ecology and Evolutionary Biology, University of Michigan, USA.*

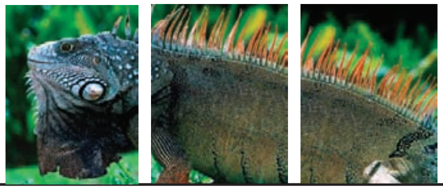
In the last decades, dominance of lianas in Neotropical forests has apparently increased. If this increase becomes significant, it may affect forest dynamics because lianas are important in gap regeneration dynamics and may compete efficiently for resources (water, nutrients, light) with their host trees, causing even a reduction in their fertility. Because it is possible that the increase in liana dominance is related to regional changes in climate, it becomes necessary to monitor the populations in the long-term. In the permanent 50-ha plot of the Yasuní Forest Dynamics Project, we are studying patterns on liana distribution, abundance, biomass and diversity, and we are also measuring functional traits (e.g., specific leaf area, nutrient content, wood density). As a pilot experience, we censused all the lianas with diameter ≥1 cm in 1.8 ha: a 20 x 500 m area and 20 subplots of 20 x 20 m evenly located throughout the first 25 ha. In the 20 x 500 m area, we also mapped the rooting points of each liana, and how their main branches (diameter ≥1 cm), creeping stems and aerial stems (<2 m from the ground) occupied the space at or near ground level. In the 1.8 ha sampled, we found 2649 liana individuals classified in 41 families, 104 genera and 236 species (78% fully identified). We estimate there are around 300 liana species in the entire 50 ha, half of what is estimated for the whole Yasuní area. We plan to recensus the community during 2008, two years after the first census. The recensus will allow us to obtain demographic data (growth, mortality and recruitment rates), and will also help to refine the methodology to be used in the census of all the lianas in the plot (an estimate of 70000 liana individuals). Regarding functional traits, we have so far data for 181 liana species. All this information will help to elucidate the ecological and evolutionary processes that make possible the origin and maintenance of the high plant diversity in these forests, and the responses of the liana community to climate change.

Proposal of a Methodological Approach for Monitoring Climate Change Effects on Tree Species within Conservation Units

EDER ZANETTI, *Embrapa Florestas, Brazil*

Cosmic rays, solar radiation, earth axis and CO_2 natural emissions, are supposed to exert influences on climate change, which determined some major modifications within our terrestrial ecosystems along thousands of years. Earth's atmosphere, a 20km tick gas envelop that surrounds the planet, came into existence circa of 1 million years after the planet itself, and the Greenhouse Effect is accountable for actual bearable climate conditions. However, the atmosphere has never experienced the fast increase on Greenhouse Gases – GHG, as the one promoted by humans since the industrial era. Increasing GHG is causing impacts all around the globe, since the phenomena reaches every single part of it. Contemporary tree species are the result of global climate change resistance along the last 2.5 million years (natural), and they portray adaptive differentiation as a response from latitude and altitude situation. The IPCC (International Panel on Climate Change) already identified terrestrial ecosystem modifications related to temperature increase, phenologic characteristics changes and incidence of extreme events, around the globe, and also that the effects of solar activity on tree growth rings can be tracked. The sum of natural and antropogenic influences can be recognized, therefore, by studying and comparing simultaneously the long and short term effects of climate change on tree species, towards its DNA, phenology and growth rings, adding carbon and water balances to the equation. Conservation Units – CUs, are the milestone strategy for world biodiversity conservation, and its perpetuity depends on the adoption of proper management strategies, including ones designed to adapt to climate change – 25% of all living species are threatened by global warming, and the process gets accelerated by the combination of natural and antropogenic influences. In order to have the most suited conservation strategy, it is necessary to identify correctly which are the major influences and at which level they impact natural vegetation at conservation units. At conservation units, tree species are the ones with larger life expectancies, therefore being the most important references as to monitor the global change impacts on towards temporal scales. This paper suggest the distribution of CUs along a North-South axis in order to capture major climate influences on tree species within those CUs, to allocate tree samples along different geographical position within the CUs and age classes distribution to include new, adult and old trees. With this methodological approach being adopted at several locations, it is expected to create a net of data from which comparisons can be done and best practices to adapt to climate change can be discussed and spread among all involved with conservation strategies. Special attention needs to be drawn, for example, to the Brazilian Amazon Ecological Corridors Project, first established in 1999, with the basic conception to create connections between conservation units to facilitate genetic and biotic fluxes. The five Amazon region corridors are distributed within the region oriented towards an East-West axis, while climate change follows North-South axis. This direction of climate influences suggest that connecting the Brazilian Amazon Ecological Corridors would be necessary to improve conditions for species adaptation.

Training Sessions



Forest Biodiversity Monitoring Plots: Tools for Measuring Forest Changes

FEBRUARY 29 TO MARCH 2, 2008
SOBERANIA NATIONAL PARK, PANAMA

The Smithsonian Institution's Measuring and Assessing Biodiversity (MAB) Program has developed an international network of research and monitoring plots to track the status of forests and changes over time. The tool for establishing these plots is the protocol officially titled *MAB Digest 11: Long-Term Monitoring of Biological Diversity in Tropical Forest Areas: Methods for Establishment and Inventory of Permanent Plots* designed to provide step-by-step directions to gather baseline information about forest structure, composition and diversity within a vegetation plot; to assess changes in these forest components over time; and to use the information to link forest vegetation parameters with multi-taxa monitoring.

The SI/MAB methods establish a framework for the long-term monitoring of biodiversity in forested ecosystems. The basic layout is a one-hectare plot (100 meters by 100 meters) divided into 25 contiguous quadrats (20 meters by 20 meters) where each tree is tagged and located with its species identified, its diameter at breast height (dbh) measured, and its height measured. The data is recorded in common field note formats, and then entered into a common software, developed by the Smithsonian Institution, called BIOMON. From the data, maps are generated for each quadrat, and are used to validate the measurements in the field.

The course will teach about methodologies currently being used for forest monitoring and their applications to climate change. Participants will have the opportunity to have a combination of lectures and hands on experience in establishing and re-censusing a forest monitoring plot in the Soberania National Park. The study plot is a representative Panamanian rainforest. Trees will be identified, tagged, measured and mapped and participants will conduct the ten year re-census of the plot. Data and information will be recorded and analyzed by the participants. While collecting data participants should prepare for a long day in a tropical forest by dressing and hydrating appropriately.

The objectives of the course are:

1. To introduce participants to biodiversity monitoring plots for forest change;
2. To provide hands-on field training for the establishment and re-censusing of forest monitoring plots, data analysis and interpretation; and
3. To discuss the linkages between forest monitoring and climate change.

INSTRUCTORS:

Francisco Dallmeier, Center for Biodiversity Conservation Education and Sustainability, Smithsonian Institution
Alfonso Alonso, Center for Biodiversity Conservation Education and Sustainability, Smithsonian Institution
Cliff Drysdale, Mersey Tobeatic Research Institute Cooperative, Canada
Marianne Karsh, Environment Canada

FRIDAY | February 29, 2008

1400 to 1800 Session 1: Introduction to Biodiversity Monitoring and Assessment

Welcome and introduction to instructors and participants and the course objectives; Monitoring and Assessment Framework; Biodiversity Indicators for monitoring; Linking plots to large scale monitoring and climate change; Principles of sampling, plot monitoring and methodologies for field work

SATURDAY | March 1, 2008

0630	Departure for field site
0730	Field team assignments and debrief
0800	Field sampling and data entry
1800	Return to lab, data entry as needed

SUNDAY | March 2, 2008

7:00	Principles of information management and Biomon demonstration
8:00	Field verifications and conclusions
12:00	Evaluations and adjournment

Climate Models: Scenarios of Future Climate Change for Impacts and Adaptation Studies

MARCH 3-4, 2008
SMITHSONIAN TROPICAL RESEARCH INSTITUTE, PANAMA

For many climate change studies, scenarios of climate change derived directly from Global Climate Model (GCM) output are of insufficient spatial and temporal resolution. The spatial resolution of GCMs, in particular, means that the representation is much simplified in comparison with reality, with consequent loss of some of the characteristics that may have important influences on regional climate.

A number of methodologies have been developed for deriving more detailed regional and site scenarios of climate change for impacts and adaptation studies. These downscaling techniques are generally based on GCM output and have been designed to bridge the gap between the information that the climate modeling community can currently provide and that required by the impacts research community.

This training session will provide information on climate models and techniques, and then a hands-on training in the use of the Canadian Climate Change Scenarios Network (CCCSN) website for deriving climate change scenarios for impacts studies.

The ‘hands on’ presentation/instruction session, on the use and information available on the CCCSN site will be informal and a mix of demonstration and instruction with student interaction on their own networked laptops. The session will inform attendees about what is available and how climate change scenario information can be displayed, downloaded and interpreted using the tools of CCCSN. Questions and interaction with attendees on their own climate change scenario interests will be addressed. Attendance is restricted to available space/ laptop availability. Handout background material will be provided at the session.

INSTRUCTORS:

Neil Comer, Meteorological Service of Canada, Ontario Region, Environment Canada
Bill Gough, Associate Chair, Department of Physical and Environmental Sciences, University of Toronto at Scarborough
Adam Fenech, Associate Director, Adaptation and Impacts Research Division, Environment Canada

MONDAY | March 3, 2008

0900 to 1030 Session 1: Climate Modelling, the Basics
Brief welcome and introduction to instructors and participants. Introduction to course objectives.

What is a model? What are climate models? What is a GCM? What is a coupled model? History of climate modelling

1030 to 1100 Break

1100 to 1230 Session 2: Climate Modelling Challenges

What are the limitations of current climate models? What is parameterization and why is it important? What is an RCM? What is downscaling?

1230 to 1400 Lunch

1400 to 1600 Session 3: Climate Modelling Applications

How are climate models used in the IPCC reports? What is climate change impact assessment? Some examples of climate modelling applications (bioclimate modelling, Fire Index, Drought index)

TUESDAY | March 4, 2008

0900 to 1030 Session 4: Background to the Canadian Climate Change Scenarios Network Website (CCCSN)

What is the CCCSN.CA website? What can it do? [Data download (Global Climate Model, Canadian Regional Model, downscaling input data); Data visualization (maps, charts, tables, variables from the models); Scatterplots; Bioclimate profiles – (temperature: mean, max, min); (heating and cooling degree days); (corn heat units); (daily growing degree days); (monthly growing degree days); (daily frost profile); (water surplus and deficit); (frequency of precipitation); (maximum temperature above threshold); (maximum temperature below threshold); (freeze-thaw cycles); and (accumulated precipitation)]

1030 to 1100 Break

1100 to 1230 Session 5: Background to the Canadian Climate Change Scenarios Network Website (CCCSN) continued
How do I find locations meeting selected criteria? What downscaling tools are available (SDSM; LARS and ASD)

1230 to 1400 Lunch

1400 to 1600 Session 6: How do I start my own investigation?

1. Reports/ Publications/ Help documents / web links to guide your own work
2. Selection of assessment / variables / models / scenarios
3. Visualization and download of data for local analysis. How to, and examples.
4. Future and further questions from attendees including the development of similar site for our international users – maps for outside of North America; expansion of bioclimate profiles given long-term observational data; development of new bioclimate profile models beyond the 12 there are now; and feedback.

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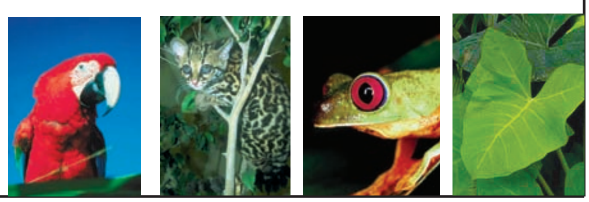

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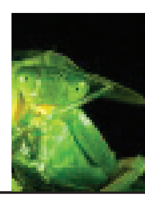

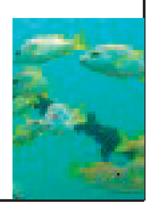

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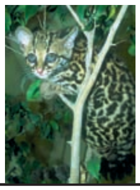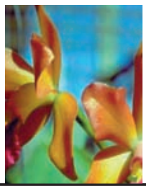

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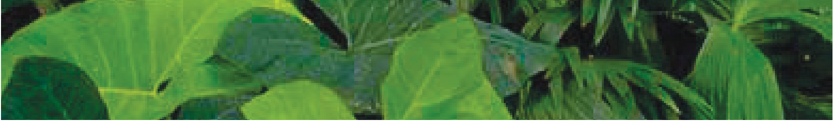

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