



# Enabling Enduring Evidence-Based Policy for the Southern Ocean Through Cultural Arts Practices

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## OPEN ACCESS

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### Specialty section:

This article was submitted to  
Conservation and Restoration  
Ecology,  
a section of the journal  
Frontiers in Ecology and Evolution

**Received:** 11 October 2020

**Accepted:** 19 April 2021

**Published:** 26 May 2021

### Citation:

Roberts L, Kutay C,  
Melbourne-Thomas J, Petrou K,  
Benson TM, Fiore D, Fletcher P,  
Johnson E, Silk M, Taberner S,  
Filgueira VV and Constable AJ (2021)  
Enabling Enduring Evidence-Based  
Policy for the Southern Ocean  
Through Cultural Arts Practices.  
*Front. Ecol. Evol.* 9:616089.  
doi: 10.3389/fevo.2021.616089

This paper provides a perspective on how art and cross-cultural conversations can facilitate understanding of important scientific processes, outcomes and conclusions, using the Marine Ecosystem Assessment for the Southern Ocean (MEASO) as a case study. First, we reflect on our rationale and approach, describing the importance of deeper communication, such as through the arts, to the policy process; more enduring decisions are possible by engaging and obtaining perspectives through more than just a utilitarian lens. Second, we draw on the LivingData Website [http://www.livingdata.net.au] where art in all its forms is made to bridge differences in knowledge systems and their values, provide examples of how Indigenous knowledge and Western science can be complementary, and how Indigenous knowledge can show the difference between historical natural environmental phenomena and current unnatural phenomena, including how the Anthropocene is disrupting cultural connections with the environment that ultimately impact everyone. Lastly, we document the non-linear process of our experience and draw lessons from it that can guide deeper communication between disciplines and cultures, to potentially benefit decision-making. Our perspective is derived as a collective from diverse backgrounds, histories, knowledge systems and values.

**Keywords:** Southern Ocean, Antarctic, Indigenous knowledge, climate science, interdisciplinary, cross-cultural

## INTRODUCTION

Communicating and understanding knowledge from a range of sources, views and diverse values are fundamental to making robust and enduring decisions (Gorddard et al., 2016; McElwee et al., 2020). In this era of the Anthropocene there is greater awareness of global values (Gurney et al., 2017; Martin et al., 2020), resulting in people across the globe connecting with regions other than those they inhabit. This is especially true for the global value of the Southern Ocean which

regulates key physical, chemical, and ecological processes (Grant et al., 2013; Cavanagh et al., 2021, Murphy et al. to be published in this research topic). This perspective is an invitation to enhance understanding of scientific data and knowledge from different cultural backgrounds through the arts.

Understanding does not hinge on trans-disciplinary and cross-sectoral academic communications alone, but on new and ancient evidence from people listening and responding to changing patterns in lands and waterways. This is demonstrated by artwork in everyday life, conveying messages in many different forms. In this paper we explore and highlight this more holistic approach for understanding and communication, through scientific data and art.

An increasing body of literature identifies how Indigenous perspectives move us away from a strictly utilitarian approach in the present, to a more socially and globally aware approach for the future (e.g., McElwee et al., 2020; Ogar et al., 2020). The latter approach is one that is grounded in deep knowledge of the past leading to the present, and provides a pathway toward a preferred future. Central to the approach we describe here is expression through many art media, to build on messages otherwise confined to scientific data and analyses alone; the arts are used for deep listening to the data and to Country, to expand understanding beyond specific science terminology, to appeal to the senses for deeper, more memorable engagement and relationships.

We regard the region of Antarctica and the Southern Ocean as a prime example of where deeper communication can help decision-making because of the heterogeneity of cultures and people directly involved in the Antarctic Treaty system. While nobody calls Antarctica home, the region is important globally for many ecosystem services (Grant et al., 2013, Cavanagh et al. to be published in this research topic; Murphy et al. to be published in this research topic) and its management relies on the best available science (Constable et al., 2000). While the work of the Commission for the Conservation of Antarctic Marine Living Resources is informed by a Scientific Committee, the interpretation and use of the science may be driven by different national norms and perspectives. Moreover, the world's people have a deep, often unacknowledged, connection with the region and value it greatly, despite not living there. Sound management of the region is dependent not only on the science but also an ability to understand different perspectives, cultural sensitivities and global priorities.

This paper is developed in the context of this region, to show how art and conversational processes can be used to facilitate not only understanding of science but also different perspectives that may not just be about use of the region but also about its value to life everywhere. We adopt the general approach used in Indigenous cultures to embed oral knowledge in stories that are introduced from childhood as moral tales. These tales provide a context for the growth of knowledge as the child grows. We approach this work with the moral perspective that we need to come together to share our experience and feelings around such issues in order to come to a unified action for ocean cultural management. We acknowledge that this approach is available to everyone (Shawn Wilson, 2008). This approach is not foreign to the scientific domain. Recent

controversies in the scientific literature about how marine fisheries should be managed have been harmonised through workshops (conversations) of scientific experts from across the spectrum views. These workshops and joint studies have yielded important lessons, intellectual growth and understanding amongst this wide group (Worm et al., 2009).

The concepts for the paper are developed in three sections. The first section reflects our rationale and approach, describing the importance of deeper communication, such as through the arts, to the policy process; more enduring decisions are possible by engaging and obtaining perspectives through more than just immediate utilitarian outcomes but with a longer term view. The second section draws on the LivingData<sup>1</sup> initiative which is using art in all its forms to bridge differences in knowledge systems and their values. LivingData provides examples of how Indigenous knowledge and Western science can be complimentary, and how Indigenous knowledge can show the difference between historical natural environmental phenomena and current unnatural phenomena, including how the Anthropocene is disrupting cultural connections with the environment that ultimately impact everyone. Our perspective is derived from a group with different backgrounds, histories, knowledge systems and world views. In the final section we document the process of this experience and draw lessons from it, on how deeper communication could benefit future decision-making.

## RATIONALE AND APPROACH

*Antarctica and the Southern Ocean are central to global life. They are the pulsing heart of our planet, regulating, refuelling and balancing (Fraser et al., 2020; Murphy et al. to be published in this volume) [http://www.lunartime.net.au/content/library/sandtalkminds/ancestor/ocean-dance-ancestor.php Ocean dance 2020. Lisa Roberts (animation), Paul Fletcher (music), Stephen Taberber (music); http://www.lunartime.net.au/content/library/sandtalkminds/pattern/ocean-dance-poem-pattern.php Southern Ocean Dance Poem 2020. Andrew Constable (poem), Lisa Roberts (dance, motion capture), Paul Fletcher (music, animation, post production)]. The Antarctic Circumpolar Current merges with deeper, warmer, nutrient-laden waters to create the frenzy of birds, fish and whales feeding on krill, which feed on phytoplankton. In the southern regions of the world we brace against its winter weather patterns on our distant shores, and watch whales, seals and seabirds touch these more northern regions. In this way we directly experience the ongoing connection between the Antarctic, the Southern Ocean and ourselves. Though we are not always aware of it, we are all deeply connected to the southern polar region.*

Since ancient times we humans have known ourselves as part of nature. We have known and respected our relationships with lands and waterways necessary for sustaining life. Indigenous knowledge of this relationship endures through experience, sharing and consensus between people. While Western science has been credited for discovering and documenting intrinsic connections between humans and the natural environment,

<sup>1</sup><http://www.livingdata.net.au/>

such discoveries and observations are older than our Western records. They have been, and are maintained through stories, merged and layered with messages about how we must behave as custodians of Country. This knowledge is passed on by generations of communication through the arts, reflecting the diverse forms in which knowledge is expressed and remembered through all the senses.

Being so geographically removed it can be difficult for us to recognise or engage with the role of the Southern Ocean in our lives. This is exemplified by the disconnection of wider society from the issues of climate change and the melting poles. While we can be shown and told about its occurrence, and lectured on its effects, our general lack of physical relationship limits our empathy. We can create empathy by sharing scientific knowledge (as stories, narratives) using methods that facilitate connecting tangible data and abstract concepts to more deeply felt emotional responses in our audience. Storytelling through the arts has been pivotal for this purpose for millennia. Re-embracing the power of the arts for sharing knowledge may allow us to establish an emotional relationship between disparate places and diverse peoples.

In the face of increasing pressures on Earth's systems, change is happening faster than we can acquire scientific data to guide environmental management. Pattern-matching between Indigenous stories and Western data, combined with their cultural endurance through arts, demonstrates the wealth of knowledge contained within the stories (Nunn and Reid, 2016; Nunn, 2018). By using established experience-based knowledge that is contained and preserved in stories that have been echoed through time, we may uncover insights into how best to face our current environmental crises. Listening to collective knowledge, we can start to fill the data gaps that will enable sustainable decision making.

Our purpose is to bring together stories from modern science and traditional cultural knowledge systems, acknowledging that wise decisions must be made now, for sustaining humanity. We invite readers to understand (through science) and to experience (through art) diverse ways of thinking that together give a holistic view of what is necessary to assess and communicate the value of the Southern Ocean globally.

In doing so, we are endeavouring to expand scientific understanding through the arts, to more fully inform policy developers and decision makers about the health of the Southern Ocean that impacts on the health of people worldwide. Here, we introduce ourselves as co-authors of a project that will evolve over the next three years (see **Supplementary Material**). We explore the role that art plays in expressing knowledge, perception, scientific evidence and cultural values across temporal and spatial dimensions.

Our approach utilises a grounded, inclusive holistic methodology. This means that through conversation, sharing of experience, stories and art, and discussing the relationships between these stories, we develop a collaborative story that reveals connections between the different perspectives. In this way we anticipate that people will recognise their own voices as part of the process of knowledge production that is necessary for expanding understanding and adapting to climate change.

Rather than adopting the linearity of a pre-specified scientific process, we used a connected round-table discussion that brings holistic understanding. This form of knowledge sharing as a group follows an Indigenous model of yarning (Bessarab and Ng'andu, 2010) and allows further integration of knowledge across this interface.

We determined that the main method to facilitate communication, understanding and relationships between different knowledge and cultural systems is the sharing of stories on location, so we use an interactive map (MEASO Cultural Connections, 2021) which features the placement of different stories and perspectives on a world map.

The MEASO website map not only collates stories and their relationships to one another but also invites others to continue the expansion of scientific understanding in the community through experience of the stories told on virtual Country and the arts presented therein. The placement of each story (see **Table 1**) from the authors onto the map relates to whether it is a perspective of Southern Ocean ecosystems generated from within the region, or from afar, through cultural understandings. Our stories are then categorised by ways of thinking that together work to give a more holistic view (see Yunkaporta, 2019). Geographic mapping of stories on the map aims to inform and inspire policy decisions with scientific accuracy and artful engagement, to support the sustainable management of the Southern Ocean ecosystem that plays a key role in the global climate system.

By journeying within this map people from different perspectives can see how the stories tie together and build a picture of a world that has been changing for millennia and is changing more rapidly now. Included in our group of authors are scientists, artists, scientific artists and artistic scientists. We include Indigenous authors from various countries along with stories they have shared with us and drawn significance into our work over many years.

## CIRCUMPOLAR CONNECTIONS: STORIES SURROUNDING THE SOUTHERN OCEAN

Weaving provides a useful analogy for the mind's process of making sense; what often begins as a tangle of threads, once woven, creates a whole that is often both beautiful and useful. Through 'sense weaving' we create connections that together, hold the form and shape of our weave, avoiding tangling or unravelling. For the mind, interweaving of ideas or information is often assisted by their delivery through story. For this reason, throughout history, stories have been used to impart lessons, ensuring the safety and survival of successive generations.

Stories are a central part of cultural identity and through continual re-telling, help awaken a broader awareness and relationship to the interconnectedness of life. Stories are formed with deep connections to place, sometimes called Country, and are typically only relevant to that area. As the environment changes between places, so too do the stories, although commonalities are often found. These commonalities

**TABLE 1** | Stories conveyed through the interactive web-based map of MEASO Cultural Connections (<http://measocc.teachingforchange.edu.au/>).

Living Data Stories	Entities involved	Cultural knowledge, Values	Ecological concepts, Lessons
<p><b>Scientific Modelling</b> <a href="http://measocc.teachingforchange.edu.au/node/130">http://measocc.teachingforchange.edu.au/node/130</a>                      How can a scientific model be communicated through art?                      Location: Margate, Tasmania/Palawa Kani 42.9769°S, 147.3083°E</p>	 People	<p>Since ancient times, cultural leaders have observed and recorded patterns in nature. They have predicted, experimented and gathered evidence of behaviours needed to sustain life.</p>	<p>Reciprocity between peoples and environments maintains balance in nature. People's failure to recognise natural patterns and disruptions to these patterns can lead to ecological collapse.</p>
<p><b>Krill Sex</b> <a href="http://measocc.teachingforchange.edu.au/node/101">http://measocc.teachingforchange.edu.au/node/101</a>                      A first time look at the complete mating dance of <i>Euphausia superba</i> (Antarctic krill) is expressed as art and scientific data.                      Location: Southern Ocean/Animation (language of change and transformation) 65.87°S, 88°E</p>	 Phytoplankton, Krill, People	<p>There are places where people must not intrude, in order to ensure that natural cycles of life endure for future generations.</p>	<p>Disturbing breeding grounds of keystone species threatens whole ecosystems. The arts can be used for deep listening to nature, and to combine scientific data and expressions of relationship.</p>
<p><b>Ocean Dance</b> <a href="http://measocc.teachingforchange.edu.au/node/147">http://measocc.teachingforchange.edu.au/node/147</a>                      Animation brings together many meanings and understandings of the Southern Ocean: flows of ideas, currents, nutrients, waste, perspectives, temperatures, ice, global connections.</p>	 Ocean currents, Cultural flows, People	<p>Flows of new and ancient cultural knowledge inform protocols for developing and sustaining relationships between peoples and places.</p>	<p>Global systems evolve through complex interactions between smaller systems. Dance, music and animation can be used to express the complex interactions that turn the clockwise Antarctic circumpolar flows into the anticlockwise flows of the Arctic.</p>
<p><b>The art of making images</b> <a href="http://measocc.teachingforchange.edu.au/node/155">http://measocc.teachingforchange.edu.au/node/155</a>                      An empirical study shows relationships between First Nations people of Tierra del Fuego, the land, water and spiritual systems.                      Location: Tierra del fuego/Yagan, Selk'nam and Kaweskar 54.8054° S, 68.3242° W</p>	 People, Whales, Dolphins, Pinnipeds, Birds, Fishes, Molluscs	<p>Knowledge of balance, union and preservation of natural resources is perpetuated through arts that embody ancestral beings and spirits with deep connections to the fauna and landscape.</p>	<p>People co-evolve as part of environments. Eliminating waste can sustain peoples, lands and waterways. Making art that appeals to spirit connections can strengthen human identity as part of the whole natural system.</p>
<p><b>Gumbayngirr story</b> <a href="http://measocc.teachingforchange.edu.au/node/118">http://measocc.teachingforchange.edu.au/node/118</a>                      Sea level rise stories from Western science and Indigenous cultural knowledge complement each other.                      Location: Ngambagabaga (Nambucca Heads)/Gumbayngirr/Animation 30°S, 153°E</p>	 Whales, Fish, Krill, Algae, People	<p>Ceremonies maintain knowledge of natural climate patterns and reciprocity between creatures of the ocean and the land.</p>	<p>Life evolves through interactions between entities in waterways and on land. Artistic and mythical expressions of ancient eye witness accounts of such events as sea level rise can make these stories memorable and believable, and so better prepare people to adapt to change.</p>
<p><b>Whales return to land</b> <a href="http://measocc.teachingforchange.edu.au/node/150">http://measocc.teachingforchange.edu.au/node/150</a>                      People across the globe relate to whales and so connect with the Southern Ocean which regulates key physical, chemical, and ecological processes.                      Location: Gulaga/Yuin 36.378°S, 150.13°E</p>	 Whales, Snakes, People	<p>Whales come to land to regurgitate the lore so that land and sea can know each other as relations (Pascoe, 2019).</p>	<p>Connections endure between terrestrial and oceanic entities, physically, biologically and spiritually, as knowledge endures and expands as new and ancient knowledge systems are valued, understood and practiced.</p>
<p><b>Way of the Turtle: Exchanging Breath</b> <a href="http://measocc.teachingforchange.edu.au/node/140">http://measocc.teachingforchange.edu.au/node/140</a>                      The primal spiral form calls for taking time to listen and deeply observe and to appreciate the world around us.                      Location: Parihaka/Māori/Yorta Yorta 39.3°S, 173.0°E</p>	 River, Blood, Sweat, Tears	<p>The river represents our bloodstream, the mist represents our sweat and the rain represents our tears.</p>	<p>An ecosystem evolves between entities relating in ways that benefit the system as a whole. Human relationships to Earth are expressed across cultures in song, symbol and story. So the spiral can be repeated in diverse forms, times and contexts, to deepen and share individual experiences of relationships in cycles of Earth.</p>

(Continued)

TABLE 1 | Continued

Living Data Stories	Entities involved	Cultural knowledge, Values	Ecological concepts, Lessons
<p><b>Shell necklace</b> <a href="http://measocc.teachingforchange.edu.au/node/163">http://measocc.teachingforchange.edu.au/node/163</a>            Indigenous knowledge can show how the Anthropocene is disrupting cultural connections with the environment that ultimately impact everyone.            Location: Cape Portland, Tasmania/Tebrakunna            Country 40.782°S, 148.026°E</p>	 Yolla (short-tailed shearwater), Kelp, Sea shells, People	Sea country traditional knowledge is disappearing as coastlines recede, and oceans become more acid.	Disruptions to natural climate patterns disrupt traditional cultural practices. Changing coastlines in Tasmania are affecting nesting of yolla, a traditional food. Rainbow kelp shell ( <i>maireener</i> ), an iconic shell for necklace-making by the tabrakunna women, are in decline.

*These stories have Indigenous, scientific, or artistic origins, each reaching into cultural traditions and values as well as providing ecological concepts and lessons. Links are to the pages underlying the map which provide the details and background of these stories. Location provides a description of the location and the approximate Latitude (decimal degrees) and Longitude (decimal degrees) from where these stories emanate and/or of where these stories relate.*

can instruct us on how to live harmoniously and sustainably with our surroundings. For example, Miriam-Rose Ungunmerr's discussion around Dadirri (deep listening) resonates not only for the Ngangikurungkurr people of the Daly River area of the Northern Territory in Australia (references to Indigenous Australia can be located on the AIATSIS Map, Horton, 1996), but provides a lesson that we can all learn from – to take the time to listen and deeply observe one's surroundings and to appreciate the world around us (Ungunmerr, 2017).

Historically, storytelling and the communication of ideas evolved through a diverse range of mediums: sand painting, dance, oral recitation, tapestry, sculpture and song, all of which enabled reliable transfer and translation of knowledge through time (Davidson, 2020). These mediums also invoke powerful emotional responses, helping us make deep empathetic connections to the elements within the story. Perhaps First Nations storytelling techniques can straddle the boundary between cultures, bringing collaboration and harmony between knowledge systems and evoke emotional engagement with environmental issues. Maybe through this lens we can effectively communicate the importance of ecological sustainability to a broader audience. There is willingness and capacity in Indigenous peoples to embrace European knowledge systems into their own where beneficial, for moving forward together for the common good. 'We are not exclusive, pushing others away. . . even in our grandparents' time, we were not a village of closed, unchanging tradition' (Bashkow, 2020, p.189). Interlacing narratives from different perspectives is generative. Melding and cross-referencing stories creates movement from fixed to evolving relational views.

Perceptions of history and culture based on traditional colonial concepts and values limit the capacity for interrelated understandings by privileging a single linear voice, thereby limiting the building of relationships. Linear story-telling on its own cuts one line of thought like an argument for possession, definitively naming and claiming through language that forms separation, not relationship; this dominant voice erases the stories of any who do not identify with this experience of history, including the exclusion of the many Indigenous voices that have for so long enabled enduring knowledge for sustaining life (Olivier, 1986; Todorov, 1987). As in nature, old and new patterns unfold in storytelling. Consider genetic conservation in

the evolution of the human brain, with its layers of ancient and recent cognitive capacity enabling "the unparalleled explosion in behavioural repertoire from tool use and language to science and art." (Bruce T. Lahn. Howard 2008. Hughes Medical Institute, Department of Human Genetics, University of Chicago, Chicago, IL, United States).

Consider the conservation of congregational ceremony of Indigenous Australians, the corroboree, where stories from far and wide are brought and shared over days through multifarious and layered forms of expression. Everyone is included in the creation of ceremony, with contributions from children through to Elders. Consider in contrast, international scientific conferences where the structure is designed to give voice only to those deemed important. Consider the power of the collaborative and coalescing practices experienced during a corroboree and how they effectively give a richness to the subject of exploration.

Pattern matching (**Figure 1**) allows us to recognise the value and endurance of stories. In the Yuin story of Guruwal (the whale, known by various names by different First Nations people), we find strong parallels (pattern matching) between Indigenous knowledge sharing and Western science. Australian Yuin Nation cultural knowledge tells us that Guruwal "...will come back to the land and regurgitate the lore so that the lore can be complete and the land and sea can know each other"<sup>2</sup>. Western science tells us whales came from the sea, evolved on land into a wolf-like creature, *Pakicetus*, before returning to the sea, first as amphibious *Ambulocetus*, and through time evolving into completely aquatic animals of the ocean, emerging as the whales we see today (Gingerich et al., 1983; Thewissen and Hussain, 1993), many of whose modern distribution patterns have been shaped by the Antarctic Circumpolar Current (Fordyce, 1980). This story illustrates the enduring link between land and sea, and how Western science can support cultural values of care for the environment, which endure through the arts. Such stories reflect patterns of relationship between the oceans and the earth on geological timescales, and knowledge of the evolution of marine mammals, propagating reverence for their nurturing and persistence.

Another example is a dreaming story by Aboriginal people in Maningrida (Arnhem Land, Northern Territory) about an island

<sup>2</sup>Bruce Pascoe, 2019, Pub. Black Inc., Salt p. 134



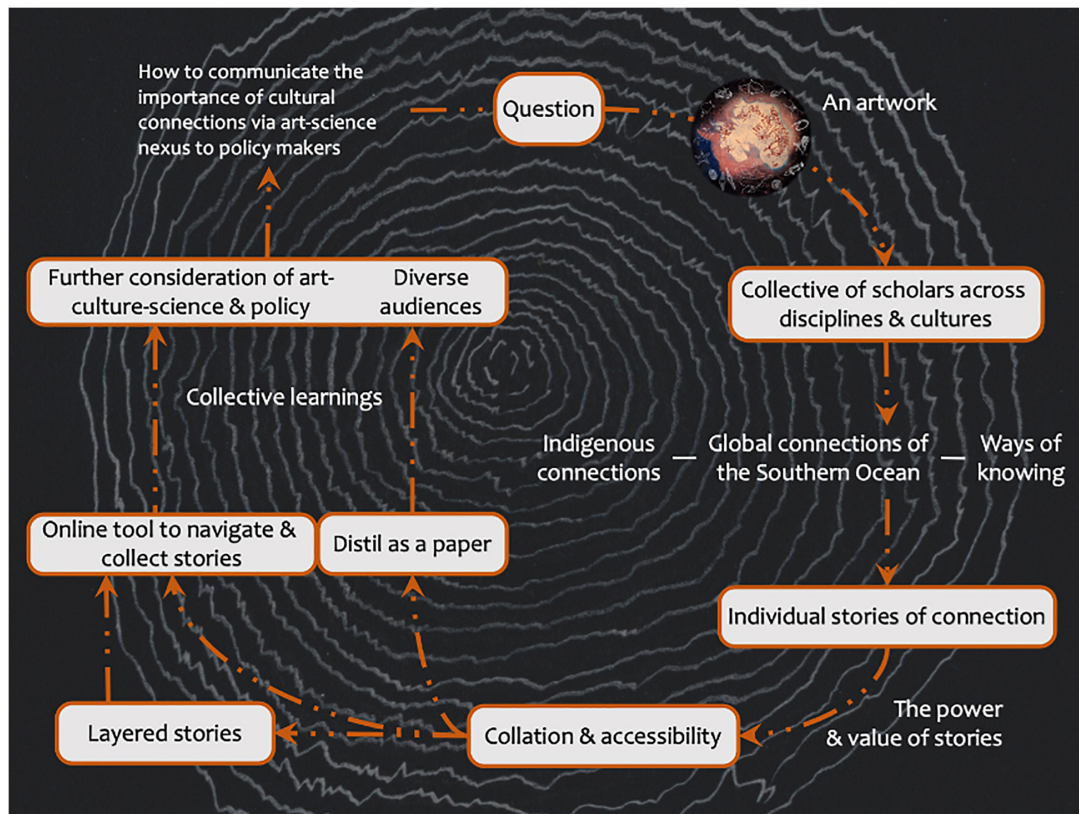
**FIGURE 1** | Artwork signifies origins of this project in bringing together Australian Aboriginal perspectives and scientific data from Antarctica and the Southern Ocean. This illustrates pattern-matching between the Australian river catchments on the ice catchments and glacial flows of Antarctica.

cut off from the mainland (John Church, UNSW, pers comm.). This story was corroborated recently by modern science using scientific data on sea level changes over the last glacial period. Using records, climate scientist John Church was able to date the origin of the story to around eight thousand years ago, a time when sea level was rising following the last glacial maximum<sup>3</sup>. Other examples of similar phenomena were explored by Nunn and Reid (2016) and if we listen closely to the messages in the stories, we find that they also carry information on the responses of Indigenous people to the threat of rising sea levels, for example to build barriers of wood or rock (Nunn, 2020). In the age of the Anthropocene, we find ourselves facing rising sea levels once again and maybe it is within these stories that inspiration for adapting to disappearing shorelines can be found.

<sup>3</sup><http://www.livingdata.net.au/content/conversations/2019conversations/SeaLevelScience-and-a-DreamingStory.php>

The arts have always been powerful languages for generating and expressing knowledge, because of their capacity to interact with our values and emotions. The immersive experience of artistic expression on its audiences can break down barriers that often prevent people from relating to places, data and facts. By inciting an emotional connection or bodily response, arts can enable people to imagine themselves as participants in the stories being told, and so may become more motivated to strive for a healthy planet and sustainable future.

The term 'art' remains epistemologically, politically and theoretically relevant in scholarly work related to Indigenous art, since it emphasises that all societies are capable of producing artworks of diverse features, which do not necessarily have to accommodate Western conceptions of what art is, or is not (Fiore, 2020). This perspective has been applied to the analysis of the production of engraved artefacts and body paintings from Tierra del Fuego (Southern South America). Drawing



**FIGURE 2 |** Process used to develop this perspective based on the question of how to communicate to policy-makers the importance of cultural connections with the Southern Ocean, and the emerging values for the region, via art-science nexus.

from archaeological and ethnographic evidence of art production in Yagan territory (also known as Yamana, located in the southernmost portion of the Fuegian archipelago), Fiore (2020) presents the relationship between the First Nations people, the land, water and spiritual systems as not only represented in images applied to tools, ornaments, non-utilitarian objects and bones, but also evident in material procurement and pigment production processes to create body painting designs. The socioeconomic life of Yagan art moves through the collection of raw materials, technical and social processes of application, to storage, discard or abandonment. Gell's (1992) concept of "technology of enchantment" is applicable here, since it helps to shed light on the fact that art is not simply the end result, but the affordance gained during the alchemical power of its making. The relational nature of making undeniably connects the maker to the environment in which the making occurs.

Yagan art/making in Southern Tierra del Fuego includes technological affordances related to the labour organisation underlying portable art and body art creation, and the contexts in which they were manipulated, displayed, viewed and reacted upon (Fiore, 2020). According to ethnographic and historical records, material and pigment procurement, preparation and storage relied on mineral colouring substances as well as organic components of whale, dolphin, pinniped (seal), fish, and mussel shell. Since prehistoric times, highly geometric

designs were applied to tools, domestic utensils and body adornment. The techniques used to produce these images reveal high skill and knowledge in managing production processes, as well as possessing spiritual portent. Currently, 'making' is viewed as a constant dialogue between the eye, mind, and hand, linked closely to problem-solving and critical thinking (Maeda, 2013). For the Fuegians, image creation constructed and reinforced social roles and relationships. The ephemeral performative affordance of body painting and non-ephemeral decorations engraved on bone artefacts conceptually broadcast the power of images being rooted in their making (Fiore, 2020). Moreover, several ceremonial body painting designs represented maritime animal referents. Therefore, we would be wrong to assume there is, or was, little connection between art/making and the Southern Ocean given its proximity to the ancestral territories of Tierra del Fuego's Indigenous populations.

This paper invites expanding understanding of scientific data through diverse languages of art, acknowledging ourselves as participants in the processes that govern our planet's chemistry and our human cultures. Indigenous perspectives develop depth and breadth that engender an unaffected connection with the environment, and ability to work harmoniously with Nature, to tread lightly, in terms of ecological footprint, through time. From a Fuegian perspective:

*“Belonging to an Indigenous Community or First Nation is a fact that gives us a deeper vision of our environment: being part of it and not considering ourselves as its owners is what makes us have a deeper connection with Nature than other inhabitants of our cosmopolitan City [TN: the referred City is Ushuaia, capital of Tierra del Fuego]. Yagan crafts are involved in our everyday life, our children grow amongst bark canoes and reed baskets. Baskets have been made with the same Ancestral process for thousands of years, which lasted with its maximum purity. Today we make miniatures so that people from all the planet can take with them our message of balance, union and preservation of natural resources, since, in the end, we are all human and we must understand that our future depends on mother nature before it is too late. It only takes us to look at the current situation that we are facing now in August 2020, to reflect about our life in this earth. It is urgent that we look back [TN: toward our past] to replicate much of the way of life of our First Nations – Pueblos Originarios – who lived in perfect balance with the environment: for this reason, they could carry on living for thousands of years. From the South of Tierra del Fuego, I send you a greeting in my mother tongue: Ala Yala mamakús, hasta pronto hermanos, see you soon brothers.”*

Víctor Vargas Filgueira  
Primer Consejero Comunidad Indígena Yagan Paiakoala  
de Ushuaia TDF  
(First Chancellor of the Comunidad Yagan Paiakoala  
of Tierra del Fuego)  
Translated from the original Spanish by D. Fiore

Linked with this paper are a selection of stories positioned on the map described above with circumpolar connections to physical and ecological processes in the Southern Ocean, told through languages of art and science (see examples of these stories in **Table 1**, with hyperlinks to these stories on the MEASO Cultural Connections, 2021, website).

We acknowledge that people have authority to share such stories through their relationship to the story and its location, so the stories are attributed to their authors. Types of authority people have to a story include the following:

1. They work where the story is located and consult with relevant cultural leaders about protocols and accuracy.
2. They are related by family to a person from that story, or to a person having close/family ties to that place.
3. They come from the country where the story is located, linked through clan, or language.
4. They are a member of the clan/group who were involved in the story.
5. They have personal involvement in the story at that place through skin or totem, and hence responsibility for the story themes and content (Povinelli, 1993).

This process ensures that knowledge is not shared by those who do not have authority on the story and may miss-tell it. This is important in the process of keeping oral knowledge ‘pure’ as we do in establishing expertise in written works. Through collaboration with others from the area we develop an objective knowledge viewpoint, that surpasses our individual interpretations.

## DISCUSSION AND CONCLUSION

Humans have always been closely connected with the sea, as a provider, passage of transport to new places and bearer of stories. The great southern continent of Antarctica lies at the intersection of the world’s oceans, where exchange between waters occurs. The heart of the planet, Antarctica pumps life throughout the global ocean, regulating temperature, transporting nutrients and oxygen to all corners of the globe (Marshall and Speer, 2012). Although there is no evidence that Antarctica has ever welcomed humans, the icy continent and its waters are part of stories and knowledge enduring through deep time and diverse cultures. This endurance is shown palpably through our animated interactive map. Through time, like the circumpolar current surrounding Antarctica, stories endure, travelling between peoples and poles, as both physical and imaginary explorations, connecting, growing and sharing knowledge of the vast Southern Ocean ecosystem.

In this perspective, we have considered how the stories and connections that bring together knowledge from Western science, Indigenous ecological knowledge and the Dreaming can promote understanding of and connection with the Southern Ocean. It has also demonstrated how deeper connections to the region and value of it are present within many cultures distant from the region. By combining new and ancient ways of expressing, embodying and passing on knowledge we hope to inspire collective ways of thinking. We encourage ways that are inclusive across diversity of experience and knowledge, and that develop deeper understanding, which will galvanise the making of a healthier future.

We came together from a range of backgrounds, with different ways of knowing and perceiving the world, to better understand the roles that Southern Ocean ecosystems play in the world and how Indigenous cultural perspectives underpin modern scientific understanding and enable enduring cultural engagement that is necessary to manage and sustain the health of the Southern Ocean and global ecosystems in these times of climate change and the Anthropocene.

**Figure 2** illustrates the process that evolved as we engaged across disciplines and cultures to more deeply understand, respect, record and combine perspectives, to contribute to the holistic view that we consider necessary for best informing government policy on management of Antarctica and the Southern Ocean.

Through this process we have described how cultural arts have power to deliver, to a diversity of people, information that is based on ‘hard data,’ and that this is not something new – the interweaving of complementary knowledge systems is ancient and intrinsic to Indigenous cultures. Communicating stories generated through the scientific method and cultural arts in all its forms, increases accessibility across diverse audiences (from the general public to policy makers), is an important means to disseminate facts, and critically, enables people to personally engage in different ways of knowing. When compared with contemporary (and in many ways fleeting) means of communicating scientific findings (reports and papers),



the sharing of knowledge through a diversity of cultural arts practices is enduring, for co-authors and readers alike.

In this paper we have brought together ways of knowing through scientific data and the languages of arts, to more wholly engage people, through the process of first engaging ourselves in relating to the Southern Ocean ecosystems (which currently face an uncertain future), through the power of cultural connections for enduring conservation and long-term sustainability. Along the way we continue to learn about ourselves and each other, having also learnt that there is a long road ahead. It has been a journey of asking questions, listening deeply to one another and to Country as Ungunmerr teaches in Dadirri (Ungunmerr, 2017), deliberating on what transpires and develops between us, and translating that sharing into outputs for sharing with others, while inviting others to engage with us. We have laughed, we have despaired, we have felt enlivened and challenged. We have seen more deeply the complexity of the challenge. There is much still to be done.

We feel enlivened by the process that has evolved between us, for helping to build new relationships between cultural knowledge and scientific data, through the diverse languages of art, which are now constructively entangled with these written words needed for academic publication.

## DATA AVAILABILITY STATEMENT

The datasets presented in this study can be found in online repositories. The names of the repository/repositories and accession number(s) can be found below: <http://www.lunartime.net.au/content/about/accession-numbers/001-SouthernOceanCulturalConnections.php> and [https://measocc.teachingforchange.edu.au/mappable\\_items](https://measocc.teachingforchange.edu.au/mappable_items), the latter of which has ID numbers for reference to map.

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## AUTHOR CONTRIBUTIONS

AC, LR, KP, and JM-T did the facilitation and oversight. CK did the interactive map. LR, TB, AC, PF, DF, EJ, CK, JM-T, KP, MS, and ST did the round table conversation. LR, TB, AC, DF, EJ, CK, JMT, KP, MS, and VF did the text. PF and ST did the music. LR and PF did the animation. KP and LR did the **Figure 1**/Graphical abstract artwork. JM-T, LR, and KP did **Figure 2**. Interactive map with stories: (<http://www.livingdata.net.au/content/collaborations/2020collaborations/2020-collaborations.php>). All authors contributed to the article and approved the submitted version.

## FUNDING

Pew Charitable Trusts for the cost of publishing this manuscript.

## ACKNOWLEDGMENTS

We thank Jenny Fraser for her Aboriginal Australian digital art perspective of the ocean contributed to the MEASO Cultural Connections web site (<http://measocc.teachingforchange.edu.au/node/105>) and to Lynden Nicholls and Tiriki Onus for participation and guidance in some of the round-table discussions. We would like to thank William Gladstone and Mibu Fischer for their insightful comments to improve this manuscript. We would also like to thank Irene Schloss for facilitating the inclusion of a Tierra Del Fuegan cultural perspective.

## SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fevo.2021.616089/full#supplementary-material>

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**Conflict of Interest:** The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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