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Human–Coyote Conflict: Research and Management within a Hazards Framework

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The application of a natural hazards framework to the research and management of human–wildlife conflicts provides geographers with an opportunity to apply their expertise to the study of the relationship between animals and human culture. This paper illustrates how the framework can be applied to human-coyote conflicts in urbanized areas in the lower mainland region of British Columbia.

Introduction

Neither the study of human–wildlife interactions nor the investigation of biological hazards has enjoyed a conspicuous place in either systematic or regional geography. These topics, however, have not been entirely ignored. Biogeographers have long been interested in the impact that human activities have had on animal distributions (see, for example Cox and Moore 1993). A few geographers have responded to Bennett's (1960: 13) suggestion that a new field of study be created, a field he termed "cultural animal geography," which would investigate "those aspects of animal geography which accumulate, analyze, and systematize data relevant to the interactions of animals and human cultures." A worthy effort is this regard is Wolch and Emel's (1998) publication of *Animal Geographies*, which represents a significant advance for geography both in terms of the quantity and range of issues addressed. Their anthology illustrates the important role that animals play in society and calls for a radical rethinking of our relationship with them. The book's premise

> …is that animals have been so indispensable to the structure of human affairs and so tied up with our visions of progress and the good life that we have been unable to…fully see them. Their very centrality prompted us to simply look away and to ignore their fates. But human practices now threaten the animal world and the entire global environment as never before (Ibid. p. xi)

The authors argue that animals ought to be included in the human moral community not only because of their economic value but also because they enrich society in other ways. In addition to Wolch and Emel's work, Gil (1966), Duffus (1988), Edgell and Nowell (1989), Wilkerson (1992), have explored human–wildlife interactions in a number of different geographical settings. While geographers have paid little attention to cultural animal geography, they have paid even less to biological hazards. Dearden's (1983) study of Eurasian milfoil and Wilkerson's (1992) investigation of wolf depredation appear to be the only studies that have explicitly approached an issue from a biological hazards perspective.

Given the nature and complexity of human–wildlife conflicts, their study and management can be approached effectively through a systems approach that marries the study of cultural animal geography and biological hazards. In this paper, I attempt to show that the General Systems Model of Natural Hazards (GSMNH) (Kates, 1971) provides a useful framework for identifying research questions and management options for human–coyote conflicts (particularly those that may potentially result in human injury or loss of life). In the interests of space, I use the framework selectively to illustrate how research and existing management policies dealing with human–coyote conflicts can be organized and understood with the GSMNH framework, identify some research opportunities, and suggest other applications of the framework.

The Hazards Framework

Although a scholarly interest in natural hazards can be traced back as far as Strabo (63 BCE to 21 CE; Hewitt, 1983), the impetus for much of the geographical hazards research undertaken since World War II derives from Barrows' (1923) programmatic address to the Association of American Geographers in 1922. Believing that the increasingly fragmented character of academic geography threatened its very existence, Barrows argued that the science of human ecology provided a much needed unifying framework for the discipline. On the whole, his pleas fell on deaf ears, perhaps because he advocated relinquishing the physical specialties of the discipline—

e.g., physiography, climatology, and plant and animal ecology—to cognate disciplines, a proposal not likely to be well received in Canada and Great Britain, where physical geography has held a strong position both in the discipline and in the academy. Nonetheless, Barrows' appeal had a strong influence on hazards research, especially in North America, notably through the work of Gilbert White, Robert Kates, and Ian Burton (see, e.g., Burton et al., 1978).

Barrows' influence on White is reflected in the latter's Ph.D. dissertation title: "Human Adjustment to Floods" (White, 1945), a study that laid the conceptual foundations for much of the subsequent resources and natural hazards research conducted by White, his students, and his colleagues. Especially noteworthy is White's concern with the range of choice and the modes of identifying alternatives in resource management decisions, themes that were elaborated in a number of studies (e.g., White, 1960; 1969) but were most clearly delineated in his essay "Choice of Use in Resource Management" (White, 1961). In that paper, White developed a model of decision-making applicable to a diverse array of resource management problems, including those associated with natural hazards. Briefly, his model describes the factors and processes that link the resource manager's selection of management strategies to an array of practical and theoretical choices.

A modified version of White's model (termed the "managerial adjustment decision model") subsequently incorporated in the GSMNH (see Figure 1) was developed by Kates (1971) in conjunction with Russell and Arey (Russell et al., 1970). The human ecology–geography link is a central element in the GSMNH, a link emphasized by Barrows (1923) in the early 1920s. The relational character of natural hazards is a central feature of the model; which is to say that natural agents are hazardous only to the degree that they occur in "the presence of a *vulnerable* human community" (Hewitt, 1983:5, emphasis in original), vulnerability being as much a function of human activities, decisions, and institutions as it is of natural processes. This may seem obvious, yet natural phenomena alone have frequently been seen as the problem. For example, livestock predation has been attributed solely to problem wolves, rather than to the human use of wolf habitat; crop failures to drought, rather than to farming in semi-arid regions; flooding to high water flows, rather than to building on the flood plain.

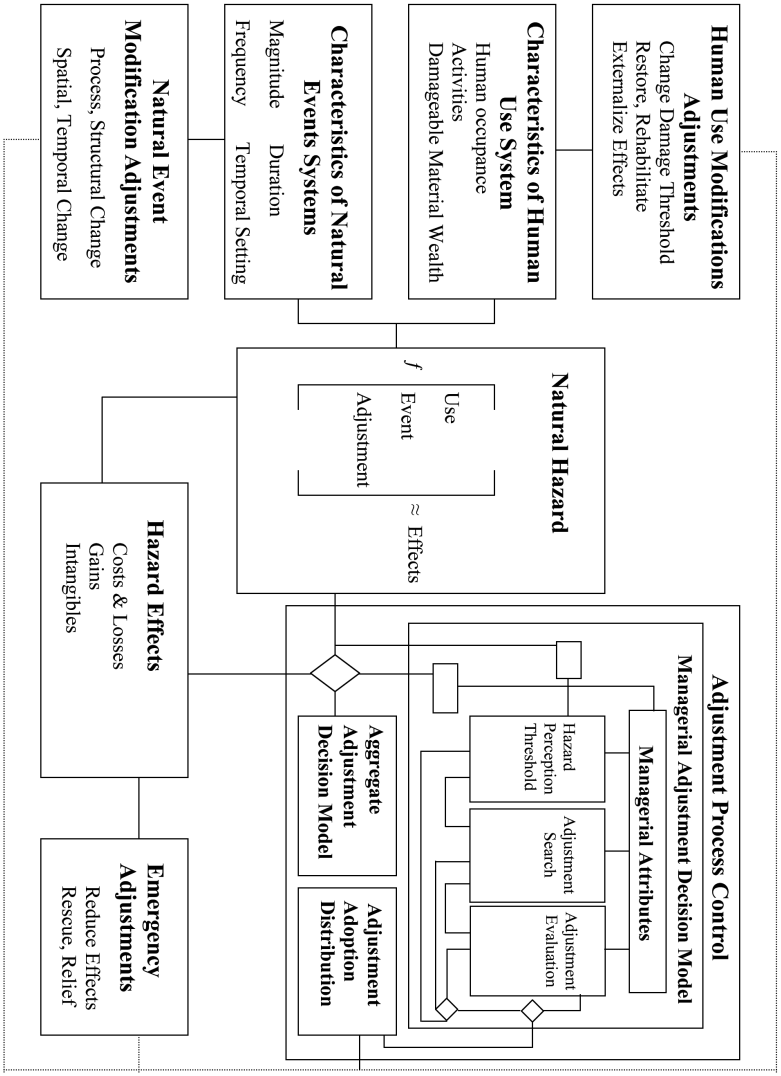

Figure 1 General systems Model of Natural Hazards (Source: After Kates, 1971)

Dangerous Human–Coyote Encounters

Because of the coyote's extraordinary ability to adapt to human presence, ill-advised human behaviour, and the preservation of natural corridors and nature reserves, urban coyote populations have increased dramatically in recent decades, creating concern in large cities such as Los Angeles, California; Toronto, Ontario; Vancouver, British Columbia (BC); and Edmonton, Alberta (Simao, 1994; Leahy, 1997; McMartin, 2001; Blanchard, 2004; Ketcham, 2004). Many urban residents fear that lost family pets have fallen victim to coyotes, a justified fear in light of studies that found cat remains in urban coyote scats and stomach contents (e.g. MacCracken, 1982; Quinn, 1997; and Webber, 1997). There is also a fear that both adults and children will suffer injuries, perhaps even death, from coyote attacks. This concern is not entirely unfounded as illustrated in the following examples.

In 1988, a coyote attacked an 18-month-old girl near Creston, BC, inflicting neck, head, arm, and facial wounds, which required more than 200 stitches (Carbyn, 1989). Two years later, in 2000, four coyote attacks were recorded in Vancouver: a 17-month-old boy suffered four head wounds; a four-year-old girl was bitten on the hip; a coyote nipped a girl on the buttock; and, in the only case involving an adult, a man was bitten on the foot (Stanley Park Ecology Society, 2002). In 2001, during a period when coyote aggressiveness was at a high in Vancouver, BC, a one-year-old child was bitten by a coyote while she lay on a blanket with her mother in their backyard, producing a facial wound requiring 10 stitches (Matas, 2001). In the same year, a six-year-old girl was bitten on the elbow while she walked with a friend and their fathers in a park (Stanley Park Ecology Society, 2002). Similar attacks have been documented in southern California (Baker and Timm, 1998). Carbyn (1989) notes that coyote attacks involving children appear to have been predatory in nature: no longer harbouring a fear of humans, coyotes often see children as prey. Thankfully, worldwide there has been only one recorded instance of a lethal attack, which involved a three-year-old child near Los Angeles in the 1980s (Howell, 1982).

The risk from other sources of injury is, however, far greater. For example, compared to the number of dog bites per year in British Columbia, coyote bites have been rare. From 1985/86 to 1992/93 dog bites accounted for an average of 88 hospitalizations per year, while during the period 1985 to July 2001, an average of only 0.14 coyote bites per year required hospitalization (Stanley

Park Ecology Society, 2002). Nonetheless, the threat to humans is real and requires a rational management response.

Public attitudes, which are increasingly sympathetic towards the welfare of wildlife, have generated the need for creative solutions which are unlikely to be found in one-dimensional approaches advocating only the elimination of coyote populations. A more effective and publicly acceptable strategy entails a more complex mixture of preventative strategies coupled, where necessary, with limited coyote control. While the advocacy of a more tolerant and complex management approach may be viewed by some as a concession to soft-headedness and muddled thinking, it is in fact based on sound reasoning and is certainly more in tune with public values and priorities.

Key Concepts

The following definitions and concepts employed in the hazards literature are useful in describing human–coyote conflicts: hazard, adjustment, and hazard perception.

Natural Hazard as a Relational Concept

Writing from an ecological perspective, Kates (1971: 438) defines natural hazard as

> …an interaction of man and nature, governed by the coexistent state of adjustment in the human use system and the state of nature in the natural events system. In this context, it is those extreme events of nature that exceed that capabilities of the system to reflect, absorb, or buffer that lead to the harmful effects, ofttimes dramatic, that characterize our image of natural hazards.

The relational character of natural hazards, a central feature of this definition, is reiterated by Burton et al. (1978), who define "hazard" as "the risk encountered in occupying a place subject [for example] to lightning or flood." They emphasize that "the actual hazard, not the natural event, is the subject of inquiry" (p. 19). Kates' characterization of natural hazards as "extreme events" is, however, a concern. As Hewitt (1983) argues, the tendency for researchers to refer to hazards as extreme, unscheduled, unprecedented, or unexpected events suggests that hazards are neither viewed as an integral part of the continuum of human–environment interactions nor are they seen to be dependent upon them.

By avoiding specific and overly constraining descriptions of dangerous natural agents, the following definition implicitly encompasses the full range of hazard characteristics: extreme, catastrophic, chronic, intense, pervasive, subtle, insidious, rare, unprecedented, predictable, unexpected and so forth. Accordingly, a natural hazard may be defined as the risk to humans, human property, or human works that stems from the interaction of humans and nonhuman nature. Risk can be can be avoided or reduced by eliminating, modifying, or relocating the potentially harmful nonhuman agent, by structuring the human use system so as to neutralize any potentially harmful effects or by relocating or avoiding certain human activities.

Adjustment

The term "adjustment" links the traditions of hazards research and human–wildlife conflict management. An "adjustment" is any human activity or human work which eliminates or reduces the level of risk associated with a natural event or mitigates the impact of hazardous events. The term may also refer to any intrapsychic responses that help individuals cope with both the risk and the costs (financial and otherwise) associated with hazardous agents.

Management Adjustment Decision Model

Several elements from the Management Adjustment Decision Model (MADM), a sub-model in the GSMNH, merits discussion here. The details of the MADM are presented schematically in Figure 1. Three components of the model—hazard perception, adjustment search, and adjustment evaluation—are examined in this section.

Hazard Perception

"Hazard perception" is used by many geographers and some psychologists to refer to an individual's assessment of the relative danger or risk that s/he faces by residing in a particular locality or by engaging in a specific activity (O'Riordan, 1986). The term is frequently employed in the context of efforts to understand why public perceptions of risk are often faulty, or at least appear to be so, and why expert and lay assessments are frequently at odds (Slovic et al., 1979). These disparities are, in part, rooted in human judgmental processes.

Judgmental Heuristics

One of the important insights to emerge from the study of human cognitive processes is that human decisions, judgments, and evaluations are guided by principles of cognitive economy (van der Plight and Eiser, 1984). Faced with limited ability to gather, assimilate, and analyze information, decision makers must form judgments on the basis of inadequate information and according to simple rules, two of which are important to this discussion: the "judgment of probability by availability (the availability heuristic)" and the "law of small numbers."

Slovic et al. (1974; 1979) argue that risk perception is often influenced by unconsciously employed judgmental rules or heuristics, which may sometimes produce an accurate assessment of the risk, but often systematically distort the perception process. Judgments, whether faulty or accurate, often involve estimating the intensity, frequency, probability, and/or predictability of future events. Generally, these judgments are based not on an understanding of probability theory and extensive baseline data but on intuitive heuristics applied to small data sets. These insights into human decision processes challenge the rational choice theories now common not only in economics, with its underlying assumption of *homo economicus*, but also in other disciplines such as political science and sociology.

Kates (1962) contends that much of the variation in human behaviours related to natural hazards can be attributed to the "prison of human experience." When people attempt to predict future flooding problems, for example, they "are strongly conditioned by their immediate past and limit their extrapolation to simplified constructs, seeing the future as a mirror of the past" (p. 88). Commenting on this phenomenon, Steinbrugge et al. (1969) note that the purchase of earthquake insurance increases dramatically after a quake but declines steadily as memories of the event fade.

The tendency to view the immediate past as a guide to the future is an example of the "availability" heuristic (Tversky and Kahneman, 1973; Slovic et al., 1974). People employ this judgmental device to estimate the probability of a future event on the basis of the number of similar cases that can be called to mind (memorability) or the ease with which pertinent examples are imagined (imaginability). Everyday experience teaches that events which occur frequently tend to be more easily recalled. So when availability is based on the frequency of events, it may provide a reasonably accurate estimation of probabilities. However, a person's ability to recall specific examples of an event can be influenced by several

factors unrelated to frequency that can lead to predictable systematic biases in judgment (Slovic et al., 1974). The more vivid the information or experience, the greater a person's ability to call it to mind; less vivid or pallid information is more easily ignored.

Information is vivid to the degree that it is emotionally salient, concrete, and proximate in a sensory, temporal, or spatial way (Nisbett and Ross, 1980). An event may have emotional salience for at least two reasons. First, events that happen to us or someone we know, especially someone we care about, will be more emotionally salient than events affecting strangers or objects for which we have no feelings. Second, the extent to which the event affects personal needs, desires, motives, and values—what Nisbett and Ross (1980) term the hedonic relevance of the event—can influence its emotional salience. Concrete information and temporal and spatial proximity also influence availability by intensifying the emotional impact of an event.

Hazard perception may also be influenced by the heuristic known as "the law of small numbers." In a series of studies of subjective probability, Tversky and Kahneman (1973) discovered that, despite their formal training in statistics, professional psychologists generally relied upon intuition and small samples when accepting the reliability and accuracy of statistical inferences. Tversky and Kahneman concluded that intuitions (not only those of psychologists) appear to conform to a "law of small numbers," which means that small samples are taken to be highly representative of the entire population. Nisbett and Ross (1980) emphasize that this insensitivity to sample size is exhibited not only by less educated or less intelligent individuals but is typical of highly educated and highly intelligent people as well. The fact that this insensitivity persists even when individuals are aware that the sample is biased (Hamill et al.,1980) is an indication of how powerful the law of small numbers can be. Moreover, while the law of small numbers does not depend on the availability heuristic, when the two work in concert, the potential for misjudgment increases significantly (Ibid.).

Adjustment Search, Evaluation, and Response

The Management Adjustment Decision Model assumes that resource managers[1] initiate a search for possible responses or adjustments to a hazard when they perceive that the level of risk, the "hazard perception threshold," has reached a certain intensity. In principle, the manager has the option to use adjustments that

have been employed elsewhere in similar situations, plus a possible innovation or two. White (1961) termed this array of alternatives the "theoretical range of choice," although managers may not be aware of the full range of options. Some of the theoretical options may be rejected immediately because of practical, cultural, or religious reasons. The remaining alternatives, which White (1961) called the "practical range of choice," are then subjected to a more thorough assessment (White, 1974) though rarely in conformance with rational choice theory.

Studies suggest that an individual's decisions are more likely to confirm to Simon's (1957) concept of bounded rationality, which involves the application of simplifying strategies to complex problems. For example, in a study of how East African households made decisions about water resources, White et al (1972) discovered that women did not search for the "best" source but used a strategy of lexicographic ordering. The choice of water source was made on the basis of several criteria that were ranked in terms of their importance. The process is deterministic: anyone knowing the rank order of the criteria and the range of alternatives would be able to predict the outcome. A similar strategy is elimination by aspects (Kunreuther and Slovic, 1986), in which each alternative is viewed as a set of aspects or attributes. The greater the weight assigned to the attribute, the greater the probability that it will be considered. All options that do not possess a specific aspect are eliminated. A decision is reached when only one option remains. The process is not deterministic since the most heavily weighted aspect may not be chosen in the first consideration. Neither strategy is likely to maximize expected utility, the objective of any decision based on economic rationality.

Applying the Framework

In this section, I show how the elements of the GSMNH can be applied to human–coyote conflicts in the urban/semi-rural environment, highlight some research opportunities, and discuss several management options (adjustments).

Natural Hazard as a Relational Concept

At the time of the European settlement of North America, coyotes occupied a range located at its northern tip in the southern parts of the Canadian Prairie Provinces, at its southern tip in central Mexico, with the largest part of it in the American Great Plains.

Today the range of the coyote covers the southern half of Alaska, a large part of Canada, the contiguous United States, Mexico, and Central America (Gompper, 2002). The opportunistic and highly adaptive nature of the coyote has contributed in part to its expansion into rural areas previously unoccupied by coyotes and into many major cities in North America.

The expansion of the coyote's range has been facilitated by a number of human-induced changes in the biophysical environment, coupled with ill-advised human activities. Thurber and Peterson (1991) suggest that the competitive pressures between coyotes and wolves, which limited the coyote's range in the past, have been reduced or eliminated largely through human persecution, leaving the coyote relatively free to expand into areas previously dominated by wolves. An animal that was formerly exploited and persecuted by humans now finds itself largely free of human harassment and, therefore, relatively safe in human settlement areas. Economic development has transformed landscapes and altered natural ecosystems through logging, agriculture, and the expansion of human occupance, opening up new habitat (Parker, 1995) and increasing the available food supply from both natural and human sources. Indeed, much of the aggressive urban coyote behaviour has been associated with the well-intended feeding of coyotes by urbanites thinking they are performing a compassionate deed. Urbanites have also fed coyotes unintentionally by leaving pet food and water outdoors, leaving garbage accessible to coyotes, and leaving fallen fruit on the ground, all of which help subsidize the coyote's diet and further reduce its fear of humans. The subsidization of the coyote's diet from human sources, the relative lack of human persecution, and the animal's increasing tolerance of humans have contributed to a dramatic increase in human–coyote contact.

Hazard Perception

The perceived threat posed by urban coyotes seems to be influenced by the law of small numbers and the availability heuristic. The first factor is the human tendency to judge the size of a population on the basis of the number of members of that population that they have seen or directly encountered rather than on the basis of accurate information. The fact that coyotes are capable of traveling an area averaging thirty km^2 in a single night (a fact not well-known by the general public), coupled with their increasing boldness, may lead to more sightings, which may in turn lead to the

false belief that the animal is more numerous in a comparatively small area (Way et al., 2004). While ignorance of the coyote's ability to travel can inflate estimates of coyote population numbers, it is probably compounded by the law of small numbers, the tendency to overestimate on the basis of a small sample. Estimates of the size of coyote populations and the level of threat the animal poses also appear to be influenced by the availability heuristic, evoked by the dramatic, concrete, and emotionally salient encounters with aggressive coyotes often reported in sensationalized newspaper accounts.

Adjustment Search, Evaluation, Response

White's (1961) model of choice and studies of elimination by aspects (Kunreuther and Slovic, 1986) and lexicographic ordering (White et al., 1972) suggest that individuals rarely assess the nature of the coyote threat in an egoistic rational way. This topic requires a good deal more study and is discussed in a later section of this paper.

Adjustments

See Table 1 for examples of measures for minimizing human-coyote conflicts organized according to the following categories: bureaucratic, social, or individual. Most of the social and individual measures listed have not been tested scientifically to determine their effectiveness, although, by and large, they are based on a scientific understanding of coyote behavior. In addition, all adjustments can, in principle, involve control or prevention. The following discussion focuses on British Columbia.

Bureaucratic

In BC, the range of adjustments for dealing with threatening coyote behaviour is limited by provincial policy and the Constitution, under which the authority to manage terrestrial wildlife is given primarily to the Canadian provinces, with the exception of lands completely under federal control. While BC law permits population reduction programs, sometimes referred to as proactive control, current BC policy is that only those coyotes which are a clear threat to human life or wellbeing will be killed. Because shooting an animal at loose in an urban area is generally too dangerous, the standard practice is to trap and kill only those animals that pose a direct threat. Measures that eliminate only problem animals are a form of reactive control that not only

Table 1: Measures for Minimizing Human–Coyote Conflicts[a]

Individual
• Refraining from feeding coyotes intentionally or unintentionally. Reporting such practices to government authorities.
• Storing garbage in sealed steel containers.
• Emptying dumpsters to prevent overflow; keeping lids closed and locked at night.
• Avoiding composting meat products or keeping poultry or livestock in back yards.
• Keeping companion animals indoors, not letting pets roam at large, and walking dogs with a short lease at all times.
• Walking dogs with family and friends in high pedestrian areas.
• Avoiding long stretches of bushy areas, paths, or roads along abandoned properties.
• Installing wooden fences (at least 6 feet high) to prevent coyotes from entering back yards.
• Avoiding areas coyotes are known to frequent, especially during key activity hours from dusk till dawn.
• Not placing or storing pet food outside.
• Picking up fallen fruit.
• Maintaining bird feeders; feeders in disrepair which may attract small mammals, which may in turn attract coyotes.
• If approached by a coyote, staying calm; if threatened making loud noises (shout in low voice, blow a whistle, etc.), using sudden movements, throwing objects, or opening and closing an umbrella to scare them off.
• Educating children.
Social
• Volunteer organizations (e.g. Stanley Park Ecology Society). Education on coyote diet, behaviour, and measures to avoid coyote conflicts. Lobbying governments to maintain coyote-tolerant policies.
• Informal neighbourhood organizations: neighbours alerting neighbours to the presence of coyotes.
Bureaucratic
• Education: Providing information on coyote diet, behaviour, and methods of avoiding conflicts with coyotes.
• Eliminating "problem" coyotes by trapping or shooting.
• Government conducted coyote population reduction programs
• Bounties on coyotes
• Firecrackers, rubber bullets
• Laws forbidding the intentional or unintentional feeding of dangerous wildlife (e.g. Sec 33.1 British Columbia Wildlife Act)

[a]This table draws on City of Toronto (n.d.) and Stanley Park Ecology Society (2002).

removes the problem coyotes but also helps to re-instill a fear of humans in coyotes (Baker and Timm, 1998). While relocating coyotes, another reactive control measure, is consistent with BC law, it is generally not considered an option since it virtually guarantees the death of the animals given the territoriality of coyotes and wolves, their natural competitor. Consequently, killing the problem coyotes is generally considered more humane. Reactive control measures are likely to be ineffective in the long term, however, if humans do not modify their own behaviour by taking measures to avoid dangerous encounters with coyotes, something the BC government encourages citizens to do. In addition, the *BC Wildlife Act* (Sec 33.1) forbids the intentional or unintentional feeding of dangerous wildlife.

BC policies on coyote control are supported somewhat by studies on the effectiveness of reactive control in the rural environment. An evaluation by Tompa (1983) of the reactive wolf control program in BC during 1978–1980 revealed that shooting, trapping, or poisoning (strychnine and compound 1080) effectively reduced predation on domestic livestock. In the United States, individual case histories indicate that sheep producers who had suffered high losses had benefited from the selective removal of problem predators (Robinson and Bolen, 1989). On the other hand, there is considerable doubt about the effectiveness of coyote culling initiatives. To be effective, culling must be large-scale and continuously sustained, or its success, at best, will be temporary. Indeed a one-time culling program may have little or no effect and may even encourage population growth (Knowlton et al., 1999).

Baker and Timm (1998) indicate that rubber bullets, low-powered pellet guns (with blunt pellets), blank pistol or rifle cartridges, and other noise-making devices will also re-instill in coyotes a fear of humans. In BC most of these options, with the exception of some noise-makers (e.g. whistles, cans filled with pennies), can be undertaken only by duly authorized personnel and are not currently employed in the province.

Social

Group responses to the threats imposed by human–coyote interactions usually involve non-government organizations such the BC Society for the Prevention of Cruelty to Animals (BCSPCA), the Stanley Park Ecology Society (SPES), and the BC Wildlife Federation (Culbert, 2001; SPES, 2002; BCSPCA, n.d.). With respect to coyotes, the first two organizations, and others with similar objectives, are devoted primarily to preventing human injury and

encouraging a non-lethal response to aggressive coyote behaviour, although they do endorse eliminating aggressive animals. The SPES (2002), for example, has developed and implemented an educational program aimed at improving public knowledge about coyotes, equipping people to respond effectively to threatening coyote behaviour, and providing guidance on preventing coyote habituation to human presence and human sources of food. In addressing these objectives, the SPES has, among other things, provided educational material on its website and prepared a coyote information package for Parent Advisory Committees in the Vancouver region's public schools (Stanley Park Ecology Society, 2002). Other non-government organizations, the BC Wildlife Federation being a case in point, have advocated the culling of urban coyote populations (Culbert, 2001).

Individual

Some urbanites have demanded the elimination of urban coyotes or a significant reduction in their populations (see, e.g., Page, 2000; Culbert, 2001; Lee & Bohn, 2001). However, for several reasons (noted above) government wildlife agencies on the whole have rejected the use of culling programs. On the other hand, an assortment of preventative approaches, suitable for use by individuals and households, has been widely endorsed by community organizations, local governments, and the provincial government. However, many of these approaches (Table 1) have not yet been examined scientifically to determine their effectiveness or the degree to which individuals employ them.

The Impacts of Coyote Behaviour on the Urban Environment

Although by definition hazards would seem to be undesirable, they frequently have a double-edged quality, creating, concurrently, both negative and positive impacts. The perception of natural agents or events as positive or negative exhibits considerable spatial, temporal, and cultural variation. Volcanism in Iceland, for example, is both a positive and negative resource, depending on whether it provides energy for industry and public utilities or threatens to destroy human lives and property.

As previously noted, coyotes often killed domestic pets (cats, rabbits, and small dogs), harassed and seriously injured people, and, in one case, killed a young child. These injurious and disquieting behaviours have created an atmosphere of fear in some urban

communities, constraining freedom of movement and other human activities.

In spite of their sometimes harmful effects, natural events or agents serve useful ecological functions. For example, an early rationale for the conservation of predators was based on their ecological value (Adams, 1925). Consequently, even people who stand to benefit personally from the elimination of predators often support their conservation. Some livestock producers, for example, report that they enjoy the presence of wolves and coyotes, even though they sometimes cause problems, acknowledging that the risks of living with them are worth the benefits (Wilkerson 1992).

Coexisting with coyotes in the city provides additional benefits. By preying on mid-sized predators (e.g., domestic cats) (Webber, 1997), coyotes indirectly increase waterfowl and songbird populations (Sovada et al., 1995; Henke and Bryant, 1999; Gompper, 2002). Studies in Europe, North America, Australia, and Africa show that domestic cats, in addition to killing a number of different types of small mammals, kill large numbers of waterfowl, songbirds, and rodents, with a British study estimating that in Britain five million house cats killed 20 million birds (Harrison, 1992; Winter, 1999). As a result, some people see coyotes as an effective way to keep the domestic cat population in check, clearly not good news for cat owners.

For some people, at least, the presence of coyotes could help increase property values by providing opportunities for urbanites to observe and learn about wildlife. In Britain in some locations, having foxes on one's property can be a selling point ("Rus in urbe,"June 10, 1995).

Research and Management Recommendations

The number of opportunities for research dealing with human–wildlife conflicts is far too large to provide a comprehensive review, but several of them merit consideration here. Many of the options for reducing the number and severity of coyote attacks are based on what appear to be sound principles; however, relatively little research has been done to confirm their effectiveness. There is some scientific support for reactive control in the rural environment, but in the urban setting, the practice is largely a common sense measure, as are the modifications in human behaviour promoted by citizen's groups and government. Scientific studies in an urban setting, though difficult to design, would help to clarify the worth of coyote control and behaviour modification (both

human and coyote), thereby providing a more adequate information base for determining public policy.

Education programs are based on the assumption that most people behave in a reasonably rational way, at least in terms of the notion of bounded rationality. White (1961) suggests that resource managers assess the economic efficiency of options (within the practical range of choice) as well as the impact on resource use in contiguous or functionally related areas. But how, or whether, people become or make themselves aware of adjustment options and make decisions with respect to human–coyote conflicts in urban or semi-rural areas is not known, although studies in other contexts suggest that strategies similar to elimination by aspects or lexicographic order may be used. It may turn out, however, that people are even less "rational" than White's model suggests. Moreover, the law of small numbers and the availability heuristic very likely contribute to a person's decision-making process with respect to human–coyote conflicts. A better understanding of how people become aware of adjustment options, what considerations inform their decisions, and what strategies they use to reach conclusions may provide useful information for designing an effective education program.

Just as the number of flood insurance policies purchased after a flood tends to increase and later taper off, citizens may well modify their behaviour for a time following dramatic newspaper accounts of coyote aggressiveness and later return to old habits. If true, education programs will need to be geared to keep the public informed on an ongoing basis. Educating the mass media could be a part of any education strategy since they may be partially responsible for hazard perception through the evocation of the availability heuristic and the pervasive tendency to treat issues superficially.

Conclusions

The application of a natural hazards framework to the research and management of human–wildlife conflicts provides geographers with an opportunity to apply their expertise to an important and interesting area of inquiry. A hazards approach helps to identify important research questions and management options. The model also has much to recommend it for guiding policy development and identifying research opportunities for other human–wildlife conflicts, for example: wolf and coyote livestock depredation; wild ungulates eating and damaging crops; human encounters with wildlife in cities, parks, and wilderness areas. Each

of these problems, which involve a complex matrix of natural and human factors, could be effectively understood and managed within a hazards framework.

Notes

1. The term "resource manager" refers to any resource manager working as an individual or for a group in the private or the public sector.

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