Conservation Medicine

Combining the Best of All Worlds

Getty Images, Matt Ray/EHP

A third-grader can figure out the easy labels: someone who practices biology is a biologist; ecology, an ecologist. But what do you call a practitioner in the fledgling field of conservation medicine? "I don't know," says Peter Daszak, executive director of the Palisades, New York–based Consortium for Conservation Medicine, laughing at yet another small hurdle for his new field. "A conservation medic?"

Creating nomenclature for the field is just one of many challenges facing conservation medicine, which is attempting to pull together human health, animal health, and ecosystem health—three fields that are tough enough on their own in terms of complexity, lack of data, and other factors. Conservation medicine—or ecological medicine, or medical geology, or whatever it may be called by various advocates—is rushing headlong against a decades-long trend of specialization in medicine and the sciences. And many of the essential data needed to rigorously establish the links between environmental factors, sick wildlife, and sick people just don't exist yet.

However, in the past few decades, a growing number of professionals have been noticing the links between illness—in both humans and wildlife—and ecosystem impacts including toxic emissions, land clearing, international travel, and climate changes. One result of these impacts, say conservation medicine advocates, has been the spate of emerging diseases associated with now-familiar names such as Lyme, Ebola, Marburg, *Pfiesteria*, and *Cryptosporidium*.

Emerging diseases such as Rift Valley fever, hantavirus pulmonary syndrome, Nipah virus encephalitis, severe acute respiratory syndrome (SARS), HIV, and West Nile virus infection have become notorious. Also of concern are lesser-known emerging diseases such as fibropapillomatosis, a marine turtle disease associated with heavily polluted coastal areas that many suspect could be an indicator portending human health problems. Other researchers are just as concerned about the pervasive effects of endocrine disruptors, the international airborne spread of dust, bacteria, and viruses, and the environmental consequences of throngs of well-intentioned ecotourists visiting the wild.

All the evidence suggesting strong connections between human health, wildlife health, and ecosystem health has whetted the appetite for hundreds of people to edge into conservation medicine. And with more than 30 emerging diseases in humans making headlines in the past three decades, advocates say even more people are becoming interested in the field, particularly the human health angle. "Everybody understands [human health]," says Mary Pearl, president of the nonprofit conservation organization Wildlife Trust and a primary catalyst behind the consortium, which is housed in Wildlife Trust offices. "You don't want to get sick, or have your family get sick."

What's in a Name?

The general concept of looking at the links between sickness in the environment, wildlife, and people is centuries old. As recently as the 19th century, health care practitioners were expected to have training in both the medical and natural sciences. But as 20th century science unveiled an increasingly complex world and specialization became the norm, those connections have become murky. "Some physicians look at you with a blank stare when you mention mercury and other environmental issues," says Ted Schettler, a physician and science director for the Science and Environmental Health Network (SEHN), an Ames, Iowa–based advocacy organization.

Fibropapillomatosis, a marine turtle disease associated with heavily polluted coastal areas, could be an indicator portending human health problems.

But individual disease, pollution, and environmental disruption scenarios have begun to merge in the minds of a few people. To begin to capture the concepts behind the potential linkages, the term "conservation medicine" was first floated in a 1996 article, "Wildlife, People, and Development," in the journal *Tropical Animal Health and Production.* Picking up on that and other threads, Pearl, along with Tufts University's David Sherman (then an associate professor of environmental and population health) and Mark Pokras (director of the Center for Conservation Medicine at the Tufts School of Veterinary Medicine), pushed for an organization that would cover the fields of both animal and ecosystem health. The human health element was added later, says Pokras.

The end result was the Consortium for Conservation Medicine. Consortium partners include Wildlife Trust, the Tufts Center for Conservation Medicine, the U.S. Geological Survey (USGS) National Wildlife Health Center, the Harvard Medical School Center for Health and the Global Environment, and the Bloomberg School of Public Health of The Johns Hopkins University. The nonprofit consortium advocates for and conducts research, develops interdisciplinary education and training programs, informs policy makers, and is trying to formulate pragmatic solutions to conservation medicine–related problems identified to date. Individuals can join, and about 25 have done so.

After much pondering over what to call this new field, the consortium adopted the term "conservation medicine." But it isn't married to the term, says Alonso Aguirre, director for conservation medicine at Wildlife Trust and senior editor of the first book covering the issue, *Conservation Medicine: Ecological Health in Practice,* published in October 2002.

Schettler isn't sold on the term "conservation medicine." "The word 'conservation' carries a lot of historical baggage," he says. Over the past century, the term has been widely used in arenas such as wildlife management, drinking water protection, and environmental advocacy. Schettler prefers SEHN's adopted term "ecological medicine," but concedes that "we probably are talking about mostly the same thing."

A third term being used is "medical geology." One of medical geology's primary advocates, USGS research chemist Robert Finkelman, says the field covers human and wildlife health issues linked with either geological processes or the tools that geoscientists use, such as satellites and subsurface monitors. However, Finkelman acknowledges that some of the several hundred people who are becoming medical geology adherents don't like adding the twist about the tools of the trade, charging that this addition may dilute the field. Some proponents would prefer to deal only with natural geological processes, not human-induced linkages. But a 2003 book about the field, *Geology and Health: Closing the Gap*, edited

Clockwise from right: U. Keuper-Bennett/P. Bennett, turtles.org; Digital Vision; Digital Stock

by geologists H. Catherine W. Skinner and Antony R. Berger, covers all these angles.

A loosely organized Madison, Wisconsin, group has solved the problem for the moment by calling itself the Conservation Health Consortium. This group performs some functions similar to those of the Consortium for Conservation Medicine, such as education and research, but is local and regional in focus. One of its members, veterinary medical officer Joshua Dein of the USGS National Wildlife Health Center, says the term "health" seemed to cover a broader spectrum than "medicine," which in a strict sense is associated solely with physician-related activities.

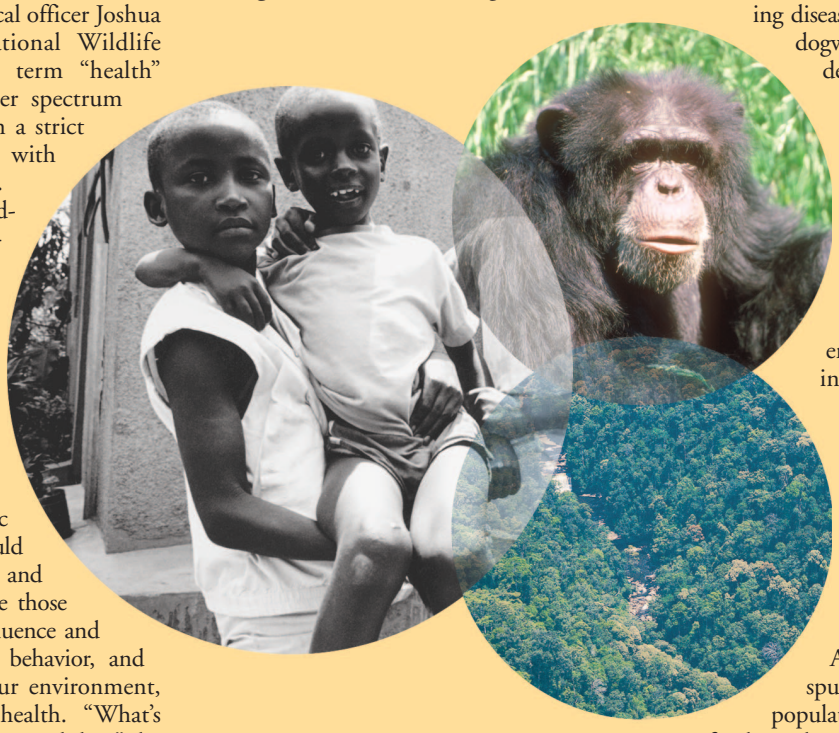
Including an even broader spectrum than the tripartite environmental health (with its largely human focus), wildlife health, and ecosystem health might help create better terminology, says Andrew Brown, associate dean for planning and development at the University of Texas School of Public Health in Houston. He would add sociology, economics, and politics to the mix, because those disciplines prominently influence and are influenced by human behavior, and human behavior shapes our environment, which then shapes our health. "What's needed is a science of sustainability," he says. "'Sustainability' is just another word for health."

"Whatever term is used, please just try to work together," Aguirre urges. And there should be plenty of work to go around. "Once you grab hold of the concept, there are almost too many things to do," Dein says.

Suspicious Scenarios

One of the first hurdles in the field is to define what is meant by health in people, in wildlife, and in ecosystems. In people, one broad definition adopted by the World Health Organization is "a state of complete physical, mental, and social well-being and not merely the absence of disease and infirmity," notes *Conservation Medicine*. That's a tall order, but given current knowledge, at least there are some ways to measure health in those terms in people. For wildlife, vast portions of the data for determining what a healthy porpoise, snail, or eagle should look like are missing. And the problem becomes even more complex when looking at all the possible perturbations of a constantly fluctuating ecosystem.

But some health impacts are obvious, at least in people and wildlife. Two of those impacts are death and acute harm caused by infectious diseases. People are vulnerable to at least 1,415 species of infectious organisms, concluded Louise Taylor and others from the U.K. Centre for Tropical Veterinary Medicine in the 29 July 2001 issue of *Philosophical Transactions: Biological Sciences.* Those organisms, more than 60% of which can be transmitted between people and other animals, are responsible for about one-quarter of the world's deaths. About 175 of the species are linked with emerging diseases that are appearing in people for the first time or are increasing substantially in incidence or geographic occurrence. Included under the "emerging" label, along with others already mentioned, are infection with avian influenza A strains H5N1 and H9N2, Hendra virus disease, East and West African trypanosomiasis (sleeping sickness), *Escherichia coli* O157:H7 infection, and monkeypox.



Clockwise from left: Betty Press/Panos Pictures; Corel; Digital Vision

Increased consumption of bushmeat in Africa, spurred by pressures such as population growth and diminished food supply, contributed to the spread of HIV from chimpanzees to humans.

According to *Conservation Medicine*, there are at least 63 emerging diseases among marine creatures, such as campylobacteriosis in New Zealand sea lions, tuberculosis in fur seals, chlamydiosis in sea turtles and some marine mammals, and herpes in northern fur seals and other animals. In terrestrial wildlife, dozens of diseases have come to the fore in the past few decades, including canine distemper, a virally caused kangaroo blindness, ranavirus infection in amphibians, and mycoplasmal conjunctivitis in some birds. Plants have suffered their own emerging diseases, such as chestnut blight, dogwood anthracnose, and sudden oak death syndrome.

Conservation medicine advocates and some other scientists, politicians, and activists blame a range of factors for the worldwide disease increases. Chief among them are human population growth and its sequelae: continued encroachment of humans into relatively undeveloped land, biodiversity loss, and poverty. Also contributing are behavioral changes large and small, such as substantial alterations internationally in the food and livestock industries and increased consumption of bushmeat in Africa (this practice, again spurred by pressures such as population growth and diminished food supply, contributes to disease largely through blood contact during butchering). More than 2 million people cross international borders every day, along with untold quantities of agricultural products, live animals, plants, topsoil, ballast water—and pathogens. For a variety of reasons, including flat or diminishing funding, there has also been a significant drop-off in government public health capacity. Other factors include climate change and microbial adaptation (pathogens jumping from wildlife to humans, as in the case of monkeypox).

With emerging diseases such as SARS, major sociological, economic, and political fallout can occur on a much broader scale. It's still too early to evaluate the full impact of the SARS outbreak, but the costs of other emerging diseases have already been examined. The Maryland Sea Grant program estimated that the combined losses to tourism, seafood, and other industries from a summer 1997 *Pfiesteria piscicida* outbreak cost that state nearly $50 million. Economies can shrink by billions of dollars when trade and travel to affected areas slow to a crawl, and local governments have to contend with panic, even

riots, as residents try to cope with an unknown new villain.

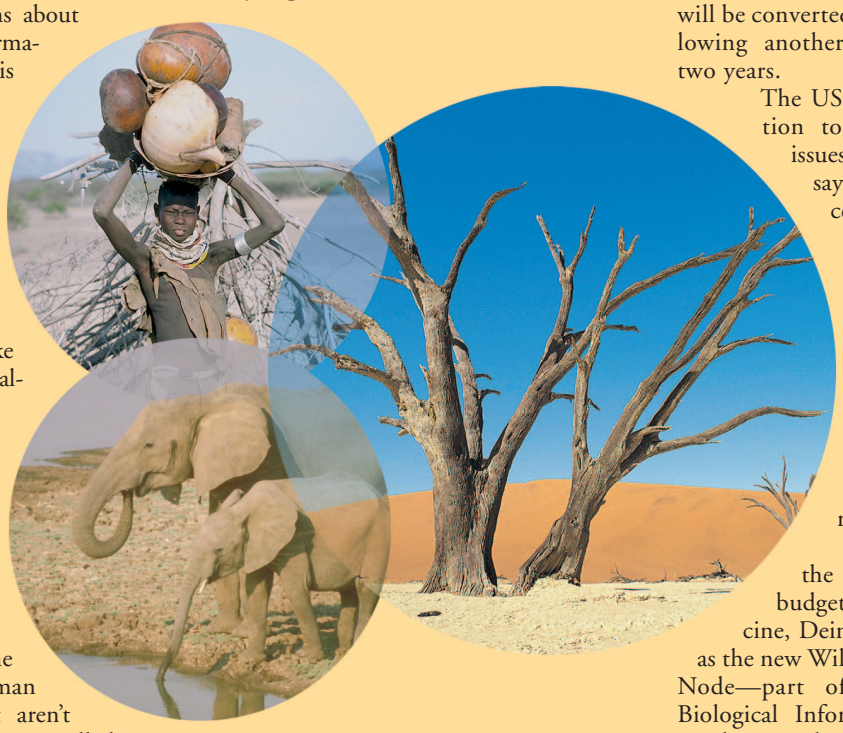
Ultimately, says Schettler, the field will need to be practiced and not just described. "We could spend many decades deciding to study certain phenomena in a cross-disciplinary way," he says, "but from the standpoint of health or medicine, there will need to be debate and decisions about what to do with the information. My fear is that this entire area will fail to recognize that ecological analyses are and will always be characterized by fundamental uncertainties because of the complexity of the systems being studied, and that the practice of ecological medicine will never take hold because people will always want more research."

Grabbing the Bull by the Horns

Many individual problems relevant to conservation medicine have been identified. But finding appropriate solutions will be difficult. One basic pitfall is that human senses and memory just aren't designed to readily detect or recall the subtle climate, land use, behavioral, and political changes that evolve over a few decades, says Brown. Problems become apparent with a crisis, but then it is often too late to prevent much of the damage, and affected governments may try to downplay or conceal problems, fearing economic or political repercussions. Until a crisis does occur, politicians usually don't allocate much money toward a problem. "We [humans] are a reactive society, but it costs a lot more than being proactive," says Daszak.

But with conservation medicine–related crises becoming more common and directly affecting tens of millions of people worldwide, the major economic and health consequences are grabbing the attention of governments and the general public. Funding for conservation medicine projects is still tiny, but is beginning to increase. There have been substantial responses to recent funding competitions run by the NIH and the National Science Foundation (NSF) for studies on topics including the ecology of emerging infectious diseases—one major focus of conservation medicine. "We got an enormous number of applications," says Joshua Rosenthal, deputy director of the Division of International Training and Research at the John E. Fogarty International Center, a branch of the NIH. "We tapped a nerve out there."

The funding for these competitions has jumped from about $4 million in the beginning to about $13 million each for fiscal years 2003 and 2004, says Samuel Scheiner, program director for the NSF Division of Environmental Biology. The competitions are designed to investigate problems that Scheiner says "had fallen between the cracks" of previous NIH and NSF efforts—current winners are investigating issues such as bat-transmitted diseases in Malaysia and canine distemper in dogs, lions, and other mammals in East Africa's Serengeti region. The projects have drawn about 55–75 competitors each year for 10–12 awards, although diminished NIH funding for new projects means only about 7–8 awards will be available in the future. The competition is scheduled to run for at least three more years.



Desertification caused by overgrazing and deforestation creates a loss of habitat for animals and exacerbates shortages of fuel, shelter, and water for people.

Awards for another competition that adds economic development issues to the human–wildlife–environment mix are expected to be announced in the fall of 2003, Rosenthal says. Planning grants of a little under $1 million, funded largely by the NIH with some potential contributions from the NSF and the USGS, will be converted into research grants following another competition in about two years.

The USGS has paid more attention to conservation medicine issues in the past few years, says Dein, although the concept is still not well-recognized. General interest was heightened by the onset and rapid spread in the United States of West Nile virus, which has been documented in about 85% of the states and now infects people as well as about 230 bird, mammal, and reptile species.

There is no line item in the USGS fiscal year 2004 budget for conservation medicine, Dein says, but programs such as the new Wildlife Disease Information Node—part of the USGS National Biological Information Infrastructure—can be considered to fall under the conservation medicine umbrella. The information node is an online national tracking system for problems such as harmful algal blooms and chronic wasting disease (an animal disease suspected of being able to cross to humans), for most of which there have been few national data.

In another effort, the USGS is beginning to look at wildlife disease sentinels, a topic also being pursued by Aguirre. He is investigating species such as manatees, dolphins, oysters, and clams to see if factors that affect their health can accurately be extrapolated to predict human health impacts.

Private veterinary hospitals also can play a role in building the database by collecting and reporting data on animal diseases, says Jonathan Sleeman, director of veterinary services at the Wildlife Center of Virginia in Waynesboro. However, in order to make the data credible, he acknowledges that the data gatherers will need to adopt standardized practices.

At the university level, interested professionals have developed curricula at institutions such as Harvard, Johns Hopkins, the Tufts School of Veterinary

Clockwise from right: Digital Vision; Corel; World Bank

Medicine, the London School of Hygiene and Tropical Medicine, and Canada's University of Western Ontario. Harvard has even exported the contents of one class, Global Environmental Change and Human Health, to 44 other medical schools, colleges, and universities, and made it available free on its website, says Eric Chivian, director of the Harvard Medical School Center for Health and the Global Environment. Jonathan Patz, director of the Program on Health Effects of Global Environmental Change at Johns Hopkins, says that school, in partnership with the Consortium for Conservation Medicine, also hopes to begin a special Ph.D. training track in global environmental health this fall.

In addition, numerous conferences held around the world in 2003 by various groups have incorporated conservation medicine–related sessions. At least four have been geared at a wide range of attendees: Natural Science and Human Health: Prescription for a Better Environment (held April 1–3), the International Forum on Ecosystem Approaches to Human Health (held May 18–23), the Chapman Conference on Ecosystem Interactions with Land Use Change (held June 14–18), and the 5th Open Meeting of the Human Dimensions of Global Environmental Change Research Community (scheduled for October 16–18). And to reach out to younger generations about conservation medicine, Patz has led an effort to create a Johns Hopkins website directed at middle school children, with sections on climate change, biodiversity, food and water scarcity, and other topics coming online throughout 2003.

People outside the traditional educational channels are also being exposed to the idea of conservation medicine. Chivian's team at Harvard annually holds symposia for U.S. congressional staff from across the political spectrum on various conservation medicine issues, reaching about 120–140 people over the past five years.

The Next Wave

Despite the tentative nature of the field, many related efforts are under way. Public health networks are slowly beginning to rebuild following the terrorist attacks in the United States in 2001. Improvements in those networks—enhanced communication, better recognition of the need for interdisciplinary work, and increased willingness to share data—were instrumental in the rapid identification of the coronavirus responsible for SARS. U.S. agencies such as the Centers for Disease Control and Prevention and the USGS continue to expand their disease and pollution monitoring programs, and the National Aeronautics and Space Administration is using its satellite equipment to greatly expand knowledge of worldwide pollution circulation patterns [see "MODIS Operandi for Mapping Haze," *EHP* 111:A458 (2003)].

The United Nations, the World Bank, the World Resources Institute, and other organizations anticipate that their study, the Millennium Ecosystem Assessment, should add much more knowledge to the field. This study is being conducted by more than 500 natural and social scientists from 70 countries, with results scheduled to be released over two years beginning in September 2003. The assessment will provide what the World Resources Institute called in a 5 June 2003 press release "the most extensive study ever of the linkages between the world's ecosystems and human well-being."

A predecessor to the Millennium Ecosystem Assessment known as the Pilot Analysis of Global Ecosystems was completed in late 2000. But it received little attention, in part because the pilot analysis was developed by a relatively narrow range of participants and did not have wide recognition in the scientific community [see "Where Do We Stand? Global Ecosystem Assessments Ask the Big Question," *EHP* 109:A588–A592 (2001)]. Organizers of the Millennium Ecosystem Assessment have tried to eliminate this problem by involving hundreds of scientists, though there is still a risk that the final reports will gather dust on shelves, especially if the problems appear overwhelming, costs and benefits are unclear or perceived as inaccurately assessed, or remedies require extensive social changes.

Small studies whose researchers may not put themselves under the conservation medicine umbrella are also developing applicable findings. In a study of Israel's heavily polluted Kishon River, researchers reported in the April 2003 issue of *EHP* that wildlife declines that began in the 1950s, following development of many nearby industries, were a key predictor of subsequent high cancer rates in naval divers who used the waterway extensively in ensuing decades.

As interest in wildlife monitoring grows, new noninvasive techniques are under development to make the job easier and more accurate. In the case of gorillas, Michele Goldsmith, an assistant professor with the Tufts Center for Conservation Medicine who has been studying mountain gorillas in Uganda for several years, says such techniques can include fecal analysis to evaluate both diet- and stress-related hormones. Other effective strategies include hair analysis and hiring locals to discreetly track the animals, she says.

To help expand conservation medicine efforts across the world, Wildlife Trust and the Consortium for Conservation Medicine have plans for cooperative ventures in Australia, Mexico, Brazil, Chile, Venezuela, India, and Indonesia. Finkelman says a group of his colleagues, now operating as the Special Initiative on Medical Geology, have plans to set up medical geology centers in China, South Africa, South America, Eastern Europe, India, and the Middle East during the next 10–15 years. These centers will conduct research and monitoring to gather data more on a par with what is available in the United States, with one aim being to build a linked system that could provide early warning of impending problems. The group also hopes to set up a professional society at some point, and will expand its educational efforts with the publication of a second book, *Medical Geology,* at the end of 2003.

The Consortium for Conservation Medicine, the International Society for Ecosystem Health, and five other groups are supporting the launch of a new journal, *Ecology & Health,* scheduled to start up in early 2004, and Daszak says that thoughts of accreditation and a professional society are bubbling about. The consortium's annual funding of about $1 million has been on the rise since its founding, and is transitioning from its private base to more government support, which now accounts for about 30% of the total.

Pokras points to the need not just for focusing on scientific issues critical to conservation medicine but also for training what he calls a new kind of student—"people who can bridge disciplines and create those fertile links that we really need for tomorrow's creative problem solving." Whether they end up being called conservation medics, medical geologists, or some other term remains to be seen. But, says Patz, "We all know what we're referring to. There's definitely a movement afoot."

Bob Weinhold