

**SCIENCE, BORDERS, AND BOUNDARIES IN THE WESTERN ARCTIC: ENVIRONMENTAL HISTORIES OF THE  
PORCUPINE CARIBOU HERD**

by

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# Abstract

The annual migration of the Porcupine Caribou Herd is an important biological phenomenon that is central to the maintenance of dynamic environmental relationships in the transboundary western Arctic (northeastern Alaska and northern Yukon). In this dissertation, I argue that far from being a purely natural or unchanging biological process, the herd's migration has an historical geography, which has been shaped by human societies, and structured by the establishment of political, conceptual, and metaphorical boundaries and borders throughout the twentieth century. Informed by recent research in the fields of transnational environmental history, the history and geography of science, and critical northern geography, I develop a conceptual framework that seeks to explicate the role of caribou science in boundary-making practices in the western Arctic. In four conceptually-linked case studies, I examine the scientific establishment and reinforcement of critical boundaries employed by state-based wildlife management agencies during the twentieth century. These include the shifting line between *domesticated* and *wild* animals; the boundaries drawn around species, subspecies, and caribou herd concepts; the violable spatial and conceptual boundary between industrial development and critical caribou habitat; and, finally, the illusory threshold between safe and unsafe levels of exposure to radioactive contamination for both caribou and people. Across these four case studies, each boundary emerges not as stable line drawn around the natural world, but rather as a contested site of knowledge production. Through an examination of scientific boundary-making practices, I show how scientists not only sought to demarcate natural boundaries, but also contested and transformed the placement of the very line that separated scientific from non-scientific knowledge, and determined which individuals and groups represented legitimate producers of scientific knowledge about migratory caribou herds.

# Lay Summary

Every year, thousands of caribou from the Porcupine Herd (*Rangifer tarandus granti*) cross the Alaska-Yukon border as they migrate between the herd's calving grounds on Alaska's coastal plain, and its wintering grounds in northern Alaska, Yukon, and the Northwest Territories. Far from being an unchanging biological phenomenon, the herd's migration is a historical process that has been shaped by human activities in the western Arctic. In this dissertation, I consider the development and application of scientific caribou management in the western Arctic. The research focuses on four sites of knowledge production: the shifting line between *domesticated* and *wild* animals; the boundaries drawn around species, subspecies, and caribou herd concepts; the violable spatial and conceptual boundary between industrial development and critical caribou habitat; and, finally, the illusory threshold between safe and unsafe levels of exposure to radioactive contamination for both caribou and people.

# Preface

Jonathan Cory Luedee conducted all of the research and writing for this dissertation.

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## Chapter 1: Political Borders, Metaphorical Boundaries, and Migratory Caribou

### 1.1. What Happens When Nature Crosses Borders?

On 19 June 1984, Alaska Department of Fish and Game (ADFG) biologist Ken Whitten spotted a female caribou from the Porcupine Herd (*Rangifer tarandus granti*) while flying above Alaska's coastal plain in a small helicopter. After tracking and securing the animal – presumably with the use of a tranquilizer – Whitten and the pilot of the helicopter worked together to fit a satellite radio-collar on the caribou's neck. What was undoubtedly a jarring incident for the animal was also an important moment in the history of scientific wildlife management in the North American Arctic. Although mid-twentieth century scientists and conservationists had adopted and employed radiotelemetry and other “electronic technologies of the Cold War and space age” to track animals, scientists noted that Whitten's use of the technology represented the first instance in which a satellite radio-collar had been placed on a caribou “in the wild.”<sup>1</sup>

For wildlife managers in Alaska and northern Canada, radiotelemetry and satellite tracking seemed to offer a technological fix to problems inherent to studying migratory caribou.<sup>2</sup> Since the early twentieth century, wildlife management agencies in both countries, driven by a modern state imperative to inventory its natural resources, had devoted considerable resources to the development of methods and techniques for visualizing caribou herds and quantifying caribou populations.<sup>3</sup> As natural historical methods of observation gave way to capital-intensive

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<sup>1</sup> Etienne Benson, *Wired Wilderness: Technologies of Tracking and the Making of Modern Wildlife* (Baltimore: Johns Hopkins University Press, 2010), 5. For details pertaining to the capture and radio-collaring of this caribou, see US Fish and Wildlife Service, *Arctic National Wildlife Refuge: Annual Narrative Report, 1984* (Fairbanks: US Fish and Wildlife Service, 1985), 64-65.

<sup>2</sup> USFWS, *Arctic National Wildlife Refuge: Annual Narrative Report, 1984*, 65-65. For a discussion of the history of radiotelemetry and its application in wildlife management and science, see Benson, *Wired Wilderness*.

<sup>3</sup> As scholars have demonstrated, the emergence of modern resource management regimes was bound up with the production and employment of methods of rendering animal and plant populations both legible (i.e., visible) and quantifiable. James Scott's articulation of “high modernism” is central to this historiographical development: James Scott, *Seeing Like a State: How Certain Schemes to Improve the Human Condition Have Failed* (Princeton: Yale University Press, 1998). Robert Wilson explores this concept in relation to the history of migration: Wilson, “Mobile

aerial surveillance technologies after the end of the Second World War, scientists increasingly made claims about the precision of their surveys and the accuracy of their caribou population censuses.<sup>4</sup>

Despite the adoption of methods of aerial surveillance, scientific uncertainty persisted. As environmental historian John Sandlos notes, mid-twentieth century methods of counting migratory caribou from above were fraught with scientific uncertainty, and troubled by scientists' incomplete knowledge of barren ground caribou migratory routes; Canadian wildlife managers and northern administrators, he argues, based the first comprehensive surveys and barren ground caribou population estimates on "a degree of speculation and conjecture."<sup>5</sup> In the western Arctic, the geography of the Porcupine Caribou Herd's range complicated the efforts of scientists and wildlife managers who not only attempted to count these mobile animals, but also sought to understand the seasonal complexities of the herd's migration. The adoption of radiotelemetry and satellite collars provided scientists and wildlife managers with an unprecedented level of detail about the spatial and temporal dynamics of caribou movements, and, therefore, represented a critical development in scientific attempts to produce a synoptic view of the Porcupine Caribou Herd. The use of collars to track caribou, however, was not an uncontentious practice. In the Vuntut Gwitchin First Nation (Old Crow, Yukon) elders and

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Bodies," 469-470. See also, Arun Agrawal, *Environmentality: Technologies of Government and the Making of Subjects* (Durham: Duke University Press, 2005). For a discussion of the relationship between visual technologies and the development of the Canadian state, see Matt Dyce, "Canada Between the Photograph and the Map: Aerial Photography, Geographical Vision and the State," *Journal of Historical Geography* 39 (2013): 69-84.

<sup>4</sup> For an important contemporaneous scientific publication and description of the method of aerial surveillance, see A.W.F. Banfield, *Preliminary Investigation of the Barren Ground Caribou* (Ottawa: Canada Department of Northern Affairs and National Resources, 1954); Ronald Skoog, "Method for Estimating Caribou Herds," *Alaska Department of Fish and Game: Informational Leaflet* 20 (1962): 1-6. For key discussions of state-based attempts to monitor and quantify migratory caribou populations in the North American Arctic, see John Sandlos, *Hunters at the Margin: Native People and Wildlife Conservation in the Northwest Territories* (Vancouver: UBC Press, 2007), 139-230; Peter Kulchyski and Frank Tester, *Kiumajut (Talking Back): Game Management and Inuit Rights, 1900-70* (Vancouver: UBC Press, 2007), 122-164.

<sup>5</sup> Sandlos, *Hunters at the Margin*, 205.

community leaders raised concerns about the use of this invasive technology, which they viewed as a profoundly disrespectful and harmful method of tracking and studying caribou.<sup>6</sup>

Nonetheless, during this early stage in its use, wildlife managers were optimistic that satellite technologies would be helpful as they worked to unlock the mysteries of the “enigmatic” migratory caribou.<sup>7</sup>

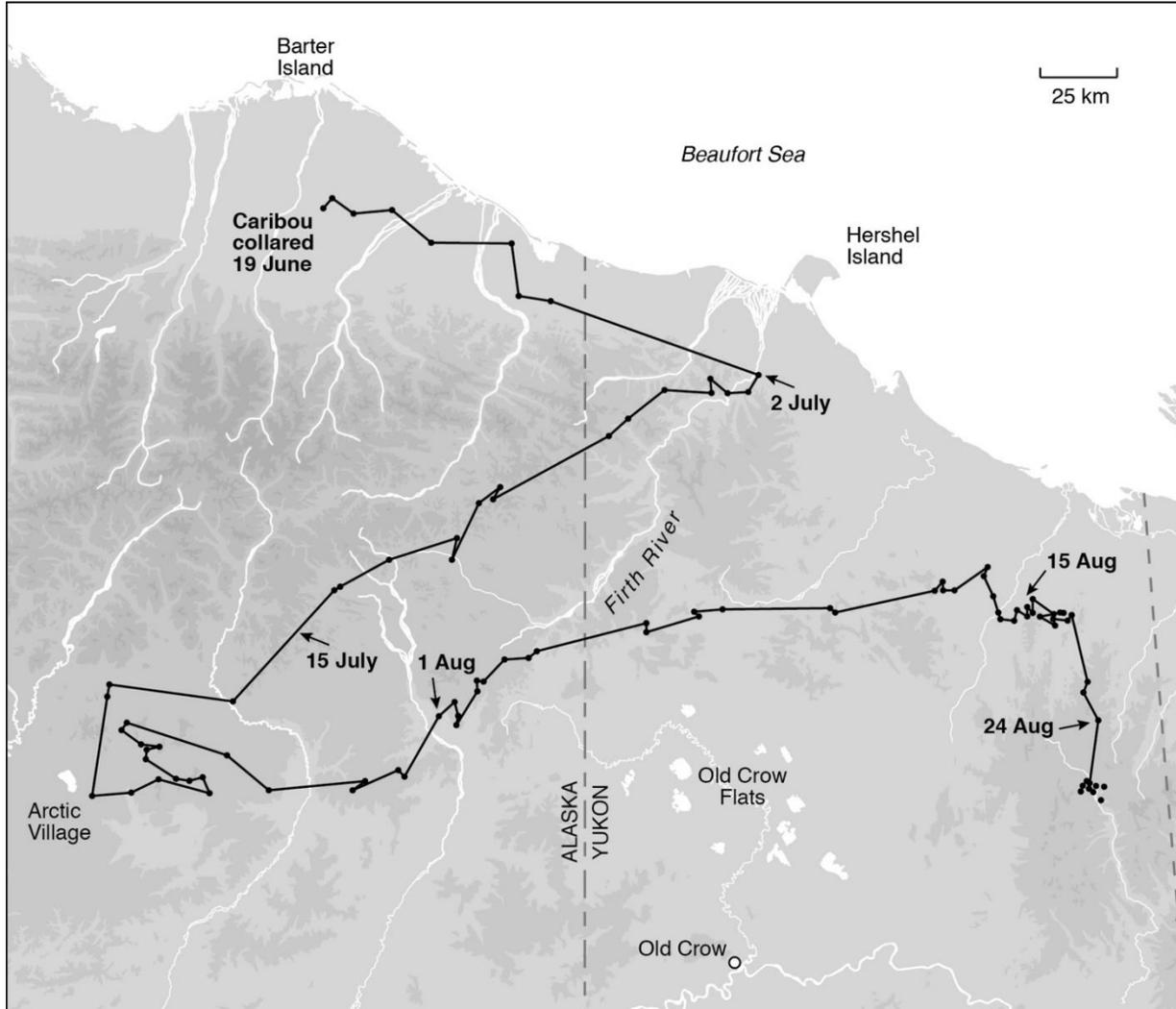
After Whitten secured the satellite collar to the caribou, wildlife managers stationed at the headquarters of the Arctic National Wildlife Refuge (ANWR) in Fairbanks began tracking the animal’s movements as it migrated from northeastern Alaska to a location near the border between the Yukon and Northwest Territories in northern Canada (see figure 1.1). Over the next two months, the cow travelled more than 1,000 kilometers as it migrated toward its wintering grounds. The caribou, however, did not follow the most direct route through the western Arctic. From their office in Fairbanks, wildlife managers mapped and plotted the cow’s migrating across several major river systems and moving between Arctic tundra and alpine ecosystems. In addition to these natural features, the caribou transected multiple cultural boundaries as it moved through Inuvialuit, Inupiat, and Gwich’in traditional territories. During its summer migration, the cow crossed the Canada-US border no less than three times, demonstrating a historical problem that environmental historian Mark Fiege has described as the “incompatibility of human boundaries and forms of mobile nature.”<sup>8</sup>

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<sup>6</sup> See Edith Josie’s contribution to the Dempster Highway oral history project in Erin Sherry and Vuntut Gwitchin First Nation, *The Land Still Speaks: Gwitchin Words about Life in Dempster Country* (Old Crow: Vuntut Gwitchin First Nation, 1999), 212. For more on the “crisis” of legitimacy spurred by these concerns, see Gary Kofinas, “Caribou Hunters and Researchers at the Co-Management Interface: Emergent Dilemmas and the Dynamics of Legitimacy in Power Sharing,” *Anthropologica* 47, 2 (2005): 179-196.

<sup>7</sup> For more on the “enigmatic” caribou in scientific wildlife management discourse, see Tina Loo, “Political Animals: Barren Ground Caribou and the Managers in a ‘Post-Normal’ Age,” *Environmental History* 22 (2017): 434-459.

<sup>8</sup> Mark Fiege, “The Weedy West: Mobile Nature, Boundaries, and Common Space in the Montana Landscape,” *The Western Historical Quarterly* 36, 1 (2005), 24.



**Figure 1.1. Transboundary Migration.** For original, see US Fish and Wildlife Service, *Arctic National Wildlife Refuge: Annual Narrative Report, 1984* (Fairbanks: US Fish and Wildlife Service, 1985). Map by Eric Leinberger.

With an estimated population of more than 200,000 animals, the Porcupine Caribou Herd is not only one of the largest barren ground caribou herds in North America, but also represents an important international resource that has cultural, social, and historical connections to

Indigenous communities on both sides of the border.<sup>9</sup> Yet, the herd's transboundary migration is a historical and geographical problem that has challenged jurisdictional control of natural resources, complicated wildlife management and local resource use, and shaped environmental politics and relationships in the western Arctic.<sup>10</sup> Throughout the twentieth century, and increasingly after the end of the Second World War, northern administrators, caribou scientists, and wildlife managers in Canada and the United States worked to reconcile the "discontinuity" between the herd's migration and the International Boundary that transects its range through the alignment of national programs and the establishment of a transnational network of caribou science.<sup>11</sup> Though caribou scientists and wildlife managers may have viewed satellite tracking and radiotelemetry as a technological fix to the geographical problems posed by the herd's transboundary migration, the adoption of this method of visualization did not represent a break from the modalities of existing and historical forms of scientific caribou management. Rather, as Whitten and his colleagues received and translated geographic information about the location of the caribou, they not only became enrolled in the production of a global network of scientific expertise, but also were active participants in and contributors to a scientific tradition that aimed to determine what happens when migratory species cross borders.

## **1.2. Bordered Natures in the Western Arctic**

This dissertation is a study of animals that cross borders and the boundaries that humans have constructed to contain them. More specifically, the historical and geographical analysis

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<sup>9</sup> For the results of the most recent census (2017-2018): Government of Yukon, "New Population Estimate for the Porcupine Caribou Herd," accessed online at <http://www.gov.yk.ca/news/18-002.html> on 26 April 2018.

<sup>10</sup> For a discussion of the role that borders have played in shaping regional histories in the Pacific Northwest, see John Findlay and Ken Coates, eds., *Parallel Destinies: Canadian-American Relations West of the Rockies* (Kingston-Montreal: McGill-Queen's University Press, 2002).

<sup>11</sup> For a discussion of the way in which the discontinuities among political borders and migratory species shaped environmental politics and conservation, see Kurkpatrick Dorsey, *The Dawn of Conservation Diplomacy: U.S.-Canadian Wildlife Protection Treaties in the Progressive Era* (Seattle: University of Washington Press, 1998), 3-4

concerns the way in which twentieth-century scientists sought to describe, classify, and, ultimately, manage the migratory Porcupine Caribou Herd through boundary-making practices in the western Arctic. Throughout the dissertation, I conceptualize boundaries in two ways: first, as political borders that demarcate national and territorial space; and, second, as metaphorical or symbolic boundaries drawn and negotiated by scientists to categorize the natural world and to order environmental relationships. In this section, I explain how my twinned conceptualization of borders and boundaries is informed by and contributes to ongoing debates in three broadly related literatures: transnational and transboundary environmental historical geography; the history and geography of science (including scholarship in science and technology studies (STS)), and the emerging field of critical northern geographies.

In the first instance, I think about political borders as both abstract and physical boundaries that demarcate the limits of the state's ability to exert jurisdictional control over territorial space and its natural resources.<sup>12</sup> Following political geographer John Agnew, I reject the notion of the state as a "fixed unit of sovereign space," and, rather, seek to understand how the state – and its territorial boundaries – came to matter in particular historical and geographic contexts.<sup>13</sup> In each chapter, I pay attention to the movement of caribou, people, energy, radioactive material, and scientific ideas across the Alaska-Yukon border, and consider the way in which these transboundary and transnational flows inflected the emergence of scientific caribou management in the western Arctic during the twentieth century.

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<sup>12</sup> Anthony Giddens, *The Nation-State and Violence: Volume 2 of a Contemporary Critique of Historical Materialism* (Berkeley: University of California Press, 1987), 19-22. See also, Paul Nadasdy, *Sovereignty's Entailments: First Nation State Formation in the Yukon* (Toronto: University of Toronto Press, 2017), 92-95.

<sup>13</sup> John Agnew, "The Territorial Trap: The Geographical Assumptions of International Relations Theory," *Review of International Political Economy* 1, 1 (1994): 53-80.

Since the early 1990s, North American environmental historians and historical geographers – spurred by a trend toward “internationalization” in historiography – have focused increasingly on issues that transcend the boundaries of the nation-state.<sup>14</sup> As environmental historians refined the conceptual tools and methodological approaches through which they examined the dynamism and complexity of human-environment interactions, they adopted spatial concepts that span international boundaries, and challenged historiographical traditions that afford primacy to national frameworks.<sup>15</sup> As excitement for topics that cross borders grew among environmental historians, however, the field witnessed a proliferation in and blurring of terminology used to conceptualize boundary crossings.<sup>16</sup> In 2008, environmental historian Joseph Taylor sounded a note of caution regarding the use – or misuse – of boundary terminology. Although environmental historians had adopted concepts developed by spatial theorists and geographers, “[t]oo often,” he argued, “historians use boundary terminology without considering how other disciplines have conceptualized these concepts.”<sup>17</sup> Taylor is not alone in stressing the importance of disciplinary coherence in the use of boundary terminology. Political geographer David Newman has argued that while there is no single theory or

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<sup>14</sup> Richard White, “The Nationalization of Nature,” *The Journal of American History* 86, 3 (1999): 976-986. For more on the “internationalization” in historiography, and the case against American exceptionalism, see Ian Tyrrell, “American Exceptionalism in an Age of International History,” *The American Historical Review* 96, 4 (1991): 1031-1055. For a discussion of the development of environmental historical thought on borders, see Lissa Wadewitz, *The Nature of Borders: Salmon, Boundaries, and Bandits on the Salish Sea* (Seattle: University of Washington Press, 2012), 9. For overviews of the development of environmental history as a field, and its broader connections with historical geography, see J.R. McNeill, “Observations on the Nature and Culture of Environmental History,” *History and Theory* 42, 4 (2003): 5-43; Michal Williams, “The Relations of Environmental History and Historical Geography,” *Journal of Historical Geography* 20, 1 (1994): 3-21.

<sup>15</sup> Dan Flores has argued that the bioregion, a natural geographic system that is not confined by political or other jurisdictional boundaries is the proper setting for environmental histories. Dan Flores, “Place: An Argument for Bioregional History,” *Environmental History Review* 18, 4 (1994): 1-18. Jeffrey Bolster employs the oceanographers’ notion of the large marine ecosystem (LME) in his examination of human interaction with the ocean in preindustrial eastern Canada and northeastern United States. See Bolster, *The Mortal Sea: Fishing the Atlantic in the Age of Sail* (Cambridge: Harvard University Press, 2012), 5; Jeffrey Bolster, “Putting the Ocean in Atlantic History: Maritime Communities and Marine Ecology in the Northwest Atlantic, 1500-1800,” *The American Historical Review* 113, 1 (2008): 19-47

<sup>16</sup> Joseph E. Taylor, III, “Boundary Terminology,” *Environmental History* 13 (2008): 454-481.

<sup>17</sup> Taylor, “Boundary Terminology,” 455-456.

explanatory framework of borders and border-making, “there are common terminologies from which border practitioners from different disciplines can borrow and enrich each other, in their attempts to broaden the study, and understanding, of the processes through which borders are created and perpetuated.”<sup>18</sup> However, analytical coherence requires a certain level of disciplinary agreement about the meaning of terminology. Through an extensive review of scholarship about things that cross borders, Taylor developed a typology to bring analytical clarity to environmental historians’ use of boundary terminology.

Taylor’s discussion of *transnational* and *transboundary* histories are of particular importance to the historical and geographical analysis undertaken in this dissertation. In my examination of the establishment of institutional linkages among scientists and wildlife managers in Canada and the United States, I employ the term transnational to describe the scientific network that emerged in the western Arctic during the mid-twentieth century. As Taylor suggests, transnational research should do more than chart the movement and flow of things across borders. Rather than simply following the circulation of people, caribou specimens, and scientific ideas across the Alaska-Yukon border, I seek to understand how these flows structured, organized, and maintained spatial relationships across a region divided by a political border.<sup>19</sup> For all its analytical power in describing the forces that have shaped the history of conservation, the term transnational, Taylor suggests, “cannot contain the messy ecological history” of migratory animals.<sup>20</sup> Rather, he suggests that *transboundary* describes better the “tension between the ecological and cultural spaces these animals inhabit.”<sup>21</sup> Though most Porcupine

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<sup>18</sup> David Newman, “The Lines that Continue to Separate Us: Borders in our ‘Borderless’ World,” *Progress in Human Geography* 30, 2 (2006): 143-161

<sup>19</sup> By drawing on scholarship in law, diaspora studies, and anthropology, Taylor also suggests the limitations of this particular framing of “transnational”. See Taylor, “Boundary Terminology,” 457-458.

<sup>20</sup> Taylor, “Boundary Terminology,” 462.

<sup>21</sup> Taylor, “Boundary Terminology,” 464.

Caribou are birthed on Alaska's coastal plain, the herd itself has no "intrinsic nationality."<sup>22</sup> Further, like the wildebeests used to illustrate Taylor's argument, throughout the twentieth century, the herd's habitat has been a complex assemblage of differing jurisdictional spaces – a socio-cultural landscape that is "beyond the control of any single human entity."<sup>23</sup> Increasingly, the herd's continual crossing of the Alaska-Yukon border has meant that any political decision about hunting, conservation, or resource extraction within its range has required "multilateral negotiations among shifting governmental, economic, and ethnic communities."<sup>24</sup>

By acknowledging that nature crosses borders, historians and geographers have not eschewed the environmental significance of political borders, jurisdictional boundaries, and the nation-states that enforce them.<sup>25</sup> Indeed, as geographer Juliet Fall argues in her examination of transboundary environmental governance in Europe, despite human efforts to manage natural resources across national divisions, political borders have continued to shape environmental relationships.<sup>26</sup> Further, following developments in political geography, which has reasserted the importance of studying political borders in response to the emergence of globalization theory and its "borderless world" discourse, environmental historical geographers have investigated the dynamic spatio-temporalities of political borders and demonstrated the importance of the "bordering process" in the making and ordering of environmental relationships.<sup>27</sup> As historian

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<sup>22</sup> Taylor, "Boundary Terminology," 464. For more on nature and nationality, see White, "Nationalization of Nature."

<sup>23</sup> Taylor, "Boundary Terminology," 464.

<sup>24</sup> Taylor, "Boundary Terminology," 462.

<sup>25</sup> Nancy Langston, "Thinking Like a Microbe: Borders and Environmental History," *Canadian Historical Review* 95, 4 (2014): 592-603.

<sup>26</sup> Juliet Fall, *Drawing the Line: Nature, Hybridity and Politics in Transboundary Spaces* (London: Ashgate, 2005). As cited in Taylor, "Boundary Terminology," 461.

<sup>27</sup> Newman, "The Lines that Continue to Separate Us," 143-161. Indeed, as Newman posits, as the field of border studies opened its disciplinary boundaries beyond political geography, key contributions have been made by scholars in fields beyond political geography. For more on the dynamism and multiplicity of border and how they come to matter, see Reece Jones, *Violent Borders: Refugees and the Right to Move* (London: Verso, 2016); Juanita Sundberg, "'Trash-Talk' and the Production of Quotidian Geopolitical Boundaries in the USA-Mexico Borderlands," *Social and Cultural Geography* 9, 8 (2008): 871-890.

Lissa Wadewitz argues, scholars interested in the transboundary and transnational dimensions of environmental change have sought to understand the environmental consequences of boundary-making and border-drawing across a broad range of geographical contexts and at multiple scales.<sup>28</sup> Within this field of scholarship, environmental historians and geographers have demonstrated that the demarcation and enforcement of jurisdictional boundaries and political borders have shaped and structured scientific, diplomatic, and managerial responses to the unique challenges posed by the transboundary movements of mobile forms of nature.<sup>29</sup> With ranges that transect “every boundary of the modern state,” migratory animals – particularly migratory birds – have been a primary point of emphasis in the fields of transnational and transboundary environmental history.<sup>30</sup> Similarly, in this dissertation I focus specifically on a migratory caribou herd that crosses the international border between Alaska and the Yukon, and seek to understand how the spatial discontinuity between the herd’s migration and the political border shaped the emergence of caribou science and management in the western Arctic during the twentieth century.

In addition to political borders, this dissertation considers certain metaphorical boundaries that scientists have constructed to stabilize the categories, concepts, and institutions through which they sought to render caribou both legible and amenable to modern regimes of

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<sup>28</sup> Wadewitz, *Nature of Borders*, 9.

<sup>29</sup> Wadewitz, *Nature of Borders*. Mark Fiege’s discussion of human responses to the spread of weeds across human boundaries in the American west is a seminal piece of scholarship in this historiography. See Mark Fiege, “Weedy West,” 22-47. Kurkpatrick Dorsey has considered the way in which governments have developed diplomatic responses to the challenge of conserving animal species that cross borders. See Dorsey, *The Dawn of Conservation Diplomacy: U.S.-Canadian Wildlife Protection Treaties in the Progressive Era* (Seattle: University of Washington Press, 1998); Kurkpatrick Dorsey, *Whales and Nations: Environmental Diplomacy on the High Seas* (Seattle: University of Washington Press, 2013). Like Dorsey, Mark Cioc has considered international treaties to protect migratory wildlife, though in a broader international context, and argued that this approach often served the interests of elite hunters, not wildlife. See Mark Cioc, *The Game of Conservation: International Treaties to Protect the World’s Migratory Species* (Ohio: Ohio University Press, 2009). For more on animals that cross borders, and the emergence of modern wildlife management regimes, see Robert Wilson, *Seeking Refuge: Birds and Landscapes of the Pacific Flyway* (Seattle: University of Washington Press, 2010).

<sup>30</sup> Quote from Wilson, “Mobile Bodies,” 465-472.

state-based wildlife management.<sup>31</sup> In developing this conceptual approach, I attend to calls from geographers and environmental historians to conceptualize state-based practices of boundary-making and enforcement beyond the confines of political borders, which have long dominated political geographical discourse.<sup>32</sup> Although the metaphorical boundaries considered in this dissertation represent lines that scientists have drawn around the natural world, they are, I suggest, cultural as well as physical.<sup>33</sup> Following sociologists Michèle Lamont and Virág Molnár, I think of metaphorical or symbolic boundaries as “conceptual distinctions made by social actors to categorize objects, practices, and even time and space. They are tools by which individuals and groups struggle over and come to agree upon definitions of reality.”<sup>34</sup> More specifically, in four conceptually-linked case studies, I examine the scientific establishment and reinforcement of critical boundaries employed by state-based wildlife management agencies during the twentieth century. These include the shifting line between *domesticated* and *wild*

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<sup>31</sup> On legibility and state-based environmental governance, see Scott, *Seeing Like a State*. See also Robert Wilson, “Animals and the American Landscape,” in *North American Odyssey: Historical Geographies for the Twenty-First Century* (Lanham: Rowman & Littlefield, 2014): 201. For a critical appraisal of Canadian environmental historians’ use of Scott’s “high modernism” concept, see Tina Loo, “High Modernism, Conflict, and the Nature of Change in Canada: A Look at *Seeing Like a State*,” *Canadian Historical Review* 97, 1 (2016): 34-58.

<sup>32</sup> Newman, “The Lines that Continue to Separate Us,” 143-161. On non-human actors as geopolitical actors, and the bounding of human and non-human as discrete ontological categories, see Sundberg, “Diabolic *Caminos* in the Desert and Cat Fights on the Río,” 318-336; Juanita Sundberg, “‘Trash-Talk’ and the Production of Quotidian Geopolitical Boundaries in the USA-Mexico Borderlands,” *Social and Cultural Geography* 9, 8 (2008): 871-890. See also Kersty Hobson, “Political Animals? On Animals as Subjects in an Enlarged Political Geography,” *Political Geography* 26, 3 (2007): 250-267. For a discussion of Indigenous boundary-making practices, and the re-making of social and cultural boundaries by the borders of the modern state in the Pacific Northwest, see Wadewitz, *The Nature of Borders* (2012). In an examination of the violence of borders, including state-based attempts to restrict the movement of people across borders, Geographer Reece Jones argues that in addition to political and international borders, other kinds of boundaries matter. Jones focuses on the violence engendered through the legitimization of private property and resource enclosures. See Reece Jones, *Violent Borders: Refugees and the Right to Move* (London: Verso, 2016).

<sup>33</sup> The conceptual focus on metaphorical boundaries is influenced by Greg Denning’s approach to the history of the Pacific Islands, and his explication of the ways in which humans have constructed their worlds according to the “reality they attribute to their categories, their roles, their institutions...”, and bounded these worlds “with their definitions of ‘we’ and ‘they’.” See Greg Denning, *Islands and Beaches: Discourses on a Silent Land, Marquesas 1774-1880* (Melbourne: Melbourne University Press, 1980): 3; 157-164.

<sup>34</sup> Michèle Lamont and Virág Molnár, “The Study of Boundaries in the Social Sciences,” *Annual Review of Sociology* 28, 1 (2002): 168.

animals; the boundaries drawn around species, subspecies, and caribou herd concepts; the violable spatial and conceptual boundary between industrial development and critical caribou habitat; and, finally, the illusory threshold between safe and unsafe levels of exposure to radioactive contamination for both caribou and people.

The individual case studies are unified through the dissertation's conceptual focus on the role of boundary-making in scientific knowledge production. For historians and sociologists of science, the matter of scientific boundaries has long been an important feature in the historiographical landscape. However, the contours of the debate about the relationships among multivalent processes of boundary-making and scientific knowledge production have shifted dramatically during the second half of the twentieth century. As Steven Shapin and Simon Schaffer have argued, during the mid-twentieth century, historians and sociologists of science were engaged in a protracted debate about which "factors" were deemed internal and external to science.<sup>35</sup> However, by the time Shapin and Schaffer published their seminal *Leviathan and the Air-Pump* in 1985, most historians of science had grown dissatisfied with the "rigidity" of the categories employed in this debate, and had disavowed the field's conceptual focus on internal and external factors and scientific change.<sup>36</sup> For Shapin and Schaffer, however, the salient issue was not the rigidity with which the constituent factors were defined, but instead the "incoherence [concerning] the placement of the boundary between what was deemed internal and what external to science."<sup>37</sup> Rather than acting as adjudicators in an historical debate about the "insides" and "outsides" of science, however, the authors sought to understand the ways in which

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<sup>35</sup> For more on the "externalism-internalism debate," see Steven Shapin and Simon Schaffer, *Leviathan and the Air-Pump: Hobbes, Boyle, and the Experimental Life* (Princeton: Princeton University Press, 2011 [1985]), xii-xvii.

<sup>36</sup> These observations based on the historiographical review included in the introduction in the 2011 edition of Shapin and Schaffer, *Leviathan and the Air-Pump*, xii-xvii.

<sup>37</sup> Shapin and Schaffer, *Leviathan and the Air-Pump*, xv.

historical processes of scientific boundary-making led to the crystallization of key categories, and determined which factors were deemed to be constitutive of science. “The language that transports politics outside of science,” the authors wrote in their 1985 publication, “is precisely what we need to understand and explain.”<sup>38</sup>

By the end of the twentieth century, most historians and sociologists of science, along with scholars in the burgeoning field of science and technology studies (STS), had rejected the notion that politics and social relations of power are in some way external to science and scientific knowledge production.<sup>39</sup> Over the past three decades, scholars have demonstrated that the very process of demarcating a social boundary between scientific and non-scientific intellectual activities is a socially-embedded, and inherently political process.<sup>40</sup> As sociologist Thomas Gieryn (1983) argues, this process of scientific “boundary-work” is bound up with social and institutional struggles for the authority to demarcate the placement of the boundary, and to determine which individuals and institutions are deemed legitimate producers of scientific knowledge.<sup>41</sup> STS scholar Sheila Jasanoff further articulates the way in which political struggles for authority inform processes of scientific boundary-work in her examination of the relationships among science advisors and policy makers in the US Government: “By drawing

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<sup>38</sup> As quoted in Shapin and Schaffer, *Leviathan and the Air-Pump*, xiii.

<sup>39</sup> Important contributions from STS include: Bruno Latour and Steve Woolgar, *Laboratory Life: The Construction of Scientific Facts* (Princeton: Princeton University Press, 2013 [1979]); Donna Haraway, “Situated Knowledges: The Science Question in Feminism and the Privilege of Partial Perspective,” *Feminist Studies* 14, 3 (1988): 575-599; Shapin and Schaffer, *Leviathan and the Air-Pump*.

<sup>40</sup> Thomas Gieryn, “Boundary-Work and the Demarcation of Science from Non-Science: Strains and Interests in Professional Ideologies of Scientists,” *American Sociological Review* 48, 6 (1983): 781-795; For more, see Sheila Jasanoff discussion of the way that boundary-work structures the legitimation of science in the policy realm: Sheila Jasanoff, *The Fifth Branch: Science Advisers as Policymakers* (Cambridge: Harvard University Press, 1990), 234-238. See also H.M. Collins and Robert Evans, “The Third Wave of Science Studies: Studies of Expertise and Experience,” *Social Studies of Science* 32, 2 (2002): 235-296; Gregory Ferguson-Cradler, “Sciences, States, and Salmon: Communicating Through Disagreement over a Cold War Fault Line,” *Environment and Planning A* 48, 9 (2016): 1864-1880; Michael Gordin, *The Pseudoscience Ward: Immanuel Velokovsky and the Birth of the Modern Fringe* (Chicago: University of Chicago Press, 2012).  
Gieryn, “Boundary-Work,” 781-795.

seemingly sharp boundaries between science and policy,” Jasanoff writes, “scientists in effect post ‘keep out’ signs to prevent nonscientists from challenging or reinterpreting claims labeled as ‘science’.”<sup>42</sup>

In this dissertation, I consider the temporal and spatial relationships among boundary-making practices in caribou science and the broader process of scientific boundary-work in the western Arctic. As scientists and wildlife managers negotiated and contested the placement of metaphorical boundaries around caribou, I argue, they not only reshaped the epistemological foundations of scientific caribou management, but also reconstituted the institutional makeup of caribou science. Once demarcated, none of the metaphorical boundaries examined in this dissertation – from the line drawn between *wild* and *domesticated* animals to the conceptual boundaries that ostensibly separated science from non-science – proved to be static or inviolable. Rather, as I demonstrate, each boundary has been shaped not only by challenges both from within and outside of the scientific community, but also by the fact that migratory caribou have transgressed every boundary that humans have created in an effort to contain and manage them.

Through an examination of scientific boundary-making in the western Arctic, this dissertation further demonstrates that location mattered in the production of scientific knowledge.<sup>43</sup> Over the past two decades, geographers and historians of science have turned their attention to the spaces and sites in which scientists work and produce scientific knowledge, thereby demonstrating the social contingencies of scientific practices, and critiquing notions of scientific objectivity.<sup>44</sup> In this dissertation, I do not draw hard boundaries around the spaces of

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<sup>42</sup> Jasanoff, *Fifth Branch*, 236.

<sup>43</sup> A key contribution of science studies, claim Noel Castree and Bruce Braun, is that “scientific knowledges are made in historically specific, socially situated practices, rather than “found.”” See Castree and Braun, “The Construction of Nature and the Nature of Construction: Analytical and Political Tools for Building Survivable Futures,” in *Remaking Reality: Nature at the Millennium*, eds. Bruce Braun and Noel Castree (Routledge: London, 1998), 27.

<sup>44</sup> David Livingstone, *Putting Science in its Place: Geographies of Scientific Knowledge* (Chicago: University of

caribou science, nor do I conceptualize the field entirely within the range of the Porcupine Caribou Herd. During the twentieth century, I argue, the spaces of caribou science extended beyond the western Arctic and included field locations in which caribou were observed or captured, labs in which caribou were taken apart and transformed into specimens, transportation and communication networks through which caribou specimens and scientific knowledge moved, and museums in which specimens were displayed and examined by scientists. Further, I do not treat the Porcupine Caribou Herd as a discrete environmental object that can be separated from its broader socio-natural context, or understood in isolation from the web of social, natural, and environmental relations of which it is co-constitutive. Rather, as I consider salient changes in scientific understandings of the Porcupine Caribou Herd, the historical analysis inevitably crosses species lines, transects political and cultural boundaries, and, quite often, involves caribou herds with migratory routes that are distant from the geographical region at the heart of this dissertation.

The western Arctic (See figure 1.2) is an ideal location in which to study the role that political borders and metaphorical boundaries have played in shaping caribou science and management in the twentieth century. As historians and geographers of science have demonstrated, the kinds of environmental politics that inform scientific boundary-work are often

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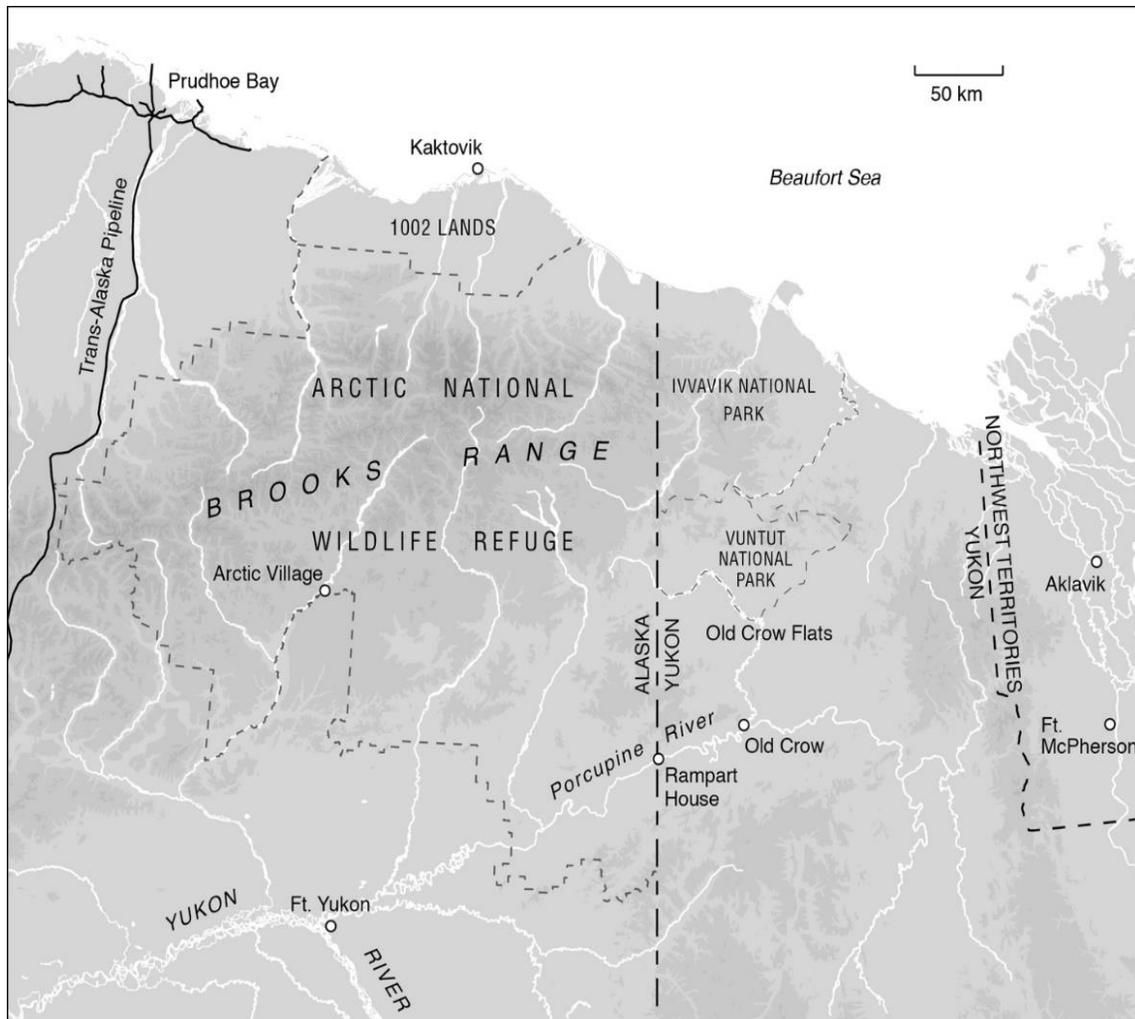
Chicago Press, 2003); David Livingstone and Charles Withers, eds. *Geographies of Nineteenth-Century Science* (Chicago: University of Chicago Press, 2011); Felix Driver, "Editorial: Field-work in Geography," *Transactions of the Institute of British Geographers* 25, 3 (2000): 267-268; Matthew Evenden, "Locating Science, Locating Salmon: Institutions, Linkages, and Spatial Practices in Early British Columbia Fisheries Science," *Environment and Planning D: Society and Space* 22 (2004): 355-372; Stephen Bocking, "Science and Spaces in the Northern Environment," *Environmental History* 12, 4 (2007): 867-894; Beth Greenhough, "Tales of an island-laboratory: defining the field in geography and science studies," *Transactions of the Institute of British Geographers* 31, 2 (2006): 224-237. Much of this scholarship built upon work in the field of science studies. See, Donna Haraway, "Situated knowledges: the science question in feminism and the privilege of partial perspective," *Feminist Studies* 14, 3 (1988): 575-599; Bruno Latour and Steve Woolgar, *Laboratory Life: The Construction of Scientific Facts* (Princeton: Princeton University Press, 1979); Bruno Latour, *Science in Action: How to Follow Scientists and Engineers through Society* (Cambridge, Massachusetts: Harvard University Press, 1987).

obscured by the discursive and institutional regimes within which science is produced.<sup>45</sup>

However, as scientists and state-based wildlife managers worked to align national programs and produce a synoptic vision of the Porcupine Caribou Herd throughout its range, they also produced a substantial historical record, which has been preserved in archives throughout Canada and the US. The same is true of the multiple and often competing cross-border efforts to protect the herd's critical habitat (which spans across the International Boundary), and to secure this region's place within a continental network of energy production and transportation. The transboundary flow of animals and scientific ideas about caribou and the transnational alignment of national institutions and research programs bring into sharp relief the metaphorical and conceptual boundaries examined in this dissertation.

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<sup>45</sup> For examples from the history of nuclear and radiation science, see Shannon Cram, "Living in Dose: Nuclear Work and the Politics of Permissible Exposure." *Public Culture* 28, 3: 519-539; Shannon Cram, "Becoming Jane: The Making and Unmaking of Hanford's Nuclear Body." *Environment and Planning D: Society and Space* 33, 5: 796-812; William Kinsella, "Nuclear Boundaries: Material and Discursive Containment at the Hanford Nuclear Reservation." *Science as Culture* 10, 2: 163-194; Adriana Petryna, *Life Exposed: Biological Citizens after Chernobyl* (Princeton: Princeton University Press, 2013).



**Figure 1.2. The Western Arctic. Map by Eric Leinberger.**

Finally, this dissertation is situated within the emerging fields of critical northern geography and northern environmental history. In recent years, there has been an upsurge in academic and popular interest in the Earth's polar regions. In North America, this has resulted in an increase in attention being placed on the Canadian north and Alaska. As scientists continue to disentangle the complexities of global climate change, and demonstrate the uneven impact that climactic warming is having on northern environments, governments representing the global Arctic powers have become involved in a scramble to lay claim to once inaccessible northern

regions, resources, and territories.<sup>46</sup> Buoyed by visions of ice-free shipping lanes, accessible oil and gas reserves, and warming terrestrial ecosystems, scholars, commentators, and politicians have begun to speak of the emergence of a “New North”, which is defined by unprecedented rates and scales of social, cultural, economic, and environmental change.<sup>47</sup> Yet, as environmental historian Andrew Stuhl argues, “New North” narratives are not simple depictions of changing northern landscapes and environments. Rather, he argues that the idea of a “New North” relies on the discursive production of an imagined “old North.” In the North American geographical imagination, Stuhl suggests, this “old North” is “a remote and unchanging place, a wilderness that has been shielded from civilization until the very moment.”<sup>48</sup> Produced primarily by non-northerners, “New North” narratives are not politically neutral. Although dramatic changes are occurring within northern communities and across Arctic environments, geographer Emilie Cameron argues these shifts are not entirely novel or unprecedented.<sup>49</sup> However, as Cameron notes, the notion of a “New North” tends to obscure the way in which “[c]ontemporary Arctic geographies are shaped by histories of imperialism and colonialism, by the specific racializations elaborated in settler societies, by historical and contemporary flows of capital and resources, by state and missionary activities in the region, by traditional cultural, economic, and ecological

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<sup>46</sup> Michael Byers, *Who Owns the Arctic: Understanding Sovereignty Disputes in the North* (Vancouver: Douglas and McIntyre, 2009), 9-11; Scott Borgerson, “Arctic Meltdown: The Economic and Security Implications of Global Warming,” *Foreign Affairs* 87, 2 (2008): 63-77; Klaus Dodds, “A Polar Mediterranean? Accessibility, Resources and Sovereignty in the Arctic Ocean,” *Global Policy*, 1, 3 (2010): 303-311.

<sup>47</sup> On sea-ice loss, see A. Mahoney, S. Gearheard, T. Oshima, and T. Qillaq, “Sea ice thickness measurements from a community-based observing network,” *Bulletin of the American Meteorological Society* 90, no. 3 (2009): 370-377.

For articulations of this concept, see “Special Issue on the Arctic: After the Ice,” *Nature* 478, 171 (2011): 172-182; Gwynne Dyer, *Climate Wars: The Fight for Survival as the World Overheats* (Oxford: Oneworld, 2011)

<sup>48</sup> Stuhl, *Unfreezing the Arctic*,

<sup>49</sup> Emilie Cameron, *Far Off Metal River: Settler Stories, and the Making of the Contemporary Arctic* (Vancouver: UBC Press, 2015), 12.

practices, by Inuit and other Indigenous political movements, and by changes in the *nuna* (land) itself.”<sup>50</sup>

In this dissertation, I am interested in understanding how the emergence of caribou science and scientific wildlife management shaped environmental geographies in and southern representations of the western Arctic. Following Cameron and Stuhl, I present this region not as an unchanging landscape that is being dragged into modernity in the present moment through a series of geopolitical machinations and environmental consequences that have been unleashed by a rapidly warming climate. Rather, I develop a relational approach that situates scientific representations of northern environments within their particular social, cultural, and historical contexts.<sup>51</sup> Although I consider scientific descriptions of certain areas of the north as “remote” and inaccessible, I do not portray these as universal understandings or empirical truths about northern locations. Instead, I aim to demonstrate how these understandings of northern environments were reciprocally shaped by and produced through scientific and managerial responses to the geographical problems posed by northern field research, and the transboundary migration of the Porcupine Caribou Herd. Further, the dissertation questions rather than accepts prevailing ideas of the North produced in the south. Throughout the second half of the twentieth century, Alaska (and, to a lesser extent, the Yukon) has occupied an increasingly conflicted position in the North American environmental imaginary: as both an unspoiled wilderness that should be protected for future generations, and as a vast hydrocarbon frontier that should be

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<sup>50</sup> Although Cameron’s historical geographical analysis relates to the making and remaking of social and environmental relations in Inuit territory, her conclusions have wide implications for historical engagements with the North American Arctic. Cameron, *Far Off Metal River*, 12.

<sup>51</sup> In taking this approach, I aim to move beyond the notion of “Nordicity”, and its inherent attempt to define the north according to a series of ostensibly “northern” characteristics. See Louis Edmond Hamelin, *Canadian Nordicity: It’s Your North Too* (Montreal: Harvest House, 1979)

opened for business.<sup>52</sup> An historical geographical examination of the Porcupine Caribou Herd's transboundary migration, I suggest, complicates this reductive framing, which relies on the maintenance of a socially-constructed boundary between nature and culture.

Through an examination of scientists and migratory caribou, I argue that the emergence and coalescence of scientific caribou management in the western Arctic were key factors in the northern expansion of the state during the twentieth century. In 2002, American environmental historian Adam Rome argued that the "environmental-management state" should be a central concern among political and other historians of the United States.<sup>53</sup> Throughout the twentieth century, he argued, environmental issues have played a key role in the growth of the state and in liberal arguments for a "vastly expanded public sphere."<sup>54</sup> Since Rome's conceptualization of environmental management as a formative area of state-building, historian Paul Sutter argues, American environmental historiography has produced an "increasingly detailed portrait" of the environmental-management state.<sup>55</sup> Indeed, over the past two decades, scholars have demonstrated that modern regimes of environmental management have transcended political borders, impacted human communities unevenly along lines social difference, and, importantly, expanded historical attention "beyond conservation, preservation, and environmental regulation to include a broader array of statist activities in areas such as agriculture, science and engineering, public health, internal improvement, warfare and national defense, and international

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<sup>52</sup> For a discussion of this dichotomous framing, see Finis Dunaway, "Reframing the Last Frontier: Subhankar Banerjee and the Visual Politics of the Arctic National Wildlife Refuge," *American Quarterly* 58, 1 (2006): 159-180; Susan Kollin, *Nature's State: Imagining Alaska as the Last Frontier* (Chapel Hill: University of North Carolina Press, 2001); Stephen Haycox, *Frigid Embrace: Politics, Economics, and Environment in Alaska* (Corvallis: Oregon State University Press, 2002).

<sup>53</sup> Adam Rome, "What Really Matters in History: Environmental Perspectives in Modern America," *Environmental History* 7, 2 (2002): 303-318.

<sup>54</sup> Rome, "What Really Matters," 305.

<sup>55</sup> Paul Sutter, "The World with Us: The State of American Environmental History," *Journal of American History* 100, 1 (2013): 100.

relations.”<sup>56</sup> Through a consideration of the interactions among the multiplicity of actors and institutions engaged in caribou science and wildlife management, I demonstrate that the state sought to expand its control over the landscapes, people, and animals of the western Arctic through specific responses to environmental issues involving migratory caribou.<sup>57</sup>

### **1.3. Analytical Boundaries, Conceptual Limitations: Framing the Research**

In organizing the dissertation around the role of boundary-making in the coalescence of caribou science and scientific caribou management in the western Arctic, I have been deliberate, though not comprehensive, in my choice of which boundaries to emphasize. Each chapter focuses on the way in which different institutions – including scientific institutions, state-based wildlife management agencies, oil and gas companies, and public health departments (among others) – produced and marshalled scientific knowledge as they negotiated the placement of conceptual and metaphorical boundaries around caribou. In many ways, the boundaries considered in this dissertation have been central to the state’s attempt to manage its natural

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<sup>56</sup> Sutter, “The World with Us,” 100-105. For historical examinations of conservation and scientific wildlife management in the US, see Karl Jacoby, *Crimes against Nature: Squatters, Poachers, Thieves, and the Hidden History of American Conservation* (Los Angeles: University of California Press, 2001); Louis Warren, *The Hunter’s Game: Poachers and Conservationists in Twentieth-Century America* (New Haven: Yale University Press, 1997); Thomas Dunlap, *Saving America’s Wildlife* (New Jersey, Princeton University Press, 1988). For work on Canadian wildlife management, see Janet Foster, *Working for Wildlife: The Beginnings of Preservation in Canada, 2 ed.* (Toronto: University of Toronto Press, 1998); Tina Loo, *States of Nature: Conserving Canada’s Wildlife in the Twentieth Century* (Vancouver: UBC Press, 2006); Sandlos, *Hunters at the Margin*. For key transnational, transboundary, and international environmental histories, see Wilson, *Seeking Refuge*; Dorsey, *The Dawn of Conservation Diplomacy*; Stuhl, *Unfreezing the Arctic*; Wadewitz, *The Nature of Borders*; Matthew Evenden, *Fish Versus Power: An Environmental History of the Fraser River* (Cambridge University Press, 2004).

<sup>57</sup> For a discussion of scientific wildlife management and colonialism in the Canadian north, see Sandlos, *Hunters at the Margin*; Kulchyski and Tester, *Kiumajut*; Nadasdy, *Hunters and Bureaucrats*. For a broader circumpolar perspective, see the essays included in David Anderson and Mark Nuttall, eds., *Cultivating Arctic Landscapes: Knowing and Managing Animals in the Circumpolar North* (New York: Berghahn Books, 2004); Michael Bravo and Sverker Sörlin, *Narrating the Arctic: A Cultural History of Nordic Scientific Practices* (Canton, MA: Science History Publications, 2002). For a discussion of science, transnational environmental history, and colonialism in the western Arctic (Alaska-Yukon), see Stuhl, *Unfreezing the Arctic*.

resources through the exertion of control over relationships among humans and the more-than-human world.<sup>58</sup>

While the boundaries considered in this dissertation have been central to the emergence and development of scientific caribou management in the twentieth century, other boundaries (and forms of boundary-making) have mattered to the dynamic relationship among people and caribou in the western Arctic. In recent decades, historians and geographers of science and scholars in the field of STS have considered the complex interactions among social relations of race, class, and gender and the production of scientific knowledge.<sup>59</sup> As Donna Haraway has argued, these social categories have not only shaped the content of modern science, but also have cohered through specific historical geographies of science.<sup>60</sup> Similarly, an examination of the way in which race, class, and gender shaped twentieth-century caribou science would demonstrate important historical and geographical particularities in the reciprocal relationship between the hardening of the boundaries around these social categories and the production of scientific knowledge. Although I do not focus specifically on the relationships among race, class, gender, and science in the western Arctic, this conceptual absence does not suggest that caribou science emerged outside of – or divorced from – these social relations.

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<sup>58</sup> As environmental geographer Dean Bavington argues, modern regimes of natural resource management have operated to organize and order particular human relationships with nature while precluding others. Dean Bavington, *Managed Annihilation: An Unnatural History of the Newfoundland Cod Collapse* (Vancouver: UBC Press, 2010), 7-8. See also Carolyn Merchant, *Death of Nature: Women, Ecology, and Scientific Revolution* (New York: Harper & Row, 1980); David Natcher, Susan Davis, and Clifford Hickey, “Co-Management: Managing Relationships, Not Resources,” *Human Organization* 64, 3 (2005): 240-250.

<sup>59</sup> Donna Haraway, *Primate Visions: Gender, Race, and Nature in the World of Modern Science* (New York: Routledge, 1989), 8-9. In the Canadian Arctic, geographer Richard Powell has examined the way that power differentials along lines of race, class and gender have structured the scientific community in the late twentieth century. See Richard Powell, *Studying Arctic Fields: Cultures, Practices, and Environmental Sciences* (Montreal and Kingston: McGill-Queen’s University Press, 2017), 7-8. Environmental historian Mark Carey has developed a feminist framework through which he aims to examine the role of gender in the development of the epistemological foundations of glaciology. See Mark Carey, M. Jackson, Alessandro Antonello, and Jaclyn Rushing, “Glaciers, Gender, and Science: A Feminist Glaciology Framework for Global Environmental Change,” *Progress in Human Geography* 40, 6 (2016): 770793.

<sup>60</sup> Haraway, *Primate Visions*, 8-9.

Despite borrowing from the “more-than-human” methodological approaches developed by scholars working in the fields of critical animal studies and animal geography, this dissertation does not focus specifically on the making and hardening of the socially-constructed animal-human divide in the western Arctic.<sup>61</sup> In a 1984 essay, anthropologist Tim Ingold reflected on the challenges posed for academics by the cultural diversity and historical plurality of human attitudes towards animality.<sup>62</sup> While the question, “What is an animal?” can be construed in multiple ways, each approach to answering the question, Ingold wrote, has been “concerned with problems surrounding the definition of boundaries...”.<sup>63</sup> A central issue, he argues, has involved the placement, negotiation, and contestation of a socially-determined boundary between human and non-human beings. Since Ingold examined this question in the mid-1980s, a new approach to animal geography has emerged around the critical interrogation of the conceptual boundary between human and non-human animals.<sup>64</sup> Though socially-constructed, this divide is not inconsequential for animal life, nor is it divorced from politics and power relations. As Kathryn Gillespie and Rosemary-Claire Collard argue, the animal-human dualism not only implies difference, but also produces hierarchical relationships among humans and non-humans.<sup>65</sup> Although this dissertation does not address explicitly the maintenance of the

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<sup>61</sup> Henry Buller, “Animal Geographies II: Methods,” *Progress in Human Geography* 39, 3 (2015): 374-384.

<sup>62</sup> Timothy Ingold, “Introduction,” in *What is an Animal?*, ed. Timothy Ingold (London: Routledge, 1984), 1-15.

<sup>63</sup> Ingold, “Introduction,” 1-2.

<sup>64</sup> As Julie Urbanik argues, this conceptual focus characterizes the “third wave” of animal geography, which succeeds developments in animal geography which oriented around zoogeographical and cultural ecological approaches to animals. Julie Urbanik, *Placing Animals: An Introduction to the Geography of Animal-Human Relations* (Lanham: Rowman & Littlefield Publishers, Inc., 2012), 21-48. For a discussion of the field and the third wave of animal studies, see Kathryn Gillespie and Rosemary-Claire Collard, eds., *Critical Animal Geographies: Politics, Intersections and Hierarchies in a Multispecies World* (London: Routledge, 2015). Seminal works that influenced the development of the field include: Jennifer Wolch and Jacque Emel, “Bringing the Animals Back In,” *Environment and Planning D* 13, 6 (1995): 632-636; Jennifer Wolch and Jody Emel, eds., *Animal Geographies: Place, Politics, and Identity in the Nature-Culture Borderlands* (London: Verso, 1998); Chris Philo and Chris Wilbert, eds., *Animal Spaces, Beastly Places: New Geographies of Human-Animal Relations* (London: Routledge, 2000).

<sup>65</sup> Kathryn Gillespie and Rosemary-Claire Collard, “Introduction,” in Kathryn Gillespie and Rosemary-Claire Collard, eds., *Critical Animal Geographies: Politics, Intersections and Hierarchies in a Multispecies World*

dualistic positioning of humans and non-human animals, it seeks to broaden our understanding of the epistemological foundations of this socially-constructed divide by examining the ongoing contestation over the authority to answer the question, “What is a caribou?”. As Ingold suggested, for caribou scientists and state-based wildlife managers, this basic question has always been bound up with problems surrounding the demarcation and enforcement of boundaries.

Further, it is important to note that the forms of boundary-making examined in this dissertation occurred largely within and had profound implications for preexisting and historically dynamic Indigenous territories. In the early to mid-twentieth century, for example, the hardening and enforcement of the Alaska-Yukon border impacted social, cultural, kin-based, and animal-human relationships among Gwich’in communities, which span across the International Boundary.<sup>66</sup> Throughout the western Arctic, Indigenous groups employed various forms of social and cultural boundaries that shaped their relationships with the human and more-than-human world, and structured their multiple “forms of socio-political organization.”<sup>67</sup>

Although Indigenous peoples in the southwest Yukon established trade networks and maintained

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(London: Routledge, 2015), 7. For more on the power relations and structures of violence that are constitutive of this hierarchical divide, see Donna Haraway, *When Species Meet* (Minneapolis: University of Minnesota Press, 2008); David Hulka, “Safe From the Wolf: Biosecurity, Biodiversity, and Competing Philosophies of Nature,” *Environment and Planning A* 40, 7 (2008): 1583-1597; David Hulka, “Form and Formlessness: The Spatiocorporeal Politics of the American Kennel Club,” *Environment and Planning D: Society and Space* 27, 3 (2009): 531-553; Rosemary-Claire Collard, “Cougar-Human Entanglements and the Biopolitical Un/Making of Safe Space,” *Environment and Planning D: Society and Space* 30, 1 (2012): 23-42.

<sup>66</sup> For oral histories of the border’s impact on the Vuntut Gwitchin First Nation and Shirleen Smith, *People of the Lakes: Stories of our Van Tat Gwich’in Elders / Googwandak Nakhwach’ànjàò Van Tat Gwich’in* (Edmonton: University of Alberta Press, 2009). For more on the official marking of the border, see Lewis Green, *The Boundary Hunters: Surveying the 141st Meridian and the Alaska Panhandle* (Vancouver: UBC Press, 1982); International Boundary Commission, *Joint Report Upon the Survey and Demarcation of the International Boundary Between the United States and Canada Along the 141st Meridian from the Arctic Ocean to Mount St. Elias* (Washington, D.C.: International Boundary Commission, 1918).

<sup>67</sup> Paul Nadasdy, “Boundaries Among Kin: Sovereignty, the Modern Treaty Process, and the Rise of Ethno-Territorial Nationalism Among Yukon First Nations,” *Comparative Studies in Society and History* 54, 3 (2012): 503.

cultural relationships across natural boundaries prior to the arrival of Europeans, anthropologist Julie Cruikshank argues, “the social meanings of such barriers seem to have varied regionally along the coast.”<sup>68</sup> In the contemporary period, the land claims process and the signing of self-government agreements have granted First Nations in the Yukon specific, though limited, “powers of governance” over traditional territories.<sup>69</sup> Despite the establishment of jurisdictional boundaries around the various traditional territories of Yukon First Nations, we cannot assume that these territorialities – and their constitutive boundaries – represent an historical continuity with preexisting spatial arrangements and relationships. Anthropologist Paul Nadasdy argues that Indigenous society in the Yukon “was not in fact composed of distinct political entities each with jurisdiction over its own territory; such entities are a quite recent phenomenon in the Yukon.”<sup>70</sup> Rather than formalizing jurisdictional boundaries, Nadasdy argues, the land claims process and self-government agreements are “mechanisms for *creating* the legal and administrative systems that bring those polities into being.”<sup>71</sup>

In the western Arctic, the reorganization of Indigenous space and the remaking of Indigenous relationships with caribou (and the broader more-than-human world) is an historical and ongoing process shaped by the northern expansion of the state, colonialism, and capitalist social relations.<sup>72</sup> In this dissertation, however, I do not claim to reconstruct or recover those

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<sup>68</sup> Cruikshank, *Do Glaciers Listen?*, 213.

<sup>69</sup> Nadasdy, “Boundaries Among Kin,” 503.

<sup>70</sup> Nadasdy, “Boundaries Among Kin,” 503.

<sup>71</sup> Nadasdy, “Boundaries Among Kin,” 503.

<sup>72</sup> The enrollment of Indigenous labour and in the fur trade, for example, had immense implications for social and spatial relations throughout the north. For example, see Arthur Ray, *Indians in the Fur Trade: Trappers, Hunters, and Middlemen in the Lands Southwest of Hudson Bay, 1660-1870* (Toronto: University of Toronto Press, 1998 [1974]); Kurt Korneski, “Planters, Eskimos, and Indians: Race and the Organization of Trade under the Hudson’s Bay Company in Labrador,” *Journal of Social History* 50, 2 (2016): 307-335; Shepard Krech, “The Eastern Kutchin and the Fur Trade, 1800-1860,” *Ethnohistory* (1976): 213-235. Scholars have also demonstrated the ways in which colonialism continues to shape northern social and environmental relationships in the post-colonial present. See Nadasdy, *Hunters and Bureaucrats*; Stuhl, *Unfreezing the Arctic*, 111-143.

Indigenous boundaries that shaped human-caribou relationships prior to and following the arrival of those naturalists, scientists, and state-based actors that sought to describe, classify, and manage migratory caribou. These stories exist, but they are not mine to tell. Further, though important to the historical narrative and argument crafted in this dissertation, my primary goal is not to articulate how the hardening of political and scientific boundaries reshaped and transformed preexisting Indigenous relationships with migratory caribou.<sup>73</sup> In their oral histories, the Gwich'in and other Indigenous groups have addressed the impact of colonialism and the hardening of political borders on their interactions with the migratory Porcupine Caribou Herd.<sup>74</sup>

By focusing on the forms of boundary-making involved in the stabilization of scientific and managerial categories, I aim to provide greater context for those scholars whose projects examine more directly the colonial (including settler-colonial) and capitalist remaking of space and social relations in the contemporary Arctic. Though beyond the scope of this dissertation, my historical geographical examination of caribou science contributes to our understanding of the ways in which settler colonialism operated in the North American Arctic during the twentieth century. Indeed, as Emilie Cameron notes, historical and geographical changes in the land – which include shifting regimes of territoriality, the establishment and legitimation of state-based jurisdictional control over natural resources, and attendant impacts on Indigenous land-based relationships – have been shaped and structured by the specific spatio-temporal dynamics of settler colonialism.<sup>75</sup> Following scholars in the field of settler colonial studies, and informed by

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<sup>73</sup> For a recent historical study that develops an archival approach to the remaking of Indigenous boundaries, see Wadewitz, *Nature of Borders*, 3-88.

<sup>74</sup> VGFN and Smith, *Googwandak Nakhwach`anjòo Van Tat Gwich'in*; Sherry and VGFN, *The Land Still Speaks*.

<sup>75</sup> Cameron, *Far off Metal River*, 17. On territoriality and colonial relations, see Nadasdy, *Sovereignty's Entailments*, 88-135 on law and jurisdiction, see Shiri Pasternak, "Jurisdiction and Settler Colonialism: Where do Laws Meet?" *Canadian Journal of Law and Society/La Revue Canadienne Droit et Société* 29, 2 (2014): 145-161. Cameron is speaking specifically about settler colonialism in Inuit territory in northern Canada. Walter Hixson describes the way in which American settler colonialism shaped Alaska's historical development since the eighteenth century. See

key contributions made by critical northern geographers, I conceptualize settler colonialism as a specific articulation of the colonial project that is marked by the logic of elimination, the replacement of Indigenous populations, and the continued and sustained dispossession of Indigenous lands and territories by settler societies.<sup>76</sup> Indeed, as Patrick Wolfe argues, the primary motive for elimination is access to territory; “Territoriality,” Wolfe states, “is settler colonialism’s specific, irreducible element.”<sup>77</sup>

In articulating the relationship between elimination and territory, it is important to note the conceptual limits of a Western epistemological framework for understanding land and territory. Land, argues Dene political theorist Glen Coulthard, is not simply a material object that is profoundly important to Indigenous peoples and cultures; it also represents an “ontological framework for understanding *relationships*.”<sup>78</sup> In describing of the system of land-based relations maintained in Sahtu Dene territory, Coulthard explains that humans are not the only beings believed to possess “spirit and agency.”<sup>79</sup> Thus, just as humans hold certain ethical obligations to other people, they are also responsible for maintaining and meeting their obligations to the land. If these obligations were met, he notes, “then the land, animals, plants, and lakes would reciprocate and meet their obligations to humans, thus ensuring the survival and well-being of all over time.”<sup>80</sup>

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Walter Hixson, *American Settler Colonialism: A History* (New York: Palgrave and Macmillan, 2013): 160-168; 190-192.

<sup>76</sup> Patrick Wolfe, *Settler Colonialism and the Transformation of Anthropology: The Politics and Poetics of an Ethnographic Event* (London: Cassell, 1999); Lorenzo Veracini, *Settler Colonialism: A Theoretical Overview* (London: Palgrave & Macmillan, 2010); Patrick Wolfe, “Settler Colonialism and the Elimination of the Native,” *Journal of Genocide Research* 8, 4 (2006): 387-409; Glen Coulthard, *Red Skin, White Masks*, 6-7; Emilie Cameron, *Far off Metal River*, 17.

<sup>77</sup> Wolfe, “Settler Colonialism and the Elimination,” 388.

<sup>78</sup> Coulthard, *Red Skin, White Masks*, 61.

<sup>79</sup> Coulthard, *Red Skin, White Masks*, 61.

<sup>80</sup> Coulthard, *Red Skin, White Masks*, 61.

Coulthard's discussion of Sahtu Dene land-based relationships resonates with emerging research on northern animal-human relations. As Métis anthropologist Zoe Todd argues, the Inuvialuit of Paulatuuk, a community in the Inuvik region of the Northwest Territories, have multiple ways of understanding and relating to fish, or "fish pluralities," which they employ "to negotiate the complex and dynamic pressures faced by humans, animals, and the environment in contemporary Arctic Canada."<sup>81</sup> Although specific elements of this relationship have changed over time, Todd argues, "the underlying legal orders and cosmologies that they represent are rooted in long-term, reciprocal engagement between humans and a sentient, storied landscape."<sup>82</sup> Todd writes specifically about human-fish relations among the Inuvialuit of Paulatuuk, yet her conclusions about fish pluralities, which are situated within a broader theoretical conceptualization of Indigenous epistemologies that transcends "dualistic notions of nature/culture and human/animal," have broad implications for and resonances with scholarship on animal-human relations throughout the North American Arctic.<sup>83</sup> Relatedly, as Eben Kirksey and Stefan Helmreich have noted, scholars employing multispecies ethnographic methods have increasingly drawn attention to the way in which the lives and death of a "host of organisms" are "linked to human and social worlds."<sup>84</sup> In developing this approach, multispecies ethnography has produced an "anthropology of life" that is not constrained by the category of the human, and, ultimately, demonstrated "how a multitude of organisms' livelihoods shape and are shaped by political, economic, and cultural forces."<sup>85</sup>

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<sup>81</sup> Zoe Todd, "Fish Pluralities: Human-Animal Relations and Sites of Engagement in Paulatuuk, Arctic Canada," *Études/Inuit/Studies* 38, 1-2 (2014): 217.

<sup>82</sup> Todd, "Fish Pluralities," 231.

<sup>83</sup> Todd, "Fish Pluralities," 218.

<sup>84</sup> Eben Kirksey and Stefan Helmreich, "The Emergence of Multispecies Ethnography," *Cultural Anthropology* 25, 4 (2010): 545. See also, Rosemary-Claire Collard, Jessica Dempsey, and Juanita Sundberg, "A Manifesto for Abundant Futures," *Annals of the Association of American Geographers* 105, 2 (2015): 322-330.

<sup>85</sup> Kirksey and Helmreich, "The Emergence of Multispecies Ethnography," 545.

Viewed in conversation with this emerging literature on animal-human relations, it is possible to draw connections among the development of caribou science and the northern expansion of scientific wildlife management – which were intended to replace Indigenous understandings of caribou, and mediate Indigenous relationships with the more-than-human world – and the machinations of settler colonialism in the North American Arctic. As Patrick Wolfe observes, the settler-colonial logic of elimination is tied inherently to the dissolution of Indigenous societies, and, in the western Arctic, the fabric of Indigenous societies was bound up with the maintenance of reciprocal, land-based relationships.<sup>86</sup> Further, as Emilie Cameron argues, due to the particular historical geographies of settlement, colonial and settler colonial relations have unfolded differently in the Arctic than in southern regions.<sup>87</sup> Although whalers, miners, missionaries, explorers, and other representatives of colonial powers targeted the land, people, and resources of the north during the early twentieth century, Cameron argues that Inuit experienced “rapid and intensive state intervention primarily by way of a modernist welfare state following the Second World War.”<sup>88</sup> The northern expansion of environmental management and the increasing regulation of Indigenous relationships with caribou in both Canada and Alaska during the second half of the twentieth century was linked to the state’s ongoing and persistent interventions in the lives, cultures, and societies of Indigenous peoples throughout the western Arctic.

Ultimately, this dissertation represents an historical examination and ethnography of caribou science. The scientists whose work forms the conceptual focus of each of the four chapters worked constantly alongside and with Indigenous knowledge holders, guides, and

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<sup>86</sup> Wolfe, “Settler Colonialism and the Elimination,” 388.

<sup>87</sup> Cameron, *Far Off Metal River*, 18.

<sup>88</sup> Cameron, *Far Off Metal River*, 18.

informants in the region, and through most of the twentieth century, caribou scientists often noted the presence and contributions of local, Indigenous peoples in their correspondence and scientific reports. Yet, as I argue in chapter three, this acknowledgement often took a form that legitimated or verified emergent scientific conceptualizations of caribou. Of course, in northern Canada, the structure of Indigenous participation in and engagement with scientific wildlife management changed dramatically after the settlement of land claims and the establishment of co-management boards for natural resource management. Although the temporal period covered in this dissertation overlaps with these later developments, I have not engaged deeply with the ways in which these structural changes in Indigenous-state relations reshaped northern scientific knowledge production. And while the Indigenous inhabitants of the region may at times not be at the center of my analysis, this does not suggest that they were not present in the region, or that they were not engaged in scientific knowledge production. Rather, it indicates that I have not yet developed an appropriate archival method to elucidate the historical and geographical dynamics that shaped the co-production of scientific knowledge about caribou in the western Arctic.

#### **1.4. Animals in the Archives: Historical Research Methods for Migratory Caribou**

In this section, I describe my evolving research design and method, which is attuned to the complex spatio-temporalities of human-caribou interaction in the western Arctic during the twentieth century. Over the past three decades, environmental historical geographers have increasingly acknowledged and engaged with animals in the stories they tell about the past.<sup>89</sup> Although animals have long held an important place in our social, cultural, and economic lives, this heightened interest among historians and geographers represents a dramatic shift after

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<sup>89</sup> Harriet Ritvo, "Animal Planet," *Environmental History* 9, 2 (2004): 204-220.

decades of scholarly neglect.<sup>90</sup> There are a number of factors driving this increase in academic interest. As environmental historian Harriet Ritvo argues, historical examinations of environmental change have demonstrated that “many of the difficult issues at the intersection of academic studies of the environment (historical and otherwise) and environmental politics have an animal dimension, or even an animal-triggered flashpoint.”<sup>91</sup> By taking seriously the role of animals in historical causation, animal historians and geographers have challenged the dominance of anthropocentric interpretations of past forms of environmental change, and expanded the boundaries of key historical concepts such as the notion of “agency” to include the more-than-human world.<sup>92</sup>

Although my primary goal in this study is to understand how scientists and wildlife managers sought to understand and control caribou and the dynamic socio-natural landscapes and environments through which they move, I suggest that humans were not the only actors in this story. Caribou lead complex social lives that are shaped, structured, and inflected by changes in the natural and built environment. Similarly, through their movements, physiology, and multiple responses to human interaction and interference, migratory caribou have shaped the way in which humans have understood them and played an important role in the making of environmental relationships throughout the western Arctic. In developing this approach, I adopt a notion of animal causation that is distinct from a historical and geographical tradition that theorizes “agency” through anthropocentric understandings of intentionality, resistance, and consciousness.<sup>93</sup>

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<sup>90</sup> For a discussion of the pervasive neglect of animals in historical and cultural geography, see Robert Wilson, *Seeking Refuge*, 11-12.

<sup>91</sup> Ritvo, “Animal Planet,” 204.

<sup>92</sup> Susan Nance, *Entertaining Elephants: Animal Agency and the Business of the American Circus* (Baltimore: The Johns Hopkins University Press, 2013), 7-9.

<sup>93</sup> E.P. Thompson, *Customs in Common: Studies in Traditional Popular Culture* (New York: The New Press, 1993).

If animals are historical actors, how, then, do historians study their role in historical change and causation through archival research methods? Unlike human societies that have recorded their shared pasts through the production of archival spaces, animals are not involved directly in the production of historical records that document their real and imagined pasts.<sup>94</sup> Nonetheless, animal traces are ubiquitous throughout archival collections and materials. But what do historians find when they look for and find animals in the archives? Are these archival inscriptions merely human representations of animals, or do they represent something more complex? What, I am asking, do these archival traces tell us about the past lives of animals and their historical interactions with human communities and their broader environments?



**Figure 1.3. “Caribou tracks on soft surface.” National Archives and Records Administration (NARA), Archives II, College Park, MD. RG 22-WB, Records of the Fish and Wildlife Service, Prints: Biological Survey Photographs of Wildlife, ca. 1899-1962. Mammals: CARIBOU thru COUGAR.**

In many ways, addressing these questions required me to adopt a reflexive and nuanced understanding of what an archive is, and what an archival collection represents. Following recent developments in archival studies and theory, I look beyond the content of the colonial archive,

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<sup>94</sup> John Ridener, *From Polders to Postmodernism: A Concise History of Archival Theory* (Sacramento: Litwin Books, 2008).

and conceptualize archives as spaces that are shaped by the politics of knowledge production.<sup>95</sup> Relatedly, I do not treat the archival collections I consulted as uncontested sources of information that can be mined simply for historical truths or facts about human-caribou interaction. Although I do attempt to reconstruct an historical record of the history of caribou science through archival research, archival collections, I suggest, must be viewed as partial or incomplete collections of material that reflect the conditions and processes of their production. In developing this approach, I seek to understand the relationship between knowledge production and the hardening of scientific and managerial boundaries while also revealing the way in which scientific knowledge has been a site of contested knowledge claims.

The complexity and vastness of the herd's migratory route meant that it was necessary to consult historical collections housed in multiple archives throughout Canada and the United States. Through their transboundary migration, Porcupine Caribou transect multiple political, jurisdictional, and cultural boundaries, and interact with a broad array of state and non-state institutions, human communities, and other actors. In Canada, management of the herd necessitated a complex and shifting set of agreements among federal and territorial wildlife management agencies, and scientific research involved actors from the responsible government agencies, and others from publicly- and privately-funded research organizations. The herd's movement across the Alaska-Yukon border enrolled a similar network of actors in Alaska and throughout the United States. Indeed, the emergence of scientific caribou management in the western Arctic is a transnational story, and the excavation of this history requires a research design that is not bound by national borders. To understand this international story, I conducted historical research at multiple archives in Canada and the United States (see bibliography for

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<sup>95</sup> Ann Laura Stoler, *Along the Archival Grain: Epistemic Anxieties and Colonial Common Sense* (Princeton: Princeton University Press, 2009), 1-17.

complete list). In addition to consulting collections at the federal archives in Canada (Library Archives Canada, Ottawa) and the United States (National Archives and Records Administration, College Park, MD, and Seattle, WA), I spent time working at northern archives in Alaska and the Yukon. In the Yukon, I conducted research in the territorial archives (Whitehorse), which contains a vast collection of historical materials produced by federal and territorial institutions, agencies, and departments that have held jurisdiction throughout the territory.

As I followed scientific representations of caribou through colonial and state archives, my research design and conceptual framework shifted and evolved. When I began the process of conducting research, I aimed to produce an environmental historical geography that considered the spatio-temporal implications of the Porcupine Caribou Herd's migration across the International Boundary in the western Arctic. What happens, I asked, when nature crosses borders? However, as I situated myself in the archives and the socio-natural landscapes of the western Arctic, I came to perceive serious pitfalls with this particular way of conceptualizing migratory wildlife. By framing the migratory Porcupine Caribou Herd as a form of border-crossing nature, I not only inverted the historical geographical relationship between animals and borders in the western Arctic, but also risked naturalizing those socially-constructed borders that the caribou have continually transgressed. Before caribou could cross the borders of the modern state – which in my analysis range from political borders between countries to scientific boundaries intended to order socio-natural landscapes – these borders had to be demarcated, established, and enforced. Following this conceptual shift in my framing of the dissertation's primary research subject, I began to ask instead, how did borders come to cross, transect, and

divide the socio-natural landscapes (including the range of the migratory Porcupine Caribou Herd) of the western Arctic?

A specific example from the archives both suggests the value of this form of boundary thinking, and outlines how I came to apply it in my research on migratory caribou in the western Arctic. While conducting early archival research at Library Archives Canada (LAC) – the primary collection of records produced by Canada’s federal institutions and agencies – I spent two frustrating weeks scanning the early records of Canada’s federal wildlife management agency in search of records related to the Porcupine Caribou Herd. As an important “international resource”, I expected to locate a sizeable collection of material related to this particular herd of migratory caribou. Yet, as I worked through the finding aids of the relevant archival collections, I was surprised to learn that there were few extant records related to this caribou herd prior to the 1960s.

Subsequent reading in the history of caribou science helped me make sense of this archival silence. As I engaged with contemporaneous reports by caribou scientists and wildlife managers, I learned that the concept of a caribou herd had changed considerably during the early to mid-twentieth century. Much like the political border between northern Canada and Alaska, the biological boundary that scientists have employed to differentiate caribou populations into distinct herds is a historical construct that has shifted and evolved over time.<sup>96</sup> When I renewed my research at LAC, I continued to search for archival traces of the Porcupine Caribou Herd within the records of the Canadian Wildlife Service (RG 109), but rather than scanning for

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<sup>96</sup> In particular, observations made by caribou biologists Don Thomas (1969) and James Hemming (1973) were helpful in my development of a method intended to excavate conceptually the idea of the caribou herd: D.C. Thomas, *Status of Barren-Ground Caribou on the Mainland of Canada* (Ottawa: The Queen’s Printer, 1969); James Hemming, “The Distribution and Movement Patterns of Caribou in Alaska,” *Alaska Department of Fish and Game Technical Bulletin 1* (1971): 1-60. The historical emergence of the modern concept of a caribou herd – defined by calving ground fidelity – is discussed in chapter 3.

documents that mentioned this herd by name, I took a geographical approach, and looked instead for historical records about caribou that included references to landmarks, cultural areas, and geographical features within the contemporary range of the PCH. As I expanded my research site to include state-based archives in the US, I continued to employ this method, and compiled a considerable collection of historical material related to caribou that crossed the Porcupine River, wintered near Old Crow, or crossed the northern section of the Alaska-Yukon border. However, this geographical approach to archival research came with its own problems and limitations as the herd's primary range has shifted over time, which made it difficult to determine whether the caribou I had located in the archives were in fact *Porcupine* Caribou.

Gradually, however, it became apparent that an approach that prioritized the correct identification of Porcupine Caribou in the archives obscured a broader and potentially more important point about the historical development of scientific caribou management in the western Arctic. Throughout the first half of the twentieth century, caribou scientists and wildlife managers had also struggled to identify migratory caribou herds west of the Mackenzie River. In the postwar period, wildlife managers addressed scientific uncertainty about the identity of the Alaska-Yukon caribou herds through the development of a set of biogeographical criteria, which they employed to refine the boundary around the caribou herd concept. As I cross-referenced documents produced by federal wildlife managers and caribou scientists in Canada and the United States, I not only began to develop a historical genealogy of the caribou herd concept (as an object of scientific concern and discourse), but also uncovered the forms of labour in which scientists engaged as they demarcated and hardened the boundaries around caribou herds in the transboundary western Arctic. In this way, a new conceptual approach and research topic began to take shape; rather than focusing solely on the movement of caribou across the International

Boundary, I became interested in the ways in which scientific wildlife management emerged and coalesced around the construction of conceptual and metaphorical boundaries that were intended to mediate human-caribou interactions in this transboundary region. What happens, I began to ask, when borders cross nature?

In addition to working in state-based and colonial archives, I sought to ground my historical research in the region by spending one month in the Vuntut Gwitchin First Nation (Old Crow, Yukon) during the autumn of 2014. Prior to receiving institutional ethics approval for this research, my proposal to conduct community-based research in Old Crow was reviewed, amended, and approved by the members of the Heritage Committee of the Vuntut Gwitchin Government (VGG).<sup>97</sup> While my primary objective in making this research trip was to work in the community's collection of oral historical material, which includes transcripts of oral history interviews conducted in and by the community, it was my work with two members of the Vuntut Gwitchin First Nation that made a stronger and more important impact on my evolving research design. During my time in Old Crow, I worked with two men who generously allowed me to accompany them on the land as they hunted caribou and otherwise prepared for the coming winter months. Through a research agreement with the VGG, I was granted permission to produce a series of photographs documenting the fall hunt. I have included a selection of images produced during this period of fieldwork at the end of the introduction. In addition to providing a visual representation of the socio-natural landscapes engaged in this dissertation, these images should provide readers with a sense of the ethic of care that informs Gwitchin-caribou relationships.<sup>98</sup>

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<sup>97</sup> UBC Human Ethics BREB #H13-01412.

<sup>98</sup> In addition to conversations with the two Vuntut Gwitchin elders, my understanding of this "code of ethics" is informed by Sherry and Vuntut Gwitchin First Nation's description of "Rules for hunting and working with caribou," in *The Land Still Speaks*, 207-211.

I planned this research trip to coincide with the usual timing of Porcupine Caribou Herd's fall migration through Vuntut Gwitchin traditional territory in hopes of observing the community hunt. Considering the persistent and recurring threat of oil and gas development in the herd's critical calving grounds on Alaska's coastal plain (covered in chapter 4 of this dissertation), I felt that it would be a valuable experience to spend time in the community to learn about and document the continued importance of the caribou to the people of Old Crow. Further, by spending time in Old Crow, I hoped to make myself and my research responsible and accountable to people whose histories and futures were linked inextricably with the migratory Porcupine Caribou Herd.<sup>99</sup> Yet, as I worked with each of the two men, and learned about the complexity and dynamism of Vuntut Gwitchin land-based relationships, I began to discern critical limitations in my research method and design. An archival research method rooted in colonial and state-based archives, I acknowledged, would prove to be insufficient in any attempt to determine how the hardening of political and metaphorical boundaries had reshaped Indigenous understandings of and relationships with migratory caribou. As this became clear, I also acknowledged that I would not be able to develop an ethnographic research design that was ethically-grounded and accountable to the community's needs and environmental relationships within the temporal constraints of my own doctoral research project. Also, the Vuntut Gwitchin are only one among a number of Indigenous groups in the Yukon, Northwest Territories, and Alaska that maintains historical connections to this particular group of animals. Further, as a settler scholar visiting the traditional territory of the Vuntut Gwitchin First Nation, I became increasingly wary of any attempt that I might make to tell the stories that had been presented to me while working on the land. The Vuntut Gwitchin have their own storytellers and historians,

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<sup>99</sup> This research objective was informed by my reading of Linda Tuhiwai Smith, *Decolonizing Methodologies: Research and Indigenous Peoples* (London: Zed Books, 1999).

and, I had to acknowledge, it was not my place to tell these stories; nor was it my goal to give the Vuntut Gwitchin *voice* through the production of a historical argument and narrative.<sup>100</sup>

However, the experience of working on the land with each of the two elders did reshape my conceptualization of the environmental history of the Porcupine Caribou Herd. During the month that I spent in Old Crow, I developed a healthy skepticism regarding the stability of the boundaries and concepts that I had employed previously to frame and conceptualize the Porcupine Caribou Herd. Rather than being a discrete environmental object or subject of scientific analysis, these men taught me about the ways in which caribou were embedded within a broader network of social, cultural, and ecological relationships. As I articulated my ideas and questions about Porcupine Caribou, these elders listened patiently and responded thoughtfully. But as we spoke about caribou, we also spent a fair bit of time cutting trees for winter fuel, setting and hauling fishnets in the Porcupine River, and hunting for moose. Through their patient tutelage, I began to learn to listen and read the landscape in ways that challenged me to think beyond the conceptual boundaries that I had imported into my fieldwork. I also began to learn that the different activities in which we were engaged were in no way separate or disconnected from the caribou that we all hoped would soon migrate through the traditional territory of the Vuntut Gwitchin First Nation.

However, for reasons that I cannot explain, the caribou followed a more northerly route than usual that year, and the throng of animals that characterizes the fall migration in Old Crow never materialized. Although some lucky hunters did manage to get meat for their freezers that

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<sup>100</sup> Following fieldwork, I reflected on and began to make sense of these academic anxieties and research concerns through reading on questions of indigeneity and anthropology, and the limiting nature of Western definitions of historical discourse. See Keith Basso, *Wisdom Sits in Places: Landscape and Language Among the Western Apache* (Albuquerque: UNM Press, 1996). For more on the politics of anthropology and Indigenous voice, see Audra Simpson, "On Ethnographic Refusal: Indigeneity, 'Voice', and Colonial Citizenship," *Junctures* 9 (2006): 67-80.

fall, many people were left with little caribou for the long winter months. In the absence of caribou, I began to understand the importance of this animal to the people of the community. As a researcher who was increasingly interested in the history of science in the western Arctic, I also began to ask how I had come to believe that I could examine these animals in isolation from the broader web of relations in which they were enmeshed. When I returned to the task of conducting archival research later that fall, this experience in Old Crow helped me reshape my research method and questions. Rather than attempting to develop a method that would allow me to claim to know or understand dynamic Indigenous worldviews (and related understandings of caribou), I chose to focus instead on the ways in which scientists – primarily, though not exclusively, male, settler, and white – claimed to know caribou.<sup>101</sup> How, I began to ask, had science been enrolled in the hardening of the conceptual boundaries through which caribou are understood and human-caribou interactions have been managed in the western Arctic?

### **1.5. Migratory Routes: Mapping a Path through the Dissertation**

The dissertation begins at the end of the nineteenth century with the introduction of domesticated reindeer to Alaska, and ends in the early 1990s with an examination of key debates about the potential impact of resource extraction and environmental contaminants on the health and survival of the Porcupine Caribou Herd. Although this periodization overlaps with the signing of comprehensive land claims in northern Canada, including the Yukon Umbrella Final Agreement (1993), and the emergence of cooperative or co-management structures for natural resources, including the establishment of the Porcupine Caribou Management Board (PCMB) in 1985, I do not undertake a thorough analysis of these developments and their implications for the

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<sup>101</sup> Shortly after conducting fieldwork, I read Emilie Cameron's *Far Off Metal River* (2015), and her articulations of *learning to learn* from Inuit (rather than claiming to know), and the importance of taking seriously southern stories about the north were helpful as I worked to make sense of my own evolving research method.

contemporary management of the Porcupine Caribou Herd.<sup>102</sup> Rather, the dissertation aims to understand the shifting and contested terrain of caribou science, and its application in scientific caribou management, in the period prior to co-management in northern Canada. While the dissertation outlines the historical emergence of caribou science and scientific caribou management in the western Arctic, the chapters do not adhere to a strict chronological narrative. Through the development of a framework that focuses on the establishment and enforcement of scientific boundaries, there is considerable temporal overlap among each of the four related case studies.

I begin the dissertation (Chapter Two) in late nineteenth-century Alaska, and consider the way in which the introduction of *domesticated* reindeer, and the subsequent growth of a reindeer industry, provoked managerial anxiety about the purity of Alaska's *wild* caribou herds, and spurred scientific and managerial efforts to harden materially and discursively the boundary around wilderness in the western Arctic. Established initially by missionaries with the dual purpose of feeding Alaska Natives and converting Indigenous hunters into pastoralists engaged in capitalist social relations, the Alaskan reindeer industry expanded well beyond the scope and scale envisioned by its original architects.<sup>103</sup> By the mid-1930s, the number of reindeer in Alaska had grown to an estimated one million animals, and there were increasing reports of

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<sup>102</sup> The Umbrella Final Agreement is a framework that outlined the negotiation process for subsequent land claims among each of the 14 First Nations and the federal and territorial governments. See Nadasdy, *Sovereignty's Entailments*, 21. Other scholars have taken up questions around power, legitimacy, and the integration of Indigenous or traditional ecological knowledge and western science within the co-management framework. Paul Nadasdy has made important contributions to our understanding of co-management. See Nadasdy, *Hunters and Bureaucrats*. For a different interpretation of the emergence and politics of co-management, though in a different geographical context, see Loo, "Political Animals." Biologist Gary Kofinas has considered the contestation over scientific legitimacy in the context of the Porcupine Caribou Management Board (PCMB). See Kofinas, "Caribou Hunters and Researchers." However, the PCMB has not yet been the subject of an extensive historical study.

<sup>103</sup> Roxanne Willis, "A New Game in the North: Alaska Native Reindeer Herding, 1890-1940," *The Western Historical Quarterly* 37, 3 (2006): 277-301; Andrew Stuhl, *Unfreezing the Arctic: Science, Colonialism, and the Transformation of Inuit Lands* (Chicago: University of Chicago Press, 2016), 61-88; see J. Sonnenfeld, "An Arctic Reindeer Industry: Growth and Decline," *Geographical Review* 49, 1 (1959): 76-94.

hybridization between reindeer that escaped from their herds and migratory caribou throughout the territory. While industry officials grew increasingly concerned about the loss of reindeer to migratory caribou herds, wildlife managers and caribou scientists worried that hybridization between these two groups of animals had depleted the value, virility, and biological purity of Alaska's stock of *wild* caribou.

In the first half of the twentieth century, the proliferation of reindeer-caribou hybrids prompted scientists and wildlife managers to demarcate boundaries that should not be transgressed by feral reindeer. Throughout this period, scientists and conservation officials, spurred by increasing reports of reindeer-caribou hybridization, undertook measures to prevent the proliferation of this new form of animal life. In the first instance, this included managerial attempts to determine the extent and impact of reindeer-caribou hybridization. Further, in response to the perceived biological threat to migratory caribou, officials ordered the killing of any hybrids found within critical areas of caribou habitat. Ultimately, wildlife managers attempted to implement a spatial division of Alaska into reindeer and caribou territories. For scientists and wildlife managers, northeastern Alaska – which scientists subsequently described as the range of the Porcupine Caribou Herd, and the future site of the Arctic National Wildlife Refuge – represented a critical location for the preservation of ostensibly pure and wild migratory caribou. In these ways, managerial attempts to preserve the wildness of the territory's migratory caribou herds became enmeshed with the environmental politics of wilderness protection in the western Arctic.

In Chapter Three, I focus on scientific and managerial efforts to demarcate and stabilize the boundaries around the species, subspecies, and caribou herd concepts. The stabilization of these managerial categories, I argue, was central to the emergence of modern scientific wildlife

management, and the ascendance and legitimacy of population-based models of caribou management in Arctic North America. In the first section of this chapter, I consider the scientific labour that went into Frank Banfield's 1961 revision of the genus *Rangifer*, which had major implications for the taxonomic classification of the Alaska-Yukon caribou herds. The second section examines a series of joint scientific investigations by the US Fish and Wildlife Service (USFWS) and the Canadian Wildlife Service (CWS) in the 1950s and 1960s, which focused on the caribou that crossed the border between Alaska and the Yukon. Through aerial surveillance, these investigations produced new information about the centrality of the calving grounds to the annual movement of caribou herds, and, ultimately, contributed to the transformation of the caribou herd concept.

Throughout this chapter, I follow the movement of scientists and their ideas about caribou across the Alaska-Yukon border, and argue that the establishment of a transnational network of caribou science was fundamental to the stabilization of these core managerial categories in the postwar period. Despite the institutional structure of state-based wildlife management agencies in Canada and the United States, wildlife managers and caribou scientists worked across the International Boundary as they sought to produce new scientific information that they could use to classify and describe the migratory caribou herds of the transboundary western Arctic. Although I pay close attention to the ways in which wildlife managers deployed technologies of aerial surveillance to refine scientific modes of representation, I argue that the stabilization of core managerial categories was not the result of technological developments alone. Rather, I suggest that establishment of a "crucial boundary" between legitimate and

rejected forms of knowledge production was central to the stabilization of the herd and species concepts in the transboundary western Arctic.<sup>104</sup>

In the fourth chapter, I engage with the environmental politics of Arctic resource extraction, and ask how caribou scientists have contributed to the debate about oil and gas development on Alaska's coastal plain. As documented by scientists (the subject of Chapter Three) and Gwich'in oral histories, the coastal plain is the site of the Porcupine Caribou Herd's primary calving grounds. Since the 1968 discovery of oil at Prudhoe Bay, there has been a protracted scientific debate about the potential impact that the development of energy infrastructure would have on migratory caribou herds. This debate intensified after the US Government passed the Alaska National Interest Lands Conservation Act (ANILCA) in 1980, which expanded the total acreage of lands designated as wilderness throughout the state, but also established the controversial 1002 lands on the coastal plain of the Arctic National Wildlife Refuge (ANWR). Rather than expanding wilderness designation to this area, Congress postponed any future decisions about conservation or development until after the completion of an environmental impact statement, which sought to determine both the extent of the oil and gas deposits under the coastal plain, and the environmental impact of development on the Porcupine Caribou Herd's calving grounds.

The outcome of this debate, which holds considerable implications for the Porcupine Caribou Herd and Indigenous communities on both sides of the Alaska-Yukon, has turned on the making and remaking of conceptual and scientific boundaries in the western Arctic. As in the preceding chapters, the historical and geographical analysis here concerns the way in which the community of northern scientists drew boundaries around accepted and rejected modes of

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<sup>104</sup> The notion of a "crucial boundary" between forms of knowledge production comes from Shapin and Schaffer, *Leviathan and the Air-Pump*, 80.

scientific knowledge production. In the postwar period, the oil and gas industry became an increasingly active participant in the production of northern environmental science, and this trend accelerated after the discovery of oil at Prudhoe Bay in 1968. After outlining the emergence of the oil and gas industry as an actor in the history of northern science, I consider the role that industry-sponsored ecologists and biologists played in scientific debates about oil and gas extraction and caribou habitat at three critical moments in the environmental history of the western Arctic: the development of the Trans-Alaska Pipeline System (1969-1974), the public inquiry into the feasibility and impact of the Mackenzie Valley Pipeline (1972-1977), and the crafting of the environmental impact statement regarding oil and gas extraction on Alaska's coastal plain (1980-1987). After a long history of defining and bounding spatially Alaskan wilderness, scientists were now engaged in a debate about the ability of the oil and gas industry to work within important wilderness areas without compromising the state's wilderness values. Throughout this period, the industry asserted the authority of its northern environmental knowledge, and touted its plans to pursue *responsible* energy development within ANWR, which promised to protect northern wilderness – and caribou – while extracting the oil and gas reserves from below the Porcupine Caribou Herd's calving grounds.

The final chapter considers a less visible, though no less threatening disturbance to the migratory Porcupine Caribou Herd. In the early years of the Cold War, scientists began to detect trace amounts of radioactive contamination in the bodies of reindeer and caribou throughout the circumpolar north. By the early 1960s, scientists feared that cesium-137 and strontium-90 – radionuclides produced by atmospheric nuclear tests and distributed globally through radioactive fallout – had contaminated the entire northern food chain through the “lichen-caribou-man” pathway of exposure. Due to its particular physiological adaptations, lichen (*Cladonia*

*rangiferina*), scientists noted, was vulnerable to the accumulation of fallout and other airborne contaminants. As scientists monitored fallout across the North American Arctic, they began to document the bioaccumulation of radiocesium in the bodies of caribou, which depend on lichen as a critical source of winter nutrients, and those human communities that hunted and consumed caribou.

In addition to mapping the pathways through which radionuclides accumulated in human bodies, scientists attempted to identify a threshold for safe levels of human exposure to nuclear material. In the North American Arctic, public health officials and scientists asked whether the consumption of contaminated caribou meat had caused human exposure levels to exceed the threshold. But rather than a natural or stable boundary, the threshold has been a site of contested knowledge claims and assertions of scientific authority. Yet, as I demonstrate in this chapter, these forms of boundary-work have been obscured by the discursive and institutional regimes within which scientists produce and contain nuclear knowledge.<sup>105</sup> To better understand the environmental politics of the threshold, I examine the production of scientific knowledge about radioactive contamination in Alaska and the Yukon between 1958 and 1993. I consider three moments in which the threshold came to matter: the discovery of radioactive cesium-137 in caribou bodies during the period of atmospheric nuclear testing (1958-1963); the expansion of human experimentation as scientists aimed to map the spatial and temporal boundaries of radioactivity in northern communities (1960-1979); and, following the Chernobyl accident, scientific and managerial attempts to assuage the fears of Indigenous communities regarding the

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<sup>105</sup> Jacob Darwin Hamblin, *Poison in the Well: Radioactive Waste in the Oceans at the Dawn of the Nuclear Age* (New Brunswick: Rutgers University Press, 2008), 10-38; Shannon Cram, "Living in Dose: Nuclear Work and the Politics of Permissible Exposure," *Public Culture* 28, 3 (2016): 519-539; Adriana Petryna, *Life Exposed: Biological Citizens after Chernobyl* (Princeton: Princeton University Press, 2003), 49-62; Scott Kirsch, *Proving Grounds: Project Plowshare and the Unrealized Dream of Nuclear Earthmoving* (New Brunswick: Rutgers University Press, 2005), 31.

potential impact of radioactive fallout on migratory caribou herds (1986-1993). Although scientists determined that radioactivity did not exceed “permissible” levels, and therefore posed no danger to caribou or humans, I argue that the scientific application of the threshold concept shaped environmental relationships and human-caribou interactions throughout the nuclear north.

## **A Note on the Images:**

Produced during the autumn of 2014, these photographs represent my own situated and partial observation of the Vuntut Gwitchin fall caribou hunt. During my fieldwork in Old Crow, I worked with two elders from the community, and these men both made indelible impressions on my research and understanding of caribou. The first, a respected hunter, devoted much of his life to teaching Vuntut Gwitchin youth about traditional land-based relationships. Indeed, as people in the community learned about my research and my reasons for traveling to Old Crow, many told me that I absolutely had to speak with this particular individual. Although he agreed to let me accompany him as he hunted caribou and moose, he asked that I not use his name in my dissertation or in any subsequent publications. Joel Peter, the second individual with whom I worked, is also a respected elder in Old Crow. In addition to participating in the vital activity of language revitalization, Mr. Peter has worked with other researchers, including scientists and wildlife managers who have studied contaminants in caribou meat.

From the outset, my goal in working with photographic field methods was to develop a visual representation that offered a counternarrative to prevailing representations of the North, which, all too often, portray the region as an unpeopled wilderness. Although I do employ visual frames of reference and techniques that are common in landscape photography, I do not suggest that the images document landscapes that are separate from human society. As I moved through the traditional territory of the Vuntut Gwitchin – in motorboat, canoe, and by foot – each of the elders described their cultural, kin-based, and spiritual connections to the different locations we encountered. For one unfamiliar with the socio-natural landscapes of the region, it might have been easy to confuse these seemingly remote places as being separate from human society.

However, as each elder narrated our movement through the landscape, it became apparent that this was a deeply peopled space. From traplines to family fishing camps to traditional locations for the gathering of medicine, every place within this landscape, I learned, was animated by stories that connected the people of the Vuntut Gwitchin First Nation to these landscapes and their relations across time and space. Further, I learned that the connections that tied these men to the places we visited were strengthened by the annual movement of the Porcupine Caribou through the traditional territory of the Vuntut Gwitchin. As I worked to photograph the fall hunt, it was this human connection to the animals and the landscape that I hoped to emphasize.

The photographs below contain a number of images that document the care and labour involved in the caribou hunt. Rather than viewing the shooting and butchering of the caribou as a violent act, I see it as one that is informed by a Gwitchin code of ethics, which emphasizes respect for the caribou, the land, and people. Each aspect of the hunt, I learned, is a carefully planned process that operates to ensure that every part of the caribou is used, leaving nothing to waste. In this way, one elder informed me, hunters show caribou the respect and gratitude the animal deserves for presenting itself to the hunter.

Further, the sharing of caribou meat plays an important role in the maintenance of Gwitchin social relations and cultural connections. For example, the caribou butchered in the images below were not shot by the elder with whom I worked, but rather, had been shot by his brother. After ferrying the caribou to the riverbank, where we skinned and butchered the animals, the

man who had shot the caribou gifted two of them to his older brother. As we worked with the animals, and the elder explained to me the significance of each aspect of the butchering process, he reiterated how important it was that his brother had given him the two caribou. He asked me to remember this gift as I wrote my dissertation about the caribou. Make sure you let people know, he said, that my brother shot the caribou and gave it to me for my family for the winter.

Since the 1980s, US lawmakers and representatives of the oil and gas industry have been clamoring to open the Arctic National Wildlife Refuge to resource extraction. Gwich'in communities in Canada and Alaska, along with a broad group of allied environmentalists, scientists, and conservationists, have pointed out that Porcupine Caribou Herd's core calving area sits on top of the area being eyed by the oil and gas industry. Exploration and drilling in this area, they have argued, would likely have catastrophic consequences for the caribou and the Indigenous people who have for thousands of years depended on these migratory animals. Given the persistence of this existential threat to the Porcupine Caribou Herd, I also hoped to emphasize the continued importance of the caribou to the Vuntut Gwitchin through these photographs. Although my dissertation moved in a very different direction than I had originally envisioned, my experience in Old Crow played a formative role in the development of my research method and design. For this reason, I have chosen to include a collection of images produced during my fieldwork in Old Crow, which, in my mind, suggests what is at stake when the US Congress moves to open the herd's calving grounds to the oil and gas industry.



Image 1.4. The Porcupine River

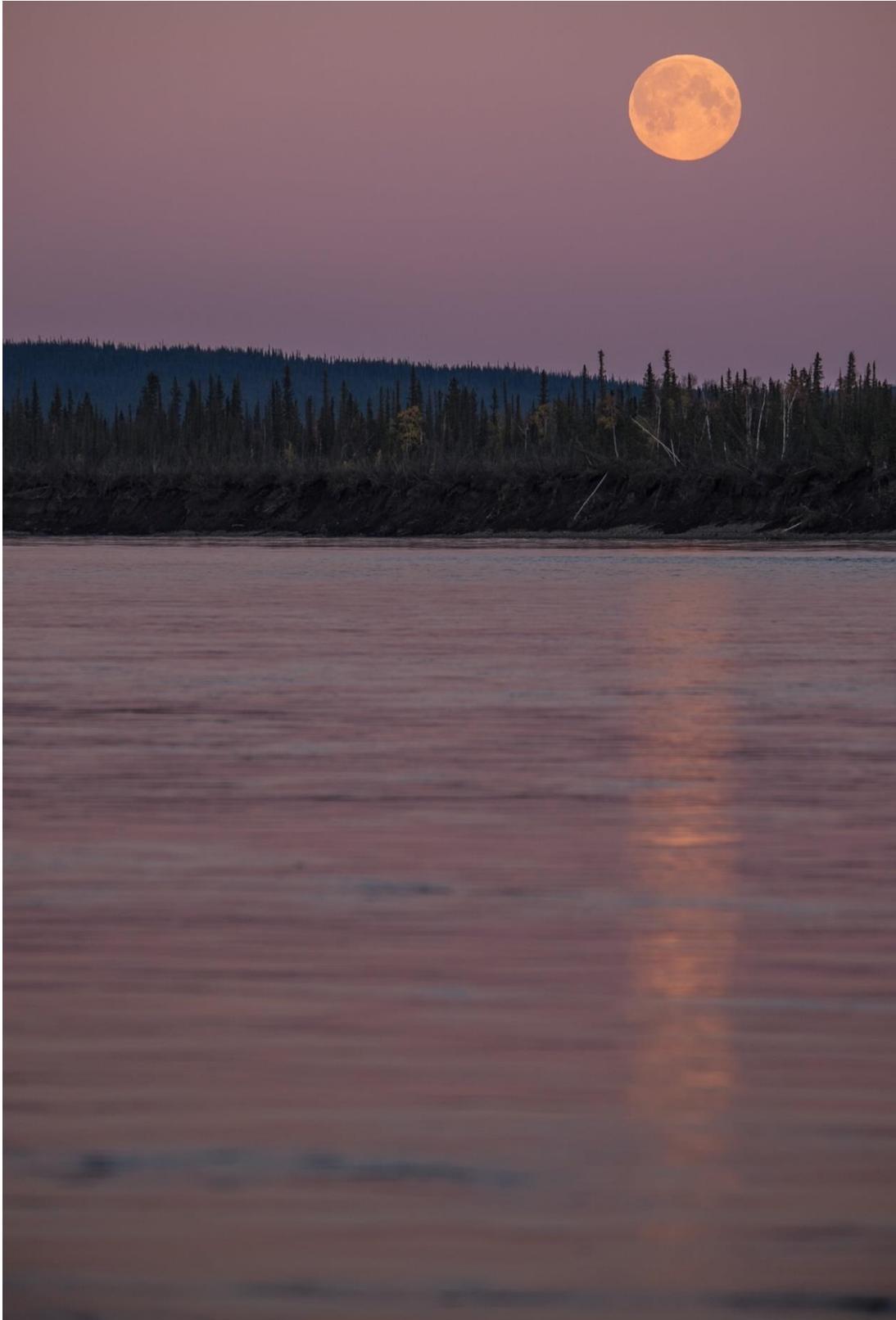


Figure 1.5. Autumn moon reflecting in the Porcupine River



Figure 1.6. Aurora Borealis above Old Crow, Yukon



Figure 1.7. The Slash: The Alaska-Yukon Border

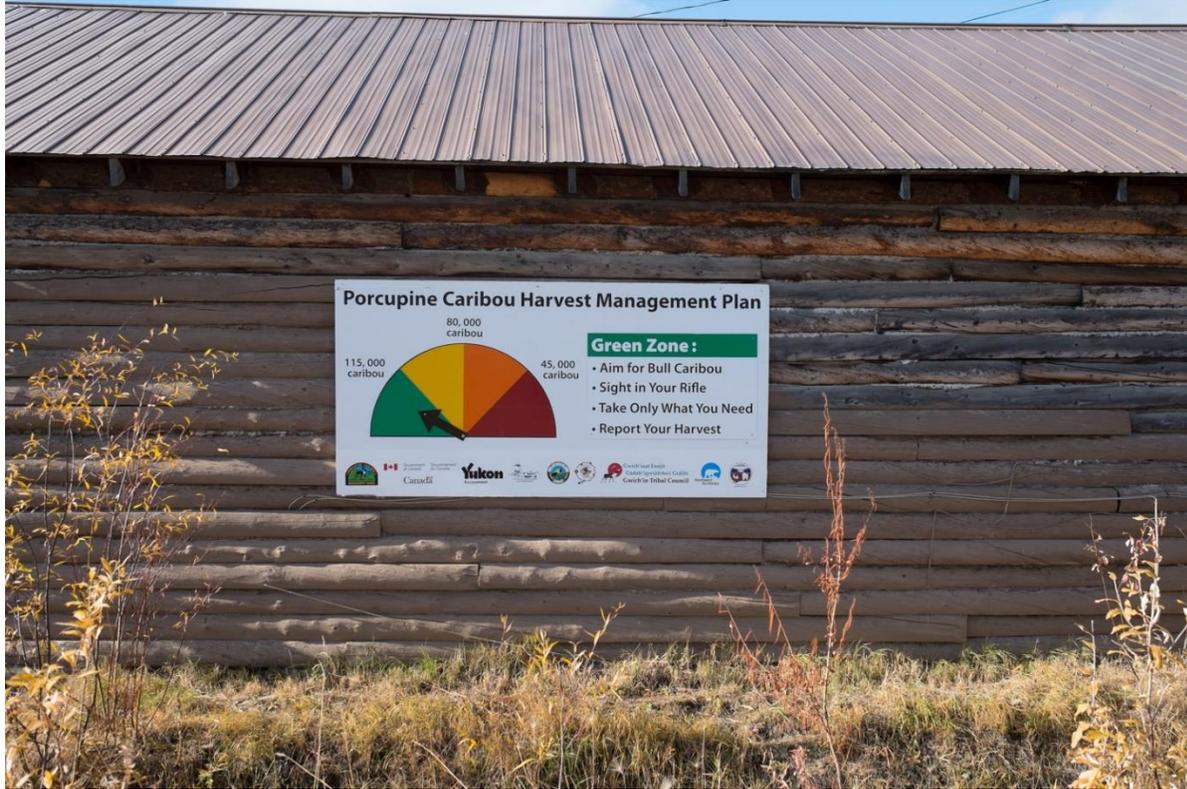


Figure 1.8. Hunting regulations displayed prominently in Old Crow.



Figure 1.9. Antlers and cotton grass on Old Crow Mountain



Figure 1.10. A hunter on the Porcupine River.



Figure 1.11. Driving to camp.



Figure 1.12. Ancient caribou trails etched on the landscape.



Figure 1.13. Vadzaih (Caribou) on the bank of the Porcupine River.



Figure 1.14. Butchering



Figure 1.15. The head of the caribou is removed first.



Image 1.16. Skinning the caribou.



Figure 1.17. The hind and forequarters are placed on willows to protect the meat.



Figure 1.18. Packing the meat.



Figure 1.19. Driving downriver to the smokehouse.



Figure 1.20. Cooking in the smokehouse.



Figure 1.21. Preserving the skin.



Figure 1.22. Reading the landscape.



Figure 1.23. Collecting firewood for winter.



Figure 1.24. Smoked salmon.



Figure 1.25. Swans prepare to migrate south for the winter.

## Chapter 2: Securing the Boundaries of Wildness in the Alaska-Yukon Borderlands

### 2.1. Introduction: The Problem of Hybridity

On 4 July 1892, Captain Michael Healy of the US Revenue Marine Service, ferried 171 domesticated reindeer from Siberia across the Bering Strait to the Teller Reindeer Station in northeastern Alaska.<sup>1</sup> Though related biologically, reindeer and caribou evolved in geographically separate regions of the circumpolar north, and while they shared many biological and behavioural traits, their distinct socio-natural connections to human communities marked reindeer and caribou as different forms of animal life.<sup>2</sup> The introduction of domesticated reindeer to the range of migratory caribou in Alaska, therefore, marked an important moment in the evolutionary histories of these two groups of ungulates. Indeed, as Alaskan anthropologist Ernest Burch argues, since 1892, “the affairs of the two subspecies in Northwest Alaska were inextricably linked,” and “the history of one cannot be understood without knowledge of the other.”<sup>3</sup>

The introduction of reindeer herds to Alaska in the late nineteenth century also represented a significant development in the environmental history of the western Arctic. During the first three decades of its existence, the industry’s rapid growth and spatial expansion exceeded the expectations of its original architects. During the first 10 years of the program, the

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<sup>1</sup> Willis, “A New Game,” 277. For more on Captain Michael Healy, and his role in the plan to introduce reindeer to Alaska, see Sheldon Jackson, *Introduction of Reindeer into Alaska: Preliminary Report of the General Agent of Education for Alaska to the Commissioner of Education* (Washington: Government Printing Office, 1891). This was, in fact, the second group of reindeer introduced to Alaska. In 1891, ten Siberian reindeer had been brought to Teller, Alaska. See A.D. Johnson, “Brief History of the Reindeer in the Arctic,” NARA-A (Seattle, WA), RG 75: Alaska Reindeer Services, Box 33, File: History Reindeer in Brower Region, 1942.

<sup>2</sup> Indeed, as Edmund Russell argues in his seminal text on evolutionary history: “Social forces have been evolutionary forces.” Edmund Russell, *Evolutionary History: Uniting History and Biology to Understand Life on Earth* (Cambridge: Cambridge University Press, 2011), 3. For more on the biological, ecological, and socio-natural similarities and differences between reindeer and caribou, see Ernest S. Burch Jr., *Caribou Herds of Northwest Alaska*, eds. Igor Krupnik and Jim Dau (Fairbanks: University of Alaska Press, 2012), 17-36.

<sup>3</sup> Burch, *Caribou Herds*, 17.

Bureau of Education oversaw the introduction of 1280 Siberian reindeer to Alaska, which formed the principle or “Mother Herd” at Teller on the Seward Peninsula.<sup>4</sup> By 1922, this original herd had grown to more than 200,000 animals, and had been used as the source for the establishment of new herds at multiple locations throughout the Territory. During the 1920s, the reindeer population continued to grow, and, by 1935, officials in the Alaska Reindeer Service estimated that there were approximately one million reindeer “scattered” between Point Barrow in the North and Kodiak Island in the south.<sup>5</sup> Yet, as quickly as the industry had grown, by the mid-1930s, Alaska’s reindeer herds began to suffer substantial losses, and the industry entered a period of rapid decline. By the end of the Second World War, there were fewer than 25,000 reindeer remaining in herds throughout Alaska.<sup>6</sup>

While historians of the western Arctic have interpreted the rise and eventual collapse of the reindeer industry differently, the historiography has developed around the role of domesticated reindeer in the northern expansion of colonial relations and administration.<sup>7</sup>

Environmental historian Andrew Stuhl focuses on the development of reindeer science in Alaska

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<sup>4</sup> A.D. Johnson, “Brief History of the Reindeer in the Arctic,” NARA-A (Seattle, WA), RG 75: Alaska Reindeer Services, Box 33, File: History Reindeer in Brower Region, 1942.

<sup>5</sup> Johnson, “Brief History,” NARA-A, RG 75: Alaska Reindeer Services, Box 33. For more on the growth of the Alaskan reindeer industry, see J. Sonnenfeld, “An Arctic Reindeer Industry: Growth and Decline,” *Geographical Review* 49, 1 (1959): 76-94; Stuhl, *Unfreezing*, 61-63.

<sup>6</sup> Willis, “A New Game in the North,” 301; Olson, *Reindeer Herdsmen*, 14-15.

<sup>7</sup> Although the reindeer industry had a profound impact on environmental politics and relationships in the western Arctic, compared to other historical developments – such as the Klondike Gold Rush, the construction of the Alaska Highway, or the emergence of the oil and gas industry in the western Arctic – it remains relatively under-examined in northern historiography. Kathryn Morse, *The Nature of Gold: An Environmental History of the Klondike Gold Rush* (Seattle: University of Washington Press, 2003); Peter Coates, *The Trans-Alaska Pipeline Controversy: Technology, Conservation, and the Frontier* (Bethlehem: Lehigh University Press, 1991); K.S. Coates and W.R. Morrison, *The Alaska Highway in World War II: The US Army of Occupation in Canada’s Northwest* (Norman: University of Oklahoma Press, 1992); Julie Cruikshank, “The Gravel Magnet: Some Social Impacts of the Alaska Highway on Yukon Indians,” in *The Alaska Highway: Papers of the 40th Anniversary Symposium*, edited by Ken Coates (Vancouver: UBC Press, 1985); Paul Sabin, “Voices from the Hydrocarbon Frontier: Canada’s Mackenzie Valley Pipeline Inquiry (1974-1977),” *Environmental History Review* 19, 1 (1995): 17-48. For important exceptions, which deal with the raising of reindeer for commercial purposes in both Alaska and the Northwest Territories, see Stuhl, *Unfreezing the Arctic*, 61-87; Roxanne Willis, “New Game.” For a historical biological perspective on the resulting reindeer-caribou hybridization, see Mager, “I’d Be Foolish,” 162-181; Mager et al., “High Genetic Connectivity,” 1111-1123.

and northern Canada, and argues that domesticated reindeer were technologies of colonial administration used by governments to foster socioeconomic development.<sup>8</sup> But unlike northern wildlife management and the establishment of national parks, Stuhl argues that the administration of the reindeer industry required the state to engage more directly with Inuit people and communities.<sup>9</sup> Historian Roxanne Willis emphasizes the agency of Indigenous reindeer herders in her examination of the industry.<sup>10</sup> Rather than portraying Indigenous participation in the industry as a tragic narrative of cultural loss, reindeer herding, Willis argues, became a “means of both individual and cultural survival for Native people in a rapidly changing world.”<sup>11</sup> Importantly, for historians of northern Canada and Alaska, the reindeer’s status as a domesticated animal was central to its role in state attempts to exert control over northern landscapes and peoples. As Stuhl argues, reindeer scientists and Arctic botanists argued that the northern tundra was wild, and the “rational approach – the natural thing to do – was to tame it.”<sup>12</sup>

In this chapter, I take a different approach, and consider the unintended environmental consequences of the state’s attempt to “tame” the tundra by focusing on the resultant interactions between reindeer and migratory caribou during the first half of the twentieth century. Despite the industry’s eventual collapse, the introduction of domesticated reindeer to the range of Alaska’s migratory caribou had unforeseen social and ecological impacts, which shaped environmental politics in the western Arctic. Indeed, as early as the mid-1920s, wildlife managers and scientists in Alaska began to perceive domesticated reindeer as a threat to Alaska’s stock of migratory

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<sup>8</sup> Stuhl, *Unfreezing the Arctic*, 62-63.

<sup>9</sup> For more on national parks and wildlife management, see John Sandlos, *Hunters at the Margin: Native People and Wildlife Conservation in the Northwest Territories* (Vancouver: UBC Press, 2007); Peter Kulchyski and Frank Tester, *Kiumajut (Talking Back): Game Management and Inuit Rights, 1950-1970* (Vancouver: UBC Press, 2008); Claire Campbell, ed. *A Century of Parks Canada, 1911-2011* (Calgary: University of Calgary Press, 2011).

<sup>10</sup> Willis, “A New Game,” 278-279.

<sup>11</sup> Willis, “A New Game,” 279.

<sup>12</sup> Stuhl, *Unfreezing*, 62. For more on “taming” the tundra, see Sandlos, *Hunters at the Margin*, 119.

caribou. As the industry expanded, and the territory's reindeer population exploded, wildlife managers became concerned about potential impacts on caribou and their habitat, which included disease transmission and overgrazing. However, it was the scientific uncertainty surrounding the biological impact that domesticated reindeer were having on wild caribou that created the most anxiety for Alaskan wildlife managers. Although reindeer and caribou have divergent evolutionary histories, they are related at the subspecies level, and, therefore, can interbreed to produce hybridized offspring. For wildlife managers and scientists in the western Arctic, reindeer-caribou hybridization was not only an unfavourable environmental development, but also represented a fundamental violation of the critical boundary between wild and domesticated animals.

With origins in the natural sciences, scientists have used the term “hybridity” to describe and categorize the offspring formed when animals of different species interbreed.<sup>13</sup> In recent years, however, geographers have adopted the concept of hybridity as a challenge to the binary or Cartesian modes of thought that have dominated analyses of nature-society relations.<sup>14</sup> Central to the project of hybrid geographies is the idea that the world – including ontological claims about its constitutive elements – is always in a state of becoming. Although scholars conceptualize hybrids as boundary transgressing beings or spaces, they also reject the notion that a hybrid represents the meeting or “mixture of two pure forms.”<sup>15</sup> In the western Arctic, wildlife

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<sup>13</sup> Alice Hovorka, “Animal geographies II: Hybridizing,” *Progress in Human Geography* (31 March 2017): 2.

<sup>14</sup> Sarah Whatmore, “Hybridity,” in Derek Gregory, Ron Johnston, Geraldine Pratt, Michael Watts, and Sarah Whatmore, eds., *The Dictionary of Human Geography, 5th Edition* (Oxford: Wiley-Blackwell, 2009), 361-362.

<sup>15</sup> Quote from Bruno Latour, *We Have Never Been Modern*, translated by Catherine Porter (Cambridge, MA: Harvard University Press, 1993), 78. For other key articulations of the concept, see Sarah Whatmore, *Hybrid Geographies: Natures, Cultures, Spaces* (London: Sage Publications, 2002); Donna Haraway, *Simians, Cyborgs, and Women: The Reinvention of Nature* (New York: Routledge, 1991). Geographer David Lulka has argued that the “pervasive centrality of humans” in Latour and Haraway’s contributions has circumscribed the project of hybrid geographies, and limited its ability to represent the natural landscape. See Lulka, “The Residual Humanism of Hybridity: Retaining a Sense of the Earth,” *Transactions of Institute of British Geographers* 34, 3 (2009): 378-393. For a historically grounded discussion of hybrid animals, see Harriet Ritvo, *The Animal Estate: The English and*

managers and scientists responded to the real and perceived threats of reindeer-caribou hybridization by reinforcing the conceptual and material boundary between wild and domesticated animals. At the most basic level, this involved managerial attempts to protect the “purity” of Alaska’s wild caribou by preventing escaped reindeer from “intermingling” with their wild, migratory cousins.

Hybridization and the resulting managerial responses were spatial processes, which shaped the geographies of wilderness in Alaska. As scientists and wildlife managers worked to determine the extent to which hybridization had impacted the ostensible purity of Alaska’s wild caribou, they also sought to demarcate spatial boundaries that should not be transgressed by domesticated reindeer. Ultimately, wildlife managers aimed to protect the *wildness* of certain spaces in Alaska, such as Mt. McKinley National Park, by preventing reindeer-caribou hybridization within the boundaries of those areas. This involved the conceptual and material division of the territory into reindeer and caribou space. In addition to the national park, however, wildlife managers also suggested that northeastern Alaska – an area that scientists would subsequently define as the range of the Porcupine Caribou Herd – should be protected from feral reindeer, and preserved as a space for wild, migratory caribou herds. Indeed, by the beginning of the twentieth century, the Alaska-Yukon borderlands had emerged as a “Last Frontier” in the American spatial imagination, marking a geography that was constructed

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*Other Creatures in the Victorian Age* (Cambridge, MA: Harvard University Press, 1987); Harriet Ritvo, *Noble Cows and Hybrid Zebras: Essays on Animals and History* (Charlottesville: University of Virginia Press, 2010). For a critique of the social monism – or the idea that society, particularly capitalist social relations, has subsumed nature – prevalent in social constructionists’ theoretical hybridity, and the development of an ecological dialectical approach to environmental relations, see: John Bellamy Foster, “Marxism in the Anthropocene: Dialectical Rifts on the Left,” *International Critical Thought* 6, 3 (2016): 393-421; Andreas Malm, “The Origins of Fossil Capital,” *Historical Materialism* 21, 1 (2013): 15-68; Paul Burkett, *Marx and Nature: A Red Green Perspective* (Chicago: Haymarket, 2014).

discursively as external to human society, and its attendant environmental depredations.<sup>16</sup>

Although the managerial and scientific dynamics considered in this chapter preceded the emergence of the conservationist-led movement to establish a wildlife preserve in northeastern Alaska and northern Yukon, the discursive and material bounding of this region as a wilderness area for wild caribou was an important moment in the spatial history of the western Arctic. In this chapter, I examine the way in which wildlife managers framed this region as a wild space that should be protected from the threat of reindeer-caribou hybridization during the first half of the twentieth century.<sup>17</sup>

## **2.2. Intersecting Evolutionary Histories: Reindeer and Caribou in the Western Arctic**

The introduction of reindeer to Alaska marked an important moment in the colonial administration of northern landscapes, people, and animals. Initially proposed in 1890 by Sheldon Jackson, a Presbyterian missionary and the General Agent of Education for Alaska, the

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<sup>16</sup> Susan Kollin, *Nature's State: Imagining Alaska as the Last Frontier* (Chapel Hill: University of North Carolina Press, 2001), 2-22. For more on borderlands historiography and theorization, see Jeremy Adelman and Stephen Aron, "From Borderlands to Borders: Empires, Nation-States, and the Peoples in Between in North American History," *The American Historical Review* 104, 3 (1999): 814-841.

<sup>17</sup> In northern Alaska, managerial anxieties about the biological purity of wild caribou were bound up with broader concerns about race and efforts to conserve an ostensibly pure, national nature. In an examination of wilderness conservation in New Mexico, Geographer Jake Kosek considers historical notions of purity, and argues that at the turn of the twentieth century, anxieties about the "dilution and degradation of race – in particular, of forms of whiteness – became entangled with fears of the degradation of New Mexico's 'pristine' forest landscapes." The concept of wilderness in the American environmental imagination, Kosek argues, was forged through "discourses of purity," which placed "diluted racial subjects and degraded landscapes into the same 'grid of intelligibility'". I share Kosek's concern with the way in which historical understandings of racial purity – both animal and human – shaped the conservation movement in northern Alaska and northern Canada. However, at this point in my research, I have not yet drawn the necessary connections between managerial attempts to protect the purity of wild caribou (and their landscapes) and efforts to classify humans into specific racial categories to be able to speak to the way in which "discourses of purity" shaped the conservation movement in this region during the first half of the twentieth century. Although there are particular historical resonances and parallels between landscape conservation in the north and the southern United States, distinct settlement patterns and particular historical geographies of whiteness distinguish in important ways the Alaskan case from the historical processes outlined by Kosek. Although this important historical geography is not developed in my analysis, it does represent one of the next steps in my research plan. I am currently working on a paper that draws from material used in Chapters two and three, and seeks to articulate connections among human efforts to classify race and managerial efforts to protect "pristine", national natures in northern Alaska and northern Canada. For above quotes, see Jake Kosek, "Purity and Power: Racial Degradation and Environmental Anxieties," in *Liberation Ecologies: Environment, Development, Social Movements*, edited by Richard Peet and Michael Watts (London: Routledge, 2004), 129.

establishment and early development of the reindeer program was driven by a mistaken belief among government officials and wildlife managers that Alaskan caribou were nearing extinction, and, as a result, Alaskan Native communities were on the “verge of starvation.”<sup>18</sup> Reindeer, which would be purchased in Siberia, and herded by Alaskan Natives, were expected to replace caribou in the northern diet.

But reindeer represented more than a simple solution to the problem of sustenance; through much of 1890, Jackson and his colleagues sought to drum up political support for the program by arguing that reindeer ultimately would play a valuable social and cultural role in Alaskan Native communities.<sup>19</sup> According to US Commissioner of the Bureau of Education W.T. Harris, the passage of legislation permitting the establishment of agricultural experimental stations for the purposes of reindeer herding in Alaska represented a “great step forward in lifting the native races of that boreal region out of barbarism and starting them toward civilization, a step from the grade of wild hunter to the grade of herdsman who live on domesticated cattle.”<sup>20</sup> Further, the establishment of a reindeer industry, he argued, would “furnish” Alaskan Native communities with “an article of exportation and commerce.”<sup>21</sup> As Harris’s comments demonstrate, domesticated reindeer were viewed by many involved in the administration of Alaska as transformative animals – grazers with the potential to convert the northern tundra into a valuable resource, and, ultimately, change the course of history for Alaskan Native communities.<sup>22</sup>

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<sup>18</sup> Sheldon Jackson, *Introduction of Reindeer*, Appendix K: 18 December 1890, Henry Woolfe to Sheldon Jackson.

<sup>19</sup> Stuhl, *Unfreezing*, 62-63.

<sup>20</sup> Jackson, *Introduction of Reindeer*, 3.

<sup>21</sup> Jackson, *Introduction of Reindeer*, 3.

<sup>22</sup> For more on the power of these imagined conversions, see: Stuhl, *Unfreezing the Arctic*, 63.

Although it is likely that officials would have eventually established reindeer herds on Alaska's Arctic coastal plain, the northern expansion of the industry occurred relatively early in its history due to an unforeseen set of circumstances.<sup>23</sup> In September of 1897, eight whaling ships became caught in ice during an early freeze in the Arctic Ocean, and, as a result, 300 men were forced to overwinter at Point Barrow. After receiving news of the incident, President McKinley, who believed that the men would not make it through the Arctic winter without outside assistance, organized an "Overland Relief Expedition", which included plans to drive a small group of reindeer to Barrow. Purchased from established herds to the south of Barrow, the animals were intended to provide the stranded whalers with a source of food and winter clothing. With the assistance of W.T. Lopp, missionary and future chief of the Alaska Division of the Bureau of Education, volunteers working for the relief expedition purchased 448 reindeer in western Alaska, and, on 28 March, 382 of these reindeer arrived in Barrow. According to local reports, however, the reindeer did not fare well on the drive, and when they arrived they were in such an emaciated condition that they were unsuitable for human consumption. Nonetheless, the whalers killed and butchered more than 100 of the reindeer in what was reported to be a show of appreciation for the relief expedition.<sup>24</sup> Following the disposition of the remaining animals at Barrow, Reverend H.R. Marsh, then head of the local Presbyterian Mission, assumed responsibility for the animals, and Charles Brower, a prominent trader in the region, agreed to finance the maintenance of the herd until it became self-supporting. Thus, as A.D. Johnson notes in his history of the Arctic reindeer herds, "[a]s a result of the shipwrecked whaling ships

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<sup>23</sup> L.J. Palmer described the coastal plain as an "ideal" site for the "production" of reindeer. L.J. Palmer, *Raising Reindeer in Alaska* (Washington, D.C.: United States Department of Agriculture, 1934), 5.

<sup>24</sup> Details regarding the Overland Relief Expedition taken from: Johnson, "Brief History," NARA-A, RG 75: Alaska Reindeer Services, Box 33, 1942; Sonnenfeld, "An Arctic Reindeer Industry."

reindeer were brought into the Arctic region. Of course the Arctic Region would have had their reindeer but it would have been many years later than 1898.”<sup>25</sup>

Despite this inauspicious start, the Arctic coast reindeer industry grew at a rate comparable to other districts throughout Alaska. In 1942, A.D. Johnson, a unit manager in the Alaska Reindeer Service, described this growth in a history of the Barrow reindeer industry. As Johnson explained, the animals that were brought to Barrow as part of the Overland Relief Expedition formed the nucleus of the industry on the North Slope. Between 1898 and 1924, Alaskan Inuit established nine additional herds from this original group of reindeer. Then, in 1924, at the suggestion of W.T. Lopp, several Inuit herders combined their animals to form the “Farthest North Reindeer Company”, the first reindeer company in northern Alaska. According to Johnson, this new herd grew rapidly, and by 1928, it was “so large that it was almost impossible to handle.”<sup>26</sup> Although the herders “were never able to get a complete check of the deer on the range,” by 1935, Johnson claimed, there were an estimated 30,000 reindeer in the Barrow region.<sup>27</sup>

Further, during this period, the spatial expansion of the reindeer industry extended across the Alaska-Yukon border. In the mid-1920s, the Canadian government began to explore the possibility of establishing a reindeer industry in the area near the Mackenzie Delta as a means of both providing Inuit communities with a stable source of food, and stimulating economic development in the western Arctic.<sup>28</sup> Encouraged by the initial success of the Alaskan industry,

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<sup>25</sup> Johnson, “Brief History,” NARA-A, RG 75: Alaska Reindeer Services, Box 33, 1942.

<sup>26</sup> Johnson, “Brief History,” NARA-A, RG 75: Alaska Reindeer Services, Box 33, 1942.

<sup>27</sup> Johnson, “Brief History,” NARA-A, RG 75: Alaska Reindeer Services, Box 33, 1942.

<sup>28</sup> Stuhl, *Unfreezing*, 66. For more on the history of the Canadian reindeer herds, including discussions of the driving forces behind the state’s efforts to establish a reindeer industry, see Sandlos, *Hunters at the Margin*, 7-20; Tina Loo, *States of Nature*, 121-148. For contemporary perspectives on the state’s efforts, see O.M. McMillion, “Reindeer Trek,” *The Journal of Geography* 38, 4 (1939): 133-141; Canada Department of Mines and Resources, *Canada’s Reindeer* (Ottawa: Lands, Parks, and Forests Branch, 1940).

the Dominion Government purchased 3,440 reindeer from the Lomen Company in 1929, and began making arrangements for herders to drive the animals across the Arctic coast to the Mackenzie Delta.<sup>29</sup> But the 4,000-kilometer drive from Alaska to the Delta, which officials expected to complete in 24 months, lasted more than five years, and involved almost insurmountable challenges for herders and reindeer alike. “Some of the hazards which men and deer would have to face,” wrote O.M. McMillion in his 1939 account of the trek, “were snowslides, avalanches, exposure, stampeding and milling of the herds, attacks from wolves and bears, ice traps, and starvation.”<sup>30</sup> Moreover, the proximity of migratory caribou herds, and the desire of reindeer to return to their home range, resulted in the loss of several hundred reindeer during the drive.<sup>31</sup> The reindeer that did escape, argued Adolph Murie, a wildlife biologist with the National Park Service, most likely joined with migratory caribou herds in the surrounding mountains.<sup>32</sup> Despite these challenges, in 1935, the herders drove almost 2,400 reindeer across the Mackenzie River, and delivered the animals to their Canadian range near Kittigazuit, located on the Arctic coast east of the Mackenzie Delta. By 1940, this herd was experiencing steady growth and had increased to more than 5,000 animals.<sup>33</sup>

Although the industry’s expansion and growth exceeded the visions of its original architects, the population of Alaska’s reindeer herds actually fell somewhat below the expectations of the industry’s 20th-century managers. As environmental historian Andrew Stuhl notes, Carl Lomen, who was the head of the largest privately-owned reindeer company, and

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<sup>29</sup> McMillion, “Reindeer Trek,” 133.

<sup>30</sup> McMillion, “Reindeer Trek,” 134.

<sup>31</sup> Department of Mines, *Canada’s Reindeer*, 2.

<sup>32</sup> Adolph Murie to George Wright, 16 April 1935, National Archives and Records Administration (NARA), College Park, MD, RG 79: Records of the National Park Service, Records of the Washington Office of the Wildlife Division, 1934-1936, Box 7, Folder: Reindeer/Caribou Alaska. For more on the loss of these reindeer to migratory caribou, see Max Miller, *The Great Trek: The Story of the Five-Year Drive of a Reindeer Herd Through the Icy Wastes of Alaska and Northwestern Canada* (New York: Doubleday, Doran, and Company, 1935), 149.

<sup>33</sup> Department of Mines, *Canada’s Reindeer*, 3.

E.W. Nelson, the chief of the US Bureau of Biological Survey, believed that range conditions could be “better managed with science,” and worked to maximize herd populations through the scientific management of lichens and reindeer grazing.<sup>34</sup> Yet, despite their intentions – and the development of an intensive experimental program – the managers of the Alaskan reindeer industry did not succeed in increasing reindeer populations to the carrying capacity that scientists calculated for the Alaskan reindeer ranges. Writing at the end of the 1950s, geographer Joseph Sonnenfeld noted the disparity between the population of the Barrow herds and the scientifically-derived carrying capacity of the Barrow region; although the reindeer population peaked at 30,000 in the mid-1930s, Sonnenfeld noted, scientists believed the Barrow range could support approximately 67,000 reindeer.<sup>35</sup> Indeed, based on a series of scientific investigations into lichen productivity and reindeer grazing – an experimental research program initiated by the US Bureau of Biological Survey – Lawrence Palmer concluded in 1926 that Alaska could support approximately three million reindeer if the herds were properly managed and handled.<sup>36</sup> Despite the Bureau’s belief in the productive capacity of scientific range management, Alaska’s reindeer herds would never reach the levels calculated by Palmer. In fact, by the end of the 1930s, the reindeer industry entered a period that witnessed the depletion of herd populations throughout the territory.

Nonetheless, the industry’s spatial expansion and the related increase in reindeer populations between 1892 and the mid-1930s caused significant socio-ecological issues for officials in the Reindeer Service and Alaskan wildlife managers. By the mid-1920s, Lawrence

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<sup>34</sup> Stuhl, *Unfreezing*, 63.

<sup>35</sup> Sonnenfeld, “Arctic Reindeer Industry,” 84.

<sup>36</sup> Lawrence Palmer, *Progress of Reindeer Grazing Investigations in Alaska* (Washington: US Department of Agriculture, 1926), 30-31. For a more detailed discussion of Palmer’s experimental research program and the application of the carrying capacity concept in the reindeer industry, see Stuhl, *Unfreezing*, 61-87.

Palmer noted that despite being far below his suggested carrying capacity for the territory, individual reindeer herds had the potential to overgraze and deplete local sources of lichen, a slow-growing plant that formed a critical part of the reindeer diet.<sup>37</sup> The depletion of lichen not only raised issues of range management for herders and officials in the reindeer industry, but also posed serious concerns for Alaskan game managers. “Depletion of the ranges will doubtless result in deterioration and starvation of the animals on a large scale,” H.W. Terhune, Executive Officer of the Alaska Game Commission, and W.B. Bell, Chief of the Bureau of Biological Survey’s Research Division, explained in a 1935 memo to the Director of the National Park Service. “[W]hat is more serious from the game standpoint,” Terhune and Bell cautioned, was the possibility that lichen depletion in critical forage areas would trigger “a migration of the reindeer eastward to important ranges of the native wild caribou.”<sup>38</sup> According to reports from those within the industry, by the mid-1930s, overgrazing had already forced herders to move their animals beyond their ranges in search of food. As the population of the reindeer herds scattered along Alaska’s coasts approached 200,000 animals, A.D. Johnson noted in his history of the Arctic reindeer herds, local sources of lichen were being depleted, and herders were increasingly moving their animals inland to secure feed during the summer months.<sup>39</sup>

For Alaskan wildlife managers, the invasion of caribou range by herds of reindeer represented a serious threat to the preservation of Alaska’s migratory caribou. Indeed, many of Alaska’s game managers agreed with biologist Adolph Murie, who, in 1935, cautioned against allowing reindeer to move beyond their ranges on the coast into the interior of Alaska; the

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<sup>37</sup> Palmer, *Reindeer Grazing Investigations in Alaska*, 30-31; Stuhl, *Unfreezing*, 72.

<sup>38</sup> H.W. Terhune and W.B. Bell to George Wright, 19 April 1935, National Archives and Records Administration (NARA), College Park, MD, RG 79: Records of the National Park Service, Records of the Washington Office of the Wildlife Division, 1934-1936, Box 7, Folder: Reindeer/Caribou Alaska.

<sup>39</sup> Johnson, “Brief History,” NARA-A, RG 75: Alaska Reindeer Services, Box 33, 1942.

resulting intensification in range utilization, he argued in a letter to the Chief of the National Park Service, would lead inevitably to the extirpation of caribou populations throughout the territory.<sup>40</sup> Writing shortly after mid-century, Aldo Starker Leopold – the son of American ecologist Aldo Leopold – and Fraser Darling articulated the threat reindeer overgrazing posed to caribou populations in an ecological treatise on Alaskan wildlife. The status of the caribou, they argued, “seems to be intimately associated with the presence of undisturbed climax vegetation of which the lichens are a prominent part.”<sup>41</sup> In the northwestern coastal region of Alaska, the authors claimed, the “great herds of reindeer” had overgrazed the “climax lichen” by the beginning of the 1920s.<sup>42</sup> The impact of overgrazing on Alaska’s migratory caribou, they argued, was evident in the spatial distribution of these two animals, and the fact that caribou herds had not returned to most of the ranges vacated by reindeer during the industry’s contraction in the 1940s (see figure 2.1).<sup>43</sup> Caribou, the authors reminded readers, had once occupied the entirety of the Territory outside of the Alaskan panhandle.

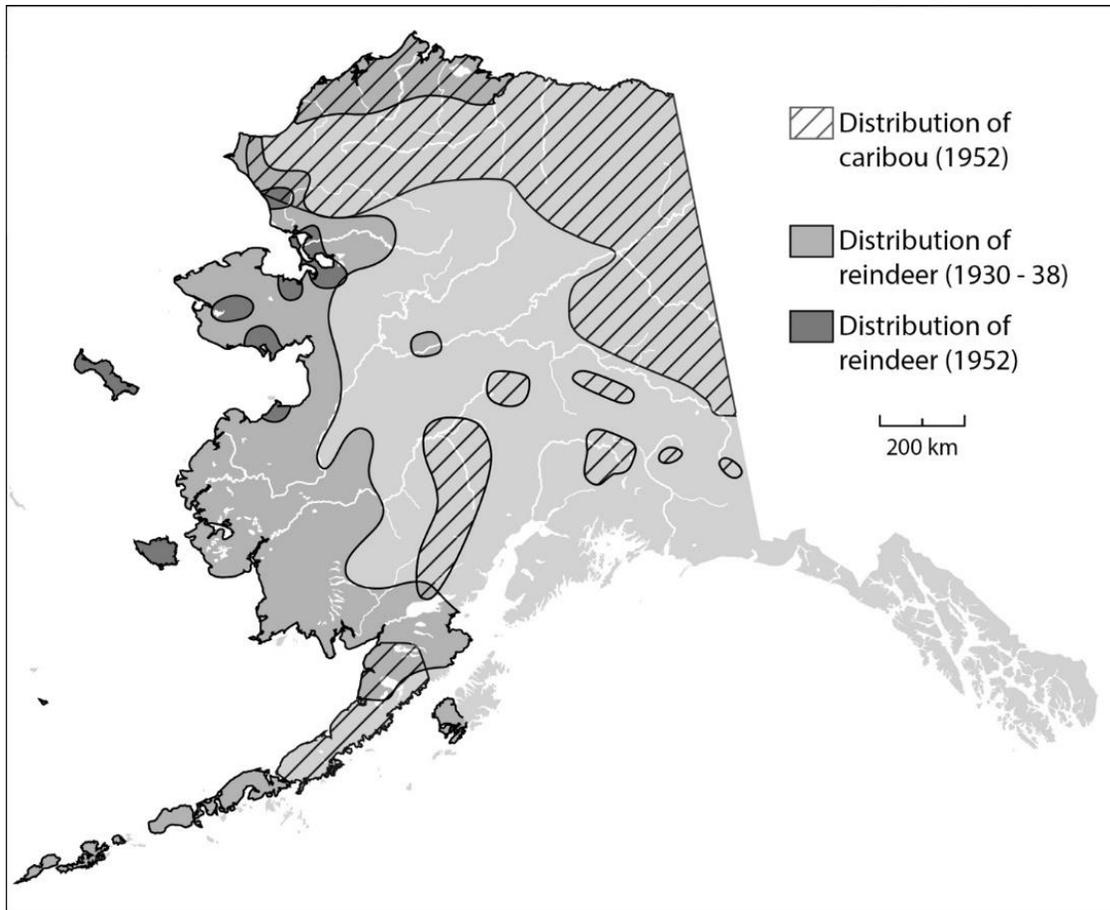
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<sup>40</sup> Adolph Murie to George Wright, 16 April 1935, National Archives and Records Administration (NARA), College Park, MD, RG 79: Records of the National Park Service, Records of the Washington Office of the Wildlife Division, 1934-1936, Box 7, Folder: Reindeer/Caribou Alaska.

<sup>41</sup> A. Starker Leopold and Fraser Darling, *Wildlife in Alaska: An Ecological Reconnaissance* (Westport, CT: Greenwood Press, 1953), 54.

<sup>42</sup> Leopold and Starker, *Wildlife in Alaska*, 54.

<sup>43</sup> The authors represented this cartographically in two maps. See Leopold and Starker, *Wildlife in Alaska*, 49; 72.



**Figure 2.1: A comparison of reindeer and caribou ranges in the mid-twentieth century. Based on two maps included in A.S. Leopold and F. Darling, *Wildlife in Alaska: An Ecological Reconnaissance* (1951). Map by Eric Leinberger**

The invasion of the caribou range by reindeer did not stem solely from the spatial expansion of the industry and the associated increase in reindeer populations. Rather, two structural changes initiated by those in control of the industry created the socio-environmental conditions that drove the increasing interaction between, and hybridization of, reindeer and caribou in the early part of the twentieth century. The first shift involved the reorganization of reindeer ownership between the late 1910s and the early 1920s. Corresponding with the original designs of the industry, through the early 1900s, officials in the Department of the Interior

pushed to ensure that reindeer were a resource primarily for the benefit of Alaskan Natives.<sup>44</sup>

These efforts, it would seem, shaped the makeup of reindeer ownership. During the first decade of the twentieth century, Inuit herders became the largest group of reindeer owners in the territory, replacing the Sami herders who had previously owned a majority of the herds.<sup>45</sup> Further, in 1939, a Senate Subcommittee on Indian Affairs reported that Inuit ownership of reindeer had increased from 41 to 64 percent between 1909 and 1914.<sup>46</sup> As Alaskan anthropologist Margaret Lantis explained in a 1950 paper, during this early period in the history of the Alaskan reindeer industry, white ownership of reindeer herds was limited by legislation prohibiting the sale of female reindeer to non-Natives.<sup>47</sup>

By the end of the decade, however, the situation was changing. After an outbreak of Spanish influenza in 1918 took the lives of many of the Inuit herders working in the growing industry, a significant percentage of the reindeer from Native-owned herds escaped their ranges and began mixing with other animals as they wandered throughout western Alaska.<sup>48</sup> This prompted two related responses by the state and local capitalists. First, in response to the loss of experienced herders, the state sought to impose a corporate structure on the reindeer industry. In the years following the influenza epidemic, W.T. Lopp, who was at that time the Chief of the Alaska Division of the Bureau of Education, urged Native herders to consolidate their reindeer into “company” herds, which, he believed, would lead to the development of more effective herding methods and better range management.<sup>49</sup> Under this system, Native herders became

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<sup>44</sup> Willis, “A New Game,” 291. For primary documentation, see Frank Churchill, *Reports on the Condition of Education and School Service and the Management of Reindeer Service in the District of Alaska*, 59th Cong., First Session, Senate Executive Document No. 483 (Washington D.C., 1906).

<sup>45</sup> Willis, “A New Game,” 291.

<sup>46</sup> Figures reported in Margaret Lantis, “The Reindeer Industry in Alaska,” *Arctic* 3, 1 (1950): 30.

<sup>47</sup> Lantis, “The Reindeer Industry in Alaska,” 32.

<sup>48</sup> Willis, “A New Game,” 295. See also Stuhl, *Unfreezing*, 62-63.

<sup>49</sup> Richard Stern, Edward Arobio, Larry Naylor, and Wayne Thomas, *Eskimos, Reindeer, and Land* (Fairbanks: Agriculture and Forestry Experiment State, 1980), 23-24.

shareholders in joint stock company herds, and their profits were derived from their investment of reindeer and their labour.<sup>50</sup> Second, as historians Andrew Stuhl and Roxanne Willis have argued, local capitalists viewed the changing social context of reindeer ownership and management as a business opportunity. The Lomen family, which was based in Nome, rushed to acquire ownership of reindeer in the years following the influenza epidemic. Despite regulations limiting the terms of white ownership, by the mid-1920s, the family had purchased more than 14,000 reindeer, making the Lomen Company the “largest private owner of livestock in Alaska.”<sup>51</sup>

The second shift involved efforts by state actors to transform herding methods through the application of modern science.<sup>52</sup> For more than three decades, Inuit herders had followed the Sami practice of close herding, which meant that they stayed with their reindeer during the entirety of the year as the herds moved throughout their range in search of forage. Although close herding was not without its problems, this method was a relatively effective preventative measure against threats to reindeer herds, particularly predation by wolves, and the loss of reindeer to migratory caribou.<sup>53</sup> In the mid-1920s, however, L.J. Palmer, whose scientific investigations were central to the Bureau of Biological Survey’s attempts to modernize the industry, proposed a system of rotational grazing, which was based on the Department of Agriculture’s science of range management in the American west.<sup>54</sup> In addition to dividing Alaska into grazing units, and investing a considerable amount of capital in the development of

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<sup>50</sup> Willis, “A New Game,” 295; Stern et al., *Eskimos, Reindeer, and Land*, 23-26; Dean Olson, *Alaska Reindeer Herdsmen: A Study of Native Management in Transition*, (Fairbanks: Institute of Social, Economic, and Government Research: University of Alaska, 1969), 57-60.

<sup>51</sup> Quote from Stuhl, *Unfreezing*, 63. For more on the Lomen brothers and their acquisition of reindeer, see Willis, “A New Game,” 295.

<sup>52</sup> Stuhl, *Unfreezing*, 73; Stern et al., *Eskimo, Reindeer, and Land*, 25.

<sup>53</sup> Mager, “I’d be Foolish,” 166-168; Lantis, “Reindeer Industry,” 30; Stuhl, *Unfreezing*, 73-74.

<sup>54</sup> Stuhl, *Unfreezing*, 72-74.

new herding infrastructure, proponents of the Bureau's modernization scheme also advocated for the industry to adopt a system of "open" or loose herding, which contrasted starkly with the method being employed by most Native herders.<sup>55</sup> Unlike close herding, which necessitated a relationship based on the spatial proximity between herders and reindeer, the establishment of a policy of open herding meant that reindeer were left free to graze and find their own forage during most of the year.<sup>56</sup> Inevitably, the industry's adoption of open herding resulted in the mixing of different reindeer herds on the range, which created considerable confusion and social conflict between Native and non-Native herd owners.

By the mid-1930s, officials in the Reindeer Service had begun to express concerns about the socio-environmental implications of the shift from close to open herding. In a 1937 report commissioned by the Indian Rights Association, W.T. Lopp, a fierce critic of the new system, argued that the introduction of open herding had not only contributed to the demoralization of Native herders, but had also constituted a serious threat to their livelihood and the industry more generally. The big cattle ranch idea that had been "foisted" upon the Alaskan reindeer industry by commercial interests, he wrote, had proven to be a "miserable and threatening failure."<sup>57</sup> In the absence of Native herders, Lopp claimed, reindeer were escaping their ranges, and the herds, "like the melting snow in the spring," were disappearing at an alarming rate.<sup>58</sup> If the herding issue was not resolved quickly, he wrote, "there will be no future reindeer question to be solved."<sup>59</sup>

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<sup>55</sup> Stern et al., *Eskimo, Reindeer, and Land*, 25; Stuhl, *Unfreezing*, 73.

<sup>56</sup> Stuhl, *Unfreezing*, 73; Lantis, "The Reindeer Industry," 32

<sup>57</sup> Report quoted in "Reindeer Report," *Indian Truth* 14, 2 (1937): 1.

<sup>58</sup> Lopp was here quoting an Inuit herder that he interviewed while conducting his investigation. See "Reindeer Report," *Indian Truth* 14, 2 (1937): 1.

<sup>59</sup> Quoted in "Reindeer Report," *Indian Truth* 14, 2 (1937): 1.

In the years following the shift to open herding, historical records suggest that there was an increase in the loss of reindeer to migratory caribou herds. Indeed, since the establishment of the first herds in the 1890s, herders and government officials had wrestled with the risk posed by reindeer-caribou interactions.<sup>60</sup> As W.M. Hemsing, a Unit Manager in the Alaskan Reindeer Service, explained in the mid-1930s, the general opinion in western Alaska was that “reindeer do tend to drift away with the caribou” during encounters on the open range. But through the 1930s and much of the 1940s, officials focused not on interactions with caribou herds, but rather argued that wolf predation was the primary cause of reindeer loss.<sup>61</sup>

It was not only the loss of livestock that concerned officials in the Reindeer Service. Lopp, for example, was particularly concerned about the social implications of open herding. In his 1937 report on the reindeer industry, he argued that the organizational transformations that had occurred in the reindeer industry had stymied the social progress of Alaskan Natives. Whereas close herding necessitated constant engagement with the reindeer, and had encouraged the transformation of Inuit into a “pastoral people”, open herding, he argued, “is turning them back towards the old caribou roundups and drives of their forefathers, when thousands of caribou were driven into lakes and crude corrals for slaughter – back to the feast and famine days.”<sup>62</sup> In

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<sup>60</sup> Karen Mager, a biologist who has conducted historical and ethnographic research in the Barrow region, argues that while officials did not see this problem until the 1930s and 1940s, caribou posed a threat to reindeer herders on the North Slope from the very beginnings of the industry in that region. See Mager, “I’d be Foolish,” 166-168. For primary documentation of this issue, see NARA-A (Seattle, WA), RG 75: Alaska Reindeer Services, Decimal Series, Box 1 and Box 3.

<sup>61</sup> Robert Rausch, “Notes on the Nunamiut Eskimo and Mammals of the Anaktuvuk Pass Region, Brooks Range, Alaska,” *Arctic* 4, 3 (1951): 190.

<sup>62</sup> As reported in “Herders Should Stay Close to Reindeer Herds,” *Seward Gateway*, 12 December 1936. Indeed, the issue of the industry’s failure to promote racial progress was one of many concerns that Lopp and his colleagues would express about the transformations occurring in the industry. Indeed, many believed that the commercialism that had been introduced into the industry during the late 1920s and early 1930s violated the original intent of the industry, which was to benefit Alaskan Native communities. Further, there were also widespread concerns about Native reports that the Lomen Company was stealing Native owned reindeer during annual roundups. For more on these and other concerns, see Willis, “A New Game in the North,” 298. See also “We Are Proud of Our Eskimos and Our Service,” *The Eskimo* 3, 1 (1936): 1.

response to this and other problems in the reindeer industry, Anthony Dimond, the Alaska Territory Delegate in the US House of Representatives, introduced legislation that aimed at preserving the “native character” of the reindeer industry.<sup>63</sup> More specifically, the legislation authorized the Secretary of the Interior to purchase all non-Native owned reindeer, reindeer-range equipment, and other property associated with reindeer herding “for and on behalf of the Eskimos and other natives of Alaska.”<sup>64</sup> Passed on 1 September 1937, the Reindeer Act effectively restricted domestic reindeer ownership in Alaska to Natives only, and eventually led to the government’s purchase of the Lomen Company’s assets.<sup>65</sup>

Yet, the passage of the Reindeer Act, which many in the industry viewed as a “complete victory” for Alaska Natives, did not resolve the herding question, nor did it address the related problem of livestock loss.<sup>66</sup> Prior to the bill’s passage, Lopp expressed doubts about the state’s ability to legislate the changes necessary to solve the herding problem. Although most of the “deermen” interviewed for his report favoured the government plan to purchase non-Native reindeer, they were concerned that the legislation “would neither simplify the herding question nor prevent or postpone the crisis which now threatens the entire industry.”<sup>67</sup> Indeed, their fears seem to have been well founded. Despite the passage of the Act, reindeer continued to escape their ranges, and herd populations declined steadily following their peak in the mid-1930s, leading government officials and industry observers to apply pressure on Native herders to resolve lingering issues in range management. In a 1938 editorial in the overtly paternalistic

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<sup>63</sup> Bill H.R. 9959, 74th Congress 2nd Session. Introduced in the House of Representatives 8 January 1936. Excerpt from proposed Legislation quoted in *The Eskimo* 3, 1 (1936): 1.

<sup>64</sup> Bill H.R. 9959, 74th Congress 2nd Session. Introduced in the House of Representatives 8 January 1936. Excerpt from proposed Legislation quoted in *The Eskimo* 3, 1 (1936): 1-2.

<sup>65</sup> Willis, “A New Game,” 300.

<sup>66</sup> Quote from Willis, “A New Game,” 300.

<sup>67</sup> Lopp would continue to argue that education was necessary to remedy to these issues. During this period, he would propose the establishment of an outdoor vocational herding school, in which Native herders would receive extensive training in “deermanship”. For more, see: “Reindeer Report,” *Indian Truth* 14, 2 (1937): 2.

magazine *The Eskimo*, Clarence Andrews, a former employee of the Reindeer Service and the publisher of the magazine, reproached the “Eskimo People” for failing to take proper care of their livestock. After reminding Alaskan Natives that the industry had been established for their benefit, Andrews wrote: “You have let yourselves fall down, and your herds have all gone nearly wild, nearly ‘GONE CARIBOU.’” In such a wild state, he argued, reindeer herds “will not be of any more use to you than the caribou were, if you do not keep them tame – DOMESTICATED.”<sup>68</sup>

Despite increasing pressure being placed on Native herders, the ongoing contraction of the reindeer industry would not be halted by government interventions. In the years following the government’s purchase of non-Native owned herds, the territory’s reindeer population collapsed completely. After reaching a peak of almost one million reindeer, by 1940 there were an estimated 250,000 reindeer in the territory. The downward trend continued through the decade, and at mid-century there were only 25,000 reindeer left in small herds scattered throughout Alaska.<sup>69</sup> On the Artic Slope, fewer than 5,000 reindeer remained after 1940.<sup>70</sup> The government herds established in Canada followed a similar trajectory. After experiencing modest growth in the years following the Canadian Government’s purchase of Alaskan reindeer, the Canadian herds began to decline during the late 1940s, and the Inuit-controlled operations in the Mackenzie Valley region had all collapsed by 1959.<sup>71</sup> In that year, the government transferred control of the remaining reindeer herds to private developers, thus marking another step in the dissolution of the state’s reindeer experiment in the western Arctic.<sup>72</sup>

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<sup>68</sup> C.L. Andrews, “To the Eskimo People,” *The Eskimo* 4, 4 (1938): 1.

<sup>69</sup> Willis, “A New Game in the North,” 301; Olson, *Reindeer Herdsmen*, 14-15.

<sup>70</sup> Stuhl, *Unfreezing*, 62; Sonenfeld, “An Arctic Reindeer Industry,” 84.

<sup>71</sup> Department of Mines and Resources, *Canada’s Reindeer*, 4.

<sup>72</sup> Stuhl, *Unfreezing*, 63.

At mid-century, scientists linked the collapse of reindeer populations in the western Arctic to a complex suite of socio-environmental determinants. In addition to the herding problems discussed above, scientists and others involved in the reindeer industry suggested that a combination of disease and parasites within reindeer herds, predation by wolves, the loss of reindeer to caribou, excessive butchering by handlers, and starvation on the range had led to the collapse of Alaska's reindeer populations and the demise of the industry.<sup>73</sup> In a 1948 survey of Alaskan reindeer operations, however, biologist C.H. Rouse noted a strong discrepancy among Native and non-Native perspectives on the causes of the collapse. While Natives emphasized the loss of reindeer to migratory caribou herds, non-Native reindeer operators believed that predation by wolves was the primary cause of population decline.<sup>74</sup>

During the reindeer industry's collapse, the ongoing interaction between reindeer and caribou raised different sets of concerns for officials in the reindeer service and wildlife managers. By the end of the 1940s, government officials and industry leaders had acknowledged the role that migratory caribou played in the collapse of reindeer populations throughout Alaska.<sup>75</sup> For many years, Native herders had argued that migratory caribou posed considerable risks to their reindeer herds. In southwestern Alaska, where Yupik herders referred to this period as the "great die out", many believed that reindeer simply did not want to be herded any longer and ran off with migratory caribou herds.<sup>76</sup> But it would be several years before non-Native

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<sup>73</sup> Lantis, "The Reindeer Industry in Alaska," 36.

<sup>74</sup> Lantis, "The Reindeer Industry in Alaska," 36; Mager, "'I'd Be Foolish," 169. The survey report can be found in NARA-A (Seattle, WA), RG 75: Alaska Reindeer Services, Box 33, Historical Files, 1929-1948, File: Reports – Special, Reindeer Survey.

<sup>75</sup> NARA-A (Seattle, WA), RG 75: Alaska Reindeer Services, Decimal Series, Box 1, File 011.1 (1942 -1962): Publications, Reindeer Predators.

<sup>76</sup> Willis, "A New Game in the North," 300; Mager, "'I'd Be Foolish," 162-181.

reindeer-herd operators and officials began to acknowledge caribou as a legitimate threat to reindeer herds.<sup>77</sup>

### 2.3. Crossing Boundaries: Feral Reindeer and Hybrid Caribou

In the early to mid-twentieth century, the problem of feral reindeer threatened to disrupt emergent forms of state-based caribou management in the western Arctic. During this period, wildlife managers in northern Canada and Alaska increasingly employed scientific methods and modes of representation as they sought to demarcate conceptual boundaries around the natural world. The historical development of scientific caribou management, then, not only involved the state's ostensible objective of protecting and conserving caribou populations, but also emerged around the efforts of wildlife managers to categorize the natural world by fixing the identity of nonhuman animals.<sup>78</sup> Feral reindeer and hybrid caribou provoked managerial anxiety precisely because they were boundary transgressing animals that challenged the legitimacy of the categories the state employed in and through managerial regimes.

The rapid decline of the reindeer industry, however, did not serve to ease managerial anxieties about the reindeer industry's impact on migratory caribou herds in the western Arctic. In addition to the threat of overgrazing, Alaskan game officials and wildlife scientists worried that reindeer-caribou hybridization would degrade the health and virility of Alaska's stock of wild caribou.<sup>79</sup> As reindeer continued to escape from their ranges, game officials in Alaska and

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<sup>77</sup> NARA-A (Seattle, WA), RG 75: Alaska Reindeer Services, Box 33, Historical Files, 1929-1948, File: Reports – Special, Reindeer Survey; Mager, “I’d be Foolish,” 169.

<sup>78</sup> Though wildlife management in northern Canada and Alaska shared many commonalities, there were distinct temporal differences between the development of caribou management in these two national contexts. These historical developments are examined in more depth in the next chapter. Further, as historian John Sandlos argues, by the mid-1940s, the Canadian state increasingly used the management of wildlife to intervene in the lives of Native peoples in the Northwest Territories. See Sandlos, *Hunters at the Margin*, 18. For more on the way in which conservation officials have sought to “fix” the identity of nonhumans, see: Lulka, “Stabilizing the Herd,” 439-463.

<sup>79</sup> NARA (College Park), RG 79, Box 7, Folder: Reindeer/Caribou Alaska. For more on the issue of reindeer-caribou hybridization, see: Robert Scott, Edward Chatelain, and Winston Elkins, “The Status of Dall Sheep and Caribou in Alaska,” *Transactions of the Fifteenth North American Wildlife Conference* 15 (1950): 612-626; Karen Mager, “I’d Be Foolish to Tell You They Were Caribou’: Local Knowledge of Historical Interactions between Reindeer and

northern Canada became increasingly concerned about the purity of the region's stock of migratory caribou. Indeed, it was this unintended consequence of the state's attempt to tame the tundra that led wildlife managers and game officials to shore up in material and conceptual terms the boundary between wild and domesticated animals.

Further, feral reindeer presented Alaskan game managers and officials in the Reindeer Service with complex jurisdictional issues that stemmed from the differing legal and property statuses of reindeer and caribou. Unlike their wild cousins, domesticated reindeer were considered to be private property, and, therefore, "capable of being owned, transferred and inherited in accordance with property laws."<sup>80</sup> As Lyman Brewster, General Supervisor of the US Reindeer Service, explained in 1933, reindeer owned by Natives were "restricted property" and, thus, were "subject to regulation through the Department of the Interior."<sup>81</sup> Once a reindeer escaped from its herd, however, its legal status as private property would be called into question. And the issue only become more complex when feral reindeer mixed with herds of wild caribou. After learning that "thousands" of domesticated reindeer in southeastern Alaska had gone "wild" and joined with migratory caribou herds, J. Sidney Rood, the former Superintendent of the Alaska Reindeer Service, would reflect on the shifting property status of escaped reindeer. Once the reindeer had "crossed" with caribou, noted Rood, they were not only "written off" as domestic stock, but also "considered entirely as wildlife under control of the Game

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Caribou in Barrow, Alaska," *Arctic Anthropology* 49, 2 (2012): 162-181; Karen Mager, Kevin Colson, and Kris Hundertmark, "High Genetic Connectivity and Introgression from Domestic Reindeer Characterize Northern Alaska Caribou Herds," *Conservation Genetics* 14 (2013): 1111-1123.

<sup>80</sup> Quote taken from a draft letter written by Brewster in response to an article published in the April 1933 issue of *The Producer*, in which the author argued that the reindeer industry represented an unfair source of competition for American cattle producers. See: NARA-A (Seattle, WA), RG 75: Alaska Reindeer Services, Decimal Series, Box 1, Folder 010 (1933-1935): Lyman Brewster, "Reindeer in Alaska," N.D.

<sup>81</sup> NARA-A (Seattle, WA), RG 75: Alaska Reindeer Services, Decimal Series, Box 1, Folder 010 (1933-1935): Lyman Brewster, "Reindeer in Alaska," N.D.

Commission.”<sup>82</sup> As reindeer escaped from their ranges and joined with migratory caribou herds, they not only crossed multiple socionatural boundaries (wild/domesticated, for example), but also transformed profoundly the network of social and legal relations through which they were owned, regulated, and managed.

For caribou managers, the problems raised by reindeer-caribou hybridization were in many ways rooted in unresolved questions about the identity of caribou. Since the mid-eighteenth century, taxonomy had played a critical role in scientific attempts to differentiate North America’s caribou from the reindeer herds of northern Europe and Asia. Between Linnaeus’ 1758 description of reindeer and the mid-twentieth century, naturalists and taxonomists described 55 species and subspecies of reindeer.<sup>83</sup> In 1898, English naturalist Richard Lydekker attempted to impose a semblance of order on the increasingly unruly systems of classification that had proliferated since the mid-eighteenth century, arguing that “reindeer from all parts of the northern hemisphere present such a marked similarity in general appearance that it seems preferable to regard them as all belonging to a single wide-spread species.” Within the species, he acknowledged six geographically distinct “races” of reindeer and caribou.<sup>84</sup> While the Barren-Ground Race extended from the “barren districts lying to the northward of the forest zone in Arctic America...to the confines of the polar sea,” the Scandinavian reindeer, he wrote, “inhabits a large part of Norway, Sweden, and Lapland, and extends into Russia.”<sup>85</sup> Despite the clear geographical boundaries between these two groups of animals, the intersection of their evolutionary paths in the late nineteenth-century, which was made possible when Alaskan

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<sup>82</sup> As reported in “Private Herds Give Reindeer Comeback Way,” *Juneau Empire*, 6 April 1945.

<sup>83</sup> A.W.F. Banfield, *A Revision of the Reindeer and Caribou, Genus Rangifer* (Ottawa: Department of Northern Affairs and Natural Resources, 1961), 6-7.

<sup>84</sup> Lydekker, *The Deer*, 37.

<sup>85</sup> Lydekker, *The Deer*, 39; 48.

missionaries arranged for reindeer to cross the Bering Strait, complicated scientific attempts to stabilize the taxonomic boundaries around, and fix the identity of, North America's reindeer and caribou.

As scientific investigations intensified through the first half of the twentieth century, scientists argued that divergent evolutionary and social histories had resulted in the development of distinct biological, morphological, and behavioural traits that favoured caribou over reindeer.<sup>86</sup> In a 1934 publication, Lawrence Palmer outlined some of the commonly accepted morphological dissimilarities between these two groups of animals, noting that there is “some difference...in conformation and general coloration between reindeer of Siberian descent and the caribou of Alaska and Canada.” Further, the caribou's ears, he wrote, are a “trifle longer,” and it is more “ungainly in appearance” than the Siberian reindeer. In his discussion of the most prominent differences in facial characteristics, Palmer drew on the racially charged – and pseudoscientific – terminology associated with early twentieth-century discourses of racial morphology: the caribou's nose, he wrote “is inclined to the Roman type, and the underlip is short and drawn up; whereas the reindeer is frequently dish-faced, and the underlip not so trim.”<sup>87</sup> Ultimately, however, scientists focused on the virility and supposed biological superiority of the male caribou when discussing the difference between these two groups of animals: whereas caribou bucks were stronger, larger, and natural leaders, their domesticated counterparts were described by scientists as being weak, prone to disease, and, in general, more

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<sup>86</sup> For more on the development of scientific understandings of the differences between reindeer and caribou, see Burch, *Caribou Herds*, 17-36; Mager, et al., “High Genetic Connectivity,” 1111-1123.

<sup>87</sup> Palmer, *Raising Reindeer in Alaska*, 7. These remarks, which represent Palmer's descriptions of general characteristics and dissimilarities, do not encompass the entire range of scientific descriptions of reindeer and caribou in Alaska. Though scientists acknowledged a variety of morphological types, they did tend to focus on the way in which evolution had led to the development of biologically superior traits in wild caribou. For more, see Palmer's 1926 discussion of “breeds and types of reindeer,” in *Progress of Reindeer Grazing*, 5-6.

“phlegmatic” in their behavior.<sup>88</sup> Reindeer-caribou hybridization, Alaskan game managers feared, was creating a breed of animal that was not only biologically inferior to wild caribou, but also one that was “less hardy” and, therefore, less capable of surviving the long Arctic winter.<sup>89</sup>

With reports of feral reindeer and hybrid caribou proliferating, wildlife managers grew increasingly concerned about the transmission of “degenerate” reindeer traits to western Arctic caribou herds during the first half of the twentieth century.<sup>90</sup> Indeed, by the late 1940s, wildlife managers in Alaska believed that hybridization had already altered the physical traits of caribou in some geographically isolated herds. In a letter to his Canadian counterparts, Robert Scott, a senior wildlife biologist with the US Fish and Wildlife Service in Alaska, explained the impact that he believed hybridization was having on Alaskan caribou. “The outstanding example of this mixing seems to have occurred on the Alaska Peninsula – a geographically isolated habitat occupied by the Grant Caribou,” wrote Scott. Although naturalists and biologists had long considered the Alaska Peninsula caribou to be “somewhat smaller” than those found in other regions, Scott argued, “the remnant form now found on the peninsula is best described as scrawny.”<sup>91</sup> Alaskan wildlife managers, he noted, attributed the physical deterioration of the region’s caribou to the “heavy infusion of reindeer stock” that occurred in the early to mid-twentieth century.<sup>92</sup> Following the establishment of the reindeer industry in the region, Scott

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<sup>88</sup> Palmer, *Raising Reindeer in Alaska*, 36; Burch, *Caribou Herds*, 17, Olaus J. Murie, “Alaska-Yukon Caribou,” 8. Although wildlife managers were concerned about the transmission of these “degenerate” traits to caribou, officials in the Reindeer Service were amenable to the inverse, and in 1920, initiated an experimental program to “upbreed” caribou traits into reindeer herds. The crossbreeding experiment, however, was ultimately a failure. For more on these efforts, see Palmer, *Raising Reindeer in Alaska*, 37; Stuhl, *Unfreezing*, 63-82.

<sup>89</sup> These concerns were expressed by A.S. Leopold following a US Fish and Wildlife Service presentation on the status of Alaska’s caribou at the Fifteenth North American Wildlife Conference. For more on this matter, and for Scott’s response, which is recorded in the conference proceedings, see Scott et al., “The status of the Dall Sheep and Caribou in Alaska,” 625-626.

<sup>90</sup> Dixon to Wright, NARA (College Park), RG 79, Box 7, Folder Reindeer/Caribou Alaska.

<sup>91</sup> Robert Scott to Harrison Lewis, 14 December 1950, LAC, RG 109, Vol 395, WL.U. 228, Part 6.

<sup>92</sup> Scott to Lewis, 14 December 1950, RG 109, Vol 395, WL.U. 228, Part 6.

wrote, caribou and reindeer ranges overlapped at the base of the Alaska Peninsula. Undoubtedly, he stated, hybridization occurred as reindeer escaped their herders and joined migratory caribou herds. The problem was exacerbated at the beginning of the Second World War, when herders released thousands of reindeer into the wild. On the Alaska Peninsula, Scott argued, the condition of the local caribou herds deteriorated as they absorbed the domesticated reindeer that once inhabited this geographically isolated region.<sup>93</sup>

Beyond the geographically isolated herds on the Alaska Peninsula, however, there was considerable scientific uncertainty regarding the biological impact of hybridization on caribou herds in the western Arctic. But reports from game officials, trappers, and Indigenous hunters on both sides of the border made it clear that the potential for hybridization was not bound by spatial parameters. In a 1952 report for Canada's Northern Administration and Lands Branch, Knud Lang, a trapper with more than two decades of experience in the western Arctic, claimed that reindeer carrying diseases like tuberculosis and "footrot" were scattered among caribou herds in the transboundary western Arctic. "Indians," he wrote, "told me about killing spotted caribou the likes of which was never known before." The spotted caribou, which he believed to be reindeer that escaped during the Dominion Government's reindeer drive from Alaska in the early 1930s, had wandered as far south as the Peel River, a critical winter habitat for caribou in the region.<sup>94</sup> In a presentation at the North American Wildlife Conference in 1950, Robert Scott of the US Fish and Wildlife Service, elaborated on the ability of feral reindeer to cover great distances. In the 1940s, he noted, a game warden shot a reindeer that was traveling with a

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<sup>93</sup> In addition to his correspondence with Canadian wildlife managers, Scott used this case as an example to describe the physical impact of reindeer-caribou hybridization at international wildlife conferences. See Scott et al., "The Status of the Dall Sheep and Caribou in Alaska," 619.

<sup>94</sup> Knud Lang, "Comments on the Caribou Herds – West of the Mackenzie Delta, based on conversations with old Eskimo and Loucheaux and personal observations during a period of twenty-four years," March 1952, LAC, RG 109, Vol. 401, WL.U. 228-6, Part 2 (1960-1959).

migratory caribou herd in the Forty-mile area near the Alaska-Yukon border. The reindeer, the warden noticed, was carrying an ear tag from the Bethel Mission, which was located at the mouth of the Kuskokwim River in western Alaska. “This animal,” Scott explained to his audience, “traveled across the entire Territory from west to east.”<sup>95</sup>

For wildlife managers on both sides of the border, the potential for reindeer-caribou hybridization represented a very serious threat to the ostensible purity of the region’s migratory caribou herds. In 1922, Alfred Bailey and Russell Hende of the Colorado Natural History Museum conducted a scientific expedition to Alaska to collect biological specimens from the Arctic Coast. Given that “[l]arge numbers of reindeer are constantly escaping their herders and joining with the wild caribou,” the two mammalogists wrote, “[i]t seems that it will be but a short time until there will be no pure bred caribou along that part of the coast.”<sup>96</sup> Writing in the mid-1920s, Bailey and Hende were among the earliest and most influential scientists to mobilize the discourse of purity to describe the impact that hybridization was having on migratory caribou in the region. In the years following the publication of their report, scientists would increasingly take up their terms, and repeat their claims about the biological purity of the caribou herds on Alaska’s Arctic Coast. In an important study of the Alaska-Yukon caribou herds published in 1935, for example, Olaus Murie, who was among the first university-trained biologists to work for the Bureau of Biological Survey in Alaska and the brother of biologist Adolph Murie, argued, “[t]he caribou’s greatest menace is not the wolf, nor the hunter, but man’s economic developments, principally the raising of reindeer.”<sup>97</sup> Citing Bailey and Hende, Murie suggested that hybridization had likely already occurred on the Arctic slope, where large

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<sup>95</sup> Scott et al., “The Status of Dall Sheep and Caribou in Alaska,” 617-619.

<sup>96</sup> Alfred Bailey and Russell Hende, “Notes on the Mammals of Northwestern Alaska,” *Journal of Mammalogy* 7, 1 (1926): 22.

<sup>97</sup> Murie, “Alaska-Yukon Caribou,” 7.

numbers of reindeer were believed to “intermingle” with caribou. “Since reindeer have been straying along the Arctic coast for years, and the caribou have been comparatively scarce in the same districts for a considerable time,” Murie wrote, “perhaps hybridization has already taken place to a large extent.”<sup>98</sup>

In 1935, Joseph Dixon, a wildlife biologist with the Department of the Interior, outlined his concerns about reindeer-caribou hybridization in a letter to the Director of the Wildlife Division. In 1926, he noted, while working as a field agent in Mt. McKinley National Park, he had discovered several “feral reindeer” mixing with a migratory caribou herd within the boundaries of the park. Like others in the Wildlife Division, Dixon viewed the hybridization of reindeer and caribou as a dangerous violation of the critical boundary between *domesticated* and *wild* animals, and he believed that federal officials in the Department of the Interior had a responsibility to prevent such forms of boundary crossing. “Wherever caribou and reindeer come together during the breeding season,” he warned officials in the Department of the Interior, “hybrids result.” And the reindeer, he argued, “is merely a domesticated and degenerated caribou from across the Pacific Ocean.” To emphasize the danger that “non-native” reindeer posed to wild caribou herds, Dixon drew a direct comparison with the “Eskimos of northern Alaska,” whose populations had been decimated by the “white man’s many children’s diseases.”<sup>99</sup> Domesticated reindeer, he argued, could similarly introduce new diseases to wild caribou herds, and therefore, “[e]very effort should be made to protect and preserve a pure native strain of caribou in Alaska.”<sup>100</sup>

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<sup>98</sup> Murie, “Alaska-Yukon Caribou,” 79.

<sup>99</sup> Dixon to Wright, NARA (College Park), RG 79, Box 7, Folder Reindeer/Caribou Alaska.

<sup>100</sup> Quotes from: Dixon to Wright, NARA (College Park), RG 79, Box 7, Folder Reindeer/Caribou Alaska.

Yet, when it came to measuring and assessing the extent to which hybridization had occurred in the western Arctic caribou herds, by the mid-1930s, wildlife managers had little empirical or scientific evidence on which they could draw. Spurred by concerns about the increasing occurrence of feral reindeer within the boundaries of Mount McKinley National Park, in 1935, J.N. Darling, Chief of the Bureau of Biological Survey, began an informal investigation into the problem of reindeer-caribou hybridization in the Alaskan caribou herds. Through correspondence with officials in the National Park Service, the Alaska Game Commission, and from within the ranks of the Bureau of Biological Survey, Darling not only attempted to ascertain the severity and extent of reindeer-caribou hybridity, but also worked to gain an understanding of measures being taken by the responsible agencies to protect the purity of Alaska's migratory caribou herds.<sup>101</sup> Through this correspondence, Darling learned that despite ongoing discussion of the problem, and potential solutions, no formal policy had been established by the mid-1930s. There was, however, some appetite among officials in the Alaska Game Commission for their federal counterparts in the Department of the Interior to establish a formal policy directed towards mitigating the reindeer-caribou problem.<sup>102</sup> In the meantime, Darling issued instructions to officials in the National Park Service to "kill any reindeer or hybrids" located within the boundaries of Mount McKinley National Park.<sup>103</sup>

As wildlife managers sought ways to protect the *wildness* of Alaskan caribou, they emphasized the demarcation of spatial boundaries that should not be transgressed by feral

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<sup>101</sup> National Archives and Records Administration (NARA), College Park, MD, RG 79: Records of the National Park Service, Records of the Washington Office of the Wildlife Division, 1934-1936, Box 7, Folder: Reindeer/Caribou Alaska.

<sup>102</sup> Terhune and Bell to J.N. Darling, 9 April 1935, NARA, RG 79: Records of the National Park Service, Records of the Washington Office of the Wildlife Division, 1934-1936, Box 7, Folder: Reindeer/Caribou Alaska.

<sup>103</sup> Harry Liek (Superintendent Mount McKinley National Park) to Darling, 7 May 1935, NARA, RG 79: Records of the National Park Service, Records of the Washington Office of the Wildlife Division, 1934-1936, Box 7, Folder: Reindeer/Caribou Alaska.

reindeer. In many respects, this involved the division of Alaska into reindeer and caribou territories. As Olaus Murie stated in his 1935 study of the Alaska-Yukon caribou, both reindeer and caribou “are of incalculable value to Alaska, and neither should be sacrificed in any misguided attempt to combine them.”<sup>104</sup> That same year, H.W. Terhune and W.B Bell, Executive Officer of the Alaska Game Commission and the Chief of the Bureau of Biological Survey’s Research Division, articulated a similar perspective in their response to J.N. Darling’s request for information regarding the reindeer-caribou problem. “The Biological Survey and the Alaska Game Commission,” the two senior bureaucrats stated, “take the position that the important ranges of the native caribou must be protected against invasion by reindeer in order to preserve the wild stock unmodified by cross-breeding with reindeer.”<sup>105</sup> In outlining their recommendations, the pair argued that officials in the reindeer industry should keep herd populations down to the carrying capacity of the range to prevent reindeer from moving eastward into caribou territory, and interbreeding with the “native caribou stock.” Terhune and Bell enclosed a map in their correspondence with Darling, which, they noted, documented the “important caribou ranges that should be fully protected from reindeer invasion.” On the map, they indicated the “dead-line beyond which the reindeer should not be permitted to migrate.” Any invasion of caribou range, they stated firmly, “should be controlled either by shooting or otherwise disposing of the reindeer.”<sup>106</sup>

For wildlife managers, northeastern Alaska represented critical caribou range that should be protected from feral reindeer. In 1913, Dixon had spent several months on the north slope

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<sup>104</sup> Murie, “Alaska-Yukon Caribou,” 7.

<sup>105</sup> Terhune and Bell to J.N. Darling, 9 April 1935, NARA, RG 79: Records of the National Park Service, Records of the Washington Office of the Wildlife Division, 1934-1936, Box 7, Folder: Reindeer/Caribou Alaska.

<sup>106</sup> The map, which was enclosed in the original correspondence, was not located in the archive. Quotes from: Terhune and Bell to J.N. Darling, 9 April 1935, NARA, RG 79: Records of the National Park Service, Records of the Washington Office of the Wildlife Division, 1934-1936, Box 7, Folder: Reindeer/Caribou Alaska.

near the Alaska-Yukon border as a member of a Harvard scientific expedition, and during that time he came to understand the biological importance of the tundra, or the “arctic treeless plain”, between Point Barrow in Alaska and Herschel Island in the Yukon. This area, he noted, was “the summer range and fawning ground of thousands of native caribou.”<sup>107</sup> In recent years, however, reports led Dixon to believe that the situation had changed dramatically. “I understand that the reindeer herds have pushed northward and eastward around Point Barrow so that it seems only a question of time until the entire coastal tundra plain of Alaska from the mouth of the Yukon to the mouth of the Mackenzie will come under the trampling hoofs of the expanding reindeer herds.”<sup>108</sup> As scientists identified increasing numbers of reindeer-caribou hybrids at sites across Alaska, conservation officials and wildlife managers began to consider measures to prevent the proliferation of this new form of animal, including the killing of any hybrids or reindeer located within critical wilderness areas, including northeastern Alaska. Again, Adolph Murie spoke for many of his counterparts when he stated: “To save our native caribou, the first thing to be considered is distribution, for obviously the caribou and the reindeer which interbreed so readily cannot exist on the same range without eliminating the caribou.”<sup>109</sup>

While Adolph Murie agreed with the establishment of firm boundaries between reindeer and caribou ranges, he suggested some of the challenges associated with the spatial division of the Territory based on contemporary scientific understandings of the migratory habits of Alaskan caribou. “To prevent the mixing of reindeer with caribou, the range of the caribou, taking into

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<sup>107</sup> Joseph Dixon (Director, Wildlife Division) to George Wright (National Park Service, US Department of the Interior), 22 April 1935, National Archives and Records Administration (NARA), College Park, MD, RG 79: Records of the National Park Service, Records of the Washington Office of the Wildlife Division, 1934-1936, Box 7, Folder: Reindeer/Caribou Alaska; Dixon, “Birds Observed,” 49-51. See also Joseph Dixon, “Birds Observed Between Point Barrow and Herschel Island on the Arctic Coast of Alaska,” *The Condor*, 45 (March 1943): 49-57.

<sup>108</sup> Dixon to Wright, NARA (College Park), RG 79, Box 7, Folder Reindeer/Caribou Alaska.

<sup>109</sup> Adolph Murie to George Wright, 16 April 1935, NARA (College Park, MD), RG 79: Records of the National Park Service, Records of the Washington Office of the Wildlife Division, 1934-1936, Box 7, Folder: Reindeer/Caribou Alaska.

account the vast fluctuations in migration routes,” argued Murie, “should be mapped and declared caribou country.” “Within these boundaries” he argued, “no reindeer herds should be permitted.” Noting that conditions on the caribou range were never static, Murie argued that these boundaries should be expected to shift over time, and would require close observation by a team of field biologists.<sup>110</sup> In 1938, Adolph’s brother, Olaus, further explained the spatial dynamics of the territorial division being conceptualized by himself and other scientists and wildlife managers in Alaska. The reindeer industry, he noted, should be confined to the Bering Sea coast. But the establishment of a spatial division, he argued was not necessarily a matter of establishing a hard boundary, or constructing a fence to separate reindeer from caribou herds. Rather, “[i]t is simply a matter of designating an area where the reindeer should be normally kept,” and providing sufficient “neutral zone” between the reindeer and caribou herds to minimize the intermingling of the two groups of animals.<sup>111</sup> Though acknowledged as ever-shifting and somewhat illusory, for Alaskan wildlife managers, the establishment of spatial division between reindeer and caribou ranges constituted an important step in the maintenance of the boundary around wilderness in the western Arctic.

Further, Alaskan wildlife managers stressed that the issue of hybridization could not be managed at the national scale alone. In addition to Mount McKinley National Park, where officers had been instructed to shoot suspected hybrids, the Alaskan interior and the eastern section of the Arctic coast emerged as key sites in managerial efforts to protect the *wildness* of the western Arctic caribou herds. “As a game resource these interior Alaska herds should be kept

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<sup>110</sup> Adolph Murie to J.N. Darling, 16 April 1935, NARA, RG 79: Records of the National Park Service, Records of the Washington Office of the Wildlife Division, 1934-1936, Box 7, Folder: Reindeer/Caribou Alaska.

<sup>111</sup> Murie’s description of the spatial boundary between reindeer and caribou territory is taken from a letter the biologist wrote to the Secretary of the Boone and Crockett Club, who had inquired about the enforcement of the division. See Murie to Dean Sage, 12 January 1938, Denver Public Library: Western History Collection, Olaus Murie Papers (1917-1973), Box 1, FF23: Caribou Correspondence.

pure,” argued Olaus Murie in his 1935 report, “and as the principal herds now remaining are international in range, passing back and forth with the seasons between Yukon Territory and Alaska, concerted action by Canada and the United States would seem necessary for the proper administration of this resource.”<sup>112</sup> Indeed, during the period of the reindeer industry’s decline, wildlife managers on both sides of the border would continue to discuss the issue of reindeer-caribou hybridization.

Yet, as Alaska’s reindeer population continued to decline during the 1940s, Canadian and American wildlife managers took few concrete steps toward addressing the reindeer-caribou hybridization problem, outside of instructing game managers to kill feral reindeer and suspected hybrids. Further, as late as 1949, Frank Banfield, a senior bureaucrat with the Canadian Wildlife Service (at that time the Dominion Wildlife Service), argued that the “intermingling” of reindeer and caribou that had been so prevalent in Alaska had not occurred to a considerable degree among Canadian herds.<sup>113</sup> However, as I demonstrate in the next chapter, Banfield’s position on the issue was challenged after he undertook a scientific investigation of the unresolved problem of caribou taxonomy. Rather, as the reindeer industry underwent structural changes intended to address herding issues, and the number of livestock in the Territory continued to decrease, wildlife management agencies seemed content to let officials in the Reindeer Service deal with the problem of feral reindeer. However, during the 1940s, the steady decline in reindeer populations was related directly to the ongoing problem of escaped reindeer. As the industry continued to contract, and herds continued to disappear into the wilderness, the sustained

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<sup>112</sup> Murie, “Alaska-Yukon Caribou,” 7.

<sup>113</sup> Banfield made this comment during the discussion following his presentation at the Fourteenth North American Wildlife Conference. See A.W.F. Banfield, “The Present Status of North American Caribou,” *Transactions of the Fourteenth North American Wildlife Conference* 14 (1949): 489.

“intermingling” of wild caribou and domesticated reindeer would continue to trouble the inchoate boundaries established by Alaskan wildlife managers.

#### **2.4. Conclusion: The Problem of Purity**

By 1950, the Alaskan reindeer industry had almost completely disappeared, save for a small number of herds scattered throughout the Territory. Since the mid-1930s, Thomas Paniattaq Brower had been one of the few remaining Native herders on Alaska’s North Slope. Indeed, Thomas Brower had inherited the reindeer from his father, Charles, shortly after the trader had financed the establishment of the first herd at Barrow in the late 1890s. In the early 1920s, Thomas had taken over the fledgling family business, and by the end of the decade had become one of the most successful herders on the North Slope. Although Brower worked to protect his reindeer from encounters with other humans, in the early 1950s, he learned that one of the most significant threats facing Alaskan reindeer herders was the proximity of migratory caribou. Reflecting on the loss of his herd during an interview in the early 1980s, Brower insisted that the trouble began in 1944.<sup>114</sup> His herd’s range, he explained, was surrounded by the US Naval Petroleum Reserve No. 4. Established in 1923 by President Warren Harding, the 95,000-square kilometer reserve sat between the Brooks Range and the Arctic coast on Alaska’s North Slope. Though designated a petroleum reserve in 1923, industrial activity did not truly begin until 1944 when the Department of the Navy initiated a ten-year exploratory period to determine the extent of oil deposits on the North Slope.<sup>115</sup> As a result, the potential for human-animal

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<sup>114</sup> Details regarding the loss of Thomas Brower’s reindeer herd are taken from an oral history project conducted by the North Slope Borough. See: University of Alaska Fairbanks Oral History Program: Project Jukebox, “Thomas Brower, Sr. Paniattaq,” interviewed by Wendy Arundale and Bill Schneider, 1982, Accessed online at [www.jukebox.uaf.edu/northslope/Chipp/html2/tobr.html](http://www.jukebox.uaf.edu/northslope/Chipp/html2/tobr.html) on 30 June 2015.

<sup>115</sup> John Reed, *Exploration of Naval Petroleum Reserve No. 4 and Adjacent Areas Northern Alaska, 1944-53, Part I, History of the Exploration: Geological Survey Professional Paper 301* (Washington, DC: US Department of the Interior, 1958).

encounters in the region increased dramatically.<sup>116</sup> Brower was particularly concerned about the risk posed by encounters with people working for the Navy. In an effort to mitigate the threat of such encounters, Brower made arrangements with the Navy to ensure that workers would not unwittingly disturb his herd. This agreement was effective for almost seven years.

During the summer of 1951, however, Brower was forced to spend several weeks away from his reindeer, and during his absence from the North Slope, the Navy conducted a series of seismic tests near his herd's summer range. According to the Brower, a "bunch of college kids" employed by the Navy attempted to photograph the reindeer from his herd. But photographing these skittish animals proved to be a difficult task. In the interview, Brower stated that the would-be photographers used one of the Navy's tracked vehicles to get close to the herd, which, understandably spooked the reindeer, and caused them to stampede toward the open range. Despite the response of the reindeer, their harassers did not relent. They chased the frightened animals over rough terrain, and pursued them all the way to the Chipp River, which formed the southern boundary of the herd's summer range. As the reindeer approached the river, however, they encountered a group of migrating caribou. Frightened and in a confused state, all 2,500 of the reindeer in Thomas Brower's herd fell in behind the leaders of the caribou, crossed the Chipp River, and ran off with their wild, migratory cousins.

The herd's crossing of the Chipp River not only hastened the demise of the reindeer industry on the North Slope, but also unleashed a series of cascading ecological and historical consequences for human-animal relationships in the western Arctic. For wildlife managers in

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<sup>116</sup> There has been sustained public and scientific debate about the impact of oil and gas exploration on the wildlife of the western Arctic. I examine the historical geography of these debates in more depth in chapter 4. For a discussion of the ongoing debate around industrial activity and conservation in the region being discussed here, see Stephen Murphy, "Oil and Gas Development, the National Petroleum Reserve-Alaska, and Our Wildlife Heritage," in *Peak Oil, Economic Growth, and Wildlife Conservation*, eds. J.E. Gates, D. Trauger, and Brian Czech (Springer: New York, 2014): 157-169.

Alaska and Canada, the loss of Brower's herd intensified concerns about the purity of the caribou herds that migrated throughout the region, and crossed the international boundary. By crossing the Chipp River, and "intermingling" with a herd of migratory caribou, Thomas Brower's reindeer both demonstrated the violability of the conceptual boundaries through which scientists and wildlife managers were attempting to order the nonhuman world, and troubled the inchoate categories they increasingly employed in emergent managerial regimes.

Questions of purity, however, would remain unresolved through much of the twentieth century. Indeed, it would not be until the scientific development of a method of analyzing mitochondrial DNA to define genetic populations that scientists would be able to quantify – though with questionable levels of accuracy – the biological extent and impact of reindeer-caribou hybridization in Alaska. Yet, even as scientists developed increasingly refined modes of scientific representation and measurement, questions remained about the extent to which reindeer genes had been introduced into caribou populations.<sup>117</sup> Questions of accuracy and measurement, however, are somewhat extraneous to my discussion of the scientific and managerial employment of the concept of purity. Rather, in this chapter, I have been concerned with the way in which wildlife managers increasingly equated the wildness of migratory caribou with their biological purity, and, relatedly, the spatio-temporal dynamics that shaped managerial responses to the conceptual and material threats posed by the proliferation of reindeer-caribou hybridization.

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<sup>117</sup> See Mager et al.'s response to Røed and Whitten (1986) and Cronin et al.'s claims that reindeer genes are not widespread among North Slope caribou. Mager et al., "High Genetic Connectivity," 1111-1123.

## Chapter 3: Science, Boundary-Making, and the Creation of the Modern Caribou

### 3.1. Introduction

On 26 March 1949, an interview with Frank Banfield, Chief Mammalogist with the Dominion Wildlife Service (DWS), aired on CBC Radio.<sup>1</sup> In the interview, Banfield discussed the preliminary results of the service's first major scientific study of the caribou herds of northern Canada. Since January 1948, he had been at the helm of the research programme, which saw biologists and wildlife managers employ technologies of aerial surveillance to locate and count migratory caribou populations across the vast expanse of the Canadian north.<sup>2</sup> As Canada's caribou herds had "never before been scientifically investigated on a large scale," he stated, the DWS had to begin its investigation "pretty well from scratch."<sup>3</sup> The host of the program, however, was skeptical about the Service's "sudden interest" in caribou. With so many issues facing the federal government in the Canadian north, he asserted, "it seems... there are more important aspects than herds of wild animals."<sup>4</sup> Banfield countered by reminding the host that caribou remained a vital element of the northern economy, further arguing that if the herds disappeared, the government would "be faced with the almost impossible task of keeping [northerners] supplied with food and clothing."<sup>5</sup> To avoid such a scenario, Banfield explained, federal wildlife managers aimed to prevent the depletion of caribou populations through the development of a system of scientific management.<sup>6</sup> From a managerial perspective, caribou

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<sup>1</sup> The Dominion Wildlife Service was the precursor to the Canadian Wildlife Service (CWS). Prior to broadcast, the Chief of the Dominion Wildlife Service reviewed the manuscript of the interview. He made editorial suggestions and recommended that the CBC cut one section of the interview in which Banfield joked about gender roles in caribou "families", stating that the "lady caribou" are the bosses of the herds. For complete manuscript, see: A.J. Baxter to R.A. Gibson, 25 March 1949, Library Archives Canada (LAC) RG 109, Vol. 394, WL.U. 228, Part 3.

<sup>2</sup> Sandlos, *Hunters at the Margin*, 196-203.

<sup>3</sup> Baxter to Gibson, 25 March 1949, LAC, RG 109, Vol. 394, WL.U. 228, Part 3.

<sup>4</sup> Baxter to Gibson, 25 March 1949, RG 109, Vol. 394, WL.U. 228, Part 3.

<sup>5</sup> Baxter to Gibson, 25 March 1949, RG 109, Vol. 394, WL.U. 228, Part 3.

<sup>6</sup> Baxter to Gibson, 25 March 1949, RG 109, Vol. 394, WL.U. 228, Part 3.

conservation and scientific research were inextricably linked with social order and economic development in the Canadian north.

Caribou, however, proved to be uncooperative scientific subjects. During the first year of the project, Banfield and his colleagues began to comprehend some of the challenges they would face as they attempted to resolve lingering questions about migratory caribou. Not only did the agency's scientists have to deal with a significant gap in their knowledge about this group of ungulates, but also their scientific methods and surveillance technologies would be stretched to the limit by the movement of barren-ground caribou as they followed unpredictable migratory routes throughout their expansive northern ranges. The temporal and geographical dynamics of caribou migration forced federal wildlife managers to work across political boundaries, and necessitated collaborations with provincial and territorial colleagues in northern Canada and counterparts in Alaska. But despite the obvious difficulties, after only one year of research, Banfield was confident that Canadian scientists were "gradually clearing up the mystery surrounding this great northern game animal."<sup>7</sup> Through scientific research, he suggested, wildlife managers were rendering the once enigmatic caribou visible, legible, and, therefore, manageable.

In this chapter, I examine the way in which Canadian and American wildlife managers employed new scientific research methods and modes of representation as they sought to refine the boundaries around two key categories in the inchoate field of caribou biology: the species and herd concepts. The mid-twentieth century was an important period in the stabilization of scientific understandings of these concepts, which emerged as central units in the development of

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<sup>7</sup> Baxter to Gibson, 25 March 1949, RG 109, Vol. 394, WL.U. 228, Part 3.

population-based models of caribou management.<sup>8</sup> By acknowledging the way in which the species and herd concepts emerged over time, and were the products of particular historical and social contexts, I am not attempting to reduce them to mere social constructions. Rather, following anthropologist John Hartigan, I ask how scientific “modes of recognition and encounter” were mediated by historical and geographical relationships, and guided by institutional and social practices.<sup>9</sup> In the postwar period, caribou biologists and federal wildlife managers relied increasingly on technologies and methods of research that expanded their visual range over northern environments and increased their capacity to discern and catalog life forms.<sup>10</sup>

Yet, the stabilization of core managerial categories was not the result of technological developments alone. The demarcation and maintenance of a crucial boundary between legitimate and rejected forms of knowledge production about caribou was central to the stabilization of managerial categories.<sup>11</sup> During the early twentieth century – and increasingly in the postwar period – caribou biologists and wildlife managers prioritized scientific knowledge production over other ways of knowing caribou. The scientific method, they suggested, represented a

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<sup>8</sup> Herd-based management remains an important model for caribou management in the Canadian north, despite the way in which caribou from multiple herds intermingle at different points during their migrations. For a discussion of methods of herd-based management, see Anne Kendrick and Micheline Manseau, “Representing Traditional Knowledge: Resource Management and Inuit Knowledge of Barren-Ground Caribou,” *Society and Natural Resources* 21, 5 (2008): 404-418.

<sup>9</sup> Hartigan is speaking specifically about species, but his argument is helpful for my discussion of the caribou herd concept. John Hartigan, “Species,” in *The Multispecies Salon: A Companion to the Book*, ed. Eben Kirksey, accessed on 20 November 2016 at <http://www.multispecies-salon.org/species>.

<sup>10</sup> Hartigan, “Species.” For more on ways of seeing and the production of scientific knowledge, see Stephen Bocking, “Ecological Concepts: Seeing, Placing, Imposing,” *Geoforum* 65 (2015): 490-491. For a discussion of the debate surrounding the use of aerial surveillance to survey caribou in Canada, see Sandlos, *Hunters at the Margin*, 196-205.

<sup>11</sup> The notion of a “crucial boundary” between forms of knowledge production comes from Steven Shapin and Simon Schaffer, *Leviathan and the Air-Pump: Hobbes, Boyle and the Experimental Life* (Princeton: Princeton University Press, 1989), 80.

“solution to the problem of order.”<sup>12</sup> As caribou biologists and wildlife managers sought to impose order on the migratory caribou of the western Arctic, they were also working to order the way in which people understood and related to caribou. Following Shapin and Schaffer, who argue that problems of knowledge production and social order are, in essence, one in the same, I argue that managerial efforts to address what was described as disorder in the scientific description and classification of caribou herds represented state-based attempts to exert control over and order social relations in the western Arctic.<sup>13</sup>

In this area of the circumpolar north, it was necessary for scientists and federal wildlife managers to work across the International Boundary as they attempted to describe, classify, and count migratory caribou herds. In addition to the development of scientific research methods, the establishment of a transnational network of caribou science was essential to the stabilization of core managerial categories in the postwar period.<sup>14</sup> For wildlife managers in Canada and the United States, institutional linkages within this transnational network were essential to overcoming the problem of distance, which had long-troubled scientific investigations of the Alaska-Yukon caribou herds. Specimens circulated through this network and accumulated at key nodes or sites that Bruno Latour calls “centres of calculation.”<sup>15</sup> However, as Latour argues, mobilization by itself merely threatens to drown the scientist in a “flood of inscriptions and

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<sup>12</sup> Again, Shapin and Schaffer offer guidance and insight into scientific methods and the “problem of order.” See Chapter 3, “Seeing Double: Hobbes’s Politics of Plenism before 1660,” in *Leviathan*.

<sup>13</sup> See Shapin and Schaffer, *Leviathan*, xlix.

<sup>14</sup> As Bruno Latour argues, the word network “indicates that resources are concentrated in a few places – the knots and nodes – which are connected with one another – the links and the mesh: these connections transform the scattered resources into a net that may seem to extend everywhere.” Bruno Latour, *Science in Action*, 179.

<sup>15</sup> Latour, *Science in Action*, 215-257. Historians and geographers whose interpretation of Latour’s “centres of calculation” have influenced my analysis in this section include: Trevor Barnes, “Geographical Intelligence: American Geographers and Research and Analysis in the Office of Strategic Services 1941-1945,” *Journal of Historical Geography* 32 (2006): 149-168; Matthew Evenden, “Locating Science, Locating Salmon: Institutions, Linkages, and Spatial Practices in Early British Columbia Fisheries Science,” *Environment and Planning D: Society and Space* 22 (2004): 355-372. See also Heike Jöns, “Centres of Calculation,” in *The SAGE Handbook of Geographical Knowledge*, eds., John Agnew and David Livingstone (London: SAGE Publications, 2011), 158-170.

specimens.”<sup>16</sup> Centres of calculation dominate people and places at a distance not only by mobilizing natural specimens, but also by “stabilizing their qualities, and transforming them into combinable forms.”<sup>17</sup> As field agents and caribou biologists collected inscriptions and specimens from across the western Arctic, they translated this scientific evidence into cartographic representations of migratory routes, estimates of caribou herd populations, and tables containing detailed measurements of caribou bodies.<sup>18</sup> Through this process, federal wildlife managers worked across the Alaska-Yukon border and aimed to refine the taxonomic and biological boundaries around caribou populations in the western Arctic.<sup>19</sup>

By focusing on cross-border linkages within this network, I aim to address a critical gap in the historical literature on the development of state-based wildlife management in the North American Arctic. Despite the development of a body of literature that considers the transboundary and international dynamics of wildlife conservation, the historiography of caribou conservation has developed unevenly along national lines.<sup>20</sup> Though indicative of the institutional structure of state-based wildlife management in Canada and the United States, this literature obscures the extent to which scientists and conservation officials worked across

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<sup>16</sup> Latour, *Science in Action*, 232-233.

<sup>17</sup> Evenden, “Locating Salmon,” 355.

<sup>18</sup> For more on the process of translation, see: Latour, *Science in Action*: 234.

<sup>19</sup> Arun Agrawal argues that the establishment of managerial categories was foundational to the development of modern natural resource management. In nineteenth-century India, the colonial government increasingly used categories, numbers, and statistics to transform the socio-economic role of forests to serve the interests of colonial rule. See Agrawal, *Environmentality*, 36-37.

<sup>20</sup> Sandlos, *Hunters at the Margin*; Kulchyski and Tester, *Kiumajut (Talking Back)*; Loo, *States of Nature*; Peter Usher, “Caribou Crisis or Administrative Crisis? Wildlife and Aboriginal Policies on the Barren Grounds of Canada, 1947-1960,” in *Cultivating Arctic Landscapes: Knowing and Managing Animals in the Circumpolar North*, eds. David Anderson and Mark Nuttall (New York: Berghahn Books, 2004), 172-199; Bocking, “Science and Spaces,” 867-894. For American literature, see Ernest “Tiger” Burch’s unfinished manuscript, *The Caribou Herds of Northwest Alaska, 1850-2000*. For a broader discussion of game laws and science in Alaska, see: Sherwood, *Big Game in Alaska*; D.J. Lindsay, *Science in the Subarctic: Traders, Trappers, and the Smithsonian Institution* (Washington, D.C.: Smithsonian Institution, 1989). For historical and geographical work on international and transboundary wildlife management and conservation see: Dorsey, *The Dawn of Conservation Diplomacy*; Cioc, *The Game of Conservation*; Wadewitz, *The Nature of Borders*; Wilson, “Mobile Bodies,” 465-472.

international political borders as they sought answers to fundamental questions about migratory caribou. Indeed, as environmental historian Andrew Stuhl argues, it is imperative that historians and other scholars conceive of northern history in transnational and scientific perspectives if they wish to escape the limits of national historiographies and aim to connect northern regions to broader historical developments.<sup>21</sup>

Between the late nineteenth and mid-twentieth century, North American wildlife managers transformed the theory and practice of their profession by adopting new scientific modes of representation, and developing more robust institutional structures for wildlife research and northern game management.<sup>22</sup> For caribou managers, the emergence of “big science” in the postwar period played an important role in ongoing efforts to stabilize the taxonomic and biological boundaries around different groups of migratory caribou.<sup>23</sup> In many ways, postwar developments in scientific wildlife management reflected a broader shift in the philosophy and institutional context of North American science. Trevor Barnes and Matthew Farish argue that during the Second World War and through the early years of the Cold War, a “new conception of science, bound up with mid-twentieth century geopolitical upheaval and pervasive militarism, changed the intellectual trajectories of a number of natural and social sciences in the United States.”<sup>24</sup> Similarly, the scientific methods employed by wildlife managers in the CWS and the USFWS underwent rapid and substantive changes as the “traditional notion of science” was replaced by a new model, which Barnes and Farish describe as theoretically abstract, model- and

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<sup>21</sup> Stuhl, *Unfreezing the Arctic*, 12-13.

<sup>22</sup> For a discussion of the professionalization of the field through the employment of university-trained scientists by Canadian wildlife management agencies, see J. Alexander Burnett, *A Passion for Wildlife: The History of the Canadian Wildlife Service* (Vancouver: UBC Press, 2003); Loo, *States of Nature*. For a discussion of the professional transformation of northern wildlife management in Alaska, see Sherwood, *Big Game in Alaska*.

<sup>23</sup> For more on the emergence of “big science” and its impact on the natural and social sciences, see Trevor Barnes and Matthew Farish, “Between Regions: Science, Militarism, and American Geography from World War to Cold War,” *Annals of the Association of American Geographers* 96, 4 (2006): 807.

<sup>24</sup> Barnes and Farish, “Between Region,” 807.

machine-based, mathematical, capital-intensive, and typically involving large teams of researchers.<sup>25</sup> Changes in the funding, organization, and production of science, which were driven by military's increasing role in research, accompanied the coupling of scientific knowledge production and matters of national interest.<sup>26</sup>

The expansion of scientific wildlife management, however, proceeded unevenly across the North American Arctic during the mid-twentieth century. While Banfield extolled the work of Dominion Wildlife Service mammalogists in the eastern Arctic, federal wildlife managers in Canada and the US expressed concerns about their lack of knowledge regarding the migratory caribou herds found west of the Mackenzie River. This was particularly true for the northern herds that crossed the Alaska-Yukon border during their annual migration. In the postwar period, federal wildlife management agencies responded to this scientific uncertainty through the intensification of scientific investigations in this transboundary region. As their work was connected to state-based efforts to inventory the natural resources of northern territories, scientific research conducted during this period was driven primarily by the objective of “discovering” universal laws that would enable the stabilization of core managerial categories and, correspondingly, the quantification of caribou populations.<sup>27</sup> By the mid-1960s, caribou biologists and wildlife managers had refined the taxonomic and biological boundaries around

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<sup>25</sup> Barnes and Farish, “Between Regions,” 807.

<sup>26</sup> Barnes and Farish, “Between Regions,” 808; Rebecca Lave, Philip Mirowski, and Samuel Randalls, “Introduction: STS and Neoliberal Science,” *Social Studies of Science* 40, 5 (2010): 659-675; Chandra Mukerji, *A Fragile Power: Scientists and the State* (Princeton: Princeton University Press, 1989): 39-61. For more on technoscience and its WWII/Cold War roots, see Andy Pickering, “Cyborg History and the World War II Regime,” *Perspectives in Science* 3, 1 (1995): 1-49; Donna Haraway, *Modest-Witness@ Second-Millennium. FemaleMan-Meets-OncoMouse: Feminism and Technoscience* (London: Routledge, 1997), 49-118. For a discussion of this process in Canada and its impact on wildlife management in the Canadian North, see: Bocking, “A Disciplined Geography,” 265-290.

<sup>27</sup> For more on the “universality of Nature” and the search for universal laws, see Tsing, *Friction*, 88-120. Dean Bavington provides insight into this process in the context of the North Atlantic cod fisheries. See Dean Bavington, *Managed Annihilation: An Unnatural History of the Newfoundland Cod Collapse* (Vancouver: UBC Press, 2011), 108-111.

these categories, classifying the Alaska-Yukon caribou as a single subspecies – *Rangifer tarandus granti*. Within this subspecies, they recognized eleven discrete caribou herds, one of which they designated the “Porcupine” herd.<sup>28</sup> In what follows, I outline the historical and geographical processes underpinning the stabilization of the boundaries around these important managerial categories.

### 3.2. The Problem of Caribou Taxonomy

Systems of taxonomic classification often reveal as much about those seeking to impose order on the natural world as they do about the species they describe.<sup>29</sup> The early naturalists who explored the North American Arctic understood the importance of order. As they moved through northern landscapes, natural history became an organizing logic through which they sought to bring order to unfamiliar socio-natural systems.<sup>30</sup> Yet, classification was not simply an act of description. Postcolonial scholars have demonstrated that natural history – and its naming imperative – not only provided the means for narrating inland travel and exploration, but was also a crucial part of colonial processes of “territorial surveillance, appropriation of resources, and administrative control.”<sup>31</sup> Further, as Arun Agrawal argues, the legitimization of new systems of classification involved an erasure of earlier ideas about and referents for the natural world.<sup>32</sup> During the late eighteenth and early nineteenth centuries, naturalists, spurred by the colonial

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<sup>28</sup> For a discussion of taxonomic classification in the 1960s, see Ronald Skoog, “Ecology of the Caribou (*Rangifer tarandus granti*) in Alaska,” (Ph.D. Thesis: University of California, Berkeley, 1968), 5-12. On the designation of eleven distinct caribou herds, see Ronald Skoog, et al., “W-6-R-4: Caribou Investigations, Work Plan C,” *Federal Aid in Wildlife Restoration*, Vol. IV (1963): 3.

<sup>29</sup> Harriet Ritvo, *The Platypus and the Mermaid and Other Figments of the Classifying Imagination* (Cambridge, MA: Harvard University Press, 1997), xii.

<sup>30</sup> Mary Louise Pratt, *Imperial Eyes: Travel Writing and Transculturation* (New York: Routledge, 1992), 33.

<sup>31</sup> Pratt, *Imperial Eyes*, 39.

<sup>32</sup> Agrawal’s argument, which is located within the colonial forests of the Indian subcontinent, provides insight into the way in which colonial science operated to marginalize Indigenous knowledge in other contexts. See Agrawal, *Environmentality*, 1-31; 34.

imperative to take stock of the *natural* resources of the north, began the process of describing and classifying the caribou of the western Arctic.<sup>33</sup> Order went hand in hand with control.<sup>34</sup>

During the nineteenth century, however, two conditions impeded the collection of scientific evidence and the development of scientific knowledge about the Alaska-Yukon caribou herds.<sup>35</sup> First, early caribou investigations typically involved small teams of researchers that spent long periods in the field searching for migratory caribou, recording local knowledge about the animals, and, when possible, collecting and preserving specimens for southern museums. Unlike their postwar successors, while they were in the field, these teams of researchers worked in relative isolation from the scientific and managerial institutions that funded their research. Second, with unpredictable migratory routes that spanned the International Boundary and traversed extremely rugged terrain, the migratory caribou of the western Arctic consistently frustrated the efforts of natural historians and the first state-based conservation officials.

Despite an increasing interest in the collection and classification of caribou specimens, natural historians and early caribou scientists were unable to overcome the problem of distance posed by the movement of migratory caribou. Andrew Jackson Stone, who spent 26 months tracking caribou in the region for the American Museum of Natural History at the turn of the century, described the difficulties he experienced in his report to the museum: “The country occupied by [the caribou] is so large, the distances are so great, and the means of travel are so

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<sup>33</sup> For an example of the former, see: Alexander Hunter Murray, *Journal of the Yukon, 1847-1848*, ed., L.J. Burpee (Ottawa: Government Printing Bureau, 1910), 80.

<sup>34</sup> See Mary Louise Pratt’s discussion of science and “planetary consciousness”. Pratt, *Imperial Eyes*, 15-36. See also, Daniel Clayton, *Islands of Truth: The Imperial Fashioning of Vancouver Island* (Vancouver: UBC Press, 2000), 12-14.

<sup>35</sup> For early examples of specimen collection, see: A.J. Stone, *The Andrew J. Stone Explorations in arctic and Subarctic America* (New York: The American Museum of Natural History, 1905); Andrew Jackson Stone, “Some results of a natural history journey to northern British Columbia, Alaska, and the Northwest Territory, in the interest of the American Museum of Natural History,” *Bulletin of the American Museum of Natural History* 13, 5 (1900): 31-62; J.A. Allen, “A New Caribou from the Alaska Peninsula,” *Bulletin of the American Museum of Natural History* 16 (1902): 119.

inadequate,” he wrote, “that the task of properly tracing the distribution and relationships of these animals is a gigantic one.”<sup>36</sup> Little had changed more than three decades later when Olaus Murie, one of the first university-trained biologists to work with the US Fish and Wildlife Service (USFWS) in Alaska, began a scientific investigation of the Alaska-Yukon caribou. After completing his research, Murie argued that a lack of specimens remained a major impediment to the development of scientific knowledge about these particular caribou herds.<sup>37</sup> As North American wildlife management agencies assumed primary responsibility for caribou research they continued to devote resources to the collection of caribou specimens from the region – maintaining a historical continuity between emergent forms of scientific caribou management and natural history’s collection and classification practices.<sup>38</sup>

Although the species concept had emerged as a core unit in North American caribou management by the mid-twentieth century, when Frank Banfield took over the role of Chief Mammalogist with the CWS in 1948, there was still considerable scientific uncertainty regarding genus *Rangifer*.<sup>39</sup> This uncertainty persisted in spite of multiple taxonomic classifications completed since the mid-eighteenth century. Indeed, after surveying the state of caribou taxonomy, Banfield would argue that disorder in *Rangifer* taxonomy persisted not in spite of these studies, but because of them. “Previous revisions,” he stated “had been conducted by the comparison of individual specimens or small series from distant localities.”<sup>40</sup> In the mid-

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<sup>36</sup> Stone, “Some Results,” 50.

<sup>37</sup> Murie, “Alaska-Yukon Caribou,” *North American Fauna* 54 (1935): 73.

<sup>38</sup> Murie explained that the Bureau of Biological Survey had built a collection of caribou specimens from all regions of Alaska. See Murie, “Alaska-Yukon Caribou,” 73.

<sup>39</sup> Geographer Jamie Lorimer argues that in the late twentieth century, “the species has been taken largely as the principal ontological unit for biodiversity conservation (in the United Kingdom and elsewhere). See Lorimer, *Wildlife in the Anthropocene: Conservation After Nature* (Minnesota: University of Minnesota Press, 2015): 62. For discussions of caribou taxonomy and the place of the species in caribou management, see Geist, “Invalid Taxonomic Tools,” 25-28; Banfield, *Revision*.

<sup>40</sup> Banfield, *Revision*, 1.

twentieth century, he argued, the “taxonomic relationships of the North American caribou populations were generally accepted as chaotic.”<sup>41</sup>

Banfield believed this critical gap in scientific knowledge represented more than an intellectual problem for caribou scientists and wildlife managers, and his colleagues and counterparts in North American wildlife management agencies tended to agree with him when he asserted that, “a lot of our caribou problems could be helped by an understanding of the taxonomy of the group.”<sup>42</sup> The disorder that characterized caribou classification systems, Banfield suggested, represented a major obstacle to the development of efficient management regimes for this important northern game animal.<sup>43</sup> By the mid-1950s, Banfield had begun to explore the possibility of revising genus *Rangifer*, and as he developed the parameters of a scientific investigation he sought to establish a crucial boundary around accepted modes of knowledge production employed in the taxonomic classification of mammals. Whereas he perceived that his predecessors’ natural historical methods had introduced considerable disorder into caribou taxonomy, Banfield suggested that he would simplify the genus and impose order on North America’s migratory caribou through the development of a more rigorous and scientific method of taxonomic classification.

In many ways, Banfield embodied the postwar transformation of North American wildlife management. When he joined the Dominion Wildlife Service in the late 1940s, Banfield was in the process of completing his doctoral dissertation in the School of Forestry and Conservation at the University of Michigan, a department that was heavily influenced by Aldo Leopold’s notion

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<sup>41</sup> Banfield, *Revision*, 1.

<sup>42</sup> A.W.F. Banfield to Robert Scott, 15 April 1955, LAC, RG 109, Vol. 397, WL.U. 228, Part 12.

<sup>43</sup> Banfield, *Revision*, 1. For an early articulation of Banfield’s belief about the value of a taxonomic revision, see: Banfield to Scott, 15 April 1955, RG 109, Vol. 397, WL.U. 228, Part 12. On his decision to undertake the study, see: Robert Scott to Frank Banfield, LAC, 16 January 1957, RG 109, Volume 404, WL.U. 228-9.

of scientific wildlife management.<sup>44</sup> As part of his doctoral dissertation, Banfield undertook one of the first major scientific investigations of barren-ground caribou in northern Canada, and during his first years with the Service he expanded upon this research, applying recently-developed methods of aerial surveillance to the study of migratory caribou.<sup>45</sup> Flying approximately 500 feet above the barren grounds, and armed with a cache of maps and a Fairchild K-20 aerial camera, Banfield and his research partners attempted to locate and count the migratory caribou that ranged between the western shores of Hudson Bay and the Mackenzie River. The information produced through these scientific investigations, he explained, would inform a “program for the future management of the caribou.”<sup>46</sup> Though gestational in form, Banfield and his colleagues in the Dominion Wildlife Service brought scientific wildlife management to Canada’s barren grounds, and it was through the application of scientific methods that Banfield intended to resolve the problem of caribou taxonomy.

For Banfield, the problem of caribou taxonomy was linked inextricably to the history of zoological knowledge production and the shifting terrain of mammalian taxonomy. After Linnaeus’s initial classification of the species in 1758, natural historians and taxonomists identified fifty-five species and subspecies of reindeer and caribou across the circumpolar north.<sup>47</sup> However, identification and the establishment of taxonomic order were vastly different endeavours. While the Linnaean system of plant and animal taxonomy replaced the diversity of local and indigenous naming practices, and simplified taxonomic nomenclature, its acceptance

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<sup>44</sup> Kulchyski and Tester, *Kiumajut*, 54; 282, footnote 7.

<sup>45</sup> Kulchyski and Tester, *Kiumajut*, 54. For the final report, see: AWF Banfield, *The Barren-Ground Caribou*. Ottawa: Department of Resources and Development, Northern Administration and Lands Branch, 1951.

<sup>46</sup> Banfield, *Barren-Ground Caribou*, 2.

<sup>47</sup> Linnaeus first described the reindeer in the tenth edition of his *System Naturae* (1758), assigning the name *Cervus tarandus* to the species. In the nineteenth century, naturalists changed the name to *Rangifer tarandus*. For more on the taxonomic history of caribou and reindeer, see: Banfield, *Revision*, 6-7.

by the Royal Society and other scientific institutions failed to resolve the protracted scientific debates concerning the ontological status of the species concept.<sup>48</sup>

Attempts to address scientific uncertainty regarding the species concept resulted in dissension among naturalists and taxonomists about the way in which newly “discovered” mammals should be classified.<sup>49</sup> While zoologists employing the typological species concept understood the spatial dynamics of speciation, they had little appreciation for geographic variation within groups of animals. Ultimately, this led to a situation in which taxonomists classified virtually every group of mammals exhibiting minor differences as a new species.<sup>50</sup> The debate, which remained unresolved at the beginning of the twentieth century, impacted the taxonomic classification of the Alaska-Yukon caribou. In 1902, Madison Grant summarized contemporary taxonomic debate by stating that “[t]here is a wide divergence of opinion as to whether or not certain departures from accepted types should be recognized as species, or merely as local races.”<sup>51</sup>

In addition to being one of the founders of the American conservation movement, Grant also played a prominent role in the development of scientific racism and eugenics in the United States; in every aspect of his work, Grant displayed a deep fascination with race, which he

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<sup>48</sup> For a historical examination of the species concept debate, see: Wilkins, *Species*: 1-8. For a discussion of Linnaeus and his conception of time as a generative force in speciation, see: Donald Worster, *Nature's Economy: The Roots of Ecology* (San Francisco: Sierra Club Books, 1979), 138. For information on the rise and decline of the notion of species fixism, see: Ron Amundson, *The Changing Role of the Embryo in Evolutionary Thought: The Roots of Evo-Devo* (Cambridge: Cambridge University Press, 2005), 50.

<sup>49</sup> For more on the history of Linnaean taxonomy, see: John Wilkins, *Species: A History of the Idea* (Berkeley: University of California Press, 2009): 47-96. For a compelling discussion of taxonomic practices and social order in the North American Arctic, see: Emilie Cameron, *Far Off Metal River: Inuit Lands, Settler Stories, and the Making of the Contemporary Arctic* (Vancouver: UBC Press, 2015), 63-83.

<sup>50</sup> David Nagorsen, Mark Fraker, and Nick Panter, “Conserving Mammals at Risk: The Role of Taxonomy,” in *Proceedings of a Conference on the Biology and Management of Species and Habitats at Risk*, ed. L.M. Darling (Victoria: BC Ministry of the Environment, 2000), 42.

<sup>51</sup> Madison Grant, *Caribou*, 5.

presented as a marker of difference and the basis of scientific classification.<sup>52</sup> In his 1902 publication, Grant recognized eleven species of reindeer and caribou as he elevated forms previously described as subspecies – or “local races” – to the rank of species.<sup>53</sup> The caribou inhabiting the Alaska Peninsula, which zoologist J.A. Allen had named *Rangifer granti* after Grant, were one such group.<sup>54</sup> Grant argued that human activity had separated the Alaska Peninsula caribou from other western Arctic herds, resulting in the development of a new species and the loss of “whatever forms there may have existed intermediate between it and its close kindred on the Arctic coast.”<sup>55</sup> Yet, shifting taxonomic conventions eventually led to the establishment of new boundaries around caribou.

During the early twentieth century, taxonomic boundaries continued to shift as scientists accumulated more information about caribou, and developed new methods of taxonomic analysis. In attempting to differentiate caribou species, Grant developed a method of triangulation that considered three highly variable physical traits: body size, pelage colour, and antler development. “When the antlers are distinguishable, and the color of the pelage of two animals at the same season is in marked contrast, and still further when there is added to these two characters a third – size – sometimes extremely marked,” he argued, “we have a group of variations clearly indicating that the extremes of the genus in the different portions of the range are at least well on the road to forming distinct species.”<sup>56</sup>

Two decades after Madison Grant published his classification, Olaus Murie also became involved in the study of the taxonomic relationships among Alaska-Yukon caribou. Murie, who

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<sup>52</sup> Jonathan Spiro, *Defending the Master Race: Conservation, Eugenics, and the Legacy of Madison Grant* (Burlington: University of Vermont Press, 2009): xii-xiii.

<sup>53</sup> Madison Grant, *The Caribou* (New York: New York Zoological Society, 1902), 4.

<sup>54</sup> Grant, *Caribou*, 7-14.

<sup>55</sup> Grant, *Caribou*, 7.

<sup>56</sup> Grant, *Caribou*, 6.

had been hired by the US Bureau of Biological Survey to locate and map the movements of caribou herds, did not intend to conduct a taxonomic classification of caribou when he began his research in 1920.<sup>57</sup> Believing that a better understanding of caribou taxonomy would help clarify the spatial relationships among Alaska-Yukon caribou, Murie became a reluctant taxonomist, stating that the task of revising the genus was “well-nigh impossible with the material now available in the collections.”<sup>58</sup> Rather than relying on fragmentary collections of specimens, Murie supplemented his taxonomic analysis with notes, sketches, and photographs created while observing “thousands” of living caribou in the field.<sup>59</sup> Not only did the inclusion of field observations and photography differ from the methods employed by his predecessors, his classification also sought to revise the taxonomic relationships of the Alaska-Yukon caribou. Unlike Grant, Murie did not believe that these animals represented separate species but, rather, comprised three subspecies of the barren-ground caribou found east of the Mackenzie River: *Rangifer arcticus stonei*, *Rangifer arcticus granti*, and *Rangifer arcticus osborni*.<sup>60</sup>

Murie’s establishment of new boundaries around the Alaska-Yukon caribou occurred during a period when shifting scientific understandings of the species concept altered prevailing taxonomic conventions. In particular, two developments in the definition of a species impacted the field of mammalian taxonomy during the first half of the twentieth century. First, as scientists began to recognize the temporal connections among geographically isolated groups of organisms, many taxonomists adopted the polytypic species concept, through which they classified distinct geographic forms as subspecies of a larger group rather than as separate

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<sup>57</sup> Murie, “Alaska-Yukon Caribou,” 73.

<sup>58</sup> Murie, “Alaska-Yukon Caribou,” 73.

<sup>59</sup> Murie Family Papers, Series 2: Olaus Murie Papers, 1910-1961, APRCA, Box 3, File 7-8; Box 5 File 12; Box 5 File 21. See also, Murie, “Alaska-Yukon Caribou,” 73.

<sup>60</sup> Murie, “Alaska-Yukon Caribou,” 74.

species altogether.<sup>61</sup> Murie's revision of the Alaska-Yukon caribou as subspecies of *Rangifer arcticus* was one such example. Second, in the 1930s, evolutionary biologist Theodosius Dobzhansky, who famously synthesized Mendelian genetics and Darwinian natural selection, redefined the species concept by proposing the idea that scientists should consider reproductive isolation as a requirement in the identification of a species.<sup>62</sup> In a 1935 essay, Dobzhansky argued that the species rank "represents that stage of evolutionary divergence, at which the once actually or potentially interbreeding array of forms becomes segregated into two or more separate arrays which are physiologically incapable of interbreeding."<sup>63</sup> As the "generative conception" gained prominence, scientists – including those engaged in the development of scientific caribou management – attempted to impose order on unwieldy classification systems by establishing taxonomic boundaries that reflected these crucial developments in biological understandings of the species concept.<sup>64</sup> Establishing order was a primary objective for Banfield as he set out to revise the taxonomic classification of genus *Rangifer*.

From its inception, Banfield's taxonomic investigation fostered the development of institutional linkages within an emergent transnational network of caribou science. After identifying the problem of caribou taxonomy as a source of managerial confusion, the Canadian mammalogist had to determine whether the problem was being tackled in Alaska or south of the border. Through correspondence and conversations with USFWS officials, Banfield learned that despite broad interest in resolving the problem of caribou taxonomy, wildlife management agencies in the US lacked the resources and personnel required for an investigation of the

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<sup>61</sup> Nagorsen et al., "Conserving Mammals," 42.

<sup>62</sup> On the synthesis of Mendelian genetics and Darwinian natural selection, see Worster, *Nature's Economy*, 402. On Dobzhansky's contribution, see Wilkins, *Species*: 183-186.

<sup>63</sup> Theodosius Dobzhansky, "A Critique of the Species Concept in Biology," *Philosophy of Science* 2 (1935): 354.

<sup>64</sup> For more on the resultant increase in taxonomic revisions, see: Nagorsen et al., "Conserving Mammals," 42. For more on the "generative conception", see Wilkins, *Species*, 10.

problems he had identified. After determining that the field was clear, Banfield sought departmental approval for his research programme. In 1957, Winston Mair, the Chief of the CWS, endorsed his plans, noting in a memorandum to the director of the National Parks Branch that the proposed research would “form a very important part of our knowledge of the overall caribou problem on this continent.”<sup>65</sup> He claimed Banfield was well positioned to take a lead on the investigation as the CWS had completed “the most continuous and extensive caribou researches to date on the continent,” further acknowledging Banfield’s extensive research network and the willingness of international scientific institutions and management agencies to support his research.<sup>66</sup> The proposed research programme received immediate departmental approval. Although he would leave the CWS in 1957 to take up the position of Chief Zoologist with the National Museum of Canada, Banfield maintained administrative control over the taxonomic investigation, and the continued participation of CWS field agents and scientists remained a vital element of his research programme.<sup>67</sup> Yet, as Winston Mair suggested, it was Banfield’s ability to enlist a broad range of actors that would prove most important as his taxonomic investigation unfolded.

As Banfield understood, the acceptance of his taxonomic revision by the scientific community in which he was embedded depended on his meeting a number of scientific criteria.<sup>68</sup>

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<sup>65</sup> Winston Mair, “Memorandum for the Director,” 6 February 1957, LAC, RG 109, Vol. 404, WL.U. 228-9.

<sup>66</sup> Winston Mair, “Memorandum for the Director,” 6 February 1957, LAC, RG 109, Vol. 404, WL.U. 228-9.

<sup>67</sup> Banfield alerted the service’s active field mammalogists to the news regarding his promotion in a letter dated 12 September 1957. See LAC, RG 109, Vol. 375, WL.U. 315, Part 2.

<sup>68</sup> As historians of science have demonstrated, scientific work is inherently tied to social interests and factors. See Steven Shapin, “The Politics of Observation: Cerebral Anatomy and Social Interests in the Edinburgh Phrenology Disputes,” *Sociological Review* 27 (1979): 138-178. For more on the production and acceptance of scientific facts, see Shapin and Schaffer’s discussion of the “three technologies of fact making,” in *Leviathan*, 25-30. In an examination of Hobbes, Boyle, and the experimental life, Donna Haraway considers the way in which gender shaped the production and acceptance of science in seventeenth-century England. Although I do not discuss gender in this chapter, this is not meant to suggest that it was absent. Indeed, Banfield’s credibility as a scientific witness was connected to conceptualizations of masculinity and objectivity, which were in flux during the mid-twentieth century. See Haraway, *Modest-Witness*: 23-45.

At the most fundamental level, it was necessary for Banfield to address critical gaps that scientists had identified in scientific knowledge about *Rangifer* taxonomy. Ultimately, this was a geographical process that involved the spatial expansion of scientific modes of representation into regions that had been inaccessible to collectors, natural historians, and scientists. As his research progressed, Banfield learned there was a great deal of scientific uncertainty regarding the taxonomic relationships among the Alaska-Yukon caribou, particularly those herds that migrated north of the Brooks Range in Alaska. In a letter to Banfield, Robert Scott, a senior administrator with the USFWS in Alaska, emphasized the importance of collecting specimens from this northerly region, which he described as “the critical area with respect to taxonomy within Alaska.”<sup>69</sup> While Banfield relied heavily on museum collections for other aspects of his taxonomic revision, this method of data collection proved to be insufficient in the description and classification of the Alaska-Yukon caribou.<sup>70</sup> Rather, he was forced to build a new collection of caribou specimens representing these northern herds.

Banfield held a distinct advantage over his predecessors in that he was able to mobilize a broad range of actors in Canadian and American scientific institutions and wildlife management agencies to assist him in the collection of scientific information about the caribou herds in this distant region. After announcing his intention to revise *Rangifer* taxonomy, American scientists and museum curators began to contact Banfield, offering to ship caribou specimens to the Natural History Museum in Ottawa, or to host him at their institutions where he was invited to examine relevant collections.<sup>71</sup> More importantly, the USFWS in Alaska provided Banfield with

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<sup>69</sup> Robert Scott to A.W.F. Banfield, 16 January 1957, LAC, RG 109, Vol. 404, File WL.U. 228-9.

<sup>70</sup> Banfield’s extensive travel plans and museum visits are documented in the Canadian Wildlife Service fonds: LAC, RG 109, Vol. 404, WL.U. 228-9. For further documentation of the museums Banfield visited over the course of his investigation, see Banfield, *Revision*, 2-3; 40; 50; 54; 59; 64; 66; 69; 86; 92; 102.

<sup>71</sup> Harold Anthony (American Museum of Natural History) to Banfield, 28 January 1957, LAC, RG 109, Vol. 404, File WL.U. 228-9; J. Kenneth Doult (Carnegie Museum), 23 January 1957, LAC, RG 109, Vol. 404, File WL.U. 228-9.

a number of new caribou specimens from those regions that were underrepresented in existing collections. Prior to the commencement of Banfield's research programme, senior officials with the USFWS in Alaska had arranged for field agents to collect caribou specimens from the northern herds, which they intended to use in a taxonomic investigation. But lacking the personnel and resources necessary to conduct an intensive study of caribou taxonomy, the agency paid to have its collection of caribou skulls shipped to the National Museum in Ottawa, where Banfield would be able to integrate them into his analysis.<sup>72</sup> After supplying Banfield with this collection of caribou skulls, officials with the agency continued to gather specimens for his research, even purchasing 30 skulls from Inuvialuit hunters who lived north of the Brooks Range, which the agency shipped to Ottawa in the spring of 1957.<sup>73</sup>

Field agents and conservation officials had to render caribou bodies mobile to enable their transportation from sites across the North American Arctic to the National Museum in Ottawa, where Banfield integrated them into his analysis.<sup>74</sup> However, the nature of these specimens – typically caribou skulls and skins – complicated this process. It was typical for field agents to prepare specimens in a hasty fashion while in the field, leaving them vulnerable to decomposition. This posed a problem for Banfield as delays in transportation compromised his ability to use these specimens in his taxonomic investigation.<sup>75</sup> Again, Banfield and his research partners addressed the logistical challenges associated with moving caribou bodies over vast distances within the context of a transnational network of science. Having prepared a small package of caribou specimens for shipment to Ottawa, John Kelsall, who was at that time

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<sup>72</sup> Robert Scott to A.W.F. Banfield, 16 January 1957, LAC, RG 109, Vol. 404, File WL.U. 228-9. Robert Scott to A.W.F. Banfield, 16 January 1957, LAC, RG 109, Vol. 404, File WL.U. 228-9.

<sup>73</sup> Robert Rausch to A.W.F. Banfield, 29 April 1957, LAC, RG 109, Vol. 404, File WL.U. 228-9.

<sup>74</sup> For more on the mobility of specimens and the way in which science acted at a distance, see Latour, *Science in Action*, 223.

<sup>75</sup> For example, see Robert Scott to A.W.F. Banfield, 16 January 1957, LAC, RG 109, Vol. 404, File WL.U. 228-9.

working for the CWS in the Northwest Territories, wrote to his colleagues at the National Museum of Canada, informing them of the package's imminent arrival. "The caribou heads are now tastefully packaged for shipment," he stated in a letter to the museum's curator of mammals. "As much surplus meat as possible has been removed from them but they are still raw – with brains intact," he warned. "They must, therefore, be picked up immediately on arrival in Ottawa."<sup>76</sup> Not only did the development of expansive transportation and communication networks enable Banfield to accumulate scientific evidence from a distance, it also facilitated the transformation of caribou bodies into scientific objects that could be transported to Ottawa and examined far from their home ranges. During the course of his investigation, he examined 855 caribou and reindeer skulls – a sample that represented the genus throughout its circumpolar range; more than 350 of these were new specimens, ninety-three of which came from the Alaska-Yukon herds.<sup>77</sup> In 1957, Banfield acknowledged the value of the new Alaskan specimens in a letter to Robert Scott, stating that the addition of this material would allow him to "make a fair job of studying variation in the genus."<sup>78</sup>

Based on the weight of this evidence, Banfield published a revision of the genus in 1961 in which he attempted to harden the taxonomic boundaries around caribou and reindeer. At the global scale, he concluded that the genus comprised a single living species, *Rangifer tarandus*, and within this species he recognized nine distinct subspecies. While his analysis of the different populations suggested the existence of a "mosaic pattern of adaptive characters," he believed that the subspecies fit "conventional concepts of migration and evolution in isolation." The

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<sup>76</sup> John Kelsall to Dr. Austin Cameron (Curator of Mammals, National Museum of Canada), 7 February 1957, LAC, RG 109, File 404 WL.U. 228-9, LAC, Ottawa, Canada.

<sup>77</sup> Banfield, *Revision*, 11; 59.

<sup>78</sup> A.W.F. Banfield to Robert Scott, 24 January 1957, LAC, RG 109, Vol. 404, WL.U. 228-9. Alaskan scientists, including biologist Robert Rausch, also contributed caribou specimens to Banfield's growing collection of Alaskan caribou skulls. See Robert Rausch to Banfield, 10 April 1957, LAC, RG 109, Vol. 404, WL.U 228-9.

relationship among the subspecies, he stated, “seems to be that of sharing a common species genetic pool, yet exhibiting an additional group of unique adaptive characters.”<sup>79</sup> Banfield was not the first scientist to propose the notion of a single living species within the genus as two Russian taxonomists had recently reached similar conclusions.<sup>80</sup> However, his revision made significant departures from the main thrust of twentieth-century North American *Rangifer* taxonomy, which tended to split the genus into multiple species. “Unfortunately,” he lamented, “there is still the subjective choice of ‘lumping’ or ‘splitting’ in taxonomic studies,” and he feared that his system of classification would lead some to dismiss him as a ‘lumper’.<sup>81</sup>

In an important departure, Banfield paid particular attention to the spatial and temporal relationships among the Alaska-Yukon herds, including the scientifically underrepresented caribou that migrated north of the Brooks Range.<sup>82</sup> Unlike Olaus Murie, who suggested that the Alaska-Yukon caribou were divided into three distinct subspecies, Banfield concluded that “contact between the various Alaskan populations was more extensive formerly and that the various populations differed only slightly.”<sup>83</sup> These differences, he stated, were not significant enough to warrant the division of Alaska-Yukon caribou into different subspecies. Rather, he argued, caribou in Alaska and Yukon represented a broad belt of intergradation between the southerly woodland caribou (*Rangifer tarandus caribou*) and the migratory barren-ground caribou east of the Mackenzie River (*Rangifer tarandus groenlandicus*).<sup>84</sup> As the only “statistically valid Alaskan race is *granti* of the Alaskan Peninsula,” Banfield stated, “one is

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<sup>79</sup> Banfield, *Revision*, 103.

<sup>80</sup> Banfield, *Revision*, 10; Ronald Skoog, “Ecology of the Caribou (*Rangifer tarandus granti*) in Alaska,” (Ph.D. Thesis: University of California, Berkeley, 1968), 5-6.

<sup>81</sup> Banfield, *Revision*, 103.

<sup>82</sup> Banfield, *Revision*, 59.

<sup>83</sup> Banfield, *Revision*, 59.

<sup>84</sup> A discussion of Banfield’s classification system is beyond the scope of this paper. For more on the line he drew between tundra caribou and the woodland caribou, see Banfield, *Revision*; Geist, “Invalid Taxonomic Tools,”; Skoog, “Ecology of the Caribou,” 1-16.

faced with the possible choice of referring to all central and northern Alaskan populations as *granti* intergrades.”<sup>85</sup> In assigning the name *Rangifer tarandus granti* to the Alaska-Yukon caribou, Banfield extended the geographical boundaries of the category to those animals that migrated north of the Brooks Range.

Banfield’s attempt to resolve the problem of caribou taxonomy had as much to do with ordering the production of knowledge about caribou as it did with refining taxonomic boundaries around the genus. Not only did he argue that his predecessors had based their revisions on inadequate and incomplete bodies of scientific evidence, but he also claimed they committed critical errors by employing flawed taxonomic methods. “Often,” he stated “the comparisons were based on antler formation, a characteristic known to be highly variable and subject to nutritional level, or upon inadequate comparisons of skins taken from different seasons.”<sup>86</sup> Although Banfield did consider these two external physical characteristics, he prioritized the statistical analysis of skull measurements – a scientific method that was known as comparative morphometrics – in his attempt to mark the taxonomic boundaries around caribou populations. As opposed to the variability inherent to descriptions of caribou skins and antler formations, Banfield and others in the scientific community viewed skull measurements as being “amenable to ‘objective’ analysis” and, therefore, more scientific than the comparative methods employed by his predecessors.<sup>87</sup>

In his taxonomic revision, Banfield maintained that the scientific method was the appropriate mode for generating facts relevant to the problem of caribou taxonomy, and by the

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<sup>85</sup> Banfield, *Revision*, 59.

<sup>86</sup> Banfield, *Revision*, 1.

<sup>87</sup> Quote taken from Geist, “Invalid Taxonomic Tools,” 26. In this paper, Geist challenges the validity of comparative morphometrics in taxonomic analysis, and asserts that many of Banfield’s assumptions about skull measurements were false.

mid-twentieth century, notions of scientific objectivity turned on the ostensible ‘distancing’ of the observer through the deployment of technological ways of seeing and representing the natural world.<sup>88</sup> Although his measurements were not dependent upon the use of capital-intensive technologies – as in other areas of North American caribou research – he took great care to explain the level of precision achieved through his system of measurement: “The larger measurements were made with arc calipers and read on a steel metric rule to the nearest millimeter. Shorter measurements such as tooth rows were made by means of a vernier caliper and recorded to the nearest tenth of a millimeter.”<sup>89</sup> Through a rigorous scientific method, Banfield connected his revision to modern trends in taxonomic theory and practice, which, he argued, “have laid less emphasis on the comparison of types and more upon the analysis of variation among populations.”<sup>90</sup>

Although Banfield had confidence in the scientific method underpinning his revision, he struggled to reconcile the boundaries he established with a fundamental problem in modern taxonomy. In 1935, evolutionary biologist Theodosius Dobzhansky had argued that taxonomists forced the “flowing and changing patterns of life” to conform to the “static limits of the taxonomic categories.”<sup>91</sup> Like Dobzhansky, Banfield had an appreciation for the dynamism of taxonomic categories, and in outlining his conclusions he argued that reindeer and caribou did not readily fit into the “classical” categories of species and subspecies. Since evolution is a

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<sup>88</sup> For more on ‘distancing’ and geographical knowledge production, see Gillian Rose, “Situating Knowledges: Positionality, Reflexivities and Other Tactics,” *Progress in Human Geography* 21, 3 (1997): 305-320. For more on “instruments of vision”, modernity, and power, see Donna Haraway, *Simians, Cyborgs, and Women: The Reinvention of Nature* (New York: Routledge, 1991), 188-189; Donna Haraway, *Primate Visions: Gender, Race, and Nature in the World of Modern Sciences* (New York: Routledge, 1989), 1-15; S. McQuire, *Visions of Modernity: Representation, Memory, Time and Space in the Age of the Camera* (London: SAGE Publications, 1998).

<sup>89</sup> Banfield, *Revision*, 11. For further elaboration of Banfield’s system of measurements, see pages 11-25.

<sup>90</sup> Banfield, *Revision*, 1.

<sup>91</sup> Dobzhansky, “Critique of the Species Concept,” 353.

“dynamic process,” he noted, “we should not expect to be always able to ‘freeze’ it at the conventional stages.”<sup>92</sup> But when confronted with the complex socio-natural determinants of dynamism, Banfield was compelled to suppress the indeterminacy of taxonomic categories to construct a system of classification that fit within the dominant paradigm of North American wildlife management. As I argue in the previous chapter, the hybridization of Alaskan caribou and escaped domestic reindeer provoked managerial anxiety about the purity, vitality, and economic value of wild caribou populations. Hybridization also threatened to undermine the taxonomic boundaries Banfield was attempting to establish around the Alaska-Yukon caribou herds.

To protect the scientific integrity of his taxonomic revision, Banfield discarded any specimens that he suspected of being “stray domestic reindeer or reindeer-caribou hybrids.”<sup>93</sup> In his published report, he stated that he based his decision about which skulls to discard on scientific information about the spatial distribution of reindeer-caribou hybridization in Alaska. However, prior to the publication of his revision, scientists and wildlife managers informed Banfield that there was actually very little scientific certainty regarding the spatial extent and biological impact of reindeer-caribou hybridization in Alaska. In fact, based on their reception of credible reports from field agents and Alaskan Natives about domestic reindeer breeding with caribou herds north of the Brooks Range, officials with the USFWS believed that hybridization had occurred throughout much of Alaska. However, they were unsure to what extent hybridization had impacted the less isolated interior and northern caribou herds.<sup>94</sup>

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<sup>92</sup> Banfield, *Revision*, 103.

<sup>93</sup> Banfield, *Revision*, 58.

<sup>94</sup> Rausch to Banfield, 29 April 1957, LAC, RG 109, Volume 404, WL.U. 228-9; Robert Scott to Harrison Lewis, 14 December 1950, LAC, RG 109, Vol 395, WL.U. 228, Part 6.

While Banfield did acknowledge the dynamism of *Rangifer tarandus granti*, the movement of domesticated reindeer into the geographical range of ostensibly wild caribou herds – and the interbreeding of these two socially differentiated groups of animals – troubled the boundaries of the static taxonomic categories with which he was working. As Dobzhansky argued, the “boundary lines between such groups become rapidly obliterated soon after they come in contact in the same locality, and free interbreeding sets in.”<sup>95</sup> However, having taken steps to excise troublesome hybrids from the body of scientific evidence upon which he based his revision of genus *Rangifer*, the boundaries Banfield established did not reflect the essence of nonhuman experience in Alaska. Rather, he aimed to develop scientific modes of representation for the Alaska-Yukon caribou that state-based wildlife managers could use to assert control over a group of animals they perceived as a valued natural resource.<sup>96</sup> As I have argued throughout this section, the exertion of managerial control over migratory caribou depended on the hardening of boundaries around core managerial units. Further, Banfield’s taxonomic revision of genus *Rangifer* is indicative of the way in which postwar North American wildlife managers employed scientific methods to legitimize new modes of representation for animals. In addition to taxonomic categories, postwar wildlife managers developed novel scientific methods to stabilize the caribou herd concept. In the next section, I examine the way in which wildlife managers with the CWS and the USFWS worked across the Alaska-Yukon border as they sought to establish boundaries around the caribou herds that migrated through this transboundary region.

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<sup>95</sup> Dobzhansky, “Critique of the Species Concept,” 354.

<sup>96</sup> For more on the way in which North American wildlife management agencies employ scientific modes of representation that reinforce the subordination of nonhuman animals, see Lulka, “Stabilizing the Herd,” 439-463.

### 3.3. Fixing the Identity of an International Caribou Herd

On 17 March 1953, Robert Scott of the USFWS and David Munro, a zoologist and wildlife management officer with the CWS, boarded a twin-engine Beechcraft airplane in Fairbanks, Alaska and flew northeast toward the community of Old Crow in the Yukon. The two game experts, each representing their respective wildlife management agencies, were conducting the first cross-border aerial survey in a collaborative investigation into the “biological characteristics and ecological status of the caribou which were known to range back and forth across the Alaska-Yukon border, in the area near Old Crow and the Arctic Coast.”<sup>97</sup> After several failed attempts to survey the caribou in this region, officials with the USFWS and CWS agreed to join forces in 1952, noting that the two countries not only shared “many common caribou problems,” in some cases they also shared the same caribou.<sup>98</sup> Though uncertain about the identity and composition of the herd that migrated across the International Boundary, Canadian and American Wildlife managers shared a sense of optimism about the joint investigation being led by Scott and Munro. “Based on the fact that these animals have no regard for international boundaries in their migratory movements,” an official for the USFWS stated in a proposed press release, “this year’s surveys are expected to give a complete picture of the herd throughout the caribou’s entire range.”<sup>99</sup> These expectations would have been at the forefront of Scott and Munro’s minds as their plane approached the Alaska-Yukon border. After noticing tracks left by migratory caribou on the snow-covered hills along the border near the Porcupine

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<sup>97</sup> Robert Scott, “Alaska Project W-3-R-7: Working Plan No. (G), Job No. 1 Caribou Movements, Abundance, Distribution,” *Federal Aid in Wildlife Restoration* 7 (4): 40.

<sup>98</sup> Howard Baltzo (Acting Regional Director, USFWS) to J.P. Richards (CWS), 20 August 1952, LAC, RG 109, Vol. 401, WL.U. 228-6, Part 1, 1952.

<sup>99</sup> US Department of the Interior, “Joint Canada-United States Caribou Surveys Launched,” 28 March 1953, LAC, RG 109, Vol. 401, File WL.U. 228-6, Part 1 (1953).

River, the two wildlife managers located a small group of caribou moving in a northerly direction, presumably toward the Arctic Coast in Alaska.<sup>100</sup>

Through cooperative agreements between the USFWS and the CWS, Scott and Munro gained access to military technologies of aerial surveillance, which they deployed as they attempted to locate and count the migratory caribou of the western Arctic. As part of the agreement struck between the two agencies, the USFWS agreed to provide an airplane for the purposes of aerial surveillance of the caribou, and the CWS provided the pair with a Fairchild K-20 aerial camera, and paid for and arranged to have a cache of gasoline delivered and stored in Old Crow to fuel the planes used in the aerial surveys. Further, Winston Mair, Chief of the CWS, made arrangements with the Department of Transport and the Department of National Revenue to ensure that Scott and the Beechcraft airplane would have clearance to cross the border and “cruise over Canadian territory”.<sup>101</sup> The use of two small airplanes not only allowed the two game experts to follow groups of caribou across a landscape that had long confounded the efforts of naturalists and scientists, aerial surveillance methods also provided them with a “mobile vantage point” from which they could count the migratory animals that they located.<sup>102</sup> After their initial flight from Fairbanks, Scott and Munro would spend more than 65 hours surveying the transboundary region, and during their time in the air they “tallied” more than 17,000 animals migrating toward the Arctic Coast in Alaska.<sup>103</sup> Based on their counts, Scott estimated a population somewhere between 20,000 and 30,000 caribou for this herd, which seemed to

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<sup>100</sup> Robert Scott, “Alaska Project W-3-R-7,” 41.

<sup>101</sup> See J.S. Howell to Scott, 23 January 1953, LAC, RG 109, Vol. 401, W1.U. 228-6, Part 1 (1953). For more on the agreement between the CWS and the USFWS, see: LAC, RG109, Vol. 401, W1.U. 228-6, Part 1 (September 15-January 1952).

<sup>102</sup> Quote from: Dyce, “Canada Between the Photograph,” 69.

<sup>103</sup> They conducted most of the surveys between March 23 and April 3. See: Robert Scott, “Alaska Project W-3-R-7,” 40. The location of a large herd of caribou near the Alaska-Yukon border garnered some attention from Alaskan and Canadian newspapers. See: “Herd of 15,000 Caribou Sighted Near Border,” *Daily News-Miner*, 31 March 1953, 1; David Munro to Winston Mair, 12 April 1953, LAC, RG 109, Vol 401, W1.U. 228-6, Part 1, 1953.

confirm managerial and local reports of an increase in caribou populations west of the Mackenzie River.<sup>104</sup>

For Scott and Munro, however, the joint CWS-USFWS investigation was not simply about counting caribou. Rather, similar to Banfield's taxonomic investigation of *Rangifer*, the two researchers aimed to clarify scientific understandings of the caribou herd concept – a core managerial unit in North American caribou management – through the deployment of new scientific research methods and technologies of visualization. Through the 1950s, wildlife management agencies increasingly adopted aviation and photography – technologies of aerial surveillance – to produce a synoptic vision of the north and its natural resources.<sup>105</sup> Although aerial photography dates from late nineteenth century, it was not until the postwar period that biologists and wildlife managers adopted this technology – which had been modified by the US military during WWII – to survey migratory animals.<sup>106</sup> As Greg Mitman argues, in the postwar period, wildlife managers began using the camera as an instrument that introduced greater distance between object and subject, thus guaranteeing a “high degree of scientific reliability and control.”<sup>107</sup> Achieving a “view from above” was an important step in the northern expansion of

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<sup>104</sup> Scott, “W-3-R-7,” 41. On managerial perspectives on fluctuating caribou numbers in the western Arctic during the twentieth century, see: J. Smart (Director, National Parks Branch) to Deputy Minister (Department of Resources and Development) LAC, RG 109, Vol. 401, WI.U. 228-6, Part 1 (December 15 – September 1952).

<sup>105</sup> Bocking, “A Disciplined Geography,” 277. See also, Banfield, “Preliminary Investigation of the Barren Ground Caribou. Part 1. Former and Present Distribution, Migrations, and Status,” *Canadian Wildlife Service, Wildlife Management Bulletin* 1, 10 (1954). For a discussion of federal wildlife management in Alaska, see Stephen Haycox, *Battle Ground Alaska: Fighting Federal Power in America's Last Wilderness* (Kansas: University Press of Kansas, 2016), 39-58; Fred Seaton (Secretary of the Interior) to Sam Rayburn (Speaker of the House of Representatives), 27 April 1959, United States Fish and Wildlife Service, “Historic News Releases, 1959,” accessed online at [www.fws.gov/news/Historic/NewsReleases/1959/19590427b.pdf](http://www.fws.gov/news/Historic/NewsReleases/1959/19590427b.pdf) on 4 August 2016.

<sup>106</sup> Daniel Leedy, “Aerial Photographs, Their Interpretation and Suggested Uses in Wildlife Management,” *The Journal of Wildlife Management* 12, 2 (1948): 191-210; A.W.F. Banfield, D.R. Flook, J.P. Kelsall, and A.G. Loughrey, “An Aerial Survey Technique for Northern Big Game,” *Transactions of the Twentieth North American Wildlife Conference* (1955): 519-532. For more on the early history of aerial photography in Canada, see Dyce, “Canada Between the Photograph and the Map,” 69-84.

<sup>107</sup> T.C. Schneirla, “The Relationship Between Observation and Experimentation in the Field Study of Behavior,” *Annals of NY Academy of Science* (1950), cited in Greg Mittman, “When nature is the zoo: vision and power in the art and science of natural history,” *Osiris* 11 (1996): 130.

scientific wildlife management and governmental authority.<sup>108</sup> Through the production of new ways of seeing caribou, wildlife managers aimed to render migratory caribou amenable to calculation and rational management.<sup>109</sup> Yet, as wildlife managers and caribou biologists relied increasingly on aviation and aerial photography to locate, track, and count migratory caribou, they also worked to adapt these technologies and devise new methods that fit the field conditions of northern environments.<sup>110</sup> They also had to account for and respond to a growing managerial awareness of the limitations of these technologies in producing accurate representations of migratory caribou herds.

Although the establishment of managerial categories preceded systems of quantification in the historical development of natural resource management, by the early 1950s, caribou scientists and wildlife managers had failed to establish firm boundaries around the caribou herd concept.<sup>111</sup> Unlike taxonomic classification, which provoked managerial confusion through the proliferation of multiple species designations, the herd concept was not underpinned by a particular system of nomenclature or identification. Rather, it was a loosely-defined term that explorers, naturalists, and scientists had used to refer to any aggregation of caribou.<sup>112</sup> In the postwar period, however, scientists became concerned that this vague definition failed to capture the spatial, temporal, and biological dynamics that bound together groups of caribou as herds.

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<sup>108</sup> Bocking, "A Disciplined Geography," 277.

<sup>109</sup> In an analysis of George Dawson's work with the Geological Survey of Canada, Bruce Braun argues that scientific knowledge gained power when state defined "ways of seeing" nature were connected to territorial expansion and control over resources; science, he argues, is constitutive of political rationality rather than simply being its instrument. See Bruce Braun, "Producing Vertical Territory: Geology and Governmentality in Late Victorian Canada," *Ecumene* 7, 1 (2000): 7-46.

<sup>110</sup> Marianne Cronin, "Shaped by the Land: An Envirotechnical History of a Canadian Bush Plane," in *Ice Blink: Navigating Northern Environmental History*, eds., Stephen Bocking and Brad Martin (Calgary: University of Calgary Press, 2016).

<sup>111</sup> Agrawal, *Environmentality*, 37. On the continued modification of the definition of a caribou herd, see Anne Gunn and Frank Miller, "Traditional Behaviour and Fidelity to Caribou Calving Grounds by Barren-Ground Caribou," *Rangifer* 1 (1986): 151-158.

<sup>112</sup> Burch, *Caribou Herds*, 19. See also, D.C. Thomas, *Population Estimates of Barren-Ground Caribou, March to May, 1967* (Ottawa: Canadian Wildlife Service Report Series No. 9, 1969), 7.

From the outset of the joint investigation, then, the process of counting caribou was linked to ongoing efforts to establish firm boundaries around core managerial units.

Scientific uncertainty about the herd concept extended to the animals that migrated across the Alaska-Yukon border. In a letter to CWS officials, Howard Baltzo, the Regional Director of the USFWS in Alaska, outlined this uncertainty, stating: “The caribou you designate as number 2 stock, may well be the same animals we have termed the Chandler herd or a portion of the Arctic group of caribou.”<sup>113</sup> Scott and Munro aimed to reduce managerial confusion about the identity of these caribou by determining the spatial boundaries of the herd’s range. In March, an official for the CWS located what Scott believed to be the eastern boundary of the herd’s winter range in the Porcupine River area.<sup>114</sup> Then, while conducting aerial surveys in Alaska, Scott marked the western boundary of the herd’s winter range. “To the west,” he stated in his official USFWS report, “the animals confined themselves to the drainage of the Black River and its tributaries above Salmon Village.”<sup>115</sup> However, as the pair mapped the movements of caribou throughout this transboundary region, they acknowledged the limitations of spatial boundaries in the description and identification of caribou herds.

Through their analysis of caribou movements, Scott and Munro contributed to a growing body of scientific thought which viewed migration as central to the concept of a caribou herd. Bolstered by the expanded range of vision provided by military surveillance technologies, postwar wildlife managers and biologists increasingly attempted to track highly mobile groups of

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<sup>113</sup> Baltzo to Richards, 20 August 1952, LAC, RG 109, Vol. 401, WL.U. 228-6, Part 1, 1952. The CWS designated migratory caribou in this region as “No. 2 Stock” to differentiate them from the main herds of barren ground caribou east of the Mackenzie River, which had long been the subject of intensive surveying and management. See J.P. Richards to Clarence Rhode, 5 June 1952, LAC, RG 109 Vol. 401 WL.U. 228-9 (September-January 1952).

<sup>114</sup> Scott, “W-3-R-7,” 41.

<sup>115</sup> Scott, “W-3-R-7,” 41.

animals such as migratory caribou.<sup>116</sup> Indeed, prior to the commencement of the joint survey, Ian McTaggart-Cowan, a leading zoologist based at the University of British Columbia, encouraged CWS officials to focus on caribou movements in future studies of caribou populations west of the Mackenzie River. “The movements of caribou are obviously not random in time, and it would be most valuable to relate the movements to the stimulating phenomena,” McTaggart-Cowan argued in a letter to the chief of the CWS.<sup>117</sup> However, identifying a general pattern within the movement of 20,000 individual animals was not a simple task. As Scott and Munro surveyed the area between Old Crow and the Arctic Coast, they mapped the location and direction of movement of the caribou they observed with the goal of reconstructing the herd’s chronological movement through the region.

Despite the enormity of the task, the two researchers argued that they succeeded in isolating a general pattern of movement among the different groups of caribou that crossed the Alaska-Yukon border. After the first year of aerial surveys, Scott stated that the most striking element of caribou movements was the “purposefulness with which the animals traveled.”<sup>118</sup> According to local hunters and Indigenous people in the region, large groups of caribou had crossed the Porcupine River near Old Crow in the spring, and then moved in a southward direction. During the winter, Scott reported, the animals spread out “over an area approximately 200 miles east and west and 150 miles north and south.”<sup>119</sup> Although the caribou dispersed widely during the winter, by spring, he noted, the animals had begun to move with purpose toward the Arctic Coast in Alaska. “Usually they were in single file, though sometimes several

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<sup>116</sup> Through the early 1950s, wildlife managers and biologists primarily employed aerial surveillance and photography to track migratory caribou. For more on the development and use of radio tracking and radiotelemetry in wildlife science, see Benson, *Wired Wilderness*.

<sup>117</sup> Ian McTaggart-Cowan to J.P Richards, 30 May 1952, LAC, RG 109, Vol. 401, W1.U. 228-9 (September – January 1952).

<sup>118</sup> Scott, “W-3-R-7,” 43.

<sup>119</sup> Scott, “W-3-R-7,” 42.

files traveled abreast or were staggered in echelon, with a cow invariably in the lead,” Scott stated in his report on the aerial surveys. “This lead animal,” he explained, “obviously was concerned primarily with moving northward.”<sup>120</sup>

In his attempt to establish boundaries around this border-crossing herd, Scott focused on the animals’ northerly movement from the wintering grounds to the concentrated summer range on Alaska’s Arctic Coast. “A purposeful movement between these two dissimilar areas is easily understood,” Scott claimed, “even though it does involve travel over great distances.”<sup>121</sup> And this purposeful movement, he argued, fulfilled the requirements for a “true definition of ‘migration.’”<sup>122</sup> Indeed, in the mid-twentieth century, a paradigmatic shift in the prevailing understanding of migration occurred as scientists began to emphasize the behavioral and physiological bases of animal movement along with its geographical description and timing.<sup>123</sup> As zoologist Hugh Dingle argues, through the 1950s, ornithologists had developed “more sophisticated notions of migration,” which outlined the “evolutionary significance of migration as a behavior molded by natural selection to ensure breeding at the right place and time.”<sup>124</sup>

Migration between “two dissimilar areas” became the criterion that Scott would use to determine which animals belonged to the international herd being studied. Whereas groups of caribou that migrated toward the Arctic Coast in the summer were counted as being part of the herd, those geographically-proximate animals that did not follow this general pattern of movement were excluded. Despite wintering in different areas, the Porcupine and the Black

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<sup>120</sup> Scott, “W-3-R-7,” 43.

<sup>121</sup> Scott, “W-3-R-7,” 44.

<sup>122</sup> Scott, “W-3-R-7,” 44.

<sup>123</sup> Hugh Dingle, *Migration: The Biology of Life on the Move* (Oxford: Oxford University Press, 1996), 21-22.

<sup>124</sup> Dingle, *Migration*, 22. Dingle argues that the paradigmatic shift was complete around 1960 when entomologists learned that insects typically began migration prior to reproduction, which meant that insects produced their young at the end of the migration. However, “parallel developments” in other areas – including Charles Elton’s work on animals – had “set the stage” for this broad shift in the conceptualization of migration.

River caribou both migrated toward the summer range and were therefore, Scott stated, “definitely part of one single herd.”<sup>125</sup> Using the same criterion, however, Scott excluded a group of 1,000 caribou that researchers had located near the herd’s winter range north of the Alaskan community of Fort Yukon. On the basis of this requirement, Scott hypothesized about the identity of the international herd, arguing that the “large caribou herds seen in northeastern Alaska in the past” may be identical to the “so-called Porcupine herd” studied by the CWS and the USFWS earlier that year.<sup>126</sup>

The identification of a general pattern of movement – or a migratory route – was an important step in the stabilization of the caribou herd concept.<sup>127</sup> Yet, after the first year of the joint investigation, scientific uncertainty about the spatial, temporal, and biological dynamics of caribou migration threatened to undermine the stability of this core managerial category. Despite documenting a general pattern of movement from wintering grounds to summer range, Scott and Munro had not determined the “stimulating phenomena” of caribou migration. While they believed the coastal range provided caribou with important protection from insects at “calving time”, they felt there were other “undetermined features” that drew the animals north in the spring.<sup>128</sup> Further, the temporal constraints of the first aerial surveys impacted the production of scientific knowledge about the Porcupine herd. When aerial surveys concluded in April, they were confident in their representation of the northerly movement of the Porcupine herd, but they were less certain about what happened once the herd left the Arctic Coast. Scott assumed that the

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<sup>125</sup> Scott, “W-3-R-7,” 42.

<sup>126</sup> Scott, “W-3-R-7,” 42.

<sup>127</sup> In addition to the “Porcupine herd” studies, federal wildlife managers in both countries were engaged in research on other groups of caribou. In Alaska, the findings related to caribou migration were developed in concert with ongoing studies of the Nelchina herd, which, due to its geographical proximity to wildlife management institutions was more studied than the animals that migrated north of the Brooks Range. The Nelchina herd studies are documented in the Federal Aid in Wildlife Restoration reports, which were published by the Alaska Department of Fish and Game.

<sup>128</sup> Scott, “W-3-R-7,” 44.

animals moved in a circuit between winter and summer ranges, and information provided by the “Natives of Old Crow” seemed to corroborate his hypothesis, but without further scientific evidence, he could not state definitively whether or not this was the case.<sup>129</sup> Nor was he certain that the migration observed during the 1953 aerial surveys was a “typical” pattern of movement for the Porcupine herd. Drawing on existing scientific knowledge about caribou behaviour, Scott suggested that the herd’s migratory routes were likely to vary from year to year; wildlife managers, he argued, would have to determine “which movement should be labeled typical, and which movement should be labeled atypical.”<sup>130</sup> Over the next ten years, caribou scientists and wildlife managers continued to focus on the movement of caribou as they aimed to stabilize the caribou herd concept.

Although the joint USFWS-CWS investigation had gotten off to a promising start, logistical and financial challenges limited future collaborative studies of the Porcupine herd. In the months following the conclusion of aerial surveys conducted by Scott and Munro, officials with both agencies continued to monitor the movement of caribou near the Alaska-Yukon border, while senior bureaucrats in Alaska and Ottawa maintained an ostensible commitment to building upon the results of the first joint investigation. Not only had the 1953 surveys demonstrated the necessity of working across the International Boundary; but for federal wildlife managers, the cross-border collaboration had also presented an opportunity to share the costs and labour associated with tracking and studying an international caribou herd.<sup>131</sup> However, by 1954, senior officials with the USFWS had begun to rethink their commitment to the “so-called”

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<sup>129</sup> Scott, “W-3-R-7,” 44. Following the conclusion of the first year of joint CWS-USFWS aerial surveys, officials with both agencies continued to track the movement of caribou through the region. See: David Munro to E.H. McEwan (CWS), 13 November 1953, LAC, RG 109, Vol. 401. WL.U. 228-6 (1953).

<sup>130</sup> Scott, “W-3-R-7,” 44.

<sup>131</sup> E.H. McEwan to Winston Mair, 20 July 1954, RG 109, Vol. 401, WL.U. 228-6 Part 2 (1955-1953).

Porcupine herd research, choosing to focus instead on herds that were more vulnerable to hunting pressure. Scott informed Frank Banfield of the USFWS decision, stating the agency had “retrenched” with respect to the Arctic herds, and had diverted their attention to the “more critical situations with caribou south of the Yukon River.”<sup>132</sup> Their main goal with the Arctic herds, he stated, was “merely to attempt a record of major movements, and continue estimates of total numbers whenever major herds can be contacted.”<sup>133</sup> Then, in December, the USFWS promoted Scott from his role as a wildlife biologist to Supervisor of Game Restoration, forcing him to relocate to Anchorage and effectively removing him from the agency’s ongoing caribou research.<sup>134</sup> Scott, of course, had been instrumental in getting the joint investigation off the ground in 1953. Although he was hopeful that Sig Olson – his replacement in Fairbanks – would be interested in collaborating with CWS officials, the two agencies struggled to find another opportunity to conduct a joint investigation of the international Porcupine herd during the period considered in this chapter.<sup>135</sup> These developments, however, did not spell the end of the collaborative scientific investigation of the Porcupine herd.

Between 1953 and the early 1960s, transnational linkages remained important to the development of scientific caribou management in the western Arctic. Despite the geographical shift in USFWS caribou studies, the agency continued to fund – though at a decreased level – research on the “Arctic Herds”, which included the animals they classified as the Porcupine caribou. Further, American and Canadian wildlife managers remained committed to building upon the results of the 1953 joint investigation. On two separate occasions in 1956 and 1957, Sig

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<sup>132</sup> Scott to Banfield, 24 June 1954, LAC, RG 109, Vol. 401, WL.U. 228-6 Part 2 (1955-1953).

<sup>133</sup> Scott to Banfield, 24 June 1954, LAC, RG 109, Vol. 401, WL.U. 228-6 Part 2 (1955-1953).

<sup>134</sup> Scott to McEwan, 21 December 1954, LAC, RG 109, Vol. 401, WL.U. 228-6 Part 2 (1955-1953).

<sup>135</sup> Olson to William Fuller, 28 August 1956, LAC, RG 109, Vol. 401, WL.U. 228-6 Part 2 (1955-1956); Fuller to Mair, 19 October 1956, LAC, RG 109, Vol. 401, WL.U. 228-6 Part 2 (1955-1956).

Olson and CWS wildlife biologists arranged to conduct collaborative aerial surveys, which aimed to follow caribou that crossed the Alaska-Yukon border. However, in both instances, the agencies abandoned the aerial surveys due to personnel issues, unfavourable weather conditions, and other unforeseen circumstances.<sup>136</sup>

While the shifting obligations of the USFWS diverted attention away from the Porcupine herd, federal wildlife managers continued to develop transnational linkages as they sought to maintain the production of scientific knowledge about this international herd. In the absence of a sustained joint USFWS-CWS research programme, federal wildlife biologists continued to survey the Porcupine caribou as they moved through their transboundary range. And while their efforts were constrained by the International Boundary, they shared the results of these surveys with their counterparts across the border, providing each agency with vital scientific information required for the production of a synoptic vision of the herd throughout its range.<sup>137</sup> In 1956, USFWS officials even offered to extend their aerial surveys across the International Boundary to collect data about the caribou in the vicinity of Dawson in the Yukon. Though appreciative of this “gesture of goodwill,” Canadian officials insisted on compensating the USFWS for flight time, as the results of the survey would be used to develop scientific methods of caribou management on both sides of the border.<sup>138</sup> Still, scientific uncertainty regarding the caribou herd concept persisted through the 1950s and into the early 1960s.

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<sup>136</sup> These aborted surveys are documented in two files: LAC, RG 109, Vol. 401, WL.U. 228-6, Part 2 (1955-1956); LAC RG 109, Vol. 401, WL.U. 228-6, Part 2 (1959-1957). On another occasion in 1954, E.H. McEwan arranged to conduct a joint survey with Robert Scott of the USFWS, which would have seen the two biologists track the northerly migration of the Porcupine caribou out of Akalvik during the spring of 1955. However, it is not clear if this joint survey – which was expected to take four to five days of flying time – actually occurred. See E.H. McEwan to Mair, 1 October 1954, LAC, RG 109, Vol. 401, WL.U. 228-6, Part 2 (1955-1953).

<sup>137</sup> For example, see Banfield to Olson (USFWS), 5 September 1957, LAC, RG 109, Vol. 401, WL.U. 228-6, Part 2 (1959-1957).

<sup>138</sup> V.E.F. Solman (CWS) to A.S. Kenney (Department of National Revenue), 23 October 1956, LAC, RG 109, Vol. 401, WL.U. 228-6, Part 2 (1955-1956). Transboundary knowledge sharing between the two agencies took many forms, including unofficial meetings at scientific conferences, and the sharing of specimens and reports. For

In the western Arctic, the stabilization of the caribou herd concept involved both the establishment of boundaries around different groups of caribou and the managerial determination of accepted modes of knowledge production about the species. And like Banfield's taxonomic investigation, federal wildlife managers relied increasingly on scientific research methods as they sought to reinforce the boundaries around this core managerial unit.<sup>139</sup> In 1953, CWS mammalogist, E.H. McEwan, authored a report in which he outlined the agency's progress in its investigation of "Number 2 Stock" caribou, a term used by Canadian wildlife managers to distinguish the Alaska-Yukon caribou from the barren-ground caribou herds east of the Mackenzie River. In the paper, McEwan reflected on the way in which the agency's employment of technologies of aerial surveillance had altered their understanding of caribou herds and populations in the western Arctic. "In this region, until recently," he stated, "our knowledge of the size of the caribou herds was based on information obtained from the hunters."<sup>140</sup> But according to McEwan, who became a lead investigator in the agency's caribou research in the western Arctic, aerial surveillance allowed wildlife biologists to estimate more accurately the number of caribou in the herds they were tracking through the region. In his paper, which was presented at the 1953 Provincial-Federal Wildlife Conference, McEwan provided readers with a sense of the managerial faith in the ability of aerial cameras to render objective and accurate representations of the natural world. However, the significance of this technological development extended beyond the act of counting caribou. McEwan suggested that aerial

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examples, see: USFWS, "Alaska Project W-3-R-12: Job Completion Reports, Work Plan B, Job No. 2 (c) Caribou Movements, Distribution, and Numbers – Arctic Caribou," *Federal Aid in Wildlife Restoration* 12, 3 (1958): 49; W.A. Fuller (CWS) to Mair, 25 April 1958, LAC, RG 109, Vol. 401, WL.U. 228-6, Part 2 (1959-1957).

<sup>139</sup> For a discussion of the herd as a managerial unit in Alaska, see Ronald Skoog, et al., "W-6-R-4: Caribou Investigations, Work Plan C," *Federal Aid in Wildlife Restoration*, Vol. IV (1963); in Canada, see John Kelsall, *The Migratory Barren-Ground Caribou of Canada* (Ottawa: Queen's Printer, 1968), 150-156.

<sup>140</sup> E.H. McEwan, "Progress of Caribou Investigation – Number 2 Stock," in McEwan to Mair, 13 May 1953, LAC, RG109, Vol. 401, WL.U. 228-6, Part 2 (1953-1955).

surveys enabled caribou biologists to collect information and data inaccessible to biologists and hunters rooted to *terra firma*; information that wildlife managers would use as they sought new ways to stabilize the caribou herd concept and refine population-based caribou management models.<sup>141</sup>

The employment of aerial surveillance technologies alone, however, did not guarantee accuracy in managerial representations of caribou herds. Rather, the production of accuracy was a complex process that involved two imbricated sets of material and discursive practices. First, caribou biologists and wildlife managers had to modify aerial surveillance technologies and techniques to fit the field conditions of northern environments. Second, during this period, scientists positioned themselves as specialists with the expertise necessary for the interpretation of scientific evidence produced through aerial surveys.<sup>142</sup> In 1948, Daniel Leedy, a wildlife researcher who had gained experience working as a photo interpreter with the US Air Force during WWII, reviewed the existing literature on aerial photography and outlined its potential application in wildlife management. Not only was there a surplus of aerial cameras available for purchase following the end of hostilities, Leedy argued that during the war the military had refined aerial cameras in ways that made the technology better suited to surveying wildlife. By analyzing “Large scale photographs taken along the flight line of the aircraft,” Leedy suggested,

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<sup>141</sup> Population-based managerial control is central to the emergence of what Carolyn Merchant describes as managerial ecology, which turns on human attempts to model, manipulate, and predict environmental outcomes. See Merchant, *The Death of Nature*, 238. In an examination of the failure of managerial ecology, Dean Bavington considers the institutional and political context for the development and implementation of population-based management units in twentieth-century North Atlantic cod fisheries. See Bavington, *Managed Annihilation*, 13-35. For a northern perspective, Stephen Bocking outlines the historical transformation of population-based ecological thought in his examination of postwar perceptions of the north, which, he argues, shifted “[f]rom a view emphasizing dramatic, uncontrollable fluctuations in animal populations, to a view of wildlife as stable if properly managed.” Bocking, “Science and Spaces,” 870.

<sup>142</sup> Matt Dyce explores this thematic development in his paper on aerial photography in Canada. See Dyce, “Canada Between the Photograph,” 69.

wildlife managers can achieve “more accurate counts of big game than visual observations alone.”<sup>143</sup>

In 1955, Frank Banfield and three colleagues from the CWS presented a paper at the Twentieth North American Wildlife Conference in which they argued that aerial surveys represented the “only practical means of obtaining big game population data in the vast regions of northern Canada.”<sup>144</sup> However, the authors sounded a note of caution about the adoption of aerial surveys, arguing that wildlife managers would have to modify aerial photographic methods to fit northern field conditions if they wished to achieve accurate results. Further, they suggested that it was necessary for wildlife managers to consider the behavioural and geographical differences among northern big game animals as they planned aerial surveys. “We have found that the best period for caribou surveys is in March and April,” they explained. “At that time the herds are migrating from the winter ranges in closely packed columns,” making it “comparatively easy to count them” from above.<sup>145</sup> Yet, it was not always so easy to locate and count migratory caribou. As Banfield and colleagues stated in their paper, each species presented a different set of challenges for wildlife managers as they sought to determine the most appropriate survey altitude and angle of observation. Drawing from more than 2,000 hours of aerial survey work in northern Canada, they concluded that large bands of caribou were visible at a distance of three miles when flying at an altitude between 500 and 1,500 feet. However, at that same height, observers would likely miss small groups and individual caribou, even in open country. The accuracy of population estimates, they suggested, increased as observers decreased the distance between the airplane and the caribou they were counting. In some cases, such as

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<sup>143</sup> Leedy, “Aerial Photographs,” 202.

<sup>144</sup> Banfield et al., “An Aerial Survey Technique,” 519-520.

<sup>145</sup> Banfield et al., “An Aerial Survey Technique,” 521.

when observers encountered “heavy local concentrations of caribou,” the authors advised the use of aerial photography for population estimates. Yet, as the authors argued, the information contained in aerial photographs was not self-evident; rather, photographic interpretation required a specialized skill set, the use of proper technical devices, and careful analysis in the controlled environment of a lab.<sup>146</sup>

The ascendance of aerial surveillance in caribou science and management did not result in the complete disavowal of local and Indigenous knowledge. Rather, scientific reports produced during this period – and the archives of federal wildlife management agencies – reveal the extent to which postwar caribou science relied on information provided by Indigenous informants and people they described as knowledgeable hunters. As both federal wildlife management agencies lacked the resources and personnel necessary to monitor migratory caribou herds through their entire range, Indigenous hunters provided caribou scientists and wildlife managers with information that was vital to their understanding of caribou herds and migratory routes. Although they prioritized the evidence collected through aerial surveys and scientific field methods, wildlife biologists did use the geographical information provided by Indigenous hunters as they built theoretical models that described the movement of caribou through the western Arctic.<sup>147</sup>

But rather than engaging Indigenous knowledge on its own terms, wildlife managers considered only those elements that were commensurable with emergent scientific understandings of migratory caribou herds. Primarily, scientists and wildlife managers

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<sup>146</sup> Banfield et al., “An Aerial Survey Technique,” 529.

<sup>147</sup> This dynamic played out on both sides of the border. For Canadian examples, see Lewis to Sinclair, 28 January 1952, LAC RG 109, Vol. 401, WL.U. 228-6 (Part 1), September 15 – January 1952; Bryant to Mair, 30 August 1957, LAC, RG 109, Vol. 401, WL.U. 228-6, Part 2 (1959-1957). For an Alaskan example, see R. Scott, “Work Plan B, Job No. 2, Caribou Movements, Abundance, Distribution,” *Federal Aid in Wildlife Restoration* 8 (2): 12.

considered Indigenous knowledge about the location and timing of caribou migrations along with estimates of caribou herd size. Caribou scientists and wildlife managers were able to transpose numbers and location details into their maps and models without challenging the legitimacy of scientific modes of representation. However, through an almost singular focus on the collection of discrete data – numbers and geographical details – caribou scientists and wildlife managers neglected the broader context in which Indigenous understandings of caribou existed, effectively marginalizing Indigenous relationships with caribou in the western Arctic.<sup>148</sup>

Interestingly, as wildlife managers sought to mark the boundaries around the Porcupine herd, they drew on Indigenous knowledge about this group of animals. “It is significant,” Robert Scott wrote in 1953, “that natives of Old Crow as well as Arctic Village seem agreed that the caribou that make periodic appearances in their respective areas, represent one big herd, or combination of lesser herds, that range generally in the Chandalar, Upper Porcupine, and Arctic Coast region.”<sup>149</sup> Writing shortly after his collaboration with David Munro, Scott would have been struck by parallels between Indigenous descriptions of “one big herd” and his conclusions about the boundaries around the migratory Porcupine herd.

However, federal wildlife managers did not intend to replace scientific knowledge production with Indigenous knowledge about caribou herd dynamics. In many cases, they would not use Indigenous knowledge to address critical gaps in their conceptualization of caribou herds. For example, in 1960, CWS biologists were asked to supply northern administrators with information about the relationships among groups of caribou in the Peel River region. That year,

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<sup>148</sup> In an examination of the wildlife co-management framework that developed in late twentieth-century Yukon, anthropologist Paul Nadasdy argues that the integration of traditional ecological knowledge (TEK) and science strips Indigenous knowledge from broader social relations through its transformation into discrete data sets that are comprehensible to western scientists. Indeed, this dynamic has roots in the mid-twentieth century and the work of the caribou scientists examined in this chapter. See Paul Nadasdy, *Hunters and Bureaucrats*, 111-112.

<sup>149</sup> Scott, “Work Plan B, Job No. 2,” 13.

a shortage of caribou near Fort MacPherson – a Gwich'in community in the Northwest Territories – led northern administrators to consider amending the Yukon Game Ordinance to allow Indigenous hunters from the community to hunt and export caribou from the Yukon. Central to their decision was the issue of Indigenous subsistence and whether the extra hunting pressure would impact the economy of Old Crow. However, the determination of this issue required a better understanding of the relationship of the caribou in question to the bigger Porcupine herd. As Inspector W.M. MacGregor with the Old Crow Detachment of the R.C.M.P. stated, "If this small herd, hunted by the Fort McPherson Indians, is part of the large herd, it is believed that quite a large number of Caribou could be taken before the economy of the Old Crow Indians would be place [sic] in jeopardy."<sup>150</sup>

In the absence of scientific consensus regarding the boundaries around caribou herds in the region, CWS officials, who had been asked to provide administrators with information about these caribou, looked to a report authored by Knud Lang for the Northern Administration and Lands Branch in 1952. Based on his conversations with Gwich'in hunters, Lang, a longtime resident and trapper in the western Arctic, elaborated on Indigenous understandings of the caribou herds west of the Mackenzie River. Not only did Lang discuss Indigenous perspectives on the spatial relationships among caribou in the region, he also commented on their understanding of herd dynamics. According to the "old natives", Lang stated, "the cows prefer the [sic] return to localities where they raised their fawns the previous year, and the young animals like to return to the parts in which they were born if no serious hazards prevent it."<sup>151</sup> But when the CWS did respond to the R.C.M.P with details about the caribou, CWS biologist

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<sup>150</sup> MacGregor to Lysyk, 25 March 1960, LAC, RG 109, Vol. 401, WL.U. 228-6, Part 2 (1960-1959).

<sup>151</sup> Knud Lang, "Comments on the Caribou Herds – West of the Mackenzie Delta, based on conversations with old Eskimo and Loucheaux and personal observations during a period of twenty-four years," March 1952, LAC, RG 109, Vol. 401, WL.U. 228-6, Part 2 (1960-1959).

Andrew Radvanyi noted that the agency had not determined if the animals in question belong to “one vast herd” or constituted “several discrete herds, each of which follows its traditional migration routes.”<sup>152</sup> Although the archival record indicates that Radvanyi and his colleagues were aware of Lang’s report, it was not mentioned in their response concerning the amendment of the Game Ordinance. Rather, Radvanyi stated that the only way to acquire the requested information was through future aerial surveys.<sup>153</sup> Nonetheless, in the spring of 1960, F.H. Collins, the Commissioner of the Yukon, granted permission to the people of Fort MacPherson to hunt for caribou on the Yukon side of the territorial border.<sup>154</sup>

For Canadian wildlife managers, this incident exposed the limits of their knowledge regarding the migratory caribou herds of the western Arctic. Officials with the CWS had, in fact, been aware of the critical gaps in their knowledge of these caribou herds since the end of the joint CWS-USFWS investigation, and in 1959 the agency sought to address this scientific uncertainty through a series of caribou investigations in the western Arctic. During the next two years, Andrew Radvanyi, a CWS wildlife biologist stationed in Aklavik in the Northwest Territories, conducted multiple aerial surveys between the Mackenzie River and the Alaska-Yukon border. Although Radvanyi also organized and ran a series of field investigations of caribou in this region, the agency placed emphasis on the completion of aerial surveys. Unfortunately for Radvanyi, unfavourable weather conditions and mechanical problems with the service’s aerial camera hampered investigations.<sup>155</sup>

Radvanyi, of course, was not the first scientist to experience difficulties while surveying herds of migratory caribou. By the early 1960s, federal wildlife managers on both sides of the

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<sup>152</sup> Radvanyi to E.R. Lysyk, 26 April 1960, LAC RG 109, Vol. 401, WL.U. 228-6, Part 2 (1960-1959).

<sup>153</sup> Radvanyi to Lysyk, 26 April 1960, RG 109, Vol. 401, WL.U. 228-6, Part 2 (1960-1959).

<sup>154</sup> W.G. Brown to Mair, 2 June 1960, LAC RG 109, Vol. 401, WL.U. 228-6, Part 2 (1960-1959).

<sup>155</sup> See LAC RG 109, Vol. 401, WL.U. 228-6, Part 2 (1960-1959).

border were growing increasingly concerned about the technical issues experienced by the scientists who undertook costly aerial surveys of caribou. Although aviation had made the north accessible to scientists, technologies of aerial surveillance had not necessarily rendered legible the caribou herds that migrated through northern environments.<sup>156</sup> As federal managers began to acknowledge the shortcomings of aerial surveillance, they began to question the efficacy of this method in the development of scientific caribou management.<sup>157</sup>

Yet, scientific debate about the role of aerial surveillance and technologies of visualization in caribou management occurred within the boundaries of accepted modes of knowledge production. That is to say, rather than suggesting a fundamental shift away from dominant modes of representation of caribou, the critique of aerial surveillance was aimed at optimizing the managerial deployment of this method. In 1963, the Chief of the CWS asked biometrician D.A. Benson to review the agency's "barren-ground caribou program" and to provide him with a "reasonably concise" answer to the question: "How is our barren-ground caribou program shaping up, and what direction is it taking?"<sup>158</sup> Although much of the document focused on personnel issues, Benson did discuss the role of aerial surveillance within the agency's caribou research and management programs. Citing his own earlier work, Benson stated that the "weaknesses of aerial surveys can be classified as sources of error in the final

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<sup>156</sup> Stephen Bocking, however, considers the political implications of this process; he argues aviation – and the related technologies discussed in this section of the chapter – encouraged a view of the north as accessible and, therefore, legible. These were the political terms that fostered the northern expansion of managerial authority. See Bocking, "A Disciplined Geography," 273. For more on aviation and the extension of managerial vision over northern landscapes, see Loo, *States of Nature*, 131.

<sup>157</sup> See Alan Loughrey's comments on his concerns about the future use of aerial surveys without further research on and evolution of technologies of aerial surveillance. Cited in D.A. Benson to Chief, Canadian Wildlife Service, 14 August 1963, LAC, RG 109, Vol. 380, WL.U. 200, Part 20 (1963).

<sup>158</sup> It is important to note that Benson was asked to review CWS caribou management programs for the barren-ground caribou east of the Mackenzie River. Yet, his conclusions about the use of aerial surveys reflect a broader managerial anxiety about the use of this method. See Benson to Chief, Canadian Wildlife Service, 14 August 1963, LAC, RG 109, Vol. 380, WL.U. 200, Part 20 (1963).

population estimate.”<sup>159</sup> Although he outlined multiple sources of error, he argued that all were linked in some way to what he identified as the failure of the human observer to discern life forms from above. “Human fallibility,” he stated, “is always important.”<sup>160</sup> For example, he claimed that during the last hour of long surveys observers were prone to missing groups of caribou, which led to inaccurate population estimates. Not only did he find fault in the methods of observation, Benson also believed that a lack of sound statistical methods and techniques placed serious limitations on the ability of the scientist to “describe mathematically the distribution of animals on the ground.”<sup>161</sup> The accuracy of aerial surveys, he concluded, was diminished by the inescapable subjectivity of human observers and interpreters: “Our conclusion must be that aerial surveys of barren-ground caribou can produce estimates of herd size that are partly subjective, and of unknown accuracy.”<sup>162</sup>

Yet, in Benson’s estimation, these were not fatal flaws. While offering multiple caveats, Benson proposed technological and methodological fixes for the problems he described in his report. Whereas the subjectivity of human observers would inevitably compromise population estimates, he suggested that advancements in camera technologies could increase the accuracy of aerial surveys: the development of infrared, heat-sensitive film, he claimed, might be useful in caribou surveys; and a hand-held camera produced by the Hasselblad company – equipped with a 250 millimeter lens – had proven to be useful in recent waterfowl surveys conducted by wildlife managers in Illinois. However, Benson argued the CWS would have to investigate the use of cameras if officials hoped to use them properly in aerial surveys.<sup>163</sup> Alongside these

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<sup>159</sup> D.A. Benson to Chief, CWS, 14 August 1963, LAC, RG 109, Vol. 380, WL.U. 200, Part 20 (1963).

<sup>160</sup> Benson to Chief, CWS, 14 August 1963, LAC, RG 109, Vol. 380, WL.U. 200, Part 20 (1963).

<sup>161</sup> Benson to Chief, CWS, 14 August 1963, RG 109, Vol. 380, WL.U. 200, Part 20 (1963).

<sup>162</sup> Benson to Chief, CWS, 14 August 1963, RG 109, Vol. 380, WL.U. 200, Part 20 (1963).

<sup>163</sup> Benson to Chief, CWS, 14 August 1963, RG 109, Vol. 380, WL.U. 200, Part 20 (1963).

technological fixes, Benson also highlighted population estimates that combined aerial surveys with other less expensive field methods. Although these were labour intensive and still required a significant amount of flight time, Benson concluded that in areas “smaller than the environment of the barren-ground caribou, a total count can be approached, and data of direct value to management may be obtained.”<sup>164</sup> Despite the issues raised by Benson, aerial surveys continued to provide an important visual frame of reference for wildlife managers aiming to quantify caribou herd populations, and the method remained central in ongoing caribou research.

However, wildlife managers in Canada and the US have re-conceptualized their relationship to, and use of, this powerful yet imperfect method of representing migratory caribou. At the time of Benson’s report, few wildlife managers believed that they could produce a synoptic view of northern environments or a complete inventory of migratory caribou herds using conventional aerial survey methods.<sup>165</sup> Not only did they perceive aerial surveys as subjective representations of the natural world that were susceptible to technological flaws, they also cautioned that due to the costs associated with aviation, one could not expect to be successful in surveying the entire range of even a single caribou herd.<sup>166</sup> Despite the managerial claims of accuracy that accompanied the postwar adoption of aerial surveys, by the early 1960s, wildlife managers and caribou scientists were learning to embrace a more limited vision of this technological approach to mapping and counting migratory caribou.

In the western Arctic, Ronald Skoog, a wildlife biologist with the Alaska Department of Fish and Game, developed a method for surveying caribou herds that employed emergent

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<sup>164</sup> Benson to Chief, CWS, 14 August 1963, RG 109, Vol. 380, WL.U. 200, Part 20 (1963).

<sup>165</sup> Ronald Skoog, “Informational Leaflet 20: Method for Estimating Caribou Herds,” Juneau, Alaska: Department of Fish and Game, 3 December 1962.

<sup>166</sup> See Alan Loughrey’s comments regarding the costs of aerial surveillance. Cited in D.A. Benson to Chief, Canadian Wildlife Service, 14 August 1963, LAC, RG 109, Vol. 380, WL.U. 200, Part 20 (1963). For more on the prohibitive costs of aerial surveillance, see Skoog, “Method,” 1.

understandings of the caribou herd concept to outline a role for aerial surveillance through which wildlife managers could achieve “acceptable” levels of accuracy.<sup>167</sup> “One of the most consistent behavioral characteristics of a caribou herd (as pertains to Alaska at least),” Skoog explained, “is that sometime during the period mid-April to late May the calving segment of the herd will move to a definite calving area where most of the herd’s pregnant cows will drop their calves.”<sup>168</sup>

Although there would be some overlap in the winter ranges of different herds – a point raised by Scott and Munro in 1952 – Skoog argued that the animals separated in the spring and began their migration toward their respective calving grounds, which he considered to be a “focal point for the movements and range of an individual caribou herd.”<sup>169</sup> Further, each year caribou herds tended to use the same calving grounds, which were spatially restricted compared to the winter range.<sup>170</sup> By focusing their attention on the aggregation of caribou utilizing the calving grounds in the late spring, Skoog claimed wildlife managers could avoid the difficulties and costs associated with surveying the herd during that part of the year in which it was dispersed widely throughout its range. For the purposes of his method, he explained, pregnant cows represent the most important segment of the herd, and when “adequately censused,” could provide an “appropriate base for estimating total herd size.”<sup>171</sup> Once wildlife managers had counted the parturient cows on the calving grounds, he stated, they could then extrapolate information about the other segments of the herd from available population composition data. His methods of statistical analysis and quantification, which made several assumptions about the fertility rates

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<sup>167</sup> Skoog, “Method,” 1.

<sup>168</sup> Skoog, “Method,” 1.

<sup>169</sup> Skoog, “Method,” 1.

<sup>170</sup> Skoog, “Method,” 1.

<sup>171</sup> Skoog, “Method,” 1-2.

and bull to cow ratios, relied on scientific evidence accumulated through previous studies of Alaskan caribou herds.<sup>172</sup>

Skoog's method for estimating the population of caribou herds involved the delineation of both geographical and conceptual boundaries. Geographical boundaries were discussed most explicitly. The first step in the process, he explained, was aerial reconnaissance in late May over the herd's calving grounds. By this time, most of the pregnant cows would have aggregated on the calving grounds, marking the end of an important part of their annual migration, and making it relatively easy for observers to determine the boundaries of the herd's calving grounds. After determining the spatial extent of the area to be surveyed, wildlife managers would divide the calving grounds into segments, which were to be "traversed as completely as possible by airplane to tally the adult caribou."<sup>173</sup> After determining the number of parturient cows in each segment, wildlife managers, he argued, should be able to estimate the total number of caribou in the herd being observed.

Further, Skoog's discussion of the geographical boundaries around the calving grounds was bound up with the broader managerial objective of stabilizing the caribou herd concept. Since Scott and Munro had completed their aerial surveys of the Alaska-Yukon caribou herds, the idea of migration between two dissimilar areas – winter and summer ranges – had been central to scientific representations of the different herds in the region. After years of failed aerial surveys, Skoog refined this idea, suggesting that managers could gain a more complete view of caribou herds while they were aggregated at their calving grounds. In terms of the stimulating phenomena of caribou migration, Skoog's conclusions reflected broader scientific

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<sup>172</sup> A full explanation of Skoog's method of statistical analysis is beyond the scope of this chapter. For more detail, see Skoog, "Method," 1-6.

<sup>173</sup> Skoog, "Method," 2.

understandings which placed animal migration within their life histories and linked this very particular form of movement with processes of sexual reproduction.

In 1961, the Alaska Department of Fish and Game conducted a survey of caribou in northeastern Alaska, giving Skoog an opportunity to test his method. The survey, he stated, was required to complement ongoing research in the northwest being undertaken by the Cape Thompson Project, “in order that more complete set of data might be obtained concerning the herds ranging throughout arctic Alaska.”<sup>174</sup> The area to be surveyed extended “north of the Yukon and Porcupine Rivers to the Arctic Ocean and east of 152 degrees W longitude to the Alaska-Yukon border.”<sup>175</sup> After fifteen hours of reconnaissance flights over this 75,000 square mile area, Skoog and his team of researchers had located the calving grounds of the Porcupine Caribou herd. The calving area, he explained, lay on the north slope of the Brooks Range between the Canning and Kongakut Rivers, an area of about 2,500 square miles.<sup>176</sup> Two extra days of flights were required to delineate the boundaries of the calving grounds. After dividing the calving grounds into five segments, which he marked according to river drainages, two crews of observers spent the remainder of the survey tallying adult caribou on the calving grounds. Through Skoog’s method of statistical analysis, the team estimated a population of 117,000 animals – excluding calves – in the Porcupine Caribou herd.<sup>177</sup>

Skoog’s population estimate of the Porcupine Caribou represented an important step in the establishment of scientific modes of representation for the Alaska-Yukon caribou herds.

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<sup>174</sup> The research mentioned by Skoog was connected to the Atomic Energy Commission’s studies of the proposed Project Chariot explosions and the potential impact of radioactive fallout on caribou. See Skoog, “Method,” 3. For more on the Cape Thompson Project, see Barry Commoner et al., “Project Chariot,” *Science* 134, 3477 (1961): 495-503; Dan O’Neill, *The Firecracker Boys: H-Bombs, Inupiat Eskimos, and the Roots of the Environmental Movement* (New York: Basic Books, 1994; 2007), 98-99.

<sup>175</sup> Skoog, “Method,” 3.

<sup>176</sup> Skoog, “Method,” 3.

<sup>177</sup> Skoog, “Method,” 3-5.

Unlike most of his predecessors, Skoog had succeeded in completing an aerial survey of the caribou that migrated north of the Brooks Range. However, in a significant departure from past investigations, he did not attempt to produce a comprehensive view of these caribou through their entire range. Rather, Skoog worked with emergent understandings of the geographical and biological dynamics of the herds to develop a method of surveying caribou herds that took into account the geographic and economic realities of working in northern environments. In this way, I suggest, postwar wildlife managers refined the boundaries around caribou herds and effectively stabilized the caribou herd concept. There was no single defining moment in the stabilization of this core managerial concept. Rather, wildlife managers in Canada and the United States refined the conceptual boundaries around this managerial unit through an iterative process, continually collecting scientific information about caribou and translating it into forms that could be employed, refined, and critiqued by future scientists.

### **3.4. Conclusion**

While being interviewed on the CBC in 1949, Frank Banfield described the way in which he and his colleagues with the Dominion Wildlife Service were employing science to dispel the mystery surrounding the migratory caribou of northern Canada. As I have argued throughout this chapter, the scientific elimination of this state of mystery – or what others would describe as scientific uncertainty – oriented around the development of scientific modes of representation for caribou and the stabilization of core managerial categories. By the mid-1960s, North American wildlife managers had established firm boundaries around the species and caribou herd concepts. Further, through the deployment of capital-intensive technologies of surveillance and the development of a transnational network of caribou science, North American wildlife managers extended scientific representations of caribou into regions of the western Arctic that had long

been inaccessible to scientists. Not only had they concluded that the Alaska-Yukon caribou represented a single subspecies (*Rangifer tarandus granti*), scientists and managers studying the movement of these animals had drawn lines around the multiple herds composing this broad taxonomic group. They defined the Porcupine Caribou herd as that group of animals that migrated north of the Brooks Range toward their calving grounds on Alaska's North Slope.

More important than the establishment of these boundaries, however, was the managerial negotiation of accepted modes of knowledge production about caribou. Indeed, scientists and wildlife managers would continue to recognize the indeterminacy of the boundaries drawn during this period. In 1968, Ronald Skoog argued that despite Banfield's revision of genus *Rangifer*, the taxonomy of Alaska's caribou remained "unsettled."<sup>178</sup> He argued that Banfield and others had based their taxonomic classifications on skull morphology and the comparison of skeletal specimens, and therefore had not determined whether the subspecific differences were indeed genetic. New scientific methods, he suggested, had the potential to reveal new taxonomic boundaries.<sup>179</sup> For those scientists and wildlife managers interested in migration and herd dynamics, there remained a great deal of scientific uncertainty about the boundaries around caribou herds. While some scientists continued to rely on geographical definitions of caribou herds, others acknowledged the need for more detailed studies of migration and calving.<sup>180</sup> Yet, in the context of North American wildlife management, dissent about the placement of these boundaries occurred within the bounds of scientific knowledge production. During this period, wildlife managers had established a crucial boundary between accepted and rejected modes of

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<sup>178</sup> Skoog, "Ecology of the Caribou," 7.

<sup>179</sup> Skoog, "Ecology of the Caribou," 6-11.

<sup>180</sup> For more on the continued variation among scientific understandings of the caribou herd concept, see Thomas, *Population Estimates*, 7-10.

knowledge production about caribou, and they would continue to prioritize scientific modes of representation over all others.

Before concluding his conversation with Banfield, the host of the CBC program speculated on the relationship between radars and caribou. Banfield, who was somewhat confused by the comment, replied that he failed to see the connection. To clarify his point, the interviewer drew Banfield's attention to the connections between the Royal Canadian Air Force's aerial photography program and emerging radar technologies. As he began to understand the nature of the host's comments, Banfield allowed himself to speculate on a future where the DWS used radar technologies to survey migratory caribou herds. "It would be something," the host concluded, "to see a caribou with radar antenna strung across its antlers, wouldn't it?"<sup>181</sup> Although the facetious comment represented an attempt to interject humour into their conversation, it was also extremely prescient as radiotelemetry would come to play an important role in caribou management in later years. Indeed, in that moment, Banfield and his interviewer inadvertently captured a sense of the managerial faith in technologies of visualization and their potential application to northern wildlife management. But despite this moment of prescience, neither Banfield nor the interviewer would have been able to predict how the 1968 discovery of massive deposits of oil on Alaska's Arctic Coast would radically alter the terms of caribou management in the western Arctic and transform the nature of caribou science. In the next chapter, I turn to an examination of science, caribou conservation, and boundary-making practices in the western Arctic in the context of oil and gas development in northern Alaska.

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<sup>181</sup> Baxter to Gibson, 25 March 1949, RG 109, Vol. 394, WL.U. 228, Part 3.

## Chapter 4: Can Oil and Caribou Coexist? The Environmental Politics of Resource Extraction in the Transboundary Western Arctic, 1960-1989

### 4.1. Petroleum, Caribou, and the Significance of Environmental Impact

In April 1987, the US Department of the Interior released its Final Environmental Impact Statement and Coastal Plain Resource Assessment for the Arctic National Wildlife Refuge (ANWR) in northeastern Alaska. Established initially by executive order in 1960, and expanded by the 1980 passage of Alaska National Interest Lands Conservation Act (ANILCA), ANWR encompasses a 76,890-square kilometer swath of land in northeastern Alaska, which includes the Porcupine Caribou Herd's calving grounds on the coastal plain.<sup>1</sup> Since 1980, however, the status of the herd's calving grounds has been complicated by Section 1002 of ANILCA, which excludes approximately 6,000 square kilometers of the coastal plain from Wilderness designation.<sup>2</sup> In addition to being the site of the herd's primary calving grounds, geologists have described Alaska's coastal plain – and the “1002 area” – as the “most promising onshore oil and gas exploration area in the United States.”<sup>3</sup> Because of the region's “potentially enormous oil and gas resources and its important wildlife values,” Congress postponed all decisions regarding the future management of the coastal plain until the Department of the Interior completed a comprehensive inventory of the resources within the boundaries of the 1002 area (see figure 4.1).<sup>4</sup> The Final Environmental Impact Statement, which met this requirement, sought to

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<sup>1</sup> US Fish and Wildlife Service, “Arctic National Wildlife Refuge,” retrieved from [www.fws.gov/refuge/arctic/1002man.html](http://www.fws.gov/refuge/arctic/1002man.html) on January 13, 2018.

<sup>2</sup> For a discussion of Congressional politics surrounding the push to open ANWR, see: Michael McMonagle, *Caribou and Conoco: Rethinking Environmental Politics in Alaska's ANWR and Beyond* (Kentucky: Lexington Books, 2008), 3; 99.

<sup>3</sup> N. Clough, P. Patton, A. Christiansen, eds., *Arctic National Wildlife Refuge, Alaska, Coastal Plain Resource Assessment: Report and Recommendation to the Congress of the United States and Final Environmental Impact Statement, Volume 1 – Report* (Washington, D.C.: US Fish and Wildlife Service, US Geological Survey, and Bureau of Land Management, 1987), 1.

<sup>4</sup> Clough et al., *Arctic National Wildlife Refuge, Alaska, Coastal Plain Resource Assessment*, 1; Pamela Baldwin, *Legal Issues Related to Proposed Drilling for Oil and Gas in the Arctic National Wildlife Refuge (ANWR)* (Washington, D.C.: Congressional Research Service, Library of Congress, 2005), 3.

determine and analyse the “potential environmental consequences” that would arise from oil and gas exploration and production on ANWR’s coastal plain.<sup>5</sup>

For Donald Hodel, Secretary of the Interior in the Reagan Administration, the issue of environmental impact on the coastal plain was inseparable from broader concerns about US energy security. With domestic oil consumption outpacing domestic oil production, Hodel warned, “America’s growing reliance on imported oil for the rest of the century could have potentially serious ramifications for our national security.”<sup>6</sup> Yet, as Secretary of the Interior, Hodel also carried a responsibility to ensure that any future exploration activities on the coastal plain would occur “in a manner that avoids significant adverse effects on the fish and wildlife and other resources.”<sup>7</sup> After more than five years of “biological baseline studies” and public consultations with multiple stakeholders, which included meetings with Canadian officials, Hodel determined that the development of an “orderly gas and leasing program” within the 1002 area would not have a significant impact on local ecosystems or the Porcupine Caribou Herd. Thus, Hodel recommended that Congress open the entire ANWR coastal plain to oil and gas leasing. “My recommendation reflects my firm belief,” wrote the Secretary of the Interior, “based on demonstrated success at Prudhoe Bay and elsewhere, that oil and gas activities can be conducted in the 1002 area in a manner consistent with the need and desire to conserve the area’s significant environmental values.”<sup>8</sup>

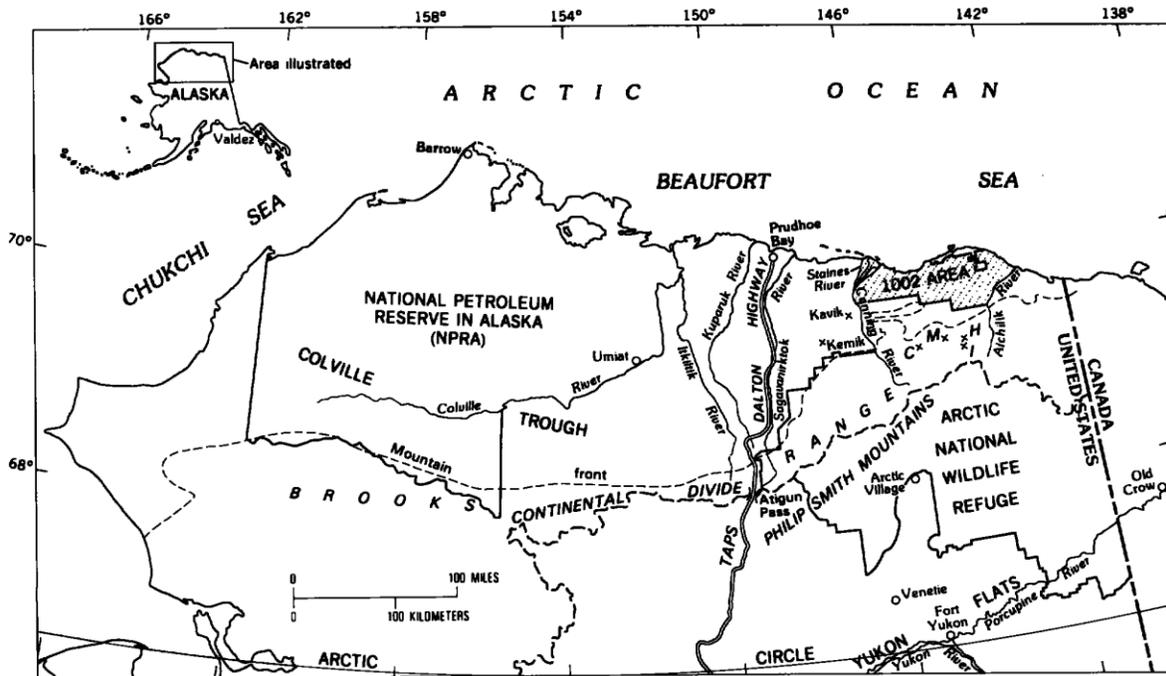
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<sup>5</sup> Clough et al., *Arctic National Wildlife Refuge, Alaska, Coastal Plain Resource Assessment*, 1.

<sup>6</sup> Clough et al., *Arctic National Wildlife Refuge, Alaska, Coastal Plain Resource Assessment*, 1.

<sup>7</sup> Alaska National Interest Lands Conservation Act, Public Law 96-487 § 1002(a)(1980).

<sup>8</sup> Clough et al., *Arctic National Wildlife Refuge, Alaska, Coastal Plain Resource Assessment*, 188.



**Figure 4.1. “Index Map of northeastern Alaska showing location of 1002 area in relation to the Arctic National Wildlife Refuge.” From United States Department of the Interior, *Arctic National Wildlife Refuge, Alaska, Coastal Plain Resource Assessment: Report and Recommendation to the Congress of the United States and Final Legislative Environmental Impact Statement* (US Department of the Interior, April 1987), 2.**

Since the 1968 discovery of oil at Prudhoe Bay, industrial development on Alaska’s North Slope has been an intensely contested issue defined primarily by oppositional framings of the Arctic environment. While proponents of drilling within ANWR have portrayed the region as a frozen wasteland – a space devoid of any value beyond its untapped oil reserves – conservationists and Gwich’in people on both sides of the border, along with their allies in Congress, have insisted that permitting oil companies to operate on the Refuge’s coastal plain would not only despoil one of America’s last “pristine” wilderness area, but also threatened the health and survival of the Porcupine Caribou Herd by compromising its calving grounds.<sup>9</sup>

<sup>9</sup> During a Congressional debate over drilling in ANWR in the early 2000s, Senator Frank Murkowski, Lisa Murkowski’s father, famously held up a blank, white poster and declared that it was an accurate representation of ANWR’s coastal plain. Dunaway, “Reframing the Last Frontier,” 164. For more on the oppositional framing of ANWR, see Haycox, *Battleground Alaska*, 39-58; Stuhl, *Unfreezing the Arctic*, 111-144; Subhankar Banerjee,

Some proponents of drilling in ANWR, however, have taken a different approach by seeking to decouple discursively industrial development from environmental degradation, and drawing attention to the ostensible benefits of increased North Slope oil production: namely the purported economic boon for the state of Alaska, and the potential to strengthen US energy security. Central to this strategic framing is the notion that the oil and gas industry can operate on the coastal plain without compromising the region's wilderness values. As one of the most recognizable charismatic megafauna in this region, migratory caribou herds have been central to the industry's claims to environmental stewardship. Between the early 1960s and 1987, oil companies devoted considerable resources to the study of migratory caribou as they sought to demonstrate that under particular circumstances, and with the proper safeguards in place, the extraction of oil and gas can occur without threatening the Alaska's migratory caribou herds. According to industry officials, oil and caribou can coexist.

To understand how this concept has shaped debates about North Slope energy development, it is necessary to examine the way in which oil companies became legitimate participants in and producers of caribou science in the second half of the twentieth century. Despite the considerable advancements made by caribou scientists in Canadian and American wildlife management agencies (examined in chapter 3), at the end of the 1960s, the Porcupine Caribou Herd's migration through the northern reaches of the transboundary western Arctic still complicated scientific efforts to study this group of animals. This began to change in 1968. Once considered to be an impediment to the production of scientific knowledge, the geography of the Porcupine Caribou Herd led to its becoming one of the most studied migratory animal

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*Arctic Voices: Resistance at the Tipping Point* (New York: Seven Stories Press, 2012); Finis Dunaway, "Reframing the Last Frontier: Subhankar Banerjee and the Visual Politics of the Arctic National Wildlife Refuge," *American Quarterly* 58, 1 (2006): 159-180; Roger Kaye, *Last Great Wilderness: The Campaign to Establish the Arctic National Wildlife Refuge* (Fairbanks: University of Alaska Press, 2006).

populations in North America after 1968.<sup>10</sup> Through their annual migration to the coastal plain, Porcupine Caribou were situated at the intersection of resource extractive schemes and the development of environmental science in the transboundary western Arctic.

Yet, scientific attempts to determine the commensurability of wilderness and development in the western Arctic spurred a protracted negotiation of scientific knowledge and expertise.<sup>11</sup> As oil companies sought ways to extract and transport North Slope oil to southern markets, they invested significantly in Arctic environmental science. While much of this research was intended to fulfill new federal requirements for environmental impact assessment in Canada and the United States, oil consortia operating in the western Arctic understood that participation in scientific research offered many business-related benefits.<sup>12</sup> Thus, the discovery of oil on Alaska's North Slope led not only to an intensification in resource exploration, but also unleashed a flurry of corporate-funded scientific activity throughout northeastern Alaska and the Yukon. The associated injection of funding – along with the resulting increase in scientific investigations – did enable wildlife scientists in Alaska and northern Canada to address critical gaps in their understanding of the Porcupine Caribou Herd, but it also had implications for the

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<sup>10</sup> Chris Johnson and Don Russell, "Long-term Distribution Response of a Migratory Caribou Herd to Human Disturbance," *Biological Conservation* 177 (2014): 52-63.

<sup>11</sup> For a discussion of the social implications of the negotiation of environmental expertise, see Sara Pritchard, "Joining Environmental History with Science and Technology Studies: Promises, Challenges, and Contributions," in *New Natures: Joining Environmental History with Science and Technology Studies*, eds. Dolly Jorgensen, Finn Arne Jorgensen, and Sara Pritchard (Pittsburgh: University of Pittsburgh Press, 2013), 12; Bocking, *Nature's Experts*; Latour, *Science in Action*. For more on corporate involvement in the production of environmental scientific knowledge claims, see Rebecca Lave, "Neoliberalism and the Production of Environmental Knowledge," *Environment and Society: Advances in Research* 3 (2012): 19. For discussions of the application of environmental science and knowledge as a means of dispossession in colonial-capitalist contexts, see Emilie Cameron, "Securing Indigenous Politics: A Critique of the Vulnerability and Adaptation Approach to the Human Dimensions of Climate Change in the Canadian Arctic," *Global Environmental Change* 22, 1 (2012): 103-114; Bruce Braun, *The Intemperate Rainforest: Nature, Culture, and Power on Canada's West Coast* (Minneapolis: University of Minnesota Press, 2002); Nadasdy, *Hunters and Bureaucrats*; Scott Prudham, *Knock on Wood: Nature as Commodity in Douglas-Fir Country* (New York: Routledge, 2005).

<sup>12</sup> Stuhl, *Unfreezing the Arctic*, 135. For more on the emergence of impact assessment, see A.W.F. Banfield, "Northern Ecology, Pipelines and Highways," *Nature Canada* 1, 2 (1972): 14-16.

development of Arctic environmental science. In this chapter, I argue that the involvement of the oil and gas industry in caribou science resulted in a form of boundary-work in which scientists and institutions engaged in a complex set of negotiations about what counted as caribou science.<sup>13</sup> Central to these negotiations was the ongoing contestation over the authority to delineate the boundaries that separated science from non-science, and determined which institutional actors were recognized as legitimate producers of scientific knowledge about caribou.

#### **4.2. Northern Impact: Oil Exploration and Arctic Environmental Science**

Between the end of the Second World War and 1968, caribou scientists working within federal, state, and territorial wildlife management agencies were the primary producers of scientific knowledge about the caribou herds that migrated north of Alaska's Brooks Range. As I argue in Chapter 3, during this period, state-based caribou scientists and wildlife managers in Canada and the United States established institutional linkages and conducted cooperative scientific investigations as they sought to overcome the problem of distance posed by caribou with migratory routes that spanned the northern reaches of the transboundary western Arctic. Through the deployment of new technologies of aerial surveillance, scientists refined their understanding of the biological relationships among different groups of caribou in the western Arctic, delineated new boundaries around caribou herds based on an emergent conceptualization of calving ground fidelity, and developed increasingly complex and, ostensibly, more accurate

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<sup>13</sup> The operational concept of boundary work employed here is derived from Gieryn, "Boundary-Work and the Demarcation of science from Non-Science," 781-795. For more on the ways in which social processes shape scientific practices and knowledge claims, see Richard Powell, *Studying Arctic Fields: Cultures, Practices, and Environmental Sciences* (Montreal & Kingston: McGill-Queen's University Press, 2017); Shapin and Schaffer, *Leviathan and the Air-Pump*; Lave, "Neoliberalism and the Production of Environmental Knowledge,"; David Demeritt, "The Construction of Global Warming and the Politics of Science," *Annals of the Association of American Geographers* 91, 2 (2001): 307-337; Mara Goldman, Paul Nadasdy, Matthew Turner, eds., *Knowing Nature: Conversations at the Intersection of Political Ecology and Science Studies* (Chicago: University of Chicago Press, 2011).

methods of quantifying caribou herd populations. Despite these considerable advancements in scientific knowledge, at the end of the 1960s, wildlife managers were struggling to address what they viewed as critical gaps in their knowledge of the Porcupine Caribou Herd. In a 1969 report on the activities of the Alaska Department of Fish and Game (ADF&G), biologists James Hemming and Robert Pegau argued that the “remote” area occupied by Porcupine Caribou simply posed too many logistical challenges, which continued to impede the collection of scientific information about this particular herd.<sup>14</sup>

This situation began to change, however, with the arrival of Big Oil in the late 1960s.<sup>15</sup> As the industry intensified the scale and scope of its exploration activities in the western Arctic, oil companies in turn made important contributions to extant scientific research programs. With traditional ranges and habitats that stood to be impacted by the industrial extraction of fossil fuel resources, migratory caribou herds became a key species of concern in corporate-funded scientific and environmental research programs. In its 1969 annual report, the ADF&G stated that aerial surveys conducted by “oil industry ecologists” were helping scientists develop a better understanding of the Porcupine Caribou Herd’s migratory patterns.<sup>16</sup> Through the participation and financial support of the oil and gas industry, caribou scientists were overcoming the problem of distance, which had stymied managerial efforts to study the Porcupine Caribou Herd during the second half of the twentieth century. But more than filling critical gaps, the emergence of corporate caribou science in the late 1960s also operated to expand the boundary around which

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<sup>14</sup> This information is drawn from an analysis of the Alaska Department of Fish and Game’s annual “Caribou Report”, which were supported by funding from the Federal Aid in Wildlife Restoration. For specific reference, see: James Hemming and Robert Pegau, “Caribou Report, Volume XI (1969),” Alaska Department of Fish and Game, Juneau (July 1970): 4.

<sup>15</sup> For a discussion of the arrival of “Big Oil”, see Stuhl, *Unfreezing the Arctic*, 113-115.

<sup>16</sup> Hemming and Pegau, “Caribou Report, Volume XI (1969),” 4.

groups and institutions were deemed legitimate producers of scientific knowledge about northern environments.

Two critical developments in the environmental history of the western Arctic shaped the contested socionatural environments being explored by oil and gas companies. First, in the period following the end of WWII, oil companies intensified the scale of their investments and exploration activities on both sides of the Alaska-Yukon border. Since the 1920s, governments in Canada and the US had pursued schemes to exploit the region's oil and gas reserves.<sup>17</sup> Yet, fossil fuel extraction did not occur on a large scale in the region until the 1950s, when heightened energy consumption in North America drove the state to establish policies aimed at opening the north to development, and led the industry to expand its search for new sources of oil and gas into regions of the Arctic once considered to be inaccessible to development. By 1960, oil companies working in the Canadian north had acquired exploratory permits to approximately 90 million acres of land in the Yukon and Northwest Territories; by 1967, the total area under permit had doubled to 180 million acres. On the Alaskan side of the border, oil companies leased more than 1.4 million acres during this same period.<sup>18</sup> The main players in the post-WWII push to transform the transboundary western Arctic into a vast "oil frontier" included Mobil Oil, Imperial Oil of Canada, Shell, British American Oil, Texaco, Husky Oil, British Petroleum, and Panarctic Oils – a joint government-industry oil exploration venture operating in northern Canada.<sup>19</sup> Exploration activities, however, increased dramatically in the years following Humble

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<sup>17</sup> On early Canadian developments, see Liza Piper, *The Industrial Transformation of Subarctic Canada* (Vancouver: UBC Press, 2010), 17-45; for a discussion of the Naval Petroleum Reserve, established on Alaska's North Slope in 1923, see Reed, *Exploration of Naval Petroleum Reserve No. 4*.

<sup>18</sup> For Canadian numbers, see A.B. Yates, "Energy and Canada's North: The Search for Oil and Gas," *Nature Canada* 1, 3 (1972): 12; for information on leasing in Alaska, see Stuhl, *Unfreezing the Arctic*, 113.

<sup>19</sup> For more on the transformation of the region into an "oil frontier", and the oil companies operating in Alaska, see Stuhl, *Unfreezing the Arctic*, 113; AmConsul (Calgary) to Department of State, "The Canadian Petroleum Industry and the New Arctic Frontier," 25 November 1968, National Archives and Records Administration (NARA), College Park, MD, RG 59, Department of State Central Files, Central Foreign Policy Files, Box 1349, File Pet 6 Can 1/1/67.

Oil and Atlantic Richfield's discovery of North America's largest oil field at Prudhoe Bay on Alaska's North Slope; by 1971, oil companies had leased 464 million acres in northern Canada, and almost 6 million acres in Alaska.<sup>20</sup>

Second, the development of a transnational environmental conservation movement in Canada and the US centering on the protection of swaths of "wilderness" in the western Arctic shaped the socionatural landscapes in which oil companies operated and conducted scientific research. Spurred by growing concerns about the environmental depredations wrought by postwar industrial development, in the early 1950s, a group of scientists and conservationists began to advocate for the establishment of the Arctic National Wildlife Range in northeastern Alaska.<sup>21</sup> Proposed initially by National Park Service (NPS) biologists George Collins and Lowell Sumner, proponents of the range sought to protect from development an area that many Americans viewed as the Arctic's last wilderness area, and preserve a natural laboratory in which scientists could study Arctic environmental processes.<sup>22</sup>

Through the 1950s, the movement gained support among American scientists and conservationists, who sought to influence members of Congress. Yet as historian Stephen Haycox argues, wilderness protection was a contentious issue in Alaska, and the movement to establish a wildlife range in the northeastern section of the territory spurred a protracted debate that pitted an emergent Alaskan environmentalism against the "traditional, pioneer, exploitative

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For a listing of the oil companies operating in Northern Canada, see the map enclosed in the following correspondence: K.J. Christie (Chief, Mining and Lands Division) to Winston Mair (Chief, Canadian Wildlife Service), 20 March 1958, Library Archives Canada (LAC) RG 109, Series B-1, Vol. 33, File 10;

<sup>20</sup> Stuhl, *Unfreezing the Arctic*, 113.

<sup>21</sup> Kaye, *Last Great Wilderness*, xiii.

<sup>22</sup> Haycox, *Battle Ground Alaska*, 43; George Collins and Lowell Sumner, "A Proposed Arctic Wilderness International Park: A Preliminary Report Concerning its Values," *Alaska Recreation Survey*, Preliminary Statement, November 1952, Arctic Wilderness International Park, US Department of the Interior, National Park Service, Region Four, GCP.

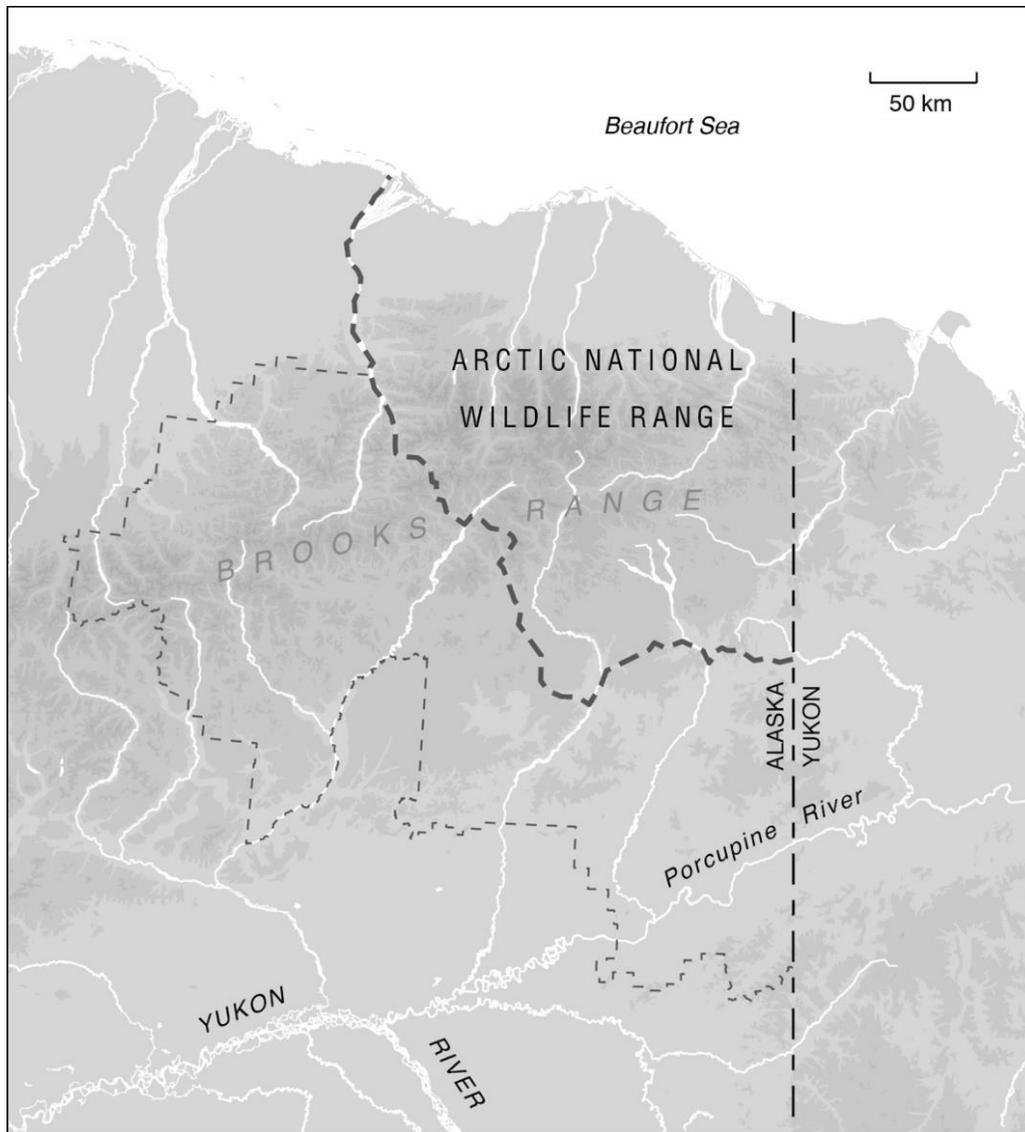
view of the land.”<sup>23</sup> Nonetheless, in 1960, just one year after Alaska had been granted statehood, President Dwight Eisenhower designated Public Land Order 2214, which established the 8.9 million acre Arctic National Wildlife Range in northeastern Alaska. Its eastern boundary coincided with the northernmost section (approximately 100 miles) of the International Boundary between Alaska and the Yukon.<sup>24</sup> Beyond the western boundary of the Range, however, the Eisenhower Administration also revoked Public Land Order 82 (1943), which opened approximately 20 million acres of the North Slope – including the area near Prudhoe Bay – to the oil and gas industry.<sup>25</sup>

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<sup>23</sup> Haycox, *Battle Ground Alaska*, 43.

<sup>24</sup> U.S. Fish and Wildlife Service, (December 8, 1960), “Public Land Order 2214: Establishing the Arctic National Wildlife Range.”; Jimmy Carter, “Foreword,” in Subhankar Banerjee, et al., *Arctic National Wildlife Refuge: Seasons of Life and Land* (Seattle: The Mountaineers Books, 2003): 12. For a historical examination of the campaign to establish the wildlife range, see Kaye, *The Last Great Wilderness*.

<sup>25</sup> McMonagle, *Caribou and Conoco*, 25. For material related to the establishment of the Range see: National Archives and Records Administration (NARA), Alaska Records (Seattle), RG 22: Records of the US Fish and Wildlife Service, 1868-2008, Series: Correspondence Relating to the Arctic National Wildlife Refuge, 1957-1962;



**Figure 4.2. The Arctic National Wildlife Range (1960), showing the expanded boundaries of the Arctic National Wildlife Refuge (1980). Map by Eric Leinberger.**

Though expansive, the boundaries of ANWR did not coincide with the ranges occupied by the wildlife species that scientists and conservationists sought to protect from industrial development. Thus, alongside efforts to establish the Arctic National Wildlife Range, conservationists and wildlife managers in Canada and the US began to articulate the concept of an international Arctic wilderness area, which, if established, would span across the International Boundary to include a game range in the northern Yukon. As early as 1958, officials with the

Department of Northern Affairs and National Resources met with Sigurd Olson, President of The Wilderness Society, to discuss Canadian participation in the potential establishment of the transboundary “Brooks Range Wilderness Area.” However, as an internal memo between officials in the Canadian Wildlife Service demonstrates, at this early stage the Canadian Government was not willing to commit to any regulations that foreclosed possibilities for the “orderly development of gas, oil and mineral deposits under the area, where such can be shown to be economically feasible, subject to the stipulations set forth in regulation for the maintenance of primary wildlife, scientific, aesthetic and recreational values and for the prevention of pollution.”<sup>26</sup> Although it would be almost 30 years before the federal land claims process paved the way for the establishment of a national park in the northern Yukon, the notion of transboundary wildlife management and conservation continued to shape political debate and discourse concerning the development of resource extractive industries in the western Arctic.<sup>27</sup>

Further, changes to the legal definition of “wilderness” at this point in time held implications for land use planning and management in Alaska and throughout the United States. As American conservationists grew increasingly concerned about the loss of natural areas, they pushed lawmakers to make wilderness protection enforceable by law.<sup>28</sup> After a protracted Congressional debate, President Lyndon Johnson signed the Wilderness Act into law in September 1964. The legislation, which established the National Wilderness Preservation System (NWPS), and protected more than nine million acres of land from development, effectively

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<sup>26</sup> See “Yukon Wilderness Area,” enclosed in Winston Mair (Chief, CWS) to David Munro, 31 July 1958, LAC-RG109, Series B-1, Vol 38, File WL.YT 300-3, Part 1 (1958-1957).

<sup>27</sup> On the establishment of Ivvavik National Park in the northern Yukon, see Brad Martin, “Negotiating a Partnership of Interests: Inuvialuit Land Claims and the Establishment of Northern Yukon (Ivvavik) National Park,” in Claire Campbell, ed., *A Century of Parks Canada, 1911-2011* (Calgary: University of Calgary Press, 2011), 273-302.

<sup>28</sup> Michael McCloskey, “The Wilderness Act of 1964: Its Background and Meaning,” *Oregon Law Review* 288 (1965): 288-321; Mark Harvey, *Wilderness Forever: Howard Zahniser and the Path to the Wilderness Act* (Seattle: University of Washington Press, 2005).

“codified an environmental ethic that placed a high value on sustaining natural conditions and plant and animal communities largely unaffected by human influence.”<sup>29</sup> Ultimately, the Act defined wilderness in opposition to those areas marked by the activities of man: “A wilderness,” the text of the Act reads, “is hereby recognized as an area where the earth and its community of life are untrammelled by man, where man himself is a visitor who does not remain.”<sup>30</sup> Though the framers of the law sought to define wilderness according to particular qualities, values, and attributes, the vague language and subjective terms employed in the legislation spurred subsequent debates about which areas should be developed and which qualified for wilderness designation.<sup>31</sup> In the years and decades following passage of the legislation, wilderness designation in Alaska reshaped environmental relationships and stoked heated debates about traditional subsistence activities on *wild* lands.<sup>32</sup>

As oil and gas companies intensified exploration activities in the western Arctic during this period, the industry also increased its participation in the production of Arctic environmental science. During the final years of the 1960s, the increasing role afforded to corporate actors was reflected in their heightened presence in spaces of scientific debate and knowledge dissemination. Founded in 1950 by the American Association for the Advancement of Science (AAAS), the “Alaska Science Conference” was an annual gathering of scientists and government officials that grew into one of the largest and most important scientific conferences in Arctic

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<sup>29</sup> Harvey, *Wilderness Forever*, 245. See also Mark Woods, “Wilderness Act of 1964,” in Julie Newman, ed., *Green Ethics and Philosophy: An A-to-Z Guide* (Thousand Oaks, California: SAGE Publications, 2011), 845-847.

<sup>30</sup> Wilderness Act, Public Law 88-577 (1964). Environmental philosophers J Baird Callicott and Michael Nelson have argued that the framers of the legislation were the inheritors of an ethnocentric and androcentric conception of wilderness that perpetuated the dualistic bifurcation of culture and nature. See J. Baird Callicott and Michael Nelson, eds. *The Great New Wilderness Debate* (Athens: University of Georgia Press, 1998), 1-22; 120-13.

<sup>31</sup> Woods, “Wilderness Act of 1964,” 846.

<sup>32</sup> Haycox, *Battleground Alaska*, 9; Ross Gorte, “Wilderness: Overview and Statistics,” *Congressional Research Services* 22 (2008): 1-12.

North America.<sup>33</sup> In 1967, organizers instituted a series of changes that were intended to modernize the conference format by making it more reflective of the shifting landscape of Arctic science and society. Whereas the “Alaskan Science Conferences have traditionally been primarily concerned with scientific and educational topics, particularly in the fields of the physical biological, medical and humanistic sciences,” organizers stated, “it is hoped that the framework of the 1968 Conference can be expanded to include active representation from the resource-oriented sectors of the Northern Community.”<sup>34</sup> Further, for the first time since 1950, the organizing committee expanded the conference theme beyond the somewhat vague notion of “Science in Alaska” to include a direct consideration of the relationship between Arctic science and northern development. And as organizers worked to include corporate actors in scientific discourse and policy debates, the oil and gas industry responded by joining the National Science Foundation (NSF) as a key funder of the Alaska Science Conference.<sup>35</sup>

The integration of industry-sponsored actors within the scientific community spurred a negotiation of the boundary that determined which groups and institutions were deemed legitimate producers of scientific knowledge, and fueled critical debates about which areas of research constituted valid topics of concern for the community of Arctic scientists. These forms of boundary-work played out in social interactions among scientists at the Alaska Science Conference in the late 1960s. As Alaskan economist George Rogers noted in his closing

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<sup>33</sup> On the growth and perceived importance of the event, see Jameson Bond (Director, Boreal Institute) to D.W. Simpson (Education Division, Department of Indian Affairs and Northern Development), 10 January 1968, LAC-85 (Northern Affairs Program), Vol 157, File 1005-3-1; Alaska Division of the American Association for the Advancement of Science, *Science in Alaska: Proceedings of Alaska Science Conferences, 20th Conference, College, Alaska, August 24-27, 1969*, (New York: Multiprint Inc., 1970), iii.

<sup>34</sup> Alaska Science Conference, First Circular, 5 December 1967, enclosed in: D.W. Simpson (Education Division, Department of Indian Affairs and Northern Development), 10 January 1968, LAC-85 (Northern Affairs Program), Vol 157, File 1005-3-1.

<sup>35</sup> Alaska Division of the American Association for the Advancement of Science, *Science in Alaska: Proceedings of Alaska Science Conferences, 20th Conference, College, Alaska, August 24-27, 1969*, (New York: Multiprint Inc., 1970), ii.

comments at the 1969 conference, the change in conference format – which included the expansion of invited participants and institutions – had been met with some resistance from senior academics and scientists who were opposed to the inclusion of perspectives they considered to be “highly unscientific.”<sup>36</sup> Despite this resistance, Rogers implored conference participants to embrace the changes occurring within the community of Alaskan and Arctic scientists. “The Alaska Science Conference,” he argued, “can no longer afford to continue as a rather cozy and pleasant club for the in-group of ‘scientific workers’.” Rather, Rogers argued, conference participants should consider their role, as scientists, in shaping public policy and promoting “human welfare” in Alaska. The conference, he averred, must “provide a means for defining and examining the key issues of Alaska.” More importantly, the venue should also “serve to inform the general public. It must embody the concept of science serving mankind – in this case, mankind in Alaska.”<sup>37</sup> As historians of science and technology have noted, in the postwar United States, scientific institutions and policy makers appealed to the notion that science contributed to social progress and economic growth through the development of technological applications and solutions.<sup>38</sup> Thus, the contestation over the authority to define the parameters of Arctic science was also bound up with a broader postwar debate about the role that science should play in shaping American society. And as the 1960s drew to a close, scientific institutions and policy makers saw a larger role for corporate actors in determining how scientific knowledge should be organized, produced, and applied in the transboundary western Arctic.

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<sup>36</sup> Alaska Division of the American Association for the Advancement of Science, *Science in Alaska*, ii.

<sup>37</sup> Alaska Division of the American Association for the Advancement of Science, *Science in Alaska*, vi.

<sup>38</sup> Hamblin, “Access Denied,” 165. For a critique of this model, see Daniel Sarewitz, *Frontiers of Illusion: Science, Technology, and the Politics of Progress* (Philadelphia: Temple University Press, 2010), 97-115. For an influential articulation of this justification for scientific funding, see Vannevar Bush, “Science: The Endless Frontier,” *Transactions of the Kansas Academy of Science* 48, 3 (1945): 231-264.

In the early 1970s, however, changes in the politics of environmental management restructured the role that the oil and gas industry played in the production of environmental science in the transboundary western Arctic. By 1970, widespread concern about the environmental damage caused by industrial development led governments in Canada and the United States to establish and implement federal frameworks for environmental impact assessment.<sup>39</sup> Scholars have noted that the establishment of environmental assessment frameworks had multiple implications for resource development and environmental management in the North American Arctic. As environmental historian Andrew Stuhl has argued, the National Environmental Policy Act (NEPA) of 1970, and the Canadian Government's establishment of guidelines for environmental impact assessments effectively "overhauled the existing political framework for managing the Arctic environment."<sup>40</sup> Ultimately, officials in both countries sought to develop systems of impact identification, prediction, and mitigation that took both social and biophysical processes into consideration. Within this framework, Stuhl argues, environmental science had to become more predictive than reactive, "it had to anticipate and evaluate the consequences of development and not merely record its effects."<sup>41</sup>

Although NEPA was an important precedent, which had a strong influence on the development of environmental assessment in Canada, the approach taken by Canadian officials differed in important ways. In the US, NEPA required relevant federal agencies and bodies to prepare an "Environmental Impact Statement" prior to authorizing any project that would occur on federal land or had been initiated by federal agencies.<sup>42</sup> Canadian officials, concerned that a

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<sup>39</sup> Stuhl, *Unfreezing the Arctic*, 126-132; Robert Gibson, "From Wreck Cove to Voisey's Bay: The Evolution of Federal Environmental Assessment in Canada," *Impact Assessment and Project Appraisal* 20, 3 (2002): 151-159; Bram Noble, *Introduction to Environmental Impact Assessment: A Guide to Principles and Practice* (Oxford: Oxford University Press, 2015), 7-13.

<sup>40</sup> Stuhl, *Unfreezing the Arctic*, 127.

<sup>41</sup> Stuhl, *Unfreezing the Arctic*, 127.

<sup>42</sup> Stuhl, *Unfreezing the Arctic*, 127.

legislative approach to environmental assessment would both open the “floodgates of litigation,” as was occurring in the US, and transfer authority and decision-making powers to the courts, opted instead for the development of a policy-based assessment process.<sup>43</sup> However, the resulting Environmental Assessment Review Process (EARP), established by Cabinet mandate in 1973, was not legally enforceable as it had not been passed through legislation.<sup>44</sup> Although relevant departments were authorized to decide which cases were appropriate for review, through the 1970s, impact assessments in Canada remained voluntary, and, therefore, were carried out inconsistently.<sup>45</sup> Importantly, EARP employed a “self-assessment” standard, which was intended to disperse the responsibility for environmental assessment throughout government, but ultimately, meant that project proponents – the companies or industries proposing particular developments – were responsible for conducting impact assessments, which they submitted to federal authorities for review.<sup>46</sup> Though the impact assessment processes differed, in the United States industries and corporate actors also contributed to environmental impact statements through the production of environmental studies that were included in the material reviewed by relevant federal authorities. Indeed, the adoption of federal environmental impact assessment frameworks expanded the scope of individuals and groups that participated in public discourse about resource development, but these frameworks also created conditions that further legitimized corporate participation in Arctic environmental science.<sup>47</sup>

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<sup>43</sup> Gibson, “From Wreck Cove,” 153; Stuhl, *Unfreezing the Arctic*, 127.

<sup>44</sup> Noble, *Environmental Impact Assessment*, 29.

<sup>45</sup> Noble, *Environmental Impact Assessment*, 29.

<sup>46</sup> Stuhl, *Unfreezing the Arctic*, 127; Gibson, “From Wreck Cove,” 153.

<sup>47</sup> Stuhl, *Unfreezing the Arctic*, 127. For a critique of the way in which the environmental assessment framework constrains Indigenous participation, see Carly Dokis, *Where the Rivers Meet: Pipelines, Participatory Resource Management, and Aboriginal-State Relations in the Northwest Territories* (Vancouver: UBC Press, 2015).

### 4.3. The Experimental North Slope

Through the early 1970s, the geography of North Slope energy development presented the oil and gas industry with considerable challenges and obstacles. From the industry's perspective, a primary area of concern involved questions related to the transportation of North Slope oil and gas to southern markets in the contiguous United States. By the end of the 1960s, however, oil companies had determined that North Slope energy development depended on the development of a network of oil pipelines; ensuing debates focused on which route prospective pipelines should follow. In 1969, the Trans-Alaska Pipeline System (TAPS) – a consortium of the three main oil companies operating on the North Slope – decided to pursue the development of an oil pipeline along a 1284-kilometer route that would deliver oil from Prudhoe Bay to the ice-free port at Valdez, Alaska.<sup>48</sup> Although a considerable amount of the industry-based research that occurred focused on the technological, infrastructural, and engineering challenges posed by Alaska's Arctic climate and physical landscape, the emergence of environmental assessment requirements meant that oil companies had to address potential ecological disturbances along the proposed route. As the proposed Trans-Alaska Pipeline route transected critical caribou habitat, oil companies sponsored scientific research that oriented around the prediction and mitigation of disturbances for the region's migratory caribou herds.

Before North Slope energy development could proceed, however, the US government had to settle existing Native land claims. As Stephen Haycox has noted, any pipeline built to transport North Slope oil to southern markets would have to cross land claimed by Alaska Natives; without settlement of these claims, he argues, there would be no oil development or

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<sup>48</sup> As Coates notes, the "Big Three" were Atlantic Richfield Company, Humble Oil, which was a subsidiary of Standard Oil, and British Petroleum. See Coates, *Trans-Alaska Pipeline*, 176; 380, footnote 1.

pipeline.<sup>49</sup> Although an extended discussion of the Alaska land claims process is beyond the scope of this chapter, it is important to note the way in which environmental and economic factors structured the process and shaped the eventual settlement.<sup>50</sup> With Alaskan politicians pegging the state's economic future to North Slope energy development, the US government moved to settle Native land claims at the end of the 1960s. In 1971, President Richard Nixon signed the Alaska Native Claims Settlement Act (ANCSA), which granted Alaskan Natives a cash settlement of \$962.5 million and fee simple title to 44 million acres of land as compensation for the extinguishment of additional claims and subsistence rights throughout the rest of Alaska.<sup>51</sup> The cash settlement and land was divided among 220 "village corporations" and 12 "regional corporations", which were created through the land claims process.<sup>52</sup> Further, the Act included an important conservation provision, which had an immense impact on environmental politics in the western Arctic. Section 17(d)(2) of ANCSA established a joint federal-state land use planning commission that would "recommend to the secretary of the interior and to Congress

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<sup>49</sup> Haycox, *Frigid Embrace*, 100.

<sup>50</sup> For a more thorough discussion of the land claims process, see Donald Mitchell, *Take My Land, Take My Life: The Story of Congress's Historic Settlement of Alaska Native Land Claims, 1960-1971* (Fairbanks: University of Alaska Press, 2001); Kenneth Pratt, ed., *Chasing the Dark: Perspectives on Place, History and Alaska Native Land Claims* (Anchorage, Alaska: US Department of the Interior, ANCSA Office, 2009); Haycox, *Frigid Embrace*, 83-133; Haycox, *Battleground Alaska*, 83-135; Stuhl, *Unfreezing the Arctic*, 89-110; Coates, *Trans-Alaska Pipeline Controversy*, 175-250; Patricia Thompson, "Recognizing Sovereignty in Alaska Native Villages After the Passage of ANCSA," *Washington Law Review* 68 (1993): 373-414.

<sup>51</sup> Haycox, *Battleground Alaska*, 95; Pratt, *Chasing the Dark*, 4; Stuhl, *Unfreezing the Arctic*, 130.

<sup>52</sup> A note on the structure of the Native Corporations formed through the ANCSA process: at the village level, Natives had to organize to form a "village corporation", which could be registered either on a profit or non-profit basis, for the purposes of holding title to the surface estate of the ANCSA land grants. Regional corporations, which were registered on a for-profit basis, received and dispersed the cash settlement among the villages within their boundaries based on population. Further, as mandated by the terms of ANCSA, each regional corporation had to distribute not less than 50% of the revenue from subsurface land rights. In addition to the 12 regional corporations, ANCSA allowed for the establishment of a 13th regional corporation for Alaskan Natives living outside the state. Although this group did not receive revenue from the subsurface estate, members received a share of the initial cash settlement. For more on the terms of the land claims, and the socio-political structure of the Native Corporations, see J.S. Frideres, "Native Settlements and Native Rights: A Comparison of the Alaska Native Settlement, the James Bay Indian/Inuit Settlement, and the Western Canadian Inuit Settlement," *Canadian Journal of Native Studies* 1, 1 (1981): 59-89.

withdrawals for new national parks, refuges, forests, and scenic rivers, a portion of which would be designated as wilderness.”<sup>53</sup>

With the US government and Alaska Natives engaged in the land claims process, oil companies pushed ahead with plans to develop the Trans-Alaska Pipeline. As requirements for environmental assessment had recently come into force, the federal government continued to investigate new ways to mitigate environmental impacts along the proposed pipeline route. Following the 1969 TAPS application for a right-of-way, President Nixon established the interdepartmental Federal North Slope Task Force on Oil Development, which was responsible for overseeing technical and environmental aspects of the proposed pipeline.<sup>54</sup> Building on an established research network in Arctic environmental science, the Task Force appointed a number of permafrost scientists to a special subcommittee to review pipeline proposals. Although this venue allowed permafrost researchers to “rebroadcast” their concerns about industrial development in the Arctic, northern scientists believed that the ambiguity of NEPA decision making process “allowed economic interests to dictate the final outcome.”<sup>55</sup>

During the early 1970s, the state placed pressure on TAPS, which was renamed Alyeska in 1970, to incorporate mitigation measures in its pipeline design to protect northern wildlife populations. At the end of 1969, Russell Train, the Undersecretary of the Bureau of Land Management (BLM) and head of a North Slope Task Force subcommittee that oversaw the pipeline proposal, presented the consortia with a list of 79 questions “that emphasized both environmental and social safeguards to be considered in the planning for pipeline construction,” and subsequently developed a “comprehensive list of stipulations governing pipeline

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<sup>53</sup> Haycox, *Battleground Alaska*, 96.

<sup>54</sup> Coates, *Trans-Alaska Pipeline Controversy*, 176-177; Stuhl, *Unfreezing the Arctic*, 128.

<sup>55</sup> Stuhl, *Unfreezing the Arctic*, 128.

construction.”<sup>56</sup> Officials with the BLM, which was the federal agency responsible for enforcing these stipulations, cautioned TAPS that they intended to “police the construction of the pipeline,” and “formulate new regulations to minimize environmental losses.”<sup>57</sup> For oil and gas companies, impact mitigation and environmental expertise were inextricably linked. Thus, at the beginning of the 1970s, TAPS became a major sponsor of an experimental research program that sought to understand Arctic ecological relationships and predict potential pipeline-wildlife interactions. One of the most important questions facing scientists was whether the presence of a pipeline would restrict the movement of migratory caribou herds in the western Arctic. As BLM biologist James Hemming explained at a 1972 conference, the proposed pipeline route from Prudhoe Bay to Valdez traversed and intersected the ranges of three migratory caribou herds: the Nelchina caribou in southcentral Alaska, and the Central Arctic and Porcupine Herds in northern Alaska.<sup>58</sup>

By 1970, however, scientists had conducted very little research on the relationship between human disturbances and wildlife populations in northern environments, and they were unable to predict how migratory caribou would react to the presence of 48-inch diameter hot-oil pipeline.<sup>59</sup> In its 1971 proposal, Alyeska responded to concerns about this potential environmental impact through the development of multiple prototypes for big game crossings, which included ramps and elevated sections of pipeline at critical points along the route.

Officials within the BLM, however, were unconvinced. Based on contemporary understandings

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<sup>56</sup> Kenneth Child, *The Reactions of Barren-Ground Caribou (Rangifer tarandus granti) to Simulated Pipeline and Pipeline Crossing Structures at Prudhoe Bay* (Fairbanks: The Alaska Cooperative Wildlife Research Unit, University of Alaska, Fairbanks, 1973), 1.

<sup>57</sup> Child, *Reactions of Barren-Ground*, 1-2.

<sup>58</sup> James Hemming, “Alaskan Problems and Prospects,” in Jack Luick, Peter Lent, David Klein, and Robert White, eds., *Proceedings of the First International Reindeer and Caribou Symposium* (Fairbanks: University of Alaska, 1975), 13.

<sup>59</sup> Child, *The Reactions of Barren-Ground*, 1-2.

of caribou-pipeline integrations, officials cautioned, “there was no evidence available to support the supposition that caribou will pass under an elevated pipe or for that matter, over a ramp.”<sup>60</sup>

To address this critical gap in scientific knowledge, Alyeska prioritized caribou studies in the development of its experimental research program. In the summer of 1971, Alyeska partnered with British Petroleum (BP) and the US Bureau of Sport Fisheries and Wildlife to co-sponsor a scientific research program that sought to document the “behavioral responses of barren ground caribou to pipeline structures and man’s activities on the North Slope Alaska.”<sup>61</sup> The research program consisted of a series of experiments at sites on the North Slope and the Seward Peninsula, which were conducted by Kenneth Child, a Ph.D. student at the Alaska Cooperative Wildlife Unit (University of Alaska). At Prudhoe Bay, Alyeska constructed more than three kilometers of simulated pipelines, which were intended to act as a physical and visual barrier to the movement of migratory caribou. To test the efficacy of the big-game crossing prototypes proposed in its 1971 report, the designers of the experiment constructed ramps over certain sections of the pipeline, and elevated other sections, which, presumably, would allow migratory caribou to cross under the structure. Child, who carried out the fieldwork for this experiment, was responsible for making observations and recording how caribou responded when they encountered different sections of simulated pipeline. Further, with research scheduled to occur during the summer months, many of the caribou that became unwitting participants in the Alyeska experiment were not travelling alone; rather, they migrated with calves that had been born just weeks prior to encountering the simulated pipeline.<sup>62</sup>

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<sup>60</sup> Quoted in Child, *Reactions of Barren-Ground Caribou*, 2. See also Alyeska Pipeline Service Company, “Summary of the Project Description of the Trans-Alaska Pipeline System: Submission to the US Department of the Interior,” September 24, 1971.

<sup>61</sup> Child, *Reactions of Barren-Ground Caribou*, 3.

<sup>62</sup> For a full discussion of the experimental design, see Child, *Reactions of Barren-Ground Caribou*; Kenneth Child, “A Specific Problem: The Reaction of Reindeer and Caribou to Pipelines,” in Jack Luick, Peter Lent, David Klein,

Through the development of its caribou-pipeline research program, Alyeska transformed the North Slope into an *experimental space* in which it sought to legitimize technological solutions to future environmental problems.<sup>63</sup> The idea of the north as a natural laboratory has a long history, which has shaped environmental relations in the North American Arctic through much of the twentieth century.<sup>64</sup> As I describe above, in the late 1950s, American conservationists deployed a similar discursive framing of the region as they lobbied Congress to establish a wildlife preserve in northeastern Alaska. The Alyeska experiment, however, was fundamentally different than the northern laboratory envisioned by advocates of wilderness protection. Rather than observing ostensibly *natural* ecological relationships, Alyeska aimed to create an experimental future landscape on the North Slope in which scientists could observe and measure the impact of pipelines on northern ecosystems.

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and Robert White, eds., *Proceedings of the First International Reindeer and Caribou Symposium* (Fairbanks: University of Alaska, 1975), 14-19.

<sup>63</sup> Here I draw on the concept of “experimental space” as articulated by Shapin and Schaffer, and their insistence that space is a social domain in which abstract cultural boundaries shape and govern social relations and interactions. “Sanctions,” they argue, “can be enforced by community members if the boundaries are transgressed.” Shapin and Schaffer, *Leviathan and the Air Pump*, 333.

<sup>64</sup> Richard Powell, “‘The Rigours of an Arctic Experiment’: The Precarious Authority of Field Practices in the Canadian High Arctic, 1958-1970,” *Environment and Planning A* 39, 8 (2007): 1794-1811; Matthew Farish, “The Lab and the Land: Overcoming the Arctic in Cold War Alaska,” *Isis* 104 1 (2013): 1-29; Stuhl, *Unfreezing the Arctic*, 61-87; Michael Bravo and Sverker Sörlin, eds., *Narrating the Arctic: A Cultural History of Nordic Scientific Practices* (Canton, MA: Science History Publications, 2002).



**Figure 4.3: “A Group of caribou feed on *Artemisia arctica* west of the snowfence and burlap barrier. Modified ramp and underpass structures are shown.” From Kenneth Child, *The Reactions of Barren-Ground Caribou (*Rangifer tarandus granti*) to Simulated Pipeline and Pipeline Crossing Structures at Prudhoe Bay* (1973), Page 9.**

Scientific authority, however, was not inherent to the experimental method. As historical geographer Richard Powell has argued, during the second half of the twentieth century, the “precarious authority” of the northern experiment rested upon scientists’ putative ability to exert rigorous control over intemperate northern natures.<sup>65</sup> Like other scientific institutions operating in the North American Arctic, Alyeska also sought to exert strict control over the experimental space that it produced on Alaska’s North Slope. For the designers of the research program, it was

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<sup>65</sup> Powell, “The Rigours of an Arctic Experiment,” 1794-1795. For more on the relationship between scientific authority and the exertion of control over experimental space in northern landscapes, see Scott Kirsch, *Proving Grounds*; Scott Kirsch, “Experiments in Progress: Edward Teller’s Controversial Geographies,” *Ecumene* 5, 3 (1998): 267-285.

essential to produce an experimental space that was amenable to scientific observation and measurement, which meant taking careful and deliberate steps to ensure that the complexities of the northern environment did not compromise the scientific integrity of the caribou experiment.<sup>66</sup>

In many ways, the success of the experiment turned on the scientists' ability to render visible social dynamics among large numbers of highly mobile caribou. Through field observations, Child and his colleagues sought to determine whether the size and composition of caribou groups changed after encountering the pipeline. Yet, as Child argued in a 1973 report, "recognizing individual animals or groups of caribou is a difficult, if not an impossible task, considering the mobility of the species and the instability of the herds."<sup>67</sup> In response to the problem of legibility, Child employed a field marking program for studying mobile animals, which had been developed by Dall sheep researchers in 1971.<sup>68</sup> Between June 21 and 30, researchers used a small single-engine airplane equipped with a 90-gallon tank to spray groups of caribou within a 56-kilometer radius of the Deadhorse airstrip with non-toxic fabric dyes (see figure 4.3). "The water-diluted dyes," explained Child, "were applied to caribou bands on a color-coded scheme according to geographic location."<sup>69</sup> Over the course of the experiment, scientists identified 48 dyed animals as they migrated through the Prudhoe Bay oil field. The presence of these dyed animals, Child argued, "facilitated behavioral observations by permitting a) recognition of groups, b) mapping of movement patterns throughout the oil field, and c) field identification of animals on a short-term basis."<sup>70</sup>

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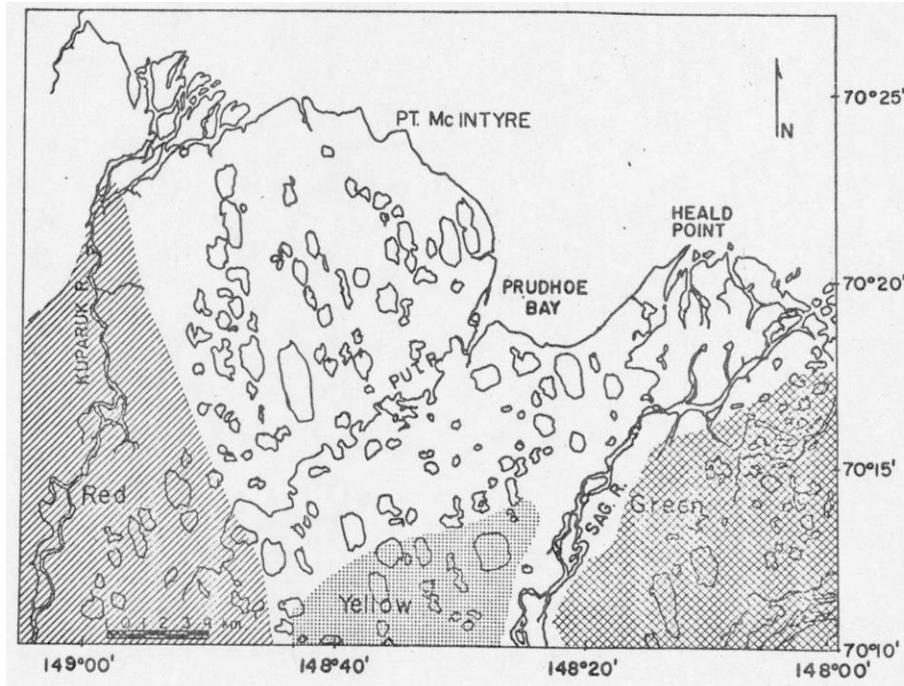
<sup>66</sup> Child, *Reactions of Barren-Ground Caribou*, 11-12; Child, "A Specific Problem."

<sup>67</sup> Child, *Reactions of Barren-Ground Caribou*, 11.

<sup>68</sup> Child, *Reactions of Barren-Ground Caribou*, 11. For original description of method, see N. Simmons, "An Inexpensive Method of Marking Large Numbers of Dall Sheep for Movement Studies," in Eugene Decker, ed., *Transactions of the First North American Sheep Conference* (Fort Collins: Department of Fishery and Wildlife Biology, Colorado State University, 1971).

<sup>69</sup> Child, *Reactions of Barren-Ground Caribou*, 11.

<sup>70</sup> Child, *Reactions of Barren-Ground Caribou*, 12.



**Figure 4.4. “Map of the Coastal Plains at Prudhoe Bay Showing the General Areas Searched and the Color-code Scheme Used in the Aerial Spray Marking Program for Caribou.”** From Kenneth Child, *The Reactions of Barren-Ground Caribou (*Rangifer tarandus granti*) to Simulated Pipeline and Pipeline Crossing Structures at Prudhoe Bay* (1973).

In addition to environmental controls, Alyeska asserted its authority over this experimental space by controlling the flow of information produced through the research program. Though visibility is central to the authority of the experimental method, officials with Alyeska leveraged their position as the primary funders of the caribou-pipeline experiment to determine how and when scientific results were disseminated. However, Alyeska’s authority and attempt to control discursively the caribou-pipeline experiment sat uneasily with the researchers involved in the research program, and raised concerns among the broader community of Arctic environmental scientists. Following a presentation at the First International Reindeer and Caribou Symposium in 1972, members of the audience asked Kenneth Child to elaborate on his description of the pipeline design and the experiment’s objectives. “[W]hat we are all interested in,” one scientist stated, “is the results. Can you give us some of the results?” Child, however,

was unable to answer that question. In response to his silence, David Klein, a biologist at the University of Alaska who supervised Child's fieldwork for the Alyeska experiment, offered something of an explanation: "In our agreement with the oil and pipeline companies," he stated, "there is an understanding that no parties will release to the public information of an inconclusive nature; that is, release of information before the field data have been analyzed."<sup>71</sup> Beyond this vague description, however, what constituted "inconclusive information" was not clear to all parties involved in the experimental research program.

Further, conference participants questioned the sincerity of the oil companies' support for scientific research. If the studies proved to be "unfavorable to the oil companies," and were therefore "kept secret," asked German forester Götz Schühholz, "will you be able to have any effect on the pipeline construction"? In response, Child reflected on the way in which the "political hassle" surrounding the pipeline shaped the production of scientific information. "Personally I feel somewhat frustrated in not being able to speak freely about our work. I think, however, if the results are conclusive the public will become aware of them." Child, however, speculated on the way in which economic interests might dictate the public dissemination of information related to the experimental research program. "[O]ne should take into account the viewpoint of the oil industry," Child cautioned. "If our results are unfavorable to their interests they quite likely would not like to see them released." But until the results have been analyzed, Child noted, "I am not really free to speculate."<sup>72</sup>

Despite concerns about Alyeska's control of the dissemination of scientific information, in 1973, the University of Alaska published Child's completion report of the simulated pipeline

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<sup>71</sup> See "Response from the Discussants," in Luick et al., *Proceedings*, 21.

<sup>72</sup> See "Response from the Discussants," in Luick et al., *Proceedings*, 24-25.

experiments at Prudhoe Bay.<sup>73</sup> While some within the scientific community critiqued the results for being both “incomplete and artificial”, others acknowledged that the simulated pipeline experiments represented “the only significant source of information from which the reactions of caribou to pipelines can be anticipated.”<sup>74</sup>

As the experimental research program focused on pipeline-caribou interactions, it was necessary for Child to engage in a broader investigation of caribou biology and migratory behaviour. Thus, the Alyeska-sponsored studies represented a significant contribution to the field of caribou studies in the western Arctic. Although the study area was situated in the “overlap zone” between the Western Arctic and Porcupine Caribou Herds – the two major herds in northern Alaska – Child confirmed the presence of a separate calving area at Prudhoe Bay; this finding led future scientists to document the continued existence of the “Central Arctic Herd”, which was believed to have disappeared after merging with the larger Arctic herd to the northwest in the 1950s.<sup>75</sup> Further, as the research program sought to determine how the presence of a pipeline affected the behavior of individual caribou and groups, the scientists devoted considerable attention to surveying and mapping the movements of migratory caribou throughout the region.

Ultimately, however, the report focused on the results of Child’s fieldwork, and suggested a number of recommendations for pipeline design based on his observations of caribou-pipeline interactions. From an environmental impact perspective, the most significant result was Child’s observation that migratory caribou tended to avoid elevated sections of

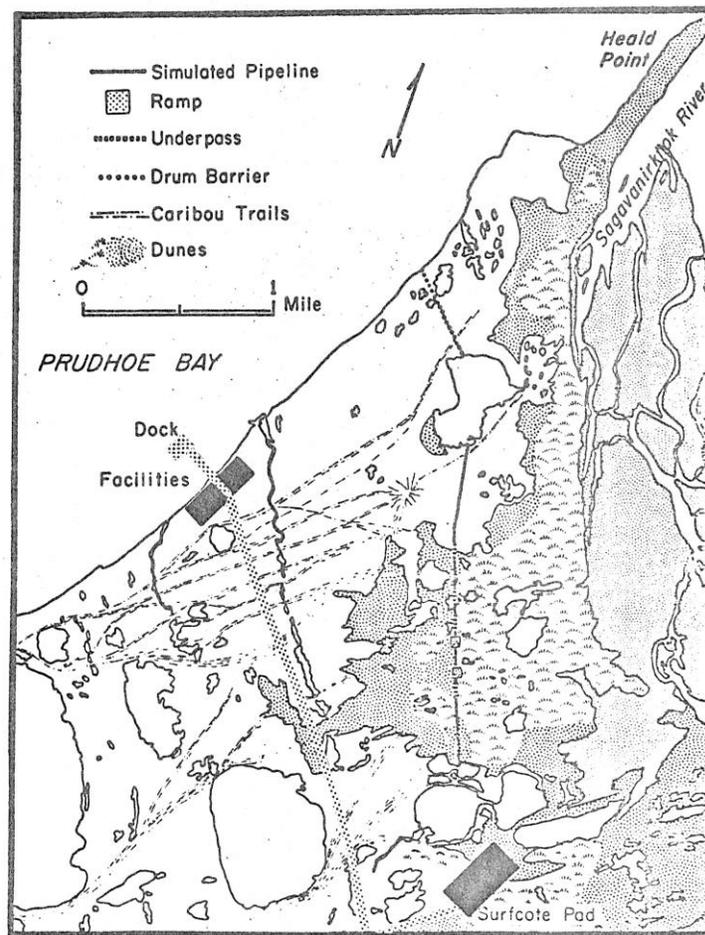
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<sup>73</sup> The completion report included a discussion of other simulated pipeline experiments that assessed the reactions of caribou and reindeer herds in other areas of Alaska, which were sponsored by British Petroleum and relevant federal and state wildlife management agencies. See Child, *Reactions of Barren-Ground Caribou*.

<sup>74</sup> Raymond Cameron and Kenneth Whitten, *First Interim Report of the Effects of the Trans-Alaska Pipeline on Caribou Movements*, No. 2 (Fairbanks: Joint State/Federal Fish & Wildlife Advisory Team, 1976), 1.

<sup>75</sup> Cameron and Whitten, *First Interim Report*, 28-30.

pipeline and chose instead to use ramps to cross the structure. After considering the implications of this finding, Alyeska opted to incorporate it in its pipeline design.<sup>76</sup> Child also pointed to the need to understand the spatial dynamics of caribou-pipeline interactions; he argued that caribou trails – which are visible on the tundra landscape – should be mapped, and in places where the proposed pipeline will intersect the traditional trail systems, Alyeska should construct multiple crossings to mitigate the impact on caribou movements (see figure 4.2).



**Figure 4.5.** “Map of Heald Point and Prudhoe Bay showing the location and orientation of Alyeska’s simulated 48-inch pipeline to the traditional trails of caribou mapped for the area.” From Kenneth Child, *The Reactions of Barren-Ground Caribou (*Rangifer tarandus granti*) to Simulated Pipeline and Pipeline Crossing Structures at Prudhoe Bay* (1973), Page 7.

<sup>76</sup> Cameron and Whitten, *First Interim Report*, 22.

Yet, Child concluded that social dynamics within groups of caribou and environmental factors determined the rate and frequency of “successful” pipeline crossings. For example, he found that groups led by cows were far more likely to cross the simulated pipeline than groups in which a bull was the leader. More important than social dynamics, however, were the environmental factors believed to drive caribou migrations. Through the computer-based analysis of multiple linear regression models, Child concluded that the single greatest factor that drove caribou to cross the simulated pipeline was the presence of biting insects. During the summer months, migratory caribou in northern Alaska moved toward the coastal plain where on-shore winds and aggregations of large numbers of animals provided individual caribou with some relief from constant harassment from mosquitoes and other biting insects. As the number of insects increased, Child noted, caribou were more likely to cross the simulated pipeline as they made their way to the coastal plain. Thus, Child not only suggested the importance of migratory behavior in determining the nature of caribou-pipeline interactions, but also pointed to the temporal limitations of his analysis and findings; caribou, he noted, may react very differently when encountering pipelines at other times of the year.<sup>77</sup>

Finally, in the discussion of his results, Child noted what he perceived to be an interesting correlation between the rate of successful crossings and the number of times a caribou encountered the simulated pipeline structure; after repeated encounters, he suggested, caribou were more inclined to use the ramp crossings. Although there was considerable noise in the sample, which complicated any conclusions he could draw from this correlation, he did suggest the possibility that caribou might eventually recognize the ramps as “avenues of access to the other side” of the pipeline.<sup>78</sup> From an industry perspective, the idea that caribou might acclimate

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<sup>77</sup> Child, *Reactions of Barren-Ground Caribou*, 21.

<sup>78</sup> Child, *Reactions of Barren-Ground Caribou*, 18.

to the presence of pipelines – and perhaps other trappings of northern oil and gas development – was a promising proposition, which continued to shape industry-sponsored caribou science in the western Arctic.<sup>79</sup>

Following completion of the final Environmental Impact Statement in March 1972, government officials, Alaska Native communities, and representatives from the oil and gas industry began to debate the terms of pipeline development.<sup>80</sup> In the end, however, broader geopolitical forces expedited the decision-making process. After an oil embargo proclaimed by the Organization of Arab Petroleum Exporting Countries (OAPEC) caused oil prices in the US to spike in 1973, President Nixon signed the Trans-Alaska Pipeline Authorization Act. Construction of the oil pipeline began early the next year.<sup>81</sup> As construction progressed, federal officials and scientists continued to monitor how caribou responded to the altered northern landscape.



**Figure 4.6. Caribou under Trans-Alaska Pipeline, Circa 1980-1981. Location unknown. National Archives and Records Administration (NARA) College Park, MD, RG 434: General Records of the Department of Energy, 1915-2007, 434-APT-8-28.**

<sup>79</sup> Cameron and Whitten, *First Interim Report*; D.R. Carruthers, R.D. Jakiumchuk, and S.H. Ferguson, *The Relationship between the Central Arctic Caribou Herd and the Trans-Alaska Pipeline* (North Saanich, BC: Renewable Resources Consulting Services, 1984).

<sup>80</sup> Coates, *Trans-Alaska Pipeline Controversy*, 217-250; Stuhl, *Unfreezing the Arctic*, 131.

<sup>81</sup> Stuhl, *Unfreezing the Arctic*, 131.

#### 4.4. A Pipeline through the Calving Grounds?

As construction of the Trans-Alaska Pipeline System began in March 1974, Canadian Arctic Gas Pipeline Limited, a consortium of 27 oil and gas companies based in Canada and the US, applied for a right-of-way for a 4,225-kilometer pipeline that would carry natural gas from Prudhoe Bay across the North Slope and then south to Alberta along the Mackenzie River Valley.<sup>82</sup> Later that year, the Foothills Pipeline Company withdrew from Arctic Gas and developed its own proposal for an “all-Canadian” route to transport gas from the Mackenzie Delta to southern Canada.<sup>83</sup> The Canadian Government appointed Supreme Court Justice Thomas Berger to lead an inquiry that, in the words of Berger, would “consider the social, environmental and economic impact of a gas pipeline and an energy corridor across our northern territories,” and “recommend terms and conditions that ought to be imposed to protect the people of the North, their environment, and their economy, if the pipeline were to be built.”<sup>84</sup>

After an extended inquiry, which included formal hearings in administrative centers and public hearings in each of the 35 northern communities that would have been impacted by pipeline development, Berger recommended that a ten-year moratorium be placed on northern pipeline construction.<sup>85</sup> Though environmental considerations and concerns about potential environmental impacts informed Berger’s decision, his recommendation was based primarily on his belief that oil development should not proceed before the government settled land claims with Indigenous communities in the region. “Native people,” he wrote in *Northern Frontier*, *Northern Homeland*, “desire a settlement of native claims before a pipeline is built.”<sup>86</sup> And while

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<sup>82</sup> Paul Sabin, “Voices from the Hydrocarbon Frontier: Canada’s Mackenzie Valley Pipeline Inquiry (1974-1977),” *Environmental History Review* 19, 1 (1995): 19; Stuhl, *Unfreezing the Arctic*, 132.

<sup>83</sup> Sabin, “Voices from the Hydrocarbon Frontier,” 19.

<sup>84</sup> Thomas Berger, *Northern Frontier, Northern Homeland: The Report of the Mackenzie Valley Pipeline Inquiry: Volume One* (Ottawa: Supply and Services Canada, 1977), 1.

<sup>85</sup> For details pertaining to the hearing process, see Berger *Northern Frontier, Northern Homeland*, 203.

<sup>86</sup> Berger, *Northern Frontier, Northern Homeland*, xxii.

the oil and gas companies objected to Native communities presenting this argument, stating that it violated the inquiry's terms of reference, Berger maintained that the assessment of social, environmental, and economic impacts could not be "disentangled from the whole question of native claims."<sup>87</sup> The ten-year moratorium on pipeline construction was intended to provide the government with the time necessary to settle northern land claims.

While the Arctic Gas and Foothills proposals stoked an already contentious debate about the socio-environmental impacts of northern development, plans to establish extensive transboundary pipelines also created new conditions and opportunities for oil and gas companies to participate in the production of Arctic environmental science.<sup>88</sup> In his 1977 report, Berger argued that the Mackenzie Valley Pipeline Inquiry revealed the persistence of critical gaps in scientific understandings of the northern environment, and the potential impact of pipeline construction on northern ecosystems and wildlife; in light of these scientific lacunae, he called for the development of a "continuing and comprehensive program of northern science and research".<sup>89</sup>

Since 1968, however, corporate funding had supported the growth of multiple fields of research within northern science. This historical dynamic intensified and extended across the International Boundary as Canadian and American oil companies pursued plans to develop northern pipelines between the early and mid-1970s. By 1973, Arctic Gas had invested approximately \$15 million dollars in the development of study programs related to northern

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<sup>87</sup> Berger, *Northern Frontier, Northern Homeland*, xxi; 164. An extended discussion of the land claims process is beyond the scope of this chapter. For a critical appraisal of the land claims process in northern Canada, see Coulthard, *Red Skin, White Masks*, 51-78; Paul Nadasdy, *Sovereignty's Entailments: First Nation State Formation in the Yukon* (Toronto: University of Toronto Press, 2017); Paul Nadasdy, "'Property' and Aboriginal Land Claims in the Canadian Subarctic: Some Theoretical Considerations," *American Anthropologist* 104, 1 (2002): 247-261; Peter Usher, "Environment, Race and Nation Reconsidered: Reflections on Aboriginal Land Claims in Canada," *Canadian Geographer* 47, 4 (2003): 365-382.

<sup>88</sup> Stuhl, *Unfreezing the Arctic*, 135.

<sup>89</sup> Berger, *Northern Frontier, Northern Homeland*, xvii-xviii.

pipeline environmental assessment, with more than \$8 million earmarked for the development of a series of biological studies that included wildlife and vegetative research in northern Canada and Alaska.<sup>90</sup> This injection of funding, and the attendant intensification in northern scientific research, contributed to the growth and coalescence of a transnational network of scientists with ties to the oil and gas industry. As Andrew Stuhl has argued, many of the oil companies that had proposed the Trans-Alaska Pipeline System in 1969 became involved in the Canadian Arctic pipeline proposals in the early 1970s, and they hired many of the scientists and researchers who had worked on the Alaskan pipeline process.<sup>91</sup> Indeed, the corporatization of Arctic environmental science was a transnational project.

With the federal government emphasizing impact prediction, much of the research conducted under the auspices of the environmental assessment process focused on the collection and analysis of data from which scientists sought to establish key environmental baselines.<sup>92</sup> In 1971, Arctic Gas hired Frank Banfield as a consultant to contribute to the development and review of the program's biological studies. With a "paucity" of published scientific material on the basic components of the environment in the region, Banfield stated in a 1977 conference presentation, it was "necessary to undertake preliminary surveys to obtain information on species inventory, populations, densities, habitats, productivity and inter-relationships (food-chains) to form an understanding of the environmental setting for the proposed enterprise."<sup>93</sup> Through

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<sup>90</sup> Earle Gray, "Why Canada Needs the Arctic Gas Pipeline," in Peter Hearse, ed., *The Mackenzie Pipeline: Arctic Gas and Canadian Energy Policy* (Ottawa: McClelland and Stewart Limited, 1974), 37-39.

<sup>91</sup> Stuhl, *Unfreezing the Arctic*, 135.

<sup>92</sup> Although the Federal Government had established the "Expanded Guidelines for Northern Pipelines" in 1972, they were never "brought into force" through legislation and remained guidelines that enumerated the government's environmental and social concerns, and outlined an appropriate planning approach. See A.W.F. Banfield, "The Development of Environmental Impact Assessments from a Canadian Perspective," in "Environmental Impact Assessment: A Symposium Sponsored by the Alberta Society of Professional Biologists, Held at Edmonton, Alberta, April 29, 1977," Alberta Society of Professional Biologists (1977): 71. See also, Stuhl, *Unfreezing the Arctic*, 135.

<sup>93</sup> Banfield, "The Development of Environmental Impact Assessments," 75.

funding provided by Arctic Gas, Banfield explained, engineers built experimental facilities to test the impact of pipelines on tundra ecosystems and permafrost, botanists studied grasses for revegetation purposes, and zoologists “undertook environmental simulation studies to investigate probable disturbances of birds and mammals.”<sup>94</sup> Banfield argued that the results of these studies, published between 1974 and 1975 as the *Arctic Gas Biological Report Series*, formed an important part of the scientific “data base” for the western Arctic.<sup>95</sup>

As the proposed pipeline route transected critical caribou habitat in northeastern Alaska and northern Canada, Arctic Gas directed its “primary effort” toward the production of a comprehensive treatment of caribou distribution in the region.<sup>96</sup> Unlike the route of the Trans-Alaska Pipeline System, which lay within the overlap area between the ranges of the Arctic and Porcupine Caribou Herds, the route proposed by Arctic Gas intersected the Porcupine Herd’s calving grounds on Alaska’s North Slope, and crossed its migratory routes at multiple locations in both Alaska and the Yukon. Although the potential disturbance for the Porcupine Caribou Herd was dramatically more significant, scientists had not determined how exactly to predict and quantify the potential impacts.

Thus, between 1971 and 1974, Arctic Gas contracted a team of scientists from the Renewable Resources Consulting Services Ltd. (RRCS), a firm based in southern British Columbia, to conduct a series of studies on the Porcupine Caribou Herd. Led by caribou scientist Ronald Jakimchuk, the RRSC studies aimed to estimate the population of the Porcupine Caribou, map the herd’s movements through its range, and delineate the boundaries around its wintering

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<sup>94</sup> Banfield, “The Development of Environmental Impact Assessments,” 75.

<sup>95</sup> Banfield, “The Development of Environmental Impact Assessments,” 75.

<sup>96</sup> D.G. Roseneau and P.M. Stern, R.D. Jakimchuk, ed., “Distribution of Moose, Muskox and Sheep in Northeastern Alaska, 1972,” in R.D. Jakimchuk, ed., *Arctic Gas Biological Report Series*, Vol. 6 (1974): i.

and calving grounds.<sup>97</sup> In addition to these primary studies, Arctic Gas contracted George Calef of Inter-Disciplinary Systems Ltd. (IDS), an environmental consulting firm based in Winnipeg, Manitoba, to conduct an environmental impact assessment of the proposed pipeline route from Alaska to Alberta, which included a survey of the Porcupine Caribou Herd in 1972.<sup>98</sup>

Collectively, these studies covered the herd through its entire transboundary range, and were intended “to serve as a baseline guide in minimizing contact between proposed construction activities and the herd’s ranges, calving grounds and critical routes of travel.”<sup>99</sup>

Despite the researchers’ focus on impact prediction, the Arctic Gas environmental studies made significant contributions to scientific understandings of the Porcupine Caribou Herd.<sup>100</sup> In particular, research completed by RRSC and IDS revealed important scientific insights into the migratory routes followed by the Porcupine Caribou, and shed light on the complex spatio-temporalities of the herd’s use of the coastal plain for calving. In addition to mapping the different routes followed by sub-groups within the Porcupine Caribou Herd, the Arctic Gas studies also described the chronology of the herd’s arrival on the coastal plain, and sought to explain animal movements and behaviour while on the calving grounds.<sup>101</sup> Further, as the consultants hired by Arctic Gas observed and analysed the herd’s calving behaviour, they also

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<sup>97</sup> See R.D. Jakimchuk, E.A. DeBock, H.J. Russell, and G.P. Semenchuk, “A Study of the Porcupine Caribou Herd, 1971,” in R.D. Jakimchuk, ed., *Arctic Gas Biological Report Series*, Vol. 4 (1974); K.H. McCourt, J.J. Russell, D. Doll, J.D. Feist, and W. McCrory, “Distribution and Movements of the Porcupine Caribou Herd in the Yukon, 1972,” in R.D. Jakimchuk, ed., *Arctic Gas Biological Report Series*, Vol. 4 (1974); D. Roseneau and P.M. Stern, “Distribution and Movements of the Porcupine Caribou Herd in Northeastern Alaska, 1972,” *Arctic Gas Biological Report Series*, Vol 7 (1974).

<sup>98</sup> G.W. Calef and G.M. Lortie, *Towards an Environmental Impact Assessment of the Portion of the Mackenzie Gas Pipeline from Alaska to Alberta* (Winnipeg: Inter-Disciplinary Systems Ltd., 1973): Appendix 1.

<sup>99</sup> Roseneau and Stern, “Distribution and Movements,” 1.

<sup>100</sup> In the mid-1980s, biologists and officials with the US Department of the Interior acknowledged the contributions made by the consultants hired by Arctic Gas, noting that the resulting studies represented one of the first detailed scientific examinations of the Porcupine Caribou Herd on its calving grounds. Clough et al., *Arctic National Wildlife Refuge*, 24.

<sup>101</sup> Roseneau and Stern, “Distribution and Movements,” 88-92; Calef and Lortie, *Towards an Environmental Impact Assessment*, Appendix 1: 13-98.

established firm boundaries around areas of scientific uncertainty in the biogeography of the Porcupine Caribou Herd. George Calef of IDS, for example, argued that in addition to further investigations of the Alaskan calving grounds, scientists should work to ascertain the importance of calving areas on the Canadian side of the border. Scientists, he argued, should not only determine the mechanisms that drive caribou to their traditional calving grounds in Alaska, but also should seek to understand if environmental or other conditions forced them to access secondary calving areas in the northern Yukon.<sup>102</sup>

That the Arctic Gas studies expanded scientific knowledge about the Porcupine Caribou Herd is perhaps not surprising. With access to considerable amounts of funding, the consultants hired by RRSC and IDS were able to deploy new, capital-intensive technologies of aerial surveillance, which, to a certain extent, enabled them to overcome the problem of distance posed by the herd's transboundary migration. Yet, these corporate-funded investigations did not exist in isolation from the broader field of caribou science; their research methods and questions were informed by past and ongoing *Rangifer* research in the western Arctic, and throughout the circumpolar north. Further, building on a well-established history of cooperative caribou science in the western Arctic, the researchers hired by Arctic Gas also collaborated with their counterparts in federal wildlife management agencies to expand the scope of their scientific investigations.

In September 1972, George Calef and G.M. Lortie of IDS Ltd. collaborated with the Canadian Wildlife Service on a pilot project that aimed to test the feasibility of tagging caribou with markers at river crossings. The objective of the project, Calef later explained, was to determine if “large numbers of marked caribou could be inserted into the population to make

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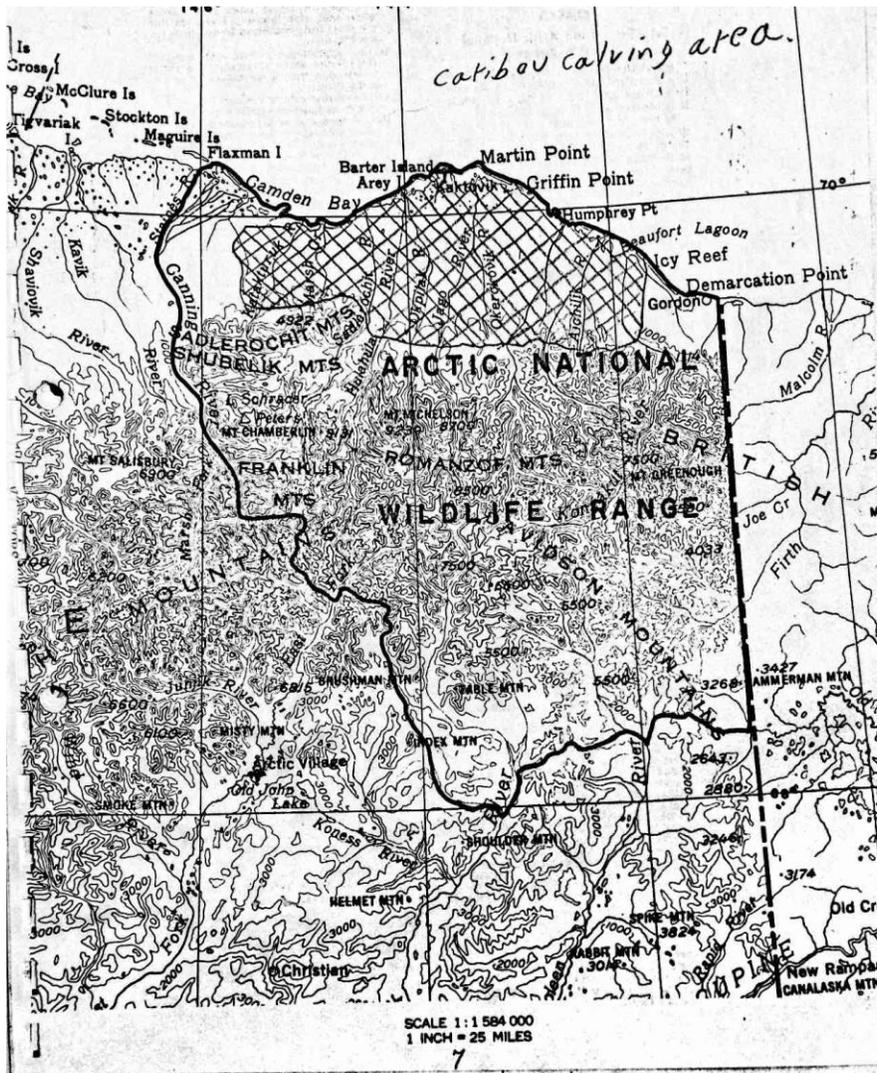
<sup>102</sup> Calef and Lortie, *Towards an Environmental Impact Assessment*, Appendix 1: 109-110.

significant observations of traditional use of migration routes and calving grounds and to aid behavioral studies.”<sup>103</sup> Between September 22 and 23, four researchers from the CWS and IDS tagged 36 caribou, which they physically “subdued” as the animals crossed the Porcupine River near Old Crow, Yukon. By mid-October, Calef and his colleagues had received information about five of the tagged caribou, three of which had been observed by wildlife managers, and two that had been shot by local hunters as they migrated toward the herd’s wintering grounds. Based on the results of this feasibility study, Calef believed their method could be scaled up to address scientific uncertainty about the migratory behaviour of individual caribou. Although scientists had made considerable progress in mapping the migratory routes followed by the Porcupine Caribou Herd, they had not determined if individual caribou followed the same route or varied from year to year. “The presence of marked animals in the population,” Calef argued, “is necessary to determine the fidelity of individuals to particular migration routes.”<sup>104</sup> While this may seem like a relatively esoteric concern within the field of caribou ethology, it was one that had considerable implications in the context of predicting how caribou might respond to industrial development within their range. And it was a scientific problem that was being addressed through a collaborative research program that brought together corporate-funded scientists and federal wildlife managers.

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<sup>103</sup> Calef and Lortie, *Towards an Environmental Impact Assessment*, Appendix 1: 111.

<sup>104</sup> Calef and Lortie, *Towards an Environmental Impact Assessment*, Appendix 1: 111.



**Figure 4.7. “Caribou Calving Area.”** From US Fish and Wildlife Service, *Arctic National Wildlife Range, Narrative Report 1971-1972*. National Archives and Records Administration (NARA), College Park, MD, RG 22: USFWS, Office of Associate Director for Fish and Wildlife: Division of Wildlife Refuges, Entry A140: Narrative Reports, Box 1: 1971-1972, Arctic NWR.

But whether the resulting increase in the production of scientific knowledge about the Porcupine Caribou Herd represented the establishment of a baseline, or a set of terms and conditions, that served to mitigate or minimize the pipeline’s potential impact on the Porcupine Caribou Herd remained an issue that scientists and other stakeholders continued to debate. Indeed, federal wildlife managers in Alaska expressed skepticism regarding the research methods

employed by the scientists involved in the Arctic Gas caribou studies. Writing in his 1972 annual report, Averill Thayer, manager of the Arctic National Wildlife Range, commented on the scientific investigations being conducted within the boundaries of the Range by private environmental consulting firms, including the RRSC. The involved scientists, Thayer noted, were studying the potential impact of a pipeline on caribou along two potential routes. “Among their scientific apparatus the investigators have a sound generator that simulates the sounds of a gas pressure boosting and refrigeration station,” Thayer explained. “They have played these sounds to groups of caribou hoping to prejudge the impact of the stations on caribou.” However, Thayer questioned what he viewed as a temporal dissonance between simulation and impact: “How can they evaluate the long-term impact of the stations on caribou, and smaller, less demonstrative, wildlife from a short-term test? We have no standards,” he argued, “for judging impacts to wildlife.”<sup>105</sup>

In its proposal, Arctic Gas suggested two potential routes for the pipeline: a coastal route traversing the Porcupine Caribou Herd’s calving grounds, and an interior route through the herd’s winter range.<sup>106</sup> Despite the potential impact on the herd’s calving grounds, Arctic Gas favoured the coastal route. During the course of their biological investigations Jakimchuk and Calef both raised concerns about the potential impacts raised by the development of the northern route.<sup>107</sup> In their testimony to the Mackenzie Valley Pipeline Inquiry, however, both suggested that the coastal route would not have a “significant impact” on the Porcupine Caribou Herd.<sup>108</sup> For Berger, this conclusion seemed to run against the grain of conventional scientific knowledge

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<sup>105</sup> USFWS, *Arctic National Wildlife Range, Narrative Report 1971-1972*. National Archives and Records Administration (NARA), College Park, MD, RG 22: USFWS, Office of Associate Director for Fish and Wildlife: Division of Wildlife Refuges, Entry A140: Narrative Reports, Box 1: 1971-1972, Arctic NWR.

<sup>106</sup> Berger, *Northern Frontier, Northern Homeland*, 32.

<sup>107</sup> Berger, *Northern Frontier, Northern Homeland*, 40-41; Calef and Lortie, *Towards an Environmental Impact Assessment*, Appendix 1: 118.

<sup>108</sup> Berger, *Northern Frontier, Northern Homeland*, 41.

about the importance of the calving grounds to migratory caribou herds. Multiple scientific investigations, including the US Department of the Interior's Final Environmental Impact Assessment (1976), he noted, had concluded that the cumulative impacts associated with pipeline construction posed a direct threat to the Porcupine Caribou; running a natural gas pipeline through the calving grounds increased the risk of geographical displacement and probable population loss. "[I]t is not surprising," Berger wrote in his 1977 report, "that the caribou biologists – except for those retained by Arctic Gas – have taken the position that no pipeline should be built along the Coastal Route through the calving grounds."<sup>109</sup>

Further, as the Inquiry progressed, Berger appeared to become increasingly dissatisfied with the epistemological foundations upon which the enterprise of impact assessment had been built, despite ostensible scientific advancements in the field.<sup>110</sup> "There is a myth that terms and conditions that will protect the environment can be imposed, no matter how large a project is proposed. There is a feeling that, with enough studies and reports, and once enough evidence is accumulated, somehow all will be well. It is an assumption that implies the choice we intend to make. It is an assumption that does not hold in the North."<sup>111</sup> Berger's critique, along with his recommendations, upset a number of the scientists who had been retained by Arctic Gas to conduct its environmental and biological studies. Jakimchuk, for example, felt that Berger's rejection of the pipeline proposals amounted to an indictment of the field of environmental impact assessment.<sup>112</sup>

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<sup>109</sup> Berger, *Northern Frontier, Northern Homeland*, 41.

<sup>110</sup> For a discussion of the development of the "scientific method" of impact assessment, see Banfield, "The Development of Environmental Impact Assessments from a Canadian Perspective," 74-76.

<sup>111</sup> Berger, *Northern Frontier, Northern Homeland*, xi.

<sup>112</sup> Stuhl, *Unfreezing the Arctic*, 136.

Other scientists, however, were more critical in their appraisal of the Arctic Gas caribou investigations. In 1976, Valerius Geist, a zoologist in the Faculty of Environmental Design at the University of Calgary, submitted to the Mackenzie Valley Pipeline Inquiry a report entitled “Harassment of Large Mammals and Birds,” in which he raised serious concerns about the research methods employed in the Arctic Gas studies. For Geist, the RRSC consultants hired to conduct the Arctic Gas biological investigations had violated fundamental scientific principles in their development of a “faulty” research methodology. The failure to develop a rigorous and objective research method, he argued, undermined the consultants’ credibility and invalidated their conclusions.

Following submission of the report, Geist and Ronald Jakimchuk engaged in a heated debate about the validity of the scientific investigations conducted by the RRSC biologists involved in the Arctic Gas studies.<sup>113</sup> At one level, the debate turned on highly technical aspects related to RRSC’s choice of research subjects – which, Geist argued, reflected “neither a comprehension of caribou nor of elementary principles of animal behaviour...” – and method – which, according to Geist, was subjective, prone to “observer bias”, and, therefore, insufficiently rigorous, and unscientific.<sup>114</sup> At another level, however, the debate between Geist and Jakimchuk suggests the way in which the participation of the oil and gas industry in scientific knowledge production had transformed the community of Arctic environmental science. Although industry funding had contributed to the expansion of scientific understanding of migratory caribou in the western Arctic since the late 1950s, many within the scientific community remained deeply

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<sup>113</sup> The debate became part of the public record through its submission as evidence in the Mackenzie Valley Pipeline Inquiry. See: Valerius Geist (University of Calgary) to Ian Scott (Counsel to the Berger Commission Enquiry on the Mackenzie Valley Pipeline), 25 May 1976, Library Archives Canada (LAC), RG 126: Mackenzie Valley Pipeline Inquiry, Vol 45, Exhibit 859 (Submitted on 12 October 1976 at Yellowknife Hearing).

<sup>114</sup> Geist to Scott, 25 May 1976, RG 126: Mackenzie Valley Pipeline Inquiry, Vol 45, Exhibit 859 (Submitted on 12 October 1976 at Yellowknife Hearing).

ambivalent about the ostensible benefits of this relationship. Implicit to Geist's critique of RRSC's scientific method was a deep-seated concern about the relationship between the economic interests of the funding agency and the consultants' findings. "Had the choice of subject matter for investigation been chosen from the viewpoint of public relations, rather than to ameliorate a potential problem," argued Geist, "I would not have been able to criticize it as a scientist." However, as the reports were supposed to investigate "highly relevant matters pertaining to disturbance," the choice to study particular aspects of industrial development, such as the noise generated by compressor stations, while excluding other more significant disturbances "is simply ludicrous."<sup>115</sup> For Geist, these were serious transgressions that should not be made by those committed to rigorous scientific methods.

Indeed, as oil and gas companies became increasingly active in northern research, scientists continued to negotiate the boundary that separated science from non-science. The debate between Geist and Jakimchuk suggests the way in which northern scientists negotiated the terms and conditions that determined which individuals and institutions were included within the boundaries of the community of Arctic environmental scientists. Although participants in the Mackenzie Valley Pipeline Inquiry challenged the science behind the Arctic Gas pipeline proposals, the forms of boundary-work inherent to the critiques raised by Berger and Geist did not necessarily invalidate corporate involvement in the production of Arctic environmental science. Despite the fact that Berger rejected the pipeline proposals, the Arctic Gas environmental studies did have a considerable and lasting impact on the shifting field of caribou science. These studies not only reshaped scientific understandings of the Porcupine Caribou Herd's calving grounds, but also expanded the terms of the debate about the potential impact that

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<sup>115</sup> Geist to Scott, 25 May 1976, RG 126: Mackenzie Valley Pipeline Inquiry, Vol 45, Exhibit 859 (Submitted on 12 October 1976 at Yellowknife Hearing).

industrial development on the North Slope would have on the health of this group of animals. Though the wider scientific community challenged the conclusions reached by Jakimchuk and Calef, their continued participation in this protracted debate further entrenched industry-funded scientists as participants in the shifting field of Arctic environmental science.

At the end of 1976, the Fairbanks Environmental Center sponsored a conference that was meant to stimulate public debate about the survival of Alaska's caribou herds. Over the course of the one-day meeting, members of the public were provided with an opportunity to "discuss and assess the factors which are critical to the survival and propagation of Alaska's caribou herds."<sup>116</sup> In addition to a series of presentations, a panel of experts convened at the conference to debate the importance of "wild lands" for Alaska's migratory caribou herds. The panel, organizers hoped, represented the diversity of stakeholders engaged in the debate about industrial development in caribou habitat. David Klein, who had been involved in Alyeska's earlier experimental research program near Prudhoe Bay, represented the viewpoint of the scientific community on the panel. In his comments, Klein spoke at length about the relationship of caribou to their range land. For Klein, the answer to the question was simple: "If [caribou] habitat is not preserved in a production state there is no possibility of maintaining caribou populations in the future."<sup>117</sup>

Max Brewer, Assistant to the Executive Vice President of Husky Oil, was the appointed representative for the oil and gas industry. Though he expressed some discomfort in attempting to represent the viewpoint of this complex group of actors, Brewer was confident in his assertion that the industry could operate in northern environments without posing a threat to the survival

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<sup>116</sup> Fairbanks Environmental Center, "A Conference on Survival of Alaska's Caribou Herds," (University of Alaska, Fairbanks, 4 December 1976).

<sup>117</sup> Fairbanks Environmental Center, "A Conference on Survival," 5.

of Alaska's migratory caribou herds. "I have been asked to consider whether caribou and mineral resource development, including oil and gas development, can co-exist," Brewer stated. "My answer is yes. Not to co-exist on the same acreage of ground but to co-exist in reasonably close proximity," he explained.<sup>118</sup> For Brewer, a respected ice physicist and former permafrost researcher at the University of Alaska, a solution to the problem of habitat degradation lay in the oil and gas industry's ability to apply insights from fields of Arctic environmental science in its project development. Though he acknowledged that North Slope oil existed in locations where caribou like to have their calves, the caribou, he argued, only "calve at one time of the year."<sup>119</sup> Through an understanding of the spatio-temporalities of caribou calving behaviour, Brewer suggested, the industry could mitigate its environmental impact by conducting its operations only at those times when caribou are absent. "So here in the spatial situation," he argued, "there can be reasonable coexistence."<sup>120</sup> Ultimately, Brewer argued that coexistence depended on the industry's ability to exert control over its own activities, and control, he suggested, was tied inexorably to the industry's participation in the production of Arctic environmental science; through the development of scientific knowledge about caribou habitat, he argued, the oil and gas industry should be able to operate in northern environments without compromising the future of Alaska's caribou herds. Indeed, as oil and gas companies eyed the Alaskan coastal plain as a potential site for future energy development, they faced increasing pressure to convince the public and lawmakers that oil and caribou could coexist.

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<sup>118</sup> Fairbanks Environmental Center, "A Conference on Survival," 22.

<sup>119</sup> Fairbanks Environmental Center, "A Conference on Survival," 23.

<sup>120</sup> Fairbanks Environmental Center, "A Conference on Survival," 23.

#### 4.5. Caribou in the Way: Petroleum Extraction and the Problem of Wilderness, 1980-1989

In December 1980, US President Jimmy Carter signed into law the Alaska National Interest Lands Conservation Act (ANILCA), which reclassified more than 104 million acres (420,873 square kilometers) of Alaskan land, and created or redesignated sixteen Alaskan wilderness refuges.<sup>121</sup> The passage of ANILCA represented a significant development in a protracted political debate about Federal land withdrawals and wilderness designation in Alaska, which had been initiated in 1971 by the inclusion of section 17(d)(2) in ANCSA.<sup>122</sup> Through its enactment, however, ANILCA also became bound up with broader debates about the presence of humans within wilderness areas. Although the framers of ANILCA employed the American wilderness ideal that had been codified in the Wilderness Act of 1964 – which defined wilderness as an “untrammelled” place “where man himself is a visitor who does not remain” – federal managers and legislators sought to preserve a place for humans in wild spaces by protecting the rights of rural peoples to a “customary and traditional” subsistence harvest.<sup>123</sup> In addition to protecting subsistence harvest rights, ANILCA included several key exceptions for the purpose of natural resource extraction and the facilitation of economic development throughout the state.<sup>124</sup> Yet, according to the terms of the legislation, Congress was also tasked with ensuring that utilization of the land occurred in a manner that was consistent with the maintenance of wilderness values and the protection of rural subsistence rights.<sup>125</sup> In the final

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<sup>121</sup> Alaska Polar Region Collections and Archives (APRCA), Series: “Alaska National Interest Lands Conservation Act (ANILCA)”; USFWS, *Arctic National Wildlife Refuge: Annual Narrative Report, 1980* (Fairbanks: ANWR Administrative Headquarters, 1981): 1-2.

<sup>122</sup> Haycox, *Battleground Alaska*, 136-159; Glenn Cravez, “The Alaska National Interest Conservation Act: Directing the Great Land’s Future,” *UCLA Alaska Law Review* 10 (1980): 33-62.

<sup>123</sup> ANILCA, Public Law 96-487 § 102(13)(1980); Michael Delcomyn, “Arctic National Wildlife Refuge Oil: Canadian and Gwich’in Indian Legal Responses to 1002 Area Development,” *Illinois Law Review* 24, 3 (2004): 789-819; Haycox, *Battleground Alaska*, 139.

<sup>124</sup> Haycox, *Battleground Alaska*, 138.

<sup>125</sup> ANILCA, Public Law 96-487 § 802(1)(1980). See also Haycox, *Frigid Embrace*, 172; McMonagle, *Caribou and Conoco*, 6-8.

section of this chapter, I seek to demonstrate the way in which the shifting and contested field of caribou science became enrolled in political debates about wilderness protection and oil and gas development in the western Arctic.

In northeastern Alaska, ANILCA created the Arctic National Wildlife Refuge (ANWR) by reclassifying and adding 9.16 million acres (37,069 square kilometers) of land to the existing ANW Range (see figure 4.2). Indeed, the creation of ANWR was tied directly to the Act's stated goal of conserving the migratory Porcupine Caribou Herd.<sup>126</sup> For proponents of wilderness protection and caribou conservation in the western Arctic, however, ANILCA's modification of ANWR was something of a mixed blessing: although the Act established legislative terms that protected a sizeable portion of the herd's habitat throughout the American extent of its transboundary range, section 1002 of the legislation excluded much of the coastal plain from wilderness designation, and postponed for future consideration all decisions regarding oil and gas development and wilderness designation within this region of critical caribou habitat. By postponing the decision on wilderness designation, section 1002 of ANILCA represented a compromise between competing Congressional interests. For more than seven years, Congress had considered and debated the ANILCA issue, and during this time members of Congress had grown increasingly concerned about the prevalence of "conflicting and uncertain information" regarding the "extent of oil and gas resources on the Range and the effect development and production of those resources would have on the wildlife inhabiting the Range and the Range itself."<sup>127</sup> Section 1002, therefore, represented Congress's attempt to resolve this seemingly intractable debate. Located in the "northernmost part of the Arctic Refuge between the Brooks

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<sup>126</sup> ANILCA, Public Law 96-487 § 303 (B)(i)(1980).

<sup>127</sup> Senate Report 313, 96th Congress, 1st Session at 241 (1979), quoted in Clough et al., *Arctic National Wildlife Refuge, Alaska, Coastal Plain Resource Assessment*, 2.

Range and the Beaufort Sea,” the 1.5-million acre “1002 area” constituted approximately 75 percent of ANWR’s coastal plain.<sup>128</sup> Section 1002 of ANILCA mandated the Secretary of the Interior to initiate a baseline study that not only documented the population and distribution of the Porcupine Caribou Herd (among other fish and wildlife populations), but also determined and analysed the “potential impact of oil gas exploration, development, and production” on the wildlife of the coastal plain.<sup>129</sup>

For the Department of the Interior, however, determining the significance of the potential environmental impact was tied to the presence of “economically recoverable oil resources” within the boundaries of the 1002 area.<sup>130</sup> Thus, as part of its baseline study, the Interior and industry conducted a joint assessment of the subsurface hydrocarbon resources that lay below ANWR’s coastal plain.<sup>131</sup> Between 1983 and 1985, exploration crews from fifteen oil companies “visited” the 1002 area, and conducted field observations, surface measurements, and collected rock samples.<sup>132</sup> To mitigate the environmental impact of these exploratory activities, oil companies applied for special permits to access ANWR’s coastal plain by helicopter, and opted against using surface vehicles.<sup>133</sup> Further, during this period, the US Fish and Wildlife Service granted a permit to Geophysical Service Incorporated – an independent company that represented an industry group of 25 companies – to collect approximately 2100 kilometers of seismic data within the 1002 area. Though industry representatives conducted the seismic tests, officials from the Bureau of Land Management and US Geological Survey analysed and

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<sup>128</sup> Clough et al., *Arctic National Wildlife Refuge, Alaska, Coastal Plain Resource Assessment*, 7-8.

<sup>129</sup> ANILCA, Public Law 96-487 § 1002 (C)(1980).

<sup>130</sup> See Clough et al., *Arctic National Wildlife Refuge, Alaska, Coastal Plain Resource Assessment*, 76.

<sup>131</sup> For a description of the methods employed in this assessment, see Clough et al., *Arctic National Wildlife Refuge, Alaska, Coastal Plain Resource Assessment*, 57-58.

<sup>132</sup> Clough et al., *Arctic National Wildlife Refuge, Alaska, Coastal Plain Resource Assessment*, 3.

<sup>133</sup> Clough et al., *Arctic National Wildlife Refuge, Alaska, Coastal Plain Resource Assessment*, 3.

interpreted the data for the baseline study.<sup>134</sup> Again, the industry and the Department of the Interior sought to build mitigative measures into the design of the seismic program by opting to conduct testing during the winter months when, officials stated, “most wildlife species were absent or were present in lesser numbers.”<sup>135</sup> Based on the results of these exploratory activities, the Department of the Interior estimated that there was a 19 percent chance of discovering 10 billion barrels of “economically recoverable oil” beneath ANWR’s coastal plain, making the 1002 area the most promising onshore oil reserve in the United States.<sup>136</sup>

Despite the mitigative measures adopted by the industry, in the early 1980s, the increasing presence of oil and gas companies on the coastal plain became a source of tension and conflict for Refuge managers, staff, and scientists. Annual reports from this period suggest the way in which differing perspectives on concepts such as the “impact” and “wilderness” led to fractious debates among federal officials and industry representatives about the potential impact of exploratory activities despite the mitigative measures built into the research designs. For example, following the creation of ANWR in 1980, Refuge manager Averill Thayer attempted to prevent helicopter access for exploratory activities by rejecting the industry’s application for the required permits.<sup>137</sup> Thayer, like many of the scientists and administrators working in the Refuge, viewed the presence of helicopters as a fundamental violation of wilderness values.<sup>138</sup> Senior bureaucrats, however, were not inclined to agree with Thayer and his colleagues. Following an appeal by the oil companies, and the subsequent release of a solicitor’s opinion stating that

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<sup>134</sup> Clough et al., *Arctic National Wildlife Refuge, Alaska, Coastal Plain Resource Assessment*, 3; 55.

<sup>135</sup> Clough et al., *Arctic National Wildlife Refuge, Alaska, Coastal Plain Resource Assessment*, 3.

<sup>136</sup> Clough et al., *Arctic National Wildlife Refuge, Alaska, Coastal Plain Resource Assessment*, 57.

<sup>137</sup> US Fish and Wildlife Service, *Arctic National Wildlife Refuge: Annual Narrative Report, 1984* (Fairbanks: ANWR Administrative Headquarters, 1984), 52.

<sup>138</sup> For an explicit articulation of this idea, see Matt Nolan and Kristin Nolan, “The First 50 years of Research on McCall Glacier,” in Steven Chase and Mark Madison, eds., *The First 50: A Historic Symposium on Arctic National Wildlife Refuge, 1960-2010* (Shepherdstown, West Virginia: National Conservation Training Center & Arctic National Wildlife Refuge, 2011), 52-59.

helicopters could be used in the wilderness areas in question, the head office of the US Fish and Wildlife Service ordered the Refuge manager to permit helicopter use in assigned areas. The Refuge, however, maintained the authority to place spatial and temporal regulations on the use of helicopters for exploratory purposes.<sup>139</sup>

As the industry's oil and gas exploration program progressed, it continued to create conflict among the Refuge staff. In his 1984 annual report, Glenn Elison, Thayer's successor as Refuge manager, wrote that the 1002 program was a "gut-wrenching" and divisive issue that went "against the philosophical grain of many staff members."<sup>140</sup> A primary source of conflict, he suggested, was the wording of Section 1002 of ANILCA, which stated that oil and gas exploration must occur in a manner that avoids "significant adverse effects."<sup>141</sup> But what exactly constituted a "significant" environmental impact? For Elison and his colleagues, the fact that "significant adverse effects" had not been legally defined in the context of Section 1002 was something of a "double-edged sword"; although the scientific uncertainty and legal ambiguity surrounding the concept offered some latitude to refuge staff who wished to protect the wildlife of the coastal plain, it was also an incredibly difficult concept to apply in the determination of environmental impacts. "Due to the inexactitudes of the biological sciences, and the long time periods generally necessary to demonstrate a cause and effect relationship in natural populations," Elison wrote, "the application of the concept of 'significance' becomes a difficult and possibly ineffective standard for protecting natural resources."<sup>142</sup> Further, Elison argued, the subjectivity of the category of wilderness complicated the issue and placed increasing pressure on the Refuge staff, which had been tasked with protecting an area that many Americans viewed

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<sup>139</sup> USFWS, *Arctic National Wildlife Refuge: Annual Narrative Report, 1984*, 52.

<sup>140</sup> USFWS, *Arctic National Wildlife Refuge: Annual Narrative Report, 1984*, 105.

<sup>141</sup> USFWS, *Arctic National Wildlife Refuge: Annual Narrative Report, 1984*, 105.

<sup>142</sup> USFWS, *Arctic National Wildlife Refuge: Annual Narrative Report, 1984*, 105-106.

as the final piece of truly wild land in northern Alaska. “Wilderness exists largely in the eye of the beholder,” Elison explained. “Indeed, it is developed by our technologically-developed [sic] society, which creates the need for it, while at the same time destroying it. It’s [sic] values are not tangible, and do not readily submit to measurement, particularly in economic terms.”<sup>143</sup>

Despite these concerns, the scientists engaged in the 1002 environmental studies did attempt to measure the potential impact of oil and gas development on Arctic wilderness. Migratory caribou were central to this calculus. In particular, the research program prioritized scientific investigations of the Porcupine Caribou Herd and its use of the coastal plain as a calving area. As the Department of the Interior and industry developed the wildlife portion of the 1002 baseline study, they focused on determining methods to measure the impact that oil and gas extraction on the coastal plain would have on the Porcupine Caribou Herd.<sup>144</sup> Unlike previous debates about pipeline routes that intersected critical caribou habitat, opening ANWR to the oil and gas industry would inevitably result in an ongoing form of resource extraction in the heart of a site that many scientists viewed as being critical to the future health and survival of the Porcupine Caribou Herd. Although previous scientific investigations had demonstrated that this area, which the oil and gas industry increasingly portrayed as the site of a potentially vast reserve of recoverable petroleum, constituted the Porcupine Caribou Herd’s primary calving grounds, there remained considerable scientific uncertainty around the spatio-temporalities that defined the herd’s use of the coastal plain. In the early 1980s, the 1002 baseline study spurred an

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<sup>143</sup> USFWS, *Arctic National Wildlife Refuge: Annual Narrative Report, 1984*, 106.

<sup>144</sup> In addition to the Porcupine Caribou, the wildlife studies also paid close attention to the population of reintroduced muskoxen on Alaska’s North Slope. See Clough et al., *Arctic National Wildlife Refuge, Alaska, Coastal Plain Resource Assessment*, vii.

intensification of scientific investigations of the Porcupine Caribou Herd's geographical relationship to its calving grounds on Alaska's coastal plain.<sup>145</sup>

An important development at this point was the adoption of radiotelemetry methods that enabled scientists and state-based wildlife managers to track with considerable accuracy the movements of migratory caribou. On 19 June 1984, Alaska Department of Fish and Game Biologist Ken Whitten placed the first radio-collar on a female caribou from the Porcupine Herd (see figure 4.7).<sup>146</sup> In his description of this “space-age technology”, Refuge manager Glenn Elison commented on the way in which the satellite tracking of caribou wearing radio-collars enrolled a transnational network of researchers, technicians, and scientists: “Signals,” he wrote, “are beamed from the satellite to a tracking station at Gilmore Creek in Alaska and from there to a data processing center in Toulouse, France. Data are accessed by computer at the refuge headquarters.”<sup>147</sup> Like many of his colleagues, Elison believed that the accuracy of radiotelemetry, which enabled wildlife managers to pinpoint the movements of individual caribou to within one mile of their actual location, was an important advancement in scientific caribou management. In the western Arctic, however, the use of radio-collars became a contentious scientific practice. In the 1990s, the continued use of this technology heightened tensions between wildlife managers and Gwich'in communities in Canada where many people believed that the practice of placing a radio-collar around a caribou's neck was a profound form of disrespect for the animal.<sup>148</sup> But despite emergent debates about the efficacy and ethics of radio-collaring, in the early to mid-1980s, scientists and wildlife managers working on the

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<sup>145</sup> Not every calving-ground study conducted during the 1983-1985 period was funded through the 1002 program, but officials included the results of every study conducted in the herd's calving grounds in the draft environmental impact statements. USFWS, *Arctic National Wildlife Refuge: Annual Narrative Report, 1984*, 9.

<sup>146</sup> USFWS, *Arctic National Wildlife Refuge: Annual Narrative Report, 1984*, 64.

<sup>147</sup> USFWS, *Arctic National Wildlife Refuge: Annual Narrative Report, 1984*, 64.

<sup>148</sup> Benson, *Wired Wilderness*. For a discussion of the debate about radio-collars in northern Canada, see Kofinas, “Caribou Hunters,” 179-196.

coastal plain advanced claims of technocratic expertise to legitimize the new and ostensibly more accurate knowledge this technology enabled them to produce about the Porcupine Caribou Herd's calving behaviour.<sup>149</sup>



**Figure 4.8. “Application of space technology to wildlife management.” Image from National Archives and Records Administration (NARA), Archives II, College Park, MD, RG22: USFWS, Office of Associate Director for Fish and Wildlife. Division of Wildlife Refuges. Entry A1 40: Narrative Reports. Box 153: 1984 Arctic NWR**

Although the scientists engaged in the 1002 baseline study harnessed new and experimental research methods to refine their understanding of migratory caribou behaviour, they also relied heavily on calving-ground studies produced by industry-sponsored and government biologists during the 1970s. Yet, as demonstrated above, the caribou studies conducted through the environmental assessment mechanisms triggered by the TAPS and Mackenzie Valley Pipeline proposals were construed broadly and focused largely on western Arctic herds other than the Porcupine Caribou. Thus, as government biologists, scientists, and

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<sup>149</sup> See “ANWR Progress Report No. FY84-122: “Calving distribution, initial productivity, and neonatal mortality of the Porcupine caribou herd,” in USFWS, *Arctic National Wildlife Refuge: Annual Narrative Report, 1983* (, 24-26; USFWS, *Arctic National Wildlife Refuge: Annual Narrative Report, 1984*, 64-65.

industry-based consultants attempted to determine the potential impact that oil and gas development within the 1002 area would have on the Porcupine Caribou Herd, they also engaged in a debate about the adequacy of the existing “database” for the purposes of environmental assessment. For Ronald Jakimchuk, President of Renewable Resources Inc., and environmental consultant contracted to review a draft of the Interior’s environmental impact statement for the pro-development Alaska Oil and Gas Association (AOGA), ANWR’s “unusually detailed baseline data base...is unprecedented as a sound basis for an environmental impact analysis, assessment and prediction.”<sup>150</sup>

Despite Jakimchuk’s confidence in the adequacy of the database, scientific attempts to predict future environmental impacts based on these earlier studies proved to be a politically-fraught process. As in the past, hard lines emerged between the interpretative methods of publicly-funded and industry-sponsored science. In particular, debates turned on the considerable gulf in scientific opinion concerning the way in which oil and gas extraction on the coastal plain would alter the temporal and spatial dynamics of caribou calving behaviour. For the scientists and wildlife managers who contributed to the baseline study, a primary concern was the issue of displacement. Although scientists were in general agreement that oil and gas extraction on the coastal plain had the potential to displace segments of the Porcupine Herd from this critical area of habitat, a contentious debate turned on disagreements about how to measure and mitigate this potential impact.<sup>151</sup>

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<sup>150</sup> Ronald Jakimchuk to William Hopkins (Alaska Oil and Gas Association), “Re: Review of Draft EIS,” 13 January 1987, in N. Clough, P. Patton, A. Christiansen, eds., *Arctic National Wildlife Refuge, Alaska, Coastal Plain Resource Assessment: Report and Recommendation to the Congress of the United States and Final Environmental Impact Statement, Volume 2 – Appendix (Public Comments and Responses)* (Washington, D.C.: US Fish and Wildlife Service, US Geological Survey, and Bureau of Land Management, 1987).

<sup>151</sup> Glenn Elison, Ann Rappaport, and Gerald Reid, eds., *Report of the Caribou Impact Analysis Workshop, Arctic National Wildlife Refuge, November 19-20, 1985* (Fairbanks, Alaska: US Department of the Interior, US Fish and Wildlife Service, and Arctic National Wildlife Refuge, 1986); R.D. Cameron, “Issue: Caribou and Petroleum Development in Arctic Alaska,” *Arctic* 36, 3 (1983): 227-231.

Between 1973 and 1985, Alaska Department of Fish and Game biologists Ken Whitten and R.D. Cameron presented a series of findings related to their ongoing investigation of the Central Arctic Herd's response to the Prudhoe Bay complex. In addition to witnessing cow and calf avoidance of the pipeline corridor, the biologists argued that the network of oil and gas infrastructure established at Prudhoe Bay had impeded caribou movements along the Arctic coast, and resulted in the cessation of caribou calving in the vicinity of Prudhoe Bay.<sup>152</sup> But despite these obvious impacts, Whitten and Cameron did not believe that industrial development had led to a decrease in herd productivity or population loss; in fact, most scientists believed that the Central Arctic Herd had tripled in population since the discovery of oil at Prudhoe Bay in 1968.<sup>153</sup> Nonetheless, in 1983, the Alaska Department of Fish and Game adopted an issue paper authored by Cameron as its official policy statement.<sup>154</sup> Based on his understanding of evolutionary theory, Cameron concluded that calf and cow displacement from the calving grounds could eventually lead to increased neonatal mortality rates in caribou herds. Therefore, he recommended that federal and state regulatory bodies adopt "conservative policies of subsurface leasing and surface development" for future industrial development on the North Slope.<sup>155</sup>

Further, as Ronald Jakimchuk argued, in drafting the ANWR environmental impact statement, officials with the Department of the Interior had adopted many of the concerns about

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<sup>152</sup> R.D. Cameron and K.R. Whitten, "Seasonal Movements and Sexual Aggression of Caribou Determined by Aerial Survey," *Journal of Wildlife Management* 43, 3 (1979): 626-633; K.R. Whitten and R.D. Cameron, "Movements of Collared Caribou, *Rangifer tarandus*, in Relation to Petroleum Development of the Arctic Slope of Alaska," *Canadian Field-Naturalist* 97, 2 (1983): 143-146; K.R. Whitten and R.D. Cameron, "Distribution of Caribou Calving in Relation to the Prudhoe Bay Oilfield," in A.M. Martell, and D.E. Russell, eds., *Proceedings of the First North American Caribou Workshop, Whitehorse, Yukon* (Ottawa: Canadian Wildlife Service, 1985), 33-39.

<sup>153</sup> Clough et al., *Arctic National Wildlife Refuge, Alaska, Coastal Plain Resource Assessment*, 187.

<sup>154</sup> For the text of the policy statement, see Cameron, "Issue: Caribou and Petroleum Development in Arctic Alaska," 227-231.

<sup>155</sup> Cameron, "Issue: Caribou and Petroleum Development in Arctic Alaska," 227.

displacement advanced by Cameron and Whitten.<sup>156</sup> Jakimchuk, however, disagreed strongly with their conclusions about the impact of displacement on calving, and objected to the way in which the draft baseline report relied on their research.<sup>157</sup> In October 1986, Jakimchuk presented a paper at the “Joint Industry-Alaska Department of Fish and Game Caribou Workshop,” in which he offered a critique of and rebuttal to the conclusions reached by Cameron and Whitten. In this paper, which had been sponsored by the Alyeska Pipeline Service, Jakimchuk argued that Cameron and Whitten lacked the necessary baseline environmental information and experimental design required to claim that there was a causal relationship between industrial development and displacement. In addition, he argued that the pair of biologists had mistaken absence for displacement. During the critical years examined by Cameron and Whitten, he stated, a series of environmental conditions and ecological factors – not industrial development – had prevented the caribou herd from accessing the Prudhoe Bay oil field.<sup>158</sup>

Finally, Jakimchuk drew on the existing database of scientific information to challenge Cameron and Whitten’s claim that the Prudhoe Bay region had been an important calving area for the Central Arctic Herd prior to the onset of oil and gas activities in 1968. Although he critiqued Cameron and Whitten for their apparent misuse of the scientific database, Jakimchuk claimed that the existing studies could be used to address objectively certain questions about of caribou-pipeline interactions. What was apparent from more than 15 years of scientific investigations, he argued, was that the Central Arctic Herd did not utilize the Prudhoe Bay area

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<sup>156</sup> Ronald Jakimchuk to William Hopkins (Alaska Oil and Gas Association), “Re: Review of Draft EIS,” 13 January 1987, in Clough et al., *Arctic National Wildlife Refuge, Alaska, Coastal Plain Resource Assessment, Volume 2 – Appendix*.

<sup>157</sup> Jakimchuk to Hopkins, 13 January 1987, in Clough et al., *Arctic National Wildlife Refuge, Alaska, Coastal Plain Resource Assessment, Volume 2 – Appendix*.

<sup>158</sup> Ronald Jakimchuk, “The Relationship of Caribou Summer Distribution and the Trans-Alaska Pipeline: Does Absence Mean Displacement?”, Presented at Joint Industry-Alaska Department of Fish and Game Caribou Workshop, 28-30 October 1986, in Clough et al., *Arctic National Wildlife Refuge, Alaska, Coastal Plain Resource Assessment, Volume 2 – Appendix*.

as a primary calving ground. This finding, he suggested, should undermine the use of Cameron and Whitten's conclusions to predict future environmental impacts of oil and gas development in the 1002 area on the Porcupine Caribou Herd.<sup>159</sup>

One of the most controversial issues that scientists addressed in the 1002 baseline environmental studies was the notion of a "core" calving ground for the Porcupine Caribou Herd on the coastal plain. Since the late 1950s, and increasingly during the 1970s, scientific investigations had documented the importance of the coastal plain for the Porcupine Caribou Herd's calving activity. Although scientists had distinguished and mapped distinct spatio-temporal patterns and rhythms within the herd's movement between its wintering grounds and calving grounds, there remained considerable scientific uncertainty around the herd's use of the coastal plain, and which areas, if any, represented the "core" calving grounds.<sup>160</sup> Although the USFWS defined an area of "sustained" calving use as "the location in which there has been concentrated calving activity in at least 5 of the last 14 years," the characterization of a "core" calving area, scientists warned, remained subjective.<sup>161</sup> The indeterminacy of the concept troubled official attempts to predict and measure the environmental impact of oil and gas extraction on the Porcupine Caribou Herd. Yet, as in the case of the issue of displacement, however, political and economic interests shaped the way in which officials interpreted differing scientific opinion on the matter.

In January 1987, Ronald Jakimchuk submitted to AOGA his review of the Department of the Interior's draft environmental impact statement, which had been released the previous year.

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<sup>159</sup> Ronald Jakimchuk, "The Relationship of Caribou Summer Distribution and the Trans-Alaska Pipeline: Does Absence Mean Displacement?", Presented at Joint Industry-Alaska Department of Fish and Game Caribou Workshop, 28-30 October 1986, in Clough et al., *Arctic National Wildlife Refuge, Alaska, Coastal Plain Resource Assessment, Volume 2 – Appendix*.

<sup>160</sup> For example, see Elison et al., *Report of the Caribou Impact Analysis Workshop*.

<sup>161</sup> Elison et al., *Report of the Caribou Impact Analysis Workshop*, 11.

In his report, which included enclosed copies of his critical reviews of several scientific papers, including those by Cameron and Whitten, Jakimchuk examined the concept of a core calving ground, and critiqued its use by the authors of the draft EIS. Again, he sought to identify what he perceived as a methodological flaw in the authors' interpretation of the existing database. The authors of the draft EIS, he argued, based their identification of the Porcupine Caribou Herd's "core" calving area on a series of individual scientific investigations conducted between 1972 and 1985, which they characterized erroneously as a "solid, 14-year data base."<sup>162</sup> During some of those years, he argued, there was a paucity of information about calving distribution. Further, Jakimchuk suggested that the criteria used to define the core calving ground (more than 50 caribou per square kilometer in at least 5 of fourteen years) may have been too "conservative". That is to say, Jakimchuk suggested that by using an alternative definition and set of criteria, the spatial parameters of the calving grounds would be much larger than they had been defined in the draft EIS. Based on these concerns, he argued that concerns about the displacement of the Porcupine Caribou Herd from its core calving grounds, and the predicted decline in population were speculative at best.<sup>163</sup>

For the oil and gas industry, Jakimchuk's conclusions and independent analyses represented an important counterpoint to scientific predictions about displacement-related population loss for the Porcupine Caribou Herd. Following the release of the draft EIS, AOGA submitted a formal written response to the document, which included Jakimchuk's evaluation of

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<sup>162</sup> R.D. Jakimchuk and L.G. Sopuck, "A Review of the Report on the Arctic National Wildlife Refuge Coastal Plain Resources Assessment," Prepared for the Alaska Oil and Gas Association, January 1987, in Clough et al., *Arctic National Wildlife Refuge, Alaska, Coastal Plain Resource Assessment, Volume 2 – Appendix*.

<sup>163</sup> Jakimchuk and Sopuck, "A Review of the Report," January 1987, in Clough et al., *Arctic National Wildlife Refuge, Alaska, Coastal Plain Resource Assessment, Volume 2 – Appendix*.

the EIS, and several of his scientific papers.<sup>164</sup> In addition, prior to Jakimchuk’s submission of his review, AOGA representatives presented testimony at a hearing in Anchorage on the draft environmental impact statement. Like Jakimchuk, Mark McDermott of Atlantic Richfield Company (ARCO) raised concerns about the way in which the report defined and employed the concept of a “core” calving area for the Porcupine Caribou Herd. Annual variability in calving distribution and the extensive area accessed by cows during the parturition, he suggested, meant that calving area “is more accurately represented as a true continuum across the Coastal Plain including portions of the Arctic coast outside the “1002” study area.” The Porcupine Caribou Herd, McDermott told those who had gathered at the public hearing, “has demonstrated numerous times in the past, including this past year, that it can and will successfully calve miles from the (quote) ‘core calving area’ (unquote).” Thus, he challenged the idea that the area, as defined in the draft report, should be designated as “unique and irreplaceable.”<sup>165</sup>

In April of 1987, the Department of the Interior released its final Legislative Environmental Impact Statement, in which Secretary Hodel recommended that Congress approve a plan to open the entirety of the 1002 area to oil and gas leasing. Five years of environmental baseline studies, he suggested, indicated that a program of orderly oil and gas development would not have a significant impact on the region’s environment or wildlife.<sup>166</sup> Yet, Hodel’s insistence that oil and caribou could coexist on the coastal plain obscured the environmental politics inherent to the practice of predicting environmental impacts. Following a series of public hearings on the draft environmental impact statement, and after receiving

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<sup>164</sup> William Hopkins to Director US Fish and Wildlife Service, “Arctic National Wildlife Refuge, Alaska Coastal Plain Resource Assessment,” 4 February 1987, in Clough et al., *Arctic National Wildlife Refuge, Alaska, Coastal Plain Resource Assessment, Volume 2 – Appendix*.

<sup>165</sup> Alaska Oil and Gas Association, “Testimony on the Draft Legislative Environmental Impact Statement, Arctic National Wildlife Refuge, Alaska, Coastal Plain Resource Assessment (Anchorage, Alaska),” 5 January 1987, in Clough et al., *Arctic National Wildlife Refuge, Alaska, Coastal Plain Resource Assessment, Volume 2 – Appendix*.

<sup>166</sup> Clough et al., *Arctic National Wildlife Refuge, Alaska, Coastal Plain Resource Assessment*, 1.

comments from a number of respondents, the authors of the draft EIS decided to strike the idea of a “core” calving ground from the baseline study. “On the basis of the respondents’ comments, it was obvious that the draft report’s designation of a ‘core’ calving area was being misinterpreted as a very specific area absolutely essential to the viability of the PCH,” the authors of the impact statement wrote in their appendix to the document.<sup>167</sup> Although the authors of the report concluded that particular birthing areas were of great importance to caribou cows, they believed that displacement from the area initially defined as the “core” calving area would not necessarily “threaten the viability” of the herd. “Accordingly,” they explained, “designations of a ‘core’ calving area...have been deleted from the final report.”<sup>168</sup>

#### **4.6. Can Oil and Caribou Coexist?**

The Department of the Interior’s recommendation to open the 1002 area to an extensive program of oil and gas leasing caused reverberations that were felt beyond Alaska’s coastal plain. Indeed, the debate about opening ANWR was not simply an American debate. As Congress inched closer to passing legislation that would enable the expansion of oil and gas development on Alaska’s coastal plain, the Canadian government, environmentalists, and Indigenous communities – particularly those Gwich’in communities that had historical relationships with the Porcupine Caribou – attempted to sway the US government to halt its plans to open ANWR. But despite Canada’s official position on ANWR, which, according to Secretary of State for External Affairs Joe Clark, “focused on ensuring the long-term viability of shared, transboundary wildlife resources,” in 1987, the Parliamentary Standing Committee on Energy, Mines and Resources released a report on North American energy security in which its

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<sup>167</sup> Clough et al., *Arctic National Wildlife Refuge, Alaska, Coastal Plain Resource Assessment, Volume 2 – Appendix, 2.*

<sup>168</sup> Clough et al., *Arctic National Wildlife Refuge, Alaska, Coastal Plain Resource Assessment, Volume 2 – Appendix, 2.*

members recommended that the federal government “encourage the United States to explore for and develop petroleum resources in Alaska’s Arctic National Wildlife Refuge, provided that environmental and aboriginal concerns can be satisfactorily resolved.”<sup>169</sup>

In response to the Standing Committee’s recommendation, Indigenous leaders from across the Canadian North, including Old Crow Chief Alice Frost, environmentalists, and territorial leaders expressed their concerns about the report to Clark. After admonishing the Chair of the Standing Committee for ignoring the official Canadian position, and for letting economic interests shape the report, Clark continued to push the US Government to extend wilderness designation to ANWR’s coastal plain.<sup>170</sup> This was not to suggest, however, that the Canadian state was opposed to northern development. Rather, as Clark argued in a 1988 *Ottawa Citizen* editorial: “We are not opposed to hydrocarbon development in the North, but wish to ensure that it is done in a way that does not put at risk the way of life of a people who have depended on this wildlife for hundreds of years.”<sup>171</sup> For American lawmakers like Frank Murkowski (R-Alaska), Canada’s position on ANWR smacked of hypocrisy and meddling.<sup>172</sup>

Alongside ongoing debates about the environmental impact of oil and gas development on the coastal plain, the boundaries of Arctic environmental science would be further challenged by political developments among the state and Native communities on both sides of the border. In Canada, the federal land claims process and the related emergence of co-management regimes, which sought to incorporate Indigenous and traditional ecological knowledge into natural resource management bodies, restructured fundamentally the terms and conditions of

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<sup>169</sup> For statement of policy, see Joe Clark’s editorial in the 18 July 1988 issue of the *Ottawa Citizen*. Accessed in Library Archives Canada (LAC), MG-26: Joe Clark Fonds, R-54, Subject Files – Porcupine Caribou. For the standing committee report, see: House of Commons Standing Committee on Energy, Mines, and Resources (Barbara Sparrow, M.P., Chair), *Oil: Scarcity or Security?* (Ottawa: House of Commons, 1987), 7.

<sup>170</sup> Library Archives Canada (LAC), MG-26: Joe Clark Fonds, R-54, Subject Files – Porcupine Caribou.

<sup>171</sup> LAC, MG-26: Joe Clark Fonds, R-54, Subject Files – Porcupine Caribou.

<sup>172</sup> LAC, MG-26: Joe Clark Fonds, R-54, Subject Files – Porcupine Caribou.

Arctic environmental science.<sup>173</sup> Further, in 1988 Gwich'in leaders in Alaska and Canada organized a gathering in Arctic Village, Alaska, in which they committed to work together to protect the Porcupine Caribou Herd's calving grounds from the ravages of industrial development. Since that time, the Gwich'in Nation has maintained its commitment to protecting the calving grounds, which they refer to as "Iizhik Gwats'an Gwandaii Goodlit" (The Sacred Place Where Life Begins).<sup>174</sup> For the communities of the transboundary Gwich'in Nation, the threat of oil and gas development on the calving grounds is antithetical to the health and survival of the Porcupine Caribou.

In the year following the release of the Department of the Interior's recommendation, Congressional Republicans and the Reagan administration pushed to open ANWR to development as quickly as possible. In Alaska, wildlife managers were concerned that officials with the USFWS had suppressed a document which claimed that the environmental impacts at Prudhoe Bay had been even greater than stated in government reports. Some believed that the report, which had been prepared at the request of Representative George Miller (D-California), could have swayed debate about the future of development in ANWR.<sup>175</sup> Later that year, the House Merchant Marine and Fisheries Committee approved a bill that included development on

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<sup>173</sup> Yet, the politics and efficacy of integrating Indigenous and Western knowledge systems has been a matter of some debate. See Tina Loo, "Political Animals: Barren Ground Caribou and the Managers in a 'Post-Normal' Age," *Environmental History* 22.3 (2017): 433-459; Nadasdy, *Hunters and Bureaucrats*; Kofinas, "Caribou hunters," 179-196.

<sup>174</sup> Gwich'in Steering Committee, "The Coastal Plain – The Sacred Place Where Life Begins," accessed online at [www.ourarcticrefuge.org/about-the-refuge/the-coastal-plain-the-sacred-place-where-life-begins](http://www.ourarcticrefuge.org/about-the-refuge/the-coastal-plain-the-sacred-place-where-life-begins) on 15 February 2017. For more on the place of caribou within Gwich'in communities, cultures, and worldviews, see: VGFN and Smith, *People of the Lakes*; Sherry and VGFN, *The Land Still Speaks*.

<sup>175</sup> For more on the controversy engendered by the apparent suppression of this report, see press clippings contained in US Fish and Wildlife Service, *Arctic National Wildlife Refuge: Annual Narrative Report, 1988* (Fairbanks: ANWR Administrative Headquarters, 1989), particularly "ANWR Report Said Kept From Congress," *Sitka Sentinel*, 11 May 1988.

the 1002 lands, which improved significantly the possibility that the bill would make it through Congress in the near future.<sup>176</sup>

Everything changed, however, on 24 March 1989 when the Exxon Valdez struck a reef and spilled almost 11 million gallons of Prudhoe Bay crude oil in Alaska's Prince William Sound. In the weeks following this catastrophic oil spill, ANWR was "inundated" with national and international media attention, as reporters and commentators sought to determine how the political fallout from disaster would impact the prospect of development within the 1002 area.<sup>177</sup> Indeed, as public opinion shifted amidst reports of lax regulations and poor safety measures, proponents of opening ANWR decided it was best to put their ANWR plans on hold. In April, Senator Murkowski, one of the most ardent supporters of development on the coastal plain, argued that ANWR should not be opened to the oil and gas companies until they have proven the adequacy of their emergency and contingency plans.<sup>178</sup> For Senator Ted Stevens (R-Alaska), another staunch proponent of development on the coastal plain, there was little doubt that ANWR would eventually be opened to drilling, but for the time being, he suggested, there was no way to move ahead with legislation.<sup>179</sup> Indeed, for American legislators, it would be almost two years before the Iraq invasion of Kuwait, and the Bush Administration's National Energy Plan, which included a key provision that would open the 1002 to oil and gas, reanimated the ANWR debate.<sup>180</sup>

In the midst of ANWR's "political lull", scientists continued to debate the importance of the calving grounds for the survival of the Porcupine Caribou Herd. As in years past, the debate,

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<sup>176</sup> McMonagle, *Caribou and Conoco*, 54.

<sup>177</sup> US Fish and Wildlife Service, *Arctic National Wildlife Refuge: Annual Narrative Report, 1989* (Fairbanks: ANWR Administrative Headquarters, 1990), 60.

<sup>178</sup> Dave Roman, "Murkowski: Put ANWR on Hold Pending Spill Plans," *Juneau Empire*, 9 April 1989.

<sup>179</sup> Beau Brendler, "Stevens Says Spill Delays ANWR Bill," *Anchorage Times*, 29 April 1989.

<sup>180</sup> McMonagle, *Caribou and Conoco*, 55.

which built on more than three fifteen years of caribou investigations, was bound up with the ongoing contestation over the authority to determine which groups and institutions were deemed legitimate producers of scientific knowledge. In 1989, *Daily News* writer George Frost traveled to Alaska to report on this debate.<sup>181</sup> For Deb Beaubien, biologist for British Petroleum (BP), the notion of a core calving ground was a misrepresentation of caribou calving behaviour. Beaubien claimed that her perspective was corroborated by the fact that the herd had largely avoided the coastal plain for each of the past three years.<sup>182</sup> Further, in her interview with Frost, Beaubien suggested that BP scientific investigations contradicted the reports of government biologists, which claimed that the mortality rate for calves was lower on the coastal plain than in other areas. When asked to account for the polarization in scientific opinion, Beaubien stated that in Alaska politics tended to “screw up” science.<sup>183</sup> In the winter of 1989, however, after more than three years of absence, thousands of caribou from the Porcupine Herd crossed the Alaska-Yukon border, and migrated down from the mountains to the coastal plain, where the cows gave birth on the herd’s traditional calving grounds within the boundaries of the 1002 area.<sup>184</sup>

#### **4.6. Epilogue**

During the fall of 2017, while I was preparing to write this dissertation chapter, the Trump Administration began to make serious moves toward opening ANWR to the oil and gas industry. Almost four decades after the passage of ANILCA and the establishment of the 1002 area, pro-drilling Congressional Republicans had not managed to pass legislation that would allow oil leasing and resource extraction within the Porcupine Caribou Herd’s calving grounds

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<sup>181</sup> George Frost’s article, “Return of Caribou Enlivens Debate over Refuge Drilling,” is included in the press clipping section of the ANWR 1989 Annual Report. See USFWS, *Arctic National Wildlife Refuge: Annual Narrative Report, 1989*.

<sup>182</sup> George Frost, “Return of Caribou,” in USFWS, *Arctic National Wildlife Refuge: Annual Narrative Report, 1989*.

<sup>183</sup> George Frost, “Return of Caribou,” in USFWS, *Arctic National Wildlife Refuge: Annual Narrative Report, 1989*.

<sup>184</sup> George Frost, “Return of Caribou,” in USFWS, *Arctic National Wildlife Refuge: Annual Narrative Report, 1989*.

on Alaska's coastal plain – though they had come close. In 1995, for example, a Republican-dominated Congress added and approved a provision to a budget-reconciliation measure that would have enabled development of the 1002 area. Democratic President Bill Clinton, however, vetoed that bill before it became law. Further, after the election of George W. Bush, Congress proposed several pro-drilling measures, though none went on to become law.<sup>185</sup>

These failures, however, had not discouraged Alaska's pro-drilling Representatives in D.C. Like her father Frank Murkowski, Senator Lisa Murkowski (R-Alaska) has been a leading voice in the Congressional push to open ANWR to drilling since her election to Senate in 2002. Yet, unlike many of the Alaskan politicians who have attempted to undermine environmental arguments by portraying ANWR's coastal plain as a barren wasteland, Murkowski has not denied the region's wilderness values. Instead, the Alaskan Senator has touted the oil and gas industry's capacity as a steward of Arctic environments, and argued that the oil companies would mitigate the impacts associated with northern resource extraction by pursuing *responsible* energy development inside the Refuge.<sup>186</sup> "Thanks to new technologies," Murkowski explained in a 2017 editorial in the *Anchorage Daily News*, Alaskans can be "confident that development will not come at the expense of our environment or wildlife."<sup>187</sup>

In 2017, Murkowski was at the center of another Republican-led effort to open the 1002 area to energy development. As the Chair of the US Senate Committee on Energy and Natural Resources, Murkowski was well positioned to lead this charge. Like her predecessors in the mid-1990s, Murkowski used a proposed piece of legislation as a vehicle for a rider that would permit

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<sup>185</sup> McMonagle, *Caribou and Conoco*, 3, 99.

<sup>186</sup> Political ecologist David Standlea argues that since the early 2000s, this has become perhaps the most obvious tactic employed by the oil industry and its allies in Congress. See David Standlea, *Oil, Globalization, and the War for the Arctic Refuge* (New York: SUNY Press, 2006), 77-78.

<sup>187</sup> Lisa Murkowski, "Tax bill, ANWR opening give Alaskans cause for celebration," *Anchorage Daily News*, 20 December 2017.

the development of an oil and gas leasing program on the coastal plain. Indeed, President Trump's Tax Cuts and Jobs Act was already a contentious piece of legislation, and the attachment of a non-tax related provision that would open ANWR only served to heighten Congressional and public debate about its passage. But with a pro-development President in the Oval Office and a Republican-dominated House of Representatives, there were fewer existential threats to the bill's passage than in years past. On 20 December 2017, during the winter solstice, Congress passed the Tax Cuts and Jobs Act along with the controversial rider that effectively opened ANWR to a program of oil and gas leasing.<sup>188</sup>

Following the bill's passage, Trump and a contingent of Congressional Republicans gathered on the south lawn of the White House to celebrate their victory. During the proceedings, the President invited Murkowski to address the assembled audience. After almost four decades of lobbying, oil companies – and their partners in Congress – had finally managed to open the “1002 area” to drilling. Standing alongside her Republican colleagues from Alaska, Murkowski recounted this protracted struggle, and reflected on the historical significance of the legislation, which had just been passed, and now awaited the President's signature. “Now it doesn't feel like it right now, but the winter solstice is the shortest day, the darkest day,” Murkowski stated in reference to the timing of the bill's passage through Congress. “And for us in Alaska, we've had some pretty dark days recently.” But just as the winter solstice signalled the end of the long Alaskan winter, the decision to allow Congress to open ANWR to the oil and gas industry, Murkowski suggested, would ultimately bring an end to the state's economic struggles.

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<sup>188</sup> For more on Murkowski's political maneuvers and the attachment of this provision to the Tax Cuts and Jobs Act, see Elwood Brehmer, “ANWR clears Senate, Young named to conference panel,” *Alaska Journal of Commerce*, 5 December 2017, accessed online on 5 March 2018 at <http://www.alaskajournal.com/2017-12-05/anwr-clears-senate-young-named-conference-panel#.Wp3MJkxFwrc>.

“[T]his is a bright day for Alaska, this is a bright day for America,” the Senator effused. “This, Mr. President, is what energy dominance is all about. So, let’s go!”<sup>189</sup>

Although Alaskan politicians believe that oil production in the 1002 area will not begin before the late 2020s, the passage of this legislation represents a significant development in the environmental politics of the western Arctic.<sup>190</sup> Throughout Canada and the United States, politicians, environmentalists, and Indigenous leaders have rallied to support Gwich’in efforts to protect the Porcupine Caribou Herd’s calving grounds.<sup>191</sup> Yet, the decision to permit oil and gas development within critical calving grounds of one of North America’s largest migratory caribou herds is perhaps not surprising. In a recent paper, Brenda Parlee, John Sandlos, and David Natcher argue that a fundamental disconnect has emerged between caribou science and policy.<sup>192</sup> In recent years, they argue, governments have placed increasingly strict regulations on Indigenous caribou hunting, and placed less emphasis on the more threatening destruction of caribou habitat by mineral and extractive resource industries. Rather than being a “tragedy of the commons” – a problem precipitated by unregulated Indigenous hunting – they argue that caribou population declines are related to the problem of access, and governments have allowed industries almost unfettered access to the minerals and hydrocarbons resources that lay beneath critical caribou habitat.

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<sup>189</sup> Quote taken from: Sen. Lisa Murkowski [lisamurkowski]. (2017, Dec 20), “Speaking on the magnitude of this historic moment,” <https://t.co/GZA6rUv33u> [Tweet], retrieved from <https://twitter.com/lisamurkowski/status/943597487608254464>

<sup>190</sup> Erica Martinson, “Alaska Delegation Says Drilling in ANWR is at Least a Decade Away,” *Anchorage Daily News*, 4 March 2018.

<sup>191</sup> For example, see the conference proceedings for “The Last Oil: A Multispecies Justice Symposium on Arctic Alaska and Beyond,” hosted by the University of New Mexico, 21-21 February 2018: accessed online on 5 March 2018 at <https://thelastoil.unm.edu>.

<sup>192</sup> Brenda Parlee, John Sandlos, and David Natcher, “Undermining Subsistence: Barren-Ground Caribou in a ‘Tragedy of Open Access,’” *Science Advances* 4, 2 (2018): e1701611.

The findings presented in the paper by Parlee, Sandlos, and Natcher not only point up the critical disjuncture between science and policy, but also suggest the limits of the idea that oil and caribou can coexist. As I have argued throughout this chapter, since the 1960s, the oil and gas industry has played a critical role in the development of caribou science in the transboundary western Arctic. During that time, representatives of the industry have leveraged the idea of environmental expertise to suggest that the industry has the capability to operate within areas of caribou habitat without compromising the health and survival of migratory caribou herds. This argument, I suggest, is premised on the discursive bounding of nature and society into separate, discrete categories; through the production of scientific knowledge, industry representatives argue, oil companies have acquired the expertise required to avoid violating this boundary. This specious argument, though, is founded upon the hardening of the socially-constructed boundary between nature and society, which, in this case, has been portrayed as a question of wilderness versus development. As Alaskan politicians continue to push for the development of the 1002 area, Americans would be wise to reflect on the historical production of this boundary, and to consider how it is that they came to accept the idea that oil and caribou can coexist.

## Chapter 5: The Contested Boundaries of the Nuclear North: Arctic Biology, Caribou, and the Problem of the Threshold

### Introduction: Environmental Histories of Northern Contaminants

During the second half of the twentieth century, the environmental issues facing the Porcupine Caribou Herd and Indigenous communities in the western Arctic were not limited to the northern expansion of the oil and gas industry. Though less perceptible than the development of a transnational resource extractive economy, the global distribution of contaminants has had an immense impact on environmental relationships in the region. While local sources of environmental contamination did exist – tailings from industrial mines, or barrels of toxic petrochemicals left at former defence sites, for example – many of the toxins scientists detected in northern environments were produced in distant locations, and transported to the north by atmospheric circulation patterns.<sup>1</sup> For many, the scientific documentation of contaminants in northern environments challenged pervasive cultural conceptions of the Arctic as pristine, unspoiled, and isolated.<sup>2</sup> But for Arctic residents, the discovery of contaminants in the northern food chain, and, consequently, in their bodies raised fundamentally different concerns about their relationship to northern environments and animals.<sup>3</sup>

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<sup>1</sup> Stephen Bocking, “Toxic Surprises: Contaminants and Knowledge in the Northern Environment,” in *Ice Blink: Navigating Northern Environmental History*, ed. Stephen Bocking and Brad Martin (Calgary: University of Calgary Press, 2017), 423; John Sandlos and Arn Keeling, “Environmental Justice Goes Underground? Historical Notes from Canada’s Northern Mining Frontier,” *Environmental Justice* 2, 3 (2009): 117-125. For more on the role of the US Environmental Protection Agency in environmental remediation at DEW Line sites, see the documents included in National Archives and Records Administration (NARA) Seattle, RG 22: US Fish and Wildlife Service, Alaska Region, 1425, Contaminant Assessment Cleanup, Restoration Case Files, 1974-2005, Box 1, File: “Military Contaminants on Refuges, 1991-1993.”

<sup>2</sup> Bocking, “Toxic Surprises,” 423.

<sup>3</sup> For more on the discovery of industrial pollutants, contaminants, and toxins in northern environments, see Terry Fenge and David Leonard Downie, eds., *Northern Lights Against POPs: Combatting Toxic Threats in the Arctic* (Montreal: McGill-Queen’s University Press, 2003); Marla Cone, *Silent Snow: The Slow Poisoning of the Arctic* (New York: Grove/Atlantic Inc., 2007); Sharon Stephens, “Chernobyl Fallout: A Hard Rain for the Sami,” *Cultural Survival Quarterly* 11, 2 (1987): accessed online on 15 January 2017 at [www.culturalsurvival.org/publications/cultural-survival-quarterly/chernobyl-fallout-hard-rain-sami](http://www.culturalsurvival.org/publications/cultural-survival-quarterly/chernobyl-fallout-hard-rain-sami).

As environmental historian Stephen Bocking has observed, the surprise engendered by the discovery of contaminants in northern environments also reshaped the conduct of northern science, and altered relationships among Indigenous communities, experts, and governments.<sup>4</sup> Further, the political, social, and cultural fallout from the detection of northern contaminants extended to and impacted local relationships between human communities and migratory caribou herds. Throughout this period, scientific wildlife management increasingly mediated human-caribou interaction, and the presence of contaminants in northern ecosystems posed an entirely new set of political challenges and environmental concerns for those involved in caribou conservation.<sup>5</sup> In addition to mapping the pathways through which toxins accumulated in northern environments, scientists also sought to determine the biological implications of chemical exposures. What level of exposure, they asked, can the human body withstand without suffering biological damage? In attempting to answer this question, scientists engaged in a protracted debate about the existence of a threshold between ostensibly safe and unsafe levels of exposure to the contaminants accumulating in northern environments.

This chapter deals with the environmental politics of the threshold. In what follows, I examine scientific attempts to determine whether the bioaccumulation of radiocesium (cesium-137) – a radionuclide distributed globally by nuclear fallout – constituted a biological threat for

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<sup>4</sup> Bocking, “Toxic Surprises,” 421-464.

<sup>5</sup> The literature on environmental contaminants is vast and growing rapidly. For a discussion of the challenges posed by contaminants see Rob Nixon, *Slow Violence and the Environmentalism of the Poor* (Cambridge, Massachusetts: Harvard University Press, 2011). Shannon Cram has documented the complexity of measuring dose and assessing the impact of radiation exposure in a series of papers; see Shannon Cram, “Living in Dose: Nuclear Work and the Politics of Permissible Exposure.” *Public Culture* 28, 3 (2016): 519-539; Shannon Cram, “Becoming Jane: The Making and Unmaking of Hanford’s Nuclear Body.” *Environment and Planning D: Society and Space* 33, 5 (2015): 796-812. For more on radiation in northern food chains, and resultant threats to caribou and reindeer see: V.K. Mohindra, “Cesium 137 Burdens in the Canadian North,” *Acta Radiologica Therapy Physics Biology* 6 (1967): 481-490; Sharon Stephens, “Bounding uncertainty: The post-Chernobyl culture of radiation protection experts,” in Susanna Hoffman, Anthony Oliver-Smith, eds. *Culture and Catastrophe: The Anthropology of Disaster* (Santa Fe: School of American Research Press, 2002): 91-112; Stephens, “Chernobyl Fallout.”

migratory caribou herds and Indigenous communities in the western Arctic. After 1958, scientists documented the ecological conditions that rendered northern environments vulnerable to the bioaccumulation of radioactive fallout, and their studies revealed that the consumption of contaminated caribou meat was an important pathway of human exposure to cesium-137.<sup>6</sup> But despite the scientific documentation of the ecological mechanisms driving this phenomenon, the threshold remained a political problem marked by scientific uncertainty and deep disagreement about the notion of safe levels of exposure to radioactive material. This chapter does not aim to resolve these scientific debates. Nor does it seek to determine whether historical radiocesium levels represented a biological threat to Indigenous communities in the western Arctic. Rather, I engage with the environmental politics of the threshold by addressing two related concerns. First, I consider the way in which northern scientists marked the boundary between safe and unsafe levels of human exposure to radiocesium. Instead of asking whether the consumption of contaminated caribou meat was safe or unsafe, I examine the way in which the scientific application of the concept of the threshold shaped environmental politics in the western Arctic.<sup>7</sup> Second, I consider the implications of this process for environmental relationships in the region. I ask how the establishment of a threshold for human exposure levels – a different kind of boundary making to that discussed in previous chapters – influenced human-caribou interaction.

Rather than a natural or stable boundary, the threshold has always been a site of contested knowledge claims and assertions of scientific authority. However, the boundary making practices employed to stabilize the threshold concept have been obscured by the institutional and

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<sup>6</sup> Eville Gorham, “A Comparison of Lower and Higher Plants as Accumulators of Radioactive Fall-Out,” *Canadian Journal of Botany* 37 (1959), 327-329; Mohindra, “Cesium 137 Body Burdens.”

<sup>7</sup> In taking this approach, I build on the method and questions developed by Jacob Hamblin in his examination of nuclear waste disposal. See Hamblin, *Poison in the Well*, 5.

discursive regimes within which scientists produce nuclear knowledge.<sup>8</sup> By this, I am considering boundaries not as political markers of territory, but as techno-scientific mechanisms employed by scientists to order natural and social worlds. In an examination of nuclear ontologies, Gabrielle Hecht argues that historical actors have tended to assume there are essential qualities that make nations, programs, technologies, and other spaces count as nuclear. However, a close examination of this boundary, Hecht argues, demonstrates that it has been contested over time; the qualities that constitute “nuclearity” are unstable. Yet, scholars have failed to challenge the assumption that there is a stable boundary between the nuclear and non-nuclear.<sup>9</sup> In this chapter, I address this gap by examining the technopolitical mechanisms through which northern scientists stabilized the notion of the threshold, and extended its logic to incorporate human-caribou relationships in the western Arctic.

To better understand the environmental politics of the threshold, I examine the production of scientific knowledge about radioactive contamination in the North American Arctic – with an emphasis on the transboundary western Arctic – between 1958 and 1993. I consider three moments in which the threshold came to matter. Each period, I suggest, is defined by a shift in the conduct of northern science, and related developments in the unfolding environmental politics of radioactive contamination and the threshold. The first section engages with the politics of perceptibility, and explores scientific efforts to document pathways of exposure to radioactive contamination in northern environments (1958-1962). During this period, scientists working in northern Alaska for the US Atomic Energy Commission (AEC) not only

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<sup>8</sup> Cram, “Becoming Jane,” 796-812; Cram, “Living in Dose,” 519-539; William Kinsella, “Nuclear Boundaries: Material and Discursive Containment at the Hanford Nuclear Reservation.” *Science as Culture* 10, 2 (2001): 163-194; Adriana Petryna, *Life Exposed: Biological Citizens after Chernobyl* (Princeton: Princeton University Press, 2013).

<sup>9</sup> Gabrielle Hecht, “The Work of Invisibility: Radiation Hazards and Occupational Health in South African Uranium Production,” *International Labor and Working-Class History* 81 (2012): 95.

rendered radioactive contamination perceptible, but also established the terms by which certain forms of exposure would remain imperceptible. Following the production of perceptibility, scientists and health officials extended the logic of the threshold to the western Arctic, and effectively rendered low levels of exposure as both safe and acceptable for Indigenous communities in the region. In the second section, I examine the development of scientific methods to monitor and measure human exposure to radioactive contamination (body burdens) in the transboundary western Arctic (1962-1979). The third section considers the way in which scientists and wildlife managers leveraged the notion of the threshold as they attempted to assuage Indigenous concerns about radioactive exposures in the wake of the Chernobyl nuclear disaster (1986-1993). Through each of these periods, the threshold came to play an integral role in defining the boundaries of the nuclear north.

While this chapter is concerned primarily with the environmental politics of radioactive contamination, it is situated within a broader environmental history of northern contaminants. In addition to radiocesium, scientists detected multiple forms of contaminants accumulating in northern environments, and as each was unique in its chemical composition, pathway of exposure, and somatic impact, every contaminant presented distinct challenges for northern scientists, health authorities, and local communities. But through their industrial networks of production and global pathways of transportation, northern contaminants were linked materially to political-economic transformations occurring in the post-war period. The detection of contaminants throughout the circumpolar north, argues Bocking, required scientists, bureaucrats, and northerners alike to reconceptualise the Arctic “as a place that is distinctive, yet embedded within political and environmental systems that extend far beyond its boundaries.”<sup>10</sup>

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<sup>10</sup> Bocking, “Toxic Surprises,” 426.

Indeed, the environmental history of northern contaminants reveals the relationship between place and the production of scientific knowledge.<sup>11</sup> Between the late 1950s and early 1990s, scientists, governmental institutions, and Indigenous communities responded to the detection of northern contaminants by reconceptualising existing boundaries, and establishing new ones intended to contain discursively and materially mobile contaminants. The toxins that scientists detected in northern ecosystems crossed multiple political borders as they were transported north by atmospheric circulation patterns, demonstrated the transboundary implications of industrial pollutants, and challenged national framings of environmental issues.<sup>12</sup> At the regional scale, the “ubiquity and extreme mobility” of contaminants complicated efforts to establish spatial boundaries around contaminated areas.<sup>13</sup> As Gregg Mitman, Michelle Murphy, and Christopher Sellers argue, the material flow of pollutants and contaminants across molecular, local, regional, and global scales produced not just contaminated sites, but *landscapes of exposure* that humans – and animals – cannot avoid.<sup>14</sup>

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<sup>11</sup> Bocking, “Toxic Surprises,” 12. For more on the relationship between place and science, see Livingstone, *Putting Science in its Place*; Evenden, “Locating Science, Locating Salmon: 355-372.

<sup>12</sup> For more on contaminants as transboundary environmental issues, see: Joseph Masco, “The Age of Fallout,” *History of the Present* 5, 2 (2015): 137-168; Michelle Murphy, “Chemical Regimes of Living,” *Environmental History* 13 (2008): 695-703; on the transboundary pathways of northern contaminant accumulation, see: Arctic Monitoring and Assessment Programme, *AMAP Assessment 2002: Heavy Metals in the Arctic* (Oslo, Norway: Arctic Monitoring and Assessment Programme, 2005): 11-41; Roseanne Schuster, Mary Gamberg, Cindy Dickson, and Hing Man Chan, “Assessing risk of mercury exposure and nutritional benefits of consumption of caribou (*Rangifer tarandus*) in the Vuntut Gwitchin First Nation community of Old Crow, Yukon, Canada,” *Environmental Research* 111 (2011): 881-887; Bocking, “Toxic Surprise,” 432. For more on the scientific and toxicological investigation of transboundary toxins, see: B.T. Elkin and R.W. Bethke, “Environmental Contaminants in Caribou in the Northwest Territories, Canada,” *The Science of the Total Environment* 160/161 (1995): 307-321; Carl Winter, “Pesticides in Food,” in *Toxins in Food*, Waldemar M. Dabrowski and Zdzislaw E. Sikorski, eds. (New York: CRC Press, 2005): 246-261.

<sup>13</sup> Bocking, “Toxic Surprises,” 424.

<sup>14</sup> Gregg Mitman, Michelle Murphy, and Christopher Sellers, “A Cloud Over History,” in Gregg Mitman, Michelle Murphy, and Christopher Sellers, eds. *Landscapes of Exposure: Knowledge and Illness in Modern Environments*, Osiris 19 (Chicago: University of Chicago Press, 2004): 1-17. The idea of “landscapes of exposure,” explored in the introductory essay and subsequent papers in this collection, has shaped the environmental history of contaminants. See Bocking, “Toxic Surprises,” 424; Jody Roberts and Nancy Langston, “Toxic Bodies/Toxic Environments: An Interdisciplinary Forum,” *Environmental History* 13 (2008): 629.

Despite such amorphous spatial dimensions, scientists and governmental institutions have attempted to map the boundaries of contaminated zones throughout the circumpolar north. What emerged, however, were not objective spatial and temporal representations of toxic geographies; rather, the negotiation and establishment of these boundaries involved a process that STS scholars refer to as boundary-work, or the demarcation of a line between science and non-science.<sup>15</sup> In the western Arctic, the ongoing contestation over this critical boundary had political, cultural, and social implications as it determined which scientific methods and forms of knowledge production gained authority in official representations of and responses to northern contaminants.<sup>16</sup> While the line between contaminated and non-contaminated environments was shifting and often illusory, governmental institutions and regulatory bodies drew increasingly on notions of scientific expertise as they asserted their authority to define and mark the boundaries of contaminated zones. Of course, human exposures did occur outside of officially-recognized boundaries.

The issue of exposure – spurred by the scientific detection of contaminants in human bodies – raised concerns about the porousness of the boundary between the body and its environment.<sup>17</sup> Throughout the circumpolar north, scientists documented the role of northern

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<sup>15</sup> Gieryn, “Boundary-Work and the Demarcation of Science from Non-Science,” 781-795.

<sup>16</sup> As Rob Nixon states, the “official dimensions of the contaminated zone may shrink or dilate depending on which political forces and which research methodologies achieve the upper hand.” Nixon, *Slow Violence*: 47. For an example of the methods employed in the delineation of a contaminated zone, or a “contaminant boundary” – though not in the Arctic – see G. Pohll, Pohlmann, K., Daniels, J., Hassan, A., & Chapman, J. “Contaminant Boundary at the Faultless Underground Nuclear Test,” *Desert Research Institute, Division of Hydrologic Sciences Publication* 45196 (2003): 19-25.

<sup>17</sup> For more on the development of scientific ideas about the body as a threshold or boundary, see Linda Nash, *Inescapable Ecologies: A History of Environment, Disease, and Knowledge* (Berkeley: University of California Press, 2006); Nancy Langston, *Toxic Bodies: Hormone Disruptors and the Legacies of DES* (New Haven: Yale University Press, 2010); Julie Sze, “Boundaries and Border Wars: DES, Technology, and Environmental Justice,” *American Quarterly* 58, 3 (2006): 791-814; Becky Mansfield, “Environmental Health as Biosecurity: ‘Seafood Choices,’ Risk, and the Pregnant Woman as Threshold,” *Annals of the Association of American Geographers* 102, 5 (2012): 969-976.

food chains in the bioaccumulation of contaminants in human bodies.<sup>18</sup> However, the detection of contaminants in northern environments was a politically-fraught process, and scientific efforts to quantify human exposure levels were complicated by the imperceptibility of the toxins being measured. From the radionuclides transported around the globe by nuclear fallout, to the heavy metals accumulating in plants and animals throughout the circumpolar north, every contaminant behaved differently as it moved through northern environments and made its way into human bodies.

Imperceptibility, however, does not negate the existence of northern contaminants, or the possibility of exposure, prior to scientific detection.<sup>19</sup> In recent years, scholars in the fields of environmental history and the history of science have developed historical ontologies of imperceptible objects, and demonstrated the way in which germs, subatomic particles, and invisible toxins were brought into being through historically specific practices of “truth-telling”.<sup>20</sup> In the circumpolar north, scientific institutions, governments, and international regulatory bodies rendered northern contaminants visible – and human exposure levels quantifiable – through the development of powerful technologies of visualization and scientific modes of representation.

But not all forms of exposure were rendered perceptible through the production of technocratic expertise. In an environmental history of indoor chemical exposures, Michelle Murphy argues that the production of visibility also established the terms by which other hazards remained imperceptible and unreal; “domains of imperceptibility”, she writes, were the

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<sup>18</sup> Bocking, “Toxic Surprises,” 440-441; Sharon Stephens, “Chernobyl Fallout”; Robert White, Dan Hollerman, and Ann Allaye-Chan, “Radiocesium Concentrations in the Lichen-Reindeer/Caribou Food Chain: Before and After Chernobyl,” *Rangifer* 1 (1986), 24-29.

<sup>19</sup> Michelle Murphy, *Sick Building Syndrome and the Problem of Uncertainty: Environmental Politics, Technoscience, and Women Workers* (Duke University Press, 2006), 7-8.

<sup>20</sup> Murphy, *Sick Building Syndrome*,” 8. See also: Joy Parr, *Sensing Changes: Technologies, Environments and the Everyday, 1953-2003* (Vancouver: UBC Press, 2010); Hecht, “The Work of Invisibility,” 94-113.

“inevitable results of the tangible ways scientists and laypeople came to render chemical exposures measurable, quantifiable, assessable, and knowable in some ways and not others.”<sup>21</sup> As a regime of imperceptibility has been “purposefully assembled around synthetic molecular relations,” she argues, “efforts to render visible such relations – by scientists, by bureaucrats, by community groups, or by NGOs – are political acts.”<sup>22</sup> Stephen Bocking argues a similar historical process occurred in the North American Arctic, where shifting regimes of perceptibility – shaped by policy agencies and scientific disciplines – resulted in certain forms of human exposure becoming visible at different times, while others remained imperceptible.<sup>23</sup> Prior to the 1980s, scientific investigations of northern contaminants tended to ignore humans, despite the documentation of toxic bioaccumulation in the animals and plants – “country food” – consumed in northern communities.<sup>24</sup> Scientists investigating radioactive fallout, however, focused on human exposure, and the implications of eating contaminated caribou meat, almost two decades earlier. Yet, perceptibility did not transform the monitoring of radioactive contamination into an apolitical exercise. As I aim to demonstrate in this chapter, when it came to measuring human exposure to northern contaminants, the boundary between perceptible and imperceptible – or, safe and unsafe – was always political.<sup>25</sup>

### **Moment I: Rendering Radioactive Contamination Perceptible**

On 16 July 1945, the world was thrust into the nuclear age. Although scientists had been aware of the genetic and somatic hazards of radiation since the early twentieth century, it was the

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<sup>21</sup> Murphy, *Sick Building Syndrome*,” 8.

<sup>22</sup> Michelle Murphy, “Chemical Regimes of Living,” *Environmental History* 13 (2008): 698.

<sup>23</sup> Bocking, “Toxic Surprise,” 436-437, 453.

<sup>24</sup> Bocking, “Toxic Surprise,” 436-437.

<sup>25</sup> Murphy argues that invisibility was often produced by industry-sponsored science. See Murphy, *Sick Building Syndrome*, 9-10. For more on the environmental politics of measuring exposure, see Adriana Petryna’s discussion of “biological citizenship.” Petryna, *Life Expose*, XXV.

detonation of the first atomic weapon at the Trinity test site in New Mexico, and the US atomic bombing of Hiroshima and Nagasaki, that transformed radioactive contamination into a planetary force.<sup>26</sup> These first nuclear explosions released vast amounts of radioactive debris into the atmosphere, which was deposited as precipitation – termed fallout – across the earth’s surface over a period of several months.<sup>27</sup> Between 1945 and 1963, the production and global distribution of fallout increased dramatically as the US, Soviet Union, UK, and France established national programs for atmospheric nuclear testing.<sup>28</sup> In 1963, the US, UK, and Soviet Union signed the Limited Test Ban Treaty (LTBT), which placed a moratorium on nuclear detonations in the atmosphere, ocean, and outer space, while allowing signatories to conduct underground nuclear tests. The LTBT, then, was intended to address the environmental and health consequences of nuclear fallout, while preserving the geopolitical logics driving the Cold War nuclear arms race.<sup>29</sup>

By the time the LTBT came into effect, however, radioactive contamination produced by atmospheric nuclear testing had already impacted global environments, and marked people, plants, and animals with the “signatures of nuclear weapons science.”<sup>30</sup> In the United States and Canada, scientists detected radionuclides that were produced by nuclear tests in the South Pacific

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<sup>26</sup> Alan Martin and Samuel Harbinson, *Introduction to Radiation Protection* (London: Chapman and Hall, 1979), 59-70. For more on early debates about radioactive contamination, see Hamblin, *Poison in the Well*, 10-38. For a discussion of fallout as a “planetary force”, see Masco, “The Age of Fallout,” 141; 153.

<sup>27</sup> UNSCEAR, “Report of the United Nations Scientific Committee on the Effects of Atomic Radiation. General Assembly Official Records: Thirteenth Session supplement 17 (A/3838) (New York: United Nations, 1958), 11.

<sup>28</sup> For more on the development of atmospheric nuclear testing, see O.A Pavlovski, “Radiological Consequences of Nuclear Testing for the Population of the Former USSR (Input Information, Models, Dose, and Risk Estimates),” in *Atmospheric Nuclear Tests: Environmental and Human Consequences*, ed. C.S. Shapiro (Berlin: Springer, 1998): 219; Edward Pochin, *Nuclear Radiation: Risks and Benefits* (Oxford: Clarendon Press, 1983), 75.

<sup>29</sup> Masco, “Age of Fallout,” 143. For the complete text of the LTBT, see U.S. Department of State, “Treaty Banning Nuclear Weapon Tests in the Atmosphere, in Outer Space and Under Water,” Signed at Moscow August 5, 1963, Entered into Force October 10, 1963. Accessed online at [www.state.gov/t/isn/4797.htm#treaty](http://www.state.gov/t/isn/4797.htm#treaty) on 30 March 2017.

<sup>30</sup> Masco, “Age of Fallout,” 153.

in food products such as milk, meat, and vegetables.<sup>31</sup> Fifteen years after the detonation of the first nuclear weapon, Joseph Masco argues, scientists recognized radioactive fallout as a “planetary industrial signature” that was inscribed at multiple scales and different levels into every being living on Earth.<sup>32</sup>

The issue of radioactive contamination, however, was not simply a biophysical phenomenon resulting from the proliferation of atmospheric nuclear testing. In the early 1960s, scientific debate about nuclear fallout had transgressed an ostensible boundary between science and politics. Prior to the signing of the LTBT, ecologist and environmentalist Barry Commoner argued, the “fallout problem” was complicated by the way in which scientific opinion had been marshalled to make political cases for and against the continuation of atmospheric nuclear testing.<sup>33</sup> To the general public, Commoner argued, the political implications of this division seemed to “violate science’s traditional devotion to objectively ascertainable truth.”<sup>34</sup> By 1963, scientists had gained an understanding of the planetary scale of the implications of radioactive fallout, but they – along with political institutions at all levels – were still struggling to comprehend the long-term environmental impacts and health consequences of nuclear exposures.

In the winter of 1962, an article appeared in *The Beaver*, a Canadian magazine published quarterly by the Hudson’s Bay Company, in which William O. Pruitt, a field biologist at the University of Alaska, suggested that radioactive fallout represented a serious biological threat to migratory caribou herds in the North American Arctic. Throughout the circumpolar north, he

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<sup>31</sup> Masco, “Age of Fallout,” 151. For more on the scientific detection of fallout produced by nuclear testing, see Nic Maclellan, “The nuclear age in the Pacific islands,” *The Contemporary Pacific* 17, 2 (2005): 363-372; Harold L. Beck and Burton G. Bennett, “Historical Overview of Atmospheric Nuclear Weapons Testing and Estimate of Fallout in the Continental United States,” *Health Physics* 82, 5 (2002): 591–608; S.M. Wright, B.J. Howard, P. Strand, T. Nylén, and M.A.K. Sickel, “Prediction of 137 Cs deposition from atmospheric nuclear weapons tests within the Arctic,” *Environmental Pollution* 104, 1 (1999): 131-143.

<sup>32</sup> Masco, “Age of Fallout,” 151.

<sup>33</sup> Barry Commoner, “The Fallout Problem,” *Science* 127, 3305 (2 May 1958): 1025.

<sup>34</sup> Commoner, “Fallout Problem,” 1025.

warned, caribou and reindeer had become “hot spots” of radioactive contamination. Strontium-90 and cesium-137 were the primary contaminants that scientists had detected in the bodies of these animals, and the source of radiation, he noted, was “undoubtedly atmospheric nuclear explosions.”<sup>35</sup>

Indeed, the article aimed to provoke. Since the early 1950s, wildlife managers with the Canadian Wildlife Service (CWS) had been puzzled by what appeared to be a dramatic reduction in Canada’s barren ground caribou populations. While many CWS officials insisted that overhunting by Indigenous communities was the primary driver of declining caribou populations, others pointed to alternative explanatory factors, such as the loss of ecologically important caribou habitat – including lichen-rich spruce forests – to destructive forest fire.<sup>36</sup> Yet, among Canadian politicians and scientists, some questioned the link between declining caribou populations and radioactive fallout. Arthur Laing, Minister of Northern Affairs and National Resources, who believed that the widespread loss of caribou populations was driving Inuit communities to integrate with the “white man’s civilization,” argued that nuclear fallout had exacerbated the problem. Much to the dismay of officials in the Canadian Wildlife Service, in 1963, Laing stated: “There is a strong suggestion of sterility in caribou herds caused by nuclear fallout.”<sup>37</sup> Though less ominous in his prognostication, Pruitt also sounded a warning about the long-term implications of nuclear fallout; radioactive contamination, he argued, represented a

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<sup>35</sup> William O. Pruitt, “A New ‘Caribou Problem’,” *The Beaver* (Winter, 1962): 24.

<sup>36</sup> John Kelsall, “Continued Barren-Ground Caribou Studies,” *Wildlife Management Bulletin* 1, 12 (Ottawa: Canadian Wildlife Service, 1957), 93. For a discussion of the problems with the results of the caribou surveys, and contemporaneous critiques, see Sandlos, *Hunters at the Margin*, 201-230. For more on the alternative explanations, see William O. Pruitt, “A New ‘Caribou Problem’,” *The Beaver* Winter (1962): 24.

<sup>37</sup> The press clipping including the article in which Laing was quoted was enclosed in the fonds of the Canadian Wildlife Service (RG 109). Though the name of the journal and the publication information are illegible, the article was printed in 1963. Double exclamation marks were written in the margin alongside Laing’s claim of caribou sterility. See LAC, RG 109, Vol 475, File W1.U. 341.

“new caribou problem” in the North American Arctic, which posed a greater threat than any factor that contributed to the caribou crisis of the 1950s.<sup>38</sup>

Though his position was not uncontentious, Pruitt was well-positioned to comment on the biological hazards posed by radioactive fallout. After completing a doctorate in zoology at the University of Michigan, Pruitt had spent a year working for the CWS, conducting caribou surveys in northern Saskatchewan and the Northwest Territories. Following completion of this research position in northern Canada, Pruitt was hired as a “Research Associate” in mammalogy at the University of Alaska, where he worked on a series of environmental studies in northern Alaska for the Atomic Energy Commission (AEC).<sup>39</sup> In the late 1950s, the AEC and its scientists working at the Livermore weapons laboratory initiated Project Plowshare, a development in the US nuclear industry that promoted the peaceful use of nuclear detonations for the purposes of “geographical engineering.”<sup>40</sup> After Livermore Director, Edward Teller, determined that there were too many political complications associated with an international experimental blast site, the AEC narrowed its search for a test site to the national scale.<sup>41</sup> In 1958, the officials with the institution began investigating Cape Thompson, Alaska as its first experimental site, where it proposed employing a series of nuclear detonations to blast a “model harbour” north of the Bering Strait.<sup>42</sup> Yet, Project Chariot, the name given to the proposed Cape Thompson blast, came

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<sup>38</sup> Pruitt, “Caribou Problem,” 24.

<sup>39</sup> William Pruitt to Louis M. Hacker (American Civil Liberties Union), 2 October 1963, Alaska Polar Region Collections and Archives (APRCA), William O. Pruitt Papers, 1959-1970, Box 2, Folder 9. For a discussion of Pruitt’s work with the CWS and AEC, see O’Neill, *H-Bombs, Inupiat Eskimos*.

<sup>40</sup> Scott Kirsch, “Peaceful Nuclear Explosions and the Geography of Scientific Authority,” *Professional Geographer* 52, 2 (2000): 179-180.

<sup>41</sup> Kirsch, “Peaceful Nuclear Explosions,” 184.

<sup>42</sup> For more on the historical geography and environmental history of Project Plowshare and its Alaskan connection, see O’Neill, *Firecracker Boys*; Susan Millar and Don Mitchell, “Spectacular Failure, Contested Success: The Project Chariot Bioenvironmental Programme,” *Ecumene* 5, 3 (1998): 287-302; Peter Coates, “Project Chariot: Alaskan Roots of Environmentalism,” *Alaska History* 4 (1989): 1-31; Denis Cosgrove, “Introduction: Project Plowshare,” *Ecumene* 5, 3 (1998): 263-265; Kirsch, “Experiments in Progress,” 267-285; Kirsch, *Proving Grounds*.

with its own set of political and environmental complexities, and was met with staunch opposition from Alaskan Native communities and American environmental activists. By April 1962, officials with Livermore recommended the cancellation of Project Chariot.<sup>43</sup>

Though the experimental blasts at Cape Thompson did not occur, Project Chariot had implications for the development of northern science and social relations in the western Arctic. As AEC officials and Livermore scientists understood that the proposed nuclear earthmoving projects would release vast amounts of radioactive fallout into the atmosphere, the institution funded a series of bio-environmental and radiological studies, which aimed to “determine radiation levels and the distribution of radioisotopes in the biota and physical environment in pre- and postdetonation time.”<sup>44</sup> At the University of Alaska, Pruitt’s AEC-funded field investigations were designed to trace the movement of energy through northern ecosystems by “unravelling” the northern food web.<sup>45</sup> Through this research, Pruitt and his colleagues not only made important contributions to the emerging field of northern ecology, but also addressed a critical gap in scientific efforts to map the pathway of radioactive exposure.

Mapping the movement of fallout through the northern ecosystems was a crucial step in scientific efforts to render radioactivity perceptible. Yet, the scientists hired to conduct the Project Chariot environmental studies were not the first to consider the bioaccumulation of radioactive contamination. As early as 1958, biologists had begun to uncover the ecological mechanisms driving the accumulation of radioactive contamination in northern environments. In that year, Eville Gorham, a Canadian botanist then working at the University of Toronto,

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<sup>43</sup> Scott Kirsch, “Peaceful Nuclear Explosions,” 185.

<sup>44</sup> N.J. Willimovsky and John Wolfe, *Environment of Cape Thompson Region, Alaska* (Springfield, VA: US Atomic Energy Commission, Division of Technical Information, PNE-481, 1966), iii.

<sup>45</sup> William Pruitt to Louis M. Hacker, 2 October 1963, APRCA, William O. Pruitt Papers, 1959-1970, Box 2, Folder 9.

published a paper in which he documented the capacity of lichens to accumulate higher concentrations of radioactive contamination than flowering plants.<sup>46</sup> Although Gorham was unable to explain why this phenomenon occurred, his research did suggest broader ecological implications for people and animals in regions where lichens were prevalent, such as the circumpolar north. “The chief practical conclusion to be drawn from this work,” Gorham argued, “is that animals feeding on mosses and lichens may well exhibit high intakes of radioactive fall-out on this account.”<sup>47</sup>

In the years following the publication of Gorham’s research, scientists continued to investigate radioactive contamination in northern ecosystems. By 1962, scientific consensus had emerged around the role of lichens – an important food source for caribou and reindeer – in the bioaccumulation of radioactive contamination in caribou bodies. As Pruitt explained, lichens, which acquire nutrients directly from the air rather than from roots extending into the ground, had evolved “such efficient mechanisms for retaining natural fall-out that they also retain virtually 100 per cent of the radioactive particles that fall onto them.”<sup>48</sup> Unlike a blade of grass, which might contain fallout accumulated during a relatively short growing season, slow-growing lichens are often contaminated by fallout particles deposited over several years.<sup>49</sup> Ultimately, Pruitt noted, this ecological condition led to an uneven distribution of radioactive contamination across species lines: compared to northern mammals that did not eat lichens, caribou and reindeer demonstrated heightened levels of radioactive contamination. Scientific studies seemed to confirm Gorham’s conclusion regarding animals that fed on lichens. Scientists, however, were

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<sup>46</sup> Gorham, “A Comparison of Lower and Higher Plants, 327-329. For a historical discussion of Gorham’s ecological studies of mosses and lichens, see Bocking, “Toxic Surprise,” 428-429.

<sup>47</sup> Gorham, “Radioactive Fall-Out,” 329.

<sup>48</sup> Pruitt, “Caribou Problem,” 25.

<sup>49</sup> Pruitt, “Caribou Problem,” 25.

still trying to determine whether radioactivity represented a threat to the people and animals that consumed contaminated caribou.

Despite a lack of data concerning bioaccumulation in carnivores, scientific reports from the circumpolar north indicated that the entire Arctic food chain had been contaminated by radioactive material. This included not only those animals that fed on contaminated plants, but also human communities that met their dietary needs through the consumption of “country food”.<sup>50</sup> To Pruitt, the issue of radioactive contamination was rooted in the complexities of Arctic tundra ecosystems, and revealed the “interdependence of all living things.”<sup>51</sup> In the north, Pruitt explained, caribou were the base of the food chain, migratory grazers that converted lichens and other vegetation into a form of protein that other animals, including humans, could utilize. Along with his colleagues working on the AEC environmental studies, Pruitt developed a graphic representation of the “food-web” in the Ogotoruk Creek Region, the site of Project Chariot, which sought to demonstrate interconnections within Arctic tundra ecosystems by mapping the movement of energy through the northern food chain (see Figure 5.1).<sup>52</sup> Radioactive contamination, these scientists suggested, followed the movement of energy up the food chain, from lichens to the human communities that depended on caribou.<sup>53</sup> By 1962, scientists had distilled this complex web of interrelationships into a relatively simple linear pathway of exposure (lichen/sedge → caribou → carnivore/man) for radioactive contamination in the north.<sup>54</sup>

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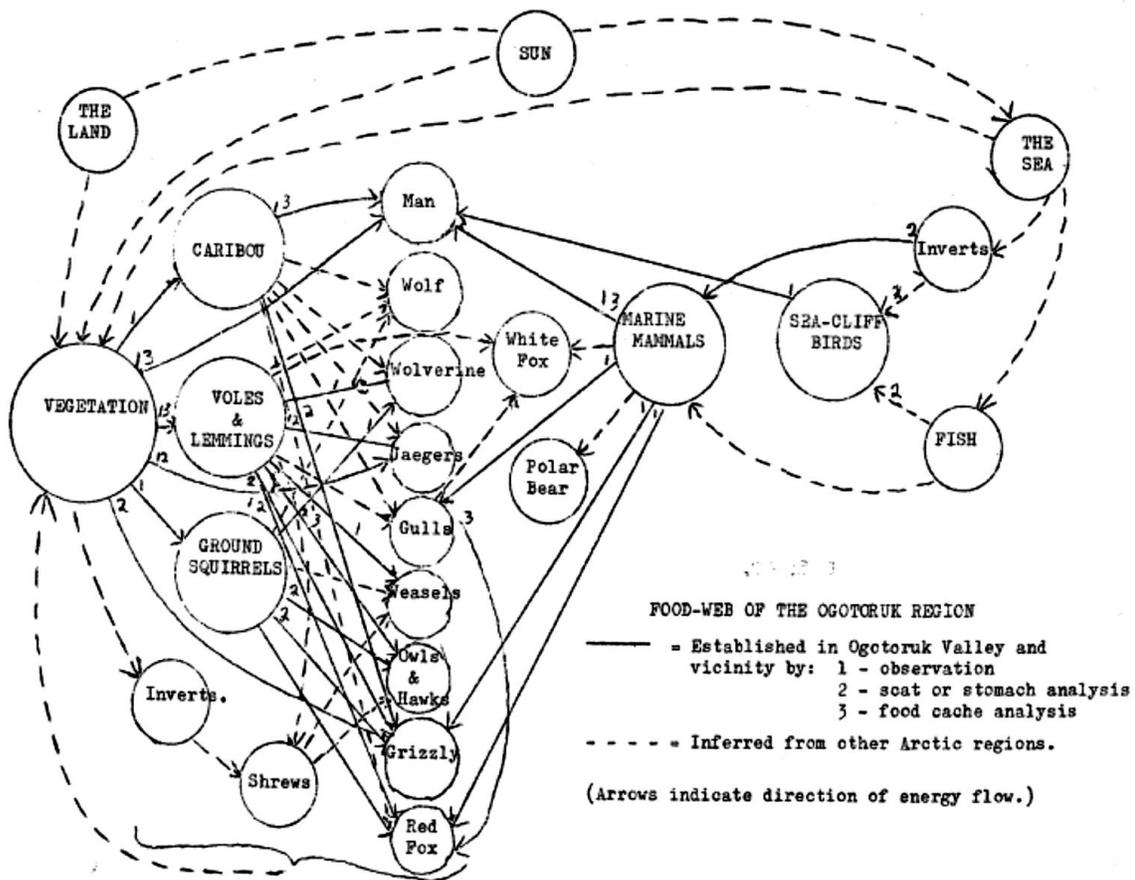
<sup>50</sup> Kurt Liden, “Cesium 137 Burdens in Swedish Laplanders and Reindeer,” *Acta Radiologica* 56, 3 (1961): 237-240. In 1962, Barry Commoner recommended this article to Pruitt, who was seeking additional studies on the lichen-caribou link in the movement of radioactivity through the food chain. See APRCA, William O. Pruitt Papers, 1959-1970, Box 2, File 10, Barry Commoner to William Pruitt, 2 February 1962.

<sup>51</sup> Pruitt, “Caribou Problem,” 25.

<sup>52</sup> Alaska Conservation Society, “Review of Biological Research Results,” *Alaska Conservation Newsletter* 2, 2 (1961): Figure 2.

<sup>53</sup> Alaska Conservation Society, “Review,” 16-25.

<sup>54</sup> Pruitt, “Caribou Problem,” 25



**Figure 5.1. “Food-Web of the Ogotoruk Region.”** Alaska Conservation Society, *News Bulletin* 2, 2 (March 1961): Figure 2.

As northern scientists conducted research on the environmental impact and biological consequences of radioactive fallout, they extended the logic of the threshold to incorporate environmental relationships in the western Arctic. While AEC officials claimed that Project Chariot did not pose any serious biological concerns for people and animals in the western Arctic, environmental activists and scientists questioned the institution’s claims, and challenged their capacity to model and predict how much radioactive fallout would be produced by the

proposed detonations.<sup>55</sup> Despite statements made by AEC officials, Pruitt and his colleagues voiced their opposition to Project Chariot, and their concerns turned on the notion of the threshold for radioactive contamination in northern environments. “I have become convinced that there is a potentially grave danger to the biota not only of the region but all Arctic regions,” Pruitt argued, “because Chariot would contribute to the radioactivity burden of the very sensitive lichen-caribou-carnivore (man) food chain.”<sup>56</sup> Further, Pruitt also suggested that existing levels of radioactive contamination represented a biological threat to the people and animals of the western Arctic. “Behind all the reassuring announcements and news releases about nuclear explosions,” he argued in the pages of *The Beaver*, “since the beginning of the Atomic Age there has lurked the spectre of the time when the so-called ‘safe limits’ would be exceeded.”<sup>57</sup> For the herds of migratory caribou in the North American Arctic, Pruitt suggested, that time had arrived. To support this claim, Pruitt pointed to recent tests on caribou bones, which revealed strontium-90 exposures that were significantly higher than the level deemed safe for human populations by the U.S. Federal Radiation Council.

Yet, in the early 1960s, there remained a critical gap between threshold values, which were produced in distant institutional contexts, and the state of scientific knowledge concerning human exposures in northern environments. Throughout this period, scientists and officials with governmental and atomic energy institutions were engaged in a protracted debate about environmental pathways of exposure. As Jacob Hamblin argues, the issue of environmental exposures was a point of contention among different groups of scientists jostling for the authority

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<sup>55</sup> This debate often played out in the pages of popular academic and radiological journals. See Barry Commoner, W.M. Friedlander, Eric Reiss and Howard Margolis, “Project Chariot.” *Science* 134, 3477 (1961): 495-503; Howard Margolis, “Project Chariot: Two Groups of Scientists Issue ‘Objective’ But Conflicting Reports.” *Science* 133, 3469 (1961): 2000-2001; Ann Widditsch, “Project Chariot,” *Bulletin of the Atomic Scientists* (1961): 426-427.

<sup>56</sup> Pruitt to Thomas Scott, 25 February 1962, APRCA, William O. Pruitt Papers, 1959-1970, Box 2, Folder 10.

<sup>57</sup> Pruitt, “Caribou Problem,” 25.

to explain how radioactive contamination reached human populations through the environment.<sup>58</sup> However, having focused primarily on industrial radiation hazards and exposures, scientists had not developed a strong understanding of the way in which human populations were exposed to radioactivity through the environment. The recommendations of the ICRP, which focused on direct human exposure in occupational settings, and neglected environmental exposures, reflected this unevenness in the production of scientific knowledge.<sup>59</sup>

Further, this gap in scientific knowledge reflected the spatial and temporal dynamics underpinning the production of *northern* nuclearity. As Gabrielle Hecht argues, nuclearity – understood as the terms by which a space is conceptualized as nuclear – is uneven, contested, and unstable. Unlike industrial spaces of atomic weapons and nuclear energy production, northern environments were not immediately perceived by scientific and government institutions as nuclear spaces, despite evidence indicating the accumulation of radioactive contamination in these spaces. Pruitt and his colleagues not only worked to render radioactive contamination perceptible by mapping pathways of exposure, but contributed to the establishment of the terms by which the north could be recognized as a nuclear space. The scientific investigation of the threshold was inextricably linked to the perceptibility of radioactive contamination, but their work would also expose the environmental politics of perceptibility.

In the western Arctic, scientific efforts to render radioactive contamination perceptible were complicated by two related socio-natural conditions. First, the material reality of ionizing radiation, which lacks the sensory markers of other forms of industrial pollutants, made it difficult to detect and measure radioactive contamination in northern environments and animal bodies. Although the ecosystem-based representation of a linear pathway of exposure was a

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<sup>58</sup> Hamblin, *Poison in the Well*, 1-9.

<sup>59</sup> Hamblin, *Poison in the Well*, 262, fn 13.

powerful tool used by scientists to demonstrate how radioactive fallout reached human bodies, as a simplified model, it obscured the spatial and temporal complexities of radioactive exposures. The various components of radioactive fallout produced by nuclear fission did not behave in a uniform manner after they were distributed across the earth's surface. Rather, the environmental circulation of fallout depended on the chemical composition of the involved radionuclides and the nature of the surfaces and bodies that were exposed to radioactive contamination.<sup>60</sup>

By the early 1960s, public health officials had concluded that iodine-131, strontium-90, and cesium-137 were the most significant fallout radionuclides in terms of their impact on northern environments.<sup>61</sup> Between 1959 and 1965, Wayne Hanson, a biologist working for the AEC at the Battelle Memorial Institute in Washington State, conducted a series of studies that addressed the spatial and temporal complexities of human exposures by tracing the movement of these radionuclides through the "lichen-caribou-man" food web.<sup>62</sup> Through scientific investigations in northern Alaska, Hanson demonstrated that these three radionuclides presented separate risks for human communities as each accumulated at different locations within caribou bodies. While iodine-131 concentrated in the thyroid glands of caribou, strontium-90 was shown to accumulate primarily in caribou bones. Cesium-137 concentrated in caribou muscle and flesh, and, as Hanson noted, posed a more significant threat of exposure for those communities that relied heavily on the consumption of caribou.<sup>63</sup> Hanson's research also contributed to an emergent scientific understanding of the relationship between radioactive exposure and nuclear

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<sup>60</sup> Pochin, *Nuclear Radiation*, 37-40.

<sup>61</sup> For an early published version of this work, see Wayne Hanson, "Fallout Radionuclides in Alaskan Food Chains," *American Journal of Veterinary Research* 27, 116 (1966): 359-366.

<sup>62</sup> APRCA, Wayne C. Hanson Papers, 1959-1980. Hanson, "Fallout Radionuclides," 359; Wayne C Hanson, "Fallout strontium-90 and cesium-137 in northern Alaskan ecosystems during 1959-1970," Unpublished Ph.D. Thesis, Colorado State University, Dept. of Radiology and Radiation Biology, 1973; Wayne Hanson, "Seasonal Cycle of <sup>137</sup>Cs in Some Alaskan Natives and Animals," *Health Physics* 11 (1965): 1401-1406.

<sup>63</sup> Hanson, "Fallout Radionuclides," 359-361.

temporalities. With its relatively short half-life of 8 days, radioiodine was quickly eliminated from the environment. Radiocesium and strontium-90, however, had half-lives of 28 and 30 years respectively, which meant that these two radionuclides represented long-term threats of radioactive exposure to caribou herds and human communities throughout Alaska.<sup>64</sup>

The second condition complicating the production of perceptibility was the political context in which scientists produced knowledge about radioactive contamination in the western Arctic. By 1961, Pruitt's public opposition to Project Chariot resulted in a confrontation with AEC officials and administrators at the University of Alaska. Although he had been promoted to the rank of associate professor of biology in 1960, Pruitt claimed that he was constantly under pressure to "tone down" the results of his biological research, which indicated the potential harm that Project Chariot would have on northern environments. "The pressures," he claimed, "were augmented by a number of public statements by AEC officials that were contrary to our research findings."<sup>65</sup> To counter what they interpreted as "breaches of scientific ethics", Pruitt and two colleagues involved in the environmental studies published a number of their findings, including the previously discussed food web, in a special issue of the Alaska Conservation Society's *News Bulletin*. Shortly after its publication in March 1961, Pruitt was informed by administrators at the University of Alaska that his contract would not be renewed beyond January 1962. After garnering national media attention, the American Civil Liberties Union (ACLU) attempted to determine whether Pruitt's dismissal constituted an infringement on academic freedom. In correspondence with the ACLU, Pruitt maintained that he had been dismissed because his public statements regarding the dangers of radioactive fallout "had endangered the future chances of

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<sup>64</sup> Hanson, *Fallout Radionuclides*, 359-366.

<sup>65</sup> Pruitt to Louis M. Hacker, 2 October 1963, APRCA, William O. Pruitt Papers, 1959-1970, Box 2, Folder 9.

continued flow of AEC funds to the University.”<sup>66</sup> Ultimately, Pruitt’s involvement in the protest against Project Chariot and the scientific debate about the environmental and health consequences of radioactive fallout hindered his ability to secure a teaching position in his field in the United States. After a protracted search for employment, Pruitt eventually returned to Canada where he took up a teaching and research position at Memorial University in St. John’s, Newfoundland.<sup>67</sup>

The potential radioactive contamination of animals in the Ogotoruk region was a major point of contention during and after the completion of the Project Chariot environmental studies. On 17 August 1960, John Wolfe, Chairman of the Committee on Environmental Studies for Project Chariot, informed the *New York Times* that a fifteen-month field study produced no evidence that “the detonation would damage the Eskimo relationship to their environment and their livelihood.”<sup>68</sup> Further, in a letter to Barry Commoner, Pruitt commented on a public statement made by Edward Teller, in which the Livermore Director claimed that there were “no animals in the region,” and argued that the statement displayed a serious deficit in scientific competence.<sup>69</sup> Indeed, public statements about a lack of biological hazards were based on a mischaracterization of the Ogotoruk Creek region as a barren Arctic wasteland. In a series of recommendations, Pruitt and his colleagues involved in the “Terrestrial Mammal Investigation” presented a fundamentally different vision of the Ogotoruk Creek region.

As AEC officials and scientists negotiated the boundary between safe and unsafe levels of exposure, the environmental politics of radioactive contamination influenced which hazards

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<sup>66</sup> APRCA, William O. Pruitt Papers, 1959-1970, Box 2, Folder 10, “Protest Letters”; Pruitt to Hacker, 2 October 1963, APRCA, William O. Pruitt Papers, 1959-1970, Box 2, Folder 9. This incident has been documented by Dan O’Neill in *Firecracker Boys*. See chapter 5: “Fracas in Fairbanks”.

<sup>67</sup> For more, see O’Neill, *Firecracker Boys*.

<sup>68</sup> As quoted in Alaska Conservation Society, *News Bulletin* 2, 2 (March 1960): 7.

<sup>69</sup> Pruitt to Barry Commoner, 18 April 1961, APRCA, William O. Pruitt Papers, 1959-1970, Box 2, Folder 10.

were rendered perceptible and which remained invisible. Although the impact of radioactivity on mammals was not the primary focus of this study, its authors drew connections between their research on the natural history of mammals in the region and the potential biological threats posed by Project Chariot. Chief among their concerns was the inability of the AEC to predict and contain radioactive exposure within the northern food web. Since many of the large mammals in the region had “extremely large home ranges,” Pruitt stated, “it follows that they are potential mechanisms for ‘leaking’ radioactive contamination over a large region.”<sup>70</sup> A radioactive caribou, for example, could travel far beyond the boundaries of the contaminated zone. In response to these and other concerns, the authors of the report recommended a series of studies that would shed light on the potential impact of radioactive exposures on mammals in the region. Pruitt, however, would state that he was dismayed to learn that the AEC rejected a proposal to initiate these scientific investigations.<sup>71</sup>

In addition to the environmental politics of radioactive contamination, AEC officials leveraged the complicated material realities of fallout radionuclides to diminish the safety concerns raised by northern scientists. Prior to leaving the University of Alaska in 1962, Pruitt submitted his final report to the university typists, expecting that it would be forwarded to the AEC. He was surprised to learn, however, that Brina Kessell, the head of his former department, intended to “modify” the document prior to submission. Upon reviewing the edited report, Pruitt claimed his findings on the environmental hazards of radioactive contamination had been “concealed” by the university.<sup>72</sup> After raising his concerns with the AEC, John Wolfe, who

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<sup>70</sup> Pruitt included the recommendations in a letter to William Wood, the president of the University of Alaska. See Pruitt to Wood, 2 March 1962, APRCA, William O. Pruitt Papers, 1959-1970, Box 2, Folder 10.

<sup>71</sup> Pruitt to Wood, 2 March 1962, APRCA, William O. Pruitt Papers, 1959-1970, Box 2, Folder 10.

<sup>72</sup> Pruitt to Louis M. Hacker (American Civil Liberties Union), 2 October 1963, APRCA, William O. Pruitt Papers, 1959-1970, Box 2, Folder 9.

oversaw the individual reports in the Project Chariot environmental studies, provided Pruitt with an opportunity to review and respond to the edited document.<sup>73</sup> Through correspondence, Pruitt brought a number of factual errors to Wolfe's attention, and commented on what he perceived to be critical – perhaps deliberate – omissions from the report.

As the two scientists traded letters, they also engaged in a debate about science and radioactive contamination. Central to this debate was the question of perceptibility. In one exchange, Pruitt expressed concern about the omission of strontium-90 values in caribou bones from a table in the report.<sup>74</sup> Wolfe, however, dismissed his concern. The data included in the table, he wrote, indicated the existence of certain isotopes in the food web, including radiocesium, that had the potential to impact human communities. “Eskimos,” he stated bluntly, “do not eat bone.”<sup>75</sup> Environmental historian Michelle Murphy provides an important perspective on this historical dynamic in her argument that, “any given way of materializing chemical exposures as perceptible and real also sets the terms of what was imperceptible and unreal.”<sup>76</sup> Although Wolfe denied that the AEC had interfered in the environmental studies at Cape Thompson, his debate with Pruitt demonstrates the way in which the agency enrolled science to establish an official boundary between perceptible and imperceptible forms of exposure. By employing an emergent scientific understanding of radioactive bioaccumulation, Wolfe, in his role as a senior official with the AEC, played a significant role in the historical production of

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<sup>73</sup> Wolfe to Pruitt, 24 January 1963, APRCA, William O. Pruitt Papers, 1959-1970, Box 2, Folder 10. Wolfe would also act as an editor of the *Environment of the Cape Thompson Region, Alaska*, a 1200-page volume published by the AEC in 1966, which drew heavily on the 40 studies conducted as part of the Project Chariot environmental studies. See Willimovsky and Wolfe, *Environment of Cape Thompson*. For an analysis of scientific controversies in the Project Chariot Bioenvironmental Program, see Millar and Mitchell, “Spectacular Failure,” 287-302.

<sup>74</sup> Pruitt to Wolfe, 8 February 1963, APRCA, William O. Pruitt Papers, 1959-1970, Box 2, Folder 10.

<sup>75</sup> Wolfe to Pruitt, 15 March 1963, APRCA, William O. Pruitt Papers, 1959-1970, Box 2, Folder 10.

<sup>76</sup> Murphy, *Sick Building Syndrome*, 9.

imperceptibility around radioactive exposures in the western Arctic. Indeed, the establishment of a boundary between safe and unsafe levels of exposure was always political.<sup>77</sup>

## **Moment II: Rendering Radioactive Exposure Permissible**

By the early-1960s, William Pruitt concluded that nuclear fallout had transformed caribou into “hot spots” of radioactive contamination. This perspective, however, was not universally shared among northern scientists. In 1962, scientists were still debating whether high body burdens of cesium-137 represented a biological threat, and there was a corresponding lack of scientific consensus regarding the hazards of consuming contaminated caribou meat.<sup>78</sup> Though the Project Chariot environmental studies led to the production of new ecological understandings of the western Arctic, including the way in which radionuclides moved through the northern food web, scientists and health officials in Canada and the United States had not determined if human exposure levels exceeded the threshold, or if radioactive contamination constituted a long-term threat to people and caribou following the signing of the LTBT. In both countries, governmental institutions made concerted efforts to answer these unresolved questions by monitoring the bioaccumulation of radiocesium in the bodies of northern people, and employing statistical methods to quantify the risks facing northern populations. By 1963, federal scientists in Canada

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<sup>77</sup> The production of imperceptibility was complex and multifaceted. In addition to the controversy surrounding the revision of Pruitt’s final report, Millar and Mitchell have documented how the AEC limited ongoing caribou studies, undertaken by Don Foote, by cutting funding, and making it impossible for scientists to complete the necessary fieldwork. These scientific controversies are covered in Millar and Mitchell, “Spectacular Failure,” 294.

<sup>78</sup> On scientific debate regarding the threat of high body burdens, see C.L. Comar, “Biological Aspects of Nuclear Weapons,” *American Scientist* 50, 2 (1962): 339-353. For more on managerial anxiety provoked by this persistent uncertainty, see E.H. McEwan’s “confidential” report to the Technical Committee on Caribou Conservation: McEwan, “Strontium-90 and Cesium-137 in the Lichen-Caribou-Man Food Chain,” 20 December, LAC, RG 109, Vol 475, File W1.U. 341.

and the United States had established monitoring programs to measure cesium-137 body burdens among populations across the North American Arctic.<sup>79</sup>

Biologists and health officials engaged in these monitoring programs had to negotiate the unstable terrain of threshold values. In the postwar period, governments in Canada and the US adopted the recommendations regarding radiation exposure levels established by the International Commission on Radiological Protection (ICRP).<sup>80</sup> Indeed, as Sharon Stephens has argued, almost every country in the world has adopted ICRP recommendations with only minor modifications.<sup>81</sup> Established at the Second International Congress of Radiology in 1928, the scope of the ICRP's recommendations – which initially focused on X-ray and radium protection – expanded in response to the international development of nuclear energy programs.<sup>82</sup> The notion of a threshold, Jacob Hamblin argues, was embedded in ICRP recommendations, and the terms these institutions used to demarcate safe levels of exposure to radiation.<sup>83</sup>

The concept of a safe exposure, however, changed over time. During the 1950s, biologists and geneticists increasingly questioned the existence of a threshold dose for certain forms of biological damage.<sup>84</sup> As new scientific evidence emerged, the ICRP replaced the term “tolerance dose”, which implied a level of exposure below which somatic damage would not

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<sup>79</sup> For more on the Alaskan studies, see H.E. Palmer, W.C. Hanson, B.I. Griffin, and L.A. Braby, “Measurements of Radioactivity in Alaskan Natives,” (14 October 1964), US Department of Energy, Hanford Battelle Public Reading Room, File Number HW-SA-3750. Accessed online on 15 March 2017 at [www.osti.gov/opennet/detail.jsp?osti-id=16458604](http://www.osti.gov/opennet/detail.jsp?osti-id=16458604); Hanson, “Fallout Radionuclides,” 359-366. For information on Canadian studies, see LAC, RG 29, Box 7, File 1107-3-1: “Radiation Protection Bureau – Co-operation with Department of National Health and Welfare”; Mohindra, “Cesium-137 Body Burdens,”; B.L. Tracy, G.H. Kramer, J.M. Zielinski, and H. Jiang, “Radiocesium Body Burdens in Residents of Northern Canada from 1963-1990,” *Health Physics* 72, 3 (1967): 431-442.

<sup>80</sup> Hamblin, *Poison in the Well*, 5; Martin and Harbinson, *Radiation Protection*, 59.

<sup>81</sup> Stephens, “Bounding Uncertainty,” 96.

<sup>82</sup> Martin and Harbinson, *Radiation Protection*, 59.

<sup>83</sup> Hamblin, *Poison in the Well*, 5.

<sup>84</sup> Martin and Harbinson, *Radiation Protection*, 59; Hamblin, *Poison in the Well*, 11-15. For more on changing notions of safe or permissible dose levels, see Cram, “Living in Dose,” 522-524.

occur, with the concept of a “maximum *permissible* dose” (emphasis added).<sup>85</sup> In its 1958 recommendations, the ICRP defined a permissible dose as the level of exposure that carried “a negligible probability of severe somatic or genetic injuries.”<sup>86</sup> Further, the agency explained, the effects that would likely be caused by a permissible dose – whether accumulated over a period of time or through a single exposure – “are limited to those of a minor nature that would not be considered unacceptable by the exposed individual and by competent medical authorities.”<sup>87</sup> Severe somatic injuries, such as leukemia, the ICRP stated, “would be limited to an exceedingly small fraction of the exposed group; effects such as shortening the life span, which might be expected to occur more frequently, would be very slight and would likely be hidden by normal biological variations.”<sup>88</sup> Permissible doses, therefore, would “produce effects that could be detectable only by statistical methods applied to large groups.”<sup>89</sup> Ultimately, the adoption of a permissible dose indicated a broader shift in the practice of radiation protection, in which official institutions acknowledged that a certain level of radiation exposure – and the associated biological damage – was both inevitable and acceptable.<sup>90</sup> At the national scale, governments aimed to mitigate individual cases of radiation damage through policies based on ICRP recommendations, but focused primarily on the prevention of statistically significant rates of mutation or biological damage at the level of the whole population.<sup>91</sup>

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<sup>85</sup> Martin and Harbinson, *Radiation Protection*, 59.

<sup>86</sup> International Commission on Radiological Protection (ICRP), “1958 Recommendations of the International Commission on Radiological Protection,” (ICRP, 1958), 9.

<sup>87</sup> ICRP, “1958 Recommendations,” 9.

<sup>88</sup> ICRP, “1958 Recommendations,” 9.

<sup>89</sup> ICRP, “1958 Recommendations,” 9.

<sup>90</sup> For more on the perception of nuclear risks as acceptable relative to the “imagined benefits of radiation,” see Cram, “Living in Dose,” 522.

<sup>91</sup> Indeed, this historical development may be conceptualized in Foucauldian terms as the biopolitics of radiation protection. Through the mid-twentieth century, governing institutions developed mathematical and statistical modes of representation for populations exposed to radiation, through which low dose levels of exposure were rendered acceptable. While many scholars have built on Foucault’s work on public health and medicalization, this later extension of biopower, and the governmental administration of populations through the development of radiation protection, has received less scholarly attention. See Michel Foucault, *The History of Sexuality: An Introduction*,

The issue of human exposure to radioactive contamination transgressed national boundaries, which led scientists and governmental institutions to frame Arctic monitoring programs within a transboundary context. Throughout the circumpolar north, scientists documented a strong correlation between the consumption of caribou and reindeer meat and high radiocesium body burdens. Scandinavian scientists studying Saami reindeer herding communities were among the first researchers to examine human exposure levels, and their work was shared among and cited by Canadian and American scientists.<sup>92</sup> Further, transnational institutional linkages were vital to the development of the first monitoring programs in northern Europe. In the mid-1950s, for example, the AEC, through its Advisory Committee for Biology and Medicine, provided funding to a team of Swedish scientists monitoring exposure levels among Indigenous reindeer herders in northern Finland.<sup>93</sup> Relatedly, for European scientists and health officials, human exposure levels in the North American Arctic represented an important comparative perspective for ongoing work in Scandinavia. As early as 1958, officials with the Canadian Department of Health and National Welfare provided human bone samples from Inuit communities to researchers with the Institute of Cancer Research at the Royal Marsden Hospital in Surrey, UK who were attempting to develop techniques to measure radioactivity in human

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Volume 1, Translated by Robert Hurley (New York: Vintage, 1990); Foucault, *Society Must Be Defended*, Translated by D. Macey (New York: Picador, 1997 [2003]); Alison Bashford, *Critical Hygiene: A Critical History of Colonialism, Nationalism, and Public Health* (New York: Palgrave Macmillan, 2004).

<sup>92</sup> For Scandinavian research see: Liden, "Cesium 137 Burdens in Swedish Laplanders," 237-240; J.K. Miettinen, et al., "Cesium-137 and Potassium in Finnish Laps and their Diet," *Radiol Health Data* 5 (1964): 83-97. For more on the dissemination of Scandinavian research, see Barry Commoner to William Pruitt, 2 February 1962, APRCA, William O. Pruitt Papers, 1959-1970, Box 2, File 10; Mohindra, "Cesium 137 Burdens," 90.

<sup>93</sup> Jared Davis, "Summary of Eskimo Studies," Presented at ACBM Meeting, 24 September 1964, NNSA/NSO Nuclear Testing Archive, Las Vegas, NV, RG 636 (US Atomic Energy Commission), Box 2, Folder 4. Accessed online at US Department of Energy, OpenNet: <https://www.osti.gov/opennet/detail.jsp?osti-id=16107790&search-for=eskimo&sort-by=&page-num=1&table-length=25&order-by=desc&sort-by=> on 29 April 2017. See also: E.H. McEwan, "Strontium-90 and Cesium-137 in the Lichen-Caribou-Man Food Chain," 20 December, LAC, RG 109, Vol 475, File W1.U. 341.

bodies.<sup>94</sup> Through the early 1960s, researchers continued to share information, reports, and biological material – which included bone and tissue samples from humans and animals – through this international scientific network as they sought to develop a comprehensive vision of radioactive contamination in the circumpolar north.<sup>95</sup>

In 1963, the Radiation Protection Division of the Department of National Health and Welfare initiated a systematic investigation of radioactivity in the Canadian North. This cooperative project, which involved multiple federal agencies, including the Canadian Wildlife Service, and enrolled administrators and bureaucrats working in the Yukon and Northwest Territories, developed along two related research trajectories: the analysis of radioactive fallout in northern mammals, and the measurement of human exposure to cesium-137.<sup>96</sup> The project, which concerned the temporal and spatial dynamics of radioactive exposures in northern environments, not only aimed to measure and assess the biological threat posed by radioactive exposures, but also sought to determine whether variations in exposure levels were related to the age, sex, geographical location, or dietary habits of northern residents.<sup>97</sup> As physicist V.K. Mohindra explained to an official with the CWS, the Radiation Protection Division undertook the mammal studies to “test the theory that there is a pronounced seasonal variation in cesium-137 in caribou and reindeer and also to give us a better indication of the geographic distribution of fallout throughout the North.”<sup>98</sup> For the purposes of mapping the spatio-temporalities of northern radioactivity, scientists divided the Canadian Arctic into six districts, with areas I-III

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<sup>94</sup> W.V. Mayneord (Royal Marsden Hospital, UK) to Dr. Bird (Department of Health and National Welfare, Ottawa), 29 May 1964, LAC, RG 109, Vol 475, File W1.U. 341.

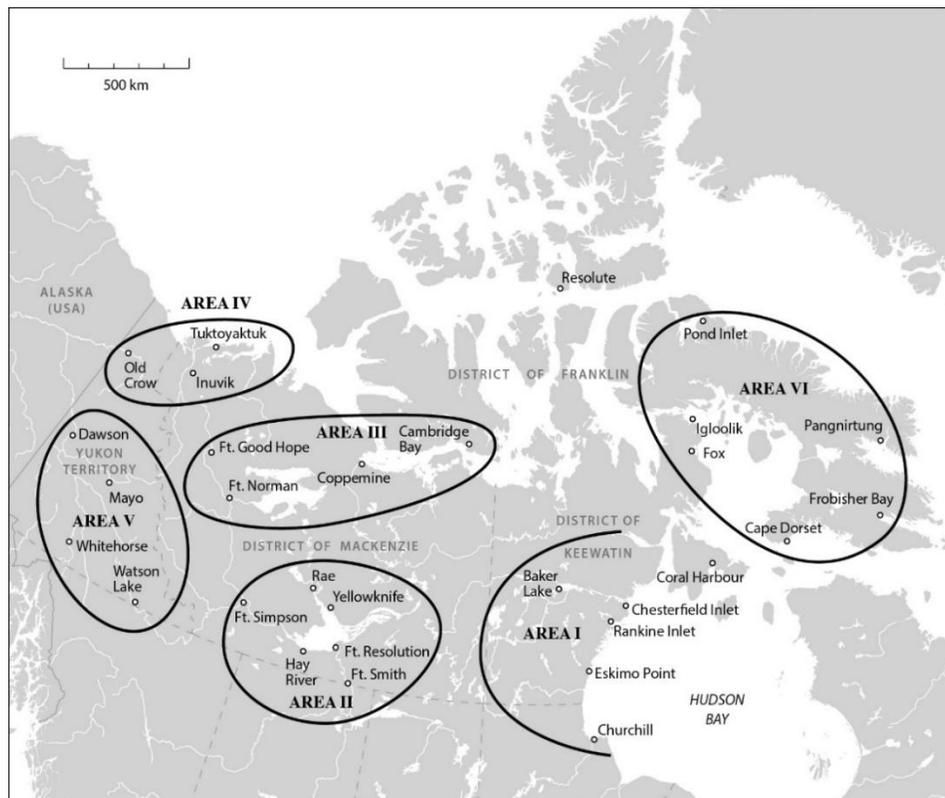
<sup>95</sup> Mayneord to Bird, 29 May 1964, LAC, RG 109, Vol 475, File W1.U. 341.

<sup>96</sup> J.R. Lotz (Northern Co-ordination and Research Centre) to A.M. Pearson (Canadian Wildlife Service), 18 September 1963, LAC, RG 109, Vol 475, File W1.U. 341.

<sup>97</sup> L.P.E. Choquette (Canadian Wildlife Service), “Radioactivity Levels in Northern Canada,” 13 September 1963, LAC, RG 109, Vol 475, File W1.U. 341.

<sup>98</sup> V.K. Mohindra to A.M Pearson (Canadian Wildlife Service), 30 July 1965, LAC, RG 109, Vol 475, File W1.U. 341.

representing the central Arctic, areas IV-V covering the western Arctic, and area VI representing the eastern Arctic (see figure 5.2).<sup>99</sup> The boundaries of each area, Peter Bird, Chief of the Radiation Protection Division, explained, generally corresponded to the movement of the major caribou herds throughout the region.<sup>100</sup>



**Figure 5.2. “Sampling Locations in the Canadian North.” Map by Eric Leinberger. Originally published in: V.K. Mohindra, “Cesium 137 Body Burdens in the Canadian North,” *Acta RadiologicaTherapy Physics Biology* 6 (1967): 481-490.**

Though officials with the Department of National Health and Welfare were hopeful that a co-operative approach would facilitate the expansion of the monitoring program across this vast

<sup>99</sup> L.P.E. Choquette (Canadian Wildlife Service), “Radioactivity Levels in Northern Canada,” 13 September 1963, LAC, RG 109, Vol 475, File W1.U. 341.

<sup>100</sup> Peter Bird, “Studies of Fallout <sup>137</sup>Cs in the Canadian North,” *Archives of Environmental Health* 17, 4 (1968): 633.

geographic region, the participation of multiple agencies also raised a series of logistical problems that complicated scientific analyses. After one year of research, Bird met with representatives from the Department of Northern Affairs and National Resources to address the analytical problems associated with the measurement of cesium-137 in the biological samples being forwarded to the Radiation Protection Division. Although game managers had procured caribou meat from sites across northern Canada, inconsistencies in preparation and packaging, he explained, compromised the measurement and comparison of radiocesium levels in the biological samples.<sup>101</sup> By the end of 1964, Bird and his colleagues had implemented a series of measures intended to “systematize” the collection of biological material. Caribou meat, Bird determined, would have to be dried before being shipped to the Radiation Protection Division laboratories, and scientists at the Inuvik Research Laboratory – an important site of scientific knowledge production in northern Canada – were tasked with determining the most effective method of doing so.<sup>102</sup>

In both countries, scientists developed technologies and techniques to measure human exposure levels that were attuned to the geographical complexities of northern science and research. In northern Alaska, the US Department of Energy established a body-burden monitoring program in 1962, in which scientists from the AEC’s Hanford Laboratory in Washington State had access to capital-intensive technologies of visualization and measurement. During the initial stages of the program, scientists employed the Hanford Laboratory’s shadow-shield whole-body counter – a large device that required more than five tons of lead shielding and a reliable high-voltage power supply. In Anaktuvuk Pass, Wayne Hanson explained, the

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<sup>101</sup> P.M. Bird, “Memorandum: Meeting with representatives from Dept. Northern Affairs and National Resources re Special Northern Fallout Studies,” 21 December 1964, LAC, RG 109, Vol 475, File W1.U. 341.

<sup>102</sup> Bird, “Memorandum,” 21 December 1964, LAC, RG 109, Vol 475, File W1.U. 341.

whole-body counter was installed in a sod igloo, where researchers conducted measurements on human subjects over a period of four years.<sup>103</sup> Reliance on this device, however, limited the spatial expansion of the monitoring program. In 1964, Hanford scientists developed the “Gamma Spectrometer,” a portable whole-body counter, which was adopted immediately by the scientists working in northern Alaska.<sup>104</sup> As many of the Alaskan Native villages were accessible to scientists only by plane, the development of a portable counter represented a new technology of visualization that enabled the spatial expansion of the monitoring program throughout the region. In 1964, for example, the researchers would conduct measurements on 58 individuals in Arctic Village, a Gwich’in community approximately 200 miles east of Anaktuvuk Pass, as they attempted to assess the geographical distribution of radioactive exposures.<sup>105</sup>

Canadian scientists faced similar geographical challenges in the development of a body-burden monitoring program. However, technical differences between these two national programs were indicative of the way in which institutional contexts shaped practices of scientific knowledge production. Unlike their American counterparts, Canadian scientists did not have access to portable whole-body counters until 1967.<sup>106</sup> In the absence of this powerful technology of visualization and measurement, Canadian scientists worked to develop a measurement technique that was attuned to the geography of the Canadian north. Between 1963 and 1967, they monitored radioactive exposures through the analysis of urine samples, which were collected at multiple sites across the Canadian north, and transported to the Radiation Protection Division’s

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<sup>103</sup> Hanson and Palmer, “Seasonal Cycle of <sup>137</sup>Cs,” 1401-1406.

<sup>104</sup> E.M. Sheen, *Gamma Spectrometer for Use in Whole Body Counting* (Richland, Washington: Hanford Atomic Products Operation, 1964), 1.

<sup>105</sup> APRCA, Wayne Hanson Papers, 1959-1980, Box 1, Folder 15, “1964 Annual Report, Third Draft.”

<sup>106</sup> Tracy, et al., “Radiocesium Body Burdens,” 432.

laboratories in Ottawa for measurement. During the first three years of the monitoring program, scientists measured urine samples from 562 people in 24 Arctic communities.<sup>107</sup>

At the time that Canadian scientists adopted this method, however, there was considerable scientific uncertainty about how best to calculate radiocesium body burdens through the analysis of urine samples. As Radiation Protection Division scientist M.R. Quastel noted in 1965, the “calculation of body burden from the CS<sup>137</sup> content of the samples remains difficult due to the lack of knowledge of the factors determining the excretion of this isotope.”<sup>108</sup> To address this gap in scientific knowledge, Quastel proposed a biological experiment designed to study the mathematical relationship between the amount of radiocesium detected in urine samples and an individual’s body burden. For Quastel, like the scientists involved in the Project Chariot bioenvironmental studies, the ability to measure human exposure levels was bound up with scientists’ ability to trace the movement of radionuclides through the environment, which, in this case, was conceptualised at the scale of the human body (see figure 5.3). The main thrust of the biological experiment, however, was the determination of the degree to which ingested radiocesium was absorbed by the kidneys, and passed as urinary excretion. As one senior official with the Northern Co-ordination and Research Center explained to his colleagues in the Department of Northern Affairs, “the intention is to feed measured amounts of caribou meat to a number of volunteers at controlled intervals, and to make a series of observations of the results, including observation of variations in human body burdens.”<sup>109</sup>

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<sup>107</sup> Tracy, et al., “Radiocesium Body Burdens,” 432.

<sup>108</sup> M.R. Quastel, “Ingestion of Caribou or Reindeer Meat, Naturally Labelled with CS<sup>137</sup> by Volunteers,” October 1965, LAC, RG 85 (Department of Indian Affairs and Northern Development), Vol. 2081, File 1003-3-14 (1): Sub-Committee on Anthrax and Radiation.

<sup>109</sup> G.F. Parsons to Director, Northern Administration Branch, 28 December 1965, LAC, RG 85 (Department of Indian Affairs and Northern Development), Vol. 2081, File 1003-3-14 (1): Sub-Committee on Anthrax and Radiation.

In his proposal, Quastel attempted to allay any ethical and medical concerns about feeding contaminated caribou meat to human subjects by invoking the notion of the threshold. In a carefully controlled setting, and with the use of a whole-body counter, Quastel explained, subjects' body burdens would be monitored carefully throughout the experiment. Following the ingestion of a single dose of caribou meat (one to two pounds), scientists would begin monitoring changes in the subjects' body burdens, and collecting urine samples for analysis. Through continued ingestion of contaminated meat, the scientists would gradually raise the subject's radiocesium body burdens to a maximum of 200 nanocuries. This level of exposure, Quastel noted, was well below the ICRP recommendation for a maximum permissible dose, which was set at 3.0 microcuries for radiocesium, and therefore posed no threat of biological mutation or genetic damage to the subjects.<sup>110</sup> After the maximum body burden had been reached, scientists would eliminate the source of radioactivity from the subjects' diet, and continue to monitor the excretion of radiocesium through urinary analysis and whole-body counting. Importantly, Quastel did not question the ability of scientists – when armed with the proper technology – to measure accurately a subject's level of radioactive exposure; nor did he acknowledge dissenting scientific claims regarding the biological and genetic threats linked to low dose exposures, claims that directly contradicted the idea of a maximum permissible dose.

Quastel's arguments were persuasive, and his proposal was endorsed enthusiastically by officials in the Departments of National Health and Welfare and Indian Affairs and Northern Development. On 20 December 1965, he met with departmental officials and "inquired about the possibility of obtaining a quantity of caribou meat for experimental purposes."<sup>111</sup> At the meeting,

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<sup>110</sup> M.R. Quastel, "Ingestion of Caribou or Reindeer Meat," October 1965, LAC, RG 85, Vol. 2081, File 1003-3-14.

<sup>111</sup> G.F. Parsons to Director, Northern Administration Branch, 28 December 1965, LAC, RG 85 (Department of Indian Affairs and Northern Development), Vol. 2081, File 1003-3-14 (1): Sub-Committee on Anthrax and Radiation.

officials agreed to provide the Radiation Protection Division with two caribou carcasses, and they determined that the animals should be procured from Areas I and II (see above map) as past observations indicated that caribou in these geographical regions “have the highest body burdens of radioactivity.”<sup>112</sup> Subsequent letters to officials with the Northern Administration Branch suggest that field agents were ordered to kill two caribou in these regions, which were shipped to the Radiation Protection Division’s laboratories in Ottawa.

But despite governmental support, Quastel’s experiment proceeded slowly. At a 1967 conference on circumpolar health at Fairbanks, Alaska, Peter Bird explained that the researchers had recruited only two subjects to the study.<sup>113</sup> Though incomplete, Bird and Quastel both expressed confidence in the findings, and claimed that the experimental procedures provided researchers with important information about daily variations in urinary cesium-137 levels. As Quastel argued at a meeting of the Radiation Research Society, the results “indicate an almost complete absorption of the isotope from the meat, but urine and fecal analyses are consistent with a recirculation of <sup>137</sup>Cs through the intestinal tract.”<sup>114</sup> Yet, the relationship between urinary excretion and body burdens, Quastel argued, was not a simple proportionality. Rather, as radiocesium moved through the human body, kidney functions, he argued, caused daily variations in excretion levels.

In addition to Quastel’s research, scientists with the Radiation Protection Division conducted other experiments that were intended to clarify the relationship between urinary cesium-137 and exposure levels. In the Division’s laboratory, for example, scientists conducted

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<sup>112</sup> Parsons to Director, Northern Administration Branch, 28 December 1965, LAC, RG 85, Vol. 2081, File 1003-3-14 (1).

<sup>113</sup> Bird, “Studies of Fallout,” 636.

<sup>114</sup> T.R. Overton and M.R. Quastel, “Absorption and Excretion of <sup>137</sup>Cs by Humans,” *Radiation Research* 31, 3 (1967): 540.

an ongoing experiment in which urine samples were collected from “Canadian eskimos” who had traveled south to Ottawa.<sup>115</sup> These research subjects, however, were not fed contaminated caribou meat; rather, they were expected to refrain from eating caribou while in Ottawa, and their body burdens were monitored during their time away from the north. Though less systematic and controlled than Quastel’s experiment, the infrequent monitoring of Inuit by scientists in Ottawa was critical to the Division’s development of a method to measure and quantify body burdens throughout northern Canada.

Additionally, institutional linkages with the US Atomic Energy Commission were important to scientists and officials with the Radiation Protection Division as they developed a system for measuring body burdens in the Canadian north. During the early stages of its monitoring program, Canadian scientists worked in conjunction with scientists from the AEC’s Hanford Laboratory to study the correlation between urinary cesium-137 and whole body counting.<sup>116</sup> Through these investigations, scientists with the Radiation Protection Division developed a mathematical formula that, when applied to the trace amounts of radiocesium detected in urine samples, represented a scientific calculation of an individual’s body burden.<sup>117</sup> This was the primary method of analysis and measurement until the development of a portable whole body counter in 1967. These experiments, which left detailed archival records, demonstrate the way in which authorities with the Radiation Protection Division not only developed techno-scientific mechanisms through which they measured radioactive contamination

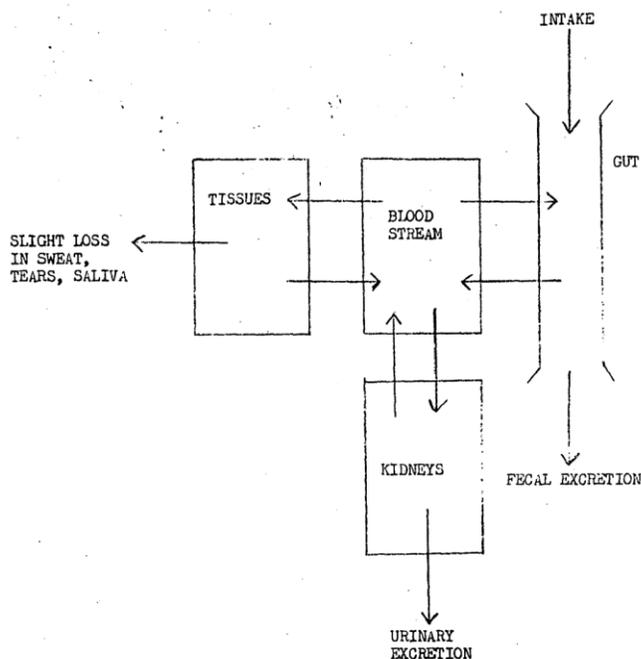
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<sup>115</sup> This study was named: “Body burden and turnover of radioactive cesium in Canadian eskimos.” See Quastel, “Ingestion of Caribou or Reindeer Meat,” October 1965, LAC, RG 85, Vol. 2081, File 1003-3-14 (1).

<sup>116</sup> P.M. Bird, “Memorandum: Meeting with representatives from Dept. Northern Affairs and National Resources re Special Northern Fallout Studies,” 21 December 1964, LAC, RG 109, Vol 475, File W1.U. 341.

<sup>117</sup> Tracy, et al., “Radiocesium Body Burdens,” 431-442.

in human bodies, but also employed the logic of the threshold as they attempted to assess the biological threats posed by radioactive exposures across northern Canada.<sup>118</sup>



**Figure 5.3. “Probable Pathways of CS<sup>137</sup> in the Body.” Ingestion of Caribou or Reindeer Meat, Naturally Labelled with CS<sup>137</sup> by Volunteers: Figure 1, October 1965, LAC, RG 85 (Northern Affairs Program), Vol. 2081, File 1003-3-14 (1): Sub-Committee on Anthrax and Radiation.**

Through these body-burden monitoring programs, Canadian and American scientists documented similar spatial and temporal trends in the bioaccumulation of radiocesium across the North American Arctic. Between 1962 and 1964, human exposure to cesium-137 was shown to

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<sup>118</sup> As scientists sought to measure human exposure to radioactivity across the North American Arctic, they had to extend their laboratory and experimental findings to the socio-natural environments of the North American Arctic. In northern Canada and Alaska, there was a reciprocal relationship between the environments that scientists attempted to interpret and the experiments they devised. Indeed, in these experimental settings, race would become a marker of difference, one that figured in scientific attempts to describe risk and vulnerability to radioactivity in the northern environment. In addition to the above-mentioned studies, see: Wayne Hanson, “Cesium-137 in Alaskan Caribou, Lichens, and Eskimos,” *Health Physics* 13 (1967): 383-389. For more on the connections between the laboratory and landscape, see Matthew Farish, “The Lab and the Land: Overcoming the Arctic in Cold War Alaska,” *Isis* 104 (2013): 1-29.

have increased dramatically, with an estimated 200 percent increase in the body burdens among Native Alaskans living in the village of Anaktuvuk Pass.<sup>119</sup> While cesium-137 in caribou bodies appeared to peak in the early months of 1963 – coinciding with the intensification of atmospheric nuclear tests prior to the signing of the LTBT – human body burdens reached their apex almost one year later.<sup>120</sup> This temporal lag represented the time it took for radiocesium to move through the northern food chain, and to reach human communities through the consumption of contaminated caribou meat. In addition, the studies both documented a seasonal variation in levels of human exposure to radioactivity, which scientists attributed to seasonal variation in caribou foraging habits and the increasing importance of lichen during the winter months.<sup>121</sup>

While both groups of scientists drew a connection between caribou consumption and radiocesium body burdens, they also documented geographical variations in this broader pattern of increasing body burdens. In Alaska, scientists would exclude Fort Yukon – a Gwich'in community in northeastern Alaska – from studies after 1964 as the recorded body burdens in that community were extremely low compared to other Alaskan villages. Similarly, in Canada, scientists concluded that body burdens were much higher in the central and eastern Arctic than the western Arctic, including the community of Old Crow, where caribou formed an important part of the local diet. As they had recorded similar levels of fallout at monitoring stations across the region, scientists attributed seasonal and geographic variations in body burdens to fluctuations in the availability of caribou meat and ecological mechanisms they were unable to explain at that time.<sup>122</sup>

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<sup>119</sup> Palmer, et al., “Measurements of Radioactivity,” 3; Mohindra, “Cesium 137 Burdens,” 481-490.

<sup>120</sup> Mohindra, “Cesium 137 Burdens,” 488.

<sup>121</sup> Palmer, et al., “Measurements of Radioactivity,” 4-5.

<sup>122</sup> Palmer, et al., “Measurements of Radioactivity,” 2-6; Mohindra, “Cesium 137 Burdens,” 485.

But did scientists believe radioactive exposures in the northern food chain had exceeded the “safe limits”, as suggested by Pruitt in 1962? After comparing their measurements with the ICRP recommendations, both Canadian and American scientists concluded that human body burdens had not exceeded maximum permissible dose levels. For individuals exposed to cesium-137 outside of an occupational setting, the ICRP recommended a maximum permissible dose of 3.0 microcuries. However, as the American scientists attempted to apply this non-occupational threshold value to Indigenous communities in the western Arctic, they demonstrated the racial exclusions enacted by the fields of radiation science and protection, noting that the ICRP had not made any specific recommendations “concerning permissible average body burdens of Cs<sup>137</sup> for groups such as the Alaskan natives.”<sup>123</sup> Indeed, both teams of researchers documented cases in which an individual’s body burden exceeded the ICRP’s maximum permissible dose of 3.0 microcuries of cesium-137, but at the level of the population, they argued, radiocesium body burdens did not represent a biological threat to Indigenous communities across the North American Arctic.<sup>124</sup> In Canada, these findings led the Radiation Protection Division to advise the government against placing any restrictions on the consumption of caribou meat.<sup>125</sup>

Additionally, these studies indicated that the level of radioactivity in northern environments declined precipitously following the signing of the LTBT in 1963. After body burdens peaked in 1964, scientists in both countries documented a steady decline in radioactive contamination in northern environments. As radioactivity levels declined, so too did northern nuclear anxieties. In Canada, health authorities suspended northern radiocesium monitoring in 1969. In Alaska, the program continued until 1979 when scientists determined that body burdens

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<sup>123</sup> Palmer, et al., “Measurements of Radioactivity,” 4.

<sup>124</sup> Palmer, et al., “Measurements of Radioactivity,” 3-4; Mohindra, “Cesium 137 Burdens,” 489.

<sup>125</sup> Mohindra, “Cesium 137 Burdens,” 489.

had decreased to approximately 2.5 percent of their 1964 values.<sup>126</sup> By the end of the 1960s, northern scientists seemed to agree that the threshold for human exposure to radiocesium had not been exceeded.

What, then, was the significance of radioactive contamination in the western Arctic? The scientific investigation of radioactive exposures in the North American Arctic not only shed light on the spatial and temporal complexities of radioactive exposures, but also suggested that radioactive contamination was not simply a biophysical phenomenon that could be assessed and managed through the production of scientific knowledge, or simple risk calculus. As Wayne Hanson argued in 1964, the prediction of the level of fallout radionuclides in the food web “must take into consideration the importance of environmental and human factors, which in turn require experience not easily gained.”<sup>127</sup> While the material realities of ionizing radiation made it difficult to detect radionuclides in the environment, the socio-natural contexts in which humans were exposed to radioactive contamination further challenged scientists’ ability to predict whether “safe limits” would be exceeded in northern communities.

Yet, in Canada and the United States, scientists and health officials not only sought to determine the spatial and temporal distributions of radioactivity in northern environments, but also adopted and employed the notion of a safe level of human exposure. Though scientists and health authorities concluded that the bioaccumulation of radiocesium did not represent a biological threat to northern Indigenous communities, their research had implications that extended beyond northern science. Through the extension of the threshold concept to the western Arctic, scientists not only rendered visible radioactive contamination, but also created the context in which health authorities would deem low dose exposure to radioactive material in northern

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<sup>126</sup> Tracy, et al., “Radiocesium Body Burdens,” 431.

<sup>127</sup> Hanson, “Fallout Radionuclides,” 360.

environments acceptable. The northern extension of the logic of the threshold had historical legacies that would play out in coming years, not only for radioactive contamination, but also in discussions about other forms of contaminants that scientists would detect in northern environments. Scientists may have concluded that radioactive fallout was not as serious as Pruitt had suggested in 1962, but the “new caribou problem” would continue to shape human interaction with migratory caribou herds – including the Porcupine Caribou – into the last decade of the twentieth century.

### **Moment III: Containing the Fallout**

On 28 April 1986, Swedish nuclear power authorities detected heightened levels of radioactivity in the northern part of the country. Levels were so high, in fact, that officials suspected a Swedish reactor as the source of contamination.<sup>128</sup> What they did not know, however, was that in the early hours of April 26, Unit Four of the Chernobyl Power Plant in the Soviet Union had malfunctioned during a safety test, and caused a catastrophic meltdown. A series of explosions and a subsequent fire in the reactor core sent a plume of smoke containing fission materials and debris as high as eight kilometers into the atmosphere.<sup>129</sup> Despite the efforts of Soviet engineers and nuclear authorities to suffocate the flames, the burning reactor continued to pump radioactive material into the atmosphere for almost 40 days.<sup>130</sup> As nuclear authorities worked to contain the radioactive contamination, state officials also engaged in a form of discursive containment, making a concerted effort to control public fallout through the regulation of information regarding the nuclear release.<sup>131</sup> Radioactive contamination, however, proved

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<sup>128</sup> Stephens, “Chernobyl Fallout.”

<sup>129</sup> Organization for Economic Co-operation and Development (OECD) Nuclear Energy Agency, *Chernobyl: Assessment of Radiological and Health Impacts* (OECD: Paris, 2002), 29, 44; Petryna, *Life Exposed*, 1.

<sup>130</sup> The release of radioactive material decreased to low level releases on 5 May 1986, some ten days after the initial explosions. See OECD, *Chernobyl*, 37.

<sup>131</sup> Petryna, *Life Exposed*, 1.

difficult to contain. Once it was clear that a meltdown in the Soviet Union was the source of contamination, international nuclear agencies and scientists began monitoring the movement of the radioactive cloud, which had crossed international borders, and was depositing nuclear fallout over countries in northern Europe, Asia, and North America.<sup>132</sup>

The Chernobyl accident led to a dramatic increase in nuclear anxieties throughout the North American Arctic. Despite the signing of the LTBT, radioactive contamination had not disappeared entirely from northern environments; with half-lives of almost thirty years, ionizing radiation produced during the period of atmospheric nuclear testing was still present in ecosystems throughout the North American Arctic. Scientists and health authorities, however, did not view this residual radioactivity as a significant threat to northern residents. But Chernobyl was a cause of concern for northern communities and environmental health authorities. As the radioactive cloud deposited fallout over the North American Arctic, scientists, wildlife managers, and Indigenous communities in the region were once again forced to consider the social, cultural, and biological implications of radioactive fallout for migratory caribou herds and those people whose lives were intimately bound up with this group of animals. The nuclear disaster not only produced a new source of radioactive contamination, but also increased scientific uncertainty about the risk of radioactive exposure through the northern food chain, and this scientific uncertainty compounded nuclear anxieties throughout the North American Arctic.

As scientists, environmental health authorities, and wildlife managers sought to quantify the impact of the Chernobyl nuclear disaster on northern environments, they leveraged the notion of the threshold as they attempted to assuage nuclear anxieties in the western Arctic.

Immediately following the nuclear disaster, scientists and environmental health authorities in

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<sup>132</sup> OECD, *Chernobyl*, 44-46.

Canada and the United States renewed monitoring programs to measure the amount of fallout deposited on the North American Arctic, and to determine the degree to which Chernobyl increased radiocesium concentrations in the northern food chain.<sup>133</sup> Indeed, within hours of receiving notification of the meltdown from counterparts in Sweden, Canadian officials with the Department of National Health and Welfare placed the fallout monitoring program on “high alert”.<sup>134</sup> One of the program’s first objectives was to assess the geographic distribution of fallout across Canada. In conjunction with the Atmospheric Environment Service (Environment Canada), which operated 28 atmospheric sampling stations at airports across the country, officials with the Environmental Radiation Health Division (ERHD) began daily monitoring of fallout. Through May and June, officials removed the air filters from each of the 28 stations, and shipped them to the Bureau of Radiation and Medical Devices, where scientists ran tests to measure fallout levels, and determine which radionuclides were present in the Chernobyl fallout.<sup>135</sup> The results from these initial tests were published in the Department of National Health and Welfare’s 1986 annual report of radiological monitoring, titled *Environmental Radioactivity in Canada*.

By mid-May, Canadian scientists had detected increased levels of cesium-137 at sites across the country. However, based on the results of its monitoring program, officials with the ERHD concluded that the “radiation dose exposures to Canadians from fallout due to the Chernobyl accident were extremely low.”<sup>136</sup> No group within the Canadian population, the agency stated, had received a dose above ten microsieverts of radiation, a number that was far

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<sup>133</sup> White et al., “Radiocesium Concentrations,” 24-29.

<sup>134</sup> Environmental Health Directorate, “Environmental Radioactivity in Canada, 1986,” 87-EHD-136 (Ottawa: Department Health and Welfare Canada, 1987), 1.

<sup>135</sup> Environmental Health Directorate, “Environmental Radioactivity in Canada, 1986,” 3.

<sup>136</sup> Environmental Health Directorate, “Environmental Radioactivity in Canada, 1986,” 9.

below the ICRP's recommended Annual Limit of Intake (ALI) of 50 millisieverts.<sup>137</sup> In contrast, the authors of the report noted, individuals received an annual dose between 440 and 790 microsieveverts of "background radiation from natural terrestrial radiation and cosmic radiation."<sup>138</sup>

Though the nuclear disaster at Chernobyl contributed to the overall amount of radioactive contamination in Canadian environments, health authorities and scientists were confident that the resulting increase in exposure levels did not represent a biological threat to the population. However, as Stephen Bocking has argued in a discussion of northern contaminants, local ecological conditions influenced the way in which human communities were impacted by radioactive contamination.<sup>139</sup> For Canadian officials, it was necessary to attend to the specificity of place when conceptualizing and quantifying environmental risk. In the western Arctic, this meant that scientists had to engage not only with the pathway of exposure documented by their predecessors, but also the complex environmental relations that constituted the northern food chain.

At the end of 1986, Canadian health officials initiated a program to determine whether radiation from the Chernobyl nuclear disaster had impacted migratory caribou as it had affected reindeer in Scandinavia.<sup>140</sup> In the wake of the meltdown at the Chernobyl power plant, European scientists detected levels of cesium-137 in the bodies of reindeer that exceeded the safe limits

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<sup>137</sup> Environmental Health Directorate, "Environmental Radioactivity in Canada, 1986," 8. In its guidelines, the Canadian Nuclear Safety Commission explains that the sievert is the unit used to measure the effective dose of radiation absorbed by the human body. A microsievevert is one-millionth of a sievert, and a millisievert is one-thousandth of a sievert. Canadian Nuclear Safety Commission, "Radiation Doses," accessed online at <http://nuclearsafety.gc.ca/eng/resources/radiation/introduction-to-radiation/radiation-doses.cfm> on 5 June 2017.

<sup>138</sup> Environmental Health Directorate, "Environmental Radioactivity in Canada, 1986," 9.

<sup>139</sup> Bocking, "Toxic Surprises," 428.

<sup>140</sup> Environmental Health Directorate, "Environmental Radioactivity in Canada, 1987," 846-2/88-14E (Ottawa: Department of National Health and Welfare, 1988), 6.

established by the ICRP.<sup>141</sup> Anthropologist Sharon Stephens has argued that Scandinavia's Indigenous minority, the Sami, were particularly hard hit by the contamination of reindeer pastureland, as this new ecological condition threatened not only their economic and political strength, but also their cultural identity, which was "bound by material and symbolic connections between humans and reindeer."<sup>142</sup> In Canada, the ERHD stated, "there was some concern that the grazing lands of Canadian caribou might have been similarly affected."<sup>143</sup>

By necessity, the monitoring of caribou herds in the western Arctic was a cooperative and transboundary project that involved multiple agencies, territorial governments, and a broad array of participants and stakeholders. During 1987, researchers from the University of Alaska Fairbanks and the Canadian Wildlife Service collaborated to measure radioactivity levels among caribou in the Porcupine Herd. Researchers involved in this study collected biological samples from 36 caribou at sites along the herd's migration route from the calving grounds in Alaska to its winter range in the Yukon.<sup>144</sup> Further to the west, and as part of a cooperative project being run by the Department of Renewable Resources of the Northwest Territories, hunters from Inuvik, Fort Macpherson, and Aklavik collected samples of caribou meat from this same herd, which were transported to Ottawa, where scientists with the Bureau of Radiation and Medical Devices ran tests to determine radiation levels.<sup>145</sup>

Through the mobilization of a broad range of actors from governmental agencies, scientific institutions, and northern communities, the ERHD began to piece together a spatial

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<sup>141</sup> Environmental Health Directorate, "Environmental Radioactivity in Canada, 1987," 6; Stephens, "Chernobyl Fallout."

<sup>142</sup> Stephens, "Chernobyl Fallout."

<sup>143</sup> Environmental Health Directorate, "Environmental Radioactivity in Canada, 1988," EHD-TR-152 (Ottawa: Department of National Health and Welfare), 8.

<sup>144</sup> For details pertaining to this study, including a paper presented at the 5<sup>th</sup> annual Reindeer/Caribou Symposium, Sweden, August 18-22, 1988, see Yukon Archives, Fish and Wildlife Management, GOV 5000, File 2.

<sup>145</sup> Kevin Lloyd (Northwest Territories Renewable Resources) to Porcupine Caribou Management Board, 11 January 1988, Yukon Archives, Fish and Wildlife Management, GOV 5000, File 2.

representation of radioactivity levels in caribou herds in northern Canada and northeastern Alaska.<sup>146</sup> Like tests conducted during the 1960s, scientists noted wide geographic variations in radioactive contamination levels throughout the region. Cesium concentrations detected in the bodies of caribou in the northern Yukon were among the lowest in the Canadian herds. On the Alaskan side of the border, however, cesium concentrations detected in the Porcupine Caribou Herd were significantly higher than in the Yukon. Though levels were significantly higher than on the Canadian side of the border, health authorities and scientists concluded that exposures were still well below the safe limits established by the ICRP. Certainly, northerners were exposed to radioactive contamination from the Chernobyl accident through the pathway of exposure documented in the early 1960s, but only at levels that scientists believed did not present a health hazard to “consumers of caribou meat.”<sup>147</sup> Based on these investigations, the Department of National Health and Welfare did not make any recommendations against eating caribou meat.

Yet, alongside these claims, officials with the ERHD did acknowledge the persistence of scientific uncertainty concerning human exposure to radioactive contamination through the northern food chain. Not only did the authors of the 1988 report on environmental radioactivity state there was “no information on the levels of cesium-137 in populations relying on the caribou,” they also noted that health officials had serious questions “as to whether the accepted models for cesium uptake and retention, based on temperate-zone populations with a modern western diet, are applicable to the diet and living conditions in northern Canada.”<sup>148</sup> In 1989,

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<sup>146</sup> See Environmental Health Directorate, “Environmental Radioactivity in Canada, 1988,” Figure 1: “Cesium-137 Concentrations in Caribou Muscle, Becquerels per Kilogram.”

<sup>147</sup> Environmental Health Directorate, “Environmental Radioactivity in Canada, 1988,” 8.

<sup>148</sup> Environmental Health Directorate, “Environmental Radioactivity in Canada, 1988,” 8.

Health Canada's Radiation Protection Bureau renewed its body burden monitoring program – a program that had been inactive since the late 1960s – to address these lingering concerns.<sup>149</sup>

In 1989, environmental health authorities with the Radiation Protection Bureau decided to conduct body burden surveys in Baker Lake and Rae-Edzo, two northern communities in which scientists had previously documented elevated levels of exposure to radioactive contamination.<sup>150</sup> In addition to historically high levels of radioactive exposures, these communities also met the technological requirements for the Bureau's body burden monitoring program; with established electrical facilities and "convenient counting locations," officials believed these communities were ideal sites for the proposed body burden monitoring program, in which scientists would employ a portable whole body counter to measure human exposure levels.<sup>151</sup> In choosing these two communities, health authorities also focused on key demographic, social, and cultural conditions, which, they believed, would enable scientists to produce results that were representative of broad trends across the Canadian north. With populations greater than 1000 people, scientists noted that each community would be able to "provide a statistically significant number of subjects."<sup>152</sup> Further, in both of these communities, they stated, caribou hunting was still prevalent, and people were "heavily dependent" on the consumption of caribou meat.<sup>153</sup> Finally, scientists argued, by conducting surveys in Baker Lake – a predominantly Inuit community – and Rae-Edzo – a Dene community – they would be able to develop a comparative study of radiocesium body burdens in two distinct cultural groups.

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<sup>149</sup> Tracy, "Radiocesium Body Burdens," 431.

<sup>150</sup> Tracy, "Radiocesium Body Burdens," 433.

<sup>151</sup> Tracy, "Radiocesium Body Burdens," 433.

<sup>152</sup> Tracy, "Radiocesium Body Burdens," 433.

<sup>153</sup> Tracy, "Radiocesium Body Burdens," 433.

Ostensibly, these investigations aimed to address lingering questions about radioactive exposures in northern environments, but they would come to play a broader role in unfolding social and environmental relationships in the western Arctic as wildlife managers attempted to assuage nuclear anxieties provoked by Chernobyl disaster. Between 1986 and 1990, Indigenous people in communities that depended on the Porcupine Caribou Herd grew increasingly concerned as scientists and health officials continued to investigate and report on radioactive contamination in northern environments. At community meetings in the western Arctic, wildlife managers, scientists, and government officials were repeatedly asked about the risk associated with eating caribou meat contaminated with fallout from the Chernobyl accident.<sup>154</sup>

In response to these concerns, federal and territorial government officials prepared reports that documented the relatively low level of radioactive contamination in the Porcupine Caribou Herd, which wildlife managers were expected to use when speaking to community members. Following a request for information from the Chairman of the of the Porcupine Caribou Management Board (PCMB), a Canadian co-management board established in 1985, Jake Epp, the federal Minister of National Health and Welfare, sent a letter in which he stated that scientists had documented radiocesium levels in Porcupine Caribou that were “well below the interim screening limit of 300 becquerels per kilogram for foodstuffs”.<sup>155</sup> That is to say, the threshold for radioactive exposures would not be exceeded by eating caribou from the Porcupine Herd. “I trust,” wrote Epp in 1987, “that this information will reassure the concerned members of your community.”<sup>156</sup>

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<sup>154</sup> Kevin Lloyd (Northwest Territories Renewable Resources) to Porcupine Caribou Management Board, 11 January 1988, Yukon Archives, Fish and Wildlife Management, GOV 5000, File 2.

<sup>155</sup> Jake Epp (Minister of National Health and Welfare) to Victor Mitander (Porcupine Caribou Management Board), 27 July 1987, Yukon Archives, Fish and Wildlife Management, GOV 5000, File 2.

<sup>156</sup> Jake Epp (Minister of National Health and Welfare) to Victor Mitander (Porcupine Caribou Management Board), 27 July 1987, Yukon Archives, Fish and Wildlife Management, GOV 5000, File 2.

Yet, environmental anxieties about radioactive contamination in the region persisted despite a proliferation of scientific analyses, quantitative reports, and ministerial assurances of safety. In fact, Doug Urquhart, Secretary-Treasurer of the PCMB, argued that the testing of Canadian caribou, combined with the confusion surrounding cesium and the potential risk of exposure, led some people in northern Canada to ask if they should stop eating caribou altogether.<sup>157</sup> But the “cesium crisis of 1986”, as it was termed by Urquhart, was not simply exacerbated by the “mystery” of radioactivity; he also cited the “inability of scientists to speak English” as a major cause of public concern.<sup>158</sup> Fearing that the dissemination of scientific information regarding radioactive exposures and the attendant risks was contributing to – rather than mitigating – environmental anxieties in the region, Urquhart advocated for scientists and governmental institutions to produce findings and recommendations that were both comprehensible and relevant to people living in the western Arctic.

Urquhart’s demands were related to broader transformations occurring in the management of northern wildlife. During the 1980s, the negotiation of land claims and the establishment of co-management boards increased the number of stakeholders involved in environmental and natural resource management in northern Canada as Indigenous people and perspectives were drawn into wildlife management regimes. Yet, the integration of Indigenous or traditional knowledge with scientific wildlife management was not without conflict.<sup>159</sup> Western scientists often portrayed these conflicts as problems of epistemology; problems that could be overcome if scientists were able to translate their research findings for Indigenous communities.

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<sup>157</sup> Doug Urquhart, “‘C’ is for Cesium,” *The Yukon News*, Undated Article. Press Clipping accessed in Yukon Archives, Fish and Wildlife Management, GOV 5000, File 9.

<sup>158</sup> Urquhart, “‘C’ is for Cesium.”

<sup>159</sup> Julie Cruikshank, “Uses and Abuses of ‘Traditional Knowledge’: Perspectives from the Yukon Territory,” in *Cultivating Arctic Landscapes: Knowing and Managing Animal Populations and the Environment in the Circumpolar North*, edited by David Anderson and Mark Nuttall (Oxford: Berghahn Books, 2004): 17-32; Nadasy, *Hunters and Bureaucrats*.

Indeed, demands for relevant and understandable scientific information were echoed in Indigenous communities across the western Arctic. But in managerial circles, this often took on condescending overtones. As Brian Pelchat of the Yukon Fish and Wildlife Branch stated, “the involvement of non-technical people in the management of fish and wildlife resources is expanding quickly, largely through the settlement of Indian Land Claims. As a result,” he claimed, “we have to start packaging technical information in a style and format that is understandable by non-technical people.”<sup>160</sup> Such representations of Indigenous participation in wildlife management not only reinscribed Indigenous knowledge as incommensurable with modernity, but also reduced the complexity of their response to northern contaminants to a technical issue that could be solved by rendering scientific findings comprehensible to people not trained in Western scientific thought.

In addition to rendering science comprehensible, Urquhart also looked to scientists to demonstrate for people living within the range of the Porcupine Caribou Herd that the risk of radioactive exposure was extremely low. As the survey being conducted by the Radiation Protection Division aimed to address public concern about the consumption of contaminated caribou meat, Urquhart suggested the extension of the monitoring program to three communities in which people relied on caribou from the Porcupine Herd. Through Urquhart’s facilitation, the PCMB provided logistical assistance to the researchers as they worked in the region.<sup>161</sup> In 1990, the participating scientists conducted surveys in the communities of Old Crow in the northern Yukon, and Aklavik and Fort McPherson in the Northwest Territories. In each community, researchers hired local interpreters who were tasked with explaining the purpose of the study to

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<sup>160</sup> Brian Pelchat to Alaska Department of Fish and Game, 30 November 1990, Yukon Archives Fish and Wildlife Management, GOV 5000, file 3.

<sup>161</sup> Tracy, “Radiocesium Body Burdens,” 433.

the participants, recorded personal information, and conducted a dietary survey “to determine the amount of caribou and other wild foods consumed.”<sup>162</sup> Immediately following each measurement, scientists provided “subjects” with a printout of the resulting body burden, and “an explanation of its meaning”; upon completion of the surveys, the Bureau’s scientists shared the results with each participating community “in the form of a written report.”<sup>163</sup>

Although results differed across the five communities surveyed, what stood out for the scientists was the overall decrease in average exposure values since the end of atmospheric nuclear testing. In the late 1960s, scientists had documented exposure levels that were near the threshold – or maximum permissible dose – recommended by the ICRP; in 1989-1990, however, scientists noted that the highest body concentration recorded corresponded to a dose “equivalent to about one chest x ray per year.”<sup>164</sup> Among the participating communities, human exposure levels were lowest in the communities within the range of the Porcupine Caribou Herd – a finding that reflected earlier studies of caribou body burdens. With exposure levels well below the threshold values recommended by the ICRP, scientists concluded that “it is improbable that any health effects would be observed, in the past, present, or future.”<sup>165</sup> Again, health authorities did not place restrictions on the consumption of caribou meat in northern Canada.

By 1990, Canadian wildlife managers believed that the issue of radioactive contamination in northern environments had been put to rest. Since the 1960s, scientists had documented

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<sup>162</sup> Tracy, “Radiocesium Body Burdens,” 433.

<sup>163</sup> Tracy, “Radiocesium Body Burdens,” 433.

<sup>164</sup> Tracy, “Radiocesium Body Burdens,” 441.

<sup>165</sup> Tracy, “Radiocesium Body Burdens,” 441. Unobservable, however, did not mean nonexistent. In 1997, scientists from the Radiation Protection Bureau used the information collected between 1963 and 1990 to calculate the collective dose for radiocesium exposures in northern Canada. By applying the ICRP’s method of calculating risk to the collective dose, they noted, “one would predict 14 additional cancer fatalities over the span of one human life.” Yet, as they would argue, this slight increase in predicted cancer-related deaths fell within the range of acceptable as it “would be undetectable against the normal cancer mortality in a population of over 100,000.” See Tracy, “Radiocesium Body Burdens,” 441.

exposure levels that were well below the “safe limits” established and recommended by the ICRP, and recent analyses revealed a steady decrease in radioactive exposures since the cessation of atmospheric nuclear testing. Although people in Indigenous communities would periodically express concern about the impact of radiation on the Porcupine Caribou Herd, Doug Urquhart claimed that the panic and confusion created by the Chernobyl meltdown had subsided by 1990.<sup>166</sup> But despite years of scientific evidence suggesting that the threshold had not been exceeded, the bioaccumulation of radiocesium – along with other contaminants – in northern environments had implications for human interaction with the Porcupine Caribou Herd.

First, as scientists worked to determine exposure levels in caribou herds and human populations, the managerial employment of the threshold concept obscured the nature of Indigenous concerns about radioactive contamination. Indeed, the threshold was a powerful concept through which scientists and health authorities measured the risk associated with radioactive exposures. For those people that depended on migratory caribou herds, however, the bioaccumulation of contaminants in caribou bodies was not simply a biophysical phenomenon that could be contained or managed through advisories regulating the consumption of potentially contaminated caribou meat.<sup>167</sup> In the late twentieth century, caribou meat was an important food source in northern communities, where southern imported foods were often low quality yet prohibitively expensive.<sup>168</sup> But subsistence was more than an economic activity in communities throughout the western Arctic. As multiple northern social scientists and scientists have argued,

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<sup>166</sup> For an example of continued concern, see Norma Kassi, “Contaminants in the Yukon,” *Northern Perspectives* 25, 2 (1998): accessed online at <http://carc.org/pubs/v25no2/index.html> on 2 June 2017. Urquhart, “‘C’ is for Cesium,” *The Yukon News*.

<sup>167</sup> Stephen Bocking develops this argument in a discussion of the environmental history of northern contaminants. See Bocking, “Toxic Surprises,” 441. See also J. Van Oostdam, et al., “Human Health Implications of Environmental Contaminants in Arctic Canada: A Review,” *The Science of the Total Environment* 230 (1999): 1-82.

<sup>168</sup> Oostdam, “Human Health Implications,” 1; Liza Piper, “From Subsistence to Nutrition: The Canadian State’s Involvement in Food and Diet in the North, 1900-1970,” in *Ice Blink: Navigating Northern Environmental History*, ed. Stephen Bocking and Brad Martin (Calgary: University of Calgary Press, 2017), 181-222.

“the concept of health in indigenous groups of the Arctic includes social, cultural, and spiritual dimensions,” and the sharing of traditional foods is an “integral component to good health among Aboriginal people influencing both physical health and social well-being.”<sup>169</sup> For the Gwich’in in Alaska and northern Canada, caribou are central to cultural identity, and the hunting, butchering, sharing, and consumption of caribou meat are activities that are vital not only to individual health but also for the maintenance of social relations.<sup>170</sup>

The movement of radioactive contamination through northern ecosystems – and the bioaccumulation of radiocesium in caribou bodies – threatened to upset these social relations. In 1997, Alfred Charlie, a member of the Vuntut Gwitchin First Nation, addressed the importance of protecting the land for the health of the animals and people. In the interview, which took place in 1997, Charlie spoke about the impact of pollution on plants and animals in the region. Charlie stated: “A long time ago our great, great grandfathers told us, ‘You don’t need money for your land. If you look after your land, you will survive. Keep your land clean.’ That’s what we are trying to do...”. In the past, he argued, the accumulation of pollution and garbage had caused animals to “move out of the country.”<sup>171</sup> Although Charlie’s comments were made in relation to the potential encroachment of industrial development into the traditional territory of the Vuntut Gwitchin, his perspective provides important context for thinking about the Vuntut Gwitchin response to the accumulation of radioactive material – and other forms of contamination – within their traditional territory and in the bodies of caribou.

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<sup>169</sup> Oostdam, “Human Health Implications,” 1.

<sup>170</sup> For more on the importance of caribou meat in Gwich’in communities, see VGFN and Shirleen Smith, *People of the Lakes*, 61-62, 85, 236.

<sup>171</sup> Vuntut Gwitchin First Nation, Old Crow, Yukon, Oral History Material: Catalogue Number VG1997-8-8, Alfred Charlie, March 1997. Excerpts from this interview also published in VGFN and Smith, *People of the Lakes*, 262.

During the late twentieth century, Indigenous relationships with migratory caribou were increasingly mediated through scientific wildlife management regimes. As Paul Nadasdy argues, this historical dynamic had immense implications for First Nations, who not only had to “restructure their societies by developing their own bureaucratic infrastructures modeled on and linked to those of the governments with which they must deal,” but also had to “learn to speak the unfamiliar languages of wildlife biology and bureaucratic wildlife management.”<sup>172</sup> Yet, to suggest a unidirectional exertion of power over Indigenous peoples by the state risks oversimplifying the ways in which Indigenous peoples have participated in scientific debate and wildlife management in northern Canada and Alaska. Indeed, science and wildlife management were the primary frameworks through which the state responded to the threat of northern environmental contaminants, but during the late twentieth century, Indigenous people in Alaska and northern Canada actively shaped and influenced the conduct of northern science, and the governmental response to northern contaminants.

In 1993, the Alaska Porcupine Caribou Commission (APCC) and the Porcupine Caribou Management Board (PCMB) organized a three-day conference in Arctic Village, a Gwich’in community in northern Alaska, the aim of which was to “foster the exchange of information between the users of the Porcupine Caribou Herd and the scientific community.”<sup>173</sup> In addition to the health of the Porcupine Caribou, and Indigenous involvement in managing caribou, participants spent one full day discussing northern contaminants and the impact on caribou and people.<sup>174</sup> Radiocesium, of course, was just one among many contaminants accumulating in northern environments, and in 1990, the scientific documentation of cadmium in caribou kidneys

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<sup>172</sup> Nadasdy, *Hunters and Bureaucrats*, 2.

<sup>173</sup> Jonathon Solomon and Albert Peter, *Notes from the Co-Chairs: The People, Science, and Caribou Conference* (Whitehorse: Porcupine Caribou Management Board, 1993), Introduction.

<sup>174</sup> People, Science, Caribou Conference, 6 November 1993, H94-40-03, APRCA, Oral History Program.

and livers reignited Indigenous concerns about toxins in caribou meat.<sup>175</sup> A key point of contention addressed by the conference participants was the production and dissemination of scientific information concerning northern contaminants. The threshold was also addressed by conference participants, with some scientists referencing the need for a better understanding of low-dose or “sub-lethal toxicity”, others reiterated that cadmium and cesium levels were below the threshold and, therefore, did not represent a serious threat to communities in the western Arctic.<sup>176</sup> What is interesting, however, is the way in which the Indigenous participants broadened the discussion and debate beyond the focus on the threshold, which, as I have argued throughout this chapter, played a fundamental role in defining the boundaries of the nuclear north.

Indeed, comments and presentations made by a number of Indigenous participants demonstrate how they were working against a regime of imperceptibility assembled purposefully around northern contaminants.<sup>177</sup> Sarah James, a Gwich’in elder from Arctic Village, not only expressed her concerns with the relationship between the military and science, but also argued that there was a need to understand better the production of northern contaminants. “We’re talking about what we see in the animal,” stated James, “but we haven’t gotten into where the pollution comes from. I mean, who produced the most pollution?”<sup>178</sup> Jonathon Solomon, a Gwich’in elder from Fort Yukon, Alaska, and one of the chairs of the conference, expressed concerns about the way in which science threatened to scare people into “not eating our native food.”<sup>179</sup> Finally, Albert Peter, who was from the First Nation of the Na-cho Nyäk Dun in the

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<sup>175</sup> Albert Peter (PCMB) to Benoit Bouchard (Minister Department of National Health and Welfare), 9 May 1993, Yukon Archives, Fish and Wildlife Management, GOV 5000, File 9.

<sup>176</sup> People, Science, Caribou Conference, 6 November 1993, H94-40-03: 13, APRCA, Oral History Program.

<sup>177</sup> Murphy, “Chemical Regimes,” 695-703.

<sup>178</sup> People, Science, Caribou Conference, 6 November 1993, H94-40-03: 55, APRCA, Oral History Program.

<sup>179</sup> People, Science, Caribou Conference, 6 November 1993, H94-40-03: 58, APRCA, Oral History Program.

southern Yukon and the chairman of the PCMB, provided participants with an important community perspective, stating: “If there’s contaminants in the environment, the animals and the fish, we’re the end of the line for all those contaminants. We accumulate or it builds up in our system, and I think that’s part of the reason that there’s so much concern being expressed by different communities that I’ve been to.”<sup>180</sup> The threshold may have been the primary frame through which scientists, wildlife managers, and health authorities continued to conceptualize exposure levels and quantify risk, but as the proceedings of the “People, Caribou, Science” conference demonstrate, in the late twentieth century, Indigenous communities across the western Arctic pushed scientists to think beyond a singular boundary between ostensibly safe and unsafe levels of exposure. Indeed, after more than four decades of scientific investigation into the biological implications of radioactive fallout, the demarcation of a boundary between safe and unsafe – or perceptible and imperceptible – was still political.

### **Conclusion: The Threshold Enforced**

Through the second half of the twentieth century, nuclear fallout transformed radioactive contamination into a planetary force.<sup>181</sup> The environmental implications of fallout, however, have been uneven across space and time, and have had varying impacts across species lines. Paying attention to the specificity of place demonstrates the way in which local ecological conditions have shaped the socio-natural implications of this new environmental condition. In the North American Arctic, the lichen-caribou-carnivore pathway of exposure rendered both caribou and people vulnerable to the bioaccumulation of radioactive contamination. Yet, as I have noted in this chapter, despite this documented ecological vulnerability, scientists have

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<sup>180</sup> People, Science, Caribou Conference, 6 November 1993, H94-40-03: 40-41, APRCA, Oral History Program.

<sup>181</sup> Masco, “Age of Fallout,” 137-168.

repeatedly determined that the bioaccumulation of radioactive contamination through the northern food chain has not exceeded the threshold for unsafe levels of exposure.

Ultimately, this chapter is concerned with the way in which science operated to extend the threshold concept to encompass human-caribou relationships in the western Arctic. I have presented three different moments in which the threshold came to matter. In the first moment, scientists employed by the Atomic Energy Commission worked to render visible radioactive contamination in the western Arctic. Their research not only pointed to the potential threat of radioactive exposures exceeding “safe limits”, but also established the terms by which certain forms of exposure would be rendered imperceptible through industry-sponsored science. In the second moment, I engaged with the shifting terrain of threshold values, and considered the shift to permissible levels of exposure. In the western Arctic, scientists in northern Canada and Alaska would argue, exposure levels were below the threshold for biological damage, and therefore did not represent a threat to those Indigenous communities that depended heavily on the consumption of caribou. In the third moment, the threshold became a techno-scientific mode of representation that health authorities and wildlife managers employed as they sought to assuage Indigenous concerns and environmental anxieties provoked by the nuclear disaster at the Chernobyl Power Plant in 1986. This historical dynamic, however, did not go unchallenged. As Indigenous communities increasingly participated in wildlife management regimes and the production of scientific knowledge about caribou during the late twentieth century, they would also push back against the purposeful production of imperceptibility around pollution, contaminants, and radioactivity in the northern food chain.

Since the beginning of the nuclear age, the threshold has played an important role in defining the boundaries of the nuclear north. Yet, the threshold is not a natural or stable

boundary; rather, it has consistently been a site of contestation, a boundary subject to historically-contingent ways of knowing and seeing, and claims of scientific authority. As in the previous chapters, I have focused on the making of this conceptual boundary to demonstrate how its negotiation and enforcement influenced environmental relationships (and human-caribou interaction) in the western Arctic.

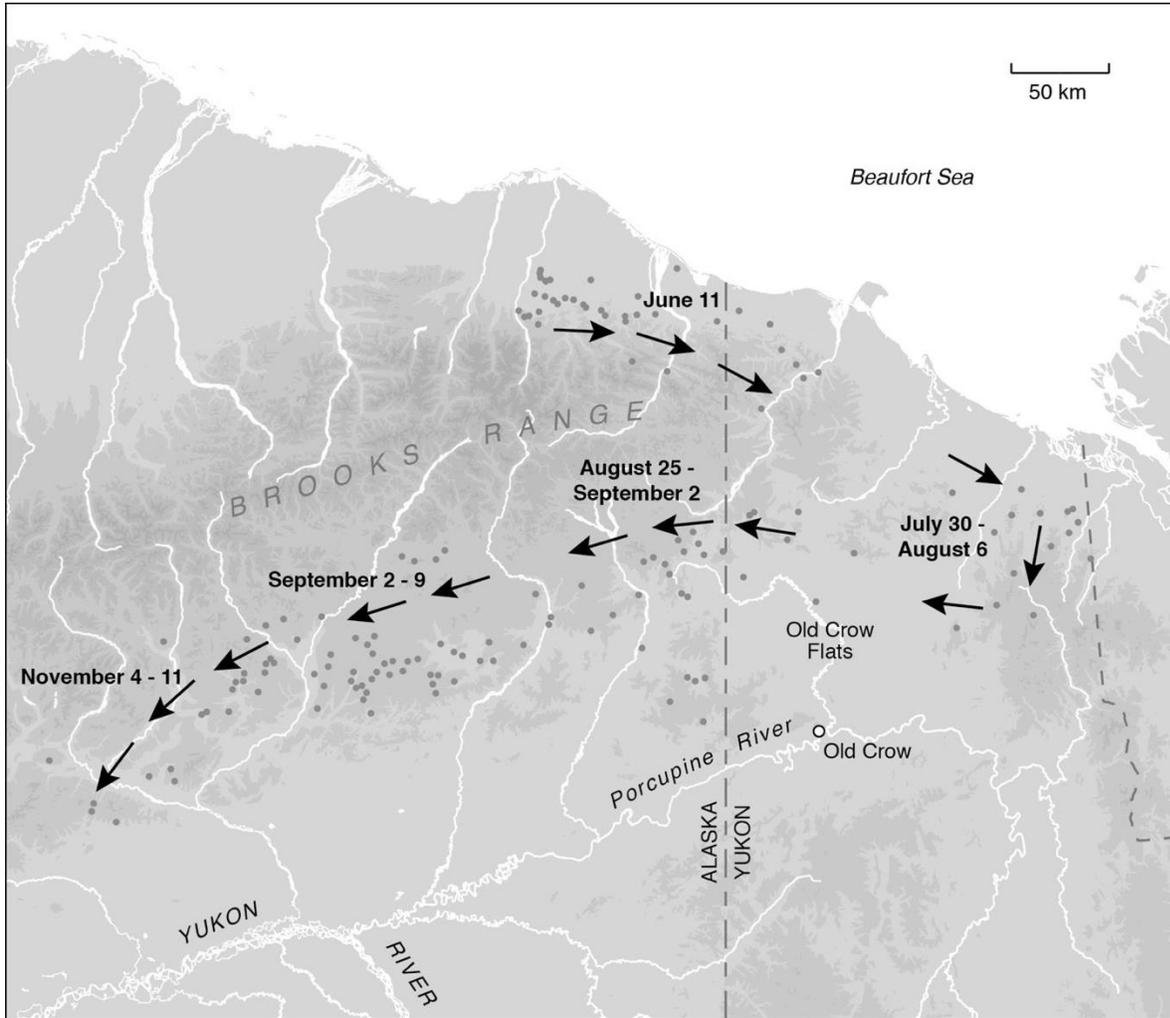
## **Chapter 6: Conclusion**

*20 September 2014: Old Crow, Yukon, Vuntut Gwitchin Traditional Territory*

“Have you seen the maps?” It was a question that I was asked several times during my last day of fieldwork in Old Crow in the fall of 2014. For the past month, I had been in the Vuntut Gwitchin community learning about caribou and life on the land. Unlike most years, however, the movement of thousands of caribou across the Porcupine River near Old Crow had not yet occurred. And with the end of the fall hunt approaching quickly, people were growing increasingly concerned that the community might be left without enough caribou meat to get them through the winter months. Many of the people that I met while in Old Crow knew about my interest in caribou, and several who saw me on my last day in town thought that I should stop by the Vuntut Gwitchin Government office to see the maps released recently by the Porcupine Caribou Management Board.

At first glance, the three maps seemed to answer a lot of questions. The maps, which had only recently been posted, contained the satellite locations of 36 caribou from the Porcupine Herd, and documented their movements between August 25 and September 15, 2014 (see Figure 6.1). Indeed, these satellite images seemed to confirm what many in town had suspected throughout the fall season. This year, a large number of caribou from the herd – represented by this sample wearing satellite collars – had stayed north of the Old Crow flats as they migrated towards their wintering grounds. Typically, the migration brought the caribou much further south, where they crossed the Porcupine River – the river for which the herd is named – near Old Crow. Then, between August 25 and September 9, most of the satellite-collared caribou crossed the Alaska-Yukon border, and, by September 15, had gathered in the area surrounding the Gwich'in community of Arctic Village in Alaska. If this group of animals that had been tracked

by satellite radio collars was a representative sample from the Porcupine Caribou Herd, then it made sense that only a small number of caribou had been seen and hunted further south in Old Crow that fall.



**Figure 6.1. The Fall Migration (2014). Map by Eric Leinberger.<sup>1</sup>**

Yet, for every question the maps seemingly answered, the information they contained and represented raised other questions and concerns for the people of Old Crow. What, for example, had caused the migrating caribou to stay north of the Old Crow flats? In a period of global

<sup>1</sup> This map is based on a series of satellite images produced by the Porcupine Caribou Management Board, which were posted in the Vuntut Gwitchin Government offices in Old Crow, Yukon in the fall of 2014. The maps are available in the Porcupine Caribou Management Board's report "Porcupine Caribou Movement, June 2014 – Present." Accessed online at <http://pcmb.ca/resources> on 15 November 2017.

climate warming, did this migratory route represent the new normal for the Porcupine Caribou Herd? Or, was this simply an aberration? Would the caribou migration return to a more normal pattern in the spring as the herd migrated to its calving grounds on Alaska's coastal plain? Indeed, it had been an unseasonably warm fall, which might explain why the caribou had stayed north of the Old Crow flats, but it is difficult to determine the cause of this current shift in the herd's migration. As local hunter Roger Kyikavichik explained during an interview on the CBC, caribou often change their migratory routes, and community members – along with researchers and wildlife managers – would have to watch the herd's migration for several years before they could determine whether this current shift was indeed caused by climate change.<sup>2</sup> For me, this series of satellite images, which had been pinned to a notice board in the main VGG office, demonstrated the contemporary significance of historical processes of boundary-making. As a researcher with an interest in the discontinuity between the herd's migratory route and the international border that transects its range, I could not help but reflect on the fact that while many people from the Vuntut Gwitchin First Nation had been out on the river in search of caribou – often at great financial expense – most of the animals they were hunting had already crossed the border into Alaska.

Caribou migration has a history, and that history is central to the geographical analysis undertaken in this dissertation. Every year, caribou from the Porcupine Herd follow a series of ancient trails – some of which have been etched into the landscape by the hooves of thousands of caribou – as they migrate between their calving grounds on Alaska's coastal plain and their wintering grounds further to the south. Driven by a series of biological imperatives and environmental conditions, this herd completes one of the longest and most arduous migrations of

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<sup>2</sup> Interview with Roger Kyikavichik, CBC Radio, *Midday Cafe*, 8 September 2014 ([www.cbc.ca/middaycafe](http://www.cbc.ca/middaycafe)).

any terrestrial mammal species in North America. As the migration progresses, caribou – both individuals and groups, including post-parturient cows and their precocious calves – choose their route based on their biological needs and the environmental conditions they encounter. Thus, the environment of the western Arctic has played a direct role in shaping the herd’s annual migration.<sup>3</sup>

For Gwich’in communities, the annual migration of the Porcupine Caribou Herd not only connects human communities throughout this transboundary region, but is also central to the maintenance of cultural traditions and land-based relationships.<sup>4</sup> In a 2001 interview, Vuntut Gwitchin elder Alfred Charlie spoke about the spatial and temporal connections engendered by the movement of the Porcupine Caribou Herd. Standing atop Tanch’ohlii, a hill north of the Crow Flats, Alfred Charlie spoke of a time when there were fewer caribou than at the beginning of the twenty-first century. “Even so,” he stated, “the caribou migrated down [northwest to the Alaska North Slope] to the calving grounds. They went there in the spring.... After that, when the young ones were raised, they came up this way in the month of August. They migrated...through the mountains...Some of them came over the mountains, over that big mountain. Some of them, by the ocean, up on the coast, up on the grass,” he explained, in reference to the portion of the Yukon’s North Slope that lay above the treeline.<sup>5</sup> “Around Arctic

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<sup>3</sup> S.G. Fancy and K.R. Whitten, “Selection of Calving Sites by Porcupine Herd Caribou,” *Canadian Journal of Zoology* 69, 7 (1991): 1736-1743.

<sup>4</sup> For a discussion of the delicate and shifting balance between “extracivist capitalism” and “traditional land-based harvesting activities” in the Northwest Territories, see Glen Coulthard, *Red Skin, White Masks: Rejecting the Colonial Politics of Recognition* (Minneapolis: University of Minnesota Press, 2014), 54-56. For more on the importance of migratory caribou to the maintenance of land-based relationships in the traditional territory of the Vuntut Gwitchin First Nation (Old Crow, Yukon), see the oral histories in Vuntut Gwitchin First Nation and Shirleen Smith, *People of the Lakes: Stories of our Van Tat Gwich’in Elders / Googwandak Nakhwach’ànjàò Van Tat Gwich’in* (Edmonton: University of Alberta Press, 2009).

<sup>5</sup> Quotes taken from an edited transcript of Alfred Charlie’s interview, which is contained in Vuntut Gwitchin First Nation and Shirleen Smith, *Googwandak Nakhwach’ànjàò Van Tat Gwich’in*, XXVIII-XXIX. I first became aware of Alfred Charlie’s description of the caribou migration after reading an unedited transcript of the interview, which is housed in Vuntut Gwitchin First Nation Oral History Materials, Vuntut Gwitchin Oral History Project, Interview with Alfred Charlie, 29 June 2001, VG2001-2-62.

Village [Alaska], when they migrated over the mountains, some of them stopped there. There Arctic Village people lived off them,” Charlie noted as he explained the importance of the caribou to the people living in Neets’aii Gwich’in traditional territory.

Through the remainder of the interview, Charlie followed the migrating caribou, tracing the outlines of their migratory routes across time and space, and explaining the importance of their movement through the traditional territories of different Gwich’in communities. “Some of them [migrated east] up at the ocean, up that way on the Mountains.... Then the Aklavik people, in the summer, them, too, they took their meat from them,” Charlie noted, referring to the Gwichya Gwich’in community that lay on the western side of the Mackenzie Flats in the Northwest Territories. “Some of them went up at Bell River...then way up where they call Loon Lake, above there they went over the mountains. Then...the Fort McPherson people, they ate good from it too,” he noted, drawing the Teetl’it Gwich’in community into his description of the herd’s migration.<sup>6</sup> Yet, as Charlie explained, the annual movement of caribou through Gwich’in territories was not an unchanging phenomenon. “A long time ago, all winter there was caribou around here,” he stated, referring to his location at Tanch’ohłii in the traditional territory of the Vuntut Gwitchin First Nation. “The Old Crow people really depended on them after New Year’s. Now the caribou don’t stay here anymore. I wonder how their food is?”<sup>7</sup>

Throughout the twentieth century, the herd’s movement across the International Boundary shaped spatio-temporal connections among human communities and this group of migratory animals. Every spring, caribou from the Porcupine Herd move toward the coastal plain on Alaska’s North Slope, where pregnant cows give birth to their calves. Following the calving period, during which thousands of caribou aggregate on the calving grounds, the herd splits into

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<sup>6</sup> VGFN and Smith, *Googwandak Nakhwach’anjòo Van Tat Gwich’in*, XXVIII-XXIX.

<sup>7</sup> VGFN and Smith, *Googwandak Nakhwach’anjòo Van Tat Gwich’in*, XXIX.

smaller groups of animals, which undertake the fall migration toward their wintering grounds in Alaska and the Yukon.<sup>8</sup> Some caribou, such as the animal collared by Whitten in 1984 and discussed in the opening to this dissertation, cross the Canada-US border multiple times as they migrate to and from the herd's calving grounds on Alaska's North Slope.

Animal migration – including the movement of caribou herds – is a biological phenomenon that is central to environmental relationships in the North American Arctic. From the bowhead whales that formed a crucial part of the Inuit subsistence economy, and supported the growth of an American whaling industry at Herschel Island, to the migratory waterfowl that were a central concern for the early conservationists and politicians who negotiated the Migratory Bird Treaty of 1916, migratory animals mark the cyclical passage of seasons in the Arctic, and connect human communities across time and space.<sup>9</sup> Yet, animal migration is not a purely natural phenomenon driven only by environmental conditions, biological imperatives, and physiological changes within the bodies of migratory animals.<sup>10</sup> Throughout North America, historical geographer Robert Wilson argues, animal migrations have been “strongly affected by cultural, economic, and political changes.”<sup>11</sup> As Canadians and Americans “felled trees, plowed land, filled wetlands, and dammed rivers,” animal populations changed their migratory routes;

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<sup>8</sup> For a scientific understanding and description of the herd's migration, see Don Russell, Art Martell, and Wendy Nixon, “Range Ecology of the Porcupine Caribou Herd in Canada,” *Rangifer* 8 (1993): 1-168; S.G. Fancy, K.R. Whitten, and W.L. Regelin, “Seasonal Movements of Caribou in Arctic Alaska as Determined by Satellite,” *Canadian Journal of Zoology* 67 (3): 644-650. Of course, as I argue above, the concept of caribou migration has changed over time. I consider the emergence of modern scientific understandings of the Porcupine Caribou Herd's migration in more detail in chapter 3.

<sup>9</sup> For more on bowhead whales, see Dorothy Eber, *When the Whalers were up North: Inuit Memories from the Eastern Arctic* (Montreal and Kingston: McGill-Queen's University Press, 1989); John Bockstoce, *Whales, Ice, and Men: The History of Whaling in the Western Arctic* (Seattle: University of Washington Press, 1986). For more on the Migratory Bird Treaty, see Dorsey, *The Dawn of Conservation Diplomacy*, 165-237.

<sup>10</sup> For more on migration as a historical process, see Robert Wilson, “Mobile Bodies: Animal Migration in North American History,” *Geoforum* 65 (2015): 465-472. Scientists have written a great deal about the historical evolution of migration, both as a process and as a concept. See Thomas Alerstam, Anders Hedenström, and Susanne Åkesson, “Long-Distance Migration: Evolution and Determinants,” *Oikos* 103, 2 (2003): 247-260; John Dingle, *Migration: The Biology of Life on the Move* (Oxford: Oxford University Press, 1996).

<sup>11</sup> Wilson, “Mobile Bodies,” 465.

material changes in the landscape, he argues, are reflected in their effects on the movement of migratory animals.<sup>12</sup> In the western Arctic, Canadian and American governments have established national parks and the Arctic National Wildlife Range (ANWR) to protect a considerable portion of the Porcupine Caribou Herd's transboundary range. Yet, as caribou from the Porcupine Herd follow ancient trails that connect them to their birthplace on the coastal plain, they traverse a vast Arctic landscape, which has been shaped by human society, despite being portrayed by many as one of North America's last untouched or pristine wilderness areas.<sup>13</sup>

Although the human imprint on the landscape is less noticeable throughout the range of the Porcupine Caribou Herd than in other parts of North America, this does not mean that the herd's migration – or the herd itself – has been untouched by the environmental transformations driven by industrialization and the historical emergence and spatial expansion of capitalist social relations.<sup>14</sup> As I have demonstrated in this dissertation, throughout the twentieth century, caribou in the western Arctic have been impacted by a series of broadly related environmental transformations and developments. At the end of the nineteenth century, missionaries and government officials imported *domesticated* reindeer from Siberia to Alaska to replace caribou in the Native diet. The subsequent establishment and development of a reindeer industry in Alaska during the first half of the twentieth century led wildlife managers and scientists to fear the potential biological impact on the Territory's *wild* caribou, which interbred frequently with reindeer that had escaped from their herds. In the second chapter of this dissertation, I argued

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<sup>12</sup> Wilson, "Mobile Bodies," 465.

<sup>13</sup> For more on the notion of Alaska as America's last wilderness, see Susan Kollin, *Nature's State: Imagining Alaska as the Last Frontier* (Chapel Hill: University of North Carolina Press, 2001); Stephen Haycox, *Frigid Embrace: Politics, Economics, and Environment in Alaska* (Corvallis: Oregon State University Press, 2002); Roger Kaye, *The Last Great Wilderness: The Campaign to Establish the Arctic National Wildlife Refuge* (Fairbanks: University of Alaska Press, 2006).

<sup>14</sup> For example, during the 1970s and 1980s, scholars debated the extent to which the whaling industry depleted caribou populations. To get a sense of the contours of the debate, see John Bockstoce, "The Consumption of Caribou by Whalers at Herschel Island, Yukon Territory, 1890-1980," *Arctic and Alpine Research* 12, 3 (1980): 381-384.

that as officials in Alaska sought ways to mitigate the biological impact of reindeer-caribou hybridization, they also became early actors in the demarcation of the spatial and conceptual boundaries around wilderness in the western Arctic.

The introduction of reindeer to Alaska had cascading ecological implications that impacted scientific efforts to stabilize conceptual boundaries around key managerial categories in the mid-twentieth century. As scientists and wildlife managers in Canada and the United States worked to bring order to caribou taxonomy through the hardening of the boundaries around the species and subspecies concepts, the presence of hybridized animals – both live animals in the field and dead animals transformed into biological specimens – troubled emergent systems of classification. Yet, as I have argued in the third chapter of this dissertation, Frank Banfield, Chief Mammalogist with the Canadian Wildlife Service and, subsequently, Chief Zoologist with the National Museum of Canada, overcame scientific uncertainty in caribou classification through the establishment of institutional linkages within a transnational network of caribou science. Further, scientific efforts to establish firm boundaries around different caribou herds in the western Arctic were troubled by the transboundary migratory routes followed by certain groups of animals. In addition to deploying new methods of aerial surveillance to follow caribou into previously inaccessible northern regions, scientists and wildlife managers in both countries worked to align national research programs through joint scientific investigations of migratory caribou. As scientists produced increasingly refined representations of the spatio-temporal dynamics of caribou migrations, they transformed prevailing understandings of the biological definition of a caribou herd, and established a critical boundary around the animals that constituted the Porcupine Caribou Herd.

Between the mid- and late twentieth century, the environmental transformations wrought by industrial developments in the western Arctic had profound implications for the landscapes through which migratory caribou moved. Since the 1950s, the exploratory activities of oil companies have played an important role in transforming Arctic tundra ecosystems throughout the western Arctic. The pace and scale of the environmental transformations caused by oil exploration, extraction, and transportation increased dramatically after the discovery of massive reserves of hydrocarbon resources under Alaska's coastal plain in 1968. In the fourth chapter of this dissertation, I argued that representatives of the oil and gas industry harnessed the means of scientific knowledge production in an effort to legitimize the industry's claims that it could extract the oil and gas resources from critical caribou habitat without compromising the health and future survival of migratory caribou.

During the second half of the twentieth century, migratory caribou have also been subject to the environmental impacts and ecological consequences of industrial and other forms of economic and technological development in distant locations. In the 1960s, scientists were surprised to learn that environmental contaminants, including artificial radionuclides produced by atmospheric nuclear detonations, had permeated and accumulated within the bodies of northern plants, vegetation, animals, and people.<sup>15</sup> In the fifth chapter, I traced the movement of radionuclides through northern ecosystems, and examined the way in which scientists rendered low levels of radioactive contamination both perceptible and acceptable in the western Arctic. As scientists documented the pathway through which radionuclides accumulated in the bodies of caribou and people, they also sought to develop methods of measuring exposure levels in human communities, and determining whether the threshold for safe levels of exposure had been

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<sup>15</sup> For more on this aspect of arctic environmental science, see Bocking, "Toxic Surprises," 422.

crossed. Through an approach that conceptualized the scientific establishment and application of threshold values as a boundary-making process, I sought to demonstrate the way in which radioactive contamination structured unfolding environmental politics in the western Arctic and reshaped human interaction with migratory caribou.

This dissertation is concerned with the way in which scientific boundaries and political borders shaped human-caribou relationships in the western Arctic during the twentieth century. Throughout the dissertation, I have conceptualized borders and boundaries in two ways: first, as political borders that demarcate the limits of national space and territorial sovereignty; and, second, as metaphorical boundaries drawn and negotiated by scientists as a means of describing the more-than-human world and ordering environmental relationships. The historical and geographical analysis undertaken in this dissertation has demonstrated that political borders and scientific boundaries are not static or inviolable lines drawn around or marked upon the natural world. Rather, as I argue in each of the four case studies, political borders and the metaphorical and conceptual boundaries demarcated by scientists are best conceptualized as spatio-temporal *processes* and not as inert or stable *things*. Through engagements with the shifting line between *domesticated* and *wild* animals, taxonomic and biological boundaries, the violable line between industrial development and caribou habitat and, the threshold concept, I have sought to demonstrate that boundaries are always sites of contestation and potential spaces of scientific boundary-work. In each case, I have argued that the placement, meaning, and significance of political borders and scientific boundaries have shifted over time in response to challenges from within and outside of the scientific community. Although humans have been the focus of this dissertation, they have not been the only actors in this story. As I have suggested throughout this

dissertation, during the twentieth-century, migratory caribou have transgressed every boundary that humans have created to contain them.

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