



Original Article

Promoting Wildlife Health or Fighting Wildlife Disease: Insights From History, Philosophy, and Science

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ABSTRACT Although healthy wildlife populations are often a goal of wildlife management, ambiguity over the meaning of the term health may limit its effectiveness in guiding management objectives. Health is a complex concept with empirical and normative qualities; if it is to convey more than simply metaphorical value in wildlife conservation, clearer articulation of the meaning of wildlife health is needed. We provide a brief overview of the evolution of wildlife disease and health management; we discuss important philosophical themes relevant to developing a clarified understanding of wildlife health; and we share perspectives on wildlife health and disease from a Delphi exercise involving North American wildlife health professionals. The Delphi group conceptualized wildlife health as a multidisciplinary concept marked predominantly by population sustainability and resilience. Disease was considered to be a specific abnormal condition that is a part of the broader concept of health. We suggest improved integration of the descriptive and normative elements of wildlife health and greater inclusion of societal values in developing wildlife health objectives as a means to broaden the scope and effectiveness of wildlife health management. © 2012 The Wildlife Society.

KEY WORDS Delphi, human dimensions, normative, philosophy, wildlife disease, wildlife health, wildlife management.

The concept of wildlife health is increasingly considered a cornerstone of wildlife management and, with greater attention being given to the role of wildlife in zoonotic disease management, is viewed as a key element in protecting human and animal health (Friend 2006, Wobeser 2006, Decker et al. 2011). The wildlife veterinary field has recently taken steps toward an emphasis on health, led in part by the influence of conservation medicine (Daszak et al. 2004) and the promotion of a One Health approach (King et al. 2008). The Association of Fish and Wildlife Agencies recently developed a National Fish and Wildlife Health Initiative, designed to enable state agencies to build capacity for management of healthy fish and wildlife resources (AFWA 2007). Similarly, the National Park Service has initiated the Yellowstone Wildlife Health Program, a multidisciplinary program aimed at restoring healthy wildlife within the Greater Yellowstone Ecosystem (National Park Service 2007).

This increasing orientation toward the notion of health, however, is potentially problematic. The concept of health is

not purely a scientific one in the biological–epidemiological sense (Temkin 1977, Ehrenfeld 1993); it is concerned with a desired condition (e.g., healthy animals or populations), so it has normative implications (Meyer 1997, Richman and Budson 2000, Nelson 2009). Like many normative concepts (i.e., those having to do with what ought to be), the term “health” can be ambiguous and vague (Lackey 2001) and has been characterized as “slippery” (Ostfeld et al. 2002:22), especially when applied to entities beyond the individual organism (Kass 1981). In various contexts, health has also been described as a “value-based ecological concept” (Lackey 2001:438) and an “ill-defined normative concept” (Callicott et al. 1999:23). The concept of health has strong positive connotations and, to a certain extent, people have an intuitive understanding of it (Kass 1981, Wicklum and Davies 1995). Given these qualities, some have argued that the metaphorical value of health is one of its greatest strengths. For example, Ehrenfeld (1993:144) suggested that trying to explain health “with the rigor and specificity that will allow us to use it as a scientific tool may well strip it of the intuitive, general meaning that is its chief value.” Yet health is also a scientific concept indicative of some measurable condition; to be effective in implementing policies that promote health, measurements of health need to be clearly defined (Lackey 2001, Salomon et al. 2003). We review the concept of wildlife health; we suggest key themes for clarifying it;

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and we present definitions of health from a Delphi exercise involving wildlife health professionals.

BACKGROUND

Historical Developments in “Wildlife Disease Management”

Investigation of wildlife disease is a relatively young field (Wobeser 2007) and developed almost entirely within the germ-theory era. This period began in the late 1800s and was characterized by scientific advances in bacteriology that led to a greater understanding of, and emphasis on, the specific causes of diseases and away from a focus on environmental factors influencing disease (Strathern 2005, Kunitz 2007). Wildlife disease management has traditionally emphasized infectious diseases (Wobeser 2007). Some historical examples of this orientation include the publication of the first textbook on diseases of free-ranging wildlife, written by a German veterinarian, in 1914 (Lowenstine and Montali 2006) and the publication of *The Study of Epidemic Diseases among Wild Animals* by the ecologist Charles Elton (1931). In 1933, the first American wildlife disease laboratory was established in Michigan (Thorne et al. 2005) and wildlife disease was first put into a management context in a chapter titled “Control of Disease” in Aldo Leopold’s book *Game Management*. In 1951, the Wildlife Disease Association was founded (Wobeser 2006), and in 1957, the Southeastern Cooperative Wildlife Disease Study was established at the University of Georgia (Friend 2006).

Beginning in the 1970s, the vocabulary of wildlife disease management shifted to greater use of the term health. In 1975, the U.S. Fish and Wildlife Service established the National Wildlife Health Center (now administered by the U.S. Geological Survey) and, in 1992, the Canadian Cooperative Wildlife Health Centre was formed (Friend 2006). Conservation medicine, referred to as a new paradigm of health and disease (Kaufman et al. 2004), was formally introduced in 1996 as a way of promoting integration of human, animal, and environmental health through a multidisciplinary perspective (Tabor 2002). Even more recently, the One Health philosophy, which is conceptually similar to conservation medicine, has emerged and gained endorsements from the American Veterinary Medical Association and the American Medical Association (Tabor 2002, King et al. 2008). It remains uncertain, however, whether these semantic shifts are substantive and whether it matters if wildlife management focuses on health, disease, or both. These concerns have not been well-addressed in the literature, nor has a clear vision of wildlife health been articulated.

Philosophical Notions of Health

In the field of human medicine, considerable attention has been given to the philosophy of health and, consequently, the nature of the term health has been thoroughly discussed and debated (Boorse 1977, Nordenfelt 1995, Brülde 2000, Schramme 2007, Tengland 2007). One key issue in the human health literature is the differentiation of health and disease (Hofmann 2005). Fundamentally, it has been

argued that a health-focused perspective promotes a broader, more integrated, and multidisciplinary approach than does a reductionist, disease-oriented strategy (Kass 1981). Indeed, increasing attention to wildlife health may be just another example of wildlife management and other natural resource fields focusing on more integrative approaches (Riley et al. 2003). Yet, unlike the debates generated on related topics, such as ecosystem health, forest health, and river or stream health (e.g., DellaSala et al. 1995, Scrimgeour and Wicklum 1996, Meyer 1997, Boulton 1999, Lackey 2001), there is a dearth of discussion in the literature about the meaning of wildlife health.

In the field of human health philosophy, 2 of the most influential lines of thought in defining and discussing health are the bio-statistical and holistic theories. The bio-statistical theory defines health as essentially the absence of disease, with disease defined as any impairment in normal functional ability (Boorse 1977). According to this perspective, health is a matter of statistical normality of function (i.e., the ability to perform all typical physiological functions with at least typical efficiency) at the species level. Proponents of the bio-statistical view argue that defining health relative to normality is ideal because the distribution of biological characteristics is an objective measure (Boorse 1977, Richman and Budson 2000).

A different perspective arises from the holistic theory of health. Nordenfelt (1995), one of the key proponents of the holistic theory, considered it preferable to take a positive approach to defining health, rather than thinking of it as the absence of disease. The focus of this conceptualization of health is not on disease, per se, but on health as a contributor to quality of life. Nordenfelt (1995:93) defined health as the ability to achieve vital goals, with a vital goal being a “state of affairs that is . . . a necessary condition for . . . minimal happiness in the long run” and, in the case of nonhumans, Nordenfelt (2007) replaced the term happiness with welfare. The holistic theory opposes a purely statistical perspective of health and strives to attain well-being rather than fight disease. Health, from this perspective, is more than the absence of disease or abnormality.

Two notable definitions of wildlife health exist and help illustrate the differences between the bio-statistical and holistic theories. Reflecting tenets of the holistic theory, Deem et al. (2008) characterized wildlife health as an ability to efficiently respond to disease and restore and sustain a state of balance. By this definition, wildlife health is measured in terms of particular conditions of wellness (i.e., efficient response to disease and maintenance of a state of balance). In contrast, Mazet et al. (2006:353) described health as a condition in which an organism is “physically and biochemically complete, does not experience abnormal growth or atrophy of its component parts . . . and does not experience drastic changes in its physical appearance or normal functions.” This definition, with its emphasis on normality, reflects tenets of the bio-statistical theory. The holistic and bio-statistical perspectives of health may not, in fact, be mutually exclusive, but further evaluation of the term wildlife health in light of these viewpoints is needed to avoid

the term becoming double-speak rather than a meaningful guideline for wildlife management objectives.

METHODS

To assess expert perspectives on wildlife health and disease, and the relationship between these 2 concepts, we conducted a Delphi exercise with a group of wildlife health professionals. Expertise adds authoritativeness to discussions, although lay perspectives, too, are important (Morgan et al. 2002). The Delphi exercise aided development of an expert model that pools knowledge in a systematic manner, thereby summarizing the group's collective knowledge rather than that of any one expert (Morgan et al. 2002). The Delphi method is a technique for obtaining consensus of opinion from a group of experts (Dalkey and Helmer 1963). It is an iterative, structured communication process that is anonymous (participants' identities are known to the moderator but not to one another); the process allows participants to view other participants' judgments and revise their own responses accordingly (Linstone and Turoff 1975). The Delphi method was originally used for technical forecasting and developing group consensus but is also useful for exploring underlying assumptions, revealing group values, and aiding concept–framework development (Turoff 1970, Moore 1987, Okoli and Pawlowski 2004).

Our nonrandom, purposive sample consisted of 18 current and retired wildlife health professionals from the United States and Canada. We solicited participants by means of a request for assistance posted on the Wildlife Disease Association (WDA) website and in the WDA newsletter and via direct e-mail requests to known wildlife health experts. Twenty individuals originally agreed to participate but only 18 completed the entire Delphi process. Of the 18 participants, 4 individuals were affiliated with the U.S. federal government, 3 were affiliated with state wildlife agencies, 1 was affiliated with a Canadian provincial natural resource agency, 7 were affiliated with academia, and 3 were affiliated with nongovernmental organizations. Participants included 14 men and 4 women. Nine of 18 (50%) participants held doctor of veterinary medicine degrees. Geographical representation included 10 states and 1 province, though some participants' work can be characterized as being national or international in scope.

We conducted the Delphi exercise by e-mail, from April to August 2010, in 4 rounds (or iterations). In the first round, we asked participants a series of open-ended questions: 1) What does wildlife health mean to you (i.e., how do you define health)? 2) In your opinion, how are the concepts of wildlife health and wildlife disease different and how are they the same? and 3) Does a focus or emphasis on one or the other (health or disease) affect or influence the achievement of healthy wildlife populations? Responses to these questions obtained during the first round were broken down into 49 statements (e.g., “population sustainability” or “health is more holistic than disease”). In the second round, we listed these 49 statements along with the number of Delphi participants who responded in accordance with each statement. We then asked participants to narrow down the list by

selecting the 5–8 statements they thought best responded to the original question. It was determined *a priori* that statements selected by <50% (i.e., fewer than 9) of the Delphi participants would be dropped. Consequently, by the third, round only 20 statements remained.

We then asked participants to rate their agreement with each of the remaining 20 statements on a scale of 1–5, with 1 indicating strong disagreement and 5 indicating strong agreement. The mean agreement ratings were calculated; it was determined *a priori* that items receiving a mean agreement of ≤ 3.75 would be eliminated. Only 2 of the 20 items, however, attained a mean agreement of ≤ 3.75 and, after rewording based on participant feedback, only one item was permanently dropped. After the final iteration, 19 items related to the original 3 questions remained and summary statements from these items were developed. For summary statements to be finalized, they had to receive a mean agreement of ≥ 4 .

RESULTS

The expert model gleaned from this Delphi exercise revealed 7 key conceptualizations associated with wildlife health (Fig. 1). When asked to describe and define wildlife health, the concept was characterized chiefly by the ideas of population sustainability and resiliency. Wildlife health was also recognized as being a distinctly multidisciplinary concept and as being influenced by multiple factors other than infectious disease, including nutrition, toxins, parasites, and habitat quality. Wildlife health was considered by the Delphi participants to be applicable to individuals, populations, and ecosystems, yet populations were considered the most important scale for applying health concepts, and there was greater overall disagreement about focusing health on either individuals or ecosystems (Table 1). The final summary statement (mean agreement of 4.6 on a scale of 1–5, with 5 representing strong agreement) was: “Wildlife health is a multidisciplinary concept and is concerned with multiple stressors that affect wildlife. Wildlife health can be applied to individuals, populations, and ecosystems, but its most important defining characteristics are whether a population

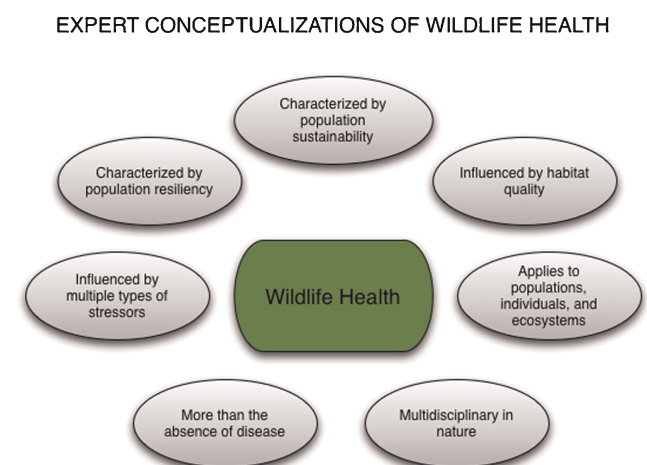


Figure 1. Mental model of expert conceptualizations of wildlife health.

Table 1. Delphi responses of 18 current and retired wildlife health professionals from the United States and Canada, as conducted by e-mail from April to August 2010, to the question, “What does wildlife health mean to you?”

Mean agreement (1–5 scale, with 5 indicating strong agreement)	Response statements
4.39	Population sustainability (e.g., healthy populations are able to sustain themselves over the long term)
4.33	Population resiliency (e.g., wildlife populations can respond appropriately to stresses)
4.89	Multiple types of stressors are relevant to wildlife health (e.g., nutrition, infectious disease, parasites, toxins)
4.78	Wildlife health is multidisciplinary in nature
4.44	Quality of the environment and/or habitat is part of the wildlife health picture
4.50	Wildlife health applies to both populations and individuals
4.11	Wildlife health applies to ecosystems

can respond appropriately to stresses and sustain itself.” Only 2 of the 18 Delphi participants explicitly stated that human-oriented objectives were relevant to wildlife health. For example, one participant stated that the goal of wildlife health management is “to promote coexistence and strike a balance between the needs of people and wildlife.” Another participant wrote that a healthy wildlife population is able to meet both ecological and social expectations (e.g., tourism, hunting).

Concerning disease, the Delphi experts described it as a component of wildlife health and, more specifically, as an alteration in an animal’s normal state, structure, and/or function. Examples of Delphi participants’ definitions of disease include: a compromised state that influences an individual animal’s ability to perform ecological roles, an infection of a host with a pathogen that affects the host’s form or function, and an abnormal condition with recognizable signs, symptoms, and laboratory findings. The final summary statement (mean agreement of 4.3 out of 5) was, “The concept of health is more all-encompassing and holistic than is disease. Disease is one part of the broader concept of health and, consequently, health is more than simply the absence of disease. Health is generally considered a state of being within which disease is a specific significant abnormal condition or deviation from health.”

Further, Delphi participants agreed that although both health and disease must be emphasized, a broader focus on all determinants of wildlife health (beyond specific disease pathogens) is needed to ensure healthy, sustainable wildlife populations. Additionally, a focus on wildlife health was considered to be more “forward thinking” and to allow managers a better understanding of the reasons for the disease. A focus on disease alone was generally viewed as being inadequate to provide the conditions necessary for healthy wildlife populations. As one Delphi participant wrote, “health connotes more a sense of preventive medicine . . . in contrast to the fire-engine type approach of fighting disease.” Another wrote, “. . . achieving healthy wildlife requires action to combat [environmental] factors, not reaction to treat sick individuals.” The applicable summary statement (mean agreement of 4 out of 5) was, “Both health and disease must be emphasized in wildlife management. A focus on disease is sometimes necessary but alone it is insufficient. A broader focus on all aspects of wildlife health is needed to achieve healthy, sustainable wildlife populations. A focus on health may bring about a shift

from documentation of disease occurrences to prevention and will help managers better understand what factors are causing the disease.”

DISCUSSION

The expert model created from our Delphi exercise reveals that wildlife health professionals believe health and disease are distinct but related concepts, both in terms of definition and influence on management outcomes. This group of experts, diverse in geographical location and agency of employment, held that disease is an important criterion of health but it is not the only criterion. Moreover, health was viewed as being applicable to individuals, populations, and ecosystems, though populations were the most acceptable scale of reference. Indeed, populations are generally viewed as the key focus in wildlife disease management (Wobeser 2007). Nonetheless, the individual-oriented perspective of some veterinarians, the wildlife manager’s population perspective, and the conservation medicine practitioner’s ecological orientation are all important aspects of the broader picture of wildlife health (Ostfeld et al. 2002).

In this expert model, we observed elements of both the holistic and bio-statistical notions of health—health is understood in relation to disease but it is also viewed in terms of concepts such as population resiliency and sustainability. In health philosophy, it has been argued that the bio-statistical and holistic perspectives are not mutually exclusive, but are simply different in their focus or orientation (Khushf 2007, Schramme 2007). An integrative conceptualization of health incorporates elements of both the bio-statistical and holistic orientations by determining healthful conditions while also continuing to focus on disease as an important criterion of health. Both orientations contribute perspectives needed in wildlife management, similar to the human health field, with medical clinicians focused on diagnosis and treatment of disease in individuals and public health practitioners emphasizing health of the broader population. To prevent these differing scopes from hindering the achievement of wildlife health, greater cooperation across disciplines is needed (Ostfeld et al. 2002). Although wildlife disease management occurs at the interface between medicine and applied biology (Wobeser 2007), Leopold (1933) argued that an overly medical, “doctoring” approach is less important in promoting health than are environmental and population factors.

To promote comprehensive approaches to wildlife health, integration of human dimensions with biological–

epidemiological insights is needed (Decker et al. 2006). Humans are an integral part of the wildlife health management system (Wobeser 2007) and the social sciences provide valuable input to health disciplines such as conservation medicine (Ostfeld et al. 2002). Accordingly, we view a beneficial approach to conceptualizing health as deliberately including both descriptive and normative elements. Descriptive elements correspond to the bio-statistical emphasis and include basic information about the ecology, epidemiology, toxicology, or etiology of disease factors. This element is important to develop a baseline measurement of health for determining what is normal for each species and to understand what limits health and normality. Normative elements of wildlife health address 2 aspects: to decide what a population needs to attain the desired condition of wellness (e.g., to survive and sustain itself into the future), and to promote integration of societal values in the development and achievement of wildlife health objectives (Meyer 1997, Decker et al. 2006). The types of questions that correspond to these elements include the following: What is the health status of the species or population and what are the threats to its health? What, from a biological perspective, are indicators of a healthy population of this species (i.e., measures of optimal wellness in addition to measures of current conditions)? and what are the relevant societal values that influence how health is defined and how health should be managed for this species?

MANAGEMENT IMPLICATIONS

Wildlife management occurs through a mix of technical and value-laden judgments (Riley et al. 2003) and management of wildlife health is no different. The hallmarks of effective management objectives are that they are specific and measurable yet linked to values related to the decision problem (Clemen and Reilly 2001). Inclusion of societal values is critical to making values and value trade-offs explicit rather than obscuring them and compromising the democratic ideal of openness in public decisions (Lackey 2001, Meyer et al. 2005). Defining wildlife health and setting wildlife health management objectives involves making value judgments. For example, the questions of whether concerns for human health trump concerns for wildlife health, what outcomes are most appropriate for wildlife populations, and which diseases are “bad” and should be eradicated are all influenced by human values. Such decisions cannot be based solely on biological or epidemiological expertise without the risk of ignoring important components of the decision problem. Human activities also have a direct influence on wildlife health, including the spread of disease and worsening of environmental impacts (Ostfeld et al. 2002, Friend 2006, Wobeser 2007).

In the face of continued threats to the sustainability of wildlife populations, adoption of policies that clearly articulate the meaning of wildlife health are needed. If wildlife health is to be a meaningful, measurable concept, and one supported by stakeholders and experts alike, additional deliberation is needed to better define and conceptualize it. A useful starting point is to examine expert perspectives to gain

understanding of existing conceptualizations of health by those who have practical knowledge of wildlife health and disease issues. The expert model that emerged in our Delphi exercise revealed that elements of both holistic and bio-statistical notions of health are present in professionals’ understandings of wildlife health, though greater emphasis is placed on holistic aspects. This may, indeed, be a natural progression of thought as knowledge is gained about the dynamics between wildlife disease and wildlife health. Building on this model, we encourage consideration of both descriptive and normative aspects of health and disease in conceptualizations of wildlife health and the integration of societal values into the normative component. Because health is unavoidably a normative concept and management is a prescriptive endeavor, and logically we cannot derive values and prescriptions from biology alone, integration of human dimensions insights will increase the probability of achieving objectives for wildlife health.

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