

# Relationships between *Rangifer* and Indigenous Well-being in the North American Arctic and Subarctic: A Review Based on the Academic Published Literature

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**ABSTRACT.** Many *Rangifer tarandus* (caribou or reindeer) populations across North America have been declining, posing a variety of challenges for Indigenous communities that depend on the species for physical and cultural sustenance. This article used a scoping review methodology to systematically examine and characterize the nature, extent, and range of articles published in academic journals on the connection between *Rangifer* and Indigenous well-being in the Arctic and Subarctic regions of North America. Two reviewers independently used eligibility criteria to identify and screen abstracts and titles and then screen full texts of each potentially relevant article. To be included in this review, articles had to discuss linkages between *Rangifer* and Indigenous well-being in the North American Arctic and Subarctic and be published prior to 2018. A total of 4279 articles were identified and screened for relevance; 58 articles met the inclusion criteria and were analyzed using descriptive quantitative and thematic qualitative methods. Results characterized the depth and diversity of what we know about *Rangifer* for Indigenous culture, food security, livelihoods, psychological well-being, and social connections across North America in the academic literature. Several gaps were identified. Little is known about the psychological ties between *Rangifer* and Indigenous Peoples and the influence of *Rangifer*-related change on Indigenous well-being and adaptive capacity. We urgently need to know more about the emotional connections that arise from Indigenous-*Rangifer* linkages, the effectiveness of adaptive strategies, and the intergenerational implications of *Rangifer*-related change. Further, enhanced inclusion of Indigenous Peoples in the production of knowledge on this topic is fundamental to the future of understanding Indigenous-*Rangifer* relationships.

**Key words:** Arctic; culture; food security; human-animal relationships; Indigenous Peoples; livelihoods; *Rangifer*; scoping review; Subarctic; well-being

**RÉSUMÉ.** Aux quatre coins de l'Amérique du Nord, de nombreuses populations de *Rangifer tarandus* (caribou ou renne) accusent une baisse, ce qui présente divers défis pour les collectivités autochtones dont la subsistance physique et culturelle dépend de cette espèce. Dans le cadre de cet article, nous avons employé une méthodologie d'examen exploratoire pour analyser et caractériser de manière systématique la nature, l'étendue et la gamme d'articles publiés dans des revues spécialisées au sujet du rapport entre le *Rangifer* et le bien-être des Autochtones des régions arctiques et subarctiques de l'Amérique du Nord. Deux examinateurs indépendants se sont appuyés sur des critères d'admissibilité pour cerner et filtrer les résumés et les titres d'articles, puis les textes complets de chacun des articles susceptibles de revêtir de la pertinence. Pour être admissibles à cet examen, les articles devaient faire mention des rapports entre le *Rangifer* et le bien-être des Autochtones des régions arctiques et subarctiques nord-américaines et avoir été publiés avant 2018. Dans l'ensemble, 4 279 articles ont été dénombrés et étudiés afin d'en déterminer la pertinence. Au total, 58 articles ont respecté les critères d'inclusion et ont été analysés à l'aide de méthodes descriptives quantitatives et de méthodes thématiques qualitatives. Les résultats ont permis de caractériser la profondeur et la diversité des connaissances au sujet du *Rangifer* en matière de culture, de sécurité alimentaire, de moyens de subsistance, de bien-être psychologique et de rapports sociaux dans les ouvrages universitaires publiés en Amérique du Nord. Plusieurs lacunes ont été relevées. Il y a peu de connaissances sur liens psychologiques qui existent entre le *Rangifer* et les peuples autochtones ainsi que sur l'influence des changements se rapportant au *Rangifer* sur le bien-être et la capacité d'adaptation des Autochtones. Il est urgent d'en savoir plus sur les liens émotionnels qui découlent des rapports entre les Autochtones et le *Rangifer*, sur l'efficacité des stratégies d'adaptation et sur les conséquences intergénérationnelles des changements caractérisant le *Rangifer*. Par ailleurs, une plus grande inclusion des peuples autochtones dans la production de connaissances à ce sujet est fondamentale à la compréhension future des rapports entre les Autochtones et le *Rangifer*.

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Mots clés : Arctique; culture; sécurité alimentaire; rapports entre l'humain et l'animal; peuples autochtones; moyens de subsistance; *Rangifer*; examen exploratoire; subarctique; bien-être

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## INTRODUCTION

Many Indigenous Peoples across North American Arctic and Subarctic regions have lived alongside and developed deep and enduring relationships with animal species over many generations (Condon et al., 1995; Wenzel, 2015). These human-animal connections include the cultural, spiritual, nutritional, social, mental, emotional, livelihood, and environmental links between people and animals (Hovey et al., 2014). Human-animal relationships throughout these regions have been conceptualized and studied from a variety of disciplines, including wildlife management and ethnographic perspectives (Wenzel, 2004).

Among Arctic and Subarctic animals, *Rangifer tarandus* has been characterized as one of the most vital terrestrial subsistence species for Indigenous Peoples living within these regions (Kofinas, 2005; Bali and Kofinas, 2014; Maracle et al., 2018). In the North American context, *Rangifer* are commonly known as caribou, although some domesticated reindeer were introduced by Europeans in the 1800s (Sonnenfeld, 1959; Meis Mason et al., 2007). *Rangifer* is the most numerous large, terrestrial mammal across the North American Arctic and Subarctic and can have expansive migrations across hundreds and even thousands of kilometres (Bali and Kofinas, 2014). Considering these large ranges, *Rangifer* has played a central role in the histories, culture, and everyday life of a diversity of people and communities across North American Arctic and Subarctic regions (Russell et al., 2015). For example, many Indigenous Peoples depend on caribou for food, cultural practices and cultural continuity, spiritual ceremonies, clothing, self-perception and identity, and livelihoods (Collings, 1997; Keith, 2004; Sejersen, 2004; Lambden et al., 2007; Meis Mason et al., 2007, 2012; Royer and Herrmann, 2011, 2013; Schuster et al., 2011; Gagné et al., 2012; Zoe, 2012; Bali and Kofinas, 2014; Beaumier et al., 2015; Castro et al., 2016; Chiu et al., 2016; Rixen and Blangy, 2016; Polfus et al., 2017; Parlee et al., 2018; Southcott et al., 2018).

Within recent decades, however, many *Rangifer* populations across North America have been declining (Gunn et al., 2011; Chiu et al., 2016) because of a variety of complex and interwoven factors, including, but not limited to, climate change (Sharma et al., 2009; Ford et al., 2013; Leblond et al., 2016; Le Corre et al., 2017; Mallory and Boyce, 2017), human developments (Bergerud et al., 1984; Parlee et al., 2018), infectious diseases (Simard et al., 2016), and changes in predator-prey dynamics (Dale et al., 1994; Latham et al., 2013; Chiu et al., 2016). Given the importance of *Rangifer* to Indigenous Peoples, these declining *Rangifer* populations may also be posing a variety of complex

challenges for Indigenous well-being, which can encompass myriad tangible and intangible dimensions of Indigenous life.

Considering that many *Rangifer* populations are currently declining across North America (Gunn et al., 2011; Chiu et al., 2016) and given the foundational importance of *Rangifer* for many Indigenous Peoples (Bali and Kofinas, 2014; Parlee et al., 2018), systematically synthesizing the literature published in academic journals around human-*Rangifer* relationships from a well-being lens is important to understand key patterns and identify gaps in the published literature. While there is a large and important body of grey literature that contributes to research and knowledge on this topic, focusing on literature published in academic journals enables an analysis of the evidence base that can contribute to regional, national, and international policy and decisions related to this topic and support increased dialogue between academics and Indigenous communities (Chambers et al., 2018). Therefore, there is value in asking not only what is known and what is unknown in the academic literature, but also, and importantly, what we need to know about this topic.

As such, this literature review examined and characterized the nature, range, and extent of published research in academic journals discussing the relationship between *Rangifer* and Indigenous well-being in the Arctic and Subarctic regions of North America. This scoping review provides insight into what we know, what we don't know, and what we need to know from the published academic literature about the complex, deep-rooted, and diverse values of *Rangifer* for Indigenous Peoples across the North American Arctic and Subarctic. We were specifically interested in what is available in academic journals to gain an understanding of the themes highlighted in peer-reviewed literature, as well as how Indigenous Peoples have been engaged in academic research pertaining to this Indigenous-*Rangifer* topic. This information can be used to inform future research and action related to *Rangifer* conservation and management and Indigenous well-being.

## METHODS

### *Review Approach and Consultation Process*

A scoping review methodology was selected for this research because it comprehensively identifies, examines, and characterizes the extent, range, nature, and results of research across diverse fields. It also transparently “maps out” research activity for a broad topic and determines gaps in the existing body of knowledge (Arksey and O'Malley,

2005; Levac et al., 2010; Pham et al., 2014; Dijkers, 2015). The methods and findings were reported according to the Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) checklist, which contains essential reporting items for scoping reviews (Tricco et al., 2018). A scoping review protocol was developed a priori and is available from the primary author upon request.

This systematic review process was informed by a Caribou Research Steering Committee situated in Labrador, Canada, with both Indigenous and non-Indigenous members spanning a range of disciplinary expertise, sectors, and knowledge systems (13 members in total). The Steering Committee consists of Inuit community leads, Inuit representatives from the Nunatsiavut Government and the NunatuKavut Community Council, co-management representatives from the Torngat Wildlife, Plants, and Fisheries Secretariat, academics, and a PhD candidate. Steering Committee members stood as representatives of their communities, organizations, governments, or boards and were well-positioned to explore what we need to know about the topic and contribute to the research design and process, such as developing the review topic, reviewing the search terms, co-identifying themes about the link between *Rangifer* and Indigenous well-being, and interpreting results.

### Search Strategy

A list of commonly used Indigenous terms was developed to be used for the final population search strings (Table 1). Similarly, a list of umbrella terms for *Rangifer* was also developed, along with search terms describing Indigenous well-being in relation to *Rangifer* (Table 1). The terms were all based on guidance from the Caribou Research Steering Committee as to what kinds of well-being topics may be embedded in Indigenous-*Rangifer* relationships.

A preliminary test search was conducted in four electronic databases (PubMed<sup>®</sup>, Web of Science<sup>™</sup>, Engineering Village<sup>™</sup>, and CAB Direct<sup>®</sup>) to ensure the sensitivity and accuracy of the selected search terms. A full search was conducted on 19 April 2018 and updated on 10 April 2019 (to capture potential additional articles published between 20 April and 31 December 2018) in nine databases: Web of Science<sup>™</sup>, ProQuest<sup>®</sup>, CAB Direct<sup>®</sup>, Bibliography of Native North Americans (BNNA via EBSCO<sup>®</sup>), Canadian Business and Current Affairs Database<sup>®</sup> (CBCAD), Anthropology Plus (via EBSCO), GEOBASE (via Engineering Village<sup>™</sup>), MEDLINE<sup>®</sup>, and JSTOR<sup>®</sup>. These databases were chosen to capture the published literature pertaining to the fields of anthropology, sociology, wildlife biology, environmental conservation, human geography, human ecology, hunter-gatherer studies, nutrition, food security and food systems, rural economies, Indigenous research, interdisciplinary studies, and public health.

Citations downloaded from the electronic databases were imported into the citation management program Mendeley<sup>®</sup>, where duplicate citations were removed. Subsequently, the citations were imported into DistillerSR<sup>®</sup>, a web-based literature review software, to facilitate article management, screening, and data extraction. To check the sensitivity of the search string, a scan of the reference lists in all included articles was also conducted; new relevant articles that were identified were recorded and analysed (Tricco et al., 2018).

### Eligibility Criteria and Screening Process

Articles were eligible for inclusion in this review based on the type of article and their study design, context, and focus (Table 2). Many articles that discuss *Rangifer* and Indigenous Peoples are currently available, so in order to attain the most relevant literature pertaining to this review, articles had to contain at least four sentences of discussion specifically related to the linkages between *Rangifer* and Indigenous well-being in the North American Arctic or Subarctic (Table 2). Theses that met eligibility criteria were included in this review as well as published articles (duplications of any work were screened out). In this scoping review, we understood “well-being” to encompass a range of experiences and relationships that influence the holistic health of individuals and communities, including the cultural, psychological, livelihood, food security, and social dimensions of well-being.

In the first screening stage, the title, abstract, and key words of each article were independently screened for relevance by two reviewers (Table 2). Articles that were understood as potentially relevant by both reviewers in the first stage then proceeded to a second stage of screening, which entailed reviewing the full text of the article. During this stage, the full text of each potentially relevant article was screened independently by two reviewers with the same questions as the first stage of screening in order to ensure potentially relevant articles met eligibility criteria (Table 2). Reviewers met throughout the screening process to resolve discrepancies. Relevant full-text articles proceeded to data extraction and analysis. To assess the reliability of the article screening process, percentage agreements were calculated (Iwarsson et al., 2005).

### Analysis

Study characteristics (e.g., date, research design, region of study) were extracted from the articles and descriptively analysed (Supplementary Appendix Table S1). Additionally, the articles were qualitatively analysed using thematic analysis (Green and Thorogood, 2004). The NVivo<sup>™</sup> software was used for article and data management. Two main questions led this thematic analysis: 1) what overarching themes about the relationship between *Rangifer* and Indigenous well-being were characterized in the literature? and 2) how were these themes described?

TABLE 1. The final search string<sup>1</sup> used to identify literature discussing links between *Rangifer* and Indigenous well-being in the North American Arctic and Subarctic via online databases. The specific search string below corresponds with Web of Science™ and was applied to other databases.

Research component	Search string
Indigenous Peoples in the Arctic and Subarctic of North America <sup>2</sup>	(Inuit* OR “First Nation*” OR Metis* OR Indigen* OR Aborigin* OR “Native People*” OR “Native American*” OR “American Indian*” OR “Alaska Native*” OR Eskimo*)
<i>Rangifer</i> in the Arctic and Subarctic of North America	AND (Caribou* OR “ <i>Rangifer tarandus</i> ” OR Reindeer*)
Indigenous well-being terms	AND (Health* OR Well?being* OR Wellness* OR “Food Security” OR “Country Food” OR “Traditional Food” OR Nutrition* OR Spiritual* OR Mental* OR Emotion* OR Cultur* OR “Cultural Continuity” OR Econom* OR Social* OR Livelihood* OR Hunt*)

<sup>1</sup> The Boolean operator OR was employed to show any one of the search terms as required to be included in the article, while AND was used to show at least one search term from each research component must be included in the article. Quotation marks were used for search terms composed of more than one word, \* shows any ending of the word may be regarded as part of the search term (e.g., Cultur\* incorporates culture, cultures, cultural), and ? indicates any symbol used may be included in the search term (e.g., Well?being incorporates well-being, well being, wellbeing).

<sup>2</sup> Terms used to identify Indigenous groups in the North American Arctic and Subarctic were based on umbrella terms for Indigenous peoples as described by the Truth and Reconciliation Commission of Canada (TRCC, 2015) and the Internal Work Group for Indigenous Affairs (IWGIA; www.iwgia.org). When developing a search string that could encompass research potentially pertinent to Indigenous populations over a broad timescale, we needed to recognize how Indigenous Peoples have historically been adversely affected by research conducted on them (Tuhiwai Smith, 1999). Consequently, unethical and harmful terminology that has previously been used to “describe” Indigenous individuals and communities (Tuhiwai Smith, 1999) was included in this search string. The use of these offensive terms does not reflect the authors’ beliefs, understandings, or relationships with Indigenous peoples in any way; rather, it reflects the attempt to include a diverse range of literature over a large time period by using historical terminology. In some cases, these terms reflect differences in regional preferences for self-identification. Any articles discovered in this search that used those terms were then critically analyzed to ensure that the content was not presented in an offensive or essentialist manner before final inclusion. Further, we acknowledge how the use of Latin terminology to name a species and describe the Western science associated with that species is another example of how colonialization has affected Indigenous languages, communities, and well-being (Tuhiwai Smith, 1999). While language revitalization is beyond the scope of this review, it is important to recognize the diverse languages and Indigenous-specific terms associated with *Rangifer*. Some examples of the diverse Indigenous-specific terminology used to describe this species include *tuktu*, *qalipu*, *atihko*, *atihkw*, *bedzeyh*, *vadzaih*, *wëdzey*, *tuttu*, *tuttuq*, *tuntu*, *udzih*, *watsix*, *mbedzih*, *whudzih*, *ekwò*, *apiscacihkos*, *adik*, and *atik* (First Peoples’ Cultural Council, 2017).

To guide the qualitative extraction, four overarching themes about the well-being relationships with *Rangifer* were identified a priori by members of the Caribou Research Steering Committee: cultural relationships, food security relationships, livelihood relationships, and psychological relationships. To be included, well-being relationships could have been discussed at the individual, family, community, or regional level. Additionally, the qualitative data were analyzed inductively, meaning that concepts and codes previously unforeseen to the researchers could emerge from interpretations about the data itself (Braun and Clarke, 2006). Therefore, this research was open to the identification of new well-being-related themes that might emerge from the literature. Reflecting the goal of our paper, we did not conduct bibliometric analyses.

## RESULTS

The search strategy identified 8936 articles from nine electronic databases (including seven articles from the

reference list search) and 58 articles eligible for inclusion in this review (Fig. 1). The first and second levels of screening achieved a percentage agreement of 93% and 89%, respectively, indicating good agreement (Iwarsson et al., 2005).

The majority of articles (50/58, 86.2%) examined the relationship between *Rangifer* and Indigenous well-being from a social science lens, while other articles (8/58, 13.8%) focused on this relationship from a health science lens. Almost all of the articles (44/58, 75.9%) described primary research, while fewer described secondary research or commentary articles. Forty articles (69%) collected only qualitative data, while six (10.3%) collected only quantitative data, and 12 articles (20.7%) used mixed methods to collect both qualitative and quantitative data.

The majority of articles (42/58, 72.4%) did not explicitly discuss collaborating with Indigenous Peoples, organizations, or governments when conducting, analyzing, or authoring the research. This finding does not indicate, however, that collaboration did not occur; rather, it is not explicitly documented in the paper or authorship

TABLE 2. The final eligibility criteria and list of questions used through the two-staged screening process to identify literature discussing links between *Rangifer* and Indigenous well-being in the North American Arctic and Subarctic.

Components	Inclusion criteria	Exclusion criteria	Questions (Stage 1) <sup>1</sup>	Questions (Stage 2) <sup>2</sup>
Study design	<ul style="list-style-type: none"> <li>• Published journal article</li> <li>• PhD or Master's thesis</li> <li>• Reported in English or French</li> <li>• Published in or before 2018</li> </ul>	<ul style="list-style-type: none"> <li>• Non-academic publications (e.g., grey literature)</li> <li>• Reported in language other than English and French</li> <li>• Published after 2018</li> </ul>	<ul style="list-style-type: none"> <li>• Is the document an article from an academic journal or a PhD or Master's thesis?</li> </ul>	<ul style="list-style-type: none"> <li>• Is the document an article from an academic journal or a PhD or Master's thesis?</li> </ul>
Study context	<ul style="list-style-type: none"> <li>• Studies taking place in North American Arctic and/or Subarctic (ESWG, 1996)</li> <li>• Studies about Indigenous Peoples</li> <li>• Studies about <i>Rangifer</i> (both caribou and reindeer)</li> <li>• Studies about the relationship between <i>Rangifer</i> and Indigenous Peoples' well-being</li> </ul>	<ul style="list-style-type: none"> <li>• Studies examining reindeer outside of North America (e.g., Taimyr herd)</li> <li>• Studies considering Indigenous Peoples outside of North America (e.g., Sami, Yakuts, Komi, Evenki, Nenets/Yamal, Sakhalin, Dukha)</li> </ul>	<ul style="list-style-type: none"> <li>• Does the title/abstract describe a study that takes place in the North American Arctic and/or Subarctic?</li> <li>• Does the title/abstract describe a study reporting on Indigenous Peoples?</li> <li>• Does the title/abstract describe a study reporting on <i>Rangifer</i>?</li> </ul>	<ul style="list-style-type: none"> <li>• Does the article describe a study that takes place in the North American Arctic and/or Subarctic?</li> <li>• Does the article describe a study reporting on Indigenous Peoples?</li> <li>• Does the article describe a study reporting on <i>Rangifer</i>?</li> </ul>
Study focus	<ul style="list-style-type: none"> <li>• Studies that had at least four sentences<sup>3</sup> of discussion on one or more of the <i>Rangifer</i>-Indigenous Peoples' relationship dynamics<sup>4</sup>: food security and dietary relationships (e.g., enhanced nutrition); livelihood relationships (e.g., income, socio-economic and subsistence activities); cultural identity and inter-generational knowledge transfer relationships (e.g., storytelling); mental health, emotional, and spiritual relationships (e.g., psychological feelings)</li> </ul>	<ul style="list-style-type: none"> <li>• Studies that had less than four sentences of discussion on one of the <i>Rangifer</i>-Indigenous Peoples relationship dynamics. For example: studies primarily focused on <i>Rangifer</i> biology/ecology; studies primarily focused on the anthropology or sociology of Indigenous Peoples studies primarily focused on the archeology of Indigenous Peoples and/or <i>Rangifer</i>; studies primarily focused on environmental contaminants</li> </ul>	<ul style="list-style-type: none"> <li>• Does the title /abstract describe a study reporting on the relationship between <i>Rangifer</i> and Indigenous well-being?</li> </ul>	<ul style="list-style-type: none"> <li>• Does the article describe a study that has at least four sentences of discussion on the relationship between <i>Rangifer</i> and Indigenous Peoples?<sup>5</sup></li> </ul>

<sup>1</sup> Questions in Stage 1 were answered with either “Yes,” “No,” or “Unsure.” Questions were dealt with in steps, starting with study design, then study context, then study focus.

<sup>2</sup> Questions in Stage 2 (the final stage of screening) were answered with either “Yes” or “No.” Questions were dealt with in steps, starting with study design, then study context, then study focus.

<sup>3</sup> For the purposes of this study, a relevant table or figure counted as two relevant sentences (e.g., two sentences of discussion and one relevant table or figure was sufficient for inclusion).

<sup>4</sup> While there are many different factors to consider, the four overarching relationship dynamics between Indigenous People and *Rangifer* were developed based on prior understandings about human-*Rangifer* connections and guidance from the Caribou Research Steering Committee. Through an iterative and inductive process, themes were added, changed, or withdrawn depending on what would be found in the data.

<sup>5</sup> Many articles mentioned *Rangifer*-Indigenous Peoples' relationships, but did not focus primarily on these relationships as a core aspect of the paper. In order to review the most relevant literature pertaining to this scoping review goal, one of the questions thus required the article to describe a study that had at least four sentences of discussion relevant to the relationship of interest. A relevant table or figure counted as two relevant sentences (e.g., two sentences of discussion and one relevant table or figure was sufficient for inclusion).

attributions. Of articles discussing direct collaboration with Indigenous Peoples, organizations, or governments, almost all (15/16, 93.7%) were conducted in or after 2012. Although few articles (13/58, 22.4%) listed an authorship affiliation with an Indigenous government, association, or organization, 40 articles (69%) did evaluate Indigenous perceptions about *Rangifer* (e.g., through in-person interviews with Indigenous Peoples).

Two-thirds of the articles (38/58, 65.5%) were published in or after 2002, with more published in 2012 (8) and 2016 (5) than in any other year (Fig. 2). The majority of articles focused on the most northern regions of North America: Northwest Territories (18/58, 31%), Alaska (15/58, 25.9%), and Nunavut (15/58, 25.9%), while the remaining articles focused on Quebec (8/58, 13.8%), Yukon (6/58, 10.3%), Newfoundland and Labrador (5/58, 8.6%), Ontario (1/58,

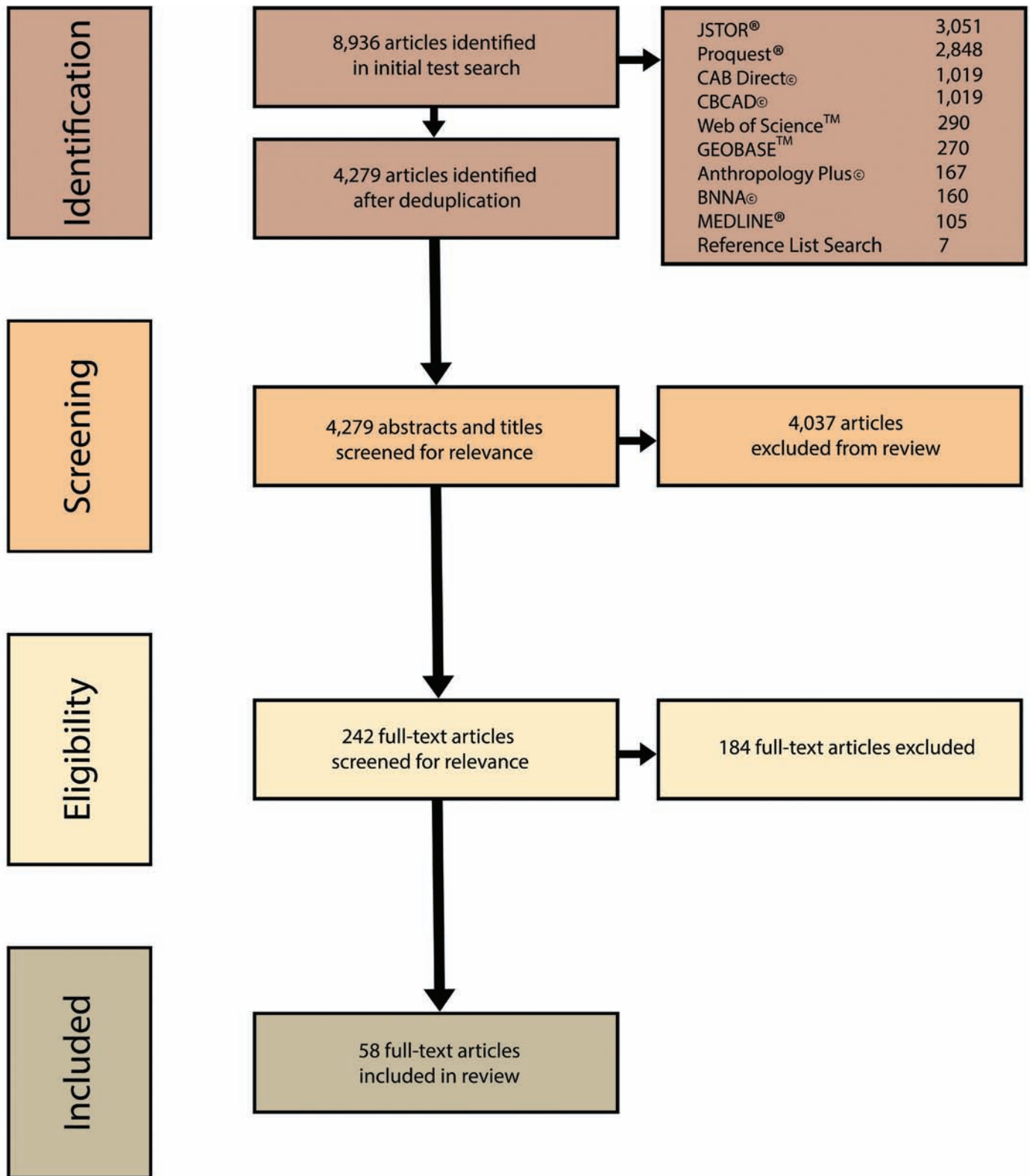


FIG. 1. Selection process used to identify articles discussing links between *Rangifer* and Indigenous well-being in the North American Arctic and Subarctic and arranged through the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) reporting flow diagram (Tricco et al., 2018).

1.7%), British Columbia (1/58, 1.7%), Manitoba (1/58, 1.7%), and one unspecified region (1/58, 1.7%). Some (8/58, 13.8%) articles discussed two or more regions (Supplementary Appendix Table S2).

The literature discussed four Indigenous groups across the North American Arctic and Subarctic. Inuit were reported in the majority of articles (39/58, 67.2%), followed by First Nations in Canada (24/58, 41.4%), and Métis (3/58, 5.2%).

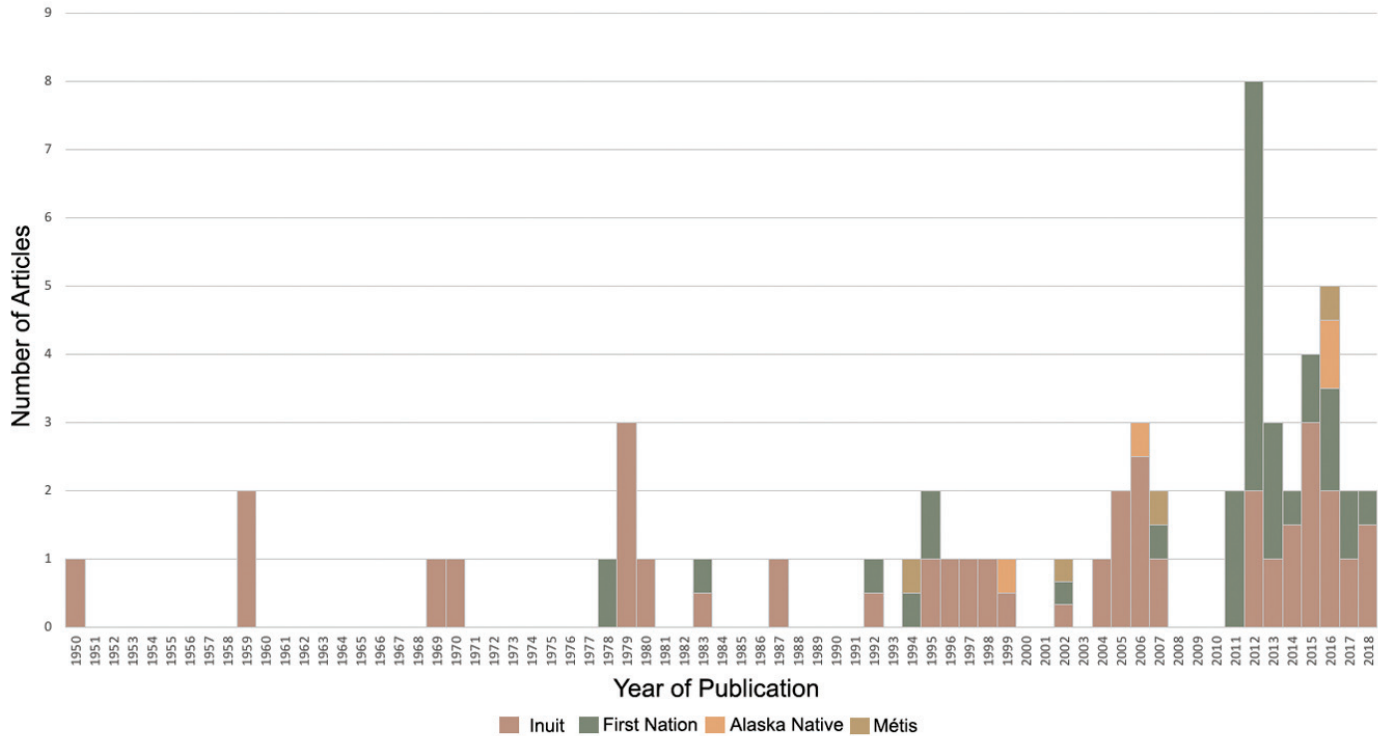


FIG. 2. Number of articles discussing links between *Rangifer* and Indigenous well-being in the North American Arctic and Subarctic by year of publication and Indigenous group discussed. One article was excluded since, for confidentiality purposes, it did not explicitly name the Indigenous group of focus nor the region in which the research was conducted.

All but one article reported the name of the Indigenous group discussed (Supplementary Appendix Table S2).

The majority of articles in this review focused only on caribou (i.e., non-domesticated or wild *Rangifer*) (42/58, 72.4%), while fewer discussed only reindeer (i.e., domesticated or semi-domesticated *Rangifer*) (9/58, 15.5%). Of the articles that discussed reindeer, all but two articles described research taking place in Alaska (14/16, 87.5%). More than a third of the articles (21/58, 36.2%) described the *Rangifer* subspecies explicitly (Supplementary Appendix Table S3).

Although very few articles had an explicit focus on examining the connection between *Rangifer* and Indigenous well-being, articles discussed a wide range of relationships between Indigenous Peoples and *Rangifer*, including themes of cultural significance, food security, livelihoods, psychological wellness, and social connectedness. Within these major themes, several subthemes emerged from the literature (Fig. 3 and Supplementary Appendix Table S4).

### Cultural Relationships

Approximately three-quarters of all articles (44/58; 75.9%) discussed some form of cultural relationship between Indigenous Peoples and *Rangifer*, including cultural identity, cultural continuity, and connections to the land (Fig. 3). By region, cultural relationships were included in the majority of articles discussing the Northwest Territories (16/18, 88.9%), Nunavut (12/15, 80%),

and Alaska (11/15, 73.3%), while there was less discussion about cultural relationships among articles that were related to other regions (Fig. 4). As a proportion of articles by Indigenous group, there were more articles (83.3%, 20/24) discussing cultural relationships between caribou and First Nations than those relationships with other groups (Fig. 5).

All but one article (43/44; 97.7%) that discussed cultural relationships primarily focused on cultural identity, which was understood as cultural living and being, self-perception, ethnic identity, language, cultural representation and symbolism, cultural integrity and pride, cultural traditions, customs, practices, and ceremonies. For example, as shared by a member of the Tłı̨chǫ Nation in the Northwest Territories, “Ekwǫ [caribou in Tłı̨chǫ] is what defines our language, culture and way of life” (Zoe, 2012:69).

Fewer articles (25/44, 56.8%) discussed cultural relationships in the context of cultural continuity, which was described in the literature through discussions around intergenerational knowledge transfer, continued existence, cultural preservation, storytelling, mythology, legends, and cultural learning. For example, for the West Moberly First Nations in British Columbia, “various myths and legends use caribou as a means to convey values, norms, history, and knowledge about the people, land, and spirituality” (Muir and Booth, 2012:462).

Among articles that discussed cultural relationships with *Rangifer*, over half (24/44, 54.5%) were described through Indigenous connections to the land. This subtheme was conceptualized through place-naming, sense of place,

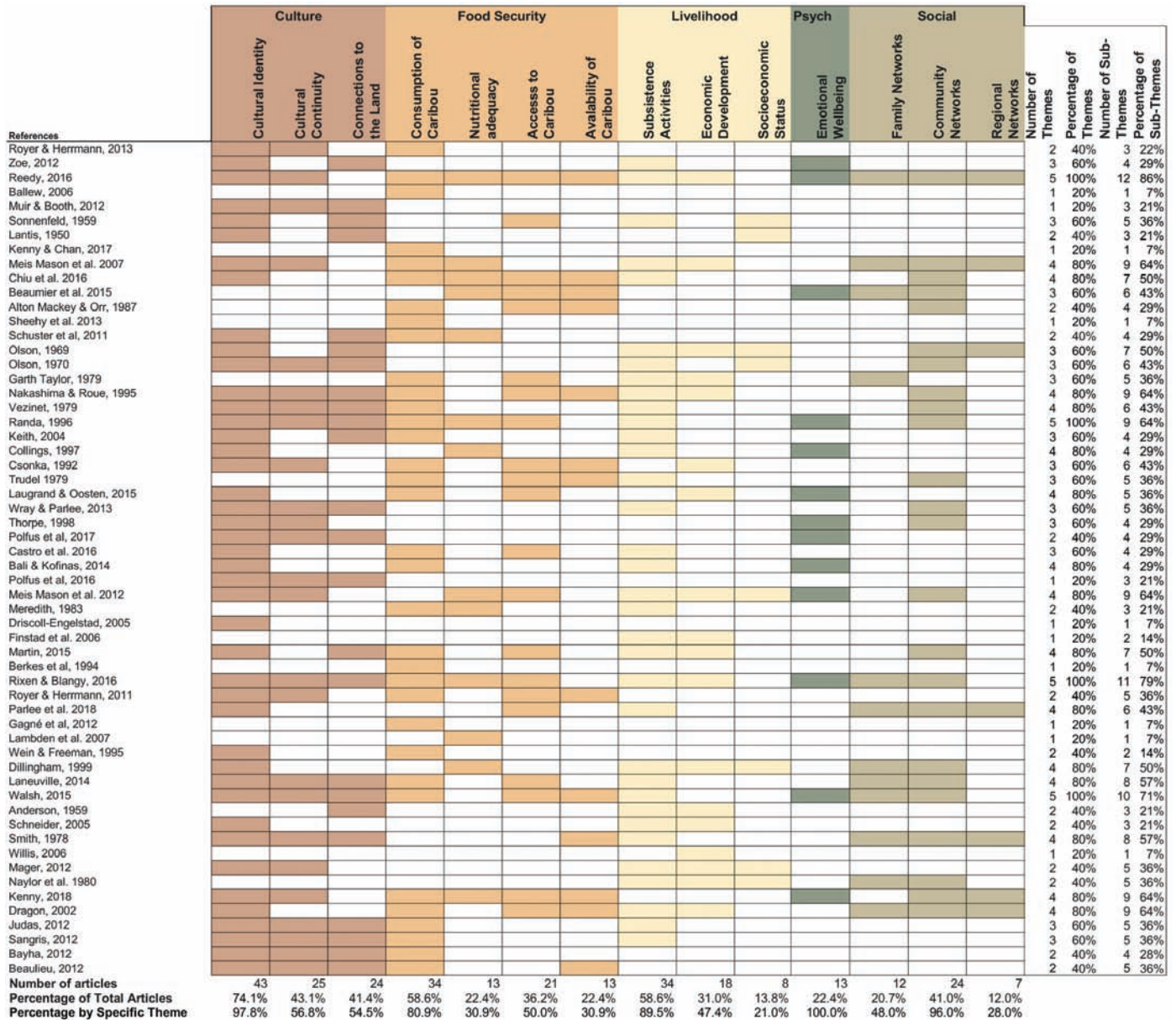


FIG. 3. Analytical findings of overarching themes and subthemes found in the literature describing relationships between *Rangifer* and Indigenous well-being in the North American Arctic and Subarctic.

place-based knowledge, settlement and organization on the land, orientation of landscapes, practical uses of the land, and attachments and commitments to the land. For example, in Nunavut, “many place names in Harvaqtuurmiut territory refer to caribou and the caribou crossing hunt” (Keith, 2004:47).

*Food Security Relationships*

Forty-two articles (72.4%) in this review referred to Indigenous-*Rangifer* relationships in terms of food security (Fig. 3), which included consumption of *Rangifer*, nutritional adequacy of *Rangifer*, access to *Rangifer*, and availability of *Rangifer*. Food relationships were included in all articles that involved Yukon and were part of the

majority of other articles from most regions (Fig. 4). As a proportion of articles by Indigenous group, all articles (100%; 3/3) discussing Métis involved discussions of food relationships, which was more than for any other group (Fig. 5).

Over three-quarters of articles (34/42, 80.9%) discussing food security relationships mentioned the amount and frequency of *Rangifer* being consumed (Fig. 3). For example, caribou “is the single most frequently consumed traditional food in the Vuntut Gwitchin First Nation community of Old Crow” in the Yukon (Schuster et al., 2011:882). Approximately a third of the articles (13/42, 30.9%) discussing food security relationships described the nutritional adequacy of *Rangifer*, which appeared through explanations of the dietary benefits, nutritional quality,



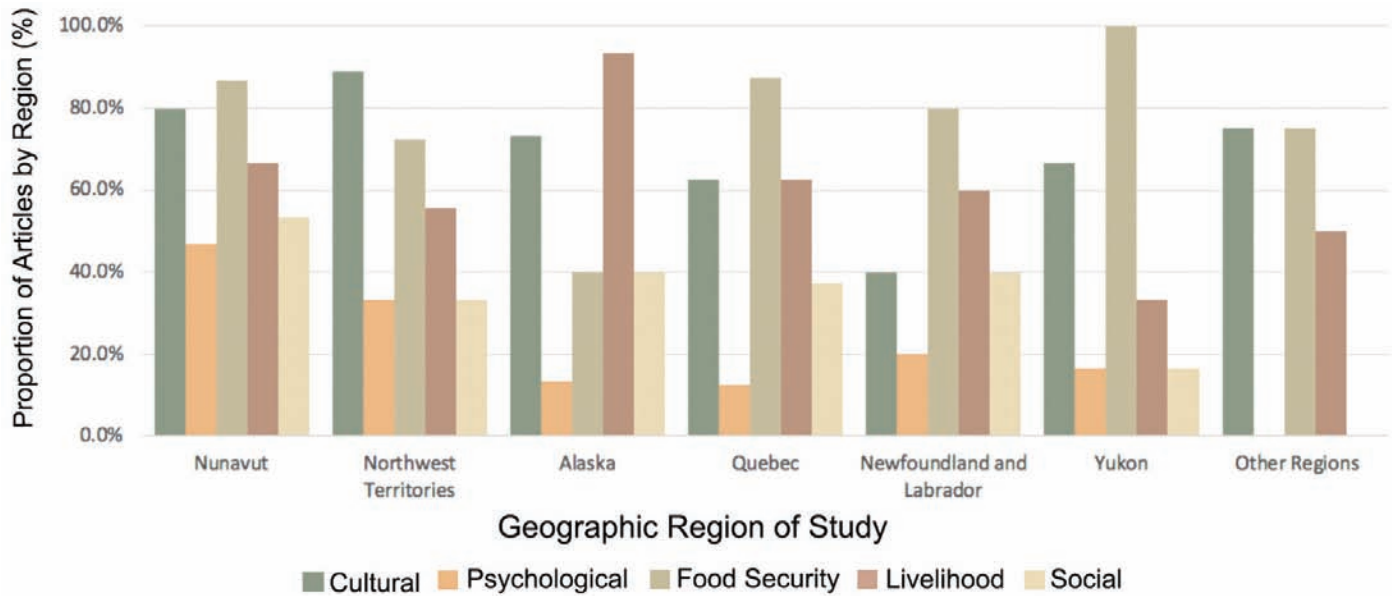


FIG. 4. Proportion of articles in each region discussing the relationship between *Rangifer* and Indigenous well-being by overarching themes. For example, 80% (12/15) of articles that focused on Nunavut discussed cultural relationships. Many articles discussed multiple themes (Fig. 3) and are thus included in more than one category. As noted in the caption to Figure 2, one article was excluded.

and low-risk of consuming inorganic products when eating *Rangifer*. For example, “caribou was shown to be a high contributor of energy (calories), protein, and nutrients such as iron” for Inuvialuit and Inuit in Northwest Territories and Nunavut (Chiu et al., 2016:765).

Half of the articles (21/42; 50%) discussing food security relationships also described access to *Rangifer*, which appeared in discussions around the financial and nutritional importance of accessing *Rangifer*, policies restricting access to *Rangifer* (i.e., hunting regulations or quotas), the negative cultural and food security impacts when there is less access to harvesting and consuming *Rangifer*, and, in the case of reindeer in Alaska, access to *Rangifer* as an alternative food source during times of difficulty. For example, Iñupiaq of Anaktuvuk Pass, Alaska, reported having “less food during the [hunting] restrictions than in the prior period, and 96% reported that the caribou regulations were the reason why” (Martin, 2015:3).

Fewer articles (13/42, 30.9%) discussing food security relationships mentioned the availability (e.g., the natural supply) of *Rangifer* and the subsequent negative impacts on food security when this supply is limited by changes in *Rangifer* populations and migration patterns (Fig. 6). For example, “previous declines in caribou at the beginning of the 1900s coincided with a period of starvation and an increase in epidemic diseases which had severe effects on the Cree people of eastern James Bay” in Quebec (Royer and Herrmann, 2013:581).

#### Livelihood Relationships

Two-thirds of all articles (38/58, 65.5%) mentioned some form of livelihood relationship between *Rangifer* and Indigenous Peoples (Fig. 3), including the importance of

*Rangifer* for subsistence activities, economic development and employment, and peoples’ socioeconomic status within society. Livelihood relationships were included in 93.3% (14/15) of articles that discussed Alaska, and were also discussed in a high percentage of articles from other regions (Fig. 4). As a proportion of articles by Indigenous group, 74.4% (29/39) of those focused on Inuit involved discussions of livelihood relationships, which was a higher percentage than for any other group (Fig. 5).

For this review, subsistence activities were conceptualized as a livelihood relationship because of the role of these activities for supporting a family or small group of people. These activities were identified in the majority of the articles (34/38, 89.5%) discussing livelihood relationships and included discussions about hunting, herding, and trade. For example, for Harvaqtuurmiut in Nunavut, “the most important subsistence activity was the caribou hunt at the caribou crossing” (Keith, 2004:40). Economic development and employment were mentioned in half of the articles (18/38, 47.4%) discussing livelihood relationships, with *Rangifer* being discussed as part of a commercial industry, community assets and resources, and opportunities for job creation and enhancing incomes. For example, “Port Heiden [Alaska] had previously been a site of reindeer herding in the early 20th century and residents [Aleut/Unangan and Alutiiq] wanted to bring it back to expand economic development for its community” (Reedy, 2016:15). Individual socioeconomic status within society was mentioned in fewer articles (8/38, 21%) discussing livelihood relationships, all of which focused on reindeer in Alaska, and was understood to relate to how individual people orient their rankings, labels, prominence, reputation, and prestige through their connection to *Rangifer*. For example, “in Arctic Alaska the reindeer were successful at

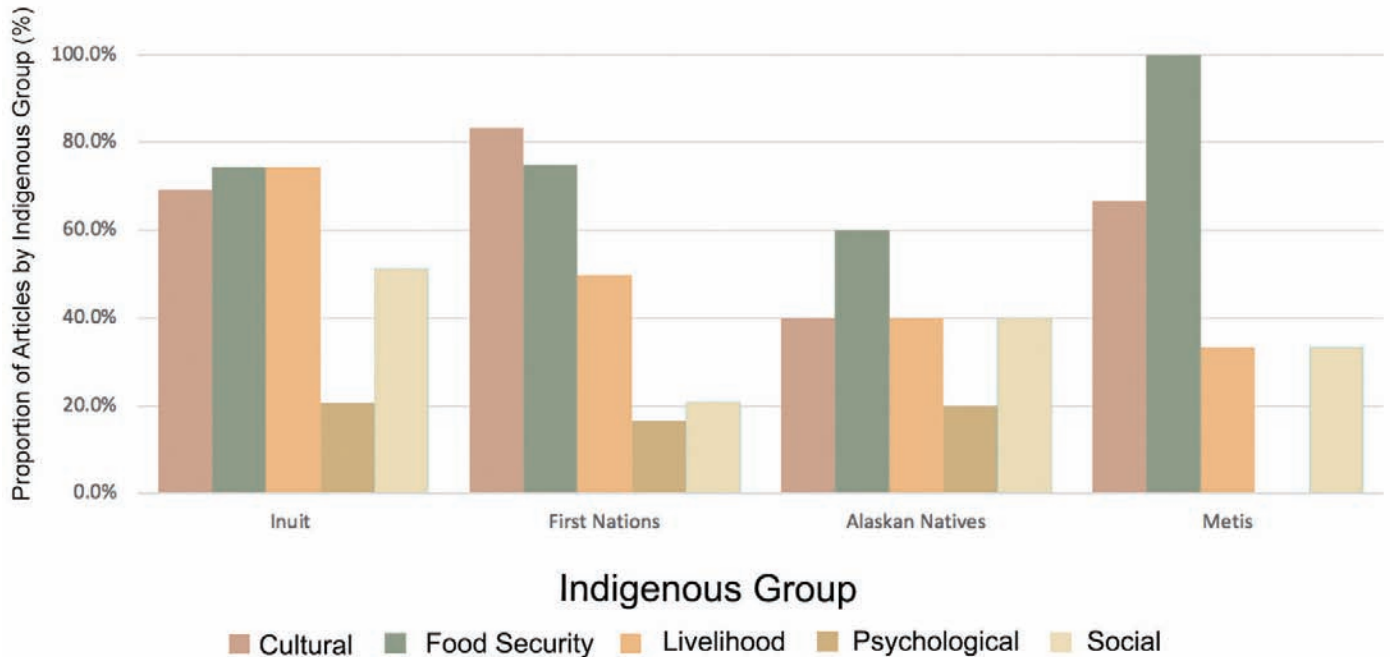


FIG. 5. Proportion of articles by Indigenous group discussing the relationship between *Rangifer* and Indigenous well-being in the North American Arctic and Subarctic by overarching themes. For example, of all articles discussing First Nations, 83.3% (20/24) discussed cultural relationships. Many articles discussed multiple themes (Fig. 3) and are thus included in more than one category. As noted in the caption to Figure 2, one article was excluded.

first apparently because of the novelty and of the prestige in ownership” (Sonnenfeld, 1959:93).

#### *Emotional and Psychological Relationships*

Under a quarter (13/58, 22.4%) of all articles in this review described the human-*Rangifer* relationship from an emotional or psychological perspective (Figs. 3, 4, and 5), focusing on the role of *Rangifer* in emotional well-being and spirituality. Psychological relationships were included in 46.7% (7/15) of articles that discussed Nunavut and in some articles from the other regions (Fig. 4). As a proportion of articles by Indigenous group, Inuit, First Nations, and Alaska Natives all had around a fifth (Inuit: 8/39; First Nations: 4/24; Alaska Natives 1/5) of the articles discussing psychological relationships (Fig. 5). The literature described the role of *Rangifer* for Indigenous Peoples’ feelings, psychological meaning, emotions, mental health, and spirituality. For example, for the Tłıchǫ Nation in the Northwest Territories, “when ekwò [caribou] declined, it really became an emotional issue for a lot of people” (Zoe, 2012:69).

#### *Social Connection Relationships*

The role of *Rangifer* in social connections emerged from the literature as a prevalent theme, which included *Rangifer* in family networks, community networks, and regional networks.

Social relationships were included in over half 53.3% (8/15) of articles that discussed Nunavut and in 40% or fewer articles focused on other regions (Fig. 4). As a proportion of

articles by Indigenous group, over 50% (20/39) of articles discussing Inuit also discussed social relationships, whereas these relationships were included in 20% to 40% of articles focusing on other Indigenous groups (Fig. 5). The role of *Rangifer* in community networks was mentioned in almost all articles (24/25, 96%) discussing social relationships and was expressed through remarks of community solidarity, community-level kinship, sharing *Rangifer* within a community, community-level welfare and well-being, social co-operation, and community cohesion. For example, for Inuit in some Nunavut communities, “part of surviving on the land is making sure that you prepare caribou for everybody in the community to enjoy” (Thorpe, 1998:407). The role of *Rangifer* in family networks was mentioned in less than half (12/25, 48%) of articles discussing social relationships and was described in terms of familial bonds and ties, family relationships, family-level kinship, family cohesion, and sharing *Rangifer* within a family. For example, Inuit in Nunavut described how “caribou livelihoods contribute to this social safety net through their role in food sharing networks, family cohesion and community gatherings” (Rixen and Blangy, 2016:307). Regional networks were identified in fewer of the articles (7/25, 28%) discussing social relationships and were described in the literature as sharing *Rangifer* between distinct communities, and even across larger geographic regions such as provinces, states, and countries. For example, “harvest sharing across larger sociopolitical boundaries including the Canada–United States border is another way that communities offset decreases in caribou meat in some places and in some years as well documented with the Vuntut Gwichin of Old Crow, Yukon” (Parlee et al., 2018:7).

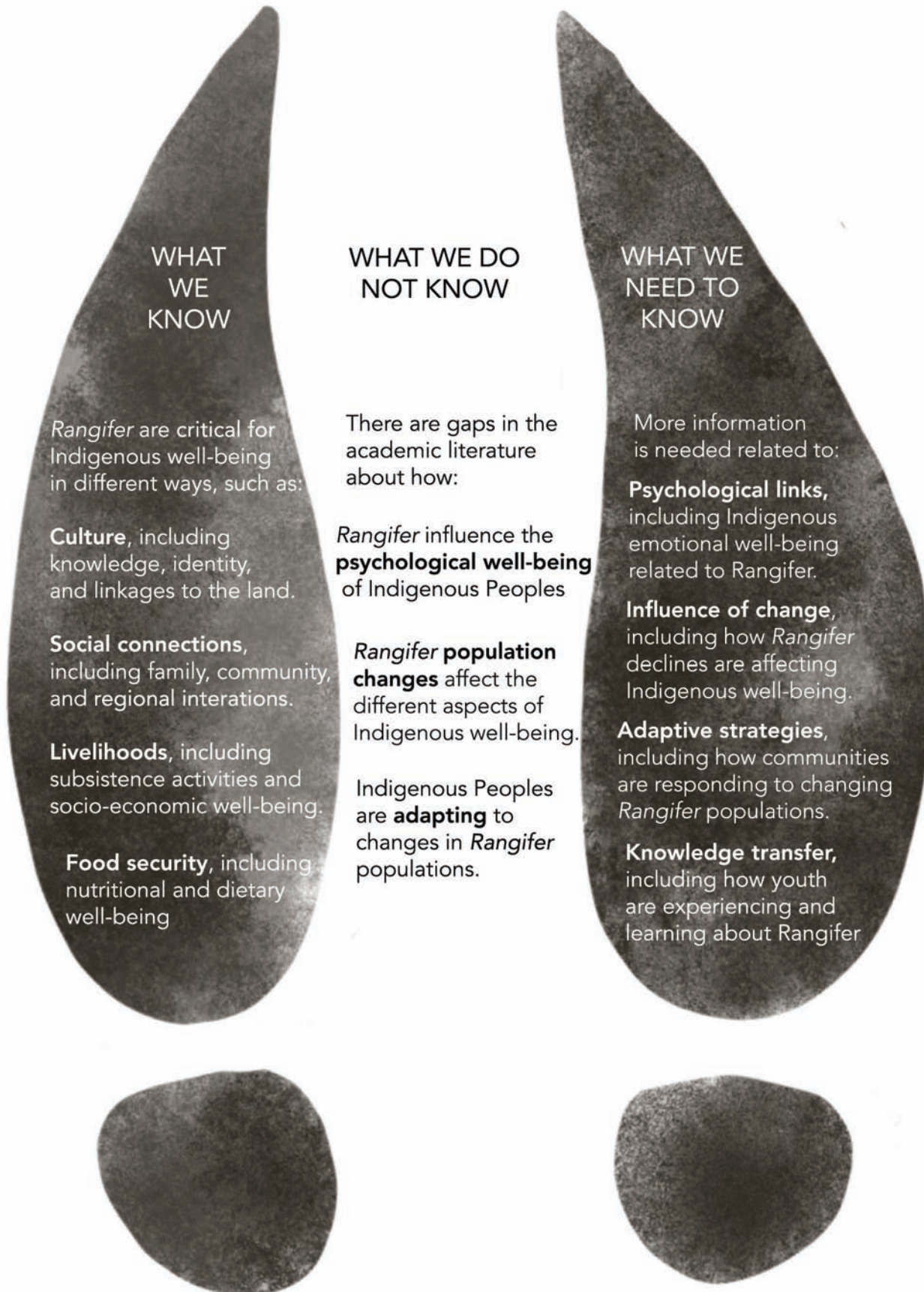


FIG. 6. Summary of what we know, what we do not know, and what we need to know in the academic literature about the connections between *Rangifer* and Indigenous well-being in the North American Arctic and Subarctic, based on research trends and gaps identified in this review.

## DISCUSSION

*What We Know about Rangifer and Indigenous Well-being*

The academic literature on this topic is highly complex, wide-ranging, and heterogenous in nature, and extends to fields as diverse as anthropology, nutrition, wildlife biology, and economics, resulting in a wide range of study designs, methodologies, and findings. In this scoping review, 58 articles published in academic journals were identified as discussing the links between *Rangifer* and Indigenous well-being. The included literature depicts these links through discussions around the cultural, food security, livelihood, psychological, and social connection relationships. More articles focused on Inuit populations than First Nation, Alaskan Native, and Métis populations combined, which may be reflective of the large amount of research conducted in Inuit Nunangat (ITK, 2018). As such, the majority of themes in the included articles were discussed within an Inuit context. Based on the literature in this review, we do not know as much about the well-being connections that First Nations and Métis people share with *Rangifer* populations.

The findings from the articles included in this scoping review indicate that a substantial number of articles discuss the connection between *Rangifer* and Indigenous culture as understood through Indigenous identities, cultural continuity, and connections to the land. These findings align with what we already know about Indigenous connections to the land (Cunsolo Willox et al., 2013), identity (Sejersen, 2004; Borish et al., 2021), and continuity of cultural knowledge as factors for both individual and community-wide well-being (Kirmayer et al., 2003; Reading and Wien, 2009; Reading and Halseth, 2013). Although the importance of *Rangifer* for Indigenous culture is unsurprising, this review demonstrates that there is substantial focus on the identity dimensions of cultural well-being within the literature.

The important role that *Rangifer* play in Indigenous livelihoods was also evident in the literature, with our review highlighting a particular focus on subsistence activities. This strong connection reflects the abundance of literature around the significance of hunting, herding, and other subsistence activities for Indigenous Peoples (Wenzel, 1987; Condon et al., 1995; Sejersen, 2004; Meis Mason et al., 2007, 2012; Kolpaschikov et al., 2015). Given subsistence activities can be vital for acquiring food, earning an income, and supporting cultural identity, psychological well-being, physical health, and community cohesion (Condon et al., 1995; Collings, 1997), maintaining Indigenous-*Rangifer* livelihood linkages may be essential for Indigenous well-being.

The included literature has shown that *Rangifer* play an important role in Indigenous social life, as *Rangifer* supports networks and bonds at the family, community, and regional level. In particular, the community level connections are shown in this review to be discussed more

than connections at other levels, signifying the importance of community ties. We know from previous research that Indigenous well-being can be strongly associated with interpersonal relationships, collectivism, and collaboration between and among community members, and especially within non-individualistic societies (Kral et al., 2011). Given these direct and indirect benefits through social connections, *Rangifer* can be seen not only as part of Indigenous social life, but also a core component of community-wide well-being within *Rangifer*-dependent communities.

*Rangifer* ties to food security remain extremely important for Indigenous Peoples. This finding aligns with the well-established knowledge of how Arctic and Subarctic animals support Indigenous diets, with discussions often focused on the nutritional benefits (Sheehy et al., 2013; Kenny et al., 2018b), cultural preferences (Lambden et al., 2007; Watts et al., 2017), and overall importance of country foods to Indigenous food security (Pufall et al., 2011; Rosol et al., 2016). Considering food insecurity and malnutrition have been characterized as some of the most pressing challenges affecting northern Indigenous communities (Parlee and Furgal, 2012), identifying ways of maintaining access to *Rangifer* as a healthy and affordable food source is, therefore, particularly important for Indigenous food security and well-being.

Contrary to other types of relationships between Indigenous well-being and *Rangifer*, a sizeable number of articles discussing food security were described in the context of changing *Rangifer* populations (e.g., Royer and Herrmann, 2011) or changing *Rangifer* management strategies (such as hunting restrictions) (e.g., Kenny et al., 2018a), which affect food availability and access. Consequently, more information is known about the nutritional and dietary implications when Indigenous-*Rangifer* relationships are altered by human or natural causes.

*What We Do Not Know and Need to Know about Rangifer and Indigenous well-being*

*Rangifer* herds are on the decline across the Circumpolar North; a synchronous, global decline in *Rangifer* populations, including most of the major caribou and reindeer herds, is occurring from North America to Scandinavia to Siberia (Boan et al., 2018; ECCC, 2018; Kenny et al., 2018a). While historical population fluctuations have been documented for many *Rangifer* populations worldwide, the ongoing and coinciding population declines raise concerns for *Rangifer* and the human populations that depend on the species (Gunn et al., 2009; Vors and Boyce, 2009; Kenny et al., 2018a; Parlee et al., 2018). We know that *Rangifer* are central to the well-being of many Indigenous communities across the North American Arctic and Subarctic, as well as Indigenous reindeer-herding communities across Scandinavia and Siberia (Kitti, 1996; Heikkilä, 2002; Barklund, 2007;

Berman, 2013; Forbes, 2013; Kolpaschikov et al., 2015; Vuojala-Magga and Turunen, 2015). However, in the context of changing *Rangifer* populations—and the changing *Rangifer* management strategies that may follow—it is clear that we really need to know more about the ways in which Indigenous communities across the Circumpolar North are being affected by these changes from a well-being lens.

In particular, more information needs to be advanced around the implications of these *Rangifer*-related changes on Indigenous psychological connections to *Rangifer*. Previous articles emphasize how emotional well-being in Indigenous communities can be further strained when wildlife and food systems are at risk of change (McGrath-Hanna et al., 2003; Pufall et al., 2011; Cunsolo Willox et al., 2013), which directly relates to the emotional concern over changes in human-*Rangifer* relationships evident in this review. Given that little is known about the implications of caribou declines for individual and community-wide mental health burdens in the academic literature (Cunsolo et al., 2020), the continued social, economic, and environmental changes that are expected to occur across the Circumpolar North (Wexler, 2006) may have further negative implications for the emotional importance of *Rangifer* for Indigenous well-being. As such, it is important to enhance the evidence base around the emotional and psychological dimensions of these relationships to support mental health planning and overall well-being within Indigenous communities.

Importantly, we do not yet know through the published literature much about Indigenous adaptive strategies for supporting individual and community relationships with caribou for maintaining well-being. There is already a lack of empirical documentation of Indigenous dietary substitutions when *Rangifer* populations change (Kenny et al., 2018a), which suggests a need to understand what substitutes exist, at what point these transitions are occurring, and how these substitutes are influencing Indigenous well-being. For example, understanding the extent that an alternative species or food sources can contribute to the diverse aspects of Indigenous cultural, social, nutritional, livelihood, and psychological well-being could further support Indigenous well-being. Knowledge also needs to be advanced around the potential long-term well-being implications of a reduced reliance on *Rangifer* and greater reliance on a substitute (Borish et al., 2021). Adaptation and response may vary by Indigenous group, as well as geographically and demographically (Ford et al., 2020). To gain a better understanding of adaptive strategies and the other gaps outlined in this discussion, further examination, exploration, and analysis of the grey literature pertaining to *Rangifer*-Indigenous relationships are also recommended.

Further inquiry must prioritize the effects of *Rangifer*-related change on Indigenous youth. Similar to adaptive strategies, the future of Indigenous-*Rangifer* relationships is dependent, at least in part, upon the interactions and

experiences that youth are having and will continue to have with this species (Snook et al., 2020). However, the changing *Rangifer* populations pose an array of challenges for the continuity of cultural knowledge, values, and practices that form the basis of Indigenous-*Rangifer* connections and the well-being dimensions embedded within this relationship. For example, hunters, cooks, carvers, and others will be increasingly limited in their abilities to transfer *Rangifer*-related knowledge intergenerationally if *Rangifer* herds continue to decline and hunting restrictions are enacted. Subsequently, youth may be unable to learn about *Rangifer* in the ways that their ancestors have before them, such as taking part in a first hunt (Ungava Peninsula Caribou Aboriginal Round Table, 2017). More information is thus urgently required related to the ways in which youth are currently interacting with *Rangifer*, the short and long-term implications on Indigenous well-being if youth cannot access and learn about *Rangifer*, and strategies to support *Rangifer*-specific intergenerational knowledge transmission within communities.

Despite the importance of Indigenous self-determination in research (Tuhiwai Smith, 1999, 2012), explicit discussion of how Indigenous Peoples, communities, organizations, and governments are involved in the production and dissemination of research is lacking. Indeed, since there is a lack of reporting and publication standards for describing how Indigenous Peoples are engaged in the research creation process for studies focused on Indigenous Peoples and wildlife, it is challenging to determine the extent of Indigenous inclusion in the production of knowledge captured in this scoping review. If authorship is an indicator of research participation and leadership, institutional affiliations of the authors demonstrate that Indigenous involvement in the articles and research was minimal. However, the findings related to collaboration with Indigenous Peoples, organizations, or governments suggest a growing trend towards increased partnerships between researchers and Indigenous Peoples; these partnerships are an important part of coproducing knowledge on this topic (Snook et al., 2020).

Of course, there is a wealth of informative grey literature relating to Indigenous Peoples and *Rangifer*. However, there have also been calls by Indigenous communities, governments, and organizations to advance understandings of reconciliation and equity in peer-reviewed research processes related to Indigenous communities and their lands and waters (e.g., United Nations General Assembly, 2007; TRCC, 2015; ITK, 2018). A number of authors (e.g., Kofinas, 2005; Bali, 2016; Castro et al., 2016) have already reported a lack of Indigenous involvement in the construction of peer-reviewed knowledge around *Rangifer*. Therefore, future *Rangifer*-related research may benefit from increased partnerships with and research leadership by Indigenous groups to further understand well-being trends related to *Rangifer*, and to ensure that multiple forms of knowledges and sciences are reflected in the academic literature. Articles such as Bali and Kofinas (2014), Polfus et

al. (2016, 2017), Parlee et al. (2018), Wray and Parlee (2013), and Zoe (2012) illustrate how coproducing knowledge in partnership with Indigenous communities can support a strong foundation for exploring issues related to Indigenous well-being and *Rangifer*.

### *Research Limitations*

There are a number of limitations associated with this scoping review. First, although non-English articles were included in this review, the search string was developed in English, which may have restricted the potential to identify information that was not indexed in English. Further, only Latin nomenclature was used as search terms, which may have omitted other relevant terminology (e.g., *Wëdzey* and *Ekwô* are other Indigenous names for caribou). We attempted to overcome this limitation by using the general words “caribou” and “reindeer” in our search, so that articles using other relevant terms (e.g., Indigenous names) would hopefully still be captured with these broader terms. Second, our search may not have included all relevant articles, as the search terms were very broad for both populations of focus (i.e., *Rangifer* and Indigenous Peoples). More detailed terminology, including the specific names of Indigenous groups, tribes, or bands (e.g., Dene), may have yielded additional content. We attempted to overcome this by including the overarching terms for different Indigenous groups across North America.

## CONCLUSION

This scoping review examined and characterized the nature, range, and extent of literature published in academic journals that met the inclusion criteria related to the connection between *Rangifer* and Indigenous well-being within North American Arctic and Subarctic regions. The findings from this review provide insight into how the academic literature has documented and conceptualized human-*Rangifer* relationships in these regions and may be useful for informing research related to wildlife management, social, and health-related decision-making into the future. While many articles across a variety of disciplines discussed these human-*Rangifer* links, the number of articles that focused on this relationship from a well-being perspective was limited.

It is clear from this review that we already know *Rangifer* are important contributors to many tangible and intangible aspects of Indigenous life: physical sustenance in the form of food security; livelihood security and activities in the form of hunting and employment; cultural sustenance in the form of identity, connections to the land, and cultural continuity; and social connections within and among Indigenous communities. Despite these established understandings, a number of important gaps remain in the evidence base of academic published literature: we do

not know enough about the emotional and psychological dimensions of Indigenous well-being in relation to *Rangifer*; little is known about the ways in which the changes in *Rangifer* populations and management strategies are influencing Indigenous well-being; and information around what Indigenous communities are doing to respond and adapt to alterations in this human-animal relationship is uncertain.

Considering *Rangifer* populations are on the decline across the Circumpolar North, there is a clear and urgent need to further understand the ways in which Indigenous well-being is being influenced by *Rangifer*-related change. As the deficiency around reporting Indigenous involvement in the coproduction of research found on this topic suggests, Indigenous Peoples should be further engaged in the advancement of knowledge on this topic, and their engagement should be clearly outlined and discussed in the peer-reviewed literature. Through Indigenous leadership, more evidence-based understanding is needed about the emotional and psychological connections that Indigenous peoples have with *Rangifer* to help address the complex mental health challenges faced in some Indigenous communities. We also need to further understand what adaptive strategies, if any, are being carried out, and how these responses are implicating the diverse dimensions of Indigenous well-being. Additionally, research focusing on how youth are interacting with *Rangifer* will be important for understanding and supporting the intergenerational knowledge transfer that is critical for the future of Indigenous-*Rangifer* relationships. Ultimately, *Rangifer* are integral for ecological, cultural, food security, livelihood, emotional, social, and other reasons. Greater knowledge of the depth and diversity of this complex human-animal relationship in the context of *Rangifer* population and management changes may support the well-being of Indigenous communities.

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