

Local Experts' Observations, Interpretations, and Responses to Human-Polar Bear Interactions in Churchill, Manitoba

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ABSTRACT. Since interactions and conflicts between polar bears (*Ursus maritimus*) and people are reportedly increasing across the Arctic, there is a pressing need to better understand how such conflicts can be prevented or their outcomes ameliorated. A great deal of knowledge about what strategies work for both preventing and mitigating human-polar bear conflicts lies with local experts, yet this knowledge has often remained relatively inaccessible to contemporary wildlife managers. This study had three main aims: to document and synthesize local knowledge of polar bear behaviour in Churchill, Manitoba, to characterize perceptions and interpretations of polar bears, and to examine the linkage between local experts' knowledge, perceptions, and actions. We identified a suite of bear behaviours that local experts consistently observe and interpret as cues to the bears' intent. These behaviours are not unique to this locale. Nevertheless, differences in perspectives on the predictability of polar bear behaviour and in interpretations of the nature of bears significantly influence study participants' strategies for responding to bears. Our findings demonstrate that human-related factors are more complex than current models of human-bear interactions account for, so there is a need to develop richer models for understanding what motivates and influences human behaviours and responses towards bears.

Key words: Churchill; human-bear conflict; local experts; local knowledge; polar bear; traditional knowledge; *Ursus maritimus*

RÉSUMÉ. Puisque les interactions et les conflits entre les ours polaires (*Ursus maritimus*) et les humains sont censément à la hausse à l'échelle de l'Arctique, il existe un besoin pressant de mieux comprendre comment il est possible d'éviter ces conflits et d'améliorer leurs issues. Les experts de la région possèdent beaucoup de connaissances au sujet des stratégies qui portent fruits, tant pour prévenir que pour atténuer les conflits entre les ours polaires et les humains, et pourtant, ces connaissances sont relativement inaccessibles aux gestionnaires actuels de la faune. La présente étude avait trois grands buts, soit de documenter et synthétiser les connaissances locales sur le comportement des ours polaires de Churchill, au Manitoba, de caractériser les perceptions et les interprétations au sujet des ours polaires, et d'examiner les liens qui existent entre les connaissances, les perceptions et les actions des experts de la région. Nous avons défini une série de comportements des ours couramment observés et interprétés par les experts de la région, comportements qui, selon eux, donnent des indices quant aux intentions des ours. Ces comportements ne sont pas uniques à cet endroit. Néanmoins, les différences de perspectives en matière de prédictibilité du comportement des ours polaires et d'interprétations de la nature des ours ont une influence considérable sur les stratégies des participants à l'étude pour réagir en présence d'ours. D'après nos constatations, les facteurs liés aux humains sont plus complexes que les modèles actuels d'interactions entre les humains et les ours ne le laissent entendre. C'est pourquoi il faut élaborer des modèles plus riches permettant de comprendre ce qui motive et influence les comportements de l'humain et ses réactions vis-à-vis des ours.

Mots clés : Churchill; conflit entre les humains et les ours; experts de la région; connaissances locales; ours polaire; connaissances traditionnelles; *Ursus maritimus*

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INTRODUCTION

Communities across the Canadian Arctic have reported increases in interactions and conflicts between polar bears (*Ursus maritimus* Phipps) and humans (Jonkel, 1970; Dowsley and Wenzel, 2008; Tyrrell, 2009; Lemelin et al., 2010; Boisen, 2013; Ewins et al., 2016; Wilder et al., 2017). As human-polar bear interactions have increased, so too has the need to identify best practices for reducing, ameliorating, and managing cases where those interactions turn to conflicts (Matt, 2010; Clark et al., 2012; Boisen, 2013; Ewins et al., 2016; Schmidt and Clark, 2018). Existing literature on human-polar bear conflicts emphasizes bear behavior and biological context, but significant knowledge gaps remain regarding how humans perceive and respond to their interactions with polar bears (Ovsyanikov, 1996; Clark, 2003; Vongraven and Peacock, 2011; Clark et al., 2012). In 2009, the International Union for Conservation of Nature's Polar Bear Specialist Group passed a resolution resolving, "all Signatory Nations to the Agreement on Conservation of Polar Bears should make immediate use of all available information, methods and means, in order to minimize detrimental interactions between polar bears and humans" (Resolution #5-2009, Obbard et al., 2010:83). Research in response to that resolution offers comprehensive summaries of trends in human-polar bear conflicts around the Arctic (Wilder et al., 2017) and specifically in Churchill, Manitoba (Heemskerk et al., 2020). However, since those analyses yielded aggregate characteristics from incidents reported to governmental authorities, they shouldn't be expected to either capture or represent the details, nuances, or context of all situations on the ground. Moreover, individual, organizational, and societal factors can affect reporting rates of human-bear conflicts, hence any conclusions about conflict frequency and severity drawn from such data must be interpreted with such potential limitations in mind (Howe et al., 2010; Wilbur et al., 2018). Consequently, we are in full agreement with Heemskerk et al. (2020) that further information is necessary to create a fuller picture of the dynamics of human-polar bear conflicts. Residents of Arctic communities where polar bears are active possess a great deal of empirical knowledge about what strategies work for preventing or mitigating conflict. They are able to observe polar bear behaviour for extended periods of time and have rich "frontline" knowledge of interacting with polar bears (Keith et al., 2005; Voorhees et al., 2014; Joint Secretariat, 2015; Ewins et al., 2016). Yet, this knowledge is too rarely synthesized or communicated to broader audiences.

Human-polar bear interactions are a complex challenge that encompasses diverse social, cultural, emotional, physical, and behavioural factors, many of which are difficult to quantify. Qualitative research provides an important opportunity to gain deeper insights into the strategies of Northerners for responding to and avoiding conflict with bears, as well as the practical interpretations of bear behaviour that inform these strategies (Clark and

Slocombe, 2009; Lemelin et al., 2010; Voorhees et al., 2014). Consequently, this qualitative study has three main aims: 1) to document local knowledge of polar bear behaviour in Churchill, Manitoba, 2) to clarify local perceptions and interpretations of polar bears, and 3) to examine the linkage between what people know about polar bears, how they perceive them, and how they craft their own responses to polar bears during interactions with them. Our specific research questions are 1) What do local experts know (or claim to know) about polar bears and their interactions with humans in and around Churchill, Manitoba? 2) What are individual strategies for responding to and avoiding conflicts with polar bears? and 3) What interpretations of polar bear behaviour inform these strategies?

This study differs from most other local and traditional ecological knowledge studies about polar bears in that we did not seek to chronicle observations of distribution and abundance or polar bear feeding and denning behaviour, nor did we seek to understand how these may be affected by climate change. Those topics have been dealt with extensively by other authors (e.g., Van de Velde et al., 2003; Keith et al., 2005; Tyrrell, 2006; Dowsley, 2007; Dowsley and Wenzel, 2008; Henri et al., 2010; Lemelin et al., 2010; Voorhees et al., 2014; Joint Secretariat, 2015; Wong and Murphy, 2016; York et al., 2016; LaForest et al., 2018). Instead, we focus here on what participants know about how polar bears interact with people, how they frame that knowledge in their own subjective understanding of polar bears as beings with agency—the ability to undertake independent action (Steward, 2009)—and how this knowledge and framing guides their actions in real situations.

METHODS

Study Area

Churchill, Manitoba is located approximately 1500 km north of Winnipeg, on the southwest coast of the Hudson Bay, and has a population of approximately 899 people (Statistics Canada, 2017). Compared to most other communities that routinely experience polar bear-human interactions in northern Canada, Churchill is culturally heterogeneous, made up of both non-Indigenous and Indigenous peoples including members of the Caribou Inuit, Sayisi-Dene, Swampy Cree, and Métis (Brandson, 2012). The Churchill region is also home to the Western Hudson Bay polar bear population that annually spends approximately 4–5 months (typically between early July and early December) on shore (Stirling et al., 1977; Stirling and Parkinson, 2006; Regehr et al., 2007). During this time, polar bears are regularly seen in and around the community, and various types of polar bear-human interactions are commonplace (Stirling et al., 1977; Struzik, 2014).

For several reasons, polar bear-human interactions in the Churchill area are unique. Polar bear hunting for sport or by

Indigenous people has been prohibited in Manitoba since 1954. This prohibition does not apply to any other polar bear subpopulations in Canada. In addition, Churchill is the only northern community with a highly developed polar bear-viewing industry (Struzik, 2014). Dawson et al. (2010) estimated that between 6000 and 10,000 tourists travel to the community each year to view polar bears. As a result, a significant number of people in Churchill have developed their knowledge of polar bears through their experiences as polar bear-viewing guides and polar bear safety monitors. While some polar bear-viewing guides are long-term residents of Churchill, increasingly guides come to the region only seasonally for the busy part of the polar bear season (in the late fall and early winter). Seasonal guides vary in levels of expertise and training, with some having little specific prior experience with polar bears, and others having significant experience working with polar bears in other contexts (e.g., Svalbard) or working with grizzly bears. Most polar bear viewing in the Churchill area takes place from tundra vehicles, although some on-the-ground interactions do occur, and local entrepreneurs constantly experiment with new bear viewing opportunities (Herrero and Herrero, 1997).

Although other Arctic communities have developed organized responses to human-polar bear conflicts, none are on the scale or level of institutionalization as in Churchill. The Polar Bear Alert Program manages human-polar bear interactions in and around the community (Townsend et al., 2009; Struzik, 2014). Established in 1969 and coordinated by Manitoba Conservation, the Polar Bear Alert Program (hereafter referred to as the PBA Program) has a mandate to protect Churchill residents from polar bears and polar bears from people. The PBA Program consists of patrols that deter, capture, or destroy polar bears that venture into the town; many problem bears are detected through a telephone hotline (Kearney, 1989; Heemskerk et al., 2020). Although conservation officers and resource management technicians are responsible for the daily operation of the PBA Program, levels of experience with polar bears have varied significantly among personnel but generally increased over time (Kearney, 1989).

Research Approach

This research process focused on building relationships and trust with the Churchill community. The first author spent approximately 7.5 months in the community over four field visits between 2013 and 2015. During these visits, the first author lived in town and was actively engaged in community activities and events. This enabled her to develop a strong rapport with research participants, many of whom expressed their support for this research topic and its methods. The third author first began research there in 1992 and lived in Churchill from 1997 to 2000, working for Parks Canada. Our research design was iterative and evolved over the course of the data collection based on input from participants. Data were collected

under the authorization of the University of Saskatchewan Behavioural Research Ethics Board, protocol number BEH 13-143.

Participant Definition and Recruitment

In this study, we sought to elicit the knowledge of a specific group of people who have extensive experience working with polar bears; we refer to this group as “local experts.” The term local is often contested and has been used in many different ways (Taylor and de Loë, 2012). Here, we use the term broadly to include both long-term residents of Churchill and people who do not live in Churchill year-round but have considerable seasonal experience working with polar bears. We recognize that this definition of local is not consistent with the way most Churchill residents would use the term. For Churchill residents, the term local tends to be used only to refer to long-term (i.e., multiyear, year-round) residents. Furthermore, being local there is associated with a specific social standing that is often, but not always, attained by demonstrating prowess in on-the-land settings. Nevertheless, we chose this definition as a way to frame local expertise that would ensure cultural and experiential diversity are both represented in our data (Davis and Wagner, 2003; Hitomi and Loring, 2018).

Participants in this study included both Indigenous traditional knowledge (TK) holders and non-Indigenous local knowledge holders. We recognize that, as differentiated by many authors, local knowledge lacks the cultural and historical continuity of traditional knowledge (Olsson and Folke, 2001). However, our intent was not to compare, contrast, or even necessarily distinguish these different types of knowledge. Instead, we focus on expert understandings of polar bears and knowledge of how to respond to bears that traditional and local knowledge holders alike have developed over extended periods of observation and experience (Fazey et al., 2006). Expert knowledge is developed when individuals receive direct feedback from their actions (Fazey et al., 2006). Local experts regularly put their knowledge of polar bear behaviour into practice to inform and guide their responses to bears during interactions. Hence, local experts receive direct physical feedback from polar bears based on their ability to accurately and effectively understand and respond to certain bear behaviours.

Data Collection

Data for this investigation came primarily from 37 semi-structured interviews conducted by the first author in 2013 and 2014. Of these interviewees, 31 (84%) were male and six (16%) were female, with eight (22%) identifying as Indigenous and 29 (78%) as non-Indigenous. The work presented here was part of a broader study on local perspectives on polar bear-human interactions, so it also benefited indirectly from insights gained through other methods (Schmidt and Clark, 2018). The first author

facilitated two sharing circles with all-female participants (seven in 2013, five in 2014). Of these 12 women, seven were Indigenous. The first and third authors together also held three focus groups with bear managers in 2014, facilitated by the second author (10 participants total, with only one female participant and two Indigenous participants).

Semi-structured interviews were chosen because they are informal, conversational, and widely accepted in the North (Huntington, 1998). Moreover, they have proven effective for documenting detailed information about bear-human interactions elsewhere (e.g., Clark and Slocombe, 2009; Voorhees et al., 2014; LaForest et al., 2018). As a result, only data from the interviews that contained explicit descriptions of bear behaviour are discussed and quoted here. Interview questions were refined based on a pilot test and consultations with interview participants to make the questions more specific (Supplementary Appendix). Interviews were held in settings of the participant's choosing and ranged between 30 minutes to two hours (with the average being about 1 hour). All interviews were audio-recorded with participant's consent.

Analysis and Validation

We analysed the text of the transcripts of all interviews using NVIVO Mac v.10 qualitative data analysis software. We used an inductive thematic coding approach that produced the conceptual framework by which we answered the research questions (Braun and Clarke, 2006). In-depth observations and interpretations of polar bear behaviour were an unanticipated finding in this study and not ones the authors initially set out to identify. Hence, observations and interpretations of bear behaviour were categories that emerged as the data were coded to answer other research questions. Interview transcripts were returned to participants for their records. Interviews were conducted over several years, and some local experts were interviewed more than once. This iteration created multiple opportunities to refine and validate interviewee's contributions. In addition, a workshop for study participants (Schmidt and Clark, 2015) and a well-attended public presentation to community members at the Town Complex's theatre in October 2015 allowed participants to respond to interpretations and to clarify any unexplained details in the findings. Themes identified in the analysis were further informally discussed with each participant to ensure that they accurately reflected the participant's knowledge and intent (Wilson, 2008).

RESULTS

Interview data were the most detailed amongst people who had multidecadal experience working with polar bears. Most of these participants had diverse experiences with polar bears that had been gained through multiple different roles as conservation officers, polar bear-viewing guides,

polar bear monitors, or in other on-the-land settings (e.g., photographer, researcher). The majority of this subset of interviewees (n = 13 out of 17) were long-term residents who had lived in Churchill for more than 20 years. Four other participants either worked in management agencies or were seasonal polar bear viewing guides.

Observed Polar Bear Behaviours during Interactions with Humans

Participants gave detailed observations of specific behaviours that polar bears displayed during interactions with humans. Quotes below are labelled with each interviewee's unique alphanumeric identification code. These observations predominantly focused on specific polar bear movements and body language that participants interpreted as aggressive behaviour. These included various head movements, changes in the position of the ears, changes in the orientation of the body as well as changes in gait, shifts in eye contact, and vocalizations (Table 1; Fig. 1).

As Table 1 shows, there was a high level of consistency in the behaviours that participants identified as well as in their interpretations of what these behaviours meant. When participants gave detailed descriptions of body language, they almost always did so in the context of a story about a specific encounter, which indicates that participants recognized that polar bear behaviours are highly dynamic, and interpretations of their meaning are extremely context dependent. Participants were also quick to point out that a specific behaviour could not be accurately interpreted by itself. As one participant noted: "I don't think it's something [where] you can just say: 'oh yeah, if the bear's ears go back, it means that he's going to attack you.' Because it doesn't always mean he's gonna attack you" (B11). Furthermore, several participants noted that the complex and nuanced nature of polar bear behaviour was difficult to describe accurately.

Polar Bear Behaviour as a Spectrum of Predictability

Participants discussed their ability to recognize specific polar bear behaviours and to make inferences about how a polar bear was going to respond to them during an interaction. However, the level of certainty with which participants' felt they could understand polar bear body language and subsequently predict their behaviour varied significantly between participants. Some participants were confident that polar bear behaviour was recognizable and therefore predictable: "you can communicate with bears, bears can communicate with you, even with two different languages, they can read you, and you can read them" (B1). On the other hand, other participants were adamant that polar bear behaviour could never be fully anticipated.

We found that interpretations of the predictability of polar bear behaviour seemed to exist along a continuum (Fig. 2). None of the participants suggested that polar bear behaviour was either completely predictable or impossible

TABLE 1. Aggressive polar bear behaviours observed during interactions with humans as described by study participants in Churchill, Manitoba (2013–14).

Observed behaviours	Supporting quotations
Head position	“I let them come, get to be that close, but I watch the behaviour, if they start to duck their head down; they’re coming into tackle mode.” (A1)
	“Is his head coming down, are his ears going back, are his shoulders humping up? (A8)
	“But if you are with them and they are walking around you or sniffing the air and then they are walking and they got their head down, that’s not a good sign—head down. That means that they’re looking do some predating or are ready for some kind of action. ... I mean you know, there are many postures that are danger.” (A20)
	“And it’s like they are coming, and it’s head low and he’s stalking.” (A2)
	“The next one is the mouthing and the head swaying. They do head sway. You know, low head. I always call that “the bull,” because now the bull’s got his head down. And guess what the next step is? He’s going to come at you. Unless someone changes his behaviour.” (A7)
	“More so their head behaviour, if they’ve got their head really down that’s kind of more of a charging behaviour, you can pick that out.” (A9)
Posture and gait	“If you see a bear come forward with one of its front feet and drop its head. That means that it’s coming. It may be a bluff charge, but it’s coming.” (A3)
	“I always look at the bear’s posture, are his back legs coiled and ready to push, and go...and then you get the head low or that stiff-legged gait where they start walking sideways and they are looking at you, like you know (raising middle figure gesture).” (A8)
Vocalizations	“And then he’s coming, from that plodding along the coast to like—it’s hard to describe, but they position every foot.” (A2)
	Interviewer: “Do polar bears bluff charge?” Participant: “Oh yeah, yeah, yeah. They start snapping their jaws and they come, you can tell that. You can tell that.” (B16)
	“I heard this, I thought it was teals [ducks], this sort of jet light sound, and I thought it was these small ducks, they make a noise when they fly...that sound was a warning, he had hissed at me.” (B11)
	“He will stomp his feet, he will hiss, he’ll jaw pop and stuff like that.” (A8)
	“He had his both front paws facing me, he turned his head sideways and shook his head back and forth and then (making a hissing sound), and I just went, oh shit!” (A1)
Ear movements	“A lot of times they will sway their head, their lips will flare, they will lick their lips, they’ll clack their jaws, those are all signs that they are displaced, agitated, you’re too close.” (A3)
	“As soon as he rolls those ears back and he’s coming after you.” (B16)
	“When the ears go back, it’s time to look out, you know, something bad is about to happen.” (B3)
Eye movements	“I touched off a shot and that shattered rock blew back and it hit him in the face and he stopped and he took a couple steps back, and his ears went right flat like it pissed him off.” (A2)
	“I kept saying NO, and he’d lift his head, he’d look at me, he’d turn sideways and he’d look out the side of his eye” (A1)
	“And then, like BOOM! His head comes up and he’s just staring at me. And then he’s coming.” (A2)

to predict; rather, interpretations of predictability existed along a gradient between extremes, ranging from more predictable to less predictable (Fig. 2). For example, participants who were confident in their ability to predict polar bear behaviour noted that they would not be as precise at anticipating the behaviour of young bears or of bears unknown to them. Similarly, participants on the other end of the spectrum still made inferences about how polar bears were going to behave based on interpretations of their body language.

Participants who viewed polar bears as unpredictable were often critical of people whose interpretations fell at the opposite end of the continuum. As one long-term bear-viewing guide noted: “You get a lot of people and their dogs

[that] say: yeah, I know bears, and yeah, I can tell what a bear is going to do. And I say to that: bullshit. I still don’t know. I still have a lot to learn” (A1). Similarly, participants who considered polar bear behaviour to be predictable often suggested that people who did not share this interpretation had not been observant enough to properly learn polar bear behaviour. As one participant explained, “all you have to do is pay attention to the bears and you could be doing something like this” (A3).

The Abilities of Polar Bears

In addition to making observations about polar bear behaviour, participants also spoke about the abilities and



FIG. 1. These two remote camera photos illustrate the transition (a) to the low head and ears back behaviour (b) described by study participants in Table 1.

high aptitude of polar bears. Participants most frequently commented on the intelligence of polar bears. As one participant noted, “they don’t miss a trick ... they know everything that is going on” (A1). Several participants pointed out that polar bears have the ability to recognize

specific individuals (and situations) and to learn from their prior experiences: “they don’t forget, they learn from their mistakes” (A13). Some participants noted that polar bears in the Churchill area have come to associate PBA personnel and their trucks with negative stimuli such as cracker shells and to avoid them as a result. One participant noted that the practice of hazing bears who entered the Churchill community taught bears to avoid specific people rather than to develop negative associations with this particular behaviour:

they [PBA personnel) do not create a negative association with what the bear is doing—they create a negative association with the people managing the situation. So then bears just run away because a certain person shows up or they recognize a truck. So then they just avoid the truck.

(A12)

Participants also pointed out that most polar bears were quick to learn from negative experiences with polar bear traps or electric fences, and that they rarely made the same mistake twice. The capacity to plan was another ability identified by participants who noted that polar bears tend to think about and be deliberate in their actions. Participants observed that polar bears are aware of and attentive to patterns in human behaviour and make “calculated” decisions when responding to humans: “I think they are methodical in what they do. They plan things out, I think, before they launch into things” (A8). Finally, two participants also described polar bears as having the ability to read human emotions and intentions. For example, “They feel the fear or the aggressivity that a person has” (B1).

Strategies for Interacting with Polar Bears

Many participants shared with us (often unprompted) their individual strategies for responding to polar bears during on-the-ground interactions (Table 2). Some participants emphasized that avoiding on-the-ground

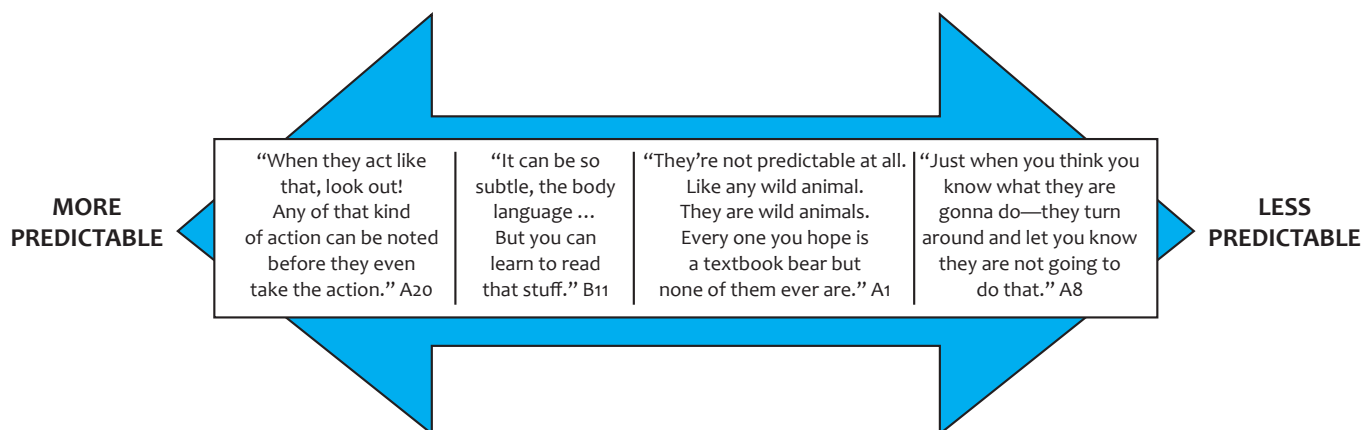


FIG. 2. The range of perspectives from study participants on whether polar bear behaviour is predictable or unpredictable.

TABLE 2. Strategies for responding to polar bears during an interaction.

Strategies for responding to polar bears	Supporting quotations
Barriers	<p>“You use what is in your environment. And I do it with polar bears, with rocks. You just, you use these kinds of blockages that are not really any physical barriers but they are emotional barriers or psychological barriers for the bear.” (A12)</p> <p>“From the start don’t put yourself in a situation that is hugely disadvantageous. Being on top [high] is always a position of dominance so you don’t want to walk just below a hill where a bear could just pop up.” (A12)</p>
Scenario planning	<p>“It’s the reaction. And people have to think that through in terms of how you do it. It all depends on where you’re at: the distance level, the charging bear or whatever. How do I go around this rock quickly? How do I navigate through this? Or as you’re walking, what if I see a bear? What am I going to do?” (A18)</p> <p>“We have a plan that if I say ‘there’s a bear,’ we are going to make for that vehicle over there, or we’re gonna get together as a group.” (A2)</p>
Human behaviour	<p>Participant: “Backing away is one of the things you shouldn’t do.” Interviewer: “Why not?” Participant: “Because you never know if they are going to keep coming towards you, because some bears are like that...Don’t turn your back on them.” (A17)</p> <p>“If you see them first then you can react and if you are in a close situation and you aren’t armed and you’ve got nothing to save your ass, basically drop jackets, hats, gloves...” (A1)</p> <p>“The safest thing to do is to let the bear decide what is happening.” (A7)</p> <p>“Give the bear a chance! If you are stuck in a spot where you have to scare the bear, or if he is approaching you, yeah. But if you can let him walk by, just let him walk by.” (A9)</p> <p>“If I am in a situation where I have a group of people around what I do is, I become the aggressor and say it’s time for you [the bear] to move on.” (A1)</p>

encounters was the most effective way to prevent conflicts with polar bears. However, others felt that face-to-face encounters could be safe as long as humans responded to polar bears in the correct ways. For some participants, this involved not showing fear and not retreating from a polar bear during an encounter. These participants gave detailed descriptions of how they used displays of confidence to deter polar bears who were approaching them. One participant described running towards the bear: “I ran between the people and the bear, in which case, just that show of confidence and the bear deflected and ran” (A2). Another pointed out that standing your ground and making aggressive movements towards the bear were effective tactics to make a bear reconsider its course of action: “I knew that he was trying to get me to turn around because they know that if they can get an animal to turn around it is much easier to take it down ... so I didn’t turn around” (B11). Several participants also described discharging their firearms into the ground at the bear’s feet, although perspectives differed on whether this was an effective strategy or merely served to aggravate the bear.

Participants who felt that bear behaviour had a high degree of predictability often suggested that displays of confidence were an effective tool for averting conflicts with polar bears. As one participant, who spoke at length about his ability to read bear behaviour and subsequently anticipate how a bear was going to react, pointed out: “I don’t like backing down from bears, you just train them to be dominant” (A12). On the other hand, participants who perceived bear behaviour to be less predictable were much more likely to suggest avoidance as the best tactic

for responding to polar bears. One such participant noted, “absolutely, I’ll do anything to get out of the bear’s way if I can” (A8). All participants emphasized the need to stay vigilant, to anticipate where encounters with polar bears might take place, and to have a plan for how they should behave towards the bear during an interaction.

Interpretations of Polar Bear Agency

Finally, participants seemed to have differing interpretations of who or what polar bears are with respect to their self-awareness and status as agential beings. Although not discussed explicitly in the interviews, these understandings were apparent in how participants talked about polar bears. We found that some participants emphasized the social role of polar bears in interactions with humans, while others spoke about them in more mechanistic terms. A range of interpretations of the nature of polar bears existed with some participants ascribing agency to polar bears while others did not (Fig. 3).

Although most participants acknowledged that individual polar bears behave differently based on their unique personalities, those that spoke about polar bears as agents were critical of generalizations that depicted polar bears simply as predators: “They have a great intelligence, power—emotional power. They are not only a machine that can kill, that is a TV example” (B1). These participants felt that the nature of polar bears is often misunderstood or misrepresented. These participants were quick to point out that polar bears are generally highly tolerant of humans: “I think they are incredibly tolerant animals, I don’t think

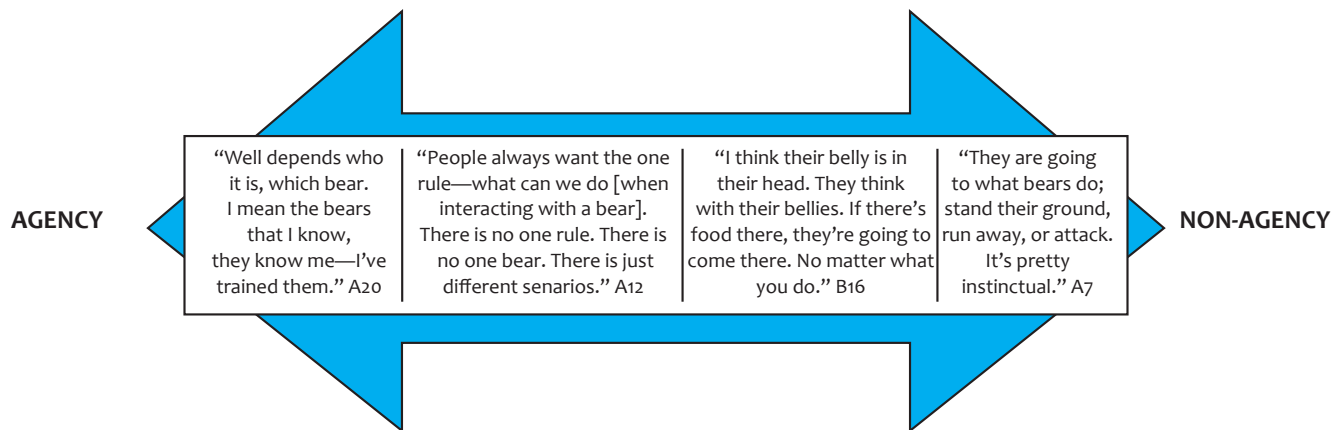


FIG. 3. The range of descriptions of polar bears as having agency or not having agency in their interactions with humans.

that they are running around hunting people” (B11). Furthermore, these participants described polar bear-human interactions as social relationships between individual bears and individual people: “I know them and I have my own bears and they know my voice” (A20). These participants emphasized the need for people to tailor responses to each individual polar bear based on feedback they received from the bear. Participants also described polar bears as capable of making decisions about how to interact with humans and emphasized that polar bears’ actions were based on the type of relationships they had developed with humans.

In contrast, other participants spoke about polar bears primarily in biological and mechanistic terms, frequently describing bear behaviour as driven entirely by instinct. These participants highlighted that polar bears are predators by nature and are motivated by their impulses to hunt: “they are a predator; you always have to remember that” (B3). As one participant noted, polar bears make decisions during interactions with humans that are based on their instinct to survive: “whatever they are going to do is going to benefit them ... their survival instinct is so much stronger than ours” (A7). When participants spoke about polar bears in this manner, they often downplayed the social relationship between humans and polar bears: “I think a bear is just going to do what it wants to do. If we shoot a cracker shell into the air, are we making it go that way because it’s scared of the cracker shell? Or is it going that way anyway?” (A13). Participants in this group did not discuss their role in shaping polar bear behaviour, nor were they as likely to explicitly acknowledge that polar bears are capable of learning from their experiences with people. Finally, participants who spoke about polar bears as non-agents were more likely to make generalizations about them as a species, often making broad statements about how polar bears should or should not behave towards people: “Bears should not want to be around people—period” (A7).

Although observations of polar bear behaviour were highly consistent between participants, perspectives on the predictability of polar bear behaviour and on the nature of polar bears were not. As Figures 2 and 3 demonstrate, participants held a range of perspectives on whether polar

bear behaviour is predictable, and whether polar bears are agents in their interactions with humans. Although we found that participants who viewed bear behaviour as more predictable were also more likely to talk about them as agents, this correlation was not always clear. Furthermore, participants who viewed polar bear behaviour as less predictable were not more likely to describe polar bears as non-agents. Likewise, we also found that participants often held multiple different frames of reference depending on the circumstances they were describing. For example, some participants described bears in mechanistic terms in some parts of the interview but as agents in others. Interpretations of the nature of polar bears therefore do not appear to be fixed or static in local experts’ minds. Such nuance and awareness of contingency may well be a significant contributor to those participants’ abilities to become experts in such a dynamic social-ecological system.

DISCUSSION

Polar Bear Behaviours

Observations about aggressive behaviours made by participants in this study were remarkably consistent with those documented in previous studies (Fleck and Herrero, 1988; Osyvanikov, 1996; Keith et al., 2005; Lemelin et al., 2010; Schmidt and Dowsley, 2010; Voorhees et al., 2014; Joint Secretariat, 2015). For example, Fleck and Herrero’s (1988) study participants from the NWT (including what’s now Nunavut) described huffing, jaw snapping, direct eye contact, a lowered head, ears back, and head swaying. These behaviours are unmistakably similar to those our participants reported (Table 1). Furthermore, signs of aggression described by participants in this study, many of whom were non-Indigenous, were also consistent with those identified by Indigenous TK holders. For example, Inuit hunters and elders in Gjoa Haven identified certain head movements displayed by polar bears during interactions with humans as threatening (Keith et al., 2005). For the

purposes of this paper, we do not differentiate between TK and Inuit Qaujimagatuqangit (IQ), although we recognize this distinction (e.g., Wenzel, 2004). The consistency between interpretations of polar bear behaviour in this study and previous ones both corroborates those TK-based observations about bear behaviour and demonstrates the significant knowledge of polar bear behaviour held by people in the Churchill region. Importantly, it also suggests there is a relatively high degree of consistency in polar bears' responses to people across a large geographic area and multiple polar bear subpopulations.

Observations about polar bears' cognitive abilities have also been documented in TK studies (Keith et al., 2005; Schmidt and Dowsley, 2010; Voorhees et al., 2014; Joint Secretariat, 2015). Much like participants in this study, Inuit and Inuvialuit acknowledge polar bears as extremely intelligent, able to plan, and hence having agency (Schmidt and Dowsley, 2010; Joint Secretariat, 2015). Furthermore, many TK holders believe that polar bears are able to read human thoughts, actions, and intentions (Schmidt and Dowsley, 2010; Voorhees et al., 2014). This perspective seemed to be shared, at least in part, by some participants in our study. Strategies for responding to polar bears that focused on human body language during interactions indicated that some participants believed that polar bears could read human actions. Although none of the participants in this study described polar bears as being able to read human thoughts, two participants did make explicit references to polar bears as having the ability to understand not only human body language but also human emotions and intentions. The observation that polar bears can "read" human emotions and intentions is often thought to be grounded in Indigenous worldviews (Schmidt and Dowsley, 2010; Voorhees et al., 2014), however, both participants who commented explicitly on this ability in our study were non-Indigenous. Clark et al. (2014) also found strong similarities between the perspectives of First Nation and some local non-Indigenous study participants with regard to the practical considerations of co-existing with grizzly bears. This finding suggests that to some extent experiential learning about bear behaviour may transcend cultural differences. That said, is it worth noting that knowledge about polar bears behaviour may also be learned from other people. Hence, the non-Indigenous participants who chose to use this particular interpretation of polar bear behaviour may be reproducing language used by their Indigenous colleagues or family members and vice versa. More research is required to determine exactly how observations about polar bear's reported abilities to read human emotions and intentions might translate across different knowledge systems.

Implications for Polar Bear Management Practices

Consistency in observations of polar bear behaviour indicates that local experts have significant knowledge of polar bears and of how to interact with them. However, as

Schmidt and Clark (2018) identified, there is a tendency for local experts to disregard or demonize each other when their strategies for responding to polar bears differ. As a result, social conflict between different groups of people who work with polar bears may be a barrier to effective knowledge sharing about polar bear behaviour and identifying effective strategies for preventing polar bear-human conflicts. This tension presents a significant loss of opportunity for increasing understandings of polar bear-human interactions at a time when there is a pressing need for these insights. As the findings of the present study suggest, local experts have much accurate information about polar bear behaviour and about how to respond to polar bears during interactions. However, the effective and collaborative sharing of this information may be hindered by a lack of common ground between different groups of people who work with polar bears.

It would, however, be a mistake to dismiss local experts' strategies because of their lack of consensus. Lute et al. (2018) found considerable divergence in bear managers' perspectives on human-bear conflict management techniques and ascribed this divergence not simply to technical knowledge and experience but to underlying values and worldviews. As such, one of the most productive near-term steps toward gaining deeper understandings of polar bear-human interactions may therefore lie in creating a forum in which the potential merits of all experience-based approaches are considered, even if they appear unorthodox or unconventional.

Furthermore, both managers and Churchill residents tend to consider polar bear-human interactions in Churchill as unique from those in other communities. As one manager noted, "a lot of people say the bears here are very different, you know, they are not the same as other bears, so what works in Iqaluit isn't going to work here" (B4). As a result, there is generally a sense that human-polar bear interactions in Churchill require different responses (e.g., different strategies for mitigating conflicts, different educational materials) from those applied in other communities. Yet, our study shows that observations of polar bear behaviour made by Churchill experts are consistent with those documented elsewhere, which suggests that specific polar bear behaviours towards people may not vary from place to place as much as is often thought, although their prevalence in different populations or regions may well differ (Clark et al., 2012); on the land, such varying likelihoods matter profoundly. For example, in a subpopulation with extensive exposure to humans and anthropogenic foods over time, such as western Hudson Bay, a greater proportion of the individual bears may exhibit habituation and food conditioning than elsewhere (Watts and Ratson, 1989). As a result, insights into polar bear behaviour from the Churchill context are more applicable to other contexts than originally thought and vice versa, as long as attention is paid to identifying particular consistent behaviours and not simply their prevalence in specific situations. Currently, there is a great deal of variation between communities

regarding conflict responses (Ewins et al., 2016). While it is important that responses are tailored to reflect specific community needs and expectations, exactly how and why polar bear behaviour varies between contexts should be a high priority for further study.

Advancing Understandings of Human-Bear Interactions

Currently the most comprehensive model for understanding the complex interplay of factors that influence human-bear interactions is Herrero et al.'s (2005) in which the outcomes of human-bear interactions are determined by situation-specific combinations of environmental factors, bear-related factors, and human behaviors and responses. To date, much of the research on human-bear interactions has focused on the first two of these elements to understand why bears react to humans in specific ways (e.g., McArthur Jope, 1983; Herrero, 1985; Gjertz and Persen, 1987; Fleck and Herrero, 1988; Stenhouse et al., 1988; Gilbert, 1989; Mattson et al., 1992; Clark, 2003; Dyck, 2006; Can et al., 2014; Penteriani et al., 2016; Wilder et al., 2017; Støen et al., 2018). This research has produced important insights into the difference between defensive and predatory behavior and the role of habituation and food-conditioning in human-bear conflicts (Herrero, 1985; Herrero and Fleck, 1990; Herrero et al., 2005; Smith et al., 2005; Elfström et al., 2014). The concepts of habituation and food conditioning are certainly necessary phenomena to understand, but the focus on them has nevertheless resulted in a body of research predominantly aimed at understanding bear behaviour, overshadowing the role of human behaviours in these interactions. Cumulatively, an epistemological bias affects the body of human-bear conflict research such that it fails to adequately consider such a significant element of the situations under study.

Assessments of human behaviours contributing to human-bear conflicts have tended to focus on proximate causes, including evaluating human activities prior to conflicts, the use of deterrents, and the person's proximate behaviour towards the bear, such as acting non-submissive, playing dead, or fighting back (Fleck and Herrero, 1988; Osvyankov, 1996; Herrero and Herrero, 1997; Penteriani et al., 2016; Wilder et al., 2017). Although proximate drivers are important, research to date does not adequately explore how human perceptions, responses, and behaviours shape the outcomes of conflicts with bears. Furthermore, assumptions about the agency of polar bears appear to have so far driven research on their interactions with people. Those assumptions, which we have described above, have significant implications for the findings of such research, yet they have not been made explicit in other studies.

People's strategies for avoiding conflict with polar bears and the practical interpretations of polar bear behaviour that inform these strategies have received relatively little attention and have not been incorporated into management plans or procedures. As our results

demonstrate, human-related factors are extraordinarily complex and there is a need to develop more comprehensive models for understanding what motivates and influences human behaviours and responses towards bears. It is also important that those who conduct the studies are explicit about their underlying assumptions about the agency of bears, and how these assumptions impact study design, data collection, and interpretation. Herrero et al.'s (2005) model for understanding human-bear interactions has provided a durable foundation for understanding the proximate human factors that influence the outcomes of human-bear interactions. While baseline information such as group size, human activities prior to conflicts, and the use of deterrents is important, our findings reveal the need for a deeper understanding of what motivates people to behave in certain ways towards bears and what informs people's decision-making during interactions. Human behaviours and responses to human-bear interactions are influenced by multiple, interrelated factors, such as 1) assumptions about who or what bears are, 2) perspectives on the knowability and predictability of bear behaviour, 3) individual understandings of specific situations, and 4) role and identity, and the expectations that accompany these (Fig. 4).

As the field of human-bear interactions continues to evolve, there needs to be a shift in focus from research that seeks to understand primarily bear-related factors (e.g., food conditioning, habituation, sex, and age) to more study of the human-related drivers. Future research on human interactions with bears of all species should involve diverse methodological toolboxes that include both qualitative and quantitative methods and focus on human responses. Human responses to human-bear interactions encompass diverse social, cultural, emotional, physical, and behavioural factors that we have only begun to understand. A focus on advancing understandings of human responses to human-bear interactions will likely provide the greatest inroads in increasing knowledge of how to prevent or mitigate human-bear conflicts. This research is necessary and urgent as it has the potential to save the lives of both bears and people.

Our findings showed that differences in perspectives on the predictability of polar bear behaviour and on the nature of polar bears provide important insights into why people's strategies for interacting with polar bears can vary significantly. What participants believe to be predictable and hence knowable about polar bear behaviour shapes what they perceive to be best practices for responding to bears. For example, participants who felt that polar bear behaviour was unpredictable were more likely to suggest avoiding or retreating from bears, whereas those who felt polar bear behaviour was predictable spoke about using displays of confidence to deter bears. Participants' situation-specific expectations may explain differences in opinions on the predictability of polar bear behaviour. Individuals form expectations about their ability to behave effectively during an interaction as well as about the consequences of their

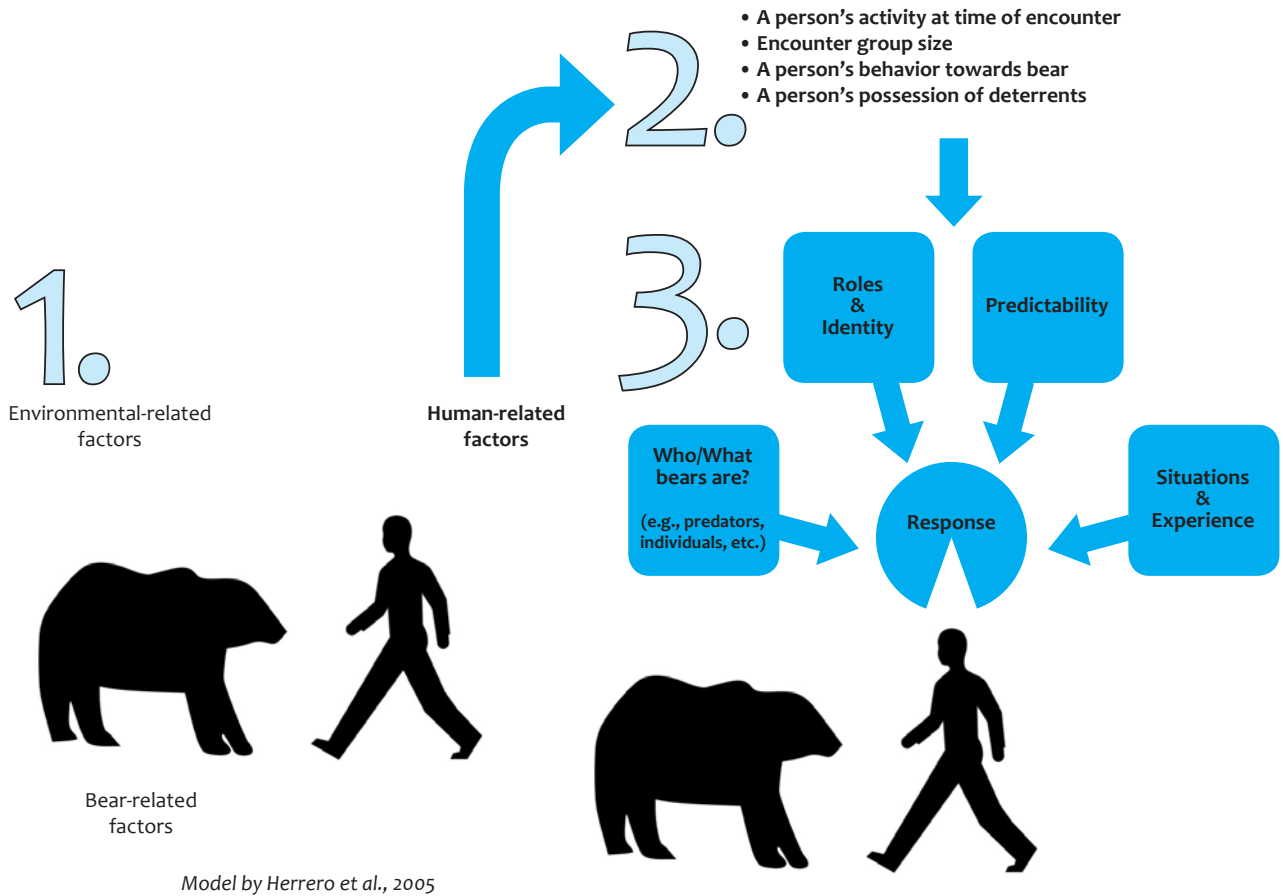


FIG. 4. A suggested elaboration of Herrero et al.'s (2005) model for understanding human responses to bear-human interactions. Section 1 shows the existing model. Section 2 highlights the existing model's variables shaping human responses. Section 3 shows our recommended additional variables that influence human behaviours and responses identified in our research.

behaviour towards wildlife (Zinn et al., 2008). A person's level of confidence in their knowledge of polar bear behaviour and in their ability to engineer positive outcomes during interactions can have a profound impact on how they respond to polar bears (Zinn et al., 2008). Hence, people with higher levels of confidence in their ability to respond to bears may view polar bear behaviour as more predictable compared to those with lower levels of confidence.

Our study shows that interpretations of polar bear behaviour and strategies for responding to them are grounded in broader ontological assumptions about who or what people think polar bears are. Those assumptions shape the kinds of relations (thoughts, actions, feelings) that people believe are possible to have with polar bears. Yet, exactly what informs these assumptions (i.e., peoples' worldviews, discourses, prior experiences, or learned behaviours) requires further study. Differences between Indigenous and non-Indigenous perspectives on bear-human relationships have been well-documented (van Daele et al., 2001; Dowsley and Wenzel, 2008; Clark and Slocombe, 2009; Tyrrell, 2009; Schmidt and Dowsley, 2010). Indigenous understandings of bear-human relationships tend to view bears as intelligent, sentient beings, capable of actively engaging in social relationships with humans (Brightman, 1993; Dowsley and Wenzel, 2008; Schmidt and Dowsley,

2010). On the other hand, non-Indigenous understandings of bear-human relationships often characterize bears as purely biological animals, whose relationships with humans are not reciprocal (Clark and Slocombe, 2009). However, our findings suggest that differences in perspectives on polar bear-human relationships may also vary significantly within cultural groups. As other researchers have noted, knowledge and perspectives are not monolithic within communities or cultural groups and can vary significantly from individual to individual (Davis and Wagner, 2003). Further comparative research into such variability would be useful and offers scope to engage multiple northern communities concerned with polar bear-human conflicts.

CONCLUSIONS

The knowledge and expertise of people who regularly interact with polar bears are demonstrably strong, so documenting local strategies for responding to polar bears may well be critical for ameliorating future polar-bear human conflicts around Churchill and elsewhere. The consistency between observations of polar bear behaviour identified in this and other studies reinforces the broader utility of such knowledge. As the Arctic continues to

undergo rapid ecological and social change, scientific studies, including those on polar bear-human interactions, may well be unable to provide answers quickly enough to inform management plans and responses (Derocher et al., 2013). Local experts already have well developed knowledge of polar bear behaviour and effective strategies of interacting with bears that likely could be mobilized more quickly than biological field studies—a substantial pragmatic advantage. Yet, as our results demonstrate, understandings of the best strategies for responding to polar bears during an interaction can vary significantly, even among people who routinely work with polar bears. Such differences raise fundamental and important questions: What is actually knowable and unknowable about polar bears and their interactions with people? What constitutes valuable knowledge about polar bear behaviour and how can this knowledge be acquired? What implications do these differing strategies have for the ways that we study and interpret the results from research on polar bears?

The need for better training and education on how to respond to and prevent conflicts with polar bears has been identified as a clear priority Arctic-wide (Boisen, 2013; Ewins et al., 2016). Exactly what strategies for responding to polar bears should inform this training needs to be clarified. As our results demonstrate, local experts can have quite different strategies for responding to polar bears because their underlying ontologies differ regardless of the commonality of the bear behaviours they understand and use as indicators. Compounding this variation, interpretations of what constitutes “safe” or “effective” responses to polar bears may differ significantly between

institutions as well as individuals (Schmidt and Clark, 2018).

Finally, our findings show that existing models for understanding bear-human interactions fail to adequately account for what motivates and influences human responses. As we demonstrate, differences in perspectives on the predictability of polar bear behaviour and in interpretations of who or what bears are may significantly influence strategies for responding to bears. Factors influencing human responses to polar bears are extremely complex and likely extend well beyond those identified here. Investigating these factors and the knowledge behind human responses to polar bears through transdisciplinary research with knowledge holders (MacDonald, 2019) may well provide the greatest return on research investment into this complex and increasingly urgent topic.

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