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Public perceptions of wildlife-associated disease: risk communication matters

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Abstract: Wildlife professionals working at the interface where conflicts arise between people and wild animals have an exceptional responsibility in the long-term interest of sustaining society's support for wildlife and its conservation by resolving human–wildlife conflicts so that people continue to view wildlife as a valued resource. The challenge of understanding and responding to people's concerns about wildlife is particularly acute in situations involving wildlife-associated disease and may be addressed through One Health communication. Two important questions arise in this work: (1) how will people react to the message that human health and wildlife health are linked?; and (2) will wildlife-associated disease foster negative attitudes about wildlife as reservoirs, vectors, or carriers of disease harmful to humans? The answers to these questions will depend in part on whether wildlife professionals successfully manage wildlife disease and communicate the associated risks in a way that promotes societal advocacy for healthy wildlife rather than calls for eliminating wildlife because they are viewed as disease-carrying pests. This work requires great care in both formal and informal communication. We focus on risk perception, and we briefly discuss guidance available for risk communication, including formation of key messages and the importance of word choices. We conclude that the risk perception and communication research available is helpful but inadequate, and that thoughtful practice with respect to message and word choice is needed.

***Key words*:** human dimensions, human–wildlife conflicts, messaging, risk communication, risk perceptions, wildlife disease, zoonotic disease

Wildlife professionals engaged in research, management, and communication at the human–wildlife interface focus on issues crucial to contemporary wildlife conservation and management. Many of these issues deal with interactions between humans and wildlife that often are classified as problems or conflicts (Conover 2002). Wildlife professionals working on the interface where conflicts arise between people and wildlife have a special challenge as they address contentious situations where wildlife species may be portrayed by some stakeholders as pests or hazards. Sustaining societal commitment to wildlife conservation requires that these issues be resolved to maintain the status of wildlife as a valued resource.

Negative impacts of wildlife-associated disease, including the potential for perceived risks of such disease to diminish public support for wildlife (Brook and McLachlan 2006, Stronen et al. 2007) is of growing concern (Wobeser 2006, Vaske et al. 2009, Decker et al. 2010). Research to date has contributed little practical knowledge to help wildlife managers and communicators anticipate how people will react to the general trends predicted for wildlife-associated disease. The need for such knowledge is urgent, given that infectious disease outbreaks are occurring more often than ever before. Analysis of >335 disease incidents during the last half of the

twentieth century indicated that emergence of new wildlife-associated diseases originating in wildlife increased each decade since the 1960s (Jones et al. 2008). The confluence of a growing human population, global movement of humans and animals, the encroachment of agricultural and urban development on wildlife habitat, and wildlife repopulating urban areas are cited as the principal reasons for rising wildlife disease rates (Wobeser 2006, Vaske et al. 2009). Scientists expect these trends to continue, suggesting that wildlife-associated diseases will persist and very likely escalate as a public issue.

As the extent and magnitude of problems produced by wildlife-associated disease grows, the ability to engage the concerns of affected stakeholders empathetically without demonizing wildlife has become one of the most difficult and high-consequence jobs in wildlife management today. While the well-being of wildlife necessarily is a focus in such situations, engaging (i.e., listening, understanding, and responding to) people's perceptions of wildlife and the impacts of wildlife that they fear is essential to avoid undesirable long-term conservation outcomes in situations of wildlife-associated disease.

The philosophy of One Health initiative (<http://www.onehealth initiative.com>) asserts that health of humans, domestic animals, wildlife, and the ecosystems in which they live and interact are interdependent. Two reasons why wildlife are crucial in a holistic, One Health perspective are: (1) the physical health of humans, domestic animals (including companion animals and livestock), and wildlife are linked inextricably through shared diseases; and (2) human well-being can be affected by animal health because most humans care about the well-being of domestic animals and wildlife (Decker et al. 2010). This view of the interdependence of human and wildlife health emphasizes that healthy wildlife populations benefit human health and well-being, and vice versa. Paradoxically, this view also implies that unhealthy wildlife may pose a potential hazard to human health and well-being.

Gaining public recognition of the interconnectedness of human and wildlife health may encourage monitoring wildlife as sentinels for zoonotic diseases, thereby guarding human physical health, but, from a One Health perspective, this is only a partial success if some other outcomes are created. Of particular concern is the possibility that public awareness of the interdependence between the health of humans and wildlife may raise concerns about wildlife as a threat to humans and domestic animals. Thus, important questions arise. As attention to wildlife-associated disease expands and garners increasing public attention, how will people react to One Health communication, carrying the message that human health and wildlife health are linked? Will wildlife-associated diseases foster negative societal attitudes about wildlife as reservoirs, vectors, or carriers of disease harmful to humans? The answers to these questions depend, at least in part, on whether wildlife professionals successfully manage wildlife disease issues communicate to promote societal advocacy for healthy wildlife populations versus calls for reducing or eliminating wildlife because they are viewed as disease-carrying pests. This is a complicated and nuanced task requiring prudent formal and informal communication.

In this article, we briefly review research that contributes to understanding how wildlife-disease messages could affect support for wildlife health and conservation. We focus on risk perception and summarize the few empirical studies that exist on perceived risk associated with wildlife-associated diseases, and we provide some general insight gleaned from the risk perception and communication literature. We identify additional knowledge that would be useful to wildlife health managers and communicators. Finally, we suggest a focus for messaging in risk communication, and we present examples of word choices to avoid when describing wildlife-associated disease, because such terms have potential to create fear, increase negative risk perception, and lead to intolerance of wildlife.

Disease risk perception and tolerance of wildlife

Although it is well-documented that most Americans are interested in and value wildlife (U.S. Fish and Wildlife Service 2006), a growing segment of our society has emerging concerns about coexisting with wildlife (Wobeser 2006, Decker et al. 2010). As more people have

direct, negative interactions (e.g., resulting in economic, safety, and health impacts) with wildlife, general good feelings about wildlife can be reversed. One can reasonably expect that these concerns temper people's enthusiasm for the presence of wildlife, whether they experience wildlife first hand or vicariously through media coverage. It is conceivable that negative perceptions accumulating over time may contribute to widespread change in public perspectives about wildlife. Signs of this kind of shift have been reported by Butler et al. (2003).

Riley et al. (2003) investigated how positive and negative impacts from human–wildlife interactions and how communications about such interactions influence people's perceptions of wildlife. Many factors influence formation of beliefs and attitudes about wildlife, including people's experience or interaction with wildlife, which can be positive or negative, direct or indirect (e.g., exposure through stories conveyed by others in conversation and through print and electronic media). While perceptions of various kinds of economic and physical harm have been studied, wildlife disease as a special class of human–wildlife interactions has only recently gained notice.

Insight about people's concerns with wildlife-associated diseases is sparse. Some studies have examined multiple potential concerns (e.g., Dorn and Mertig 2005), but most concerns have related to human health, and not the possibility that people may have other salient concerns about the effects of a wildlife disease (e.g., Shadick et al. 1997, Wilson et al. 2005, Figuié and Fournier 2008). Some studies have asked only how concerned individuals are about a certain disease, without revealing the nature or development of those concerns by the individual (e.g., Peltz et al. 2007). This research is inadequate for understanding perceptions of disease from the perspective of wildlife management and health.

A few studies have focused on how characteristics of wildlife-associated diseases influence risk perceptions (Peterson et al. 2006), but this area of inquiry also needs further development. Vaske et al (2009) documented the lack of human dimensions research on most wildlife-associated diseases. Although research on the effects of Americans' beliefs about hazards presented by wildlife-associated diseases is sparse, a few studies provide some indications of people's reactions.

A study in Wisconsin revealed that people gave up hunting white-tailed deer (*Odocoileus virginianus*) because of human health issues that they perceived, incorrectly, as being associated with chronic wasting disease (CWD). One-third of hunters were concerned about eating venison from harvested deer because of CWD (Vaske et al. 2004), despite the fact that no associated human health link has been identified. Another study of hunters in 8 western states indicated that the hypothetical combination of high CWD prevalence and a perceived connection to human health risk resulted in substantial reduction in hunting interest in the area affected (Needham and Vaske 2008). In upstate New York, a survey of deer hunters and nonhunters revealed that approximately 75 and 50%, respectively, were concerned about CWD, with 60% concerned respondents worried about human health generally (Brown et al. 2005).

Other studies also suggest wildlife-associated diseases are affecting tolerance of wildlife. In a 2007 study of suburban residents' experiences with and attitudes about coyotes (*Canis latrans*) in Westchester County, New York, every interviewee mentioned concern about rabies associated with coyotes as a major issue for residents. These results emerged even though the study focus was on encounters with coyotes that might present physical risk to people and pets and only 1 case of rabies in a coyote had been reported in the entire state in the previous 15 years (Hudenko et al. 2008).

Another recent study examined impacts from white-tailed deer on community residents adjacent to the extensive open lands surrounding the Cornell University campus in central New York state (Siemer et al. 2007). Nearly 90% of residents had little tolerance or had conditional tolerance of deer in their neighborhood, and 50% of the residents surveyed were very concerned about diseases carried by deer; 38% believed that deer presented a serious health risk, even though the study was conducted in an area that at the time had no recorded endemic deer-associated diseases that might normally be of concern for humans or their pets and livestock (e.g., no endemic Lyme disease, bovine tuberculosis, or CWD; Siemer et al. 2007).

Figure 1. Emerging negative perceptions about co-existence with wildlife is a growing concern among wildlife managers. (*Photo by S. Hildebrand, courtesy U.S. Fish and Wildlife Service*)

Further, a longitudinal study of residents of the suburban community of Islip, New York, showed the potential for marked changes in their perception of risk over time and changes in perceived hazards of wildlife. Concerns about Lyme disease increased strikingly from 48% in 1984 to 96% in 1999. In 1984, >50% of the Islip residents surveyed unconditionally enjoyed deer in their neighborhood, and 38% expressed some level of concern about deer. Fifteen years later, 78% expressed concerns about deer (Decker and Gavin 1987, Siemer et al. 2003; Figure 1).

Risk perception in a nutshell: applying social science to communication about wildlife-associated disease

Few studies to date have focused specifically on content and treatment of wildlife disease messages, but wildlife professionals and public health officials engaged in communicating about wildlife-associated diseases could benefit from current understanding of risk perceptions, the social psychology that underlies them, and their potential impacts on behavior, as explored for CWD by Heberlein and Stedman (2009). The theory and empirical research available on risk perceptions and risk communication regarding environmental hazards provide insight for communicating about risks posed by wildlife-associated diseases. Members of the lay public typically perceive risk differently than do specialists, such as wildlife biologists (Morgan et al. 2002). Such specialists usually evaluate the need for management based on assessed risk, which is a measure of the probability and severity of a hazard based on scientific evaluation and professional judgment (Kasperson et al. 2003, Slovic 1987). Unlike scientists who deal with hazards as a technical phenomenon, managers often need to account for another kind of risk in their work with various stakeholders: perceived risk (i.e., the public's perceptions of a hazard), which may or may not align closely with managers' perceptions of risks. An understanding of the processes and causes of risk perception can facilitate effective management of wildlife disease risks (Decker et al. 2006, Stronen et al. 2007).

Effective management includes effective risk communication. Some useful research is available to wildlife managers who seek to improve risk communication skills. For example, studies have identified factors needing attention when tailoring communication content to giv-en populations (e.g., Dorn and Mertig 2005, Brook and McLachlan 2006, Zielinski-Gutierrez and Hayden 2006).

We describe 3 important kinds of influences that affect how individuals perceive risks: community history and culture, societal response to a hazard, and characteristics of the hazard.

History and culture of the community where the hazard emerged

Cultural theories of risk emphasize that evaluation of risk acceptability must consider social processes, norms, and values (Douglas and Wildavsky 1982, Rayner, 1992, Lupton 1999). Cultural theories have used the structure of social units and the desire to maintain order to explain why some people may pay attention to a given hazard when others do not (Earle and Cvetkovich, 1997). M. Douglas (Douglas 1992, Douglas and Wildavsky 1982) is credited with pioneering cultural approaches to risk perception; her core argument is that cultural groups reflect existing social organization and seek to maintain their group solidarity by defining themselves in opposition to other groups (see also Dake 1992).

Douglas and Wildavsky's cultural theory of risk posits that the range and nature of social actions occurring within a social unit,

or group and grid, are imperative organizing components of culture (Rayner 1992). Grid speaks to the hierarchical structure of the social unit (including power dynamics); group refers to the degree to which the individual is a part of that unit (Rayner, 1992). Some researchers have argued that, while grid and group demonstrably affect risk perceptions, additional socio-cultural factors are necessary to understand risk perceptions holistically (Sjöberg 2000, Rippl, 2002). For example, some theorists stress culture's role in defining what risks and hazards are acceptable. Jaeger et al. (2001) asserted that risks are acceptable when they do not pose a cultural threat and unacceptable when they undermine cultural vital presuppositions. Short (1984) used the term "social fabric" to expand traditional conceptions of what is at risk (e.g., human life, health, and economic values) to include everyday concerns (e.g., social capital, norms of reciprocity, and trust) that are embedded in social relationships. If hazards threaten things that humans value, then it makes sense to engage both a broad conception of what is valued, as well as how these values are created through social interaction.

An important consideration for risk communication is that an individual's past experience can also lead him or her to trust or mistrust risk management entities, such as wildlife management agencies and public health agencies. History of trust or mistrust in authorities could affect an individual's level of perceived risk about wildlife-associated disease (Slovic, 1993).

Culture predisposes individuals to think in certain ways about the risks associated with given risk events or hazards. Such predispositions may vary among different stakeholder groups. People in those groups express their interests about a risk event largely as a way to maintain or enhance their interests. Although it is unlikely that a person would rely exclusively on cultural cues to make a decision about risks posed by wildlife-associated diseases, little to no research exists to inform us about how cultural influences predispose people to perceive wildlife-associated diseases (Vaske et al. 2009).

Societal response to the hazard

Societal responses to a hazard include: (a) actions taken by risk management agencies (e.g., state or federal wildlife management and agricultural agencies, state and local health departments); (b) the public's perception about the ability of risk management to handle the hazard; (c) the quantity and quality of media coverage; and (d) education efforts undertaken by federal and state governmental agencies, nongovernmental organizations, local governments, or other actors. All of these societal responses may affect the magnitude of a perceived hazard, the type of information available about it, and the risks it presents.

The Social Amplification of Risk Framework (SARF) identifies the importance of societal response in affecting an individual's risk perceptions (Kasperson et al. 2003). Several factors could affect which hazards people choose to give their attention to and the amount of attention they afford the associated risks. SARF suggests that formation of risk perceptions begins with human recognition of a risk event and develops further largely by experience with and communication about the event. Kasperson et al. (2003) define a risk event as any threat that people acknowledge, whether through direct experience, conversation, formal study, mass media, or some other means. After people recognize the presence of a risk event, perceptions of the hazards are conditioned by many psychological, social, institutional, or cultural processes (Kasperson et al. 2003).

A few studies have examined the role of mass media coverage in development of risk perceptions and acceptance of wildlife-associated disease management strategies and actions (Vaske et al. 2009). Heberlein and Stedman (2009) offer an account of how managerial response itself shaped perceptions of wildlife-associated disease. Many other aspects of the societal response to a wildlife-associated disease hazard largely have been unexplored.

Media coverage of the risks of disease can help individuals understand an issue better and alert them to risks they were unaware of, as well as, actions they can take to limit exposure to a disease. Substantial media coverage of actions people could take to prevent exposure to or contraction of a disease may allay people's fears (Roche and Muskavitch 2003, Dudo et al. 2007). Unfortunately, media coverage also can misinform people about risks of disease

if that coverage is inaccurate or otherwise distorted (e.g., sensationalized), resulting in social amplification of risk (Kasperson et al. 2003, Heberlein and Stedman 2009).

Characteristics of the hazard

The third kind of influence that affects how individuals perceive risks involves characteristics of the hazard. These include proximity of the hazard, its prevalence, how visible the hazard and its effects are, the manner in which people can become exposed to risk, whether the effects of the hazard are immediate or delayed, how the hazard affects humans and things humans care about, who and what the hazard affects, and the severity of the hazard's effects (e.g., whether it has catastrophic potential and whether it has fatal consequences (Slovic 1987, Slovic 1992). For these and other aspects of a hazard to be relevant to formation of risk perceptions, people need to be aware of them. Therefore, the agenda for public discourse about a hazard can be influenced by whether or not mass media pick up on it and how they describe it. Further, culture plays a central role in determining the characteristics of a hazard that people find salient (Kahan et al. 2009). People identify certain aspects of a hazard as important (or unimportant) due to cultural values, interests, habits, and education. The knowledge available to people about a hazard plays a large role in forming risk perceptions (Slovic 1992).

Influences on risk perception are interconnected

Cultural influences, the societal response to a hazard, and people's understanding of the characteristics of the hazard form the foundation on which individuals develop their risk perceptions. Culture may aid communities or subsets (i.e., stakeholder groups) to identify and develop concern about particular risks. Societal response to a hazard can influence people to think about the hazard in a certain way. Characteristics of a hazard can make it more or less visible to people, but even if a hazard is readily recognizable, individuals can be expected to have differing risk perceptions because of their particular life experiences.

The 3 categories of influences on risk perception outlined above are interconnected (Pidgeon et al. 2003), and all of them potentially affect an individual's experiences with the hazard, knowledge about the hazard, and other characteristics with respect to the hazard (e.g., their values, attitudes, interests, and activities with respect to the hazard). Unfortunately, scientific understanding of these 3 categories of factors affecting perceptions of wildlife-associated diseases is limited.

Formal and informal risk communication: messages and words matter

Given the complexity of risk perception, it is possible for wildlife managers and others communicating about a hazard and the risks associated with it to inadvertently foster negative views of wildlife and the spaces they inhabit. But even in the absence of a comprehensive body of research, there are some basic ways that wildlife professionals working on the front lines of wildlife-associated disease management can diminish amplification of risk perceptions and concomitant negative beliefs about wildlife.

Communication about wildlife-associated disease, which is almost certain to swell as wildlife-associated diseases emerge and re-emerge, could generate 2 different public reactions. On one hand, public support for healthy wildlife populations could increase if messages create public awareness that protecting wildlife health will also protect human health and well-being. On the other hand, wildlife management and health professions need to be mindful that simply increasing public awareness of diseases associated with wildlife may lead people to unintended attitudinal and behavioral responses. For example, people may disassociate with wildlife, which could set back wildlife conservation. Knowledge of the factors discussed above that help us understand how and why people form their perceptions of wildlife-associated disease risks could also help wildlife management and health professionals anticipate public responses to messages and even to certain words in One Health communication, thereby enabling them to influence the development of risk perceptions positively. One question we do not have an answer to is whether people will respond favorably to the One Health message promoting the idea that healthy wildlife could protect them

from diseases or whether they will prefer to be rid of wildlife because they perceive wildlife primarily as a reservoir or vector of disease. Certainly, we can expect undesirable collateral effects of some careless representations in wildlife-disease messages. Despite the limits of research, knowledge exists about how people perceive disease risks that can be used to inform design of messages to avoid such effects.

Efficacy message

Risk communication that raises public awareness of wildlife-associated diseases without also raising unjustified apprehension is imperative. Messages need to be designed to foster human beliefs and behaviors that protect against potential human health effects associated with a disease while at the same time sustain general support for wildlife. Ideally, identifying how risk perceptions about wildlife-associated disease are developed among specific populations or in specific communities potentially affected by wildlife-associated disease allows wildlife managers and health communicators to tailor messages to address misinformation, lack of information, or misunderstanding of risks. Even in the absence of such context-specific information, however, we know some things that can be very helpful.

Research has found that provision of efficacy information helps reduce unsubstantiated concern about wildlife-associated diseases (Roche and Muskavitch 2003, Dudo et al. 2007). Efficacy information is that which gives the public a sense of personal control over risk in the face of hazards. Communicators can seek to generate 3 forms of efficacy to temper public concern for hazards:

- Self-efficacy (a person's belief that he or she can respond adaptively to reduce personal risk);
- Proxy efficacy (knowledge of actions that public or private entities can take to reduce an individual's exposure to a hazard); and
- Response efficacy (a person's belief that an adaptive response actually will reduce a particular risk; Bandura 2000, Floyd et al. 2000).

Many examples of risk messages reflecting these 3 types of efficacy appear on the Centers for Disease Control and Prevention (CDC) website (<http://www.cdc.gov>). For example, with regard to the risks of hantavirus pulmonary syndrome, the CDC website site offers specific self-efficacy measures that individuals can undertake to control rodent populations in and around their homes with its simple, "Seal Up, Trap Up, and Clean Up" risk message. Communication about oral rabies vaccination typically portrays this as a strong government program to reduce human exposure to wildlife-associated rabies, thus, addressing proxy efficacy, while simultaneously informing people that the vaccination also protects wildlife from an exotic disease. Finally, messages about rabies stress response efficacy when noting that the disease is 100% preventable in humans with prompt medical care. In their own ways, each of these messages tries to impart a greater sense of control or efficacy, which can both increase the likelihood that individuals will reduce their exposure to risks and decrease unnecessary alarm and negativity toward wildlife.

Words matter

Reading or hearing about wildlife-associated disease can serve as a form of vicarious exposure to a hazard and can influence how people perceive the risks that wildlife present to humans and domestic animals. This reality emphasizes the importance of word choice in both formal and informal communication. Words matter in terms of images they create, and poor word selection may have negative collateral effects on risk perceptions. For example, it has been documented that the reference to swine flu rather than H1N1 harmed the pork industry because people associated the disease with the animal used in the common name of the illness (Pappaioanou and Gramer 2010). Other examples to think about include:

- Referring to deer ticks, which implies deer are the problem, rather than the correct name for the implicated ticks when discussing Lyme disease;
- Referring to wildlife as harboring or serving as a reservoir for a disease;
- Referring to wildlife as being a vector for disease or carrying disease;
- Allowing claims that a wildlife disease (e.g., CWD) posed risk to humans (i.e., is zoonotic) to go uncorrected, when no such evidence exists; and

- Allowing common descriptions, such as mad-deer disease or mad cow disease, that create a word association (e.g., people going mad) to stand uncorrected.

Scientific terms, such as significant, relative (versus absolute) risk, and probable (versus probability) also can confuse public audiences. For example, referring to epidemiological test results as positive rather than negative to indicate the presence of disease or death in wildlife may imply the exact opposite to public audiences who associate a positive result with good news and a negative result with risk (Jardine and Hrudey 2006).

When considering word choice, also keep in mind that individuals vary with respect to cognitive versus affective or emotional processing to evaluate risks; some people tend to rely more heavily on logical, rational thinking, while many others depend primarily on emotion and affect to guide their decisions (Slovic and Peters 2006). Using emotion-eliciting terms in messages (e.g., mad-cow disease instead of bovine spongiform encephalopathy) can influence individuals to react more on the basis of emotion than estimates of personal risk (Sinaceur et al. 2005). It is important to recognize that some people will try to use words inappropriately to instill fear or dread in citizens. Such misnomers need quick correction when negative collateral effects (i.e., inappropriately negative risk perceptions) could otherwise result.

Conclusion

Wildlife-associated diseases may threaten human health, and thereby, have potential to produce a shift in attitudes about wildlife. If predicted trends for wildlife-associated diseases occur, the accumulating perceived risks may cause people to isolate themselves from wildlife. Elevated apprehension among segments of society toward wildlife could lead to physical and emotional disassociation with wildlife. This situation has potential for many undesirable outcomes, including decline in visitation to parks and other natural areas, depressed participation in hunting, and reduced tolerance toward wildlife living in or near areas of human habitation. This scenario also suggests potential for decline in people's enthusiasm for existence of parks, protected areas, and other open spaces of conservation value for wildlife, borne out of concern that those wildlife may venture into their yards or their children's and pets' play areas.

Fortunately, this undesirable scenario is not a certainty, but avoiding it takes purposeful intervention. Communication about One Health should be designed with knowledge of how individuals perceive wildlife-associated diseases so that they relay risk messages in ways that effectively inform, but do not inappropriately incite, people. Through communication designed to reduce misinformation and fill important information gaps, wildlife agencies can help create a climate for informed decision-making by publics. By implementing coordinated communication actions based on communication theory and best practices, wildlife agencies can communicate the message that wildlife disease is a call for conservation and not eradication of wildlife. Toward this end, wildlife professionals working on wildlife disease (and other risky human–wildlife interactions) need to be thoughtful about how their formal and informal communication about wildlife disease is interpreted and feeds into formation of people's risk perceptions. Further, wildlife professionals have an opportunity to work in a One Health context where such knowledge and concerns for wildlife conservation can be shared with public health counterparts to develop integrated messages. These messages and specific choice of words about wildlife-associated disease matter.

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