

Title

Re-centering Relations: The Trouble with Quick Fix Approaches to Beaver-based Restoration

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Text

We write in response to the recent explosion of interest in North American beaver (*Castor canadensis*) as the potential savior of temperate and subarctic North American riverscapes (and destroyer of Arctic ones). Cast as adorable eco-saviors in the popular press (e.g. news articles, wildlife shows, non-fiction bestsellers), some ecologists and watershed advocates position beaver as an ecosystem engineer capable of thwarting wildfire and drought, flood and disturbance (e.g. Pollock et al., 2014; Law et al., 2017; Jordan & Fairfax, 2020; Thompson et al., 2021). A common theme tends to flow through these discussions: Humans have problems, including those caused by removing beavers from the landscape. And reintroducing beavers and beaver-inspired fixes is a key to solving them.

As castor-curious scholars and practitioners, we are closely following the beaver fever increasingly sweeping the river restoration community, in the form of beaver reintroductions and beaver-inspired fixes like beaver dam analogs (woven brush dams reinforced with fence posts). From our positions as Euro-settler and Native river researchers—many living and working in and adjacent to the homelands of the Anishinaabek, but not exclusively—we see ourselves invested in supporting beaver-filled landscapes across North America. All of us, in different ways, work towards dynamic and thriving river systems across these lands and take inspiration from the variety of Tribal beaver reintroduction projects happening especially across the Pacific Northwest (e.g. the Tulalip Tribes, the Cowlitz Indian Tribe, the Puyallup Tribe, the Karuk Tribe) that focus on beaver in their own right and in relation to their landscapes. But we increasingly bristle at the ways that beavers—as bounded beings, as distinct entities—are held up in wider restoration conversations as a management instrument of salvation for North America’s freshwater problems. We frequently see a strong emphasis on what beavers can *do*, with little

attention to how they live and world-make: the multispecies and Native ecocultural relations within which they and their lifeways emerge. And we worry that this increasingly intense interest from some settler journalists, policy makers, researchers, and restoration practitioners in instrumentalizing, conscripting, monetizing, and capitalizing on beavers sets them up as yet another quick fix to our riverine woes, replacing past structural answers—earthen levees, riprap, reconfigured channels, concrete dams, natural channel design—with a livelier being still enlisted to perform a narrow, settler-centric fix.

We understand that these managerial logics likely emerge from genuine interest and investment in *Castor canadensis* among river researchers and practitioners and in the lively and dynamic river systems of which they are a part. But we increasingly see a common argumentative move in restoration discussions: one that focuses on beaver's worth (read: value) to human lives. We understand this argument is commonly an oversimplification, offered by beaver advocates for the sake of winning over non-beaver believers, rather than fully representing their nuanced views on beaver-filled landscapes. But we caution that this oft-repeated justification has the energetic capacity to take on a life of its own. And it has: instrumentalizing beavers; justifying their surveillance; isolating them from their broader ecosystem relations; and often ignoring the millennia of theory and practice and protocol from Indigenous thinkers about beaver relations and river systems on the continent (e.g. Stark, 2010; Simpson, 2017, 2019; Whetung, 2019; Biber, 2023), evident in the Tribal beaver projects we drew inspiration from above and detailed in Indigenous theory and guidance documents we include below. Further, this justification feeds back on itself, used as evidence to support the practices that harness beaver worth, and the sets of settler relations that make those practices seem necessary.

So we write here with hope of interrupting, intervening in, reeling back this public relations campaign for the North American beaver as the ecological Swiss army knife that will get humans out of the climate disaster of our own making, “our” as especially the whitest and wealthiest among us. And, instead, we want to point river thinkers and doers to other ways of thinking with and living with beavers: ones that avoid a focus only on prescriptive results—on what beavers get us—and instead embrace beavers in relational process. We encourage practices that, as Wilson (Opaskwayak Cree) (2008) and other Indigenous scholars detail, emphasize relational accountability through respect, reciprocity, and responsibility, and, crucially, expand the management conversation beyond narrowly focused human-centered objectives to embracing more-than-human relationships.

This importance is emphasized in the recent *Tribal Climate Adaptation Menu* (2019), with authors from the Red Cliff Band of Lake Superior Ojibwe, Menominee Nation, Lac du Flambeau Band of Lake Superior Chippewa Indians, Sault Ste. Marie Tribe of Chippewa Indians, Keweenaw Bay Indian Community, Reno-Sparks Indian Colony, Bad River Band of Lake Superior Ojibwe, Oneida Nation of Wisconsin, and Northern Wisconsin and Upper Michigan settler communities, a document “intended to empower tribal governments, federal and state agencies, nongovernmental organizations (NGOs), individual landowners and others to incorporate

Anishinaabeg perspectives, specifically from the Great Lakes region, into a climate adaptation framework" (p. 8). That document insists on the importance of human-nonhuman relationships, emphasizing that "relationships are the interwoven bonds that form the framework of place within which we exist" (p. 8). As it continues:

We consider beings in the natural environment to be elders and teachers who can teach us valuable lessons. This has ensured an equitable, long-term, sustainable, and generational existence for many of these human and nonhuman communities. These relationships have developed in a multiplicity of cultures that have passed down a knowledge of place through thousands of years of experience to subsequent generations. They provide the framework of relationships and the roadmap to a truly sustainable way of life, with respect and understanding for all aspects of creation. (Tribal Climate Menu Adaptation Team, 2019, p. 8)

Learning from the perspectives and tribal management approaches detailed there and elsewhere, and from beavers themselves, we want to move the settler river restoration community towards an attitude or comportment of being in good relation with beaver, and attending to the emplaced knowledge about beaver developed in reciprocal relation with them over thousands of years. This is a continually evolving activity that makes space for the potential of shared and always ongoing mending of riverscapes and relations, valuing impermanence and working against what coauthor Widell (2023) has theorized as physical, political-economic, and discursive fixity, of both riverscapes and our ideas of them.

To be clear, this isn't entirely a new point, but it's one we see taking on increasing urgency in the context of North American river restoration efforts. We agree with coauthor Woelfle-Hazard (2022) who has noted the ways that settler restorationists frequently, "instrumentalize beavers, whether as useful tools or harmful disruptors" (p. 76), and consider beaver primarily, "through the prism of human interest" (p. 76), offering narratives "presenting beaver dams as a means to maintain a settler-dominated landscape" (p. 77). In extending this critique, we build our argument from the thinking and writing of Indigenous scholars to question the current state of North American river restoration and its beaver turn. We take seriously the warning of coauthor Myhal (Sault Ste. Marie Tribe of Chippewa Indians) with Flood (2022) that many such "turns" in scholarship, "often mask colonialism's continuation through the continued appropriation and lack of engagement with Indigenous theories of knowledge" (p. 322). Instead, they argue, "These turns need to be situated in conversations around relationality and discussions of how to take Indigenous ways of knowing through their own descriptions and not simply through the narrow definitions of 'property' or 'resource' that settlers understand" (p. 322). That is work we try to take on here.

While Flood and Myhal's (2022) argument is focused not on beaver and river restoration, but on eastern white pine (*Pinus strobus*) and herbalism, the tendency for settler restorationists to isolate beavers as useful (for humans) ecosystem engineers is analogous to the appropriative

move Flood and Myhal identify: "Drawing from the work of Patrick Wolfe, Eve Tuck and K. Wayne Yang, and Zoe Todd, we argue that settler appropriation is the dynamic through which settlers remove plants such as white pine from people, place, and time and replace white pine within a placeless, timeless, consumable identity" (p. 304); as they continue, "plants such as white pine became material resources and objects of knowledge that continue to be used to produce Western herbalism as a predominantly white settler modality of medicine" (p. 304). It's an easy interpretive move from *zhingwaak* [eastern white pine] to *amik* [beaver]: *Settler appropriation is the dynamic through which settlers remove animals such as beaver from people, place, and time and replace beaver within a placeless, timeless, consumable identity*. This move is no doubt familiar in the logic that converted beavers into placeless, timeless, consumable pelts during the fur trade, the very dynamic that helped create the conditions river managers are responding to today. But, thinking with Flood and Myhal (2022), we see the same logic that prompted beaver removal and beaver extirpation in some current moves towards beaver reintroduction and beaver mimicry where: *Animals such as beaver became material resources and objects of knowledge that continue to be used to produce Western river restoration as a predominantly white settler modality of science*. In other words, reintroducing beaver or beaver works to a landscape does not necessarily undo (and can, in fact, reinforce) the harms of removal, when it is the settler appropriation of beaver-separated from place, time, and relation—that is at the heart of the problem.

So we invite settler river scientists, river restorationists, and river thinkers to question this increasingly taken-for-granted logic of beaver as isolated creature, ecosystem engineer, and river savior; defer to the millennia of theory about beavers and their relations on this continent, partnering with beaver and with the Native peoples who have known them longest; and reconnect beaver back to people, place, and time. We admire the growing energy for beaver-based restoration, but worry that it risks eroding the very work it purports to do: to create lively, dynamic, diverse, flourishing river systems across the continent.

In a spirit of invitation, then, to consider a shift in thinking and praxis, we offer a set of provocations to highlight the potential damage these types of beaver fixes can and do pose for stream restoration. And we conclude by considering the ways these beaver fixes are bad for beavers and for the lands and waters they inhabit with humans and other beings.

Beaver fixes are bad for stream restoration, because they downplay the complexity of beavers, beaver works, and beaver impacts to advocate for beaver use, and minimize the social and ecological challenges of reintroduction and the importance of relations and contexts. Because we see this as a systemic issue and offer these ideas in what we hope is a generative spirit, we intentionally focus our critique here not on individual scholars, but on broader examples that illuminate the moves we identify.

For instance, we see an increasing number of workshops, working groups, guidance documents, resource libraries, research articles, and presentations that detail the positive impacts of beavers and their works, often downplaying the dynamic suite of impacts that beavers have on their

environments, which are wide-ranging (Larsen et al., 2021) and stochastic, as coauthor Woelfle-Hazard (2015, 2017, 2019, 2022) has argued for many years. This focus primarily on positive impacts of beavers can also foreclose important understandings of beaver impacts as disturbance, and of disturbance as a key driver of habitat complexity and temporal variability in aquatic-riparian ecosystems (Penaluna et al., 2018). Furthermore, seeing beaver as a tool for human use is counter to some Indigenous worldviews, which see humans and other species as collaborating to maintain ecocultural landscapes. In this view, basketweavers might see beavers' pruning of willows as commensurate with their coppicing and management of willow stands with fire (Leaf Hillman [Karuk], personal communication, 7/2/23).

Related to this focus on positive impacts, we see a frequent tendency towards beaver management practices that are based on little or no long-term data about geomorphic, hydrologic, vegetative, and fisheries impacts of beaver activities, and a somewhat surprising but concomitant leveraging of this lack of long-term data to suggest that beavers do not have negative impacts on humans and recreationally important fish species. We want to advocate for the financial, physical, mental, emotional, and relational investment necessary for long-term learning in and with the places where we work, and suggest, at minimum, beaver-related restoration efforts require additional monitoring of their ongoing impacts in particular landscapes. Because of the singular stochasticity of beaver effects, this work will also require a shift towards the quantitative and qualitative documentation of impacts and process pathways (Nash et al., 2021).

This stochasticity and complexity matters, also, for modeling efforts related to beaver-based restoration. We frequently see an oversimplification of beaver dams in hydrologic models, often leading to confirmation bias. Beaver dams are commonly modeled as sanitized, static versions of themselves, with models generally limited to parameterizing representations of structural engineering technologies (e.g., concrete dams with broad-crested spillways) with a critical tuning parameter representing their leakiness. Emerging research suggests that these static and problematic *in silico* representations—computer simulations of complex biophysical systems—do not account for the complex dynamism of their *in situ* counterparts, which include frequent shifts in flow states (Aguirre et al., 2024) and gapflow water release unlike many human-engineered structures (Larsen et al., 2021).

This tendency to model beaver activity out of context appears more broadly in a frequent move to take beavers themselves out of context, emphasizing the portability of beaver-based restoration techniques and outcomes across landscapes and ecoregions. We see frequent arguments that beavers' ability to provide particular human desired benefits—like significantly raising water tables, or increasing drought resistant vegetation, or creating persistent fire breaks in the American West—will transfer seamlessly to the other portions of the continent with significantly different climates, topographies, geomorphologies, hydrologies, and scalar logics. And the impacts of these mismatches are exacerbated by the current saturation of federal funding in the American West for process-based restoration (PBR), mostly in the form of beaver

dam analogs and post-assisted log structures. Beaver-based structures, without beaver themselves, further abstract beaver works and try to employ their messiness and dynamism in static, human-focused ways, replacing key aspects of place, process, and geomorphic understanding so critical to project success (Wohl et al., 2024). PBR project funding is increasingly tied to mandated monitoring, but the simultaneous urgency to implement projects on the ground—often without cohesive watershed planning or science- and place-based, relational knowledge—risks interrupting potential benefits because of the frequently incompatible timescales of practitioners, science professionals, funding agencies, and beaver themselves, as Beardsley (2024) also warns.

The overemphasis on portability and scalability of beaver fixes—and the frequent glossing over of incompatibilities—threatens successful restoration outcomes and forecloses possibilities to learn from deep and significant knowledge in place, including what Watts (Mohawk and Anishinaabe Bear Clan, Six Nations of the Grand River) (2013) has detailed as the importance for the Haudenosaunee and Anishinaabek of *Place-Thought*, "the non-distinctive space where place and thought were never separated because they never could or can be separated. Place-Thought is based upon the premise that land is alive and thinking and that humans and non-humans derive agency through the extensions of these thoughts" (p. 21), and what Kanngieser and Todd (Red River Métis) (2020) emphasize as the central connections between place, thought, and relations" (p. 386). As Kanngieser and Todd (2020) insist, acknowledging this co-constitutive set of relationships demands that environmental researchers, "address the importance of maintaining ethical and reciprocal relationships with Land and place (and all the co-constituents thereof)" (p. 386). We see the Tribal beaver reintroduction programs we mentioned above working in various ways to honor the beaver's sacred history and learn from and practice these co-constitutive sets of relationships. In the spirit of Kanngieser and Todd (2020), we want to invite settler river restoration practitioners, as well, to build and maintain their (our) own ethical and reciprocal relationships with Land and place.

We argue that this emphasis on ethical and reciprocal relations should be central to beaver-based restoration, working against what we see as a consistent impulse to separate beavers from their relations: banking on the restorative impacts of beavers without deep consideration of the wider conditions—the *relations*—that allow them to thrive. And the cultivation of these wider relations—the relations on which beavers depend—are essential for getting something close to what restoration practitioners would hope for as "successful" outcomes. For instance, many beaver reintroductions seem to happen independently from the reintroduction of other historically extirpated creatures with whom beaver have long relations. This includes wolves, who put checks on beaver and the extent of their landscape transformations through predation in places where the two share ranges (Gable et al., 2020).

This emphasis on beaver relations extends, too, to the complex social and political ecosystems of beaver reintroduction. We have witnessed a frequent overlooking of this context, especially in urban and suburban areas, where reintroduction may not be viable or desirable, at least without

a significant change in interspecies social and ecological relations to actually welcome beavers—and the conditions they need—back. Many land and river managers are all too familiar with this complexity, and an uncritical embrace of positive beaver impacts might come across as dismissive of concerns about flooding, tree depredation, and so on, lowering chances of collaboration by some actors already skeptical of restoration. This challenge may be part of the reason for the saturation of beaver-based fixes in sparsely populated areas, including federal lands, which have their own violent history of acquisition and persistence, and again sidesteps important engagement with beaver-human relations. The human complexity of reintroduction has been widely studied in Europe (e.g. Crowley et al., 2017; Auster et al., 2020; Coz & Young, 2020), but much less so in North America with a few exceptions (e.g., Siemer et al., 2013; Charnley et al., 2020), and is an important area for future study.

Beaver fixes are also bad for beavers. The growing assumption that beavers will "fix" temperate and subarctic North American river systems, in the face of wildly distinct particular contexts, sets an impossibly high bar. Coauthor Widell (2023) has detailed the ways that river fixes are designed to fail from the start, never ultimately able "to discipline and constrain the unruly dynamism of the fluvial landscape" (p. 4). The wily-ness of beavers allows them, in many cases, to be framed as an un-fix: an agent that can reintroduce dynamism to anthropogenically constrained river systems. And yet, we see beavers and their works most commonly leveraged in settler restoration efforts as a quick fix that will solve a river's problems with the least amount of financial and human burden. But these fixes—like all fixes—will ultimately fail.

The current energy in positioning beavers as ecological saviors—able to perform extremely well across multiple monetizable dimensions (flood resilience, water quality improvement, carbon capture, etc.)—sets them up for failure. We recognize that the desire in western science to know and quantify is often incompatible with the dogged craftiness of beavers. What happens when the evidence turns out to be more complicated than it was first presented, or is impossible to interpret at all? When beavers do not build in the "best" locations identified by models and managers for specific stream ailments? When they can't deliver on the hype promised by beaver believers and low-tech practitioners? We worry about the backlash, having seen it before in cases like reed canary grass (*Phalaris arundinacea*), intentionally planted in stream restoration efforts since the 1960s and now considered a threat to the ecological integrity of wetlands (Wisconsin Reed Canary Grass Management Working Group, 2009), and rainbow trout (*Oncorhynchus mykiss*), who were enthusiastically introduced across the continent to be followed decades later with widespread removals (Halverson, 2011). Will enthusiasm again be followed with extirpation?

In many ways, the potential repudiation we detail is foreshadowed in North American Arctic landscapes. The narrative of beavers as saviors of temperate zone ecologies, so prevalent in beaver-based restoration research, implicitly assumes that many impacts of a warmer, weirder climate lie in the future—one that beaver engineering can help avoid or mitigate. For Arctic and sub-Arctic environments, however, where the pace of warming is at least twice that of lower

latitudes, ecosystem change is well under way. Earlier springs and longer autumns are moving the treeline—the latitude at which willows, spruce, and other substantial plants can grow—further north. Beavers are following their food. In 2008, Inuvialuit hunters saw beaver lodges on the north slope of the Yukon for the first time. In the years since, beavers have built homes in Arctic landscapes where their relations to local peoples and ecologies is new. Where beaver hydrology is seen as a panacea in many temperate regions, the potential for beaver ponds to speed permafrost thaw and methane emissions raises opposite concerns in the Arctic (Clark et al., 2023).

Coverage of northward-moving beavers, particularly outside Alaska, has repeated the tendency to remove beavers from their relations and from political context, referring to them as “invaders,” “colonizers,” or in the case of the *New York Times*, “agents of Arctic destruction” (Pierre-Louis, 2017). The narrative of beaver as an invader that exacerbates climate change displaces discussions of the industrial capitalist and colonial origins of a warming planet. Seeing beavers instrumentally—as only what they can do for people—diminishes beavers to a binary of helpful or destructive. Put another way, beaver presence in the Arctic is linked to ongoing settler colonial politics that support capital accumulation and extraction over alternative forms of relationship to environments, analogous to dynamics Martinez (Tutunaku and Mexica), Seraphin, Marks-Block, Nelson (Coast Miwok and tribal citizen of the Federated Indians of Graton Rancheria), and Vinyeta (2023) identify in the case of Indigenous fire management. How beaver movements interact with the sovereignties of Indigenous peoples is also often left out of this discussion. This occludes both local community concerns—as in some Alaska Native homelands—that beaver hydrology alters local waters in potentially harmful ways, or adaptations to live with newly arrived beavers. Forms of relation with beaver from lands where beavers have long been common are often not highlighted as potential ways to live with new beavers. In Gwich'in country, for example, communities have long seen a need for active human intervention into beaver lives so their dams do not prevent whitefish movement or otherwise harm the capacity for other species to also thrive. Critically, Indigenous residents involved in monitoring projects like the Arctic Beaver Observation Network and the Beavers and Socio-ecological Resilience in Inuit Nunangat emphasize that beavers can simultaneously bring hazards like giardia while offering benefits in fire reduction or hunting. In short, beavers relate to Land in ways that escape easy summation like the term “invasive,” a framing that brings American ideals of prelapsarian wilderness to Arctic landscapes long home to change and adaptation.

The complexities unfolding with beaver in communities in the Arctic demonstrate the importance of relationality and context for beaver landscapes across the continent. Beaver relations emerge in place, and are always multispecies. Beaver-based restoration practices that fail to attend to place and multispecies relation replicate the same extractive and exploitative settler colonial logics that drove beaver extirpation in the first place, that continue to displace beaver and alter the conditions for their thriving, and that drive the changes in climate that amplify the stakes of all of these discussions.

We understand that river researchers and practitioners—ourselves included—are facing truly overwhelming problems. And that our argument here may seem like an impossible additional burden. We're asking the restoration community not only to try to address the on-the-ground challenges of anthropogenically damaged river systems across the continent, but also to take on the ethical responsibility to build Native-settler relations that help to deeply support the conditions for beaver—and multispecies—thriving.

This work is essential.

Leveraging beavers as tools to fix problems that have been caused, in some cases, by their long-term, cumulative removal across the landscape, distracts from the dire need to engage with and address the root causes of environmental degradation and socio-ecological inequities, which are largely tied to the same issues of colonialism and capitalism that prompted beaver extirpation in the first place. Any hope of the kind of transformation of vision and of relations that we describe will only come when settler river scientists and managers engage with these root causes and logics and with the discourses and practices they drive, as coauthors Gottschalk Druschke, Booth, Lave, Widell, Lundberg, and Sellers (2023) have argued, building from coauthor Woelfle Hazard (2022), Whyte (Citizen Potawatomi Nation) (2018), and Barra (2023).

To truly practice beaver-based restoration efforts—collaborations that work towards beneficial futures for North American rivers and that deliver on the often well-intended and hopeful promises of many beaver-based fixes—we insist on the importance of long-term, place-based knowledge and on the significance of intentionality, time, and relation. This means reconsidering natural resources management not from a standpoint of dominion but, instead, as one Tribal leader from the 1836 Treaty of Washington (D.C.) Ceded Territory rephrased it, "living the way we are supposed to live with the things the Creator put here for us" (qtd. in Holtgren & Auer, 2023, p. S122). This means thinking about the material consequences of restoration decisions for humans and nonhumans and working for equitable outcomes. This means taking the time to build multi-generational relationships and engage in mutually beneficial practices with an eye towards the best interests of rivers and beavers and all their relations, including Native and settler peoples.

Put simply, treating beavers as fixes is bad for stream restoration, bad for beavers, and bad for the lands and waters beavers inhabit, including the Native and settler folks who are a part of them. We urge settler river researchers and practitioners to consider different ways to relate with beaver, ways that learn from Native understandings of beaver relations and partner with beavers and Native peoples in (y)our own places, to consider how to exist differently in relation to beaver.

References

Aguirre, I., G. A. Hood, and C. J. Westbrook (2024), Short-term dynamics of beaver dam flow states, *Science of the Total Environment*, 919: 170825.

Auster, R. E., Puttock, A., & Brazier, R. (2020). Unravelling perceptions of Eurasian beaver reintroduction in Great Britain. *Area*, 52(2), 364-375.

Barra, M. P. (2024). Restoration otherwise: Towards alternative coastal ecologies. *Environment and Planning D: Society and Space*, 42(1), 147-165.

Beardsley, M. (2024). A Perspective on the LTPBR Phenomenon. White paper. https://www.researchgate.net/publication/377967162_A_Perspective_on_the_LTPBR_Phenomenon

Biber, N.K. (2023). Michigan DNR 'Kill List' Impacts Sovereignty, Cultural Preservation. *Native News Online*. <https://nativenewsonline.net/opinion/michigan-dnr-kill-list-impacts-sovereignty-cultural-preservation>

Charnley, S., Gosnell, H., Davee, R., & Abrams, J. (2020). Ranchers and beavers: Understanding the human dimensions of beaver-related stream restoration on western rangelands. *Rangeland Ecology & Management*, 73(5), 712-723.

Clark, J. A., Tape, K. D., Baskaran, L., Elder, C., Miller, C., Miner, K., O'Donnell, J. A., and Jones, B. M. (2023). "Do beaver ponds increase methane emissions along Arctic tundra streams?." *Environmental Research Letters*, 18(7): 075004.

Coz, D. M., & Young, J. C. (2020). Conflicts over wildlife conservation: learning from the reintroduction of beavers in Scotland. *People and Nature*, 2(2), 406-419.

Crowley, S. L., Hinchliffe, S., & McDonald, R. A. (2017). Nonhuman citizens on trial: the ecological politics of a beaver reintroduction. *Environment and Planning A: Economy and Space*, 49(8), 1846-1866.

Flood, M., & Myhal, N. (2022). White Pine in Time and Place: Anishinaabe History, Western Herbalism, and the Settler Dynamics of Appropriation. *History of Pharmacy and Pharmaceuticals*, 63(2), 302-327.

Gable, T. D., Johnson-Bice, S. M., Homkes, A. T., Windels, S. K., & Bump, J. K. (2020). Outsized effect of predation: Wolves alter wetland creation and recolonization by killing ecosystem engineers. *Science Advances*, 6(46), eabc5439.

Gottschalk Druschke, C., Booth, E. G., Lave, R., Widell, S., Lundberg, E., Sellers, B., & Stork, P. (2023). Grass versus trees: A proxy debate for deeper anxieties about competing stream worlds. *Environment and Planning E: Nature and Space*, 25148486231210408.

Halverson, A. (2010). *An entirely synthetic fish: how rainbow trout beguiled America and overran the world*. Yale University Press.

Holtgren, J. M., & Auer, N. A. (2023). Forging a new path for multi-cultural fishery management. *Journal of Great Lakes Research*, 49, S116-S127.

Jordan, C. E., & Fairfax, E. (2022). Beaver: The North American freshwater climate action plan. *Wiley Interdisciplinary Reviews: Water*, 9(4), e1592.

Kanngieser, A., & Todd, Z. (2020). From Environmental case study to environmental kin study. *History and Theory*, 59(3), 385-393.

Larsen, A., Larsen, J. R., & Lane, S. N. (2021). Dam builders and their works: Beaver influences on the structure and function of river corridor hydrology, geomorphology, biogeochemistry and ecosystems. *Earth-Science Reviews*, 218, 103623.

Law, A., Gaywood, M. J., Jones, K. C., Ramsay, P., & Willby, N. J. (2017). Using ecosystem engineers as tools in habitat restoration and rewilding: beaver and wetlands. *Science of the Total Environment*, 605, 1021-1030.

Martinez, D. J., Seraphin, B., Marks-Block, T., Nelson, P., & Vinyeta, K. (2023). Indigenous Fire Futures: Anticolonial Approaches to Shifting Fire Relations in California. *Environment and Society*, 14(1), 142-161.

Nash, C. S., Grant, G. E., Charnley, S., Dunham, J. B., Gosnell, H., Hausner, M. B., Pilliod, D. S., and Taylor, J. D. (2021) Great expectations: Deconstructing the process pathways underlying beaver-related restoration. *BioScience*, 71 (3): 249-267.

Penaluna, B. E., Reeves, G. H., Barnett, Z. C., Bisson, P. A., Buffington, J. M., Dolloff, C. A., Flitcroft, R. L., Luce, C.H., Nislow, K.H., Rothlisberger, J.D. and Warren Jr, M.L. Using natural disturbance and portfolio concepts to guide aquatic-riparian ecosystem management. *Fisheries*, 43, no. 9 (2018): 406-422.

Pierre-Louis, K. (2017, December 20). Beavers emerge as agents of Arctic destruction. *The New York Times*. www.nytimes.com/2017/12/20/climate/arctic-beavers-alaska.html.

Pollock, M. M., Beechie, T. J., Wheaton, J. M., Jordan, C. E., Bouwes, N., Weber, N., & Volk, C. (2014). Using beaver dams to restore incised stream ecosystems. *BioScience*, 64(4), 279-290.

Siemer, W. F., Jonker, S. A., Decker, D. J., & Organ, J. F. (2013). Toward an understanding of beaver management as human and beaver densities increase. *Human-Wildlife Interactions*, 7(1), 114-131.

Simpson, L. B. (2017). *As We Have Always Done: Indigenous Freedom Through Radical Resurgence*. Minneapolis: University of Minnesota Press.

Simpson, L. B. (2021). *A Short History of the Blockade: Giant Beavers, Diplomacy, and Regeneration in Nishnaabewin*. Edmonton: University of Alberta Press.

Stark, H. (2010). Respect, responsibility, and renewal: The foundations of Anishinaabe treaty making with the United States and Canada. *American Indian Culture and Research Journal*, 34(2).

Thompson, S., Vehkaoja, M., Pellikka, J., & Nummi, P. (2021). Ecosystem services provided by beavers *Castor* spp. *Mammal Review*, 51(1), 25-39.

Todd, Z. (2016). "An Indigenous Feminist's Take on the Ontological Turn: 'Ontology' Is Just Another Word for Colonialism," *Journal of Historical Sociology* 29(1): 4-22.

Tribal Adaptation Menu Team. (2019). Dibaginjigaadeg Anishinaabe Ezhitwaad: A Tribal Climate Adaptation Menu. Great Lakes Indian Fish and Wildlife Commission, Odanah, Wisconsin. Accessed 16 March 2024.
<https://glifwc.org/ClimateChange/TribalAdaptationMenuV1.pdf>

Tuck, E., and Yang, K. W. (2012). "Decolonization Is Not a Metaphor," *Decolonization: Indigeneity, Education & Society*, 1(1).

Watts, V. (2013). Indigenous place-thought and agency amongst humans and non humans (First Woman and Sky Woman go on a European world tour!). *Decolonization: Indigeneity, Education & Society*, 2(1).

Whetung, M. (2019). (En)gendering shoreline law: Nishnaabeg relational politics along the Trent Severn Waterway. *Global Environmental Politics*, 19(3), 16-32.

Whyte, K. (2018). Settler colonialism, ecology, and environmental injustice. *Environment and Society*, 9(1), 125-144.

Widell, S. (2023). Fixing Streams. M.S. Thesis. University of Wisconsin-Madison.

Wilson, S. (2008). *Research is Ceremony: Indigenous Research Methods*. Halifax: Fernwood Publishing.

Wisconsin Reed Canary Grass Management Working Group. (2009). Reed Canary Grass (*Phalaris arundinacea*) Management Guide: Recommendations for Landowners and Restoration Professionals. PUB-FR-428 2009

Wohl, E., Rathburn, S., Dunn, S., Iskin, E., Katz, A., Marshall, A., Means-Brous, M., Scamardo, J., Triantafillou, S. and Uno, H., 2024. Geomorphic context in process-based river restoration. *River Research and Applications*. DOI: 10.1002/rra.4236

Wolfe, P. (2006). "Settler Colonialism and the Elimination of the Native," *Journal of Genocide Research* 8, no. 4: 387-409.

Woelfle-Erskine, C. A. (2017). The watershed body: Transgressing frontiers in riverine sciences, planning stochastic multispecies worlds. *Catalyst: Feminism, Theory, Technoscience*, 3(2), 1-32.

Woelfle-Erskine, C. (2019). Beavers as commoners? Invitations to river restoration work in a beavery mode. *Community Development Journal*, 54(1), 100-118.

Woelfle-Erskine, C., & Cole, J. (2015). Transfiguring the Anthropocene: Stochastic reimaginings of human-beaver worlds. *Transgender Studies Quarterly*, 2(2), 297-316.

Wölfle Hazard, C. (2022). *Underflows: Queer trans ecologies and river justice*. Seattle: University of Washington Press.