

From Somewhere to Nowhere and Back Again: Emplaced Abstraction in Science Communication

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ABSTRACT: Science and environmental communication often relies on place-based narrative elements to explore relationships between particularity and abstraction. By combining Hayakawa's abstraction ladder with Sack's relational geographic framework, a useful tool emerges for identifying narrative dimensions for creating compelling place-based nonfiction. This tool may be particularly useful in science communication teaching and learning. Hayakawa's ladder of abstraction extends from particularity low on the ladder to higher-order abstractions up top. Sack's relational geographic framework explores the role of place in creating knowledge, stretching from a focal point of emplaced ontological forces – materiality, meaning, and social relations – through increasingly abstract knowledge and value dimensions.

KEYWORDS: ladder of abstraction, narrative nonfiction, relational geographic framework, writing

1. INTRODUCTION

Science communication involves multiple strategies for effective public engagement while building and maintaining trust and credibility. One such strategy to convey scientific information is by using methods of storytelling, an approach often referred to as creative or narrative nonfiction. Answering the question of 'What's the scientific point?' is not always a communicator's first task; finding a good story that will lead readers or listeners to the main points, is paramount, however (National Academy of Sciences Engineering, and Medicine, 2017, p. 11). While experienced writers may have a well-honed sense of what to include and exclude for a compelling piece, inexperienced storytellers may not have such a sharpened sense of how to match evidence-based information with an impactful narrative arc. Frameworks for thinking through elements of classic storytelling, such as plot points, scenes, or characters, are useful for beginner and intermediate communicators (National Academy of Sciences, Engineering, and Medicine, 2017). The focus of this paper is to consider two models – one of linguistic hierarchy and another of emplaced contextualization – that can be useful for helping communicators identify and organize primary elements in an emerging narrative arc.

Journalist and writing instructor Roy Peter Clark (2007) has invoked the ladder of abstraction model, popularized by S.I. Hayakawa (1941), as a useful tool for approaching the basic elements of narrative nonfiction. Hayakawa's ladder metaphor extends from concrete linguistic details on the lower rungs to broader abstractions higher up. Alternately, humanistic geographer Robert Sack (1992, 1997) developed a relational geographic framework to explore the role of place in creating knowledge. Sack's cone of knowledge similarly stretches from a foundational vertex of emplaced ontological forces – pinpointing place as the intersection of materiality (nature), meaning, and social relations – to wider generalizations of scientific

ecologies, experiential psychologies, and normative/evaluative frameworks at the open end of the cone. In short, the relational geographic framework connects a view from somewhere to a view from virtually nowhere (Williams, 1995). Sack's model has been used and interpreted by human dimensions of natural resources researchers like Daniel Williams (2013; 2014) to explore and extend concepts of place in environmental tourism and place-based approaches to natural resources conservation and management.

By comparing these models in light of trust and credibility considerations science writers, instructors, and students can identify central elements of their story as well as the relationships that exist between these elements while they traverse levels of abstraction in their writing and other communication. Doing so can help science communicators construct meaning and describe relationships between emplaced particularities and useful universals with a general emphasis on avoiding lingering in the often-used but less-than-helpful "muddle of the middle" (Clark, 2007, p. 70).

Donal Carbaugh invokes the ladder metaphor in his forward to *Environmental Communication: Pedagogy and Practice* (Milstein, Pileggi & Morgan, 2017) when connecting links between particles, chemicals, organisms, and bioregions each "as a rung on a ladder" (p. xviii). There is "a ladder of understanding... or similarly a nested conceptualization of matters," Carbaugh (2017) says, that can be used "each time we move up or down the ladder of discourses" (p. xviii) to offer new perspectives on familiar relationships. Scaling up and down the ladder of abstraction is also echoed as a micro-to-macro continuum in the first Science of Science Communication (Fischhoff & Scheufele, 2013) colloquium structure. Topics were arranged from a "micro-to-macro arc, beginning with the analytical research needed to reduce the vast volume of research that scientists could communicate to kernels of information that their audiences most need" (p. 14032). Moving to-and-fro from general contexts to practical kernels of specific insight, science communicators can build trust and credibility by helping audiences navigate the parameters and relational components of their *glocal* stories. Alan Leshner (2017) invoked this compound word, *glocal*, during introductory remarks at the Science of Science Communication III colloquium. To take "a global issue and make it meaningful at the local or the personal level," Leshner said, connects ideas across levels of abstraction and is "one of the most important principles of communicating anything effectively" (Leshner, 2017, 5:46).

Lee Gutkind and Laura Helmuth (2017) had an open discussion about conveying science to popular audiences as part of a 2016 workshop hosted by the National Academies of Sciences, Engineering, and Medicine. Noting the difficulty of telling a good story while simultaneously conveying factual information, Gutkind, author and writing professor at Arizona State University, noted that people often forget details of a fact-filled presentation but that audiences "will never forget the story" (National Academies of Sciences, Engineering, and Medicine, 2017, p. 11). Helmuth, science editor at the *Washington Post*, said, "The best way to get people to pay attention to what you are doing is to tell stories" (National Academies of Sciences, Engineering, and Medicine, 2017, p. 11). Using the devices of good storytelling – metaphors, imagery, scenes, plot, transitions, etc. – helps to translate and contextualize technical or scientific topics that may be unfamiliar a general audience, which is to say an audience without field-specific knowledge of the science topics at hand. For students just beginning to think of their various technical papers, research essays, experiential reflections, and multimedia projects as "stories," structural frameworks can be a useful organizational step for identifying central narrative elements prior to the in-depth writing and revision process.

My approach to this work stems from teaching mostly undergraduate students at a small, environmentally-focused liberal arts college, Unity College, in rural Maine. In teaching courses such as environmental communication, introduction to new media, science writing, and a core curriculum course titled Environmental Issues & Insights, I have seen students struggle with choosing suitable topics for their research essays and multimedia projects. At Unity College, where sustainability science buttresses all curriculum, many students are focused on science but do not often get explicit training in science communication in their regular courses. In my courses, we make the distinction between *science* communication and *scientific* communication, the latter tending to be structurally formulaic, rigid in tone, and burdened with passive voice and field-specific jargon. The former aligns with the focus of this paper. Guided by principles discussed in edited volumes such as *The Field Guide for Science Writers* (Blum, Knudson, & Henig, 2006), I encourage students to choose topics that address social-ecological systems through particular examples as a means to convey broader social, ecological, and political-economic concerns, concepts, and practices.

A consistent challenge in my science writing and environmental communication courses, however, is that students often select topics at a very broad level of abstraction and are not sure, at least at first, where the conceptual parameters of their project might lie. In speaking with other instructors in the general education curriculum, where students produce short multimedia presentations as a course capstone project, relational vagueness and lack of conceptual boundaries are also consistent concerns. Commentary by Seabury (1991) suggest this is not a new phenomenon for college writing courses or in efforts to encourage quality in writing across the curriculum. Students often want to explore general ideas or phenomena (e.g. coral bleaching, renewable energy, ocean plastic, species extinction, etc.) and do not always offer context-rich examples in order to make connections between broader abstraction and context-rich particularity. In trying to help students engage with writing and other communications projects, instructors offer different models (e.g. concept maps) in hopes of helping students develop a bounded framework from which to explore the relational details of their narrative.

This paper is an effort to identify and elaborate on frameworks that seem useful for helping students think through and construct trustworthy and credible science communication efforts. It is also an invitation for constructive feedback on further integration of these models for more effective teaching and learning across the curriculum.

2. FRAMEWORKS OF RELATIONAL ABSTRACTION

Science writing involves the process of abstracting at multiple levels, with great concern for word choice that highlights relationships between primary elements and influential forces. In the *A Field Guide for Science Writers* chapter on writing about nature, McKay Jenkins (2006) points out that such writing brings about “the challenge of the poet: With lofty, often abstract imaginative aspirations, he or she must find the most vivid details with which to express them” (p. 230). Jenkins invokes Aldo Leopold’s description of his encounter with the fierce yet fading green fire in the eyes of a wolf he had just shot – a turning point toward Leopold’s thinking more like a mountain and less like a man. Likewise, Jenkins invokes Rachel Carson’s account of DDT trucks rolling through mid-century American suburbs and the approach to pest control sometimes characterized as better living through chemistry. DDT, Jenkins (2006) writes, is “a subject for environmental reporting” whereas “hubris is a subject for nature

writing” (p. 231). The best nature writing, says Jenkins, will invigorate the space “between hard science and artistic abstraction” (p. 235).

In the science communicator’s want to explore broad topics, Jenkins addresses the challenge of devising narrative strategies to convey abstract ideas. These narrative strategies are the “teaspoon of sugar to help the medicine go down” (p. 231). Jenkins uses a simple conceptual model comprised of two circles and an arrow (Figure 1) to illustrate connections between particularity – drawn from data such as observation, interviews, and expeditions – and broader philosophical questions related to topics such as species extinction, climate change, the mind of a wolf, or indiscriminate use of chemicals.

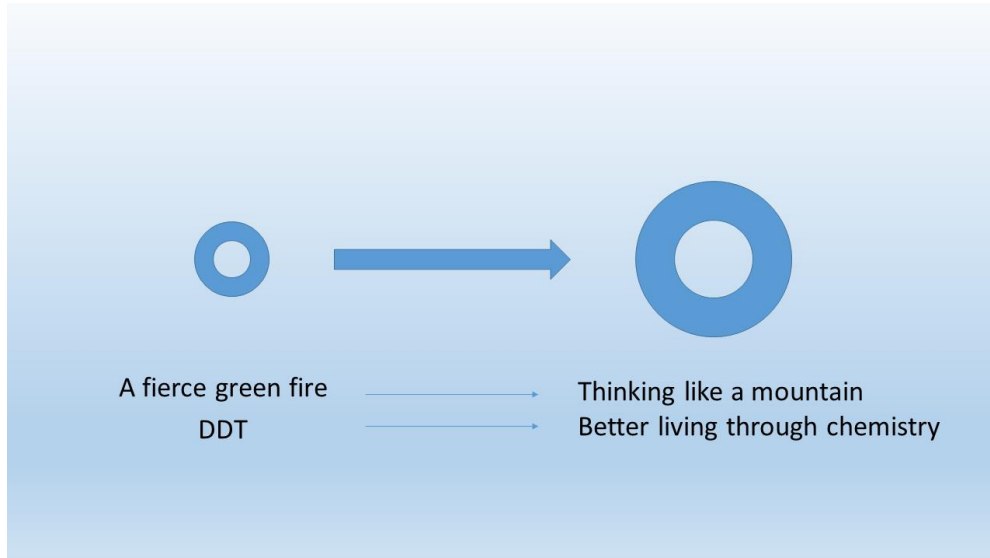


Fig. 1: McKay Jenkins’ (2006) model wherein the smaller circle represents detailed information and the larger circle represents more abstract concepts

Jenkins has developed a basic yet useful way to help students develop the components and parameters of a writing project. By identifying potential polarities in a storyline and highlighting relationships between higher order abstractions and context-rich particularity, students can better envision both the forest *and* the trees, as it were. This is a simple yet limited conceptual model.

Writing instructors and students have been drawing guidance from S.I. Hayakawa’s (1941, 1972) book on semantics, *Language in Thought and Action*, since it was first published in 1939. The concept and image of the abstraction ladder, itself based on work by Alfred Korzybski (see Hayakawa, 1941, 1972; Seabury, 1991), has been a useful guide for communication instructors and students wishing to enact critical thinking while developing effective writing practice across the curriculum (Seabury, 1991). Journalist and writing instructor Roy Peter Clark (2007) of the Poynter Institute drew on Hayakawa’s abstraction ladder in a short interjection for the Neiman Foundation collection *Telling True Stories: A Nonfiction Writer’s Guide*. The ladder of abstraction is “one of the most useful tools for a narrative journalist,” Clark (2007, p. 70) writes, as it helps the storyteller create meaning among the general or abstract language at the top of the ladder and ways to exemplify that meaning through more concrete and specific details below. Identifying and integrating elements from both the top and the bottom of the abstraction ladder helps address a common

problem, Clark notes, of journalists getting mired in the “muddle of the middle” (p. 70). “Writing at the top of the ladder is *telling*,” Clark says, whereas “writing at the bottom of the ladder is *showing*, presenting detail” (p. 70, emphasis in original).

A common mantra in journalism is “show, don’t tell.” For students just learning how to integrate methods of storytelling with evidence-based insights from credible scientific sources, I have found it useful to encourage a “show *and* tell” approach. Doing so encourages students to describe not only the “what” but also answer the question of “so what?” or “why does this matter?” Evidence-based information is therefore presented clearly while students are also able to explain how such scientific facts or assertions relate to systemic social-ecological concerns.

In Hayakawa’s (1941) original description and diagram, the ladder is an absent metaphor. Hayakawa’s drawing is more a series of circles, rectangles and embedded dots (Figure 2). It connotes a relatively linear relationship between concrete and abstract elements. By the third edition of his book (Hayakawa, 1972), the ladder image was added to help further illustrate and extend the metaphor.

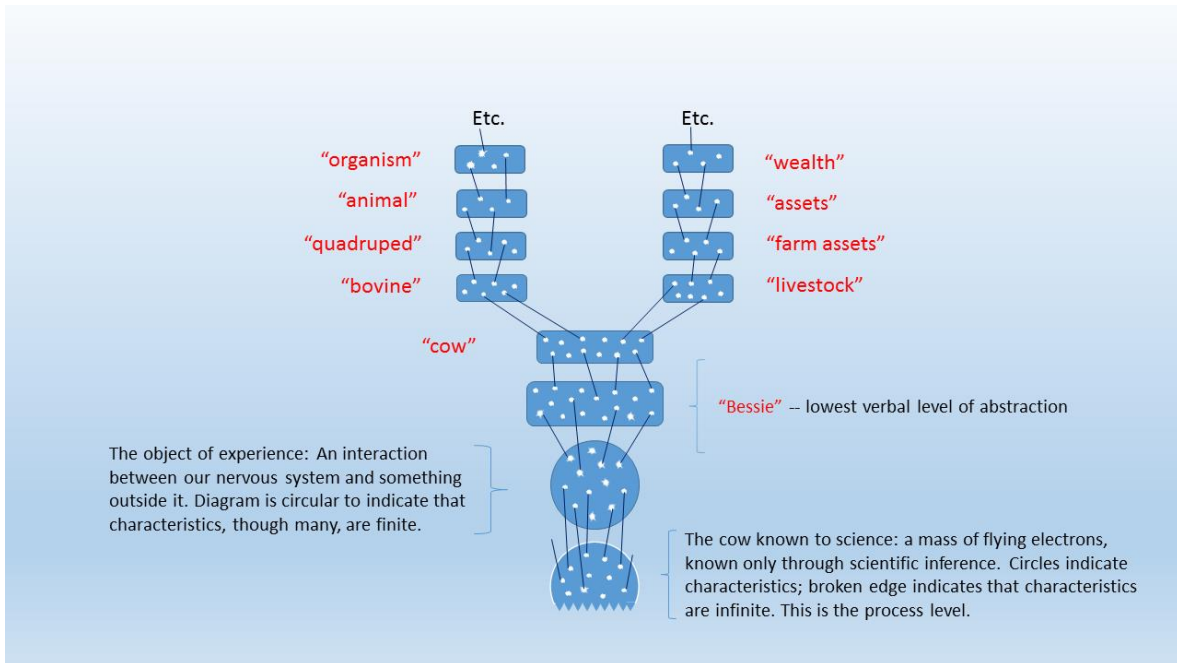


Fig. 2: Reproduction of Hayakawa’s (1941) original abstraction ladder.

Though Jenkins’ model offers simplicity and is effective in distinguishing between detailed information and more abstract concepts, it lacks nuance. Hayakawa’s model includes more nuance and allows students to understand and practice the utility of abstracting experiential phenomena through strategic word choice. Drawing on Hayakawa’s work, writing teacher David N. Chung (n.d.) offers four levels of abstraction as examples for his students. Level one is the most specific, using concrete and identifiable nouns such as Levi 501 jeans; African violets; and a blue, three bedroom house on Hollis Street. Level two moves into more defined noun categories or groups such as the clothing industry, teenagers, parents, middle-class, newborn child, house plants, etc. In level three, abstractions move into noun classes which cluster people, places or events into broader groups with minimal specification. These might include men, women, transgender people, everybody, nobody, therapist, teacher, the media,

etc. Level four abstractions are even more general and might include topics such as life, beauty, time, education, well-being, hope, good, evil, etc. Elaborating on Hayakawa’s “Bessie” example or other specific abstractions, such as Chung has done, may be a useful point-of-entry for student writers to explore the parameters of their project topics and the relationships between elements within. A sample assignment as such is included below.

While the prior examples were developed from and by writers specifically to help students better define and delineate their topical choices, humanistic geographer Robert Sack (1992, 1997) developed his relational geographic framework to explore the role of place in creating knowledge. Sack’s model has been interpreted and developed by researchers such as Daniel Williams (2013, 2014) to explore and extend concepts of place in environmental tourism, place-based conservation, and human dimensions of natural resources management.

Sack’s (1992) cone of knowledge stretches from the vertex of emplaced ontological forces – materiality (nature), meaning, and social relations – to wider generalizations of ecology, environmental ethics, psychology, economics, and politics. Drawing on Nagel (1986), researchers such as Williams (1995, 2014) have characterized this epistemological range as one stretching from of a view from somewhere to a view from virtually nowhere (Nagel, 1986; Sack, 1992; Williams, 2014). Sack’s (1992) basic representation of the role of place in creating knowledge (Figure 3) was presented by Williams (2002) to provide a conceptual map for understanding qualities of place-based experience and knowledge generation. “Place” in this context can be considered a specific geographic location imbued with meaning (Cresswell, 2015). The open end of the cone of knowledge invites space for critical pluralism across wider sets of abstraction. In this earlier representation, mezzo-layer elements are not included.

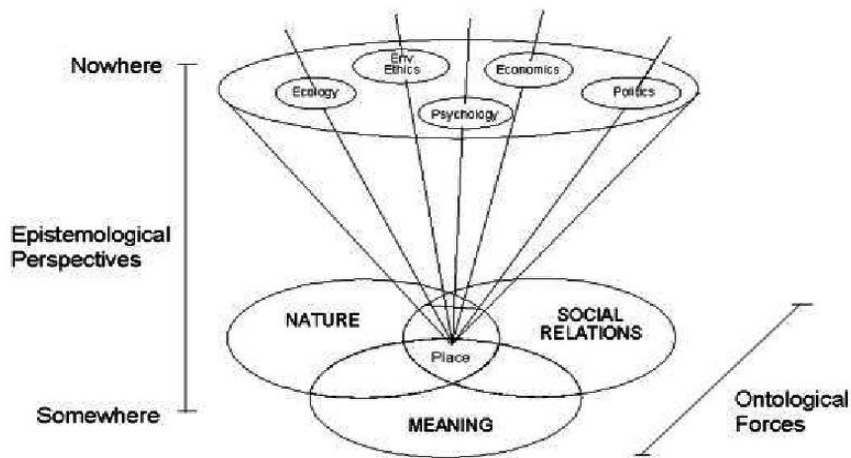


Fig. 3: Williams’ (2002) treatment of Sack’s (1992) relational geographic framework.

Abstracting in this way is useful but offers some undesirable consequences, as Williams (2002) points out. First, such abstraction is “a decontextualizing process that results in a loss or ‘thinning’ of meaning” (p. 119) as evidenced by the general propensity of scientific

discourse to overlook influential factors such as everyday experience or meanings of place from a phenomenological perspective. Second, Williams suggests, knowledge production at the open end of the cone tends to become highly fragmented by way of discipline-specific epistemologies; abstraction in the traditional academic sense has tended to isolate and segment understandings of particular people interacting in particular places within the context of larger social-ecological forces.

The critical pluralism Williams (2014) has called for helps researchers to not only identify influential experiential factors at the cone’s narrow end and more universal, often discipline-specific, theoretical paradigms at the top (Figures 4); it also identifies mezzo layers of epistemological, axiological, and ontological betweenness (e.g. Entrikin, 1991) informed not only by technoscientific discourse but also humanistic elements of history, culture, and place.

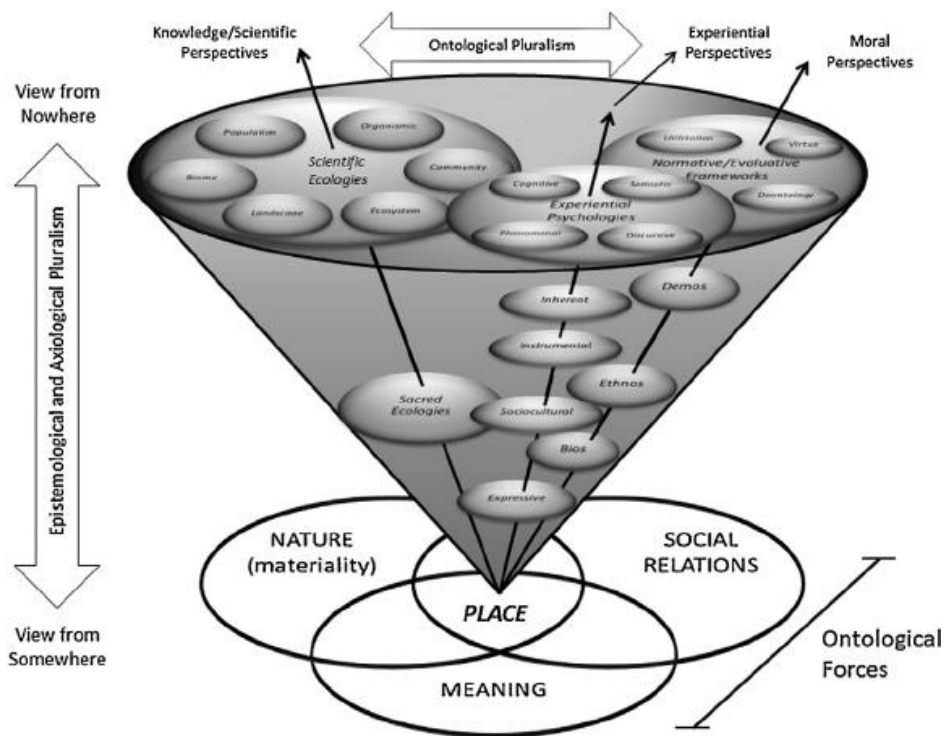


Fig. 4: Further elaboration of Sack’s relational geographic framework, from Williams (2014), including examples of ontological, epistemological, and axiological pluralism and related positional lenses.

These frameworks offer useful guides for developing the parameters and central elements of cohesive narrative nonfiction stories, particularly those dealing with terrestrial or place-based phenomena. While experienced writers likely already have useful systems in place and can draw on the first-hand experience of developing engaging evidence-based narratives, beginning and intermediate writers may find these frameworks more useful as they move from research and reporting to outline, drafting, and revision. Identifying central narrative elements – key people, places, scenes, plot points, and transitions – at the outset of a project seems just as helpful as identifying the parameters or boundedness of the story being told.

3. APPLYING THE EMPLACED ABSTRACTION FRAMEWORK

If we are to take writing selected for collections such as *The Best American Science & Nature Writing* (Jahren, 2017) as a proxy for trustworthy and credible work, then elements of emplaced abstraction should appear in that context. Three selections from the 2017 edition of *The Best American Science and Nature Writing*, edited by Hope Jahren, make useful brief examples of how science/nature writers employ various levels of abstraction to develop trustworthy, credible, and compelling narratives. Selected stories examined here are “The Battle for Virunga” by Robert Draper, “The New Harpoon” by Tom Kizzia, and “The Parks of Tomorrow” by Michelle Nijhuis. All three are found in “Changing Land and Resources” (Part II) of the *Best American* collection.

Both “The Battle for Virunga” and “The New Harpoon” open with vivid, detailed, and place-based anecdotes situating the reader in details while alluding to broader social-ecological relationships. From Draper (2017), we are introduced to a “ragtag crew” (p. 65) of seven young men, all former conscripted militia fighters, working to repair a rugged rural road connecting the Democratic Republic of Congo’s Virunga National Park to the Bukima ranger post several miles away. This road not only connects Western tourists – and their money – to opportunities for viewing the rare mountain gorilla families living within the park’s border, it also “connects farmers outside the park with village markets and the city of Goma beyond” (Draper, 2017, p. 65). The men themselves connect a backdrop of longstanding political unrest and armed conflict with reforms and restorative justice sought by many in the region. The road, also now a higher-order abstraction in Draper’s writing, represents “a bond, albeit a slender one, between the region’s most visible national institution and villagers who view the park with hostility, and at times rage, believing the land should still belong to them” (p. 65). Throughout the story, Draper connects tensions of grueling poverty, international tourism, post-colonial warfare, and infrastructure projects to specific stories of people, places, and ecosystems in a constant state of flux.

Tensions regarding indigenous peoples’ land sovereignty, subsistence living, and the creep of modernity’s definitive taint – global climate disruption – also emerge in the introduction to Kizzia’s story, “The New Harpoon”. In the littoral zone of northern Alaska’s Chukchi Sea, near the village of Point Hope, Kizzia introduces readers to Inupiat whalers negotiating unstable spring ice and two 30-ton bowhead whales. One of the central tensions specified by Kizzia in this story is how:

Few Americans are as bound to the natural world as the whale hunters of the Arctic, or as keenly affected by the warming atmosphere. Yet few Americans are so immediately dependent on the continued expansion of the fossil-fuel economy that science says is causing the change. (Kizzia, 2017, p. 79)

By exploring contemporary life in the North Slope Borough – in light of a fairly linear timeline of historic cultural, political, and ecological change – Kizzia interrogates perspectives and highlights relationships that some strident environmentalists may find challenging to reconcile. Attempting to merge traditional knowledge and scientific methodology, Kizzia interviews regional Inupiat community leaders as well as biologists from the borough’s Department of Wildlife Management. In the end, this is a story of concern for future generations guided by traditional ecological knowledge and moderated by contemporary problems and potential solutions. Concrete details of shifting ice, local housing, social life, political history, and community interdependence are linked in a series of seemingly intractable challenges related to

climate change, species migration, subsistence hunting, dependence on oil extraction revenues, and social norms of avoiding community conflict.

In “The Parks of Tomorrow,” Michelle Nijhuis introduces the reader to higher-order abstractions such as how the National Park Service approaches its management role through the particulars of place-based anecdotes at several national parks. Nijhuis begins and ends at Assateague Island National Seashore, its shifting sandscapes symbolic of a growing understanding by Park Service management that nature does not, indeed, tend toward a static ecological state but toward a more-or-less balanced dynamism.

Using Assateague Island National Seashore as a bookend example, Nijhuis identifies specific adaptations such as moveable latrines and shelters, porous clamshell parking lots, and other “Eastern Shore engineering” (p. 132) devised by colleagues of Ishmael Ennis, the recently retired Assateague Island maintenance chief. Moving from particularity to broader concerns, in the next paragraph, Nijhuis explains how the Assateague management plan is among the first national parks in the country to “explicitly address – and accept – the effects of climate change” (p. 132).

Examples of the incremental adjustments park managers must contend with in the face of global change are brought to the fore in examples from Yosemite, Glacier, and Sequoia national parks. Nijhuis (2017) highlights in-the-field ecologists working to see the forest and the trees while weaving in evidence that management plans and Park Service doctrine over the past century have been based on a “largely imagined past” (p. 133). Looking ahead, Nijhuis helps the reader see how the value of imagining “wildly different futures” (p. 136) will depend on a complex mix of human response, natural variation, and vigorous attention to the global-to-local problems facing public land managers nationwide.

Context is crucial in all these stories; from Kizzia’s details of Point Hope on Alaska’s North Slope to Nijhuis’s shoreline exploration of Assateague Island and literal forest-and-the-trees details of resilience in Sequoia National Park. Likewise in Draper’s writing of M23 and other regional militia conflicts affecting Virunga National Park; the author views these systemic issues from a perspective of how local communities are confronting a range of obstacles while simultaneously “daring to harbor modest dreams” (Draper, 2017, p. 76) in the pursuit of good living.

Models such as the abstraction ladder and the relational geographic framework share elements of connectedness with the more refined elements of systems thinking, complexity theory, and Castell’s (2009) integration of networks and communication power. Emphasizing the importance of relationships is key. As Sack’s (1992) original sobriquet suggests, his was a *relational* framework meant to not only identify key social-ecological elements but also to help recognize how nature (materiality), meaning-making, and social relations merge to create a sense of place. This foundational sense of being-in-the-world – or, as Cantrill (1998, 2004) and Cantrill and Senecah (2001) might suggest, a sense of self-in-place – is a central tension in the stories mentioned above. From within the constraints and opportunities of these tensions, people ground-truth their own experience in relation to higher-order abstractions such as science, economics, cultural norms, personal values, metaphysics, and the like.

Like much of science and nature writing, these stories align with another sub-genre of narrative nonfiction: place writing. Robert Macfarlane’s (2015) *Landmarks* is one such book-length example. Writing of another influential place-writer, Barry Lopez (1986) and his celebrated book *Arctic Dreams*, Macfarlane (2015) notes that “gyres from the phenomenal to the philosophical” (p. 210-211) demonstrate how attention to particularity can be effectively

connected to the universal or, as Macfarlane writes, how “first-hand experience could be related to broader questions of place-consciousness” (p. 211). Writing about particular places often begins by evoking the aesthetic, Macfarlane says, but “must always tend to the ethical” (p. 211). Connecting aesthetics with ethics helps writers provoke critical thought in the reader. Each of the examples above, in Virunga, Point Hope, and across locations managed by the U.S. National Park Service, creates connections between particular people living and working in particular places while grappling with higher-order ethical considerations.

Invoking Robert Lowell’s “grace of accuracy,” and other qualities of Northern artists and writers, Macfarlane (2015) exalts the value of such work – no doubt common among place-writing from any latitude or longitude:

Looking from afar – from present to past, from exile to homeland, from island back to mainland, mountain-top down at lowland – results not in vision’s diffusion but in its sharpening; not in memory’s dispersal but in its plenishment. (p. 212-213)

Working up and down the abstraction ladder, with elements of place-consciousness held near at hand, helps aspects of detail anchor reader perception “in a context of vastness” (Macfarlane, 2015, p. 212). This is the framework of emplaced abstraction. When the reader feels anchored – guided by a trustworthy Virgil through the wildness of scientific fact, public policy, warfare, land management or other abstract ontological, epistemological, and axiological phenomena – readers tend to come away reassured by the tenacity of reporting shown in the work and the flow of a narrative that helps create meaningful connections between details of particularity and contexts of vastness.

A relatively simple assignment for applying these frameworks in a science communication classroom would be to first introduce students to the abstraction ladder and the relational geographic framework. After establishing the basic concepts and vocabulary, instructors could assign a reading such as those discussed above (i.e. Draper, Kizzia, or Nijhuis). Reflecting on that story, as a class or in small groups, students could use the basic four-level, fill-in-the-blank framework such as David N. Chung’s (Table 1) to work through layers of abstraction in light of the reading. After working through the specific examples brought about by the reading, students would then be asked to approach their own impending project idea using the same four-level, fill-in-the-blank worksheet. In doing so, students would consider central components of their own project and sort them in ways that best make sense relative to each student’s working knowledge of their chosen topic. By filling in the blanks, followed by small-group discussion about the categorical choices made, students could then develop more elaborate concept maps (Novak, 2010) as a way to further identify and refine linkages, relationships, and narrative boundaries related to their stories. Using these basic categorizations, students could then develop a working outline to better define overall structural elements and their emerging narrative arc.

Table 1: Four categories for identifying basic levels of abstraction. Specific examples here based on “The New Harpoon,” by Kizzia (2017).

<p>Level 4: Broad issues of particular concern <i>Oil extraction, Indigenous rights, Traditional Ecological Knowledge, climate change, community</i></p>
<p>Level 3: Noun classes: Clusters of people, places, things <i>Subsistence hunting, public policy, Native corporations, oil boom</i></p>
<p>Level 2: More defined noun categories <i>Alaska, Shell Oil, oil revenue, seasonal ice, whale migration</i></p>
<p>Level 1: Identifiable nouns, very concrete <i>Steve Oomittuk, Chukchi Sea, Point Hope, Arctic Slope Regional Corp</i></p>

There are limitations to these models, to be sure. The abstraction ladder tends to suggest static, linear relationships between high and low abstractions rather than more holistic relations at play in dynamic, heterogeneous assemblages of social-ecological phenomena. The more refined versions of Sack’s relational geographic framework, via Williams (2013, 2014), might also be too complex for undergraduate or introductory science communication students. Other metaphors might include a river, an oceanic gyre, or a tree.

In the symbol of a tree, grounded particularity could be seen as the solid trunk, deeply rooted in place. The probabilistic variability among the stemming branches swaying above, moving within fairly predictable limits, extends to create a full and productive canopy of abstraction. The essential rootedness of a tree, where crucial elements also extend into less visible or shadow territories, are still highly influential forces and can help signify values, beliefs, and norms that often exert unconscious or quiet influence on individual and collective thought and behavior. Such axiological considerations – value judgments – are drawn from beyond the realm of easy perception but still must be taken into account. Despite the limitations, working through the elements of these models can help science communication students and professionals (re)consider what narrative elements might be most effective in their developing stories.

Future refinement of ideas, frameworks, and examples presented above could include deeper investigation from the vantage of narrative theory or mass communication theoretical frameworks such as thematic/episodic framing. Examining the particular elements of particular stories, students might also be encouraged to explicate the particular ontological forces at play as well as how epistemological and axiological pluralism influences the connections between “somewhere” and “nowhere” to reach a point of ontological pluralism such as those at the wide end of Williams’s (2014) elaborate relational geographic framework. On the applied side, creating a more well-defined assignment connected to particular course-level and/or program-level learning outcomes can help instructors and students understand how such an assignment fits within the larger strategic educational aims of a particular course and program.

4. CONCLUSION

Lists of scientific facts are rarely memorable; embedding science-based fact and information within a coherent and cohesive narrative arc will help produce science communication projects

that are credible, trustworthy, and memorable for lay audiences. Hayakawa’s abstraction ladder paired with Sack’s relational geographic framework, as developed by Williams (2013, 2014), offer conceptual frameworks for helping students of science communication better identify and categorize integral people, places, plot points, and relationships inherent in quality, evidence-based storytelling.

Having students identify levels of place-based abstraction through a simple four-part assignment can help them categorize central story elements, and better identify not only the core elements to their stories but also the parameters (what to include and exclude) of their narrative. The framework of emplaced abstraction allows students to show *and* tell – creating narrative nonfiction stories that account for multiple particular points-of-view while connecting those particularities to higher-order social-ecological systems.

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