

Communicating Environmental Research: Harnessing the Power of Curation

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Abstract

Never before has public communication of critical research, science, and knowledge on climate change and biodiversity loss been more important. The 2018 Intergovernmental Panel on Climate Change (IPCC) special report, *Global Warming of 1.5 °C*, stated that we only have 12 years to limit the catastrophic effects of climate change, including extreme weather, flood, drought, and poverty. The 2019 Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) Global Assessment Report on Biodiversity and Ecosystem Services revealed that roughly 1 million species of plants and animals are threatened with extinction. Given these dire warnings, the threat of climate change and biodiversity loss have never been more relevant, considering the impact these unprecedented issues will have on human survival, health, and well-being. This paper describes the results of our study, which explores findings used to develop the practice of research curation, which found that adapting and applying museum engagement strategies, using art to communicate science, and applying social media content curation and marketing strategies in combination with social learning practices are key to successful knowledge mobilization. This article focuses primarily on the methodologies and results of three projects: an art and literary exhibit, a biodiversity conversation series, and a sustainability-themed Instagram account. Based on our experience and findings, we share the lessons learned that we believe are actionable for other researchers with similar goals, in particular those who are communicating research on climate change and biodiversity loss.

Introduction

Research shows that if we do not find ways to engage the broader public in understanding the pace and scale of changes that are necessary, we will not meet our domestic or international climate and biodiversity commitments (Dale, Robinson, King, Burch, Newell, & Jost, 2020). These include Canada's commitment to significantly reduce our greenhouse gas emissions, as per the Paris Climate Agreement (Government of Canada, 2020). They also include establishing protected areas that account for 17% of our terrestrial land by 2020 as per Canada's commitment to achieving Aichi Biodiversity Target 11: "By 2020, at least 17 per cent of terrestrial and inland water, and 10 per cent of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, are conserved through effectively and equitably managed, ecologically representative, and well connected systems of protected areas and other effective area-based conservation measures, and integrated into the wider landscapes and seascapes" (Convention on Biological Diversity, 2012). However, the goal post has now shifted as the Canadian federal government has committed to protecting 25% of

terrestrial lands by 2025, and 30% by 2030 (Nature Canada, 2019).

Public literacy and understanding of the consequences of not acting on biodiversity loss and climate change adaptation and mitigation needs to accelerate in order to generate increased public demand for action by political leaders. The Fridays for Future climate movement that began spreading across the globe in 2018 is a clear indication that children fear for their futures (*Guardian*, 2019). Swedish teen activist Greta Thunberg has continuously urged decision-makers to listen to the scientists (Milman, & Smith, 2019); however, the science is not always presented in accessible and engaging formats for the public, decision-makers, and policymakers. Furthermore, it often takes several months to years for academic research to be published in journals, which are often inaccessible to nonacademics as a result of pay walls.

As part of our research goals as a transdisciplinary team exploring various topics under the umbrella of sustainable community development, we wanted to explore how to better engage diverse audiences (communities) in our research outcomes. Another goal was

to develop a framework for curating research that could help others within our academic community more effectively disseminate their research to the public. We did so by conducting an 18-month study centered on the following research questions: 1) which curatorial practices developed in museums can be adapted and applied for improved online research communication? 2) which online communication strategies and best practices centered on social media marketing and web content development can be applied to research communications? 3) how can the intersection of art and science strengthen research communication? and finally, 4) how can museum curatorial practices, online communication strategies, and the intersection of art and science inform a user-friendly and practical framework for research curation?

This paper describes the results of our study in which we researched and experimented with online communication strategies, social media channels, and curatorial practices in order to develop the practice of research curation. Based on our experience and findings, we share the lessons learned that we believe are actionable for other researchers with similar goals, in particular those who are communicating research on climate change and biodiversity loss.

This article begins by exploring the practice of research curation, before detailing contemporary curatorial practices established in museums and their subsequent application to academic research dissemination. In addition to drawing upon relevant curatorial practices from the museum field, we build on marketing techniques, such as content curation, before detailing social learning and the online environment. We then explore the use of art to communicate science and the power of the artist/scientist relationship, and subsequently share examples of different artists communicating climate change and biodiversity. The study used a series of projects to collect data, to survey best practices, and to uncover different methodologies for effective visual communications. This included an environmental scan, student survey, social media research and testing, and a research exhibit. However, this article focuses primarily on the methodologies and results of three projects: an art and literary exhibit, a biodiversity conversation series, and a sustainability-themed Instagram account.

What Is Research Curation?

We describe the practice of research curation as a way to communicate research outcomes online to diverse audiences (Clifton-Ross, Dale, & Newell, 2019), integrating dynamic Internet communication technologies, museum curatorial and communication strategies, and social media marketing best practices. It adapts museum engagement frameworks, audience research strategies, content marketing, and curatorial practices for critical knowledge mobilization and transfer. It also considers different audiences and how they connect to knowledge by providing multiple points of entry via a range of communication channels. Research outcomes are also reformatted into a variety of engaging media—including data visualizations, videos, blog posts, artworks, and subsequently curated across social media platforms and websites. Through such formats (which are not traditional mediums used in academia) research curation offers a solution to the lengthy timelines of academic research projects as this practice helps disseminate research outcomes as they are developed on the ground, thereby shortening the time lag of the take-up of knowledge. Ultimately, our objective for this practice is to disseminate research to a diverse cross-section of Canadians, enhance civic literacy around critical environmental and social issues, foster deeper connections to knowledge, and bridge existing polarized debates leading to greater social resolution on more sustainable futures. We developed research curation after conducting extensive research on museum engagement and curatorial strategies, art as a medium for communication, social media marketing and content curation, along with social practice theory.

Museums and Engagement

Museums come in many different shapes and forms. From natural history museums and heritage sites to art galleries and botanical gardens, there are many cultural venues that fall under the museum umbrella. Some are traditional brick and mortar sites while others are pop-up venues or even exist online as web exhibits. However, what links these exhibits together is that they all facilitate different forms of interpretation and communication, whether through dioramas, artifacts, and artworks or interactive science experiments, meaning-making activities, or storytelling. The museum of the 21st century challenges the dominant view

that such cultural venues must solely exhibit objects within institutional buildings. According to Montgomery, “the notion of agency site and space have decentered the focus on the object in museums” (Alexander, Alexander, & Decker, 2017, p. 2). She further argues that this occurred alongside the expansion of global public education, as “museums joined schools as agencies for conveying cultural traditions” while introducing “new cultural contexts” (p. 10).

The Royal Botanic Gardens, Kew, in London, UK, is a great example of how museums can exist in different forms. Home to *The Hive*, this 44-ton metallic installation was collaboratively created by a team of artists, landscape architects, musicians, and scientists under the direction of artist Wolfgang Buttress. Stimulated by the activity of 50,000 honeybees pollinating in the surrounding gardens, it creates an immersive, multisensorial experience for visitors through flickering real-time LED lights and harmonious sounds of musical instruments. The goal for this project was to convey the importance of bees to our planet, since they pollinate over 30% of what humans eat, and to encourage visitors to consider their place within the natural world. While considered a historic garden, Kew engages in many qualities of 21st century museums as it is a space for interpretation, education, engagement, immersion, participation, and exhibition of contemporary issues projected through the lens of living wildlife.

However, museums in the Western world were not always visitor focused. Many existed as private collections or cabinets of curiosities owned by royalty, wealthy merchants, and aristocrats (Balzer, 2014). Through specimens, antiquities, art, and geological samples (among many other items), such collections were designed to assert the wealth, knowledge, and socioeconomic status of their owners (Balzer, 2014). Museums transitioned into the public realm by the late 17th century in the form of university museum repositories (Alexander, et al., 2017). These sites, accessible to those affiliated with the university, were managed by institutions of higher education for the teaching of research. Many museums of 18th and 19th century Europe came into existence in connection with social reformative practices. Some were designed as venues for upper classes to assert their standards for public conduct onto working class visitors in hopes they would emulate or even assume such behavior (Bennett, 1995). As ideas of social progress were often linked to materiality

of art and artifacts (Witcomb, 2003), such objects were assigned authoritarian value and meaning with little regard for the actual impressions and existing knowledge of working-class visitors.

Museums continued to privilege the voice of the curator and elevate the object for many years to come. However, they slowly began to acknowledge the needs of their visitors and surrounding communities in the 20th century. After undergoing a paradigmatic shift, museums began to perceive visitors as active rather than passive (Hooper-Greenhill, 1992). Nina Simon (2010) describes this shift as the passive consumer to the cultural participant. This made museums more mindful of the visitor experience and led many to improve accessibility, inclusivity, education, and engagement practices (Alexander, 2017).

More recently, many small and large-scale museums have been grappling with how to address climate change and its increasing impact on society, in addition to the environment. In reimagining their roles as meaning-makers and public spaces for facilitating engagement with topical issues, McGhie (2019) suggests museums need to “reposition themselves to engage people more constructively with climate change” (p. 13). He argues that they must go beyond simply relaying information and “create public value by connecting their work with external agendas to promote positive social and environmental outcomes relating to those agendas, rather than an internally focussed agenda” (p. 20). As sites for interpretation of the past, present, and the future—as seen in the *Deep Time* exhibit at the Smithsonian National Museum of Natural History where they illuminate how Earth’s past is inherently connected to the present and how this informs the future in relation to climate change (Smithsonian, 2019)—museums are in a unique position to tell the story of real-world issues as they take place.

This transformation in museum practice mirrors the democratization of information in the 21st century and increased demand for public access and influence over culture (Reeve & Woolard, 2016), as well as the role of museums as accelerators of progress (McGhie, 2019). With museums embracing digital technologies in response to the information needs of society and to maintain cultural relevance, this opened up the possibility for elements of curatorial practice to be applied to and adapted for online use (MacDonald & Alsford, 1991). With the advent of online exhibitions and the ubiquitous use of social media, museums expanded their audiences to include

digital visitors from afar who can access and engage with information online. For example, the Rijksmuseum in Amsterdam developed Rijksstudio in 2013, an image-based website evocative of Pinterest featuring user-curated collections of artworks. Google Arts and Culture collaborated with thousands of museums to create an expansive database of collections from around the world. They also curated numerous interactive online exhibitions featuring noteworthy moments in history via text, images, and videos. The University of British Columbia's Museum of Anthropology developed a series of online exhibitions in collaboration with the Virtual Museum of Canada detailing artifacts and anthropological findings. These are just three examples of how museums began to successfully adapt curatorial practice for online use while mobilizing their knowledge beyond their institutional walls. They also harnessed the power of social media over the last decade and have developed thriving digital communities.

As a parallel to this transformative development, we believe academic research ought to be mobilized online much in the same way, especially given the topical nature of climate change and biodiversity loss. However, with the sheer volume of information circulating online it is critical that it is presented in ways that connect public audiences to researchers and engenders social learning and ideally action. In our experience, this can be achieved by adapting and applying different frameworks developed in museums, social media marketing best practices, content curation strategies, and by integrating art.

Content Curation

Social media content curation in combination with museum engagement strategies and the use of art are key methodologies for communicating science. In marketing circles, content curation is defined simply as finding content that other people have already created and/or posted online, and reposting it to your own social media feeds, often with added annotation, commentary, or context (Kanter, 2011; Mullan, 2011; Gaasterland, 2011). Importantly, for this method to actually work, with respect to getting noticed by an audience, it must provide a service to the audience, which strong content curation practices do. In other words, content curation is successful when it: a) begins with an awareness of an audience or community and their interests, b) finds strong content which

speaks directly to that audience or community, c) tags the content appropriately using signifiers such as hashtags, and d) adds value by providing additional insight or context to the content. Since everyone can contribute content online, and many people do, the result is a type of information overload. Content curation thus offers a valuable service insofar as it provides a filter for information that other people can rely on. In that sense, curating content is not dissimilar from the practice of creating online Personal Learning Networks using social media tools (Wolf, Beckem, & Matias, 2011; Baird & Fischer, 2010). In each case, content is chosen and shared with a community with the hope of growing that community and sharing something of value.

Wilkes and Hodson (2013) operationalized the practice of content aggregation and curation as a method of sourcing and distributing content on a trend or issue. They recommended that content curation always be thought of as a moving target. In other words, one who is curating content must begin with an understanding of the target audience(s) but cannot also end there. Content curation is an iterative process, dialectic in nature (Harris, 1987), that relies on ongoing measurement of the performance of curated content and adjustments where necessary to determine the direction of future posts (Wilkes & Hodson, 2013). If done correctly, and if content is appropriately tagged, curated posts can vastly outperform other types of content as the nature of folksonomic online tagging tends to follow a power-law distribution (Halpin, Robu, & Shepherd, 2007).

For our study, the second author managed our social media platforms and carried out content curation tasks. With a background in cultural communications, she received training through her graduate studies along with internships and employment within the museum and arts sector before moving over to the environmental sector. To ensure trustworthiness and reliability of sources, she followed content curation best practices aimed at identifying and stopping the spread of misinformation and disinformation. These include the following basic steps: 1) ensuring the source is credible, 2) ensuring the author is credible, 3) confirming whether the content is opinion or fact-based, 4) ensuring the information is confirmed by other sources, and finally, 5) confirming the timeliness of the content (Bellemare, 2019). Once these important details are confirmed, she shared the content across social media. After a period

of time, it became easier to curate content as the second author assembled a list of credible and relevant sources to pull from.

Social Learning and the Online Environment

In addition to adopting museum engagement strategies and using content curation strategies, social learning is essential to the practice of research curation. Social learning can be defined as “a change in understanding that goes beyond the individual to become situated in wider social units or communities of practice through social interactions between actors within social networks” (Reed, Evelyn, Cundill, Fazey, Glass, Laing, Newig, Parrish, Prell, Raymond, & Stringer, 2010, p. 6). The goal of social learning is to mobilize relevant and useful knowledge across networks in order to contribute to action that improves a situation. There are three defining features of social learning: 1) a change in understanding or practice occurs, 2) learning extends beyond the individual, and 3) how, through which modes, networks, and social relations this learning is mobilized (Reed et al., 2010). Knowledge dissemination is foundational for social learning, and we would argue that proactive transfer of research outcomes, particularly interdisciplinary research, is critical. Like social movement theory, in social learning a cognitive praxis forms around a common goal or outcome to mobilize behavior change and broader societal action (Jamison, 2011). For social learning to occur, the ideas and attitudes of these participants (small group) must diffuse to members of the wider social units or communities of practice to which they belong (Reed et al., 2010). This concept is comparable to social media micro- and macro-influencers who often have high levels of expertise and/or influence in a particular field or niche. This praxis may occur at the individual scale, influenced by cognitive and affective conditions, but until this learning contributes to exchange and learning at a broader scale, it does not classify as social learning (Reed et al., 2010).

Processes of social learning are both drivers of innovation and outcomes (Yuen, Jovicich, & Preston, 2013). Building response capacity among institutions, networks, and actors is viewed as necessary to deal with complexity and uncertainty and to enhance adaptive capacity and adaptive management approaches through involvement of

diverse knowledges and stakeholder practices in decision-making processes (Adger, et al., 2007; Bos, Zimmerman, Olson, Yew, Yerkie, Dahl, & Olson, 2007; Hume, 2012; Walters & Holling, 1990). An outcome of social learning is to understand how learning scales from the niche or individual level to the landscape or regime level or across to broader social units (Reed et al., 2010; Rodela, 2011)¹.

With communications technology, the potential for this acceleration is significant and requires experimentation and considered reflection on the ways communities can learn from one another (Dale, 2005; Dale & Naylor, 2005; Dale & Newman, 2008). The shift to web-based technologies presents the opportunity to disseminate information and knowledge easier, faster, and with greater extent than ever before. This helps to generate networks of exchange and learning that can build capacity and prevent the isolation that innovators may face in taking innovative action alone. Much of this knowledge is contextually dependent but some may be transferable.

Online environments can also help to build human and intellectual capital (understood as knowledge, wisdom, experiences, skills and capacity) by increasing access to ‘outside’ expertise by communities that ordinarily would not have such access, through forums independent of place and ability to pay for that expertise to travel. In fundamental ways, dialogue differs from consensus building, agenda setting, or consultation, since it provides a more sustained, engaged, open-ended, and inclusive modality of shared decision-making with the public. Renewed work on deepening civic engagement (McCoy & Scully, 2002), the recent identification of a democratic deficit, along with the general recognition that ‘something’s wrong somewhere’ (Lind, 1995), suggest that these asymmetries are real. Complex developments over the last twenty years, particularly widespread dissatisfaction with electoral politics and policy development (Minister of Supply and Services Canada, 1991), have pointed to the need for the state to include and account for an increasingly diverse society that *wants in*—to play a greater role in decisions once thought to be the sole prerogative of the state (Dale, 2001).

Communicating Science Through Art

In addition to adapting and applying museum curatorial practices for communicating academic research, implementing content curation

¹ In the case of climate change, the goal of changing energy forms and services while reducing emission and increasing resilience requires significant change on a massive scale.

strategies and social learning practices using art to communicate science presents many opportunities. Art is a catalyst for bringing social, and now environmental issues, to the public. It can raise awareness, prompt dialogue, encourage personal growth, and even motivate action and change. Nineteenth-century French Realism, for example, provided a glimpse into the challenging daily lives of the working class. Frida Kahlo conveyed her political views and refusal to conform in her paintings, making her an icon for subsequent feminist and LGBTQ+ movements. The Harlem Renaissance movement saw literature, art, and music celebrate African American culture while challenging racism and stereotypes. And more recently, the world has witnessed Banksy discreetly inscribe social commentary, some linked to climate change, through graffiti art in public spaces. These are just a few examples of how art has impacted society by bearing witness and facilitating cultural resistance and growth.

Whether visual, musical, or performative, art has the potential to communicate ideas through different lenses while reflecting relevant social issues. As stated by Marshall McLuhan, "...art, at its most significant, [is] a DEW line, a Distant Early Warning system that can always be relied on to tell the old culture what is beginning to happen to it" (1964, as cited in Black, 2015). As an embodiment and mirror of culture, art offers an alternative form of expression that can encourage contemplation on a range of topical issues.

As communicating information alone (following the information deficit model) is not enough to capture different audiences, art can be used as an effective medium for engaging people on both emotional and intellectual levels. According to Friedman (2013), the arts have the power to tap into people's emotions through affect. Lesen, Rogan, and Blum (2016) further contextualize this as "the affective domain of learning (i.e., engagement, attitude, or emotion) rather than on the cognitive domain (i.e., understanding, comprehension, or application)" (p. 657). However, in their literature review, they also found that Scheffer et al. (2015) suggests that harnessing the power of both domains—creativity and discovery—in the communication process encourages intuitive thinking (Lessen, et al., 2016). Bättig-Frey, Jäger, Treischler, and Bratschi, 2018, propose the concept of the "narrative environment" that combines "highly evocative environments with storytelling" (p. 317) to facilitate an immersive and emotional

experience for visitors. This approach, often taking place within museum environments, builds on the existing knowledge, experiences, and interpretive capacities of audiences while inserting "cultural and historical contexts that reflect on social implications" (p. 317). Given the abstract and often complex nature of climate change and biodiversity science, these studies suggest that tapping into emotion in combination with intellect can help increase awareness and enhance engagement with science research. As Leonardo da Vinci is thought to have proclaimed, "Art is the queen of all sciences communicating knowledge to all the generations of the world."

The benefits of the artist-scientist partnership are also something to consider. Art and science are traditionally separate silos, "with the former focused on expression and creativity and the latter centered on the pursuit of data and discovery" (Clifton-Ross, 2018, p. 4). However, Maeda (2013) argues that scientists and artists have many things in common despite the polarization of their fields. He points out that they often "approach problems with a similar open-mindedness and inquisitiveness" and that both prefer taking leaps rather than incremental steps (para. 7). He also suggests that artists are suitable collaborators for scientists as they can help "navigate the unknown" and "are great partners in the communication of scientific knowledge" (para. 3). Scheffer et al. (2015) believe artists have the ability to extract "meaningful aspects of the complex world around us that is quite complementary to what scientists tend to do" (p. 3). Unconventional collaborations are therefore necessary given the issues our world is facing. With diverse backgrounds, skills, and knowledge-sets, transdisciplinary teams can and should experiment with new and innovative ways to mobilize information. Since art taps into the hearts and minds of the public, scientist-artist partnerships can help bring vital information to the forefront and present it in more compelling ways to move people to action.

Given the growing momentum and cultural impact of climate change and environmentalism, there are many artists harnessing the power of art as a communication medium. Artist Zaria Forman joined NASA's IceBridge operation aimed at mapping ice in the north and south poles to collect data on the effects of climate change. Using soft pastel on paper, Forman drew a series of large-scale, hyper-realistic renditions of the icy landscapes she witnessed during the excursions. Through electric

blue and frosty whites, her goal was “to illuminate this data through a medium that can move us in a way that statistics cannot” (Lescaze, 2018, para. 11). As keystones of climate change, her work is intended to transport viewers to these remote and awe-inspiring landscapes to help them build a more tangible connection. In her practice, she focuses on the beauty of the landscapes rather than the devastation. She wants to empower and inspire her viewers, not overwhelm or depress them. She uses her drawings to convey hope—a message not commonly associated with climate change.

Visual artist Andreas Lie blurs the boundaries of nature by blending landscape scenes with the wildlife that call it home (Lee, 2016). Through double exposure photography, he transforms the texture of their fur and feathers into misty forests and snowy mountain peaks. Each portrait is contained within the stark silhouette of the subject with negative space occupying the backdrop. While his work is not explicitly connected to environmental education and activism, his photographic effects remind viewers that animals are inherently connected to their habitats.

Jill Peltó blends her two professions as visual artist and earth scientist by creatively communicating extreme environmental issues through art. Her vivid watercolors depict the beauty of nature while incorporating real scientific data on climate change. Through line graphs, her work visually raises awareness by incorporating such data into renditions of melting glaciers, rising sea levels, and threatened species. As a different lens for communication, Peltó views art as a “universal language” as many people enjoy it and can feel its emotional impact (Fessenden, 2016, para. 13). While using contrasting artistic approaches, these three examples demonstrate the potential and breadth of art as a powerful medium for visual communication.

Methods

We conducted an environmental scan, delivered a student survey, consulted secondary social media research, experimented with different social media platforms including Facebook, Twitter, and Instagram, hosted a community conversation series on biodiversity conservation, and curated an art exhibit to investigate the following research questions: 1) Which curatorial practices developed in museums can be adapted and applied for improved online research communication? 2) Which online communication strategies and best

practices centered on social media marketing and web content development can be applied to research communications? 3) How can the intersection of art and science strengthen research communications? and 4) How can museum curatorial practices, online communication strategies, and the intersection of art and science inform a user-friendly and practical framework for research curation?

Environmental Scan

To study online communication strategies and best practices centered on social media marketing and web content development, we conducted an environmental scan. This helped us identify researchers, artists, and community leaders who were communicating and sharing knowledge about the critical challenges the world is facing. The main selection criteria were: 1) emphasis on mobilizing knowledge, research, and information about a variety of subjects related to sustainable community development (climate change, health, resilience, biodiversity, energy, policy, etc.); 2) use of visual messaging and/or the fine arts (visual art, music, theatre) to communicate their work; and 3) active social media use to reach new audiences.

Our goal in conducting an environmental scan was to uncover the following information: 1) shared/promoted content types (e.g., blog posts, videos, podcasts, data visualizations, news articles, academic articles, art); 2) which content types were popular; 3) scheduling patterns and posting frequency; 4) which social media and website platforms are used to amplify their content and messaging; 5) their followers and who they followed; 6) subject matter; and finally 7) voice, tone, and style. Our assumption in exploring this information was that our findings would help us better understand the media ecosystem we were hoping to join and to inform our communication style and strategic approach.

We plotted our findings into an interactive Kumu map that is organized into a series of nodes representing collectives, research labs/institutes, (academic and non-academic), nonprofits/charities, museum organizations, media organizations, and artists. Individual entries are connected to the larger nodes and contain biographical information, relevant website and social media links, along with a linked image (not uploaded for copyright reasons) and/or embedded video, if available. To highlight connections between individual entries and to highlight specific

areas of communication, a color-coded legend lists a series of secondary classifications: social media, arts, blogging, publishing, music, storytelling, video, radio, and theater. Users can also search by subjects listed along the top of the map, including: Anthropocene, Arctic, biodiversity, cities, climate change, ecology, energy, governance, health, oceans, and resiliency, among others. This is intended to further emphasize connections between entries while also helping users explore the map via specific subjects.

Student Survey

After completing the environmental scan, we collected survey results from 203 undergraduate students at Royal Roads University (RRU) from March to May 2018. We selected this survey sample since our main goal was to better understand the online habits of 18–34-year-olds, an age range that predominantly makes up the undergraduate student body at RRU. We were also able to secure an opportunity to deliver the survey to students in-person with the support of their professors. Our assumption was that this would elicit a higher response rate (which was the case) especially since the second author gave a short presentation on the research project and was available to answer questions. We did not rely on recruiting participants online because online surveys do not guarantee high results. Our first-hand experience confirmed this assumption as we received only four full responses after circulating our survey to 12 online classes made up of 20 or more students. Our survey methodologies, results, and analyses are extensively detailed by Hodson, Dale, Jost, and Clifton-Ross in “Sustainability issue communication and student social media engagement: Recommendations for climate communicators” (in press).

Our survey questions were centered on how students ages 18 and over used social media and accessed information online. Our survey protocol was structured around the following queries: Where did respondents search for scientific and research information online? How did they engage with this information? Which content types and platforms did they trust? What forms of media and website features did they find most interesting and attractive? How did they use social media platforms in their day-to-day lives. Descriptive statistical methods were used to analyze and interpret the results. In addition, to determine whether there is a statistical relationship between

two variables, association tests were conducted. As variables included more than two categories, post-hoc analyses with pairwise Fisher's exact tests were conducted where a correction for multiple tests was accordingly applied to the p-values (adjusted p-values).

Social Media

Because our survey sample was exclusively made up of undergraduate students, we needed to conduct further research to better understand how the wider public used social media. We also wanted to explore secondary research and resources published by leading social media management and publishing tools, including Buffer, Sprout Social, and Hootsuite. Since social media is a moving target that evolves quickly, these platforms provide a range of topical articles and how-to guides highlighting current trends, best practices, and methods for successful social media management. They also share analyses of audience research and data, which helped expand our understanding of the online habits, interests, and behaviors of various publics beyond our survey. While we consulted a wide range of articles, we found the following topics most helpful (for usefulness, we included the most up-to-date versions, as these articles are revised annually): demographic data for social media platforms (Chen, 2020); best posting times (Arens, 2020); how to use social media analytics tools (Newberry, 2019); and, how to create a social media marketing strategy (Lee, n.d.).

Experimenting with Social Media

We have experimented with disseminating research outcomes online for many years, in particular through building an extensive research website, collaborative online spaces, and through our social media channels including Facebook, Twitter, Instagram, Pinterest, HEADTalks (YouTube), and our blog At the Edge. Prior to 2016, marketing and content curation strategies were not applied to Community Research Connection's social media strategy. To help inform our initial strategy and for the purpose of this study, we focused on gathering analytics of key performance indicators (i.e., likes, shares, comments, reach, impressions, etc.) on Facebook, Twitter, and Instagram to help identify best practices for our research curation framework. Our content promoted Community Research Connection's blog posts, videos, and data visualizations and curated

content developed by other academics and other trustworthy sources like news sites, blogs, and non-profits. These activities helped us establish a suitable voice and tone, an effective posting schedule, while building relationships with other users.

To test whether Instagram could be used effectively for communicating academic research, we launched an account called “Sustainability Stories” in November 2017 (this account has since been rebranded for a different project). This helped us test whether the intersection of art and science can help strengthen research communications. As an incredibly powerful and popular platform, it boasts 1 billion users worldwide and has an incredibly wide reach. It is, however, very different from Twitter and Facebook. As it is an image-based platform, you cannot share links unless you have thousands of followers, which is why you need to harness the power of visuals in combination with hashtags and social interaction. Aimed at communicating messages of making a difference, our Instagram content illuminated positive developments centered on sustainable community development, climate change, and biodiversity. Framed as “Sustainability Stories,” we presented innovations, progress, and uplifting stories through the lens of photography, art, quotes, and videos. Most written content was repurposed from the Community Research Connection’s blog, “Views from Edge,” and adapted as micro-blogs to suit the casual tone of the platform. Strategically selected hashtags and high quality, open source photographs and select artworks were used to visually communicate scientific ideas and innovations.

Biodiversity Conversation Series

We selected biodiversity conservation as a specific community-centered project to test elements of our research curation framework. It was chosen as a singular issue, as it can be defined as an even greater imperative than climate change adaptation and mitigation, since there is no second chance with extinction. And in many ways, biodiversity loss intersects and is heavily impacted by other modern challenges, from climate change to habitat loss to overpopulation. From September 2017 to April 2018, we led four biodiversity conversations on the importance of the common loon and polar bear to Canadians. This series was hosted on our virtual, real-time conversation platform, Changing the Conversation, and

was developed in partnership with Women for Nature and Nature Canada. Designed to increase civic awareness, engagement, and literacy on the importance of biodiversity conservation in Canada, this series brought together over 20 female researchers, practitioners, and civil society leaders from diverse sectors to stimulate ideas, dialogue, and local actions. Expert panelists identified and discussed strategies to help inform decision-makers as well as the Canadian public. An action agenda was released in April 2019 outlining policy recommendations for Canadian decision-makers. This project was used to experiment with social media marketing and network formation practices. We also tested the Skim, Swim, Dive framework, a content methodology first conceived by the former Digital Media head at The National Gallery in London, by Charlotte Sexton (Clifton-Ross, Dale, & Newell, 2019).

Edging Forward Art Exhibit

To test the efficacy and impact of using art to communicate and disseminate complex scientific concepts, we curated a collaborative art exhibit that experimented with the integration of text and visual art. Exhibited at the Bateman Foundation Gallery of Nature and the Royal Roads University Library Showcase in Victoria, British Columbia, Canada, this multimedia project, entitled *Edging Forward: Reconciliation, Reconnection and Regeneration*, communicated over 17 years of research on sustainable development. Centered on a book written by the first author (Dale) on climate change adaptation and mitigation, the exhibit featured literary interpretations, nine oil mixed-media paintings by Canadian artist, Nancyanne Cowell, and a rich online resource library displayed on iPads. Responding to the core themes from the book, the exhibit featured large-scale artworks to illuminate the ideas presented in each chapter of the manuscript, *Edging Forward: Achieving Sustainable Community Development* (Dale, 2018).

Results

Survey

Of the 203 students who completed the survey, the highest percentage were 18 to 24 years old (59.1%), followed by 25 to 34 years old (30%), 35 to 44 years old (7.4%), and 45 and above (3.5%). Among the respondents, 109 identified as female (53.7%), 87 as male (42.9%) and 7 students (3.4%) identified as non-binary/non-conforming or did not select an option. The survey also revealed that

most participants spend five hours or more per day online (56.2%), with 36.9% spending around 3 hours and only 4.4% spending one hour online daily.

While bearing in mind that the respondents were university students, the mutually non-exclusive preferred online sources for information were news websites (70%), academic and non-academic journals (62.1%), government websites (53.2%), and research websites (48.3%). On the other hand, the least preferred sources for information were social media sites such as Facebook (30%), Twitter (15.3%), and Reddit (13.3%). These results were consistent with the sources of information students believed were most reliable and trustworthy. In fact, 92% of the respondents selected one of the four most preferred sources of information noted above as the single most reliable source, whereas 81.7% of them selected either Facebook, Reddit, or Twitter as the least trustworthy online source among the 10 available social network options. Despite these results, 60.6% of the students went on Facebook daily. Furthermore, Instagram and YouTube were also visited daily by 54.7% and 51.2% of respondents, respectively. When ranking their most preferred social media sites for personal use, 60% of respondents listed Facebook, Instagram, or YouTube within their top three options.

In terms of website features, images, layout, and content were selected by most respondents as the most attractive features, with 62.6%, 57.1%, and 50.2% respectively. Association tests were carried out between variables for this research. As an example, among the related variables, significant differences (adjusted p-value <0.1) were found between the respondents' age category and the length of compelling blog posts. More specifically, the majority (74.4%) of students aged 18 to 24 years indicated that their ideal length was three paragraphs or less. On the other hand, 60% of the participants aged 35 to 44 years preferred longer blog posts, having ideally four or more paragraphs.

Social Media and Content Curation

After experimenting with content curation and disseminating our research outcomes on social media, we saw steady increases across our channels each year. We gathered data of Key Performance Indicators, including likes, shares, link clicks, impressions, and reach, which are supplied internally by the platforms. Following the implementation of our strategy, we had increases of

250% in likes and 259% in shares for our Facebook platform during the 2016–2017 period. The following year, 2017–2018, it had further increases of 43% and 1% respectively. Our Twitter page also saw significant increases of 7,100% in likes and 24,100% in retweets for the 2016–2017 period. We had additional increases of 140% in likes and 114% in retweets for the 2017–2018 period.

Increases in social media stats also translated to growth in web traffic on Community Research Connection's website via link clicks. On Twitter, we received a 648% increase in clicks during the 2016–2017 period and a 219% increase for the 2017–2018 period. On Facebook, during the 2016–2017 period, there was a 910% increase in link clicks and a 62% increase during the 2017–2018 period.

Instagram's internal analytics tool is limited in comparison to Twitter and Facebook, which made it challenging to gather in-depth analytics, most notably impressions and reach. From November 24, 2017 to March 31, 2018, we shared 65 posts, received 2,543 likes, 105 comments, and garnered 301 followers. From April 1, 2018 to March 31, 2019 we shared 101 posts, received 4,449 likes, 245 comments and garnered an additional 191 followers. As of July 2019, we reached 504 followers. As age demographics on Instagram are typically younger, it was unsurprising that 45% of our followers were ages 25–34; 14% of followers were ages 18–24, while 24% of followers were ages 35–44, a 6% increase over the previous year. Female followers make up the majority at 68%, while male followers make up 32%.

Biodiversity Conversations

The four-part virtual online biodiversity conversations reached 157 real-time e-audience members and subsequently received 12,567 page views throughout the eight-month period. Webpages created for the series were viewed by 5,273 users. A total of 7,821 e-blasts promoting the e-dialogues were opened, 30,502 users were reached on Facebook, while tweets received a total of 105,289 impressions. We also curated a biodiversity conservation resource library, highlighting articles, reports, atlases, art projects, videos, and data visualizations that were shared by expert panelists during the conversations. Since its launch in September 2017 to April 2019, this library has been viewed over 1,925 times.

Edging Forward Exhibit

During the run of Edging Forward at the

Bateman Foundation Gallery of Nature from October 10 through November 10, 2017, the gallery received over 1,653 visitors. The opening exhibit and book launch event received 144 visitors, not including those who were not admitted due to capacity constraints. The iPads received 804 page views in the gallery. Gallery staff informed us that this was one of the most successful exhibits, in terms of attendance, that the Gallery had presented to date.

Research Curation Findings

Conducting an environmental scan and audience research combined with our student survey and social media experimentation helped us uncover different strategies and techniques that informed our research curation framework. While some of our research methods were quantitative in nature, our findings nonetheless were as equally enlightening as qualitative data and provided community insight that cannot be measured in numbers. As outlined in our Research Curation guide (Clifton-Ross, Dale & Hodson, 2019), after conducting *audience research* (first finding), our second finding is to *go where the audience is located* (Clifton-Ross, Dale & Hodson, 2019). Social media marketing is ineffective if you fail to reach your target audience. This is why it is incredibly important to identify where they are located online (which can be achieved by investigating relevant hashtags and community influencers), how they communicate, and what topics are of interest. This will ultimately help researchers develop well-crafted content that resonates and better contributes to their desired community. The third finding is to *create emotional appeal* (Clifton-Ross, Dale, & Hodson, 2019). Since writing for social media is incredibly different from academic writing, it is important to write to engage both the heart and the mind. This is particularly important as people often interpret information through their personal filters, which are instinctually influenced by emotions. Through this psychological lens, we can more easily understand how people interpret and use information.

Our fourth finding is to *personalize your work* (Clifton-Ross, Dale, & Hodson, 2019). Social media is increasingly becoming a walled garden so humanizing the research can help audiences better relate to the content. By making the researchers behind the work more visible and personal, content can be more engaging and impactful. Our fifth finding is to *keep interactions positive* (Clifton-

Ross, Dale, & Hodson, 2019). Climate change and biodiversity research is often framed through doom and gloom messaging. While shock value can be an effective and common communication method, sharing innovations, progress, and solutions can help empower audiences and differentiate content. Our sixth finding is to create *entertaining and engaging content*, including GIFs, memes, and humour (Clifton-Ross, Dale, & Hodson, 2019). This will help ensure researchers create topical and frame research using platform-appropriate media. Our seventh finding is to *make use of media* such as images, videos, art, data visualization, GIFs, and music (Clifton-Ross, Dale, & Hodson, 2019). This can help command attention on busy social media feeds, make content more memorable, and insert a performative element to the strategy.

Our eighth finding is to *offer multiple points of entry* (Clifton-Ross, Dale & Hodson, 2019). To engage a diversity of audiences, it is important to communicate research through multiple media types since some audiences are drawn to videos and data visualization while others prefer peer-reviewed journal articles and reports. Our ninth finding is to *provide added value* (Clifton-Ross, Dale & Hodson, 2019). It is not sufficient to simply share links; communicators must provide additional insight and commentary when sharing information, especially when curating content created by others. Our tenth and final finding is to *build trust and show support* by maintaining a consistent content schedule and only sharing reliable and high-quality content (Clifton-Ross, Dale & Hodson, 2019). Not only will this help build trust with your audience, this will also help fight misinformation and disinformation.

Discussion

Survey

Our survey outcomes reveal that most students spend a considerable amount of time online and particularly favour social media and online news sites for personal use. Many listed entertainment and celebrities along with local and national news as most engaging; content types that undoubtedly dominate social media sites. However, our outcomes also revealed that respondents clearly recognize that social media sites are among the least trusted platforms and instead choose academic and non-academic journals, government and research websites as their primary sources for gathering reliable information. Most respondents cited the credibility of sources as

a main influencing factor for this preference, and supported it with the following reasons: a) credible academic journal articles undergo peer review, b) information is often based on primary data, c) information is often supported by external sources, d) such articles are written by researchers/experts, and e) reference lists are included.

While these results are not surprising, this provides academics with an opportunity to harness the power of social media to mobilize their research, given the amount of time respondents spend on social media and the level of trust they placed on academics or experts. Social media sites typically convey information in shorter fast-paced formats and often use imagery or media to communicate messaging. When disseminating academic research outcomes on such platforms, academics can reformat their research outcomes into bite size videos, podcasts, art, or data visualizations to engage the senses (auditory, visual, etc.) and provide additional points of entry beyond traditional text-based formats. To reach new audiences, engage them in academic research, and to increase public climate change awareness, it is critical that academics meet target audiences where they are located (i.e., social media) and evolve, adapt, and speak the language of those platforms to achieve effective knowledge transfer.

Social Media, Content Curation, and Audience Research

A third marketing and museum method relevant to this study is audience research. As a key phase in the development of exhibitions and educational programming in museums along with social media marketing, it helps uncover the needs and expectations of different audience groups while providing museums and marketers with a greater understanding of how they can effectively engage existing and new audiences. Conducting such research also provides curators, educators, and marketers with insight necessary for future planning (Hooper-Greenhill, 1994). Audience research is also vital for harnessing the power of social media and is a first step in developing an effective digital communication strategy. We examined how this method is applicable to social media and website content curation to help determine how academic researchers can engage digital communities, effectively disseminate information, and continually re-evaluate their curatorial approach.

To engage new followers on social media, it is important to understand their interests, where they are located and what attracts and engages them (e.g., media types, voice, tone, etc.). Before the second author (Clifton-Ross) adjusted our social media strategy, she audited our channels (Facebook, Twitter, YouTube) to determine the efficacy of our existing communication strategies and to better understand our current audience. She subsequently experimented with different posting types (research, news, video, live-tweeting, etc.) and tested our posting schedule to determine what works and what does not work. While closely monitoring analytics, she continually adjusted the strategy, determined best posting times, and established an online voice and tone.

Harnessing the Power of Instagram

We experimented with a series of posting strategies on our Instagram account, “Sustainability Stories.” Our content showcased a variety of striking images and videos portraying visuals of biodiversity, people, animals, cities, pollution, renewable energy, art, and more. We also designed graphics showcasing paintings and quotes from the first author’s (Dale) book, *Edging Forward: Achieving Sustainable Community Development* (2018). The designs, integrating text and art, were inspired by the Instagram posts of Canadian poet Rupi Kaur. However, we were mindful of consistently sharing images of people, not just nature, as we wanted to dispel the notion that humans are separate from nature, and instead, emphasize that we are a part of nature and are therefore key to solutions for tackling climate change and biodiversity loss.

We also tested different caption strategies, including reduced blog posts, impactful quotes from famous individuals, and again, quotes and excerpts from Dale’s 2018 book. The strategy we found that best adapted our research, which also fit within the identity of sustainability stories, was posting captions containing adapted blog posts from “Views from the Edge.” After considerable experimentation, our Instagram feed organically transformed into a micro-blog (Hodson, Dale, & Peterson, 2018), showcasing uplifting stories, innovations, and progress related to sustainable community development. Our posts had a simple formula: present a problem, highlight the research, link it to the social context, and conclude with solutions. Whenever possible, we would frame information and research using a narrative

structure to not only create affect, but to also help users connect to the content personally. If they could picture themselves within the framework of the story, they may engage more with the content.

We also experimented with using different combinations of hashtags to expand our reach and increase our following. According to Hodson, Dale, and Peterson (2018), hashtag use on Instagram has the potential to “connect disparate communities of networked individuals” (p. 20). It also enables users to categorize and broadcast their content with a goal of contributing to exchange and learning at a broader scale, given the reach of the platform. Therefore, we researched a series of hashtags to determine which were most popular and relevant to our research. While we used many variations on sustainability (#sustainabledevelopment, #greenenergy, #renewables, #biodiversity, #climatechange, #climatehope, #scicomm, #plasticpollution, etc.), we also wanted to tap into hashtag communities outside our field to reach beyond our filter bubble or echo chamber (Hodson, Dale, & Peterson, 2018). Therefore, when relevant to the content and image, we used variations of more playful platform-specific hashtags, including #instaart #animalgram #naturegram, #naturelover, #treemagic, etc. Our testing ultimately revealed the importance of integrating subject-specific hashtags with playful ones as it helps cast a wider net. It also helps users move beyond simply preaching to the choir by embracing the cultural context of the platform.

Another strategy we tested was the use of an external reposting app to share content generated by others. This ensured that we credited the original creator, which is incredibly important when sharing art. We also reached out to artists for permission prior to reposting their content, many of whom were incredibly receptive. While this was an easier method for sharing content generated by others, this practice does not follow Instagram community guidelines. We subsequently experienced a “shadow ban” for a few days, where the platform limits the reach of your content for not following platform rules. We had no way to verify whether the ban was explicitly linked to using an external reposting app; however, it could have also occurred as a result of our hashtag use. To crack down on spam and bots, Instagram discourages using the same hashtags in consecutive posts.

This experience actually provided us with a great learning moment. Not only did we rethink our hashtag strategy, but we also decided to

embrace the internal focus of the platform. Instead of trying to emulate the same strategies we used for Twitter and Facebook, we came up with a new Instagram approach that somewhat counters traditional academic methods of disseminating information. The content we shared on Facebook and Twitter was typically link-based or retweets/shares. By using Instagram, we were forced to rely on visuals, hashtags, and captions to attract and engage audiences with our content, rather than encouraging users to visit our website for more information. This meant that we had to adapt our content to suit the platform and ensure that it could stand on its own rather than rely on external websites.

One of the major lessons we learned was that ignoring the social factor of Instagram significantly decreases your visibility. While posting high quality images, writing engaging captions, and using hashtags strategically is important, failing to interact with other users through liking, following, and commenting can stifle engagement. For example, we found the most effective way to boost engagement was by following other relevant users in mass. Consistent authentic interaction through liking and commenting on the content of other users, without the use of bots, is also effective as it functions as social “pings”. Not only does this behavior boost engagement potential, but it also demonstrates that you are invested in other users and not solely focused on your own self-interests. In addition, replying to comments on your posts is also important as it indicates to your followers that you acknowledge and value their input.

Instagram is not always a go-to social network for communicating academic knowledge. However, when harnessing the power of the platform and its unique functionalities, academics have an opportunity to reach younger and more diverse audiences. While posting on Twitter and Facebook is much easier and more efficient, when used strategically, Instagram can cast a far wider net and can garner a considerably higher level of engagement through likes, comments, and follows. However, academics must be prepared to reformat their research outcomes (Clifton-Ross, Dale, & Hodson, 2019) and engage in social activities to successfully meet the standards, trends, and general approach of the platform. In our experience, Instagram forced us to harness the power of visuals to not only entice users to read our captions but to also connect this information to visual symbolism. This was especially important as images can be

evocative of people's existing experiences, cultures, and narratives. Using imagery to communicate metaphors or symbols can be a powerful strategy and can help users think differently about global issues such as climate change and biodiversity loss.

Edging Forward Exhibit

Museum exhibits are an effective medium to transfer climate change and biodiversity research to new audiences. They disseminate information via interpretive labels and text panels containing stories, narratives, and facts. They serve to “explain, guide, question, inform or provoke” readers (Serrell, 1996, p. 10) while facilitating “communication between a knowledgeable guide and an interested listener” (p. 11). They also harness the power of storytelling through media—including artworks, images, videos, and digital interactives—to offer multiple avenues for viewers to access, interpret, and ultimately engage with information.

The main curatorial goal for the *Edging Forward* exhibit was to offer multiple points of entry for visitors by creating an engaging multimedia experience. One of the initial challenges we faced was determining how much text to present, considering we were interpreting a book manuscript with a large interdisciplinary literary content. We debated following the standard museum interpretive framework with a series of labels exploring the core themes from the book. However, we ultimately decided that using the voice of the first author would be more powerful, in addition to a detailed curatorial statement. We also wanted to showcase the literary style and tone of the book, which no interpretive text could have replicated. We selected a series of short passages that represented the core ideas and sentiments from each chapter. They were printed on exhibit panels that reflected the design and aesthetic of the book, placed alongside each painting. What made this curatorial decision different from standard interpretive exhibit labels was that each quote was treated as an art work in and of itself. This not only illuminated the interconnected nature of the creative partnership but also encouraged the two mediums to play off one another. Many visitors commented on the power of combining the literary interpretations with the large-scale oil mixed-media paintings.

Because museums have a long history of educating and engaging the public (Clifton-Ross, Dale & Newell, 2019), we conducted research on curatorial and communications practices

developed in museums that were applicable to the dissemination of research outcomes. We examined the highly influential report, *Ideas, Objects, or People?* A Smithsonian Exhibition Team Views Visitors Anew, which introduced a new visitor typology emphasizing the need to curate more audience-centered exhibitions since the prior experiences and personal dispositions of visitors often determines the impact of exhibitions (Pekarik & Mogel, 2010). They argue that offering multiple points of entry whether through historic or scientific facts, material objects or stories of people is key to engagement of wider audiences.

We applied elements of the *Ideas, Objects, or People* framework, to offer multiple points of entry for visitors. It ensured that we established cohesion among the three forms of media—literary interpretations, paintings, and the resource library. Displaying the book passages inherently tapped into the ideas element as they explored concepts, theories, and research around sustainable community development. However, they also embodied the people element from the framework. As the book reads as semi-autobiographical, sharing the passages provided insight into the first author's (Dale) thinking. To fulfill the objects element of the *Ideas, Objects, or People* framework, we paid close attention to the atmosphere of the exhibit and the way in which we hung the paintings. On their own, the paintings make a huge impact—not just due to their large size but also because of their luminosity, vibrancy, and texture.

To extend the experience of the exhibit and to enable visitors to dive deeper, we created an extensive resource library. Filled with articles (both academic and from print media), videos, podcasts, reports, as well as a high-resolution art gallery featuring accompanied original paintings, it curated a series of research used in the first author's book (Dale, 2018). Displayed on iPads in the gallery, this provided additional context for visitors, especially individuals, who wished to learn more. The library also enabled visitors to continue to engage with the project beyond the gallery walls by giving them user-control over the content presented, potentially kick-starting their own learning on the subject.

Biodiversity Conversations

In academia, there is often concern that communicating research outcomes through social media or other online platforms can oversimplify

or convolute scientific facts. The skim, swim, dive museum framework provides an effective and adaptable online content structure for curating a range of information types. Centered on three levels of engagement, it can engage audiences at different depths of content (Blasco, 2016) as it enables users to: a) skim the surface of information, b) swim through the information for additional context, and c) dive into the information for an in-depth look. Since each level varies according to its application, we tested the framework by using it to structure a series of web content associated with our biodiversity conversation series.

For the skim level, we created four web pages promoting each conversation from the series. This included high-level descriptions of the conversations and connection details and information about each panelist (Clifton-Ross, Dale & Newell, 2019). If users wished to learn more, they could transition to the swim level by clicking on the various links provided. This included the World Wildlife Foundation 2016 Living Planet report stating that 67% of wild animals will disappear by 2020—the very report that inspired the conversation series. If they wished to take a deep dive into the subject, they could join the conversations as audience members, download the subsequent conversation transcript, visit a curated biodiversity resource library (including articles, atlas, reports, videos, art projects, and data visualizations) or read the final biodiversity conservation action agenda listing policy recommendations (2019). The skim, swim, dive framework ultimately ensures that “content from all levels of depth are available at the users’ fingertips” (Clifton-Ross, Dale, & Newell, 2019, p. 8). It also provides information through different media types (articles, videos, blog posts, data visualizations, art, etc.), thereby providing multiple points of entry since different audiences gravitate toward different forms of information.

Testing Conservation Marketing Techniques

When communicating information about biodiversity and conservation, a common marketing technique is the flagship species strategy, where different species, ecosystems, or plants are used to represent a wider issue in conservation (Macdonald et al., 2017; Wright et al., 2015). For example, polar bears have become synonymous with the melting Arctic, bees are associated with the disappearance of wild pollinators, and orangutans are associated with deforestation. While this

technique has both benefits and drawbacks, it presents opportunities for visual communication.

We tested a series of images of animals on our web pages and on Instagram to not only promote our biodiversity conservation series and the release of the action agenda, but to also elevate awareness and engagement around the critical need for biodiversity conservation. For example, our conversation “From the local to the global” used the monarch butterfly to illuminate local to global interdependencies of biodiversity conservation and the need for migratory paths and protected spaces. We posted an excerpt from the conversation on Instagram with a colorful image of a monarch butterfly surrounded by subtle purple flowers. It received 39 likes and one comment while it reached 115 accounts and garnered 155 impressions. We also used the wood bison to convey threatened species and to underline how the survival of animals is inherently linked to our own. This post received 34 likes and no comments while it reached 151 accounts and garnered 180 impressions. However, one of the most striking visuals we used was of a barn owl surrounded by yellow wildflowers with the following caption: “Climate change respects no man-made political boundaries.” This post received a total of 70 likes and two positive comments from two environmental-based users on Instagram. Impressions and reach statistics were unfortunately unavailable for this post.

Conclusion

Our research for developing the practice of research curation found that adopting museum engagement strategies, using art to communicate science, applying content curation and marketing strategies in combination with social learning practices is key to successful knowledge mobilization. Significant increases in our social media outreach from the 2015–2016 to 2017–2018 periods demonstrate the importance of several factors. First, actively applying research curation practices to translate research outcomes is a critical strategy for engaging more diverse and younger audiences. One anecdotal lesson particularly important for actively engaging younger cohorts we learned is the importance of always providing solutions for acting in addition to articulating the challenges. This is especially important given the overwhelming amount of doom and gloom messaging circulating across the Internet. Providing such information may help

create a smoke signal around your work (Clifton-Ross, Dale & Newell, 2019) while disseminating vital information necessary for tackling climate change or biodiversity loss. Second, researching your audience and disseminating research outcomes means respectfully meeting people where they are and communicating in ways that appeal to them is essential. Online platforms and audience dynamics are in constant flow and flux, so engaging audiences through evolving strategies is very important. Third, the power of integrating art with science appeals to much wider audiences and reaches both the hearts and the minds (Peavy, 1985) of many more people than we anticipated.

Throughout our history as a research group, we have been aware of the power of art to move us since framing issues through diverse lenses helps us reflect, interpret, and make meaning, thereby expanding our learning experiences. Art often provides a kind of mirror that reflects what we most need to see, revealing the potentials and the possibilities beyond words. In the academy, we so often privilege text over art. While art and science are traditionally separate silos, we believe that integrating the two tells a more compelling story. At the intersection of climate change and biodiversity loss, the most critical issues of the day, the marriage of art and science can provide a richer, more pluralistic discourse. As climate change and biodiversity science can be abstract and hard to understand for the wider public, we believe that integrating visual communications and art, tapping into the power of affect to engage audiences on an emotional level, and blending this with scientific knowledge can create a more holistic path to understanding and acting. The aesthetic imagination, with its potential to connect beauty, emotion, and knowledge, can radically change the conversation about how our existence is inherently linked to nature.

References

- Adger, W.N., Agrawala, S., Mirza, M.M.Q., Conde, C., O'Brien, K., Pulhin, J., Pulwarty, R., Smit, B., & Takahashi, K. (2007). Assessment of adaptation practices, options, constraints and capacity. In M.L. Parry, O.F. Canziani, J.P. Palutikof, C.E. Hanson, & P.J. van der Linden (Eds.), *Climate 2007: Impacts, Adaptation and Vulnerability*, pp. 719–743). Cambridge University Press.
- Alexander, E.P., Alexander, M., & Decker, J. (2017). *Museums in motion: An introduction to the history and functions of museums*. Rowman & Littlefield.
- Arens, E. (2020). The best times to post on social media in 2020. *Sprout Social*. Retrieved from <https://sproutsocial.com/insights/best-times-to-post-on-social-media/>.
- Baird, D.E., & Fisher, M. (2010). Pedagogical mash up: Gen Y, social media, and learning in the digital age. In *Social computing: Concepts, methodologies, tools, and applications* (pp. 2023–2044). IGI Global.
- Balzer, D. (2014). *Curationism: How curating took over the art world and everything else*. Coach House Books.
- Bättig-Frey, P., Jäger, M.U., & Treichler Bratschi, R. (2018). Combining art with science to go beyond scientific facts in a narrative environment. *Journal of Museum Education*, 43(4), 316–324.
- Black, S. (2015). Herbert Read: His contribution to art education and to education through art. In R. Skelton (Ed.), *Herbert Read: A memorial symposium* (pp. 57–65). Routledge.
- Blasco, E. (2016, May 26). Skim, swim, and dive: Engage visitors at different depths of digital content. That shared language useful in many areas. #musetech #aam2016 [Tweet]. Retrieved from <https://twitter.com/erinblasco/status/735911282407276545>.
- Bellemare, A. (2019, July 5.) So, you think you've spotted some 'fake news' — now what? CBC News. Retrieved from cbc.ca/news/technology/fake-news-disinformation-propaganda-internet-1.5196964.
- Bennett, T. (1995). *The birth of the museum: History, theory, politics*. Routledge.
- Bos, N., Zimmerman, A., Olson, J., Yew, J., Yerkie, J., Dahl, E., & Olson, G. (2007). From shared databases to communities of practice: A taxonomy of collaboratories. *Journal of Computer-Mediated Communication* 12(2), 652–672.
- Chen, J. (2020). Social media demographics to inform your brand's strategy in 2020. *Sprout Social*. Retrieved from <https://sproutsocial.com/insights/new-social-media-demographics/>.
- Clifton-Ross, J. (2019, March 13). *Curating research-based climate exhibits — 4 challenges and how we addressed them* [case study] [blog post]. Retrieved from <https://coalitionofmuseumsforclimatejustice.wordpress.com/2019/03/13/curating-research-based-climate-exhibits-4-challenges/>.
- Clifton-Ross, J. (2018). *Edging Forward: Reconnection, Reconciliation, Regeneration* [video]. Fernweh Press. Retrieved from https://issuu.com/fernwehpress/docs/edging_20forward_20exhibit_20catalo_4222f2d5d9aef2.

Clifton-Ross, J., Dale, A., & Hodson, J. (2019). Academic research curation: Best practices guide. Retrieved from <https://www.changingtheconversation.ca/sites/all/images/research-curation/research-curation-best-practices.pdf>.

Clifton-Ross, J., Dale, A., & Newell, R. (2019). Frameworks and models for disseminating curated research outcomes to the public. *SAGE Open*, 9(2). Retrieved from <https://doi.org/10.1177/2158244019840112>.

Convention on Biological Diversity (CBD). (2012, May 25). TARGET 11 – Technical Rationale extended (provided in document COP/10/INF/12/Rev.1. CBD. Retrieved from <https://www.cbd.int/sp/targets/rationale/target-11/>.

Dale, A. (2018). *Edging forward: Achieving sustainable community development*. Fernweh Press.

Dale, A. (2005). A perspective on the evolution of e-dialogues concerning interdisciplinary research on sustainable development in Canada. *Ecology and Society*, 10(1), 37.

Dale, A. (2001). *At the edge: Sustainable development for the 21st Century*. Vancouver: UBC Press.

Dale, A., & Naylor, T. (2005). Dialogue and public space: An exploration of radio and information communications technologies. *Canadian Journal of Political Science*, 38(1), 203–225.

Dale, A., & Newman, L. (2008). Social capital: A necessary and sufficient condition for sustainable community development? *Community Development Journal*, 45(1), 5–21. doi:10.1093/cdj/bsn028

Dale, A., Robinson, J., King, L., Burch, S., Newell, R. & Jost, F. (2020). Meeting the climate change challenge: Local government climate action in British Columbia, Canada. *Climate Policy* 20(7), Special Issue: National Development and Mitigation Pathways.

Díaz, S., Settele, E.S., Brondízio, E.S., Ngo, H.T., Guèze, M., Agard, J., Arneth, A., Balvanera, P., Brauman, K.A., Butchart, S.H.M., Chan, K.M.A., Garibaldi, L.A., Ichii, K., Liu, J., Subramanian, S.M., Midgley, G.F., Miloslavich, P., Molnár, Z., Obura, D., Pfaff, A., Polasky, S., Purvis, A., Razzaque, J., Reyers, B., Chowdhury, R., Shin, Y.J., Visseren-Hamakers, I.J., Willis, K.J., & Zayas, C.N. (Eds.), IPBES (2019). *Summary for policymakers of the global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services*. IPBES secretariat. Retrieved from <https://doi.org/10.5281/zenodo.3553579>.

Fessenden, M. (2016, March 11). These watercolour paintings actually include climate change data. Smithsonian. Retrieved <https://www.smithsonianmag.com/arts-culture/these-watercolor-paintings-actually-include-climate-change-data-180958374/>.

Friedman, A.J. (2013). Reflections on communicating science through art. *Curator: The Museum Journal*, 56(1), 3–9.

Gaasterland, M. (2011, April 13). What is content curation? And how it's useful to you and your network. Social media tactics you can trust. Retrieved from <http://www.michielgaasterland.com/content-marketing/what-is-content-curation-and-how-it%E2%80%99s-useful-to-you-and-your-network/>.

Government of Canada. (2020, January 27). *Canada's international action on climate change*. Canada.ca. Retrieved from <https://www.canada.ca/en/environment-climate-change/services/climate-change/canada-priorities.html>.

Guardian. (2019, May 23). 'I feel empowered and scared: pupils speak before climate strike.' Retrieved from <https://www.theguardian.com/environment/2019/may/23/i-feel-empowered-and-scared-pupils-speak-before-climate-strike>.

Halpin, H., Robu, V., & Shepherd, H.A. (2007). The complex dynamics of collaborative tagging. Paper presented at the Proceedings of the 16th International Conference on World Wide Web. Banff, Alberta, Canada.

Harris, E.E. (1987). *Formal, transcendental, and dialectical thinking: Logic and reality*. SUNY Press.

Hodson, J., Dale, A., Jost, F., & Clifton-Ross, J. (in press). Sustainability issue communication and student social media engagement: Recommendations for climate. *Journal of Digital and Social Media Marketing*.

Hodson, J., Dale, A., & Peterson, B. (2018). The Instagram #climatechange hashtag community: Does it impact social capital and community agency. *Interdisciplinary Environmental Studies*, 12(3/4), 17–35.

Hooper-Greenhill, E.H. (1994). *Museums and their visitors*. Routledge.

Hooper-Greenhill, E.H. (1992). *Museums and the shaping of knowledge*. Routledge.

Hume, M. (2012). Adopting organisation learning theory in the classroom: advancing learning through the use of blogging and self-reflection. *International Journal of Learning and Change*, 6(1–2), 49–65.

- Jamison, A. (2011). Ecology and the environmental movement. In *Ecology Revisited* (pp. 195–204). Springer.
- Kanter, B. (2011, October 4). *Content curation primer* [blog post]. Retrieved from <http://www.bethkanter.org/content-curation-101/>.
- Lee, A. (2016). 10 Questions with Andreas Lie: The Norwegian illustrator opens up about his digital double exposures. *Gestalten*. Retrieved from <https://us.gestalten.com/blogs/journal/10-questions-with-andreas-lie>.
- Lee, K. (n.d.). How to create a social media marketing strategy from scratch. *Buffer*. Retrieved from <https://buffer.com/library/social-media-marketing-plan/>.
- Lescage, Z. (2018, August 22). 12 artists on: climate change. *New York Times*. Retrieved from <https://www.nytimes.com/2018/08/22/t-magazine/climate-change-art.html>.
- Lesen, A.E., Rogan, A., & Blum, M.J. (2016). Science communication through art: Objectives, challenges, and outcomes. *Trends in Ecology & Evolution*, 31(9), 657–660.
- Lind, C. (1995). *Something's wrong somewhere: Globalization, community and the moral economy of the farm crisis*. Fernwood Publishing.
- Macdonald, E.A., Hinks, A., Weiss, D.J., Dickman, A., Burnham, D., Sandom, C.J., Malhi, Y., & Macdonald, D.W. (2017). Identifying ambassador species for conservation marketing. *Global Ecology and Conservation*, 12, 204–214.
- MacDonald, G., & Alsford, S. (1991). The museum as information utility. *Museum Management and Curatorship*, 10(3), 305–311.
- Maeda, J. (2013, July 11). *Artists and scientists: More alike than different* [blog post]. *American Scientist*. Retrieved from <https://blogs.scientificamerican.com/guest-blog/artists-and-scientists-more-alike-than-different/>.
- Masson-Delmotte, V., Zhai, P., Pörtner, H.O., Roberts, D., Skea, J., Shukla, P.R., Pirani, A., Moufouma-Okia, W., Péan, C., Pidcock, R., Connors, S., Matthews, J.B.R., Chen, Y., Zhou, X., Gomis, M.I., Lonnoy, E., Maycock, T., Tignor, M., & Waterfield, T. (Eds.). *IPCC, 2018: Summary for policymakers in Global Warming of 1.5°C. An IPCC special report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty*. Geneva, Switzerland: World Meteorological Organization.
- McCoy, M., & Scully, P. (2002). Deliberative dialogue to expand civic engagement: What kind of talk does democracy need? *National Civic Review*, 91(2), 117–135.
- McGhie, H. (2019). Climate change engagement: A different narrative. In W. Leal Filho et al., (Eds.), *Addressing the challenges in communicating climate change across various audiences*, pp. 13–29). Springer.
- Milman, O., & Smith, D. (2019, September 19). 'Listen to the scientists': Greta Thunberg urges Congress to take action. *The Guardian*. Retrieved from <https://www.theguardian.com/us-news/2019/sep/18/greta-thunberg-testimony-congress-climate-change-action>.
- Minister of Supply and Services Canada. (1991). *Citizens' Forum on Canada's Future: Report to the People and Government of Canada* (Catalogue No. CP32-57/1991). Canadian Government Publishing Centre.
- Mullan, E. (2011, November 30). What is content curation? [blog post]. Retrieved from <http://www.econtentmag.com/Articles/ArticleReader.aspx?ArticleID=791>.
- Nature Canada. (2019, December 5). Press Release: Nature Canada applauds historic nature protection commitment in speech from throne. Retrieved from <https://naturecanada.ca/news/press-releases/press-release-nature-canada-applauds-historic-nature-protection-commitment-in-speech-from-the-throne/>.
- Newberry, C. (2019, August 26). How to use Twitter analytics: A complete guide for marketers. *Hootsuite* [blog]. Retrieved from <https://blog.hootsuite.com/twitter-analytics-guide/>.
- Peavy, F. (1985). *Heart Politics*. Black Rose Books.
- Pekarik, A.J., & Mogel, B. (2010). Ideas, objects, or people? A Smithsonian exhibition teamviews visitors anew. *Curator: The Museum Journal*, 53(4), 465–482.
- Reed, M., Evelyn, A.C., Cundill, G., Fazey, I.R.A., Glass, J., Laing, A., Newig, J., Parrish, B., Prell, C., Raymond, C., & Stringer, L. (2010). What is social learning? (A response to Pahl-Wostl, 2006. The importance of social learning in restoring the multifunctionality of rivers and floodplains.) *Ecology and Society*, 15(4). Retrieved from <https://www.ecologyandsociety.org/vol15/iss4/>.
- Reeve, J., & Woollard, V. (2016). Influences on museum practice. In C. Lang and J. Reeve (Eds.), *The responsive museum: Working with audiences in the twenty-first century*, pp. 5–18). Routledge.

Rodela, R. (2011). Social learning and natural resource management: The emergence of three research perspectives. *Ecology and Society*, 16(4), 30.

Scheffer, M., Bascompte, J., Bjordam, T., Carpenter, S., Clarke, L., Folke, C., Marquet, P., Mazzeo, N., Meerhoff, M., Sala, O., & Westley, F. (2015). Dual thinking for scientists. *Ecology and Society*, 20(2).

Serrell, B. (1996). *Exhibit labels: An interpretive approach*. AltaMira Press.

Simon, N. (2010). *The participatory museum*. Museum 2.0.

Smithsonian. (2019). David H. Koch Hall of Fossils – Deep Time. *Museum of Natural History*. Retrieved from <https://naturalhistory.si.edu/exhibits/david-h-koch-hall-fossils-deep-time>.

Walters, C., & Holling, C. (1990). Large-scale management experiments and learning by doing. *Ecology*, 71(6), 2060–2068.

Wilkes, G., & Hodson, J. (2013, July). Using social media aggregation and curation techniques in the classroom to identify discourse trends and support brand operations. In IEEE International Professional Communication 2013 Conference (pp. 1–7).

Witcomb, A. (2003). *Re-imagining the museum: Beyond the mausoleum*. Routledge.

Wolf, D., Beckem, J., & Matias, A. (2011). Interactive technologies: Enhancing academic learning and stimulated student engagement with social media. Waynesville, NC: Association for the Advancement of Computing in Education. Retrieved from <https://www.learntechlib.org/primary/p/38230/>.

Wright, A.J., Verissimo, D., Pilfold, K., Parsons, E.C.M., Ventre, K., Cousins, J., Jefferson, R., Koldewey, H., Llewellyn, F., & McKinley, E. (2015). Competitive outreach in the 21st century: Why we need conservation marketing. *Ocean & Coastal Management*, 115, 41–48.

Yuen, E., Jovicich, S.S., & Preston, B.L. (2013). Climate change vulnerability assessments as catalysts for social learning: Four case studies in south-eastern Australia. *Mitigation and Adaptation Strategies for Global Change*, 18(5), 567–590.

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