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RESEARCH ARTICLE



Whose Authority Drives the Narrative?: Framing the Spread of Mountain Pine Beetle in Canadian News Media

Jenna Hutchen^a, Valerie Berseth^{a,b} and Vivian Nguyen^{a,b,c}

^aDepartment of Biology, Carleton University, Ottawa, Canada; ^bDepartment of Geography and Environmental Studies, Carleton University, Ottawa, Canada; ^cInstitute of Environmental and Interdisciplinary Science, Carleton University, Ottawa, Canada

ABSTRACT

Climate change is facilitating the expansion of biorisks (invasive species, viruses, diseases) into new environments. While news media are a key site where expert authorities communicate about risks in the public sphere, there is limited understanding of how media narratives change as biorisks spread into new areas. We use mountain pine beetle (*Dendroctonus ponderosae*) in Canada as a case study to examine how narratives in media coverage evolved as outbreaks intensified and spread eastward. Media narratives were more common in British Columbia, where the beetle is endemic, and war narratives were more common in Alberta, where the beetle spread and is considered a “native invasive” species. Narrative framing in both places was driven by journalists, while quotes by authoritative sources lent support to journalistic framing. These findings demonstrate that affective narrative frames are widespread in environmental crisis communication and that framing of crises changes dynamically based on geographic context.

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Introduction

Climate change has led to stronger and more frequent environmental crises – from wildfires (Westerling et al., 2006) and floods (Hirabayashi et al., 2013) to invasive pests (Gutierrez & Ponti, 2014) and zoonotic diseases (Rillig et al., 2021). Invasive and pest species are climate-affected biorisks that have wreaked havoc on ecosystem health in much the same way that zoonotic infectious disease has impacted human health. Where wildfires and floods are singular events, invasive species and diseases can spread and persist past their initial outbreak. This spread means that novel ecosystems are exposed to environmental threats and there may not be specific knowledge to address the issue (Cudmore et al., 2010; Bodin, 2017).

In this article, we analyze how news media use narrative frames and authoritative sources to construct stories about spreading biorisks. To do so, we present a case of an endemic Canadian forest pest, the mountain pine beetle (MPB; *Dendroctonus ponderosae*), which spread into new environments and jurisdictions (Bleiker, 2019) after reaching epidemic levels, causing unprecedented forest loss. As a biorisk whose growth and spread has damaged ecosystem function, economic opportunities, and human safety (Bleiker, 2019) in historic and novel ecosystems, MPB is an excellent case study for how spreading environmental crises are presented in the media.

CONTACT Jenna Hutchen  jennahutchen@cmail.carleton.ca  Department of Biology, Carleton University

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We aim to understand how narrative frames and authoritative sources were used to portray mountain pine beetle in news media to inform future environmental crisis communication. Following Benson and Wood (2015), we examined to what extent quoted authoritative sources contributed to the narrative framing of the issue. By tracing expert authorities quoted in journalists' coverage of the spreading epidemic of mountain pine beetle, we advance prior work in crisis communication literature. We demonstrate that social context and changing environmental conditions affect whose voices are represented as authorities and discuss the implications for responding to a cross-jurisdictional problem. Our study is a novel contribution to both media framing research and environmental crisis communication, as it discusses how narrative frames and authorities change as environmental threats spread over geographic space and across jurisdictions.

Literature review

Crisis communication in news media

Media studies of epidemics (e.g. Pentzold et al., 2021; Shih et al., 2008) have documented the importance of news media as a site where expert authorities communicate about the emergence of hazards (the point at which the issue gains significant media attention), the cause and impact of the crisis (environmental, health, social, and economic consequences), and the actions or responses that should be taken. While risk communication involves communicating *before* a potential negative outcome, crisis communication is precipitated by an event (Steelman & McCaffrey, 2013). Therefore, environmental crisis communication for novel risks relies heavily on developing specific messaging that can affect and direct public perception of the risk (Forrest, 2012; Reyes et al., 2021). When biorisks spread into novel environments and there is minimal applicable knowledge, communication about the magnitude, duration, cause, and consequences of a crisis becomes a challenge (Forrest, 2012). Broader changes in social or environmental events may create a window of opportunity for media coverage to change how it covers a crisis (Ho et al., 2022).

Several studies have demonstrated that how issues are framed differs over the course of attention cycles (Nisbet & Huge, 2006), as epidemics shift from pre- to post-crisis (Ng et al., 2021; Pan & Meng, 2016; Shih et al., 2008), and across cultural contexts (Brossard et al., 2004; Duru, 2020). However, less is understood about how media narratives change as outbreaks intensify and spread into new social and ecological environments. What happens with media narratives when a localized disease or species expands to new areas, enrolling new actors in the crisis, and requiring a much broader response? Understanding this provides insights into the dynamics surrounding convergence and divergence in how neighboring jurisdictions respond to a crisis over time.

Narrative framing

Narratives are the stories we tell, connecting plots, settings, characters, and moral outcomes (Raile et al., 2022). Narrative analysis considers the sum of the frames, characters, and the context in which narratives are constructed and shared (Ryan, 2004; Shanahan et al., 2019). We use the term "narrative frame" (Spartz et al., 2015) to describe both the story (its plot, actors, and setting) with the language that "frames" the story's presentation. Frames are socially constructed "interpretive packages" (Gamson & Modigliani, 1989, p. 2), which activate varying schemas (unconscious cognitive structures and systems), through narratives and languages (Lakoff, 2010). Framing involves selecting or emphasizing some facts, views, or arguments while excluding or minimizing others (Entman, 1993; Snow & Benford, 1992). The same characters, setting, plot, and outcomes may be framed differently within a narrative by the author's language. Where a narrative is the story, the narrative frame is *how* this story is told.

Framing is not politically neutral and relies heavily on power dynamics (Carragee & Roefs, 2004; Vliegenthart & van Zoonen, 2011). Framing influences agenda-setting and public perceptions and discourse of a crisis, and authorities work to legitimize certain frames over others (Jönsson, 2011; Jones-Jang et al., 2020; Stoddart et al. 2017, 2023). Understanding how newspapers and expert authorities discuss biorisks in news media matters because they legitimize or obscure narrative frames and influence public understanding of emerging crises and can direct support towards particular solutions (Chadwick et al., 2020; Walker et al., 2020). As a biorisk spreads into novel regions, these new journalists may not rely on the same authorities that were consulted in earlier stages of a crisis and the original narrative may continue unaltered, or the discourse may take on new characteristics.

Narratives and authority

Journalists are not alone in creating narrative frames of environmental issues in media (Scheufele & Tewksbury, 2007); they rely on authority and expertise to bolster the authority of their narrative frames (Hall et al., 1978; Zelizer, 1989; Chadwick et al., 2020). Whose authority (journalist, politician, or otherwise) creates and supports which narratives is central to understanding how key actors influence agenda-setting, shaping political decision-making and public support (Franklin & Carlson, 2011; Kim et al., 2002; Rochefort & Donnelly, 2012). How expertise is constructed and legitimized in the public media sphere is debated, though much of the literature on environmental news framing has shown that politicians dominate media discourse, to the exclusion of scientists or other knowledgeable groups (Boykoff, 2007; Painter & Ashe, 2012; Belfer et al., 2017; Dekavalla & Jelen-Sanchez, 2017). Sources quoted in news articles act as characters within a narrative and their affiliations may help to further specific goals for managing or responding to environmental crises (Carragee & Roefs, 2004; Benson & Wood, 2015).



Figure 1. Photograph of mountain pine beetle affected forests in Jasper National Park, Canada. Photograph taken by Glen Berseeth, used with permission.

Methods

The Case: the mountain pine beetle epidemic

Mountain pine beetle is one of Canada's foremost examples of a spreading environmental crisis. Mountain pine beetle is a bark-boring beetle that feeds on tree phloem, resulting in widespread tree mortality during outbreak years (Cullingham et al., 2011; Figure 1). Historically, physiological barriers (e.g. cold intolerance, limited dispersal flight range) largely restricted mountain pine beetle to British Columbia (BC) (Bleiker, 2019). Successive warmer winters driven by anthropogenic climate change and forest management practices (e.g. fire suppression) contributed to unprecedented population growth and expanded the beetle's range (Bleiker, 2019). By the early 2000s the beetle had crossed the Rocky Mountains and reached the eastern edge of pine forests in Alberta (Cullingham et al., 2011). This explosive growth caused massive forest losses (over 18,000 hectares) and forced provincial and national governments to respond to an environmental crisis when much of the science was still emerging (Cooke & Carroll, 2017).

Data collection

We collected newspaper articles in November 2021 using Canadian NewsStream, with search terms "mountain pine beetle" in FullText and "beetle" in Summary/Abstract (n = 4982). We selected newspapers from Alberta (n = 106) and BC (n = 194, Appendix 1) to compare narratives across the historic (BC) and expanded (Alberta) range. We included articles between 1988 and 2019 to cover the period before BC's major outbreak, the period of active spread into Alberta, and the period of beetle decline following the peak of outbreaks in both provinces (Figure 2). To enable longitudinal comparisons over three decades and across two provinces, we stratified news coverage by year, as mountain pine beetle outbreaks follow a yearly cycle (Bleiker, 2019) which we expected would produce differences in coverage year-to-year. We randomly selected 10% of articles within each year, following the standard recommendation for random sample size (Altheide & Schneider, 2013). We removed articles that only briefly mentioned mountain pine beetle and duplicate articles published by multiple

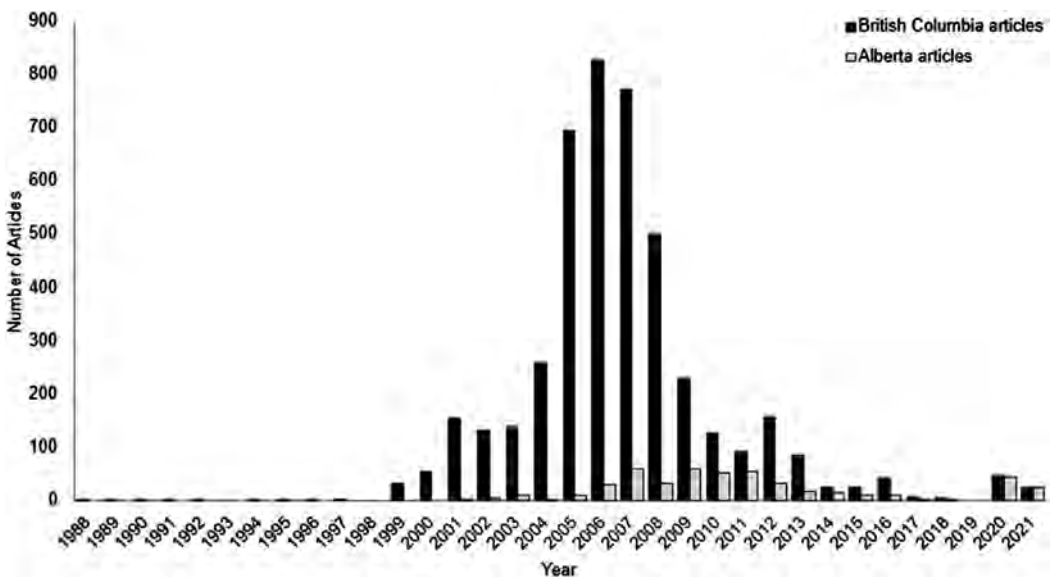


Figure 2. Distribution of the number of newspaper articles on mountain pine beetle published in British Columbia (black bars) and Alberta (grey bars) over time. Values show the total number of articles published each year and data analysis was done on a random 10% subset of papers per year per province.

newspapers (including wire stories). Articles were replaced with another randomly selected article to maintain a 10% per year sample. Yearly stratified sampling, however, is too coarse to analyze variation in media coverage across smaller time scales, meaning our sample does not control for cyclical biases (e.g. weekly news patterns) that may be present in media coverage. Further research that employs different sampling strategies would enhance our understanding of how news cycles affect patterns of media attention and narrative communication of the spread of biorisks.

At the initial time of searching, Canadian Newsstream only archived articles up to 2019. We conducted a second search in October 2022 to include more recent articles, including those published during the COVID-19 pandemic. Due to the decline in articles published after 2014 (Figure 2) we searched for “mountain pine beetle” in FullText to widen the search. We found an additional 93 and 97 articles for Alberta and BC, respectively, where we pulled a random 10% per year per province, consistent with Search 1 (Figure 2). The total combined sample comprised 497 articles.

Narrative frame coding

We combined deductive and inductive coding to identify narrative framing using a grammar and language approach (Saldaña, 2022). Considering the beetle to be the “actor” in the narrative, we were interested in what terms, phrases, or descriptions were used when talking about its spread or its management. Based on prior research (McFarlane et al., 2016; Clarke et al., 2020), we began with “war-conflict” as our only top-level deductive code. We simultaneously coded inductively through a bottom-up technique, looking for other language evoking imagery of the beetle, with no presumptions about what language would be used. We followed a negotiated agreement process (Campbell et al., 2013), with two coders (JH and KS) coding the same randomly selected articles and meeting to discuss and resolve disagreements. After 12 articles, there were no disagreements between the coders. We grouped similar terms under higher-level organizing codes based on emergent themes and maintained a codebook with definitions of each code and details regarding

Table 1. Codebook descriptions for the three narratives used to describe mountain pine beetle in Canadian news media. Italicized words show examples of the language used to inform code development.

Narrative Frame	Number of articles	Definition	Examples
Anthropomorphic	58	Narrative framing that speaks of the mountain pine beetle and its activities in a way that is akin to a human OR descriptions of the beetle showing agency or decision-making capacity	"All told, <i>the beetles felled</i> 730 million cubic metres of pine between 2000 and 2015 in British Columbia . . ." " <i>The mountain pine beetle's dish of choice</i> is the lodgepole pine, which it penetrates and sucks dry."
Medical	208	Narrative framing that speaks of the mountain pine beetle and its activities akin to a disease, medical condition, medical treatment or medical diagnosis	" <i>A plague of tiny mountain pine beetles</i> , no bigger than a grain of rice . . ." "The ministry wants to remove as many <i>infected trees</i> as possible before July when the beetles take flight."
War	166	Narrative framing that speaks of the mountain pine beetle and its activities akin to war, combat, siege, battle, attack, fighting, or military related activities	"We're calling it the <i>all out war on the forests</i> , and they're not considering the long-term consequences," said Cliff Wallace of Canadian Parks and Wildlife Society." " <i>There's a war in northern Alberta</i> . It's <i>hand-to-hand combat</i> , fought on the ground in the boreal forest. <i>The enemy is the mountain pine beetle</i> , a bug no bigger than a grain of rice."

inclusion and exclusion criteria where relevant (see [Table 1](#) for simplified codebook). The final codebook was applied to the remaining articles. Weekly meetings were held to ensure coding consistency and discuss emerging themes and patterns.

Quote coding

To understand the types of authority presented by journalists we coded quotes by individuals quoted in more than one article (Benson & Wood, 2015; Chadwick et al., 2020). We did not include paraphrased content, which may be shaped by the journalist's narrative style. We determined the profession (Figure 3) of the individual quoted via the article. Finally, we compared the content of the individuals' quotes to the narrative frame codes to assess how much narrative framing is done through quotes relative to journalist writing (Benson & Wood, 2015).

Results

How were MPB outbreaks framed?

We found three narrative frames used to describe the spread of mountain pine beetle in Western Canada: medical, war-conflict, and anthropomorphic.

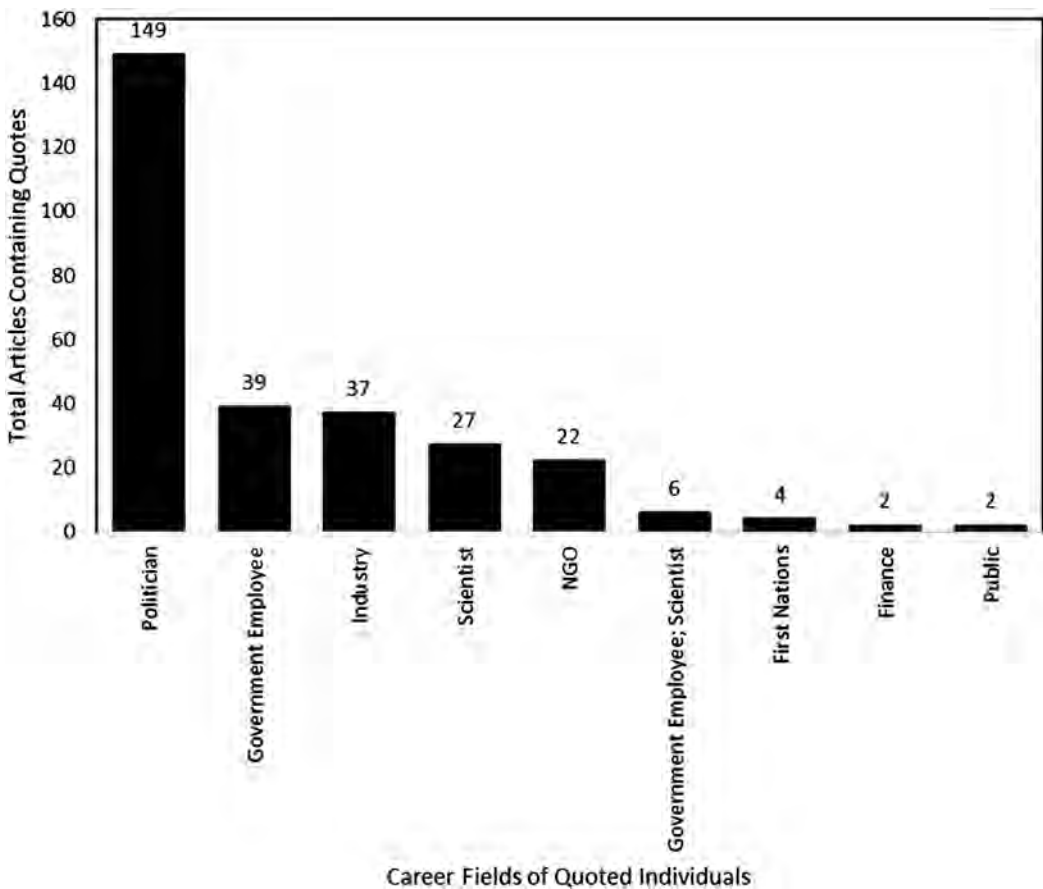


Figure 3. Total number of articles containing quotes from individuals with specific affiliations. Article can have quotes from more than one individual.

Table 2. Number of articles in each province that show narratives. Percentages are calculated as the total articles with narrative framing in that province by the number of articles with the specific narrative frame.

Narrative Frame	Provinces			Total	
	Alberta		British Columbia		
Anthropomorphic	13	19%	45	12%	58
Medical	17	25%	191	52%	208
War	38	56%	128	35%	166

Medical framing: mountain pine beetle as a disease

Medical narrative framing was found in 208 articles, with BC having a higher frequency of “medically” framed articles than Alberta (Table 2, 52% vs 25%, respectively). As a character, mountain pine beetle was often described negatively as an infectious agent. One-hundred and thirty-five articles used the term “epidemic,” and 40 articles used the terms “infect(ed)” or “infection” when describing beetle outbreaks. This situates MPB firmly within medical language, as opposed to similar terms such as “infestation.” Beetles were also described using disease-specific metaphors, such as cancer and plague.

“Right now we’re faced with massive cancer surgery, desperately trying to save the life of the patient,” he said. There are other treatments, as well, the equivalents of chemotherapy and radiation therapy, he said. ... The contained area is then logged – like cutting out a tumour, he said. (BC-2001-49)

A second group of characters in this narrative was forests and trees, which were depicted as sick or dying hosts.

The bug could . . . eat up massive swaths of trees in pristine parks and devastate the forestry sector in Alberta, which likens the looming beetle epidemic to the mad cow . . . (AB-2007-21)

. . . . By the time the disease has feasted on local trees for another 10 years, 80 per cent of the lodgepole pine in the area is expected to be dead. (BC-2004-146)

Medical narratives described the story of the mountain pine beetle as an acute problem with social, economic, and ecological implications. The severity of the crisis as an epidemic and the spread of infection – either within areas already affected, or into new areas – were the primary ways that beetles were discussed in the articles. Removing “infected” trees was described by journalists, government, and industry actors as necessary to solve the rapid spread and to recover timber value.

Officials expect to cut up to 1,000 infected trees this fall and to begin selective burning of the 65,000-hectare park’s lodgepole pine forests next summer in an attempt to control the spread of the outbreak and create a healthier forest. (BC-2001-90)

Medical narratives were also used to argue against particular types of industrial management (e.g. large-scale tree removal). Some eco-groups and unions argued that “the cure embraced by industry is proving far worse than the epidemic” (BC-2007-432). An article in the Kelowna Daily News explained, “By clearcutting, log salvagers send a forest into release, the ecological equivalent of full cardiac arrest.” (BC-2007-61). Similarly, the solution of logging “infected” areas was criticized for treating the symptoms, rather than the “disease” itself.

. . . you’re just treating some of the conditions. “It’s like having cancer and thinking if you take an Aspirin that that’s going to do something because it makes you feel better for a little while; you have to go to the actual conditions to have an affect [*sic*].” (AB-2016-1)

Despite the prevalence of medical narratives, there were few or no references to health care, medical professionals, or medicine, though there were some references to tree immunity and beetle swarms inoculating trees.

War-conflict framing: MPB as an invading force

Within a war-conflict narrative framing, the beetle was often presented as an antagonist that must be fought and destroyed. The protagonist fighting this “war” was predominantly government, as opposed to forest managers, scientists, or other interest groups. How the beetle should be fought (i.e. what management techniques should be used) was not a significant debate in the media. Rather, the debate focused on funding needed to fight against advancing beetle forces.

The declaration also adds pressure on the federal government to meet Alberta’s request for \$100 million over three years to fight the tree killer. (AB-2007-21)

Where medical narratives characterize the forest as a sick or dying host, in the war-conflict narrative, the forest is not a character, but either the battleground or a casualty of war:

The dead and dying trees, . . . are casualties in an environmental disaster scientists say has been fuelled, at least in part, by climate change. (AB-2003-5)

As beetle populations began expanding beyond their endemic ranges, especially into Alberta, the narrative framing shifted from a simple antagonistic conflict to one of an invading army:

On the front lines in a pitched battle against the bug are giant forestry companies like Weyerhaeuser and Canfor. (AB-2007-11)

As proven in British Columbia where pine beetles heavily damaged forests before invading Alberta, when vast amounts of forests fall victim . . . (AB-2014-07)

Particularly in Alberta, MPB is presented as a destructive army erupting from BC and threatening Alberta’s forests. These stories focus on Alberta as the last line of defense separating the Boreal Forest from the beetle threat:

Officials in Saskatchewan are keeping an eye on their western border, fearful the beetles may advance. (AB-2012-32)

We also found examples of war narratives used for education and communicating facts. Green, red, and grey attack are scientific terms that refer to the color of pine needles during that stage of an infestation, evoking both a visual aspect to an attack and communicating a way for people to identify an MPB-affected tree:

In simple terms, green attack is where the beetle currently is; red is where it has been, leaving dead trees behind; and grey is where the red attack trees have lost their needles. (BC-2005-500)

We found a subtle temporal shift from war-conflict narrative frames being the most common when beetle outbreaks were new in both the provinces to medical narrative frames when the beetle began established over time (Appendix 2). In BC, the earliest news stories (1988–1999) only contained war-conflict narrative frames, and medical frames became more common after 2000. In Alberta, both war-conflict and medical narrative frames were used early, though war-conflict has consistently remained the most common (Appendix 2). When present, anthropomorphic narrative frames did not appear to follow as clear a trend.

Anthropomorphic framing: MPB as decision-maker

Some articles (n = 54, Table 1) presented the beetle in anthropomorphic terms unrelated to war or medicine. This framing emphasized the agency and decision-making capacity of mountain pine beetles:

... billions of tiny beetles scramble out of their holes in coming weeks and take flight in search of trees to kill. (AB-2003-5)

Alternatively, beetles were anthropomorphized not in terms of killers seeking to destroy but as hungry and needing food. In this narrative frame, the beetle spread because it was hungry, its appetite was unlimited, and it needed to sustain itself: “Basically the beetle ate itself out of house and home (in B.C.)” (BC-2012-09).

Whose authority drives narratives?

In the 496 articles reviewed, 79 individuals were quoted more than once by journalists. Sources quoted most were politicians (N = 149, 52% of articles containing quotes).¹ The next two highest quoted groups – government employees and industry – trailed far behind at 14% and 13%, respectively. Scientists made up only 9% of sources quoted in more than one article. Government employees who were explicitly identified as scientists (e.g. entomologist with the Canadian Forest Service) made up 2%. Representatives from Non-Governmental Organizations made up 8%. First Nations, financial organization representatives, and the public each comprised less than 1%. Only three individuals were quoted in both BC and Alberta articles (Allan Carroll [Canadian Forest Centre], Bill Wilson [Canadian Forest Centre], and Michael Rosen [Tree Canada]).

We found that 19% of articles with quotes had a narrative frame within the quoted text (Table 3). Twenty-one quoted individuals had narrative framing present in at least one of the statements (Figure 3). The most common narrative frame in quotes was medical (14 articles), with war and anthropomorphism roughly equal (9 and 8 articles, respectively). Politicians used a narrative frame more than any other quoted sources, and most often used the medical narrative frame. Many politicians explicitly called mountain pine beetle a harmful epidemic that requires government intervention:

“The government of Canada recognizes the impact this epidemic is having in B.C. and we are acting to do our part,” said [Mary Emerson, Regional District Manager for the Cariboo Region in British Columbia]. (BC-2005-102)

Of the 27 politicians quoted in more than one article, only one was from an opposition party (i.e. the non-leading party in the province or country). The remaining politicians comprised mostly provincial forest ministers, provincial Members of the Legislative Assembly and premiers, federal Members of Parliament and prime ministers, or municipal mayors. BC newspapers did not quote any Albertan politicians, and vice versa, showing minimal overlap between political messaging in the provinces.

Scientists used medical, anthropomorphic, and war narrative frames equally (Table 3), alternately describing MPB as an infectious agent to be inoculated against, an actor creating new homes in forests, or a threat that must be kept below a critical threshold:

“If there are enough beetles inoculating the tree and attacking it all at once, that’s it for the tree,” he says. (AB-2003-05)

Table 3. Number of articles where quoted individuals used any one of the three prevalent narrative frames in their quotes. First Nations, NGO, or financial source quotes did not contain any reference to the narrative frames presented in this study, nor did the remainder of any other affiliations quotes.

Affiliation	Narrative			Any Narrative
	Anthropomorphic	Medical	War	
Politicians	3	9	2	14
Scientists	3	2	2	7
Government Employee	0	2	2	4
Government Employee; Scientist	2	0	2	4
Industry	0	1	1	2
NGO	0	0	0	0
First Nations	0	0	0	0
Finance	0	0	0	0
TOTAL	8	14	9	31

“You’re trying to buy a bit of time,” Wilson said of Alberta’s new level of attack. “You’re trying to keep that beetle population down within Alberta below a critical mass.” (AB-2006-27)

Two government scientists from the Canadian Forest Service were quoted in both BC and Alberta articles. All university researchers or non-university scientists quoted were from BC universities or organizations. Government scientists and industry representatives rarely used narrative framing in their quotes. We found no narrative framing in quotes from First Nations, NGOs, or financial representatives (Table 3).

Discussion

Narratives change as environmental crises spread

Media coverage of climate impacts is a key site where journalists and authorities direct attention to the causes, consequences, and set the agenda for policy and governance solutions. As climate change facilitates the spread of biorisks into new regions, it is critical to understand how media narrative frames change in response. War-conflict narrative frames were the most frequently used in places and times where the beetle epidemic was a novel crisis (British Columbia in the 1980s, Alberta in the 2000s; Appendix 2). War and battle narratives depicting the early spread of a biorisk as an enemy invasion are increasingly common (Clarke et al., 2020; Lahlou & Rahim, 2022). With a new “enemy” on the horizon, be it insect or disease, the language in a war-conflict narrative frame provides a sense of urgency and encourages action to be taken to prevent the enemy from winning the war.

As the MPB crisis became less acute in BC we saw narratives shift from war to medical, where beetles were a virus or cancer that spread through forests, infecting and killing trees. Medical and war language both frame mountain pine beetle as something to be monitored and managed. Where war-conflict language is immediate and may imply the beetle’s eradication as “winning”, medical language is slower and the options for management broader. The timing of narrative frames is an important lesson for how crisis communication around biorisks plays out in the news: first was a battle to stop the crisis and then, when the battle was not (and could never be fully) won, comes learning to live with the crisis.

War-conflict narratives

War-conflict (Karlberg, 1997; Clarke et al., 2020) narratives are common in environmental crisis reporting and are one of the most common narratives for threats to human society (Horsley, 2016). This narrative frame presents a crisis – in this case, mountain pine beetle – as an enemy combatant to be fought and conquered. War-conflict is highly prevalent in Albertan news articles, where mountain pine beetle was a new invasive pest. In describing the beetle as an actor that can search, synchronize, and organize itself the anthropomorphic narrative reinforces the war-conflict narrative, an “us-versus-them” mentality, and supports aggressive action to stop an “enemy”. Clarke et al. (2020) found a similar fatalistic representation of how the exotic invasive species Emerald Ash Borer (*Agrilus planipennis*) is described in American news media. War-conflict narrative frames obscure the fact that MPB is endemic to small areas of southern Alberta (Safranyik et al., 2010). The war-conflict narrative frame implicitly placed responsibility for the outbreak on BC, while presenting Alberta as the actor who must deal with the consequences:

“The beetle explosion, spurred by an alarmingly massive insect migration over the Rockies from pest-scarred British Columbia, forced the province to shift its attack strategy from culling single trees to aggressive, large-scale cuts.” (AB-2006-27)

Notably absent in both provinces was an ecological counter framing. In an ecological frame (Goodman et al., 2016), mountain pine beetle may be presented as a natural part of the forest regardless of its impact. Ecological frames are common in scientific literature on pests but less common in news media (Ballari & Barrios-García, 2022). Larson et al. (2005, p. 263) suggest that naturalistic framing

of forest pests would have “much less action potential than the framing in terms of war or battle and is also much less newsworthy.” If mountain pine beetle is simply part of the ecosystem, it may not need monitoring or management.

Medical narratives and biorisks

While prior work found that war narratives are common in literature on insect pests (McFarlane et al., 2016; Clarke et al., 2020) and infectious diseases (Lahlou & Rahim, 2022), to our knowledge the use of medical narratives to describe invasive species has not been previously identified.² This is particularly noteworthy, as there have been recent calls to more clearly articulate to the public and policy-makers that climate change and the COVID-19 pandemic are interconnected human effects on the planet (Rillig et al., 2021). We demonstrate a shared language between discourse around infectious disease and the spread of biorisks, including pests and invasive species. Beetles were described as a cancer or plague infecting and killing forest hosts, particularly in the region where it is an endemic species. The normative use of medical language to describe insect pests (e.g. “outbreak” or “epidemic”; Carroll et al., n.d.) may result in scientific experts overlooking the medical narratives in their language. However, with growing awareness that many crises are socio-ecological in nature (Gong et al., 2022), medical narratives may be increasingly used to communicate about environmental risks and crises. Publics have been primed to understand this narrative in the context of global disease spread and associated mandated actions related to the COVID-19 pandemic, which contributed to increasing public politicization of biorisks globally (Bolsen et al., 2020; Hart et al., 2020). As a result, future communication about spreading endemic and non-native invasive species may invoke strongly affective and polarized responses from publics.

Anthropomorphic narratives

Anthropomorphizing non-human species is a common way to represent the relationship between humans and non-human species (Root-Bernstein et al., 2013; Goodman et al., 2016; Clarke et al., 2020). Often, this is done using positive characteristics for charismatic species of conservation concern to evoke stronger emotional responses from people (Root-Bernstein et al., 2013). Our findings show that mountain pine beetles were largely given negative characteristics, such as being voracious in their hunger or possessing a coordinated intelligence for seeking out forests to infest.

Though we distinguish between anthropomorphic and war-conflict narrative frames, it could be argued that all war narratives are inherently anthropomorphic. Beetles are not literally “marching” to the border nor “waging war.” We make the distinction because war narratives present mountain pine beetle as an enemy, while anthropomorphic narratives, though negative, present mountain pine beetle as possessing individualistic traits. In these two narrative frames, beetles are actors, as they are seen as possessing agency and human-like decision-making capabilities. Assigning human traits and violent tendencies to an insect moves mountain pine beetle closer towards humans on a human-nature dichotomy (Root-Bernstein et al., 2013).

Journalists drive narratives for mountain pine beetle in the news

Narratives are powerful ways to communicate environmental/scientific issues with non-expert audiences (Dahlstrom, 2014). While scientists tend to communicate in logical-scientific ways, narrative creation in media is largely the work of the journalist (Yang & Hobbs, 2020). Similarly, we found most narrative frames in passages written by journalists, rather than in quoted content suggesting that for mountain pine beetle, journalists are the ones influencing public opinion through specific affective language (Reyes et al., 2021). By quoting authoritative individuals, journalists can signal implicit support for a narrative frame by that individual (Zelizer, 1989). Quotes legitimize journalists by co-opting the source’s authority, demonstrating that they have done their due diligence to find trustworthy sources of information. For example, in an earlier study of MPB in Albertan news, McFarlane et al. (2016) found that although scientists agreed their quotes

were representative of the science at the time, the articles still presented MPB in fatalistic terms. Therefore, while statements from expert sources on environmental crises might be fact-based, they are likely interpreted within the narrative frames the journalist presents.

The prominence of political authority

Journalists routinely quote politicians more often than scientists in news articles on environmental issues (Boykoff, 2007; Painter & Ashe, 2012). We found that politicians were the most quoted group in mountain pine beetle news coverage, followed distantly by government and industry employees. Scientists were rarely quoted, suggesting that science and scientists were not actively positioned as significant authoritative sources by journalists. Taken with our findings that scientists' quotes rarely contained war, medical, or anthropomorphic narrative frames, this may suggest that journalists view scientific authority as less powerful than political authority for legitimizing narrative creation.³

Access to scientists can be challenging and translating science across disciplines even more so (Goodman et al., 2016). Even in cases where a scientists' perspective is desired, journalists may not know how to identify key scientific sources from inside of academia. Identifying politicians is an easier task. Academia is routinely obscure (Lam, 2010) and scientists are not rewarded for speaking to media and making their findings more accessible to the public (O'Hara, 2010), which may contribute to the lack of scientists quoted in environmental media coverage. There is growing awareness that scientists should be more active in engaging with the public, lest the cycle of journalists allowing politicians to dominate media coverage of environmental crises remain unchanged (Downs, 2014).

First Nations Chiefs were only quoted once in MPB news coverage, leaving First Nations perspectives largely absent. First Nations voices and perspectives are often absent from media coverage of environmental issues, and when included, First Nations are portrayed as recipients or beneficiaries of scientific knowledge rather than knowledge holders themselves (Anderson & Robertson, 2011). In such cases, First Nations experiences with mountain pine beetle are voiced through journalists and their language and narrative choices, contributing to further marginalization (Belfer et al., 2017). In a similar fashion to scientists, Indigenous knowledge and authority was not legitimized in news coverage of the mountain pine beetle outbreak.

Implications

Our findings have important implications for developing effective crisis communication for spreading biorisks. First, narrative frames can be used to support different responses to a crisis. The imagery of a battle line being drawn in the woods was not just figurative – it also characterized Alberta's management response to the epidemic, which was guided by a directive to eradicate MPB at the leading edge of the eastward spread (Alberta Sustainable Resource Development, 2002). We found that narrative framing of the beetle's arrival in Alberta was not focused on management solutions. War-conflict narrative frames co-occurred with financial support for continuing standard beetle management dominated coverage. Second, the disconnect between media narrative framing and the expert authorities in BC and Alberta presents a potential barrier to cross-jurisdictional collaboration. Previous work has strongly articulated the need for shared, cohesive visions to proactively manage transboundary biorisks (Ansell et al., 2010; Creutzburg et al., 2022; Stokes et al., 2006). The beetle's spread into Alberta was partly driven by failed attempts in BC to maintain populations below epidemic levels, enrolling new actors in the crisis (Carroll et al., n.d.). To improve coordination across jurisdictions, we recommend greater attention to strategic public communication through news media and other outlets as part of cross-boundary crisis response.

We also found that authority and sources were localized and the participation of non-political or non-scientific groups was limited. There is a consistent trend in the news to quote and legitimize the talking points of politicians over the expertise of scientists in both environmental (Boykoff, 2007) and

medical (Hubner, 2021) crises, marginalizing dissenting voices or alternative viewpoints (Benson & Wood, 2015). The fact we found only one instance of a non-leading political party being quoted more than once, demonstrates that not only are politicians dominating news stories, but politicians from leading parties are legitimized most prominently in the media. Therefore, we recommend that scientists and other stakeholders and rightsholders who wish to engage with the media on environmental crises should identify themselves to local media early to help journalists identify varying expertise and pay attention to how their own language can be interpreted by non-experts.

Conclusion

This study examined how biorisks are presented in the media across temporal and spatial scales. In the case of mountain pine beetle coverage, war-conflict narratives paint an “us vs. them” imaginary, where humanity is in a battle against the beetle. Medical narratives present the beetle as a disease from which forests must heal. Anthropomorphic narratives present mountain pine beetle as voracious, eating away at forests indiscriminately. All narratives can play a role in responses to a crisis, but further work is needed to link specific crisis responses with media narratives. As a spreading crisis, we found medical frames were common in BC relative to war-conflict frames in Alberta. This also reflected responses such as salvage logging in BC where the beetle is endemic (i.e. medical frame of treating a disease), to front line defense (war-conflict narrative) of a new threat in AB where the beetle is a novel invasive.

Expertise recognized in one province was not quoted in another, potentially adding to the gap in inter-jurisdictional communication. Most narrative framing came from journalists, and politicians were quoted most often. Although most quotes did not contain narrative frames (Benson & Wood, 2015), that does not mean their inclusion and source authority are not important for the overall framing of the crisis (Nisbet, 2009), simply that the language of the narrative frames came largely from journalists. These findings highlight gaps in the voices and perspectives that shape news media coverage of environmental crises, and the power of journalists and politicians to control the narrative in periods of heightened uncertainty. Further, the findings underscore the dynamic nature of environmental crisis communication and the importance of regional geopolitical context managing the spread of biorisks.

Notes

1. As articles may contain more than one quoted source per article, we present the percentage of articles containing quotes by specific sources.
2. One exception is Stoett (2010) who finds that that medical professionals and pharmaceutical companies associate the risks of invasive species with potential spread of infectious disease.
3. We note the outbreak occurred when there was significant muzzling of Canada’s government scientists (Westwood et al., 2017). However, government scientists were still quoted more frequently than university scientists in news coverage.

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Declaration of competing interest

The authors declare that they have no known financial, personal, or professional relationships that could have appeared to influence the work reported in this paper.

Credit authorship contribution statement

Jenna Hutchen: Conceptualization, Methodology, Investigation, Data Curation, Formal Analysis, Writing – Original Draft, Review & Editing; **Valerie Berseth:** Conceptualization, Methodology, Writing – Original Draft, Review & Editing; **Vivian M. Nguyen:** Writing – Review & Editing, Supervision, Funding acquisition.

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Appendices

Appendix A1 – Summary of terms used to search Canadian NewsStream. Attached as separate document

A1.1 – Newspapers included in article searches

British Columbia. (“mountain pine beetle” AND ab(“beetle”) AND pub((“Harbour City Star” OR “Abbotsford Times” OR “Terrace Standard” OR “Delta Optimist” OR “Alberni Valley Times” OR “The Record” OR “The Lady-smith – Chemainus Chronicle” OR “The Kootenay Advertiser” OR “Goldstream Gazette” OR “Kelowna Capital News” OR “The Interior News” OR “The Standard” OR “The Review” OR “Saanich News” OR “Maple Ridge, Pitt Meadows Times” OR “Langley Times” OR “North Thompson Journal” OR “Penticton Western News” OR “The Vancouver Sun (Online)” OR “Cowichan News Leader” OR “Lake Cowichan Gazette” OR “Nanaimo News Bulletin” OR “Parksville – Qualicum News” OR “The Leader” OR “Salmon Arm Observer” OR “Omineca Express” OR “Eagle Valley News” OR “Castlegar News” OR “Daily Townsman” OR “Cowichan Valley Citizen” OR “Nelson Daily News” OR “South Delta Leader” OR “The Golden Star” OR “Langley Advance” OR “Nanaimo Daily News” OR “The Chilliwack Progress” OR “The Province (Online)” OR “The Merritt Herald” OR “Alaska Highway News” OR “The Caledonia Courier” OR “WestEnd” OR “The Morning Star” OR “The North Shore Outlook” OR “Quesnel Cariboo Observer” OR “100 Mile House Free Press” OR “Courier – Islander” OR “Cowichan News Leader Pictorial” OR “Bowen Island Undercurrent” OR “Prince George Citizen” OR “Similkameen Spotlight” OR “Victoria Weekend” OR “Business Examiner” OR “Dawson Creek Daily News” OR “The Peace Arch News” OR “North Shore News” OR “Mission City Record” OR “Kamloops Daily News” OR “Revelstoke Times Review” OR “Oak Bay News” OR “The Northern Sentinel” OR “The Province” OR “The Tribune” OR “Times – Colonist” OR “The News: Esquimalt” OR “Burnaby News Leader” OR “Summerland Review” OR “B.C. Business Magazine” OR “The Vancouver Sun” OR “Vancouver Courier” OR “The Courtenay Comox Valley Record” OR “The Times” OR “The Lake Windermere Valley Echo” OR “The Prince George Free Press” OR “The Aldergrove Star” OR “Lakes District News” OR “Campbell River Mirror”

OR "Chilliwack Times" OR "Equity" OR "Houston Today" OR "Burnaby Now" OR "The News" OR "Daily Bulletin" OR "The Tri City News" OR "Victoria News" OR "Arrow Lakes News" OR "The Sooke Mirror" OR "Peninsula News Review" OR "North Island Midweek" OR "The Tri – Cities NOW" OR "The Tri – Cities Now" OR "Richmond News" OR "The Agassiz – Harrison Observer" OR "Kamloops This Week" OR "North Island Gazette" OR "The Journal" OR "Daily News" OR "Trail Times")) AND stype.exact("Newspapers") AND la.exact("English")) NOT pub.exact("The Times – Transcript")

Alberta. ("mountain pine beetle" AND ab("beetle") AND pub(("Edmonton Journal" OR "Crownsnest Pass Herald" OR "The Peace Country Sun (Online)" OR "Wainwright Star" OR "The High River Times" OR "Beaverlodge Advertiser" OR "The Nanton News (Online)" OR "Consort Enterprise" OR "Whitecourt Star" OR "The Brooks Bulletin" OR "The Camrose Canadian (Online)" OR "Red Deer Express" OR "Cardston Temple City Star" OR "The Camrose Canadian" OR "The Brooks & County Chronicle" OR "The Medicine Hat News" OR "Wainwright Star Chronicle" OR "The Daily Herald-Tribune (Online)" OR "Record-Gazette" OR "Vermilion and Area Voice" OR "The Lakeside Leader" OR "Pincher Creek Echo" OR "Lloydminster Source" OR "The Stettler Independent" OR "Fox Creek Times" OR "The Pipestone Flyer" OR "Connect" OR "Edmonton Examiner" OR "The Nanton News" OR "The Calgary Sun" OR "Whitecourt Star" OR "The Lacombe Globe (Online)" OR "Claresholm Local Press" OR "The Mayerthorpe Freelancer" OR "Calgary Herald (Online)" OR "The Drumheller Mail" OR "Drayton Valley Western Review (Online)" OR "Drayton Valley Western Review" OR "Edmonton Journal (Online)" OR "Cochrane Times" OR "Sun Times" OR "Pincher Creek Echo (Online)" OR "The Castor Advance" OR "Sherwood Park News" OR "The Lamont Leader" OR "The Lacombe Globe" OR "Grande Cache Mountaineer" OR "Grizzly Gazette" OR "Weekend Regional" OR "The Capital" OR "The South Peace News" OR "The Lethbridge Herald" OR "The Leduc Representative (Online)" OR "Hanna Herald (Online)" OR "The Fitzhugh" OR "The Hinton Parklander" OR "Vegreville Observer" OR "The Edmonton Sun (Online)" OR "Vulcan Advocate" OR "Spruce Grove Examiner (Online)" OR "Farm 'n' Friends" OR "Ponoka News" OR "Beaverlodge West County News & Advertiser" OR "Eckville Echo" OR "Lloydminster Meridian Booster (Online)" OR "The Edmonton Sun" OR "The Valleyview Valley Views" OR "Devon Dispatch News" OR "The Signal" OR "Sherwood Park News (Online)" OR "Smoky River Express" OR "Fever" OR "Vulcan Advocate (Online)" OR "The Provost News" OR "The Hinton Parklander (Online)" OR "Commerce News" OR "Strathmore Times" OR "The Wainwright Edge" OR "Cold Lake Sun" OR "The Peace Country Sun" OR "Rimbey Review" OR "Airdrie City View" OR "Rocky Mountain Outlook" OR "The Oyen Echo" OR "The Tofield Mercury" OR "Wainwright Star Edge" OR "Bashaw Star" OR "Fort McMurray Today (Online)" OR "Standard (Online)" OR "The Community Press" OR "Beaumont News" OR "Spruce Grove Examiner" OR "Alberta Business" OR "Airdrie Echo (Online)" OR "Edson Leader" OR "The Free Press" OR "The Daily Herald-Tribune" OR "The Macleod Gazette" OR "Redwater Review" OR "Scope Newspaper" OR "The Strathmore Standard" OR "Cochrane Times (Online)" OR "The Weekly Anchor" OR "The High River Times (Online)" OR "Record-Gazette (Online)" OR "Wetaskiwin Times Advertiser" OR "Northern Journal" OR "Smoky Lake Signal" OR "East Central Alberta Review" OR "The Mayerthorpe Freelancer (Online)" OR "The 40 – Mile County Commentator" OR "The Bassano Times" OR "The Westlock News" OR "The Simcoe Reformer" OR "The Vauxhall Advance" OR "Beaverlodge West County News" OR "Calgary Herald" OR "The Taber Times" OR "Saint City News" OR "Fairview Post (Online)" OR "The Stony Plain Reporter" OR "Standard" OR "The Mountaineer" OR "Bow Valley Crag & Canyon" OR "Wetaskiwin Times Advertiser (Online)" OR "Fairview Post" OR "Inside Drumheller" OR "The Sunny South News" OR "The Weekly Review" OR "Fort McMurray Today" OR "The Calgary Sun (Online)" OR "The Stony Plain Reporter (Online)" OR "Airdrie Echo" OR "Edmonton Examiner (Online)" OR "The Strathmore Standard (Online)" OR "The Wainwright Review" OR "Cold Lake Sun (Online)" OR "Edson Leader (Online)" OR "Bow Valley Crag & Canyon (Online)" OR "Hanna Herald" OR "Sylvan Lake News" OR "The Leduc Representative")) AND stype.exact("Newspapers") AND la.exact("English")) NOT pub.exact("Terrace Standard" OR "The Standard" OR "Standard – Freeholder")

A2 – Descriptive figures showing the change in narrative frame frequency over time

A2.1 – Figures for narrative frame changes over time

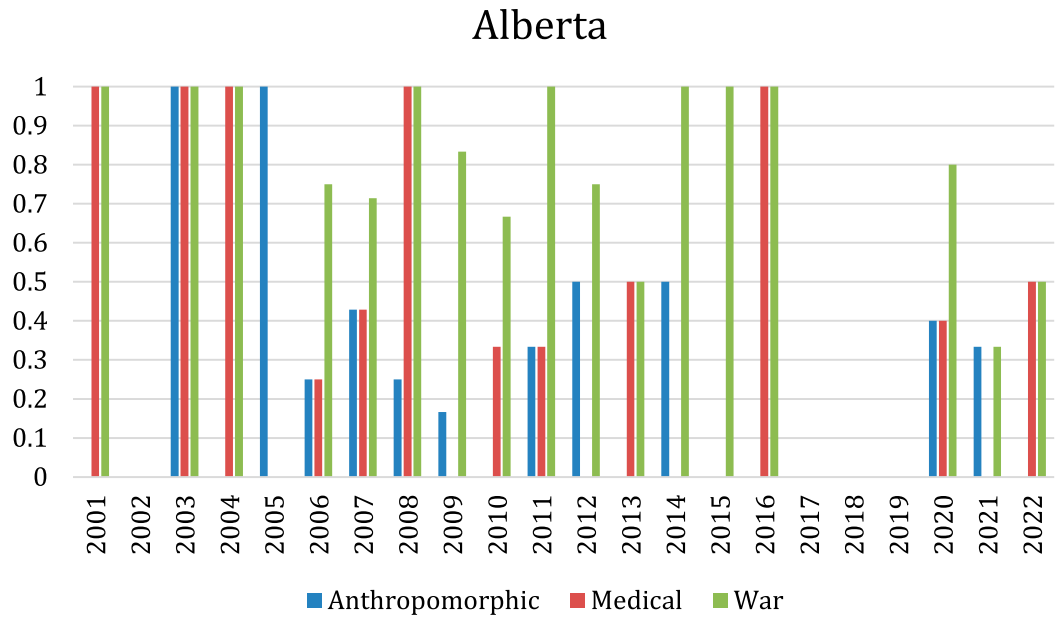


Figure A1. The proportion of articles containing narrative frames in Alberta, differentiated by the type of narrative frame present. The proportions do not represent the ratio of overall articles to articles with narrative frames – each bar represents the proportion of the three narrative frames in articles that had a narrative frame present. For example, 100% of articles with narrative frames (not articles published) in 2001 and 2016 used both medical and war narrative frames.

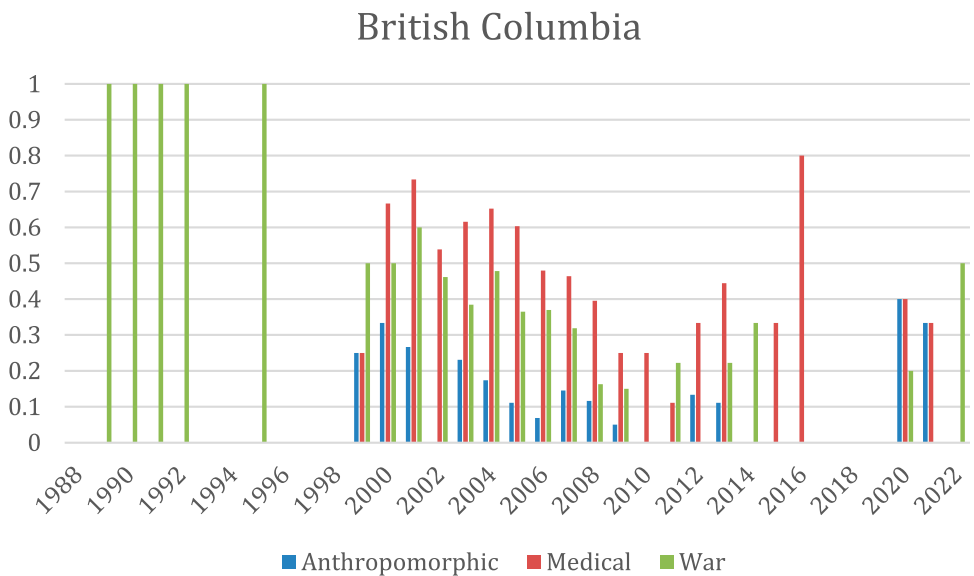


Figure A2. The proportion of articles containing narrative frames in British Columbia, differentiated by the type of narrative frame present. The proportions do not represent the ratio of overall articles to articles with narrative frames – each bar represents the proportion of the three narrative frames in articles that had a narrative frame present. For example, 100% of articles with narrative frames (not articles published) in 1988 used war narrative frames and 80% of articles with narrative frames in 2016 used medical narrative frames.