Transdisciplinary Research, Indigenous Knowledge, and Wicked Problems

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Source: Rangelands, 43(4) : 133-141

Published By: Society for Range Management

URL: https://doi.org/10.1016/j.rala.2021.04.002

Forum

Transdisciplinary research, Indigenous knowledge, and wicked problems

By Karim-Aly Kassam

On the Ground

- Knowledge is not in our heads but arises out of our relations with the environment we inhabit. This implies cognitive diversity in our knowledge systems.
- Expertise is not enough for solving the major problems of the third millennium and difference (another way of thinking) is just as important.
- Transdisciplinarity is achieved through collaborative and participatory research processes that cogenerate insights by *communities of social practice* working in tandem with *communities of enquiry*.
- Time is a unique experience that reflects relationality and flexibility in its sociocultural context.
- This framework may assist with climate change adaptation at the local level.

Keywords: Anthropocene, Anthropogenic climate change, Arctic, Ecological calendars, Iñupiat, Pamir Mountains, Central Asia.

Rangelands 43(4):133–141
doi 10.1016/j.rala.2021.04.002

Introduction

With a name like "Karim-Aly" one may wonder how do the Arctic and the Pamirs come together? In an age when there is a strong impulse to pigeonhole our identities on racial terms, like most peoples, and certainly many North Americans, we do not fit these facile social constructs that defy our reality and lived experience. I was born in East Africa, raised in the Rocky Mountains of Canada, and undertake research along with my students in high latitudes in the American, Canadian, Russian Arctic, and the Boreal Forest, and high altitudes of the Pamir Mountains of Central Asia, including Afghanistan, Tajikistan, Kyrgyzstan, and Xinjiang, which is currently under martial law in China.

These high-latitude and high-altitude regions have a history of colonial oppression accompanied by external forces of industrialization. For nearly a century, these regions were the frontiers of the Cold War.[1,2] Now they have been reconceptualized by yet another monolithic and dogmatic approach, the so-called "Clash of Civilizations,"[3] that has no basis in empirical evidence of diverse lived experiences. Like the Cold War, this approach has informed international foreign policy since the late 1990s. In reality, these regions manifest significant biological and cultural diversity and cannot easily be characterized by uninformed stereotypes. They are endowed with vast renewable and nonrenewable natural resources, which make them strategically important and ripe for exploitation. Furthermore, these are the lands of Indigenous peoples who have called the area home for millennia. Whether we accept anthropogenic climate change or not, these regions are also at the forefront of dramatic climate change. Within these parts of the globe, different ecological professions exist such as farming, fishing, herding, hunting, and orcharding to secure human livelihoods and wellbeing. Like the rangeland ecologists, managers, and ranchers consisting of the target audience of this journal, these societies are very much part of the 21st century. They are simultaneously and actively engaging in these diverse ecological professions and activities that directly link land-based livelihoods with their food security. This journal is ideally placed to appreciate the transdisciplinary research where place-based insights of Indigenous communities are a central pillar to knowledge cogeneration and are therefore, able to address the fundamental concerns of the 21st century.

Over 3 and a half decades, many stories have come together as I reflect on my personal growth resulting from working with Indigenous communities internationally. I will directly draw from these experiences and articulate how they inform my current work. In particular, I will share insights from a project that is currently underway and builds on the foundation of this long engagement. It is not yet concluded, so there is potential for us to write this narrative together. The impetus for this tale arises from the peoples of the Arctic in the late 1990s and is manifested in the Pamir Mountains of

Central Asia at the beginning of this millennium. I am going to share with you a larger narrative that builds on three intertwined stories binding the Arctic with the Alpine and Indigenous peoples internationally.

Like the theme of this special issue, this narrative begins with acknowledgement of the necessity for transformation and recognition that difference of perspectives matters to addressing complex problems. Such wicked problems will be described because they demand transdisciplinary thinking. Subsequently, a methodology of hope will be conveyed with respect to anticipating the consequences of climate change on Indigenous communities and their livelihoods. Finally, promising future pathways are explained.

Learning and transformation

To describe sociocultural and ecological transformation, we must acknowledge transformation in our own thinking and work. My learning from over 35 years of collaborative research among diverse peoples and places demonstrates fundamental and mutually reinforcing relationships between biological and cultural diversity. I am not going to use the euphemism of "coupled human and natural systems." Humans and nature are not a couple. Such monolithic categories hide complexity and are incorrect. Human beings are embedded within their habitat; they are fundamentally dependent on it. As such humans do not exist outside of nature. Humans and nature cannot be two separate things so that they can be described as a couple. The language of Coupled Human and Natural Systems was institutionalized by the National Science Foundation at the beginning of the third millennium through grant funding in "Biocomplexity in the Environment" and continues to be used[i]. Although most users of Coupled Human and Natural Systems funding would agree with these criticisms, the use of this language continues to be used. Anthropogenic climate change is precisely the outcome of over two centuries of flawed thinking fueled by industrial economic systems that argue that we can separate humans from their habitat. Such neoliberal economic policy assumptions ignore the impact of our exploitative activities on the environment as an externality, thereby, creating an illusion of the absence of consequences. The language of coupled human and natural systems reinforces this erroneous ideological perception that is damaging to both human existence and the planet as a whole. The Anthropocene is a direct outcome of this flawed form of thinking.

Transformation emerges from reflection through self-interrogation of assumptions and conclusions. In academic life, we often encounter enthusiastic individuals who have "solutions" for problems. They have a formulaic and technocratic answer where all they need is a place to implement it. They seek to visit their prescriptions on an unsuspecting Indigenous community with very real challenges. Such an approach to scholarship is merely a continuation of the colonial legacy and privilege because the solution being prescribed is arrived at without inquiring into what the community's priorities are and without engaging their participation. If nothing else, we, as scholars and researchers, are a *community of enquiry*. We must ask questions and then have the humility not only to hear but actually listen. Often what is missing are questions that open-up new pathways of thinking to bring diverse and relevant insights into a novel frame of reference based on listening. In that sense, the questions we ask are more important than our answers because they yield deep and thoughtful responses from community members grounded in the local sociocultural and ecological context.

Given the challenges we are facing in the 21st century, scholars have argued for double and triple loop learning where we interrogate the fundamental structures of our thinking and engage in paradigmatic shift.[4–8] This type of learning seeks to create collaborative processes where diverse ways of knowing make explicit the values and objectives that underlie different approaches to learning.

Below are a series of four "what if" questions that helped reconceptualize the challenge of building local level anticipatory capacity to anthropogenic climate change in my own research.

- What if knowledge is not in our heads but in our relations with the environment we inhabit?
- What if expertise is not enough for solving the major problems of the third millennium and difference (another way of thinking) is just as important?
- What if time is a unique experience, flexible, and relational?
- What if speaking truth to power requires recognition of difference and collaboration?

The first question is akin to acknowledging that we need air to breathe and yet this obvious realization does not seem apparent to most. Knowledge is not some commodity that we have squeezed into our brain like a cumulative investment portfolio resulting from hoarding. Rather it is the outcome of relationships that we have with our habitat, whether habitat is rangelands, forests, mountains, or cityscapes. It is from these contextual relationships that knowledge speaks to us.[9] The second question is an acknowledgement of one's own limitations. This question builds on the first, in that, we recognize knowledge formation is achieved through collaborative relations. Such collaboration requires self-interrogation like double and triple-loop learning as well as openness to other ways of knowing. The third question illustrates that the relationships in our habitat gives us the context to draw insights from the passage of the seasons, and therefore, time itself. Historically, human communities have used biophysical indicators and cues to keep track of time. It is this experience of time that has guided their livelihoods and food systems.[10,11] Furthermore, knowledge is only recognized when it is shared and pointed out to us in the context of our habitat. As the fourth question intimates, it is through rigorous collaborative work where different ways of knowing form the foundation of our

[i] See NSF https://www.nsf.gov/news/priority_areas/biocomplexity/index.jsp and https://www.nsf.gov/pubs/2014/nsf14601/nsf14601.htm.

understanding so we can genuinely and effectively speak truth to power.[12]

A case for different ways of knowing

Our narrative begins at the dawn of the third millennium in the Arctic with the collapse of the Soviet Union. The events of what occurred in these regions of the Soviet Empire was an important transformational lesson about the ontology of different ways of knowing and living in the 21st century. The Indigenous peoples of the Arctic and sub-Arctic as well as those from Central Asian Republics of the former Soviet Union, soon after its collapse, were struggling for survival because the centralized economy stopped the supply chain of food and fuel going to these outlying regions. Therefore, each family had the prospect of starving and freezing to death. As we are learning from the effects of the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2 or more commonly known as COVID-19) on the disruption of supply chains, international industrial systems can collapse easily and rapidly while wreaking tremendous havoc on the socioeconomically vulnerable, in this case Indigenous communities.

At that historical moment, the power of human agency revealed itself. Here I will share the first story in my larger narrative from the Arctic and sub-Arctic. The Sami on the Kola peninsula from Norway, Sweden, and Finland came to the assistance of the Sami in the Russian Federation.[13,14] Similarly, on the Chukotka peninsula, the Iñupiat, Inuvialuit, Inuit, and Yupik came to the assistance of the Chukchi and Yupik. This is an illuminating lesson because of its unique character. Indigenous peoples were helping other Indigenous peoples. Much like any humanitarian assistance, the first reaction was to send emergency aid to stave off starvation. In the Anthropocene, it is common to characterize hunting, fishing, and gathering as recreational or sporting activities. However, in many parts of the world including the Arctic and sub-Arctic, it remains a fundamental part of the food system. It is central to the nutritional wellbeing of a community and is a key element of the household food basket. At the time of the collapse of the Soviet Union, a post-secondary education was not significant to meeting immediate needs of a family. Another cognitive skill was essential for survival—knowing *how* to live off the land and sea. In the Soviet command economy, much like the market economy, these skills have been largely neglected and devalued through industrialization. A significant impact of the Anthropocene, which coincides with colonization of the mind, not just the land, is that other ways of knowing are diminished and actively suppressed. Iñupiat on the North Slope of Alaska sent supplies and weapons to their neighbors across the Bering Sea so that they may sustainably hunt for food. In order to hunt marine mammals, the Iñupiat also had to negotiate with the International Whaling Commission, on behalf of the Chukotkans, to extend quotas to enable hunting and achieve food security. Furthermore, the Iñupiat engaged community leaders, hunters, and scientists from the Chukotka Peninsula and brought them to the North Slope Borough. This facilitated the transfer of knowledge and strengthened institutional infrastructures to secure hunters' rights and build capacity for sustainable use of marine and terrestrial food sources.[9]

The Iñupiat's own historical experience of transformational change informed their response toward fellow Indigenous communities in the Chukotka Peninsula. The fact that the Iñupiat acted so effectively to support their neighbors speaks to their own history and ability to adapt to the impacts of Euro-American colonization. They retained their Indigenous knowledge by continuing to sustainably engage their food system based on local biodiversity. A key element of this process is the role of cultural values informing the social institutions of the Iñupiat and drawing on the ecological foundation of their habitat. One such central cultural value is "sharing" the fruits of their hunt with the whole community.[9] At various points during the year, key events supported by Iñupiat social infrastructure, such as the Nalukataq festival after a successful whale hunt, Thanksgiving, or Christmas, are moments when this value is seen in practice for public viewing. However, sharing also occurs throughout the year in more subtle and less obvious ways. For instance, during the Nalukataq villagers gather not only to share the hunt but to express their gratitude to both the whale and the whaling crew. Social bonds among community members and with bowhead whales are simultaneously renewed and reinforced. For the Iñupiat, whaling is more than just a major food source—it defines the sociocultural life of the community in which sustainable practices and ethical behavior is governed by the relationship to the bowhead whale. To put it tersely sharing limits overuse, on the one hand, and simultaneously ensures equitable distribution of food, on the other. Although to an outsider this efficient calculus may seem important, for the Iñupiat is an outcome of a more complex relationship.

This recent transformational event in human history has four key lessons. First, a different way of knowing and living mattered at the dawn of the third millennium and remains relevant in the Anthropocene.[ii] Second, a sustainable culture of hunting, fishing, and gathering demands conservation practices, which have been historically demonstrated by northern Indigenous cultures. Third, the Iñupiat undertook practical action in response to their empathy for the peoples of the Chukotka Peninsula with real consequences for their food security. They affected policy change at the International Whaling Commission. Finally, *communities of social practice*, such as Indigenous leaders, hunters, gatherers, and resource stewards, worked in tandem with *communities of enquirers* such as scientists, researchers, and students to collaboratively deal with the "wicked problems" caused by the collapse of the Soviet Union.[12]

[ii] As SARS-CoV-2 is currently demonstrating, supply chains are easily disrupted, and health and food insecurity are critical issues for vulnerable populations.

Wicked problems

The level of human connectivity in the 21st century is forcing upon us novel realities that bring about transformation of societies. Different ways of knowing are becoming critical to addressing wicked problems. Drawn from the field of social planning and systems science,[14] wicked problems 1) defy easy and singular formulations, and 2) are difficult to perceive and therefore, understand; 3) as a result, they resist quick resolution; 4) becoming challenging to solve because of changing circumstances[15]; and 5) because of complex interdependencies, attempts to resolve them generates other problems.[16,17]

To deal with the transformative effects of wicked problems, we need to have a pragmatic orientation with a focus on problem solving. The case of disruption in food and fuel supply chains resulting from the collapse of the Soviet Union is a clear illustration of the urgent need to respond to grave humanitarian consequences of transformations. Addressing wicked problems demands maturity from the *community of enquiry* such as scientists and students. It requires in the first instance rigor in one's own field while simultaneously the humility to recognize the limits to one's own understanding—in other words, to see value in the knowledge of others and their different ways of knowing. Therefore, collaborative and participatory approaches are key for framing the issue and problem, in teasing out its complexity, in determining multiple optimal solutions, and then dealing with the unintended consequences of those solutions.

Case of transdisciplinary research: A methodology of hope for the challenge of climate change

The problem

Indigenous Arctic, Boreal forest, and coastal and mountain societies are at the vanguard of climate change and yet they contribute least to its causes. Anthropogenic climate change is having a direct impact on these people's livelihoods and food systems. This dynamic is a source of debilitating anxiety for these societies because of the inability to anticipate weather fluctuations and seasonal variations, both of which have previously been predicted with relative ease.[11,18] However, while this is an issue of justice and fairness because yet again, they are being visited upon by the consequences of colonization promoted by industrial development, there are also pragmatic reasons for concern by *communities of enquiry*. It is estimated that 70% to 80% of the world's food system depends on the small landholder with less than 2 hectares of land.[11,19,20] While these numbers may seem inflated,[18,21] the evidence still indicates that a significant portion of the regional food system globally depends on small land holders. This has practical consequences for urban supply chains in cities internationally like Bishkek, Dushanbe, Kabul, Nairobi, New York, Ürümqi, and so on. Thus, anthropogenic climate change exacerbates existing inequities while posing not only as an intellectual challenge for *communities of enquiry* but also an ethical challenge because these groups and their research have benefited significantly from industrialization characterized by the Anthropocene.

In the late 1990s, I directly encountered the anxieties Arctic communities faced with respect to the impact of climate change on their food systems because it was altering sea-ice formation and decay for over 25 years. This is my second story that is weaved into the first. Like most hunters and gatherers, the Iñupiat of Wainwright, Alaska make extensive use of their habitat, compared with farmers who tend to use their land more intensively (Fig. 1). While their population is low, they engage a large space of their habitat that they call home. Before forced sedentarization, these communities moved across this vast sea and landscape to sustain themselves. They are fundamentally dependent on sea ice, like other marine mammals in their ecosystem, to feed (Fig. 2). For instance, in 2014 near the shores of Wainwright, approximately 35,000 walruses landed in late September, exhausted, not being able to feed, and having nowhere to go because there was no sea ice. In fact, ice in general is also a prominent feature of the landscape and influences fishing and hunting of terrestrial mammals by humans.[23] To put it succinctly, ice influences and contributes to their survival. However, over a period of 25 to 40 years, sea ice has been forming as late as January, instead of October, and decays swiftly by June.[9] The implications on the household food basket are dramatic and potentially devastating as existing food sources are threatened (Fig. 3). Yet again, we see another way of knowing being jeopardized by the industrial culture that contributes to anthropogenic climate change.

From the Arctic to the Pamir Mountains

Food and livelihood security are the common threats that weave the high-latitude Indigenous communities with those from high altitudes. The industrial impact of the Soviet Empire is historically a common feature. COVID-19 gives us a small but clear glimpse of what the impacts of climate change will be for the so-called "market" industrial economies. The impact of the Anthropocene is unevenly distributed on the vulnerable Indigenous populations irrespective of one's affiliation with command or market economies. The resulting consequences are the same. The fact remains that the origins of industrial market and command economies arise from the same culture of exploitation of "natural resources," including exploitation and colonization of human populations. Now we move to Central Asia for our third story that weaves into the tapestry of this evolving narrative.

This region of the world is marked by biological and cultural diversity and characterized by ethnic, linguistic, and religious difference while simultaneously living in a variety of ecological zones. It is an area pregnant with valuable renewable and nonrenewable resources to which major industrial powers want to gain access. Arguably, this may be the reason we have a 40-year global proxy war localized to Afghanistan.[24] Given the common but critically unexamined stereotype of intolerance regarding this region, it is worth noting that long

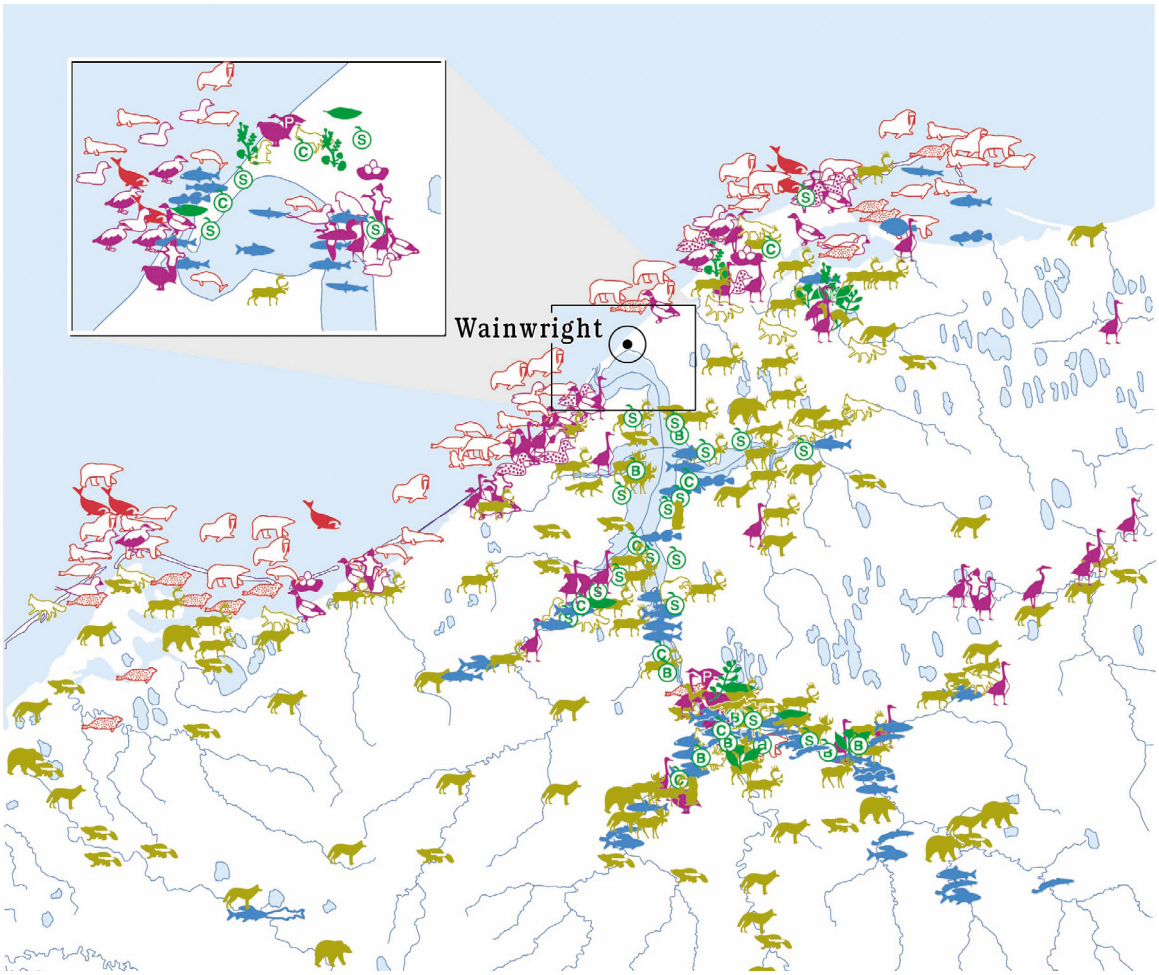

Figure 1. Land and marine use of the Iñupiat of Wainwright, Alaska.[22]

before there was the European Union, or the North American Free Trade Agreement, for thousands of years these societies faced conflict and figured out how to deal with that dispute, movement of human populations, and established trade routes. They supplied the relatively parochial, less tolerant, and uneducated Europeans with silk and spices and more importantly with ideas and knowledge. They knew how to engage across different ethnicities long before the Europeans appreciated the notion of pluralism.[10,12]

Ecological calendars

As described earlier, "ecological calendars are knowledge systems to measure and give meaning to time based on close observation of one's habitat." They are comprised of seasonal indicators that include abiotic phenomena, such as the first snowfall or last frost, as well as biotic events, such as the flowering of a certain tree or the arrival of a migratory bird species. These calendars differ from celestial calendars, such as the familiar Gregorian calendar, in that they do not rely solely on fixed cycles of the sun, moon, or stars. Unlike those cycles, the indicators within an ecological calendar respond to climate and other seasonal processes that directly impact livelihood activities. By referring to seasonal cues, the measurement of time becomes flexible with respect to celestial cycles, and communities can identify the optimal timing for their activities. Therefore, ecological calendars may enhance anticipatory capacity for climate change by enabling communities to synchronize their activities with their ecosystem while accommodating climate trends and increasing variability.[11]

In 2006 when my research began in the Pamir Mountains of Central Asia, the phrase *climate change* was not used. Nonetheless, villagers were describing dramatic seasonal impacts of climate change to their food and livelihood systems.[24] They made reference to an ecological calendar that they referred to as the calendar of the human body. In their calendar, the human body is an embedded expression of their habitat while simultaneously a living instrument to mark time based on seasonal changes.[25] Although these ancient calendars were no longer in use, they were not making mere nostalgic references to anticipating time. Despite decades of Soviet style education and suppression of Indigenous knowledge, certain concepts and specific words that belong to the calendar of the human body remain in use. While not in common parlance, the intellectual and cultural infrastructure of these calendars remains, thus providing the potential for rebuilding, recalibrating, and revitalizing them through collaborative transdisciplinary research in the 21st century.[11,18]

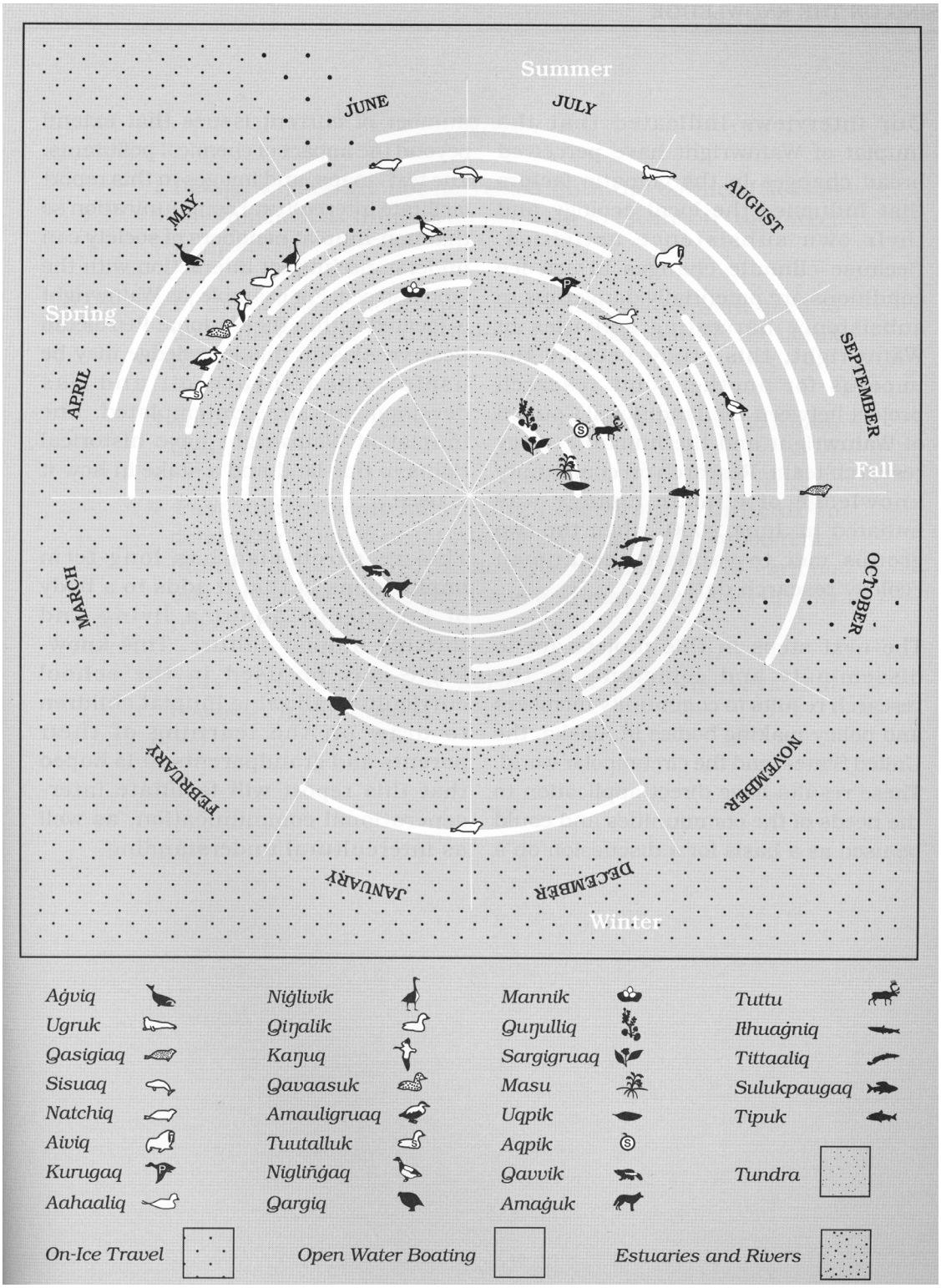

Figure 2. Seasonal round of the food basket of the Iñupiat of Wainwright, Alaska. The dotted areas represent periods of ice at sea and in rivers and estuaries. Ice is a key component of the food system.[22]

Transdisciplinary research had to be participatory where the social scientist is engaging with the climate scientist or ecologist and together, this *community of enquiry*, are in conversation with the farmer, the herder, the fisher, the hunter, the teacher, and so on, who comprise the *community of social practice*. Our research depends on cognitive diversity and participation of these diverse communities to cogenerate knowledge and insights. This research is currently underway in The Pamir Mountains of Afghanistan, Tajikistan, and Kyrgyzstan, and Xinjiang in Central Asia.

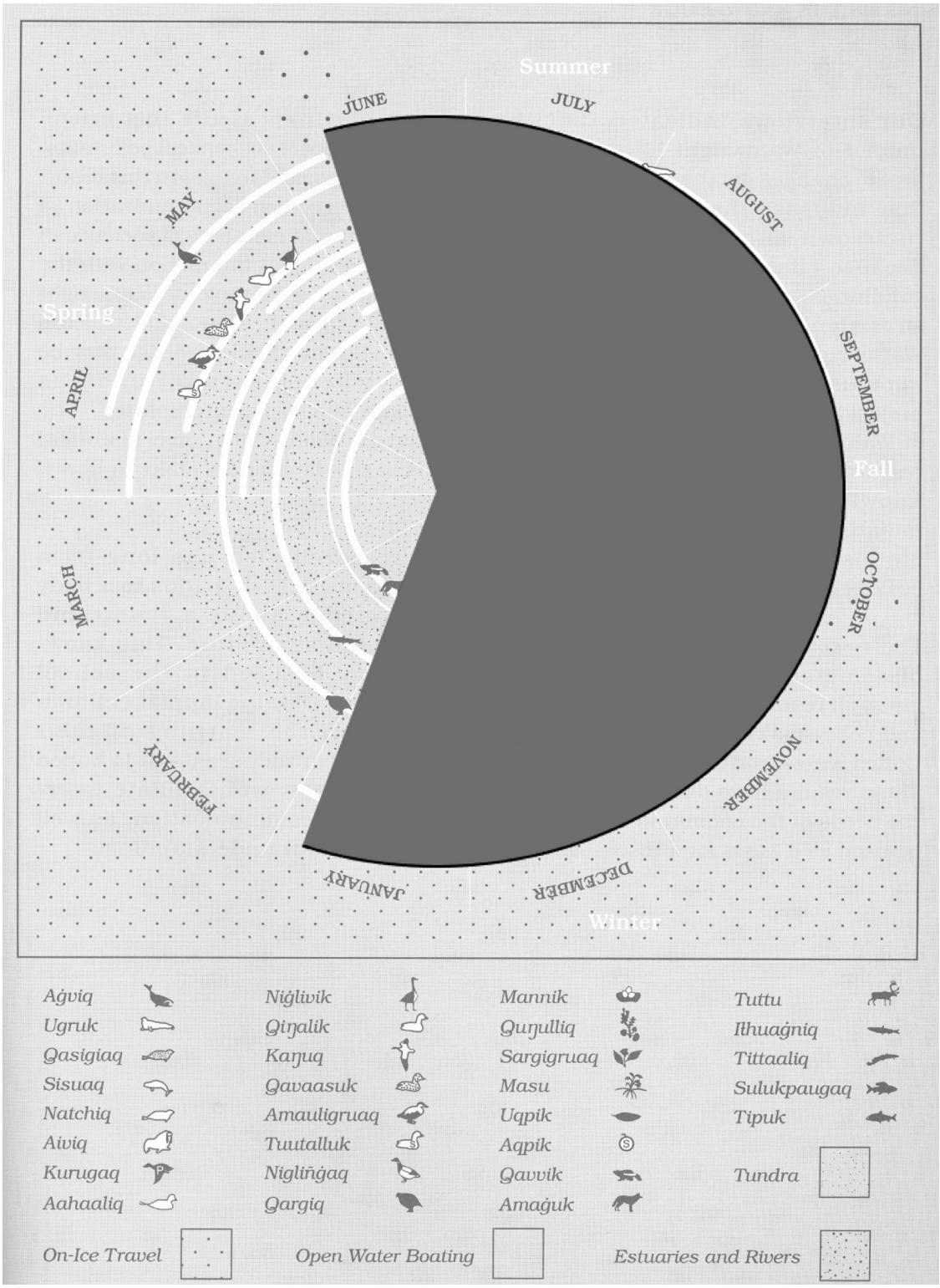

Figure 3. Potential impact on the food basket of the Iñupiat of Wainwright due to climate change resulting from late sea-ice formation and early decay.[22]

In North America we are working collaboratively in the Standing Rock Sioux Nation in North and South Dakota at Oneida Lake in upstate New York. Therefore, our narrative is not yet concluded and is indeterminate with many possible futures.

We envision expected outcomes to include:

1. Ecological calendars for each of the communities, which can be tested, modified, and implemented;
2. Intergenerational transmission of this knowledge through innovative STEM curriculum;

3. Development of policy between communities, civil society institutions, and government agencies to build anticipatory capacity for climate change; and
4. Inspire other related research lead-by Indigenous and non-Indigenous communities to develop a greater understanding of their habitat through such calendars.

Why difference matters at a time of transformation

This narrative is intended to be provocative because it reflects the reality of my research experience. It is not meant to be a prescriptive "to-do" list of solutions. Like the "wicked problems" described above, there are no formulaic responses. Rather, as *communities of enquiry* we need to ask questions that open new and diverse pathways for knowledge co-creation with *communities of practice*.

Returning to the four "what if" questions with which I began at the start of this narrative of transformation, all three of the intertwined stories illustrate that *knowledge is not in our heads but in our relations with the environment we inhabit*. This is how the people of the Arctic were able to overcome the vagaries of the failed industrial system characterized by the Soviet Union. Another way of knowing was key to their survival at the dawn of the third millennium. The ecological calendars are similarly emergent from relations humans have with their environment in which they are embedded. All stories demonstrate that *expertise is not enough for solving the major problems of the third millennium and difference is just as important* because of the ethical and practical problem of justice raised by the uneven impact of climate change in the Anthropocene. Humility through participatory approaches to research and collaboration across knowledge systems is key. In order to address the challenge of building anticipatory capacity to anthropogenic climate change, we questioned industrial conceptions of time and wondered if time is a unique experience, flexible, and relational. This type of interrogation allowed multiple ways of knowing to engage in a methodology of hope; namely locally based ecological calendars. Finally, in order to genuinely engage structural change and affect policy, speaking truth to power requires recognition of difference and collaboration.

These questions, while vexing, are not particularly novel. They reflect the ontology that I have encountered among the various Indigenous communities that I have described. In the social and biophysical sciences, *communities of enquiry* test for efficacy of ideas by asking if a proposition is falsifiable. The type of transdisciplinary participatory research described here tests the knowledge that is cogenerated by its usability or workability for the communities of practice. This strong pragmatic or practical underpinning is particularly relevant to the audience of this journal consisting largely of rangeland ecologists, managers, and ranchers. This remains the promise of our work which is in the process of being realized and therefore, emergent.

Declaration of Competing Interest

Author declares no conflict of interest.

Acknowledgments

I am grateful to have been invited as Plenary Speaker at the Denver 2020 Society for Range Management Annual Meeting from which this narrative was formed. Dr. Leslie Roche provided valuable comments and suggestions on previous drafts of this essay. Dr. Karen Launchbaugh and Dr. Jocelyn Aycrigg helped bring this manuscript to publication. My undergraduate research assistants Ms. Anna Ullmann and Ms. Hayley Tessler provided valuable support. Responsibility for any shortcomings is solely mine. Funding for research on the "Case of transdisciplinary research: A methodology of hope for the challenge of climate change" in this manuscript came from "Collaborative Research Belmont Forum: Ecological Calendars and Climate Adaptation in the Pamirs (EC-CAP)" Project – Award Number 1630490.

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