

Society & Natural Resources

An International Journal

ISSN: 0894-1920 (Print) 1521-0723 (Online) Journal homepage: <https://www.tandfonline.com/loi/usnr20>

Land Trusts as Conservation Boundary Organizations in Rapidly Exurbanizing Landscapes: A Case Study from Southern Appalachia

Katherine Brownson, Jessica Chappell, Jason Meador, Jennifer Bloodgood, Jillian Howard, Linda Kosen, Hannah Burnett, Tara Gancos-Crawford, Elizabeth Guinessey, Nik Heynen, Caitlin Mertzlufft, Sebastian Ortiz & Catherine Pringle

To cite this article: Katherine Brownson, Jessica Chappell, Jason Meador, Jennifer Bloodgood, Jillian Howard, Linda Kosen, Hannah Burnett, Tara Gancos-Crawford, Elizabeth Guinessey, Nik Heynen, Caitlin Mertzlufft, Sebastian Ortiz & Catherine Pringle (2020): Land Trusts as Conservation Boundary Organizations in Rapidly Exurbanizing Landscapes: A Case Study from Southern Appalachia, *Society & Natural Resources*, DOI: [10.1080/08941920.2020.1731034](https://doi.org/10.1080/08941920.2020.1731034)

To link to this article: <https://doi.org/10.1080/08941920.2020.1731034>



Published online: 05 Mar 2020.



Submit your article to this journal [↗](#)



Article views: 103



View related articles [↗](#)



View Crossmark data [↗](#)



Land Trusts as Conservation Boundary Organizations in Rapidly Exurbanizing Landscapes: A Case Study from Southern Appalachia

Katherine Brownson^a, Jessica Chappell^a, Jason Meador^b, Jennifer Bloodgood^c, Jillian Howard^c, Linda Kosen^d, Hannah Burnett^e, Tara Gancos-Crawford^c, Elizabeth Guinessey^a, Nik Heynen^f, Caitlin Mertzlufft^f, Sebastian Ortiz^c, and Catherine Pringle^a

^aOdum School of Ecology, University of Georgia, Athens, GA, USA; ^bMainspring Conservation Trust, Inc., Franklin, NC, USA; ^cDaniel B. Warnell School of Forestry, University of Georgia, Athens, GA, USA; ^dDepartment of Anthropology, University of Georgia, Athens, GA, USA; ^eDepartment of Anthropology, University of Chicago, Chicago, IL, USA; ^fDepartment of Geography, University of Georgia, Athens, GA, USA

ABSTRACT

Exurban development is occurring in many formerly rural areas nationwide, often outpacing the ability of institutions to update land use regulations. These pressures can negatively impact local ecosystems and natural resources, including reduced biodiversity and degraded water quality. Local nongovernmental organizations play an important role in promoting conservation in exurban landscapes, where there is relatively little regulatory and institutional infrastructure. Here, we draw on boundary organization theory to discuss how land trusts can function as boundary organizations, by using boundary objects and working as a bridge between community members, scientists, and governments to navigate complex conservation challenges. *Mainspring Conservation Trust* in southern Appalachia serves as a case study to explore methods for engaging and connecting diverse stakeholders. We show that land trusts can provide a flexible and necessary alternative to regulations for meeting conservation objectives by working at the boundary between science and local action.

ARTICLE HISTORY

Received 10 October 2018
Accepted 23 November 2019

KEYWORDS

Biomonitoring; boundary objects; boundary organizations; citizen science; exurbanization; land trusts; watershed conservation

Introduction

Efforts to encourage conservation on private lands are essential for biodiversity conservation (Knight 1999) and the continued provisioning of ecosystem services (Goldman et al. 2008). In some areas, private lands are under pressure from “exurbanization”, which is developed in rural areas tied to one or more metropolitan centers, but occurring beyond that urban area and its suburbs (Kirk, Bolstad, and Manson 2012; Spectorisky 1955). Land trusts are nonprofit conservation organizations that facilitate conservation on private lands (Chang 2016) primarily through the use of conservation

easements (Kiesecker et al. 2007). As of 2015, land trusts had conserved 56 million acres in the United States, with 30% of these acres protected under voluntary conservation easements (Chang 2016). Conservation easements provide a flexible approach that limits certain development or extractive activities in exchange for a reduced property tax burden (Merenlender et al. 2004).

In this paper, we demonstrate how land trusts can act as boundary organizations in exurbanizing areas where conservation regulations are limited. Boundary organizations were initially defined as organizations that work at the interface of science and policy and have three main characteristics (Guston 1999). First, they offer a platform for boundary objects and standardized packages to be created and used. Boundary objects foster communication between heterogeneous groups of stakeholders (Star and Griesemer 1989) and maybe tangible objects or conceptual frameworks (Sternlieb et al. 2013). Standardized packages are similar to boundary objects but encourage cooperation across the boundary to define a common workspace (Guston 1999). Second, boundary organizations involve the collaboration of actors from both sides of the boundary, as well as professional mediators. Finally, boundary organizations function at the interface of two distinct social worlds while maintaining accountability to each (Guston 1999, 2001).

The main benefit of boundary organizations is their capacity to stabilize the divide between two parties with different values, helping both sides achieve mutually beneficial outcomes and providing a service that neither can fulfill independently (Guston 1999). However, this definition was limited to organizations that span across science and policy. We argue the definition should expand to include any organization that works to reach a common outcome by bridging distinct stakeholder groups while being responsive and accountable to the interests of parties on both sides of a boundary. This argument builds on ongoing conversation in the conservation field, where boundary organizations have served to enhance communication not only between scientists and policymakers (Borkhataria et al. 2017; Kennedy 2018), but also to facilitate multi-stakeholder groups in developing policies and management strategies (Cook et al. 2013; Caine 2016) and to coordinate conservation activities across landscapes (Westerink et al. 2017; Cash 2001). Broadening the definition of boundary organizations enables flexibility in identifying the most locally relevant boundaries and actors to engage in boundary work to meet specific conservation objectives and allows for a wider understanding of how organizations can successfully maintain trust on either side of a boundary.

Here, we draw on Guston (1999) and utilize *Mainspring Conservation Trust*, a land trust operating in Franklin, North Carolina, as a case study to demonstrate how land trusts can function as boundary organizations. As much of the existing empirical literature on boundary organizations is descriptive (Gustafsson and Lidskog 2018), we seek to apply theory to our case study and demonstrate how land trusts can facilitate interactions between otherwise disparate stakeholders. Although the boundary organization concept has been applied to agricultural extension agencies (Cash 2001), integrated catchment management agencies (Carr and Wilkinson, 2005) and conservation NGOs (Caine 2016; Borkhataria et al. 2017), to our knowledge, it has not been applied to land trusts. We will show how land trusts can facilitate adaptive, long-term relationships that

stabilize the divide between different parties, achieving the objective of boundary organizations (Cash 2001; Cash and Moser 2000).

We draw on our direct experiences collaborating with *Mainspring* and working in southern Appalachia. We first discuss the context for *Mainspring's* activities, including an integrative review of the socio-ecological conservation challenges presented by exurbanization in southern Appalachia. We then summarize *Mainspring's* conservation initiatives and use boundary organization theory to evaluate their function as a boundary organization. We conclude with “lessons learned” for successful conservation actions land trusts can implement in areas with diverse stakeholders and a dearth of conservation enforcement.

Case Study

Background on Southern Appalachia

Southern Appalachia includes over 37 million acres of mountainous region from northeastern West Virginia south into northern Georgia and Alabama (Southern Appalachian Man and the Biosphere Cooperative 1996; Figure 1). This region has high aquatic and terrestrial biodiversity (Vieites, Min, and Wake 2007) and is experiencing significant exurbanization pressure, largely as a result of “amenity migration”, as urbanites are drawn to rural natural resources (Taylor 2011). Exurban development in the southern Appalachians is also driven by socio-economic incentives, including minimal zoning restrictions and land use regulations (Kirk, Bolstad, and Manson 2012; Gragson and Bolstad 2006).

Ironically, the lack of regulation threatens to undermine precisely those natural amenities that spurred development in the first place (Vercoe et al. 2014). Newcomers whose homes serve as secondary residences are more likely to remove riparian vegetation than generational residents (Evans and Jensen-Ryan 2017). Additionally, steep slope development increases the likelihood of landslides for the region (Burkett et al. 2001) and climate predictions suggest wetter winters may lead to more frequent flooding (Wu, Clark, and Vose 2014). These activities threaten water quality, as even relatively modest reductions in forest cover (18–22%) can significantly increase sedimentation (Price and Leigh 2006). Increasing development pressures makes the maintenance of diverse aquatic and terrestrial ecosystems a significant challenge.

In exurban watersheds, working to build dialogue and stronger social networks may help prevent the capture and marketization of unregulated resources by private developers that export revenues outside of local communities (Heynen et al. 2007). This is especially true in areas where regulations are not likely to be introduced due to the high-value local residents place on private property rights (Evans and Jensen-Ryan 2017). In this context, land trusts and conservation easements may be particularly relevant, as they maintain private land ownership (Kiesecker et al. 2007) and provide flexibility in allowing certain productive or extractive land uses (Owley and Rissman 2016). Considering that landowners are more likely to enroll land in a conservation easement if they do not rely on it for income (Farmer et al. 2015; Cross et al. 2011) and many exurban landowners value their land for its natural amenities rather than its productive

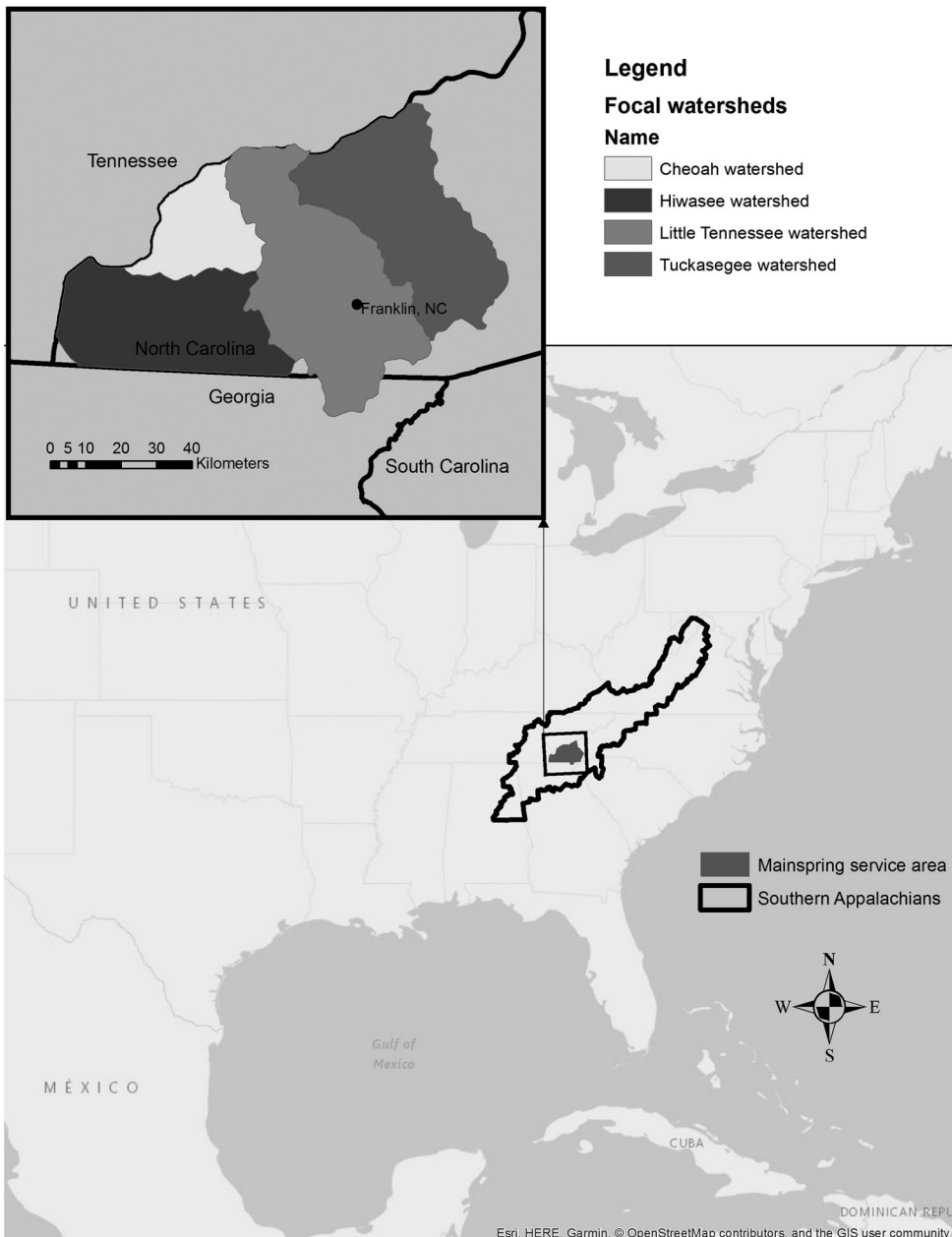


Figure 1. Map of the southern Appalachians and Mainspring Conservation Trust’s service area.

capacity, conservation easements can be a valuable tool for voluntarily restricting further development on private lands.

Mainspring Conservation Trust

Mainspring Conservation Trust is based in Franklin, North Carolina and functions as a land trust in the Upper Little Tennessee and Hiwasee River valleys, an area

covering over 1.65 million acres in western North Carolina and Northeast Georgia (Figure 1). *Mainspring* operates on a \$1.4 million budget, with funding from individual donations (71%), private foundations (28%), and governmental entities (2%) (Mainspring Conservation Trust 2018). The nonprofit is made up of a Board of Directors, which governs the Executive Director who oversees 11 full-time staff members. *Mainspring's* mission is to conserve the waters, forests, farms, and heritage in their service area. The organization has a diverse range of strategies to achieve these objectives, including community education, citizen science, stream monitoring and restoration, land acquisition and protection, and landowner stewardship. Conceptually, all of *Mainspring's* activities can be categorized into one of three focal areas: land, water, or cultural heritage. However, the activities are interconnected, in that land protection leads to healthier waters, aquatic monitoring identifies land in need of conservation or restoration, and the entire landscape is blanketed in rich cultural history.

The foundation for *Mainspring* was laid in 1993 when conservation-minded citizens held the Little Tennessee River Watershed Conference to bring awareness to the need for protection of the area's rich natural resources. These needs were met through the development of two separate entities, a watershed association (est. 1994) and land trust (est. 1997). In 2012, the organizations merged into the Land Trust for the Little Tennessee (LTLT). *Mainspring Conservation Trust* was established when LTLT changed its name in 2016 to reflect an earlier expansion of geographic scope into the Hiwassee watershed and the inclusion of aquatic-based programs typically unassociated with land trusts.

Mainspring protects land through voluntary conservation easements, land donations, or by land acquisitions that are then transferred to agencies, tribal entities, or private conservation buyers. *Mainspring* has conserved or partnered to conserve, over 26,000 acres of land (Mainspring unpublished data). In 2017 alone, 992 acres were protected through eight different land conservation projects (Mainspring Conservation Trust 2017). Although water cannot be protected through easements or acquisition, *Mainspring* uses water to underscore the need for land protection given the vital importance of clean water for local people, economies, and ecosystems. Since 2010, *Mainspring* has helped enhance aquatic habitat and restore connectivity by stabilizing over three miles (16,000 feet) of eroding streambank and removing six barriers to aquatic organism passage in their service area (Mainspring unpublished data).

Mainspring Conservation Trust as a Boundary Organization

We use Guston's (1999) three criteria to assess how *Mainspring* functions as a boundary organization. *Mainspring* meets the first criteria by providing a platform for boundary objects to be created and used. Since 1990, community members working with *Mainspring* have collected biomonitoring data in local waterways. By engaging the community in this citizen science effort, *Mainspring* has facilitated public engagement in the prioritization of restoration and conservation actions (Cosquer, Raymond, and Prevot-Julliard 2012). Though multiple regional and international data repositories have been interested in hosting the biomonitoring database since its inception, most were

short-lived and are no longer maintained due to funding limitations or staff turnover. In some cases, new staff were not able to develop the needed relationships with *Mainspring* to effectively manage their complex biomonitoring dataset. *Mainspring* has instead decided to internally provide a platform for this boundary object, which is publicly available on their website (www.mainspringconserves.org). Although the audience reached through *Mainspring* is smaller than those reached through regional or international databases, the biomonitoring data nonetheless serves as a repository, which is a recognized boundary object (Star and Griesemer 1989).

The biomonitoring data repository has been used by governmental entities, scientists, and *Mainspring* itself for diverse purposes. State agencies and the U.S. Fish and Wildlife Service have used this biomonitoring data to establish conservation priorities by identifying “hotspots” for aquatic species of concern. The data is also used by researchers studying fish communities in southern Appalachia and was incorporated into an international collection of biodiversity time series data (Dornelas et al. 2018). In 2009, *Mainspring* used this dataset to secure funding to restore fish passages with landowner cooperation at three sites within biologically impaired watersheds. By serving as a tool to engage community members with watershed conservation and providing data utilized by scientists and government agencies, the biomonitoring dataset has increased capacity to target conservation efforts by bridging these distinct stakeholders.

Mainspring also fulfills some aspects of Guston’s (1999) second criteria of a boundary organization by involving actors from both sides of the boundary. *Mainspring* relies on the collaboration of many actors to fulfill its goal as a land trust, including tribal entities, government, and private landowners. To facilitate this collaboration, the Board of Directors includes individuals from diverse backgrounds. Most members have lived in the area for decades, and many continue to be active in community development, economic, and cultural initiatives. Some board members are trained as scientists, and one is a member of the Eastern Band of Cherokee Indians. This engagement of actors across boundaries has helped *Mainspring* develop the long-term relationships it needs to meet its environmental and cultural conservation objectives by providing a mechanism to hold *Mainspring* accountable to these diverse actors.

Finally, *Mainspring* meets the third characteristic of boundary organizations: it functions at the interface of distinct social worlds while maintaining accountability to each (Guston 1999). For example, *Mainspring* has formed strong partnerships with social scientists working at the Coweeta Long Term Ecological Research (LTER) site through the Coweeta Listening Project (CLP). The CLP is a venue for researchers to participate in public communication, collaboration, and socio-ecological research (Burke et al. 2016). In partnership, *Mainspring* and the CLP wrote a series of columns for *The Franklin Press*, a widely read community information source, to increase the visibility of local conservation efforts and programs. This boundary work also led to a technical working paper designed to improve the efficacy of *Mainspring*’s biomonitoring program and facilitate public participation (Gancos-Crawford et al. 2014) and helped bridge the divide between scientists and non-scientists within the community.

As part of its mission to preserve cultural heritage, *Mainspring* has partnered with the Eastern Band of Cherokee Indians, who have inhabited the Upper Little Tennessee River Valley since 1000 B.C. (Delcourt et al. 1986). The partnership began in 2005

when Cherokee artisans began harvesting established white oak and rivercane stands along select *Mainspring* lands. *Mainspring* has facilitated interactions between the Cherokee and local government by helping launch an independent organization: Mountain Partners (Dunsmith 2017). The establishment of Mountain Partners was based on values shared by both groups, including reconciliation, economic growth, and preservation of the area's diverse cultural history. As part of the reconciliation process, *Mainspring* utilized a professional mediator to help resolve historic tensions between the tribe and the city of Franklin. One of the organization's initial actions was to develop the Cherokee Cultural Corridor, five miles of culturally rich land along the Little Tennessee River (Dunsmith 2017). While this joint effort of Cherokee and non-Cherokee community residents is maintained through mutual objectives and values, *Mainspring* initiated the dialogue that led to the group's formation (Cherokee One Feather 2016).

Mainspring also works at the interface of diverse social worlds by mediating the sometimes politically contentious boundary between land conservation and private property rights. *Mainspring*'s "Shade Your Stream" initiative encourages landowners to voluntarily re-vegetate their riparian area. In working with private landowners to complete their own low-cost property restoration projects, *Mainspring* reduces the financial burden of improving water quality without imposing restrictive zoning regulations. Although *Mainspring* does not advocate for government regulations, it does provide expertise in navigating the complex processes associated with acquiring government funding for local watershed conservation actions. For example, *Mainspring* has partnered with municipalities to conserve areas around their drinking water sources by submitting grant proposals to the state on their behalf (*Smoky Mountain News* 2013). *Mainspring* therefore spans multiple distinct social worlds, including between scientists and non-scientists, Cherokee and non-Cherokee, and private property rights advocates and conservationists. Their ability to effectively navigate the boundary between distinct social worlds to advance their conservation and restoration objectives has only been possible because they have built trust over time with actors on both sides of these boundaries.

Mainspring's work to connect disparate stakeholders using multiple activities has not been without challenges. Earlier in their history, *Mainspring* had some communication breakdowns with the local community. For example, *Mainspring* encountered challenges while preserving their flagship Needmore Tract, encompassing 5,100 acres which includes 26 miles along the Little Tennessee River. The conservation effort required coordination across multiple partners, leaving *Mainspring* without adequate capacity to sufficiently engage with the public regarding this initiative. Even though the Needmore Tract was saved from residential development and remains publicly accessible, some community-members have negative feelings toward *Mainspring* as certain land uses are restricted. *Mainspring* saw first-hand the importance of public opinion and now prioritizes targeted outreach efforts to engage with local landowners and cultivate public awareness of their activities. This engagement is also important because *Mainspring* does not have cash incentives to encourage landowners to enroll in conservation easements. However, the time and resources required to build relationships and trust with landowners are often not covered by grants that fund conservation easements and can pose a significant out-of-pocket expense.

While *Mainspring* fits the three criteria of a boundary organization, we recognize there are aspects of the term which it does not fulfill. Boundary organizations described in the literature most commonly work to bridge science and policy (Borkhataria et al. 2017; Gustafsson and Lidskog 2018). In order to effectively engage and maintain trust with landowners in a place where regulations are politically contentious, *Mainspring* does not advocate for policies that would impose additional regulations. This restricts the nonprofit's ability to link conservation science and policy. However, *Mainspring* has used its stream biomonitoring data to enable science to better inform policy and target local action while maintaining connections between governmental entities, scientists and community members. Additionally, while *Mainspring* has effectively used their stream biomonitoring dataset as a boundary object to connect stakeholders and facilitate targeted conservation actions, there are no associated standardized packages. Finally, *Mainspring* does not regularly use professional mediators to facilitate collaboration across their diverse partners and board members.

Discussion

In this paper, we demonstrate how *Mainspring* acts as a boundary organization that works at the interface of science and local action by connecting diverse stakeholders to achieve common objectives (Cook et al. 2013; Caine 2016) and maintaining accountability to both parties (Guston 1999). We use Guston's (1999) three criteria of a boundary organization to frame how land trusts can serve in this role and outline ways in which acting as a boundary organization can help land trusts meet their conservation objectives. The stream biomonitoring database serves as a boundary object, as scientists and non-scientists created the dataset and utilize it for their own purposes. Additionally, the representation of citizens, scientists, and developers on the Board of Directors has allowed *Mainspring* to act as an intermediary, facilitating cooperation among stakeholders to conserve significant ecological and cultural sites. *Mainspring* has also functioned at the interface between multiple social worlds, maintaining accountability to governmental, tribal, scientific, and community partners. Table 1 illustrates several projects *Mainspring* has used to facilitate community engagement and trust-building among these stakeholders.

This case study has two primary transferrable lessons for other land trusts and boundary organizations working in exurban landscapes or other places where conservation activities are urgently needed but politically contentious. First, in bridging the divide between science and local action, it is important to maintain flexibility by using a diversity of approaches. Although *Mainspring* is in some ways similar to other land trusts using conservation easements (Kiesecker et al. 2007), they also engage in a variety of additional activities not commonly associated with land trusts. One way they differ from more traditional land trusts is their focus on aquatic ecosystems through their biomonitoring and stream restoration projects. *Mainspring* has also worked with Cherokee partners to protect the region's cultural heritage, with social scientists to develop newspaper publications, and local landowners to restore riparian buffers. Finally, in contrast with other land trusts that often rely on public subsidies and grants to help offset their costs (Merenlender et al. 2004), *Mainstream*

Table 1. *Mainspring Conservation Trust* projects, the local groups which participated in each initiative, and their intended outcomes.

Mainspring project	Participatory groups	Intended outcomes
Stream biomonitoring	Community members Government entities Scientists	<ul style="list-style-type: none"> • Community engagement and awareness • Informing policy • Scientific research advancement • Increased government funding
Mountain partners	Community members Eastern Band of Cherokee Indians Government entities	<ul style="list-style-type: none"> • Cultural land preservation • Economic development • Improved relations
Local newspaper publications	Community members Scientists	<ul style="list-style-type: none"> • Increased public communication • Higher visibility of conservation initiatives
Shade Your Stream	Landowners	<ul style="list-style-type: none"> • Relationship-building with landowners • Improved water quality
Watershed conservation grant applications	Communities Government entities	<ul style="list-style-type: none"> • Improved water quality • Land conservation • Relationship-building with communities

has tapped a diversity of funding sources, with most of their funding coming from individual donations. Their capacity to access multiple funding streams is a result of relationships built while conducting boundary work. Future research should conduct a more thorough review of the land trust literature, including gray literature, to evaluate the extent to which other land trusts are similarly working as boundary organizations.

Second, a focus on fostering long-term relationships with multiple stakeholder groups can improve the efficacy of conservation boundary work. Given the importance of private property rights in the region, *Mainspring* has developed trust and long-term relationships by avoiding politics and not advocating for additional regulations. By engaging landowners and community members in biomonitoring and riparian restoration, *Mainspring* has cultivated relationships, improving the likelihood that local landowners will put land into voluntary conservation easements (Cross et al. 2011). Like other boundary organizations that focus on building trust in the community while promoting organizational goals (Caine 2016), *Mainspring* provides a nuanced approach in navigating tensions between local politics and science that has facilitated long-term relationships.

Conclusions

In summary, the *Mainspring Conservation Trust* case study demonstrates how a flexible and multi-pronged approach to engaging stakeholders can be an effective conservation strategy within a rapidly changing landscape characterized by limited land use regulations. *Mainspring's* ability to work directly with landowners minimizes the social and economic costs of addressing these conservation challenges. *Mainspring's* long history of working as a boundary organization between indigenous communities, academics, landowners, and government entities provides an example of how land trusts in exurban landscapes with limited regulations can successfully meet their conservation mission. Boundary work is especially relevant in this exurbanizing context, as scientists have

demonstrated a clear need for additional conservation activities on private property to protect biodiversity and ecosystem services.

This case study contributes to the boundary organization literature by expanding our conceptualization of boundary organizations beyond groups working at the science-policy interface. By expanding the definition, we highlight the critical role of organizations bridging the divide between science and local action to conserve biologically and culturally rich landscapes despite inadequate regulations.

Acknowledgments

We would like to thank Mainspring Conservation Trust for their insights and support in developing this manuscript as well as four anonymous reviewers for their thoughtful suggestions which greatly improved the quality of this manuscript.

Funding

We also acknowledge funding support from the NSF LTER program (award # 0218001).

References

- Borkhataria, R. R., P. R. Wetzel, H. Henriquez, and S. E. Davis. 2017. The Synthesis of Everglades Restoration and Ecosystem Services (SERES): A case study for interactive knowledge exchange to guide Everglades restoration. *Restoration Ecology* 25:S18–S26. doi:10.1111/rec.12593.
- Burke, B. J., M. Welch-Devine, S. Gustafson, N. Heynen, J. L. Rice, T. L. Gragson, S. R. Evans, and D. R. Nelson. 2016. Can science writing collectives overcome barriers to more democratic communication and collaboration? Lessons from the environmental communication praxis in Southern Appalachia. *Environmental Communication* 10 (2):169–86. doi:10.1080/17524032.2014.999695.
- Burkett, V., S. Ritschard, J. J. McNulty, R. O'Brien, J. Abt, U. Jones, B. Hatch, S. Murray, S. Jagtap, and J. Cruise. 2001. Potential consequences of climate variability and change for the southeastern United States. In *Climate change impacts on the United States: The potential consequences of climate vulnerability and change*. Report for the US Global Change Research Program, 137–166. Foundation Report. Cambridge, UK: Cambridge University Press.
- Caine, K. J. 2016. Blurring the boundaries of environmentalism: The role of Canadian parks and wilderness society as a boundary organization in northern conservation planning. *Rural Sociology* 81 (2):194–223. doi:10.1111/ruso.12094.
- Carr, A., and R. Wilkinson. 2005. Beyond participation: Boundary organizations as a new space for farmers and scientists to interact. *Society & Natural Resources* 18 (3):255–65. doi:10.1080/08941920590908123.
- Cash, D. W. 2001. In order to aid in diffusing useful and practical information: Agricultural extension and boundary organizations. *Science Technology and Human Values* 26 (4):431–53. doi:10.1177/016224390102600403.
- Cash, D. W., and S. C. Moser. 2000. Linking global and local scales: Designing dynamic assessment and management processes. *Global Environmental Change* 10 (2):109–20. doi:10.1016/S0959-3780(00)00017-0.
- Chang, K. 2016. National land trust census report. <https://www.landtrustalliance.org/about/national-land-trust-census> (accessed July 18, 2018).
- Cherokee One Feather. 2016. Mountain partners envisioning Nikwasi-Cowee future. <https://theonefeather.com/2016/02/mountain-partners-envisioning-nikwasi-cowee-future/> (accessed September 4, 2018).

- Cook, C. N., M. B. Mascia, M. W. Schwartz, H. P. Possingham, and R. A. Fuller. 2013. Achieving conservation science that bridges the knowledge-action boundary. *Conservation Biology* 27 (4): 669–78. doi:10.1111/cobi.12050.
- Cosquer, A., R. Raymond, and A. C. Prevot-Julliard. 2012. Observations of everyday biodiversity: A new perspective for conservation? *Ecology and Society* 17 (4):2. doi:10.5751/ES-04955-170402.
- Cross, J. E., C. M. Keske, M. G. Lacy, D. L. K. Hoag, and C. T. Bastian. 2011. Adoption of conservation easements among agricultural landowners in Colorado and Wyoming: The role of economic dependence and sense of place. *Landscape and Urban Planning* 101 (1):75–83. doi:10.1016/j.landurbplan.2011.01.005.
- Delcourt, P. A., H. R. Delcourt, P. A. Cridlebaugh, and J. Chapman. 1986. Holocene ethnobotanical and paleoecological record of human impact on vegetation in the Little-Tennessee River Valley. *Quaternary Research* 25 (3):330–49. doi:10.1016/0033-5894(86)90005-0.
- Dornelas, M., L. H. Antão, F. Moyes, A. E. Bates, A. E. Magurran, D. Adam, A. A. Akhmetzhanova, W. Appeltans, J. M. Arcos, H. Arnold, et al. 2018. BioTIME: A database of biodiversity time series for the Anthropocene. *Global Ecology and Biogeography* 27 (7):760–86. doi:10.1111/geb.12729
- Dunsmith, G. 2017. Nikwasi: A cultural corridor highlights Cherokee culture in the mountains of North Carolina. https://static1.squarespace.com/static/5af338fb55b02c9f4c61e4f2/t/5b3272a588251bbafaff95a5/1530032805436/Dunsmith_Nikwasi.pdf (accessed September 4, 2018).
- Evans, S. R., and D. Jensen-Ryan. 2017. Exurbanization and its impact on water resources: Stream management among newcomer and generational landowners in southern Appalachia. *Appalachian Journal* 44 (1–2):26–50.
- Farmer, J. R., V. Meretsky, D. Knapp, C. Chancellor, and B. C. Fischer. 2015. Why agree to a conservation easement? Understanding the decision of conservation easement granting. *Landscape and Urban Planning* 138:11–9. doi:10.1016/j.landurbplan.2015.01.005.
- Gancos-Crawford, T., C. E. Mertzlufft, S. Ortiz, J. Bloodgood, E. Guinessey, K. Brownson, H. Burnett, J. Chappell, J. Howard, L. Kosen, et al. 2014. Grade Your Stream Program Planning Guide.
- Goldman, R. L., H. Tallis, P. Kareiva, and G. C. Daily. 2008. Field evidence that ecosystem service projects support biodiversity and diversify options. *Proceedings of the National Academy of Sciences of the United States of America* 105 (27):9445–8. doi:10.1073/pnas.0800208105.
- Gragson, T. L., and P. V. Bolstad. 2006. Land use legacies and the future of southern Appalachia. *Society & Natural Resources* 19 (2):175–90. doi:10.1080/08941920500394857.
- Gustafsson, K. M., and R. Lidskog. 2018. Boundary organizations and environmental governance: Performance, institutional design, and conceptual development. *Climate Risk Management* 19: 1–11. doi:10.1016/j.crm.2017.11.001.
- Guston, D. H. 1999. Stabilizing the boundary between US politics and science: The role of the Office of Technology Transfer as a boundary organization. *Social Studies of Science* 29 (1): 87–111. doi:10.1177/030631299029001004.
- Guston, D. H. 2001. Boundary organizations in environmental policy and science: An introduction. *Science, Technology, & Human Values* 26:399–408. doi:10.1177/016224390102600401.
- Heynen, N., J. McCarthy, S. Prudham, and P. Robbins. 2007. *Neoliberal environments: False promises and unnatural consequences*. New York, NY: Routledge.
- Kennedy, E. B. 2018. Supporting scientific advice through a boundary organization. *Global Challenges* 2 (9):1800018. doi:10.1002/gch2.201800018.
- Kiesecker, J. M., T. Comendant, T. Grandmason, E. Gray, C. Hall, R. Hilsenbeck, P. Kareiva, L. Lozier, P. Naehu, A. Rissman, et al. 2007. Conservation easements in context: A quantitative analysis of their use by The Nature Conservancy. *Frontiers in Ecology and the Environment* 5 (3):125–30. doi:10.1890/1540-9295(2007)5[125:CEICAQ.2.0.CO;2]
- Kirk, R. W., P. V. Bolstad, and S. M. Manson. 2012. Spatio-temporal trend analysis of long-term development patterns (1900–2030) in a Southern Appalachian County. *Landscape and Urban Planning* 104 (1):47–58. doi:10.1016/j.landurbplan.2011.09.008.
- Knight, R. L. 1999. Private lands: The neglected geography. *Conservation Biology* 13 (2):223–4.

- Mainspring Conservation Trust. 2017. A legacy of caring for our mountains: 2017 Annual report. https://issuu.com/mainspringconservationtrust/docs/final_pdf (accessed July 18, 2018).
- Mainspring Conservation Trust. 2018. <http://www.mainspringconserves.org/what-we-do/> (accessed July 18, 2018).
- Merenlender, A. M., L. Huntsinger, G. Guthey, and S. K. Fairfax. 2004. Land trusts and conservation easements: Who is conserving what for whom? *Conservation Biology* 18 (1):65–75. doi:10.1111/j.1523-1739.2004.00401.x.
- Owley, J., and A. R. Rissman. 2016. Trends in private land conservation: Increasing complexity, shifting conservation purposes and allowable private land uses. *Land Use Policy* 51:76–84. doi:10.1016/j.landusepol.2015.10.026.
- Price, K., and D. S. Leigh. 2006. Comparative water quality of lightly- and moderately-impacted streams in the southern Blue Ridge Mountains, USA. *Environmental Monitoring and Assessment* 120 (1–3):269–300. doi:10.1007/s10661-005-9060-1.
- Smoky Mountain News. 2013. Land trust for the little Tennessee helps gain protection for another town watershed. February 20. <http://www.smokymountainnews.com/outdoors/item/9885-land-trust-for-little-tennesseehelps-gain-protection-for-another-town-watershed>
- Southern Appalachian Man and the Biosphere Cooperative. 1996. The Southern Appalachian assessment: Summary report. http://www.samab.org/wpcontent/uploads/2011/06/SAA_summary_report.pdf (accessed July 18, 2018).
- Spectorsky, A. C. 1955. *The exurbanites*. Philadelphia, PA: Lippincott.
- Star, S. L., and J. R. Griesemer. 1989. Institutional ecology, translations and boundary objects – Amateurs and professionals in Berkeley’s Museum of Vertebrate Zoology, 1907–39. *Social Studies of Science* 19 (3):387–420. doi:10.1177/030631289019003001.
- Sternlieb, F., R. P. Bixler, H. Huber-Stearns, and C. Huayhuaca. 2013. A question of fit: Reflections on boundaries, organizations and social-ecological systems. *Journal of Environmental Management* 130:117–25. doi:10.1016/j.jenvman.2013.08.053.
- Taylor, L. 2011. No boundaries: Exurbia and the study of contemporary urban dispersion. *GeoJournal* 76 (4):323–39. doi:10.1007/s10708-009-9300-y.
- Vercoe, R. A., M. Welch-Devine, D. Hardy, J. A. Demoss, S. N. Bonney, K. Allen, P. Brosius, D. Charles, B. Crawford, S. Heisel, et al. 2014. Acknowledging trade-offs and understanding complexity: Exurbanization issues in Macon County, North Carolina. *Ecology and Society* 19 (1):11. doi:10.5751/ES-05970-190123.
- Vieites, D. R., M. Min, and D. B. Wake. 2007. Rapid diversification and dispersal during periods of global warming by Plethodontid salamanders. *Proceedings of the National Academy of Sciences of the United States of America* 104 (50):19903–7. doi:10.1073/pnas.0705056104.
- Westerink, J., R. Jongeneel, N. Polman, K. Prager, J. Franks, P. Dupraz, and E. Mettepenningen. 2017. Collaborative governance arrangements to deliver spatially coordinated agri-environmental management. *Land Use Policy* 69:176–92. doi:10.1016/j.landusepol.2017.09.002.
- Wu, W., J. S. Clark, and J. M. Vose. 2014. Response of hydrology to climate change in the southern Appalachian Mountains using Bayesian inference. *Hydrological Processes* 28 (4):1616–26. doi:10.1002/hyp.9677.