

## TOWARD A MODERNIZED DEFINITION OF WILDLIFE HEALTH

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**ABSTRACT:** There has been, to date, little discussion about the defining features and measures of wildlife health in the literature or legislation. Much wildlife health work focuses on the detection and response to infectious or parasitic diseases; this perspective has been reinforced by the focus of the One Health initiative on wildlife as sources of emerging infections. The definition of health as “the absence of disease” lags 70 yr behind modern concepts of human health and emerging concepts of wildlife health in terms of vulnerability, resilience, and sustainability. Policies, programs, and research that focus on the integration of wildlife health with natural resource conservation, ecosystem restoration, and public health need a working definition of health that recognizes the major threats to fish and wildlife are the result of many other drivers besides pathogens and parasites, including habitat loss, globalization of trade, land-use pressure, and climate change. A modern definition of wildlife health should emphasize that 1) health is the result of interacting biologic, social, and environmental determinants that interact to affect capacity to cope with change; 2) health cannot be measured solely by what is absent but rather by characteristics of the animals and their ecosystem that affect their vulnerability and resilience; and 3) wildlife health is not a biologic state but rather a dynamic social construct based on human expectations and knowledge.

*Key words:* Animal, definition, health, resilience, vulnerability, wildlife.

Entering the term “wildlife health” into an Internet search engine produces many Web sites that are predominated by discussion of death, diseases, pathogens, and pollutants. The definition of health in humans as “the absence of disease” was updated in the 1940s and replaced with “complete physical, mental and social well-being and not merely the absence of disease or infirmity” (World Health Organization 1948). By the 1990s, that definition evolved to reflect health as the capacity to adapt to, respond to, or control life’s challenges and changes (Frankish et al. 1996). Despite these developments in the concept of health in humans, most wildlife health regulations and research remains focused on disease. The One Health movement has exacerbated this focus by identifying wildlife as a major source of emerging infections of public health concern, thus fostering intense research in wildlife

pathogen detection (Sutherland et al. 2008). If the goal of wildlife health programs is to protect and sustain healthy wildlife, then a clear and explicit definition of what constitutes wildlife health is required. Significant work has gone into developing standards that provide an understanding of what is needed, what is possible, and where resources should be targeted to protect and promote human health beyond disease control. There has been, to date, little discussion of what defines animal health, including wildlife, in the literature or legislation (Nordenfelt 2011). In this paper, I discuss how a disease-centered approach to wildlife health is inadequate for the task of directing research and action that will improve wildlife’s capacity to cope with, adapt to, or recover from the principal health challenges imposed by the unprecedented environmental changes that characterize the 21st century.

The lack of a shared definition of wildlife health is more than an academic concern. For example, the Cohen Commission, which investigated the disappearance of Fraser River sockeye salmon recognized that it was the responsibility of Fisheries and Oceans Canada to conserve the health of wild fish stocks, yet noted that the lack of a fish health standard prevented scientists and regulators from properly assessing risks to wild salmon and taking informed preventive actions (Cohen 2012). A second example is the One Health movement that aims to forge a coherent perspective of health across species and scientific disciplines. Because the way we may assess and measure health is ill defined or inconsistent across animal species and goals for animal health and welfare may conflict with the way society uses animals (Gunnarsson 2006), health has different philosophic and applied meanings in domestic animals, wildlife, and people, leading to a lack of a shared conception of health.

A definition of wildlife health as the absence of disease can be criticized on five fronts. First, as some level of disease or infection is normal and parasites and pathogens are ubiquitous in wildlife populations, freedom from disease is not a plausible standard. Relying on the absence of a list of specific diseases for the definition of health begs the question of what should be on the list (Lerner 2008). A single list would not be biologically reasonable as the tolerable degree of disease depends on the capacity for individual and populations to cope with the disease, which, in turn, is affected by species, life stage, environmental quality, and other factors. Second, absence of disease does not define the threshold of dysfunction, disruption, or infection when an animal changes from being healthy to diseased along the clinical course from exposure to death or recovery. This issue is relevant to debates about pathogen traffic between wildlife, humans, and domestic animals. Third, the absence of disease standard does not recognize that a

population can be deemed healthy (often based on measures of abundance, productivity, and profitability) but still have individual members that harbor disease-causing agents or are diseased. Fourth, a focus on pathogens and pathology results in a situation wherein wildlife health programs are defined by what is dysfunctional and unacceptable rather than on positive attributes of the animals. This, then, requires us to describe why they died or became ill rather than how to keep them healthy, productive, and sustainable. It is a backward-looking strategy that makes programs reactive to problems rather than proactively protecting and promoting health. The fifth criticism of the absence of disease as a standard of health is that it is inconsistent with modern ideas of health as a coping capacity arising from socioecologic interactions and neglects the harms that most significantly threaten fish and wildlife populations (Stephen 2013).

There is a growing consensus that major threats to populations of fish and wildlife will come from activities and agents other than pathogens and parasites, such as habitat changes due to natural resource use, globalization of trade, and land-use pressures. Unprecedented environmental changes that are accompanying exponential human population growth are creating pressures that seriously impact wildlife health, viability, and persistence (Acevedo-Whitehouse and Duffus 2009). Recent work underscores the threat to wildlife from diminishing environmental health (Sutherland et al. 2008; Acevedo-Whitehouse and Duffus 2009). However, I believe that science and policy have been held back from advancing in this area because of a paradigm that equates understanding health with inventorying hazards and describing their mechanisms of harm. A health-focused definition would fully incorporate the environmental dependencies and social determinants having the greatest impact on wildlife vulnerability and resilience.

The human population health approach may be a useful starting point to conceptualize how we incorporate vulnerability and resilience into wildlife health. This approach focuses on the interrelated conditions and factors that influence population health over time and applies the resulting knowledge to actions to improve health (Public Health Agency of Canada 2012). The population health approach views health as the product of interactions between social factors, the physical environment, and individual attributes and behaviors. These factors are referred to as determinants of health. Determinants of health include those affiliated with animal biology and ecology and those associated with human actions influencing animals. Determinants can influence access to the requirements for daily living (e.g., food and water, habitat, and shelter). They can influence the ability of wildlife to cope with stress or change (e.g., physiologic functions and behaviors, redundancy in numbers or functions in the population, nature of living conditions imposed on the animals, etc.) or the capacity of human interventions to influence wildlife. Using a population health paradigm, healthy wildlife populations should be able to satisfy their needs for daily living, cope with environmental and social changes, and achieve the goals society holds for wildlife health.

There is growing recognition that a more integrated, determinants of health approach will be required to make further gains in managing wildlife diseases, especially those at the wildlife, human, and domestic animal interface. For example, Nishi et al. (2006) concluded that understanding the ecologic, socioeconomic, and political factors that affect the wildlife-human-agriculture interface was equally important to having technically sound information when developing bison tuberculosis management plans. The historic focus on pathogens and pathology in wildlife health has deepened the historic separation of those with a focus on animal

disease from those who deal with their determinants of health found in ecology, management, and sustainability. This separation results in a system wherein a definition of wildlife health as the capacity to deal with life's demands, changes, and challenges has failed to evolve. An adaptive, comanagement approach is needed to better link those with the authority to manage animal health with those having the knowledge and tools to manage population vulnerability and resilience.

Wildlife health has begun to be reconceptualized in terms of resilience and sustainability of populations (Deem et al. 2008; Hanisch et al. 2012). Policies and programs with goals to better integrate wildlife health with natural resource conservation, ecosystem restoration, and public health need a definition to match that intention. It is right to have standards to prevent the spread and impacts of pathogens, but this should not be confused with the objective of promoting wildlife health. Modern concepts of health emphasize the idea that healthy individuals or populations need to have a minimal set of resources, functions, and capabilities that operate within an environment that enables them to cope with changes and challenges to meet expected end points (Nordenfelt 2011).

Because it is unrealistic to think that we can judge the health of all wildlife in varying social and ecologic settings based on a single definition of health, it is to be expected that details of health goals will need to be tailored to different situations. However, I propose that a modern definition of wildlife health should emphasize three features: 1) health is the result of interacting biologic, social, and environmental determinants that promote and maintain health as a capacity to cope with change over time; 2) health cannot be measured solely by what is absent (i.e., lack of disease or hazards) but rather by characteristics of the animals and their ecosystem that affect their vulnerability and resilience to a suite of interacting social and environmental harms; and

3) wildlife health is not a biologic state but rather a dynamic human social construct based on social expectations and scientific knowledge. Including measurements and management of hazards, along with measures and management of the determinants of population vulnerability and resilience in a wildlife health program, accommodates an approach that works proactively to maintain health, rather than just responding to adverse outcomes, such as death or disease.

It is not my intent to argue that there are no programs directed at protecting wildlife health. Indeed, many fish and wildlife agencies devote significant resources to protecting fundamental determinants of wildlife health, even though these efforts are not typically implemented as “health programs.” Rather, my objective is to inspire discussion about the lack of wildlife health literature or legislation concerning health promotion in the absence of pathogens, parasites, or toxins. With the looming challenges of biodiversity loss, climate change, depletion of ecologic services, conflicting land and water users, and exponentially growing human population, setting standards for animal health based on the presence or absence of disease alone seems ill advised.

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