Article

Amplifying Indigenous community participation in place-based research through boundary work

Melanie Zurba [ID]

School of Resource and Environmental Studies and the College of Sustainability, Dalhousie University, Canada

Kirsten Maclean and Emma Woodward

Commonwealth Scientific and Industrial Research Organisation, Australia

Durdana Islam

The University of Winnipeg, Canada

Abstract
'Boundary work' is a relatively new and innovative qualitative approach in place-based research and often involves the creation of 'boundary objects'. Such objects can be created collaboratively with Indigenous communities, and can be used to communicate knowledge, values and aspirations across social and political boundaries. This article provides an account of boundary work within place-based research communities of practice developed between geographers and Indigenous communities. We draw on our own boundary work research and present a conceptual framework for geographers to draw on when engaging in boundary work and co-creating boundary objects with Indigenous communities.

I Introduction

Increasingly, geographers must account for place-based governance systems in their research that are complex, are governed by multiple parties, and often require joint action from multiple partners (Armitage et al., 2010; Berkes, 2010; Sattler et al., 2016). Governance is not always easily implemented, especially if there are multiple centres of authority and interested parties involved (Andersson and Ostrom, 2008). This often means there will be numerous perspectives, interests, and values at play at the different and specific places in which the governance is enacted. Deliberative and

Corresponding author:
Melanie Zurba, Dalhousie University, Kenneth C. Rowe Management Building, 6100 University Ave., Halifax, NS Nova Scotia B3H 4R2, Canada.
Email: Melanie.Zurba@dal.ca

participatory processes, including those that can engage communities, are important in order to promote sustainability and social responsibility within place-based governance (Coombes et al., 2012). Despite their continuous involvement in navigating place-based governance over several decades (Berkes, 2009; Watson et al., 2014), Indigenous communities are often marginalized from decision-making processes, or are assigned roles in governance that are less than meaningful and do not create outcomes that are reflective of local, traditional, cultural or spiritual values (Carter, 2010; Suchet-Pearson et al., 2013; Maclean et al., 2015). Such structural injustices are at least partially maintained by a lack of understanding across communication barriers existing at the 'boundaries' between groups.

The work of Indigenous communities and their allied partners in promoting Indigenous rights and pathways to participation in place-based governance has led to a growing awareness among Indigenous communities, academics, governments, and organizations that more work needs to be done to diminish structural injustices and revise governance systems towards building equity and reaping the social and environmental benefits of local and Indigenous participation and collaboration within governance systems (Zurba et al., 2012; Gebara, 2013; Woodward and McTaggart, 2016). This article explores the potential for 'boundary work' and the creation of 'boundary objects', two emerging concepts in human geography research and allied fields such as planning and natural resources management, to guide how research communities of practice, or '(R)CoPs', involving researchers and local and Indigenous communities may overcome barriers in place-based governance. The connection between communities of practice and place is explained by Doreen Massey in the following way: 'what gives a place its specificity is not some long internalized history but the fact that it is constructed out of a particular constellation of

relations, articulated together at a particular locus'(1993: 66). We work with this understanding of communities and also frame (R)CoPs as having three core components (Wegner, 1998; Wenger et al., 2002). The first is the *domain*, which refers to a 'concern, set of problems, or passion about a topic' (Wenger et al., 2002: 4). Such concerns and problems are embedded in place: they relate to issues about the governance of and care for those particular places. The second is the *practice*, which refers to actions and knowledge generated by the group. These actions and knowledge are both enacted and generated at particular places, and shaped by those same places. The third is the *community*, representing the interpersonal relationships that are built through engaging in practice and learning together (Wegner, 1998; Wenger et al., 2004) that are shaped by concerns, knowledges and actions that are embedded in and influenced by place.

We adopt Kooiman's (2003: 4) understanding of governance as 'the totality of interactions, in which public as well as private actors participate, aimed at solving societal problems or creating societal opportunities', and agree that institutions are central to governance and the establishment of contexts and norms guiding governance systems (Kooiman, 2003; Kooiman and Jentoft, 2009). We draw on Crawford and Ostrom's (1995) understanding of institutions as structures, rules, norms, and shared strategies affecting human actions and physical conditions manifesting in various social organizations. Institutions, as such, can range from formally enshrined organizations, such as legally bound partnerships, to less formally defined groups, such as groups of people in a community coming together around a common concern (Ostrom, 1990, 2005). These concepts enable us to frame how boundary work has become an important emerging concept and way of working with Indigenous communities on place-based research. We illustrate the concepts and frameworks through case studies of

boundary work and the types of boundary objects from our own place-based research, and explain how boundary objects are an extension of participatory action research (PAR) principles. We then illustrate how boundary work can guide practice within (R)CoPs and make the case for the functionality of framing boundary work towards overcoming barriers and creating spaces for interaction in place-based governance and enhancing equity, learning, and relationship building between local and Indigenous communities and researchers.

II Indigenous participation in geographic research

The history of Indigenous people's engagement with research is predominantly one of exclusion, marginalization, disempowerment and appropriation, embedded in unequal relationships of power and privilege (Smith, 2012). The history of research is so deeply embedded in colonization that it is still regarded by many Indigenous people as a tool only of colonization and not as a potential tool for self-determination and development (Smith, 2012). Geographers, mindful of these histories and cognizant of the disempowering and marginalizing effects of 'researcher-researched' dichotomies, are seeking to engage with local and Indigenous communities in joint enquiry through participatory and community-based research methodologies that create 'new spaces for engagement beyond the academy' (e.g. Pain, 2004; Pain and Kindon, 2007; Marika et al., 2009; Castleden et al., 2012; Maclean and Woodward, 2013; Suchet-Pearson et al., 2013; Coombes et al., 2014; Zurba and Berkes, 2014; Islam et al., 2017; Woodward and McTaggart, 2016). Such approaches aim to unsettle practices which historically excluded local and Indigenous communities and their knowledge in research (attending to the colonial legacy of the discipline) (e.g. Rigney, 1999; Smith, 2012; de Leeuw et al., 2012), and to develop flexible and innovative research approaches that turn away from research 'on and for' Indigenous peoples and local communities toward research 'by and with' those same people (Davidson-Hunt and O'Flaherty, 2007; Wexler et al. 2015; Menzies, 2015). In many cases, long-term research involving non-Indigenous researchers and Indigenous peoples has resulted in the building of strong and meaningful relationships leading to co-learning and the building of collectives that are guided by shared ontology and a relational ethic of care (Bawaka Country et al., 2015; Castleden et al., 2017).

Participatory action research (PAR) approaches are increasingly being used within (R)CoPs as a way of promoting ethically sound research that aims to support the self-empowerment of marginalized groups (e.g. Castleden et al., 2008; Kana'iaupuni et al., 2017) to work as co-researchers (e.g. Clark and Lewis, 2016) to guide problem definition and in some instances to co-conduct the research (e.g. Mooney-Somers and Maher, 2009; Smithers Greame and Mandwe, 2017). To this end PAR approaches are informed by the philosophy of participatory rural appraisal (Chambers, 1983, 1994a, 1994b, 1999), feminist critique of conventional research practice (e.g. Haraway, 1991), decolonization theory (e.g. Mark and Boulton, 2017), and post-colonial critique (e.g. Rattansi, 1997). However, despite the intended aim to debunk conventional research practice, these approaches are not immune to critique, and nor should they be. In their review, Coombes et al. (2014) remind the reader that a researcher's assertions that they have engaged in participatory, community-empowering research may not actually equate with ethical or morally-sound conduct.

Critics also question whether these methodologies can genuinely work in partnership with the poorest of the poor and/or the most marginalized and disenfranchised who are less likely to have the capacity to engage, and who

engage from the position of greatest disempowerment (Matunga, 2013). Coombes et al. (2014) further question the effectiveness of PAR processes that emphasize cross-cultural dialogue without transference of research capacity, and are concerned with geographers' placed-based ethnographies when engaging Indigenous people in research, as they believe they 'confine' or limit Indigenous aspirations. Mindful of such critiques, many geographers working in this context see PAR as continuing to support the co-production of knowledge to create spaces for future empowerment opportunities, on-ground research actualization, and policy change to support the inclusion of minority voices in planning and management contexts (e.g. Armitage et al., 2011; Johnson et al., 2016). Frequently, such researchers consider that the research *process* is more important than the final product as the development of collaborative partnerships as well as protocols for knowledge sharing and knowledge co-production are considered opportunities for two-way self-empowerment in themselves (Cochran et al. 2008; Zurba and Berkes, 2014; Zurba and Friesen, 2014; Woodward and McTaggart, 2016).

Indigenous geographers and geographers working with Indigenous communities and in the emergent area of 'Indigenous geographies' continue to question what constitutes genuine co-research. Indeed, in their most recent essay on Indigenous geographies, Coombes et al. (2014: 849) aptly point out:

> research that took the once-radical step of 'giving voice' now patronizes and silences those whose voice is quite capable of self-expression. Qualitative methods and representational conventions that are recently commonplace are now considered inapt for fluent encounters across numinous intersecting worlds.

Geographers have responded by acknowledging the power of diverse ontologies and epistemologies in the research process and in knowledge co-production (e.g. Parsons et al., 2016). For example, Suchet-Pearson, Lloyd and Wright in their collaboration with Yolngu research partners from Arnhemland (northeast Australia) acknowledge the agency of the location of their research, Bawaka Country, in their research via co-authorship, even lead authorship (i.e. Bawaka Country et al., 2013). This act enforces the reality that 'Yolngu ontology takes seriously the more-than-human beings and influences that co-produce our world' (Wright et al., 2012: 50). Other geographers have turned their focus to consider cross-cultural research and what it means to work across different ways of knowing (e.g. Zanotti and Palomino-Schalscha, 2016). Such work includes the development of methods to 'weave scientific knowledge and Indigenous knowledge' (e.g. Johnson et al., 2016; Robinson and Lane, 2013; Robinson et al., 2016; Tengö et al., 2017) to enhance knowledge, practice and ethics to move towards sustainability at multiple scales and landscapes. These approaches highlight the importance of scientists respecting the protocols of practitioners of Indigenous science (e.g. Whyte et al., 2016) and also include a consideration to how Indigenous methodologies can inform scientific assessments of, for example, climate change (e.g. Herman, 2016; Cochran et al, 2016; Kealiikanakaoleohaililani and Giardina, 2016).

Critically, at the same time, Indigenous peoples and communities are seeking sociocultural, economic and ecological benefit from engaging in/with research, research methodologies and debates about research with communities and researchers (Tobias and Luginaah, 2013; Davidson-Hunt and O'Flaherty, 2007; Ball and Janyst, 2008; Wexler et al., 2015). Strategies include informing the research process through negotiated research agreements with their co-research partners (e.g. Maclean and Bana Yarralji Bubu Inc., 2015); involvement on ethics boards and panels (e.g. Couzos et al., 2005), leading the research process with co-research partners (e.g. Hill et al., 2014); and,

co-authoring reports and journal articles (e.g. Zurba et al., 2012; Woodward et al. 2012). Further, some Indigenous organizations are active in using research to inform state planning regimes. They do this via diverse strategies that include working with their research counterparts to develop objects to inform regimes, as well as using consensus building approaches (e.g. Peterson et al, 2005; Natcher et al, 2005; Baldwin and Ross, 2012; Maclean et al., 2015) and constructive conflict towards incremental and transformative change (e.g. Ojha et al., 2010; Maclean et al., 2015). Coombes et al. (2014: 851) also highlight the need for shifts in power within leadership and other forms of practice within (R)CoPs:

> As feminist methodologies shifted the discipline's view of its purpose a generation ago, debates about approaches, collaborations and ethics in Indigenous geographies unsettle our journey as researchers. They invite and challenge, but they also insist on a fundamental reconception of research partnerships and the grounds for mutually beneficial praxis and pedagogies. With careful response, decolonized Indigenous geographies may reveal their potential to nurture, enliven, teach and transform.

III Boundary work and boundary objects in geographic research

MacMynowski (2007: 3) defines boundary work as 'those acts and structures that create, maintain, and break down boundaries'. Within the context of a (R)CoP, boundary work can involve the support and legitimization of marginalized knowledge systems (Robinson and Wallington, 2012), and as such can be thought of as a central component of genuine co-led research. Boundary work includes methodologies to support knowledge sharing and co-creation between research partners as well as work that can translate research outcomes into on-ground action. Geographers who focus upon

methodologies that can 'weave together knowledge systems' often speak about 'boundaries' and 'boundary work' (e.g. Murray, 2001; Robinson and Wallington, 2012; Zurba and Berkes, 2014; and others discussed in Table 1). Attributes of boundary work have included joint participation in agenda setting (of the research and anticipated outcomes), co-governance approaches to broker interactions between knowledge systems, the production of boundary objects, and processes to support the translation and dissemination of new knowledge to inform on-ground action and/or policy and planning (e.g. Zurba and Berkes, 2014).

Research partnerships that are capable of producing knowledge that can transcend multiple boundaries require special attention to research methodology with a particular foresight towards knowledge translation and dissemination (e.g. Maclean and Bana Yarralji Bubu Inc., 2015). Some boundary work involves the creation of boundary objects, which Cash and Moser (2000: 115) describe as items that are 'valued on both sides of the boundary and provide a site for cooperation, debate, evaluation, review, and [institutional] accountability'. Examples of boundary objects include maps, reports and art installations. Policy itself can also act as a boundary object between groups or communities with different perspectives on how policy should be designed and implemented (Berg, 2002).

The seminal work on boundary objects by Star and Griesemer (1989) was produced in the context of knowledge translation of heterogeneous scientific interpretations occurring within Berkeley's Museum of Vertebrate Zoology. In this work they describe how boundary objects 'inhabit several intersecting worlds and satisfy the informational requirements of each of them' and state that they must be 'both plastic enough to adapt to local needs and the constraints of the several parties employing them, yet robust enough to maintain a common identity across sites' (Star and Griesemer, 1989: 393). Sapsed

Table 1. Findings and lessons from boundary work with Indigenous communities.

Research focus and governance context	Location	(Governance) Boundary (*domain*)	The Research Community of Practice (*community*)	Boundary object created or used in the research (*practice*)	Findings about boundary objects
Indigenous participation in the development of environmental flow assessments for the Wet Tropics Water Resource Planning process (see Maclean and Robinson, 2011; Maclean et al., 2015).	North Queensland, Australia	Government-led water planning and Indigenous-led country based water planning.	i. Girringun Aboriginal Corporation staff members including rangers, arts centre coordinators ii. Wigis (artists) iii. Elders iv. Government employed aquatic ecologists v. Maclean, Robinson (geographers)	(Workshop 1) Drawings and/ or paintings were created to map the values of the river system. (Workshop 2) Photograph of an iconic aquatic eel species.	(W1) The artwork acted as boundary objects to enable individuals to share knowledge and cross boundaries between elders, youngers, and different language groups *within* their community. (W2) The photograph enabled the actors (GAC and government aquatic ecologists) to discuss their diverse water values and interests. Discussion was informed by follow-up interviews with GAC elders.
Indigenous participation in sustainable water governance (see Maclean and The Bana Yarralji Bubu Inc., 2012, 2015).	North Queensland, Australia	Government-led water planning and Indigenous-led country based water planning.	i. Kuku Nyungkal Elders associated with the BYB ii. Kuku Nyungkal Rangers associated with the BYB iii. Maclean (geographer)	1. Selection of photographs taken by individuals. 2. Co-authored research reports, a co-authored journal article.	1. Photographs enabled elders and rangers to discuss their water values and interests within their group. 2. The research report was a co-created boundary object between the BYB community and the researcher. Two reports were created – one included information that was only for the Kuku Nyungkal participants, the other was created for the wider public (now a co-authored journal article).

Table 1. (continued)

Research focus and governance context	Location	(Governance) Boundary (*domain*)	The Research Community of Practice (*community*)	Boundary object created or used in the research (*practice*)	Findings about boundary objects
Girringun Traditional Owner values and perspectives for *caring for country* (traditional territory) as it relates to protected areas planning, agreements and management (see Zurba and Berkes, 2014).	Girringun Traditional Owners, Queensland, Australia	Indigenous participation in multi-jurisdictional protected areas co-management including World Heritage Areas, and the development of the first Indigenous Protected Area over both land and sea jurisdictions. Also, endangered species management through a Traditional Use of Marine Resources Agreement (TUMRA).	i. Girringun Traditional Owner groups ii. Other Indigenous communities iii. Protected areas managers iv. Policymakers (national protected areas program) v. Zurba and Berkes (geographers)	Collaborative art (an acrylic painting)	The use of participatory art and the creation of a boundary object enabled Traditional Owners to express themselves in ways that were authentic, culturally relevant and meaningful. This form of expression was not possible through merely verbal responses. The boundary object (painting) was considered by Traditional Owners to be a political statement that was effective for sharing values for communicating values and aspirations across three boundaries: (1) within the community; (2) with other communities; and (3) with policymakers.
Indigenous intergenerational participation in the collaborative governance of shared forest land in an areas with past and ongoing conflict over the forest management (see Zurba and Friesen, 2014).	Northwestern Ontario, Canada	Planning for shared lands involving the Indigenous, settler and Métis communities of Northwestern Ontario.	i. Anishinaabe (First Nations) communities ii. Métis community iii. Settler community (includes Friesen, community co-author) iv. Zurba (geographer)	Collaborative art (glass mosaic and mixed-media installation)	The boundary objects that were created (glass mosaic and mixed-media art installation) communicated a powerful and inclusive message for the individual and shared values and connections to land. The artwork was given a permanent home at the region's main interpretive centre (the Lake of the Woods Discovery Centre) so that it could continue to communicate this message with locals and visitors.

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Research focus and governance context	Location	(Governance) Boundary (*domain*)	The Research Community of Practice (*community*)	Boundary object created or used in the research (*practice*)	Findings about boundary objects
Indigenous management of native vegetation on Girringun traditional territory (see Robinson et al., 2016).	North Queensland, Australia	Different natural resource management staff groups within Girringun.	i. Girringun Nursery staff ii. Girringun Indigenous Rangers iii. Other Girringun IPA staff (including Bock, a consultant to GAC) iv. Robinson and Maclean (geographers)	Participatory 'maps' – individual and collective drawings of trees that depicted the values and partnerships that each participant had for native vegetation on their country.	Maps acted as boundary objects to facilitate discussion between all GAC actors about the kind of knowledge and partnerships that enable them to work together to look after their country. This included better knowledge sharing between these two groups.
Perspectives of Indigenous youth about the role of traditional foods for long-term community food security in Northern Manitoba. (see Islam et al., 2017).	Norway House Cree Nation, Northern Manitoba, Canada	Long-term planning for involving Indigenous youth in traditional food systems.	i. Indigenous youths ii. Other Indigenous community members iii. Policymakers iv. Teachers (includes Rogalski, community co-author) v. Islam, Zurba and Berkes (geographers)	Collaborative art (acrylic painting on canvas)	The use of participatory art and the creation of a boundary object made it possible for Indigenous youth to share their experiences and explore their understandings of traditional foods. The boundary object (collaborative painting) was used to communicate youth perspectives on traditional foods across generations within the community (through display at the school) and with the academic community and policymakers (through an academic publication about the creation of the boundary object and outcomes of the project).

and Salter (2004) elaborate on boundary objects by explaining how they are typically central and more easily understood within particular communities or parts of communities, yet they are also designed to work at the margins by communicating and reaching outside of communities to those with different perspectives. Bergman, Lyytinen and Mark (2007: 546) describe four essential features of design for boundary objects: (i) 'capability to promote shared representation'; (ii) 'capability to transform design knowledge'; (iii) 'capability to mobilize for action'; and (iv) 'capability to legitimize design knowledge'. They explain how such features help 'align, integrate, and transform heterogeneous technical and domain knowledge across social worlds as well as mobilize, coordinate, and align stakeholder power'.

Departing from the original concept of boundary objects as satisfying informational requirements, studies have revealed the importance of providing contextual information about boundary objects in order for the objects to be useful. For example, understanding the context of the inception of a boundary object – including its history and surrounding negotiations – is a necessary precursor for boundary objects to be intelligible to those who are encountering the object on the other side of the boundary (Mambrey and Robinson, 1997; Henderson and Siefert, 1999; Lutters and Ackerman, 2002; Diggins and Tolmie, 2003; Subrahmanian et al., 2003). Lee (2007: 310–11) explains that '[b]oundary objects may also need to be augmented with additional contextual information in order to be effective', and that there are five characteristics that do not fit the definition of boundary objects: (i) 'self-explanation'; (ii) 'inclusion'; (iii) 'compilation'; (iv) 'structuring', and (v) 'borrowing'. Star (2010) qualified boundary objects further by explaining that their importance is not hinged on building consensus among groups, and that their effectiveness is primarily situated around their potential for creating dialogical space. This dialogical space created around a boundary and the boundary object itself can become scaled up or standardized, resulting in a shift from boundary objects to 'boundary infrastructures' (Bowker and Star, 1999; Star, 2010), which in turn can become powerful conduits for decolonizing research practice. Within boundary infrastructures, the rigid lines between groups become blurred and the infrastructure works as a site of interaction and emergence, which have been conceived of as borderlands (e.g. Anzaldúa, 2016), spaces of cultural interface (e.g. Nakata, 2007, 2010), and a site of co-becoming (e.g. Bawaka Collective et al., 2016).

Wenger (2000) explains how knowledge is produced across boundaries of (R)CoPs, and how boundary work is important for creating connections and learning opportunities through being exposed to abstract thinking and 'foreign competences'. Wenger (2000) also describes how boundary work promotes collaborative action (i.e. *engagement*), mental flexibility around existing roles (i.e. *imagination*), and the ability to understanding how actions can affect processes beyond one's own engagement (i.e. *alignment*). Furthermore, boundary work has been found to be important for transcending disciplinary fields (Trompette and Vinck, 2009), and creating the ability to either establish or destabilize concepts and practices within (R)CoPs (Lee, 2007). Boundary work can also connect disparate communities (Pawlowski, Robey and Raven, 2000), including multidisciplinary research teams engaging Indigenous people, and can become the catalyst for meaningful connections within and between communities (Lee, 2007; Zurba and Berkes; Zurba and Friesen, 2014; Islam et al., 2017; Rathwell and Armitage, 2016), including policy-makers (Guston, 2001; Berg, 2002; Zurba and Berkes, 2014). Connecting to this, Clark et al. (2010) state that 'improving the ability of research programs to produce useful knowledge for sustainable development will require both greater and

differentiated support for multiple forms of boundary work'.

Central to the success of (R)CoPs involving co-research between geographers and Indigenous communities are participatory research methods that are flexible and dynamic (Tobias and Luginaah, 2013; Agboola, 2014). Flexibility provides the opportunity for research to be redirected in response to the interests and concerns of research partners throughout the research engagement. Research methods (including tools and techniques) that seek to foster a safe space for expression and engagement and accommodate diversity in literacy and numeracy skills are also important for ensuring that participation is meaningful and not tokenistic (Jardine and James, 2012). Attention to such factors promotes cultural safety in a research program, whereby power is redistributed so that the knowledge, values, and belief systems of Indigenous peoples are prioritized in any initiative, practice, or relationship (Brascoupé and Waters, 2009).Participatory processes supporting boundary work often appeal to Indigenous communities due to their culturally appropriateness. They require the research partners to be situated in place (Maclean and Woodward, 2013), are frequently visual, and can be engaging and inspiring for partners in the research process.

Geographers and their Indigenous research partners have found participatory visual methods particularly successful in facilitating culturally safe co-research. Participatory visual methods are image-based, participant-centred techniques that 'facilitate participants in finding their own language to articulate what they know and help them put words to their ideas and share understandings of their worlds, thereby giving participants more control over the research process' (Enright, 2013). Methods that incorporate art and art-making can simultaneously nurture Indigenous knowledge, bridge knowledge across generations and cultures, and be the site of knowledge co-production (Rathwell and

Armitage, 2016; Zurba and Berkes, 2014; Islam et al., 2017). Affirmed by Christie (1992: 17), research steeped in the Western scientific tradition is in great need of structural readjustments that create the potential for diversified knowledge and power sharing:

> When we remember that every scientific statement carries with it a field of privilege and power for those who prosecute it, and at the same time renders all other possibilities absent, we perceive a need of great urgency to reshape the knowledge making business in Western society so that everybody and everything is given a voice.

Examples of visual participatory methodologies resulting in the co-creation of boundary objects include participatory mapping (e.g. Chapin et al., 2005; Bryan, 2011; Robinson et al., 2017); Photovoice (e.g. Maclean and Woodward, 2012; Maclean and Bana Yarralji Bubu Inc, 2015; Fantini, 2017); participatory art (Zurba and Berkes, 2014; Zurba and Friesen, 2014; Islam et al., 2017; Rathwell and Armitage, 2016); participatory video and/or filmmaking (e.g. Kindon, 2003; Parr, 2007; Garrett, 2010; Mistry and Berardi, 2012); and the co-development of art installations (e.g. Dwyer and Davies, 2010).

IV Insights from human geography research involving boundary work and the creation of boundary objects with Indigenous communities

Our research projects have included collaborative boundary work and the co-creation of boundary objects with Indigenous communities in Canada and Australia. The findings from these projects have been published in peer-reviewed journals, and are summarized in Table 1, where we provide details on the boundary(s) being crossed (i.e. *domain*), the members of the (R)CoP (i.e. *community*), the boundary object created in the research (i.e. *practice*), as well

as the findings from the boundary work and production of the boundary object(s). While a significant number of boundary objects have been created by the authors through participatory research practice to date (see Zurba et al., 2012; Woodgate, Zurba and Tennent, 2017a; Woodward et al., 2012; Woodward and Marrfurra McTaggart, 2016), the table draws from publications that specifically state the terms 'boundary work' or 'boundary object' in the context of work with Indigenous peoples. It should be noted that the roles of members of the *community* can be fluid. People may not always discretely fit into a single identity (e.g. artists, elders, geographers) and can shift or take on multiple roles. In the table we identify members according to their primary identity in relation to the (R)CoP and boundary work.

Several insights can be gleaned from this research into boundary work (outlined in Table 1) that can inform how geographers might engage in boundary work with Indigenous communities and co-researchers and, in turn, use the boundary object generated by the (R)CoP to inform government policy and planning. As our research illustrates, it is first important to identify the environmental governance context, described in Table 1 as the 'research focus' in which boundary work will be useful. As shown in Table 1, these contexts might be diverse and complex, such as multi-jurisdictional protected areas co-management or collaborative forest governance; they may relate to specific place-based environmental issues, including water planning and endangered species management; they may relate to risk, risk assessment, for example, in relation to water and native vegetation; or they may focus upon futures such as long-term planning for traditional food systems. The boundaries that exist between governance actors operating within the given environmental governance context also need to be investigated. Actors may exist on either side of the governance boundary – in Table 1 we refer to this as the 'boundary' or 'domain'. Boundaries might exist

between each of the stakeholder groups which, drawing on the cases provided in Table 1 as examples, might include: Indigenous community representatives, government managers, program managers, and policy-makers. Important to note is that boundaries are also likely to exist within the (R)CoPs, who have initiated and will facilitate the boundary work (discussed further below). In our examples the (R)CoPs were made up of different members of the Indigenous communities (i.e. community leaders, including elders, youths), the geographer(s) and, in some instances, government-employed scientists (see Maclean et al., 2015) and policy-makers (e.g. Zurba and Berkes, 2014).

Next, it is useful to understand *why* boundary objects might be created and by whom. In the cases provided in Table 1, boundary objects included items that were created by Indigenous co-researchers and participants to express their values and aspirations (see Zurba and Berkes, 2014); other objects were (co-)created by Indigenous co-researchers and participants, or with members of the wider community, to develop a common understanding and highlight different perspectives (see Maclean and Robinson, 2011; Maclean et al., 2015; Zurba and Friesen, 2014; Robinson et al., 2016; Islam et al., 2017). Other boundary objects were created by Indigenous communities and researchers towards communicating particular messages across boundaries (see Maclean and Bana Yarralji Bubu Inc., 2015), or were used (not created) amongst Indigenous participants, researchers and, in one example, government scientists, towards facilitating relationship building and promoting discussion (e.g. Maclean and Robinson, 2011; Maclean et al., 2015). As the Indigenous co-researchers and participants are active creators of the boundary objects, they actively choose media that allow them to express themselves in culturally appropriate ways. The boundary objects highlighted in Table 1 included maps (see Maclean and Robinson, 2011; Robinson et al., 2016), photographs and a co-authored

research report (Maclean and Bana Yarralji Bubu Inc., 2012, 2015), and collaborative artworks (see Maclean and Robinson, 2011; Zurba and Berkes, 2014; Zurba and Friesen, 2014; Islam et al., 2017). Interestingly, a photograph that was not created by members of the (R)CoP was also used as a boundary object for exploring common and divergent perspectives around water issues.

It is also important to consider *how* the created boundary object might be used to facilitate boundary work while it was being created, immediately after it was created, *and* into the future. In the cases shared in Table 1, the boundary objects provided different opportunities for cooperation, debate, evaluation, review, and accountability between governance actors and their institutions. They were used as tools for communicating outwards from marginalized/ less powerful groups; to communicate cross-cultural and intergenerational values *within* and *across* Indigenous communities; and to communicate environmental governance interests and aspirations with decision-makers. The creation of boundary objects made it possible for diverse perspectives to be shared among co-researchers who were working together and would discuss what they were hoping to express through artworks (see Zurba and Berkes, 2014; Zurba and Friesen, 2014). In some cases, the boundary objects were used to tell particular 'stories' relating to colonization, past wrongdoings, and reconciliations that were deemed too difficult to explore in direct conversation (see Zurba and Friesen, 2014). In other examples, photographs produced by the Indigenous co-researchers were used as boundary objects by elders to share important place-based stories with rangers, sometimes for the very first time, and in turn rangers used the photographs to discuss their water management aspirations with elders (see Maclean and Bana Yarralji Bubu Inc., 2012, 2015). In another instance, photographs that were *not* co-produced during the research practice but brought to the table were used as

boundary objects to facilitate discussion between Indigenous elders and government scientists (see Maclean and Robinson, 2011; Maclean et al., 2015).

Two examples from Table 1 highlight how boundary objects may *continue* to be used by their co-creators long after the research project is complete and the (R)CoP has disbanded. The collaborative mosaic art installation that was co-created by Indigenous and non-Indigenous communities in northwestern Ontario, Canada, to explore their perspectives, values and aspirations for the land, and presented to the wider community immediately after their creation, is now located permanently at a public art centre, and thus continues to facilitate discussion within the wider community (see Zurba and Friesen, 2014). The research report that was created as part of a Photovoice project in north Queensland, Australia, was used by the Bana Yarralji Bubu Inc. long after it was created, to facilitate boundary work with other Indigenous people from the region, with scientists, planners, university students and 'research tourists' (see Maclean and Bana Yarralji Bubu Inc., 2015).

Important to note here, and discussed in more detail later, is the role of geographers as 'boundary agents' both *within* the (R)CoP – alongside their Indigenous co-research partners – but also *outside* the (R)CoP, when they had an important role of brokering knowledge to decision-makers. Geographers may also play an important role in translating knowledge into a form that is accessible to those on *either side* of the identified boundary in a way that maintains the cultural integrity of the research data and the voices of the co-researchers (Maclean and Woodward, 2012; Maclean and Bana Yarralji Bubu Inc. 2015).

Finally, the examples presented in Table 1 also highlight how geographers can work with Indigenous communities (as part of related (R)CoPs) to facilitate opportunities for dialogue that may result in unexpected innovation with

the (R)CoP and the Indigenous communities themselves. Of particular note is how the boundary work that resulted from the creation of certain boundary objects enabled Indigenous co-researchers to arrive at different interpretations of their *own* stories and experiences. In one case, the intrinsically collaborative nature of boundary work also mediated the risk that could have resulted from Indigenous actors expressing knowledge claims that were not similar in nature (see Robinson et al., 2015). In another example, the creative nature of boundary work enhanced co-researchers' memories of impactful moments in their lives and enabled them to express their memories using paint on canvas (see Zurba and Berkes, 2014; Islam et al., 2017) and thereby communicate with the wider community. A final learning from all the examples provided in Table 1 was how the research practice was dependent upon relationship building and resulted in joint learning for all those involved. Through their initial boundary work, members of the (R)CoPs became more intertwined as a community and set foundations for further boundary work together into the future for decision-making.

V Boundary work framework and the role of the geographer

In this final section of the paper, we present a framework to highlight how geographers can use boundary work to support their Indigenous and local community co-research partners as the means to amplify the role of Indigenous communities in place-based research. Geographers who are keen to develop ethical co-research projects with Indigenous and non-Indigenous local communities might use this framework. The framework is derived from the experiences of the authors and the insights presented in Table 1. The framework includes eight steps that are articulated in Table 2 and represented graphically in Figure 1. Importantly, we note that although this framework is derived from

our work with predominantly Indigenous communities, it may also be useful to inform research collaborations with marginalized and non-Indigenous local communities. This is because boundary objects and the associated boundary work required to create or use them can be useful for amplifying marginalized perspectives (Zurba and Berkes, 2014) and can be used in research for political and social action (e.g. Maclean and Woodward, 2013; Zurba and Berkes, 2014; Maclean and Bana Yarralji Bubu Inc., 2015; Robinson et al., 2016).

The eight steps outlined in Table 2 are integral to boundary work and the creation of the boundary objects. It is intended that researchers and communities work together through each of the steps; however, the ordering and relative importance of each step will be guided by place-based and community-driven interactions and the evolution of the participatory process and emerging influences on each research partner. Importantly, the eight steps are not always linear and may take on an iterative quality. For example, Steps 1, 2 and 3 – 'identifying of the boundary', 'initiation of the boundary work' and 'establishing ethical principles' – may require several cycles of feedback before the members of the (R)CoP feel confident enough to proceed to the next step. Feedback occurring within the (R)CoP could take shape as verbal or non-verbal cues which the dominant research partner should be consistently be mindful of, and attend to. Such cues may involve silence, withholding, or stopping at different times. Some participants may require an invitation to contribute and participate, while all parties involved in the process should be prepared to respectfully accept refusal to participate. Consistently checking-in with project partners as to their ongoing satisfaction with the research process also enhances the potential for building trust within the (R)CoP and proceeding through to further stages in the framework.

In the process of sharing the boundary object with others, the geographer can consider how

the voice of the most marginalized community member is heard as the intent of the boundary object may be missed if the most marginalized community members and their voices are not included. Further, the geographer should also consider how the boundary object will be presented to those who are active creators of the relevant governance context. This is because the full potential and power of the boundary object is lost when it is removed from the context in which it was created, or if all those who created it are not instrumental in expressing what the boundary object is, and explaining what it represents.

Step 1 of the framework for boundary work with local and Indigenous communities identifies the role of geographers in supporting co-research partners in articulating the boundary to be bridged in the governance context but, importantly, recognizes that the Indigenous co-researchers must be empowered to prioritize the issues to be addressed through the research engagement, and the boundaries that need to be crossed.

In Step 2 of the framework, once the boundary has been identified, the boundary work and co-research partnership is developed. Participatory action research methods and empowerment principles support the ethical and meaningful engagement of each research partner in determining what kind of boundary work is most appropriate for the boundary that they are aiming to bridge.

Step 3 draws attention to the criticality of ethical research processes in the creation of boundary objects, through a co-research process, in order for mutually beneficial outcomes to emerge from the (R)CoP. Ethical research practice incorporates early research discussions between co-partners to recognize the importance of communication, relationships and research transparency at all stages, and in regards to all aspects of the research process. Consideration of what each partner is contributing to the research process and the

responsibilities and obligations of each party are also critical.

Step 4 involves the partners deciding on the boundary object to be created. This may evolve through an iterative process and may incorporate one or more creative platforms. Boundary objects can be complex and multi-layered in that they can demonstrate multiple uses, purposes and meanings to different people and audiences that engage with them.

Step 5 is closely linked with Step 4 and involves determining the custodianship of the boundary objects created. Relevant discussions should occur as early as possible, recognizing that over the longer term ownership and/or custodianship may have different stipulations or time limitations, and may also require re-negotiation.

Step 6 is critical to the realization of the co-created object as a boundary object. Interpretation is imperative. Interpretive materials are important for negotiating shared meanings across boundaries, and the process and procedures for translating and sharing objects across boundaries at Step 7 should be collectively decided, including the roles and responsibilities of Indigenous co-researchers and geographers.

Step 8 involves planning for the sharing of the knowledge values and aspirations conveyed through the boundary objects. Such planning occurs among members of the (R)CoP, and may result in singular or multiple modalities for mobilization of the boundary object. This would largely depend on the decision-making within the (R)CoP, the type of boundary object(s) that were created, and the parties involved on each side of the boundary. The geographer(s) have much of the responsibility to ensure others (e.g. policy-makers) view the boundary object and may act as the knowledge broker to do this (Maclean and Woodward, 2013).

At each step of the framework space needs to be made for reflection and self-evaluation by the (R)CoP members of the research partnership, and opportunity created for integrating

Table 2. Framework for boundary work and the creation of boundary objects with Indigenous communities.

Framework principle	Description of the boundary work
1. Identifying the boundary	Geographers can assist Indigenous co-researcher(s) to identify the boundaries within the governance context, but the Indigenous co-researchers should be empowered to prioritize the issues (and boundaries that need to be crossed) that are of most importance to them.
2. Initiating the boundary work	Someone (usually the researcher) has to make the explicit decision to take action to engage with the marginalized community in a participatory process. Geographers should engage Indigenous co-researchers early in the research development phase and should follow participatory action research protocols.
	Communities should be involved in the creation of boundary objects from the inception of a project. The creation of boundary objects should be guided by empowerment principles.
3. Establishing ethical principles	Ethical process of engagement is an essential building block of participatory action research which includes, for example, joint negotiation of a research agreement that outlines ownership of items both captured and generated during the research process, payment for time spent engaged in the research and joint publication of research outcomes. Ethical principles should be transparent and acknowledge that *each* member of the (R)CoP has certain responsibilities to their wider community and to themselves. For example, Indigenous co-researchers are responsible to ensure that sensitive information is not shared in the boundary object as the geographers may not know how to determine this. Geographers have responsibilities to their institution that they need to fulfil (e.g. funding timeframes).
4. Deciding on the boundary object	Boundary objects can involve almost any kind of creative platform as long as it is practical and appropriate for the community. They can be complex and multi-layered in that they can demonstrate multiple uses, purposes and meanings to different people and audiences that engage with them.
	Geographers should work collaboratively with Indigenous community partners to determine realistic goals for creating boundary objects that will be effective for crossing the boundary determined in Step 2.
5. Establishing ownership and custodianship of the boundary object	It should be determined as early as possible who the owners and/or custodians of a boundary object will be.
	Ownership and/or custodianship may have different stipulations or time limitations.

(continued)

Table 2. (continued)

| Framework principle	Description of the boundary work
6. Interpretation	Interpretation is imperative. The goals for the boundary work are less likely to be achieved if the boundary object lacks interpretive materials, or interpretation from a member of the (R)CoP. Interpretive materials are important for negotiating shared meanings across boundaries.
7. Planning and activation of boundary crossing	The process and procedures for translating and sharing objects across boundaries should be collectively decided, including the roles and responsibilities of Indigenous co-researchers and the geographers.
8. Evaluation and process feedback	Members of the (R)CoP should seek opportunities to periodically self-evaluate and integrate feedback throughout various stages of the boundary work process, as is expected in the participatory action research method, including when the work ends and the (R)CoP disbands.

these learnings back into the research partnership. This is critical in maintaining positive ongoing research engagement and relationship building. Following Step 8, the knowledge, values and aspirations that are conveyed through the boundary object are transmitted to parties on the other side of the boundary, who process the information, and may in turn transmit their knowledge, values and aspirations back to the (R)CoP. Elements of the model therefore include process feedback, (cross-cultural) learning, reciprocity, attention to different forms of knowledge, shifting power and decolonization, and the development of trust and an ethical and moral basis for engagement between Indigenous and marginalized communities and geographers.

VI Conclusions and next steps

Boundary objects are used in different disciplines varying from ethnographic studies (Harris, 2009) to the field of management (Sapsed and Salter, 2004). In this paper we have demonstrated that boundary objects, such as maps, reports and art installations, can be created collaboratively with local and Indigenous communities to communicate knowledge, values and aspirations across social and political boundaries. We have demonstrated that boundary objects can be powerful tools for knowledge translation and research dissemination in these contexts, facilitate dialogue and learning between disparate stakeholders and communities, and potentially provide a site for cooperation, debate, evaluation and review. While acknowledging that all research relationships exhibit a power differential (Koster et al., 2012), the research engagements that we have described, in co-creating boundary objects with Indigenous and local communities, have actively sought to form engagements that create a culturally safe space that has promoted shared learning. We believe this paper contributes to the argument for decolonising geography by demonstrating how the co-production of some objects ('boundary objects') has effectively bridged cultural boundaries and opened up the respectful dialogue on sensitive issues.

Our framework details eight essential stages for researchers to draw on when conducting boundary work and co-creating boundary
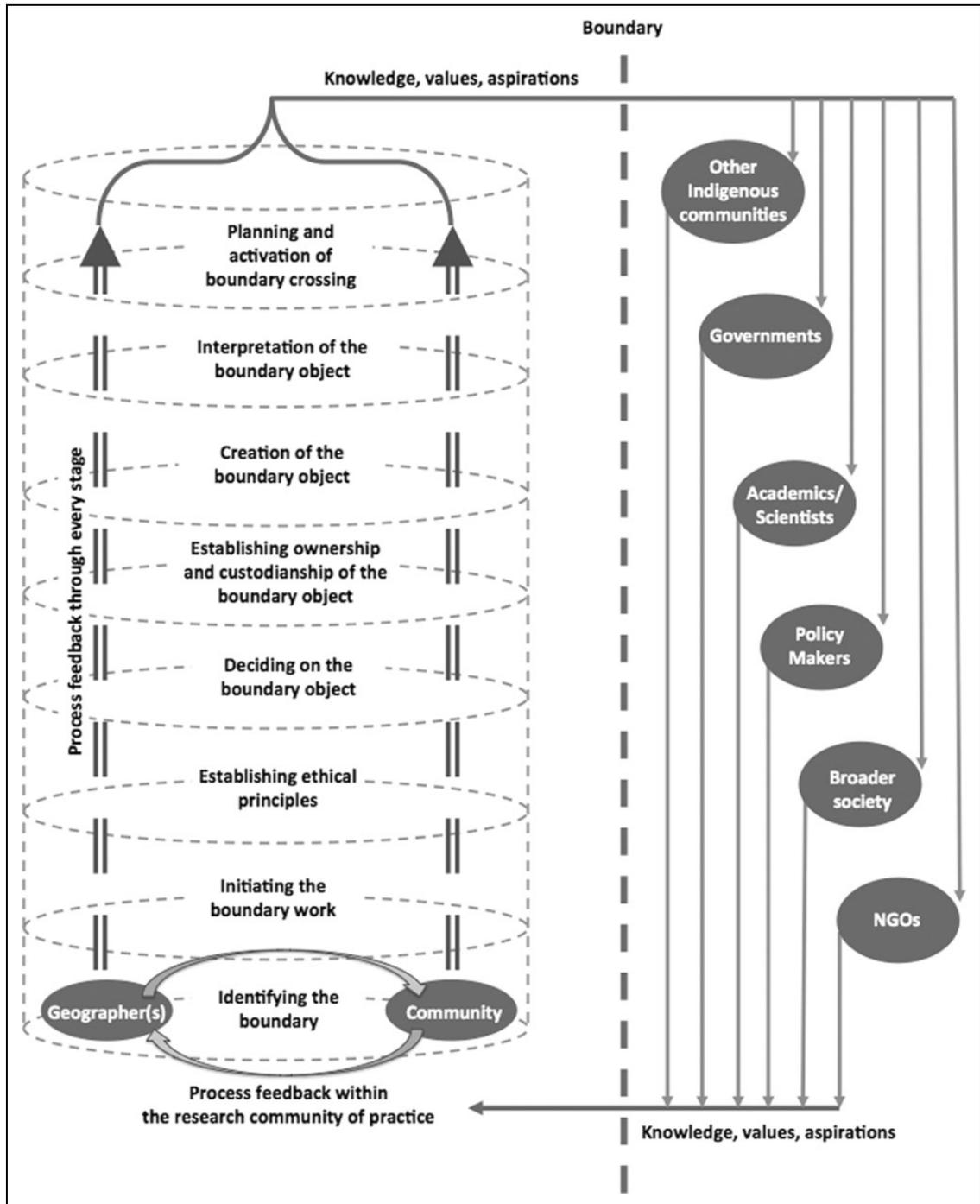
Figure 1. Framework for boundary work with local and Indigenous communities.

objects with local and Indigenous communities. We advocate for the use of participatory methods that broker such engagements, value Indigenous protocols, respect Indigenous knowledge and culture, articulate concern for its safe keeping, and facilitate place-based joint learning via the co-production of research agendas through to co-authoring of research outcomes (Davies, 2007; Maclean and Cullen, 2009; Walsh et al., 2013; Woodward and McTaggart, 2016). The framework also acknowledges the powerful/privileged position of geographers who often have access to research funds and are entrusted with funds as they are situated within recognized governance/organization structures. Indeed, funding may determine how much of the research process takes shape (e.g. the funded party – who is often the geographer – may initiate the process and create a start and an end time). While time consuming, and often resulting in challenges when met with some of the rigid structures of research institutions, we have demonstrated the numerous ethical and practical reasons for engaging in boundary work and the creation of boundary objects. Connected to the ethical reasons behind such work are often deeper personal and moral reasons for wanting to engage with communities in this work that, at its core, is empowerment focused.

Although our paper focuses on creating boundary objects with Indigenous communities in mind, the lessons learnt from this may be applicable in global contexts. For instance, marginalized communities across the world can follow the steps outlined in this paper to create boundary objects for collaboration and discussion of sensitive issue (i.e. issues affecting immigrants and minority groups in Canada or Australia). Through attention to this step-wise process the boundary objects can be created to facilitate engagement of policy makers and community members, to identify common ground or differences, and work towards addressing broader issues. Boundary work also holds great potential for facilitating communication and building common ground around issues that are within communities and are viewed differently by different members of communities (i.e. between different cultures and generations). Further, the ethical protocols for co-creation of boundary objects can create meaningful pathways for reconciliation between Indigenous communities and researchers/research communities, especially where there may be a legacy of knowledge dispossession and other unethical research practices (Woodward and McTaggart, 2016).

There are numerous possibilities for the use of boundary work into the future, and the creative possibilities for boundary objects are limitless. The future of boundary work and boundary object research will need to focus on further case studies where the framework can be applied to different place-based contexts. Furthermore, once boundary objects are created they can take on a life of their own. There is much potential for research that aims to understand the effects of boundary objects that are passed along, inherited or appropriated and continue to affect social and political change.

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ORCID iD

Melanie Zurba http://orcid.org/0000-0001-8411-6083

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Author biographies

Melanie Zurba is an Assistant Professor at the School for Resource and Environmental Studies and the College of Sustainability at Dalhousie University. Her work focuses on community-engagement, environmental governance, collaboration and social change. Melanie's community-partnered research program has been primarily focused in Canada and Australia, but also spans the globe through her work on international policy frameworks that aim to support community rights and leadership in environmental governance.

Kirsten Maclean is a Senior Research Scientist (Human Geographer) working as part of the Adaptive Urban and Social Systems program of the Australian Commonwealth Scientific and Industrial Research Organisation. She is based in Brisbane, Australia. She uses co-research practice and participatory methodologies to investigate the role of diverse people, their knowledge and values in relation to their natural and cultural resource management and planning interests and aspirations in regional and rural Australia. Much of this work is developed in partnership with relevant government agencies, industry bodies and community and Indigenous organisations to ensure it responds to relevant national, state and place-based challenges. Importantly and as appropriate, research is often conducted in partnership with Indigenous co-research partners who actively care for their traditional country via diverse governance strategies and to address the challenges of, and harness future opportunities in relation to, Reconciliation and to 'Close the Gap', both identified as areas of great importance by CSIRO.

Emma Woodward is a Research Scientist (geographer) with the Commonwealth Scientific and Industrial Research Organisation (CSIRO) in Australia. Emma tests innovative methods with her Indigenous research partners to inform best practice natural and cultural resource management. Weaving Western-science and Indigenous ecological knowledge Emma has influenced local to international learning and decision-making through Australian Government water allocation planning; teaching of Indigenous knowledge systems in schools and tertiary institutions nationally; and through publication of co-produced research by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES). Critical to delivering impact from her research is the building of mutually-beneficial research partnerships with Indigenous Australians and their representative institutions across Australia.

Durdana Islam is a postdoctoral fellow at The University of Winnipeg. She has many years of working with Indigenous communities in northern Manitoba. Her research interests include participatory research, boundary objects, climate change and Indigenous food security.