Medical Ecology: the link between public health and the ecological sciences

Project Summary

The term Medical Ecology was first coined by Rene Dubos to describe a new way of viewing the human condition in context with the environment. Slow to take hold in the mainstream of public health, this paradigm has rarely been applied in the last two decades, though the urgency to do so has dramatically increased, mainly due to the dramatic increase in the human population, and the emergence and re-emergence of a wide variety of infectious diseases. The scientific community-at-large now realizes the extensiveness of the relationship between human health and a damaged environment.

Medical Ecology is still considered an emerging hybrid science striving to supply the missing connections between the health and the ecological and earth sciences, enabling a more complete understanding of human health in the context of ecosystem services. Despite widespread acknowledgement among practicing physicians as to the overall impact of the environment on health, much of their efforts are focused on treatment of individuals rather than in the prevention of diseases for which there are major environmental components. Most public health practitioners at the local and state level are similarly drawn to definable small-scale issues, and rarely get the opportunity to become involved with global concerns such as climate change and stratospheric ozone depletion. Ecologists have generally focused their studies on ecosystem functions in light of natural events and ecosystem inhabitants—with the common glaring exception of
concern for the human component of each. A coherent understanding of the method and the degree to which disturbance in ecosystems causes ill health in humans (in cases such as malaria, encephalitis, including the West Nile virus, cholera, etc.), has the potential to significantly transform the ways health agencies, doctors, researchers, and even historians approach these problems.

Given the significant potential benefit of the Medical Ecology paradigm to human health, the Medical Ecology Website will serve as an online center and resource for the documentation and dissemination of work in this growing interdisciplinary field. Medical Ecology will be a widely accessible, clearly organized, and extensive home for research, curriculum models, integrated data sets, discussion, and scholarly information as it develops in the field, and in fields that now contribute to Medical Ecology.

The Medical Ecology Website will be the linchpin connecting the ecological and earth sciences with those of public health. It will serve as the repository for databases relevant to diseases with strong environmental components; it will hold resources pertinent to scholarship in and application of the ideas of Medical Ecology; and it will be relied upon by health professionals and scholars to identify current health problems, research causes and possible solutions, and interact with peers toward the common goals of scholarship and improved human health.
1. Background

a. The Public Health Paradigm

The influence of the environment on the outcome of human health is complex, and at best, poorly understood. Despite the general acceptance of this concept, public health practitioners, for the most part, discharge their duties without due consideration for the ecological impact of anthropogenically-induced alterations in the very environment in which public health is forced to operate.

Global climate change, stratospheric ozone depletion, air and water pollutions, the over use and mis-use of fertilizers, herbicides, and insecticides, numerous arthropod-borne infectious diseases, and contaminated food supplies represent current hazards to the well-being of vast numbers of people living throughout the world.

All of these problems have major environmental components associated with them. Most of those who carefully study these issues would admit that global climate change, alone, raises grave doubts as to whether standard public health practices could be implemented in a world in which the rise of the oceans, if unchecked, would likely overwhelm whole cities and rearrange the coastlines of all land masses, both large and small. Several recent Environmental Protection Agency-sponsored symposia address solutions to this urgent world-wide problem.

It is a given that environmental disturbances which result in alterations of essential ecosystem components at the global level, and often place large numbers of humans at
risk to acquiring infectious and non-infectious diseases. Awareness of such global issues usually begins in the high school or college classroom. Concern for these issues among young people is high. But, ironically, at the graduate school level, it is not the norm in most health sciences curricula throughout the United States to embrace, and then include, ecologically relevant information and their data sets into the base of knowledge required for advanced training in any health-related specialty track. As the result, practicing physicians and public health professionals, alike, are deprived of gaining even an elementary level appreciation for the influences that environmental change can have on the health status of each and every one of us.

The science of environmental health, a required specialty subject at all accredited schools of public health, has attempted to define some external factors that influence the outcome of a given disease process, and incorporate them into their research programs. But as currently configured, this interdisciplinary science has evolved into a set of narrowly focused laboratory-based areas, addressing for the most part, local rather than global issues.

b. The Ecological Paradigm

In contrast to medicine and the public health sectors, ecologists tend to concentrate on large-scale, field-based areas, particularly those dealing with the ways in which the physical aspects of nature (air and sea surface temperatures, climate, and weather) combine to influence behavior of most life forms on earth (population dynamics, factors that determine the geographic distributions of plants and animals, parasitism, energy
flow, trophic relationships, etc.). They have until very recently, largely excluded the human element and their activities from their studies, focusing instead more on gathering basic information related to ecosystem functions than on practical, health-related issues and ecosystem services.

Yet, ecologists for many years have advocated that constant oversight and careful management of the life forms that contribute to the functioning of a given ecosystem are essential to being able to maintain those functions. It is widely accepted that wherever this knowledge has been applied, a better, healthier life style was achieved for humans living within that zone, as well as for the rest of the life forms there.

The scientific community-at-large has only recently come to realize the degree of intimacy and connectedness that humans have with most of the places we inhabit. Conversely, disturbing segments of a given ecosystem that are not perceived as posing a health risk have often turned out to be just that, witness the increase in the transmission of many arthropod-borne diseases (malaria, Lyme disease, West Nile virus, and other encephalitis viruses), cholera, stratospheric ozone depletion, and the indiscriminate discarding of a wide variety of highly toxic wastes, to name but a few of the more high profile problem areas confronting humankind.

One concrete example will serve to illustrate some of these points. The relationship between climate and weather, two related ecological factors, to the transmission of various infectious diseases is an area of great concern and active research among some
teams of researchers. These teams are typically composed of climatologists, geologists, plant and animal ecologists, infectious disease biologists, physicians, biostatisticians, and epidemiologists. As a result of their efforts, we have come to appreciate that knowing what the patterns of rainfall and temperature profiles were for a given region one year allows for accurate predictions for the coming year regarding the population dynamics of those plants and animals living there that could take advantage of those short term pattern changes. This is particularly true for arid and semi-arid ecozones, where heavy rain events are rare, and their impact on wildlife is profound. Some of these kinds of plants and animals play major roles in the transmission of the above-mentioned diseases; relationships that have just recently emerged from those research units into the scientific literature. Outbreaks of plague, hantavirus, Lassa virus, and encephalitis viruses, including the West Nile virus, wherever they occur, fall into this category of diseases that wax and wane at perturbations in local patterns of weather.

Conveying that kind of knowledge efficiently to the public health sector in a standard format will allow local, state, and federal health agencies to better prepare for them once those patterns become understood and incorporated into disease control strategies.

Never before has the urgency for acquiring and implementing this kind of information been so much in demand as it has at this moment in our history, for several reasons. Human populations are increasing in many regions, and therefore encroaching more and more into natural systems. Civil unrest and war help to exaggerate already deteriorating environmental conditions due to the mass movement of people into places that never had
them before. Crowding allows for more efficient transmission of infectious diseases, especially those that are vector-borne, witness the resurgence of African sleeping sickness throughout the sub-Saharan regions of that continent. Climate changes continue to re-arrange the distribution of plants and animals, many of which play a role in disease transmission.

Exceptions to the first two paradigms abound, but the total effort represents but a small number of scientists who have “crossed over” from both the basic and applied sciences. None of the majority of the work force in either group is trained to deal with health problems confronting human populations requiring multi-disciplinary approaches to: 1. describing in biological terms the failure of a given ecosystem service to provide us with that service; 2. perform health risk assessments of having to live within a damaged portion of a given ecosystem, and most importantly; 3. generate practical, cost-effective strategies for remediation of a given ecosystem, thereby improving the health of those living within it.

c. The Medical Ecology Paradigm

**Medical Ecology** is a hybrid science which brings the principles of ecology, earth sciences, and public health together for the purpose of analyzing problems of the environment as they impact on human health. In doing so, it is expected that the information contained therein will serve to encourage professionals engaged in the both applied and basic sciences to enter into more comprehensive collaborative efforts. **Medical Ecology** can be likened to a kind of informational ecotone, (an ecotone is the
border between two or more ecosystems). It is well established that ecotones harbor the greatest varieties of species, compared to the adjacent ecosystems that contribute to them, and ecotones are therefore places which serve to maintain ecological diversity and resiliency. If environmentally-related health problems affecting millions of people in different locales are of such a complex nature that it requires numerous scientific disciplines just to define them, then a new, more inclusive way of dealing with those problems must be forthcoming if we are to continue to succeed as a species.

**Medical Ecology** strives to supply the missing connections between the health and the ecological sciences, allowing both groups to develop a richer language, in which both can take advantage of the relevant parts of the other’s disciplines, resulting in more powerful ideas for solving common problems. Formulating new, more inclusive, iterations for old problems caused by a disturbed environment is the main objective of Medical Ecology. Identifying all of the essential components of a problem, in turn, allows for a more complete solution to it.

I have constructed a course entitled **Medical Ecology**, which I have taught for the last five years at Columbia University. The term *Medical Ecology* was first coined by Rene Dubos during his illustrious days as a researcher at The Rockefeller University. I had the privilege of knowing him during my stay there as a Guest Investigator between 1967-1969. This term has fallen out of use in recent times. I elected to offer a course in **Medical Ecology** out of a need to draw attention to an obvious connection between one’s well-being and the environment in which we all live. Another important learning
objective was to demonstrate that problems related to damaged ecosystems and human health risks could be couched in ecological terms compatible with the practice of public health. The initial course was successful, as deemed both by student evaluations and peer review comments. It continues to be well attended and appreciated by all who enroll.

2. Proposal for continued support for the Medical Ecology Website.

In 1999, I posted the first web pages for medical ecology on the internet. It was a modest beginning that has now grown to a substantial body of knowledge regarding ecological and health-related aspects of the atmosphere, food, water, and infectious diseases. Today, there are over 40 pages of information, with hundreds of useful links to the world’s literature and resources for these critical topics. It has received over 1,500 visits with the last 6 months and is being used as an educational tool in the classroom, judging by the regularity of visits. What is more encouraging is the international distribution of use. Virtually every time zone is represented. Recent additions to the site include The Vertical Farm Project under “Food”, and numerous infectious diseases. Trachoma will be added to the site soon.

3. Budget

A total of $20,000 will be sued to maintain the Medical Ecology website and expand its information base. $10,000 will be needed to hire a web coordinator, while the rest will be
used to support my own work on the site over the next year. A 25% overhead allocation is requested for grant management by Columbia University ($5,000).

Total funding level requested: $25,000

Biographical Sketch

Dickson Donald Despommier

A. Professional Preparation

Fairleigh Dickinson University  Biology  BS  1962
Columbia University  Medical Parasitology  MS  1964
University of Notre Dame  Biology  Ph. D.  1967
Rockefeller University  Guest Investigator  1967-1969

B. Appointments

Professor of Public Health and Microbiology, Columbia University, NYC, 1982-present.
Associate Professor of Public Health and Microbiology, Columbia University, NYC, 1975-1982.

Assistant Professor of Public Health, Columbia University, NYC, 1970-1975.

Assistant Professor, Medical College of Ohio, Toledo, Ohio, 1969-1970.

C. Publications:

Related to Proposal:


Despommier, DD. Medical Ecology Website, 1999-2003 at: www.medicalecology.org


Unrelated to Proposal:

Conference Trichinellosis. Warsaw, Poland. Wiadomosci Parazytologiczne. T.X.V. Nr. 5-6: 612 (abstract).


**BOOKS**


CHARTERS


**INVITED LECTURES**

5. The 5th International Conference on Trichinellosis, Noordwijk aan Zee, The Netherlands, 1980. Co-chairperson, Session in Immunopathology; presented two papers on the antigens of *Trichinella spiralis*.
11. Chair, session on Trichinellosis. Lecture title: Biology of the parenteral phase of *Trichinella spiralis*. Third Latin American Congress of Tropical Medicine and the Ninth National Congress of Parasitology. Mexico City,


22. University of Pennsylvania School of Veterinary Medicine, New Boulton Center Annual Conference on Parasitism. May 3, 1997 “*Trichinella spiralis*: how the worm turns”.


24. Key note speaker, International Health Conference, Einstein Medical College.


27. Keynote speaker: Coastal Ecology and Health held at Marine Biological Station in Wilmington, North Carolina, Sept 7th, 2000. "Medical Ecological Aspects of Estuarine Environments"


**OTHER ACTIVITIES AND LECTURES**


4. 1982 - “New Horizons” - Lecture East Jersey Trout Unlimited

5. 1983 - “New Horizons” - Lecture East Jersey Trout Unlimited


22. Arbor Day Tree Planting, Roscoe Central School, Grade 3. April 25th, 1995. 60 saplings of various hardwood trees planted.
33. “Stream Ecology Lecture” CFFCM, May 8th, 1999
40. Arbor Day 2000. Tree planting, Roscoe, NY
42. West Nile virus. City As School. May 11, 2001
43. West Nile virus. Wingate High School. May 18, 2001

COURSES AND GUEST LECTURES IN COURSES

1. “Parasitic Diseases”. Required course to the second year medical students. Since 1971 to present.


5. “Medical Ecology” section of first year medical school course. Three lectures: Atmosphere, ozone depletion and skin cancer; Food and Disease; Water and Disease; Cases.1996-1998.


10. Topics. Cholera: Then and Now. Fall, 2000