



Michael Balick

The New York Botanical Garden, Bronx, NY, USA

Ethnomedical Systems, Biodiversity, and Primary Health Care in Micronesia

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Micronesia is a remote part of the world, with a rich ethnomedical tradition and, in many areas, high levels of plant endemism. Island peoples are particularly skilled at discovering and developing technologies for plant utilization, as their resource base is limited by the island's size and degree of isolation. Micronesian peoples have used plants for many purposes, including provision of primary health care. Since 1997, a research team of local and international researchers—biologists, physicians, traditional healers, conservationists, and specialists in local culture—has been conducting biodiversity and ethnomedical surveys on the islands of Pohnpei and Kosrae in the Federated States of Micronesia and The Republic of Palau. One focus of the program is to inventory the medicinal plants of the region, collecting data on diversity and abundance of species and their uses. We have recently published a book on Pohnpei Island, which details medical uses, dosages, and formulations for 206 species of plants found there, an astonishing 21% of the total flora. Concurrently, we are working on a primary health care manual that incorporates an evidence-based approach to using local plants in health care. The model developed by this program is to incorporate sustainable plant resources and ethnomedical modalities into the state run systems of village dispensaries, clinics, and the hospital. As village dispensaries on many Pacific islands lack prescription pharmaceuticals, traditional medical systems and the plants they use can play an important role in improving health care. With a greater awareness of the importance of local resources in contemporary life comes the realization that these modalities must be managed in a sustainable way, particularly on small islands. Thus, it is clear that improving primary health care depends on maintaining a diverse environment, and biological conservation is now attracting a new and influential constituency—the local physicians in the region.

Martin Blaser

New York University, New York, NY, USA

Helicobacter pylori, a Resident of the Human Gastric Micro-Environment that Both Causes and Protects Against Disease

Helicobacter pylori is an ancient bacterial member of the human gastric micro-environment. *H. pylori* populations are highly dynamic and interactive with the gastric epithelium. The net interchange affects both local and systemic human physiology. As a result of modern lifestyles, *H. pylori* is disappearing from human populations, and becoming extinct; as such, it now is clear that *H. pylori* status affects both physiology and disease risk. *H. pylori* positivity increases risk for both ulcer disease and gastric cancer. With its decline, diseases of the esophagus related to Gastroesophageal reflux disease (GERD) and its consequences, including adenocarcinoma of the esophagus, are becoming more frequent, and an extensive body of evidence links these reciprocal events. Similar observations have been made recently about childhood asthma and related disorders. The ways in which *H. pylori* might protect against disease involve hormonal and chemical regulation, immunologic mechanisms, and/or effects on other residential microbiota. Using the example of *H. pylori*, secular changes in our micro-environment mimic changes in our macro-environment (e.g., global warming) with unanticipated consequences.

Jane Carlton

New York University, New York, NY, USA

Health and the Environment in the Age of Genomics

Genomics—the study of genomes of living organisms—is an immensely powerful discipline that is being harnessed to examine interactions between human health and the environment. The genomes of thousands of parasites, bacteria, and viruses that cause serious human diseases have been decoded, as have genomes of animals, fungi, and plants, providing insights into evolution, new drug and vaccine targets, and novel methods of disease surveillance. Examples of genome projects will be given, including the Human Microbiome Project, which aims to sequence the DNA of all the microbes found in bodily micro-environments, and environmental genomics projects that are cataloguing microbial diversity.

Carlos Corvalán

Regional Office for the Americas of the World Health Organization, Brasilia, Brazil

Environmental Burden of Disease: Acting to Reduce Current and Emerging Threats

The World Health Organization (WHO) has estimated that around one quarter of the global burden of disease could be



reduced through existing environmental interventions. This fraction is higher in poor countries and among children. In spite of action in many countries to address current environmental health problems and their inherent inequalities, emerging issues such as ecosystem degradation, depletion of water resources, changes in land use and climate change in particular, are threatening these advances. Recent interest to implement a global agenda for climate change and health is an opportunity to address simultaneously current and emerging issues, and build an integrated agenda for action.

Andrew Dobson

Princeton University, Princeton, NJ, USA

Biodiversity, Climate Change, and Health

Human health and the health of all the non-voting species is intimately linked to climate and the surrounding environment. In this talk I will give a number of examples of how changes in the environment interact with climate change to create changes in the health of humans, “animal” and plant populations and communities. Understanding the dynamics and impact of these problems requires a significant increase in interactions between ecologists, epidemiologists, and economists. Genomics may also be useful for many post-hoc analyses, but it will never allow us to develop a predictive framework needed to understand the interactions between health, climate, and the environment at the spatial and temporal scales where we need to develop effective management and intervention strategies. So a redistribution of funding priorities is desperately needed if we are to understand this important class of environmental problems.

Pablo Eyzaguirre¹, T. Johns¹, I. F. Smith¹

Bioversity International Diversity for Livelihoods Programme, Rome, Italy

Biodiversity for Nutrition and Health: Reversing the Simplification of Diets and Ecosystems

Human health is based on adequate supply of foods containing the energy, nutrients, and functional properties that are essential for good health. Humans have met these fundamental needs through the consumption of a diverse range of plant and animal foods available in a wide range of ecosystems. Dietary diversity has been the basis of good nutrition and health across food cultures by using the food resources available in local ecosystems including agro-ecosystems. Using examples from the ecologies and food systems of West Africa, East Africa, South and Southeast Asia, and South America, the paper describes the range of foods sourced from local biodiversity that are being eroded as ecosystems are simplified and biodiversity is reduced or lost. The concomitant global trends to simplify diets and food systems along with the simplification and erosion of ecosystems have focused attention on the link between biodiversity, dietary diversity, and human health. From the perspective of human health, food-based approaches to improved nutrition depend on the maintenance of dietary diversity. However, such a strategy is at risk as many of the world’s ecosystems that provide foods with important nutritional value and health properties are increasingly threatened and diminished. The link between biodiversity as the basis of good nutrition and health may provide a strong incentive and clear rationale to maintain diversity in local ecosystems as it underpins healthy diets and food cultures. Some examples are given of how biodiversity can be sustainably used to address global health problems arising from simplified, high-energy modern diets.

Majid Ezzati

Harvard School of Public Health, Cambridge, MA, USA

Evidence-Based Policies for Global Environmental Health Risks

Despite the wide awareness of the important role of the environment as a determinant of the population health, there are substantially fewer systematic analyses of which environmental policies and technologies can provide large and equitable improvements in population health. This presentation will use examples of global, national, and sub-national analyses of environmental risk factors and interventions to demonstrate a systematic approach to developing scientific evidence for priority setting and policy implementation.

Lora Fleming

Miller School of Medicine and Rosenstiel School of Marine and Atmospheric Sciences, Miami, FL, USA

Understanding the Links Between Human Health and the Oceans

As the only board certified occupational and environmental medicine physician and epidemiologist in South Florida, Lora Fleming serves in a unique role at the University of Miami. Her areas of research and teaching are Occupational and Environmental Medicine and Epidemiology. As the Co Director of the National Science Foundation (NSF)-National Institute of Environmental Health Sciences (NIEHS) University of Miami Oceans and Human Health (OHH) Center (www.rsmas.edu).



miami.edu/groups/ohh/) and the Associate Director of the Florida International University (FIU)-University of Miami NIEHS ARCH Program (<http://arch.fiu.edu/>), she works in the areas of marine and freshwater toxins, recreational microbes, environmental human health, and epidemiologic issues. Working with various OHH Center colleagues and others, she has created educational materials concerning the human health effects of marine and freshwater natural toxins, and performed research in Ciguatera Fish Poisoning, Florida Red Tides (Brevetoxins) and cyanobacterial toxins; and is currently involved in a NIEHS-funded study of the human health effects of aerosolized red tide toxins (www.mote.org/niehsreddidestudy/) and in a CDC, FL DOH and OHH Center-funded study of the possible human health effects of microbial pollution in recreational beach waters. With a group of interdisciplinary colleagues, she is exploring the health disparities, morbidity, and mortality of US workers in the National Health Interview Survey, funded by the National Institute of Occupational Safety and Health (NIOSH) (www.rsmas.miami.edu/groups/niehs/niosh/), as well as issues of second-hand-smoke on worker health and the prevention of tobacco-related diseases. As Medical Director of the Florida Cancer Data System (www.fcds.miami.edu/), Florida's incident cancer registry, she works with researchers and students to promote work in cancer epidemiology and prevention, and health disparities in Florida. She teaches physicians and residents, and PhD and Masters of Public Health, medical, law, architecture, and undergraduate students in environmental and occupational health and epidemiology. She also acts as a consultant in occupational and environmental medicine and epidemiology both locally and internationally, and serves on a number of university, state and national taskforces and committees. Dr. Fleming received an MSc from London University, her MD-MPH from Harvard Medical School, and a PhD from Yale School of Medicine.

Howard Frumkin

Centers for Disease Control and Prevention, Atlanta, GA, USA

The Environment and Human Health: The Need to Paddle Upstream

The links between environment and health have been recognized since the beginning of history. The places in which we live, work and play, the water we drink, the air we breathe, and the food we eat, all have impacts on health. In an increasingly complex world, other factors also play a role: the ways we design our communities, the ways we travel, the sources of energy we utilize, the ways we conserve land. This talk provides an overview of the dynamic relationship between health and the environment by focusing on these "upstream" forces, and suggests how the health professions can link with other fields to advance science and health protection.

Tony Goldberg

University of Wisconsin-Madison, Madison, WI, USA

Ecology and Molecular Epidemiology of Human-Primate Disease Transmission in Western Uganda

Infectious diseases transmitted between humans and non-human primates pose a serious threat to human health, animal health, and primate conservation. By adopting a combined molecular and ecological approach, the Kibale EcoHealth Project endeavors to understand how human behavior, primate behavior, and land use patterns alter infectious disease transmission among primates, people, and domestic animals in and near Kibale National Park, Uganda. Molecular epidemiological analyses of bacterial and protozoan pathogens indicate that anthropogenic disturbance to primate habitats and ensuing ecological overlap between people and primates is the primary force driving interspecific transmission of gastrointestinal pathogens in this system. Specifically, genetic similarity between populations of *E. coli* bacteria and the protozoan parasite *Giardia duodenalis* from people and primates are highest in the most disturbed habitats and decline with decreasing intensities of habitat disturbance. Human health and human behavior modify these effects, with factors such as experiencing gastrointestinal symptoms and tending livestock being associated with elevated genetic similarity between human and primate bacterial populations. Human-to-primate transmission is also enhanced by forest fragmentation and close interaction among species, due to such factors as research and tourism, as evidenced by molecular analyses of antibiotic-resistant bacteria in wild primates in such areas. For example, the prevalence of antibiotic resistant bacteria in populations of endangered mountain gorillas in Bwindi-Impenetrable National Park, Uganda, declines among populations with decreasing ecological overlap between humans and apes. Serologic and molecular studies indicate that primates in this region have been exposed to previously uncharacterized poxviruses and retroviruses, raising both conservation and public health concerns. Using molecular tools to identifying specific links between habitat disturbance and human-wildlife pathogen exchange will facilitate targeted interventions that should lead to improved conservation planning and public health.



Donna Green

University of New South Wales, Sydney, Australia

Climate Impacts on Indigenous People's Health and Well-Being

Indigenous people are incredibly resilient. For millennia, indigenous people have lived in a wide range of ecosystems across the world, gradually adapting to a naturally changing climate. In the last couple of hundred years, however, many remote indigenous communities have struggled to keep up with changes to their way of life brought by colonisation, industrialisation and globalisation. The outcome for many of these communities has been devastating. Not only do many of these communities have some of the lowest socio-economic indicators in their respective countries, these changes have affected their physical and psychological health. Unfortunately, unless bold actions are taken to mitigate climate change and prepare culturally appropriate adaptive strategies, it is likely that the direct and indirect impacts of climate change will further negatively impact their culture and ability to live on their land.

Indigenous Australians living in remote communities in the north and central regions of the country are likely to be disproportionately disadvantaged by the adverse impacts of climate change. Their vulnerability is heightened due to at least three factors: existing non-climate stresses, a culture that does not necessarily differentiate between natural and human systems in relation to the concept of "health," and a connection between the need to ensure the well-being of country.

Peter Hudson

Penn State University, University Park, PA, USA

Expecting the Unexpected in Disease Emergence

Can we predict the emergence of novel infectious diseases? Where do they come from? Why do they become virulent? And what leads to their emergence? The simple answer is we simply don't know because these are rare events and the data are lacking. There again greater insight could be obtained if we look at the variation between individuals, and seek to identify the functional groups or individuals responsible for transmission and some of the mechanisms responsible for making an individual highly infectious.

Patrick Kinney

Columbia University, New York, NY, USA

Air Pollution, Climate Change and Human Health: Impacts and Opportunities

Fossil fuel combustion is responsible for the bulk of anthropogenic climate change, as well as for a substantial global burden of disease and premature mortality due to direct health effects of air pollutants like fine particles and ozone. Furthermore, these pollutants play a variety of roles in climate forcing and are in turn influenced by climate via changes in pollutant dispersion, transport, and atmospheric reactions. Because of these complex feedbacks, policies aimed at climate mitigation will affect air quality and visa versa. This talk will examine the current evidence for these interactions, and will illustrate an approach for integrated assessment of climate mitigation and human health.

Pim Martens

Maastricht University, Maastricht, The Netherlands

Globalisation and Human Health: Sustainable Health in a Changing World

From a public health perspective, globalisation appears to be a mixed blessing. On the one hand, accelerated economic growth and technological advances have enhanced health and life expectancy in many populations. At least in the short-to-medium term, material advances allied to social modernisation and various health-care and public health programmes yield gains in overall population health. On the other hand, many aspects of globalisation are jeopardising population health via, amongst others, the erosion of social and environmental conditions, the global division of labour, and the exacerbation of the rich-poor gap between and within countries, and the accelerating spread of consumerism. A major manifestation of the increasing scale of the human enterprise is the advent of global environmental changes. The health of a population, if it is to be maintained in a "sustainable state," requires the continued support of clean air, safe water, adequate food, tolerable temperature, stable climate, protection from solar ultraviolet (UV) radiation, and high levels of biodiversity. The processes of social-economic change, demographic change, and global environmental change in today's world oblige us to broaden our conception of the determinants of population health. We must be increasingly alert to the influences on population health that arise from today's larger-scale social-economic processes and systemic environmental disturbances. We will present a framework to conceptualise the health risk of global (environmental) changes and will present future developments



according to a set of scenarios.

Karen Nelson

The J. Craig Venter Institute, Rockville, MD, USA

Genomic and Metagenomic Approaches to the Study of Pathogen Genomes and their Evolution

In the mid 1990s the real launch of the genomic era began with the availability of the complete genome sequence of *Haemophilus influenzae*. Since that major success, there have been numerous examples of genomes from organisms that represent all the domains of life, including the completion of hundreds of microbial genomes that represent both pathogenic and non-pathogenic species (hundreds of partial genomes are also available). The genomes have given tremendous insight into microbial evolution, lateral gene transfer, and approaches that microbes use to adapt to new niches. This sequencing work also laid the foundation for generating genome sequence information from whole environments without using a first culturing step, a field of research now known as “metagenomics,” and the study of the human microbiome is now a major worldwide initiative. The evolution and adaptations of pathogenic species as we continue to learn from genomic and metagenomic studies will be presented.

Camille Parmesan

University of Texas at Austin, Austin, TX, USA

Human Health Impacts of Climate Change: Insights from the Wild

The World Health Organization has concluded that human-driven climate change has already affected human health. While some consensus has developed about future direct effects of climate change (e.g. impacts of increasing floods, more heat waves, and fewer cold snaps), there is much less consensus on how more complex impacts, such as disease incidence or food quality and availability, may develop. Part of the difficulty in developing projections for disease impacts is that data is skewed towards incidence of disease in human populations, rather than the ecology of diseases and their vectors in the wild. However, 66% of human pathogens also use wild animals as hosts. Poleward range shifts of up to 2000km, and upward range shifts of up to 400m, have been detected in meta-analyses of hundreds of insects, birds, and mammals over the past 30 to 130 years. Many species in each of these groups act as reservoirs or vectors of human diseases. It is likely, then, that climate change has already had a significant effect on the geographical range of many vector species and associated pathogens. Substantial evidence already exists that many vector-borne diseases are sensitive to climate variations. However, differences in disease incidence in climatically similar regions make it clear that models which consider climate alone without incorporating societal aspects of disease growth and transmission are likely to over-estimate disease expansion with climate change. Conversely, the rate of climate change is expected to increase rapidly in coming decades, which might lead to an underestimation of health impacts. Careful consideration should, therefore, be given to maximizing the chances of detecting early effects of climatic changes on disease distributions and dynamics in the wild, as well as on incidences in human populations. More subtle effects of climate change are also possible. Local food resources may be impacted in multiple ways by increased atmospheric carbon dioxide and associated climatic and sea level changes. Both subsistence and commercial fish populations may be reduced by loss of coastal nursery grounds due to rising sea level and by loss of tropical coral reefs. Terrestrial crops may be impacted by more than geographic shifts of growing regions. For example, studies of insect/plant interactions indicate a lowering of nutritional value of plants grown in a high CO₂ environment sufficient to significantly impact insect growth, with obvious implications for human crops.

Oliver Pybus

University of Oxford, Oxford, UK

Phylogenetics: Integrating The Evolutionary And Ecological Dynamics Of Infectious Disease

Many micro-organisms, particularly RNA viruses, evolve so quickly that their evolutionary and epidemiological dynamics occur on a similar timescale and interact in complex ways. Understanding and measuring this relationship is the key goal of the new field of phylogenetics, which combines ideas from phylogenetics, ecology, population genetics, and immunology. Evolutionary and epidemiological processes are typically combined by placing them on a common timescale or spatial frame of reference, an approach that can be applied at hugely different biological scales, from studies of global pandemics to investigations of pathogen evolution within a single organism. I hope to explain and illustrate the range of empirical questions open to phylogenetic analysis, with an inevitable bias toward RNA viral infections of humans.



William Sullivan

University of Illinois at Urbana-Champaign, Urbana, IL, USA

Forging New Connections Among Environmental Health Scholars

There is wide recognition that the environments in which we live, work, and play impact human health both positively and negatively. In spite of this recognition, however, there are few opportunities for scholars from Medicine, Public Health, Environmental Design, and the Environmental Sciences to collaborate while teaching about the environmental health challenges of this new millennium.

A unique partnership is working to address this paucity of interaction among environmental health scholars. Our collaboration involves the National Institute of Medicine's Roundtable on Environmental Health Sciences, Research, and Medicine, the Centers for Disease Control and Prevention, and the Council of Environmental Deans and Directors. Our purpose is to engage scholars from a variety of disciplines, prepare instructional materials (e.g., case studies, exercises, lectures), and develop a learning community of scholars who will interact with each other and share resources. This talk considers our progress to date, and invites your participation as we move forward.

Gary Yohe

Wesleyan University, Middletown, CT, USA; Yale University, New Haven, CT, USA

On Prioritizing Risk-Reducing Strategies in a Dynamic Environment

Risk-based analyses of how humans might respond to dynamic sources of external stresses by reducing exposure (through mitigation) and/or sensitivity (through adaptation) have become increasingly popular. Based on first principles of economic efficiency, these analyses explain why people buy insurance, diversify their portfolios and, perhaps most generally, try as hard as they can to "hedge their bets" in confronting uncertain futures by adopting robust strategies. This presentation will demonstrate how the statistical definition of risk can prioritize alternative responses across sectors, space, and time even with limited information and thereby identify (2) cost effective collections of robust strategies when resources are tight and information is sparse. It will build on a decision-support tool derived by the New York Panel on Climate Change to characterize climate-related vulnerabilities to critical infrastructure. The template was designed to illuminate critical tradeoffs across a wide range of possible responses and across multiple vulnerabilities that all make claims on the same resource base. While climate change was the motivation for its creation, it can also be applied to environmental and health risks derived from any external source of dynamic stress. Of course, as we have learned from the recent financial meltdown, it is important to emphasize reducing risk cannot guarantee that catastrophic consequences will be avoided.