



Human Health as a Judicious Conservation Opportunity

In Southeast Asia, smoke from fires used to clear lowland forest drifts downwind to Singapore and other population centers, measurably increasing cardiopulmonary disease (Johnston et al. 2012). Around the world, dams, irrigation projects, and deforestation are associated with significant human exposures to vector-borne diseases such as malaria, dengue, filariasis, onchocerciasis, and Japanese encephalitis (Jobin 1999).

These examples highlight a growing appreciation of the links between ecosystem alteration and human health. Until fairly recently, the health community viewed the natural world mostly as a source of disease and disability. This view has changed as the world has begun to recognize the importance of natural systems in the provision of a range of services needed to support human health. Such a position was lent significant weight by the Millennium Ecosystem Assessment (MEA) that mapped out the nature and extent of human reliance on ecosystem services and the ways in which altering natural ecosystems could negatively impact humans.

Human health is a global priority and a major source of spending—at a scale that dwarfs conservation spending. For example, in 2006 spending on global health efforts was \$45 billion (Garrett 2009), whereas annual global spending on conservation at that time was estimated at \$3 billion (Waldron et al. 2013). This level of global investment and the idea that natural systems supply ecosystem services has led some in the conservation community to claim in brochures or on Web sites that biodiversity is a foundation for human health.

Despite attempts to link conservation and health, human health and its relationship to natural ecosystems has unfortunately not been the subject of much scientific attention by the conservation community (but see Myers & Patz 2009; Sala et al. 2009; McMichael 2012). As the pendulum swings toward an increasingly human-modified Earth, conservationists are struggling to base their arguments for biodiversity conservation on the significance of relatively intact ecosystems. Facing tenuous support for saving biodiversity, conservation professionals must find new partners who can help make the case for conservation. Such new partnerships should be forged with the human health community, but they need to be based not on convenience or conviction but on sound science and

compelling evidence. The cornerstone research question for building this partnership is the relationship between human health and ecosystem intactness. In other words, when, where, and how do the interests of the conservation community and the public health community coincide? Science can help us figure that out.

For example, despite the realization that intact ecosystems provide vital goods and services to humans, there are many cases where substantial alterations to ecosystems have resulted in dramatically improved human health. In many cases, the motivation to significantly alter ecosystems for dams, agriculture, and built infrastructure has been to provide cornerstones of health such as clean energy, food security, and better housing. Clearly destruction of ecosystems can be good for human health. We do drain swamps to eliminate malaria.

Despite the relative lack of mainstream conservation attention, the relationship between ecosystems and health (human and animal) has drawn considerable attention from the veterinary and public health communities, with new interdisciplinary groups (e.g., One Health, EcoHealth) holding conferences, establishing new journals and initiatives, developing government programs, and creating new funding streams. Important publications have laid out general frameworks on health-ecosystem and environment linkages (e.g., Chivian & Bernstein 2008). The conservation community has been largely left out of these advances. Even our current fascination with ecosystem services has largely omitted careful examination of human health.

A recent review paper (Myers et al. 2013) made the case for a new field that focuses on the impacts on human health of anthropogenic alterations to the structure and function of Earth's natural systems. This field would build on, but be different from, the dose-response epidemiological model that makes up the current environmental health focus on threats such as indoor air pollution and exposure to asbestos or lead paint. It would study what happens as humans replace natural ecosystems that have provided mixes of ecosystem services, including food, safe drinking water, fuel, fiber, and protection from infectious disease, with agricultural lands engineered to maximize food production or engineered infrastructure to manage water supplies. Myers et al. (2013) argue that

an “ecological transition” has increased health benefits for those people able to take advantage of expanding markets and infrastructure, but leaves disadvantaged populations increasingly vulnerable because they are unable to access engineered substitute services and ecosystem degradation simultaneously deprives them of natural services. What is needed now is a body of evidence that addresses the health implications of changes in the state of natural systems that distinguishes the vulnerabilities of different categories of society. Understanding such relationships could help direct the substantial global effort to improve the health of poor populations while simultaneously catalyzing the management of natural systems for goods and services, and for conservation.

We have no robust cross-ecosystem and cross-disease understanding of what or how changes in the global burden of disease are caused by alterations in the structure and function of natural systems. Some changes can be brought about by a loss of provisioning services. For example, iron-deficiency anemia arises in children in Madagascar where wild sources of meat are not accessible due to over-hunting; models based on field data indicate that loss of access to meat from wild animals would induce a 29% increase in the number of children with anemia and a tripling of anemia cases among the poorest children (Golden et al. 2011).

Good practice, in both public health and natural capital policy and management, requires a much fuller characterization of how changes in natural systems can impact a variety of critically important dimensions of human health. Such information will have the potential to change the practices of the public health community, perhaps augmenting interest in upstream rather than downstream interventions and thus increasing the likelihood that public health agencies will incorporate data on the health impacts of changes in natural ecosystems. The expanding application of health impact assessments (HIAs) reflects the need for more comprehensive thinking on environmental impacts and supporting legal frameworks (cf. Collins & Koplán 2009).

The intersection of conservation and public health will produce a rich vein of important and policy-relevant research. Research to date has mostly yielded only correlations between changes in natural systems and human health outcomes. The conservation and public health communities now need to proactively and jointly investigate questions such as whether, how, and under what circumstances intact ecosystems deliver health benefits; which people receive health benefits from intact ecosystems and how these benefits can be quantified as well as maintained; what are the trade-offs between certain health benefits and ecosystem alteration; under what conditions might conservation be a cost-effective health intervention; what role does technological replacement play; what are the production functions that describe these relationships; how do these vary between

ecosystems; what role do ecosystems play in providing health benefits in urban settings; and can health benefits be restored by restoring ecosystems.

This is an exciting new area of study that extends a long history of environment-health work to include the health impacts of changing ecosystem structure and function. It would be an excellent early focus for the Intergovernmental Platform on Biodiversity & Ecosystem Services (IPBES). It could also be a theme at the World Parks Congress in 2014 as well as an expanding focus for The Economics of Ecosystems and Biodiversity (TEEB) initiative, centered largely on the monetary benefits of conservation. This would be an interdisciplinary area with enormous potential applicability for public health and conservation. By incorporating social and intergenerational equity, resilience, and cost implications, we will be able to provide information of use to policy makers—particularly those in ministries of finance, health, and environment. For the health community, we may be able to demonstrate how “upstream” conservation to maintain ecosystem goods and services and biodiversity fits within and even significantly augments existing health promotion approaches.

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