Conservation (In)Action: Renewing the Relevance of UNESCO Biosphere Reserves

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Abstract
The research and policy landscape for biodiversity conservation is changing. Protected areas are now expected to meet a broad range of objectives including effective and equitable management. In this new landscape, organizations strive to find ways to ensure the rights of local and Indigenous peoples are respected while conservation scientists have endorsed the need for platforms for international research and practice. For 40 years, a growing international network of sites support such research and practice, yet, it has been underutilized and largely ignored by scientists and decision-makers alike. To better understand this paradox, this article explores the evolution of the World Network of UNESCO Biosphere Reserves internationally and its application in Canada. Analysis of archived materials, a national survey of practitioners, and interviews with past and present members of Canada’s national committee reveals an expanded mandate for biosphere reserves beyond conservation science and biodiversity protection. The article recommends that to support the expanded conservation agenda, biosphere reserves work with governments and conservation scientists to connect more effectively with global concerns and initiatives such as the Convention on Biological Diversity and Sustainable Development Goals; establish appropriate, reliable, and active transdisciplinary partnerships; and meaningfully engage a broader range of knowledge holders.

Introduction
The research and policy landscape for biodiversity conservation is changing. Biodiversity conservation is no longer solely a matter of nature protection; protected areas today are expected to make a broad range of contributions to human society including maintaining critical ecosystem “goods and services” such as water, food, carbon storage; mitigating climate change; alleviating poverty; and even providing opportunities for economic development (Watson et al. 2014). Conservation scientists who seek to protect biodiversity have called on one another to participate in a new social contract that supports “effective and just conservation” (IUCN 2014: 38) and to connect conservation science and practice through effective long-term collaborations with practitioners and other stakeholders (Pressey et al. 2007). International initiatives such as the IUCN-led Conservation Initiative on Human Rights, and the Aichi Targets associated with the Strategic Plan of the Convention on Biological Diversity (CBD) call for protected areas that are effectively and equitably managed taking into account the rights and needs of local and Indigenous peoples (Woodley et al. 2012). Additionally, scientists studying socioecological systems have argued the need for an international network to provide platforms for interdisciplinary, longitudinal, and comparative research to better understand human-environment relations at multiple scales (Liu et al. 2007). These initiatives and calls also reinforce the potential relevance of an existing and longstanding international network of sites dedicated to conserving biodiversity, demonstrating sustainable development, and conducting research and education—the World Network of Biosphere Reserves (BRs) of the United Nations Educational, Cultural and Scientific Organization (UNESCO).

Described as “groundbreaking” and “innovative” when first introduced (Bridgewater 2016), UNESCO’s Man and
Biosphere (MAB) program was conceived as an interdisciplinary (involving physical, biological and social sciences), intergovernmental program of problem-based research and action focused on human-environment interaction. Its primary tool became BRs—representative ecological sites where environmental change could be monitored, policies or practices could be “tested,” and lessons could be learned to inform environmental policy and management practice (Batisse 1982). Success was measured by the ability of sites to address local management priorities and share results across an international scientific network (Franklin 1977; Sokolov 1981). In 1995, the Statutory Framework for Biosphere Reserves included sustainable development as an official objective, involving the inclusion of local and Indigenous peoples and knowledge in research and management. Subsequent strategic plans reinforced these priorities. Indeed, BRs’ stated objectives fit with the emerging consensus for conservation through protected areas that are equitably and effectively managed (Woodley et al. 2012; MacKinnon et al. 2015).

And yet, despite the 2016 distribution of BRs of 669 sites across 120 countries, the network operates in relative obscurity. Scientists, policy and decision-makers, and even local communities where they are situated, remain unaware of the purpose, activities and potential benefits of BRs. For example, a review of Conservation Letters from 2008 to 2015 reveals only nine articles that mention BRs. Of these, only two make passing reference to BRs as potential conservation tools (Eigenbrod et al. 2010; Tscharntke et al. 2015) and none focuses on BRs as key supports for better understanding of biodiversity conservation, sustainability or networked research. Indeed, their value as a network has been significantly underutilized (Reed & Egunyu 2013).

With a need to conduct action-based research that supports the conservation of biological diversity so pressing, and a ready network first formed by conservation scientists in the 1970s, why are BRs such minor notations in the research and action agendas of scientists and policy-makers? How did this network evolve and what is its current mandate? How can this network be utilized more fully to address contemporary conservation issues? To address these questions, I provide a short history of the evolving philosophy of BRs internationally, explain their application in Canada, and consider the potential they offer to scientists, policy-makers, and local people united in the interests of conservation.

**Methods**

Canada was selected for more intensive scrutiny because of its key conceptual and logistical contributions to the MAB program and BR formation. Canadians served on...
the International Coordinating Council of MAB six separate times between 1970 and 1983. Canada was the first country to establish national procedures and nomination processes for BRs that were subsequently adopted elsewhere. Today, the country hosts 18 BRs—the largest, active national network with historical records available in English (Figure 1).

Data for this research included documentary materials archived at UNESCO (Paris, France), available online, and the Wilfrid Laurier Archives (Waterloo, Canada). Records of Canada’s national program include the Francis Fonds (a collection of records now 50.6 m long), Roots Fonds, Birch Fonds, and Canadian BRs Association Fonds. Additionally, since 1995, BRs have been subject to periodic review approximately once every 10 years. The accompanying reports provide extensive information on the social and ecological characteristics of each BR, as well as the research, conservation, sustainability and public education programs undertaken during the review period. Only UNESCO documents cited directly are listed here; Supplementary Material provides a list of periodic review reports consulted and full citations for UNESCO documents mentioned in this article. Additionally, I draw on a 2011 survey of the then-15 BR managers to better understand how they interpreted their mandate. The survey was conducted at the beginning of a 4-year action research project designed to help Canadian BR managers become more effective through social learning and networking strategies (Reed et al. 2014). Managers came to their positions with backgrounds in natural and social science education, community organizing, and business. Sixteen interviews were also conducted in 2011 with past and present members of the Canadian-MAB committee. Former Canadian-MAB committee members included active and retired academic or government scientists, civil servants and private consultants. I have served as a member of the Canadian-MAB committee since 2010, allowing me to understand the connections between the international directives and national and local implementation. Three themes emerge from these diverse sources: (a) a programmatic evolution from research for biodiversity conservation to management for sustainability; (b) a shift away from selecting representative ecosystems as BR sites; and (c) an enlarged scope of activities for BR managers.

Results

The evolving mandate of BRs internationally

In 1968, an international “Biosphere Conference” in Paris sparked the creation of an international network of research sites that would examine ecological questions from the perspective of human use. BRs were first created in 1976, modeled philosophically and practically on the experience and expertise of North American and European scientists of the early and mid-20th Century. Russian zapovedniki, British conservancies, and American experimental forests (Bocking 2012) allowed for long-term field observations and experimentation and drove the intellectual foundation of the original primary objective of BRs—to establish sites for research related to biodiversity conservation.

In the mid-20th Century, conservation scientists such as Arthur Tansley (1945) and Aldo Leopold (1949) promoted conservation for scientific, moral, and aesthetic reasons, contributing to the second objective of BRs—to grapple with complex issues where humans are embedded in nature. The introduction of “big science” in the 1960s—particularly the International Biological Program—helped produce reliable ecological research at a global scale and raised awareness among scientists and citizens of the global extent of challenges at the human–environment interface (McCormick 1995). This experience contributed to the third objective of BRs—to build a scientific network to expand knowledge and action about the effects of human activities on or in the natural environment. Hence, BRs were created to “to safeguard the genetic diversity of species,…provide areas for ecological and environmental research, and provide facilities for education and training” (UNESCO 1974).

The evolution of BRs can be considered in two phases (Reed & Massie 2013). In Phase 1 (1974–1994), BRs were to be representative ecosystems based on an international classification of biogeographical provinces developed by Miklos Udvardy (1975). Although this ideal was never achieved, the focus on representativeness over uniqueness was aimed at understanding and redressing widespread environmental challenges across a diversity of landscapes rather than focusing on biological exceptions (Batisse 1982). The International Council of Scientific Unions (ICSU) (now the International Council for Science) endorsed this approach, identifying the value of BRs as field laboratories wherein scientific research could serve humanity and address regional and global problems.

The network was to include natural and seminatural ecosystems; individual sites were to have a strictly protected area at their core with zones of increasing human influence, thereby allowing for manipulative research (Figure 2). Related to this vision, scientists were encouraged to investigate the human-use system rather than the ecosystem, a concept that invited human–nature interaction and, importantly, encouraged the involvement of local people in learning how conservation and development might be reconciled (di Castri et al. 1980).
Some MAB scientists suggested that in Phase 1, BRs were also created to support a development function, although this function was not well-practiced (Batisse 1986). The development function became prominent in Phase 2 (1995 to present) once the Statutory Framework for BRs was introduced. The framework dictated that BRs become sites of excellence to demonstrate approaches to conservation and sustainable development. Hence, by 1995, the original objectives were translated into three official functions: biodiversity conservation, sustainable development, and logistical support for research and capacity building. The 2015 MAB Strategy and the 2016 Lima Action Plan suggest that BRs are to be model regions for sustainable development. These changes exemplify a gradual shift in orientation from “a research-driven to a management-driven program” (UNESCO 2007) and a broadening of focus from conservation science to sustainability science. This shift is also evident in Canadian practice.

Canadian experiences: Shifting away from representative ecosystems

In Canada, BRs do not have legal jurisdiction over lands, waters, or resources, or dedicated government funding, but work with public, private, and civic sectors to identify mutually beneficial research and action initiatives. In 1987, Canada adopted a national action plan that reinforced UNESCO’s 1984 International Action Plan. Both called for systematic ecological representation as a criterion for designating BRs. Canada’s plan was never implemented, yet the archival records show that the idea resurfaced periodically. In 2007, for example, BR practitioners roundly rejected a Parks Canada proposal based on ecological representation.

When asked “Do you think that the network of BRs should be representative of ecosystems like national parks?,” 5 of 16 MAB committee interviewees responded “yes,” 1 responded “maybe,” and 9 responded “no.” Three interviewees who said “yes” are still very active with BRs. All interviewees, however noted that the absence of BRs north of the 60th parallel was a “gap” in the network (a gap that was filled in 2016 with the designation of Tsú Tșe BR). This gap also featured in discussion documents that circulated across the network in 2007 and 2008. One, in particular, recommended that the Canadian BR Association continue the process of opportunistic planning, based on the coincidence of a local organizing committee with a plan to meet the UNESCO criteria such as diversity of ecosystem type and encouraging a geographic spread of BRs across the country and networking opportunities. This opportunistic approach remains today.

Canadian experiences: enlarging the scope of BRs

Research and monitoring once dominated Canadian BR functions. For example, McGill University Archives
reported that scientists had completed 698 research outputs at Mont Saint-Hilaire BR between 1978 and 2006 (Reed 2009) and the original six BRs were part of the national Ecological Monitoring and Assessment Network (EMAN) of Environment Canada between 1994 and 2010 (Vaughn et al. 2001). Additionally, these BRs conducted a collective study of landscape change in their regions to inform knowledge users of the drivers of landscape change and develop a common database (Canada MAB 2000).

Yet, in the 2011 national survey of BR managers, respondents indicated the importance and effectiveness of the conservation function lower than the sustainable development or logistical support functions (Table 1).

Only 53% (8/15) of respondents indicated biodiversity conservation and associated research was a strong or very strong priority and two-thirds saw themselves as effective in this regard. The other Phase 1 function, providing logistical support for research, was rated as a high priority in 10 BRs. However, fewer BR managers saw themselves as effective in this regard. Fostering economic development was a high or very high priority for 93% (14/15) of BRs; though only half rated themselves as effective. With respect to facilitating collaboration between organizations and generating regional awareness of BRs, 93% (14/15) rated these objectives as high priorities. Seventy-three percent (11/15) rated themselves as effective in facilitating collaboration and 40% (6/15) rated themselves as effective in generating regional awareness. Logistical support for monitoring and education was ranked as a high or very high priority in about two-thirds of BRs, with about one-third rating themselves as highly effective (Table 1). At least two-thirds of BRs in Canada are located in regions with significant resident Indigenous populations and/or traditional territories. The survey determined that Indigenous organizations participated in the events of eight BRs, and partnered with seven. Yet, only three of the then-15 BRs indicated that they maintained communication with Indigenous organizations about their activities and only two BRs reported having Indigenous representatives on their management boards.

Discussion: reframing conservation in UNESCO BRs

The ratings of importance and effectiveness in protecting biodiversity were lower than anticipated. Periodic review reports between 1998 and 2015 reveal that many Canadian BRs have longstanding conservation and research programs involving scientists and citizens including for amphibians and reptiles (e.g., Clayoquot Sound, Long Point, Georgian Bay), birds (Redberry Lake, Mont Saint Hilaire, Long Point), large mammals (Waterton, Riding Mountain), and forest ecosystems (Long Point, Mont Saint Hilaire). Some of these were documented in a compilation of “proven good practices” that was first shared across the national and international network in 2013 (Godmaire et al. 2013).

The low ratings, however, could be interpreted in a variety of ways. Respondents may view that the conservation mandate is taken up by organizations or agencies, such as Parks Canada, that have a legislative mandate for conservation in the core areas of BRs. Many of the activities in BRs are conducted in partnership with such organizations. BRs may have rated their effectiveness low because of the general difficulty in assessing how specific interventions affect long-term conservation success. Schultz et al. (2011), who conducted a similar survey internationally, suggested that low ratings of effectiveness in reaching conservation goals may be an indication that “management relying mainly on volunteer efforts is not sufficient in reaching the ambitious objectives of BRs.” This concern may also be at play in Canadian BRs.

Another possible explanation is that conservation is no longer viewed as separable from economic development. For example, periodic review reports and the development of the best practices booklet revealed that the longstanding mammal conservation programs at Waterton and Riding Mountain and the forest corridor projects at Fundy and Mont Saint Hilaire involved extensive negotiations and debates among local peoples whose livelihoods depended on resource use. These same sources indicated that other BRs are facing difficult economic pressures such as human population declines from agricultural intensification (e.g., Redberry Lake, Riding Mountain) and development pressures from ex-urban growth (e.g., Mount Arrowsmith, Mont Saint Hilaire) or tourism (e.g., Georgian Bay, Niagara Escarpment). Respondents identified some projects involving associated land use conflicts as economic projects rather than conservation or sustainability projects. Hence, they may be not-so-subtly breaking away from the earlier label that they are primarily environmental organizations.

The high ratings of importance and effectiveness in stimulating and facilitating regional collaboration suggest that BR organizations are undertaking tasks as honest brokers in regional efforts to advance conservation and sustainable development. Indeed, the good practices guide provided examples from every contributing BR (Godmaire et al. 2013). Notably absent, however, was the reporting of systematic and regular collaboration with Indigenous peoples. Furthermore, awareness of, and adherence to, the 2008 Madrid Action Plan and international
protocols for biodiversity protection were highly variable, with strongest connections made by BRs located in Québec and those that had recently been subject to a periodic review.

It is difficult to tell if Canada is representative of BRs around the world, but it does reflect UNESCO's observed shift from a science to a management agenda. Two key points demonstrate this shift internationally and in Canada. First, the commitment to biodiversity conservation has become embedded within a broader sustainable development mission. At the international level, the initial draft Strategic Action Plan, released February 2015, set its first strategic objective for BRs to, “conserve biodiversity, maintain ecosystem services and foster the sustainable use of natural resources” (UNESCO 2015). However, in the revised plan, (released February 2016), conservation became subsumed under Strategic Action Area A in which “BRs [are to be] recognized as models contributing to the implementation of sustainable development goals (SDGs) and multilateral environmental agreements (MEAs)” (UNESCO 2016). In the final plan, approved March 2016, the associated actions include contributing to implementing MEAs, with explicit reference to the Aichi Targets of the CBD and establishing alliances for biodiversity conservation and benefits to local people.

Second, the goal of selecting representative ecosystems as sites for BRs no longer prevails. Although never realized, this transition in aspiration began with the 1995 Seville Strategy that suggested that BRs “promote a comprehensive approach to biogeographical classification that takes into account such ideas as vulnerability analysis, in order to develop a system encompassing socio-ecological factors” (UNESCO 1996). The Madrid Action Plan contained only one target for designation – that individual BRs must engage in open and participatory procedures. This theme pervades the 2016 Action Plan.

The “opportunistic” or “grassroots” approach now adopted in Canada appears synchronized with international requirements. Eleven of the 18 BRs have national parks as part of their core areas. Although Canada has had an ecologically based systems plan for establishing national parks since 1971, its application has been criticized as simplistic and incomplete (Wright & Rollins 2009). Furthermore, Canada has no national biodiversity strategic plan to guide site selection for the protection of biodiversity (MacKinnon et al. 2015). Since at least 2010, new BR applications in Canada have been judged by their community commitment and governance arrangements rather than their ecological representation. Without equal consideration to ecological representation, BRs will lose the potential to serve as reference sites for understanding the biogeography of biodiversity change or loss.

Canadian BRs today are active organizations engaged in collaborative management for regional sustainability but they face significant challenges to operating as a national network including the lack of core funding, large geographic distance and multiple time zones, and cultural differences. However, their engagement in a national partnership initiative helped them identify common concerns, systematically evaluate and practices related to the provision of ecosystem goods and services, sustainability education, and sustainable tourism (Reed et al. 2014). Canadian BRs raised their international profile in 2013 when they hosted the EuroMAB conference, showcased the outcomes of their partnership

### Table 1  Self-assessment of priorities and effectiveness across biosphere reserve objectives

| Priority                                      | Average rating of priority (n) | Number of BRs that rated this priority high (4–5) | Average rating of effectiveness (n) | Number of BRs that rated their effectiveness high (4–5) |
|-----------------------------------------------|--------------------------------|-----------------------------------------------|-----------------------------------|-----------------------------------------------|
| Biodiversity conservation                     | 3.8 (14)                       | 8                                             | 3.7 (13)                          | 10                                            |
| Logistical support for research               | 3.5 (15)                       | 10                                            | 3.2 (13)                          | 6                                             |
| Logistical support for monitoring             | 3.2 (14)                       | 8                                             | 3.2 (13)                          | 4                                             |
| Logistical support for education              | 3.7 (15)                       | 9                                             | 3.2 (12)                          | 5                                             |
| Fostering economic development               | 4.1 (13)                       | 10                                            | 4.1 (13)                          | 10                                            |
| Fostering social and cultural development     | 2.2 (15)                       | 1                                             | 2.4 (12)                          | 3                                             |
| Fostering dialogue within organization        | 3.7 (14)                       | 7                                             | 3.6 (13)                          | 7                                             |
| Facilitating collaboration between organizations | 4.6 (15)                      | 14                                            | 4.2 (13)                          | 11                                            |

Note: 1 = very low priority/effectiveness; 2 = low priority/effectiveness; 3 = medium priority/effectiveness; 4 = high priority/effectiveness; 5 = very high priority/effectiveness.

Total number of possible responses = 15 (number actually responding to the question).
The dotted horizontal line separates “first generation” (before 1995) from “second generation” priorities (1996 to present).
and demonstrated leadership in two key international networks—NORDMAB (a consortium of northern countries with BRs) and the Working Group for Indigenous Peoples. NORDMAB has been raising awareness of climate change by participating in programs such as “Students on Ice” (http://studentsonice.com/) while the Working Group has consistently encouraged BRs to take more action related to climate change and the CBD (e.g., McDermott et al. 2015). Both the Canadian and international networks can offer platforms for networked governance, research, training, and colearning among scientists and community members. Their contribution to international initiatives for effective and equitable conservation and sustainability initiatives, however, requires strengthening their connection with international priorities and programs.

In March 2016, the 4th World Congress of BRs convened in Lima, Peru and approved the Action Plan for 2016–2025. To shift from conservation inaction to conservation in action, BR networks across Canada and internationally, must address three interrelated challenges:

1. Demonstrate tangible contributions of BRs to conservation and sustainability among researchers, citizens, private sector interests, Indigenous peoples, and public agencies. For Canadian and international BRs, grappling with a conservation agenda more directly will require BRs to reconnect more effectively with global concerns and initiatives such as long-term monitoring, the CBD and the SDGs. For Canadian BRs, this also will mean renewed federal leadership to translate international objectives into national targets and local action (see Lemieux et al. 2011). These connections can then be used as a platform to raise the profile of the program both within and beyond the scientific community.

2. Establish appropriate, reliable, and active partnerships that retain action research agendas. Bridge-water (2016) documented several missed opportunities at the international level for BRs to connect with other initiatives such as World Heritage Sites and the CBD while Hadley observed that MAB has suffered from being situated “in an institution structured on program sectors based on nineteenth-century disciplinary lines.” (Hadley 2006). The 2016 plan appears poised to break down the walls of sectoral governance in UNESCO, while the emergence of sustainability science in academia suggests that biologists will likely have to work on transdisciplinary research teams to maintain the conservation agenda. Action for researchers may include renewing the role of BRs as monitoring sites for ecosystem change and governance approaches, and undertaking networked research programs; for practitioners it may mean developing uncommon allies to secure funding. The greatest financial stability for Canadian BRs has come to those operating as social enterprises with a clear mission, new partners, focused governance structure and a service-oriented delivery model (George & Reed 2016). The international network has adopted this approach in the Lima Action Plan; success may rely on its widespread application and ability to meet its targets for broadening engagement and outreach.

3. Engage knowledge-holders with specialized western scientific knowledge, and local experiential and Indigenous knowledge might be brought into productive conversation towards achieving mutually desirable conservation and sustainability goals (e.g., Haenn 2014). Partnering with, and learning from, other initiatives such as the IUCN-led Conservation Initiative on Human Rights and/or Indigenous Peoples’ and Community Conserved Territories and Areas offers such opportunities.

Through the BR network, there is an opportunity to marry a critical research need with existing platforms to promote research that is scientifically sound and socially desirable. Conservation scientists, with their extensive experience of national and international conservation practice, can enhance the mission of BRs to advance knowledge and action towards a sustainable and socially beneficial biosphere without compromising the conservation agenda. Reconnecting with the mission and practices of BRs can be of mutual benefit—offering scientists unparalleled access to research sites and a global network across which lessons can be shared, while breathing new life into the network. By addressing these challenges, BRs can shift once again from a “nice to know” program into a “need to have” model for understanding socioecological systems (Liu et al. 2007), connecting conservation science and practice (Pressey et al. 2007), and demonstrating effective and just conservation (IUCN 2014).

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Supporting Information

Additional Supporting Information may be found in the online version of this article at the publisher’s web site:

UNESCO and Canadian MAB Committee Documents Described and Used in the Text

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