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Transforming tree-ring research through collaborations with Indigenous peoples

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Integrating Indigenous knowledge into tree-ring fire histories without meaningful collaboration with Indigenous peoples is an ongoing form of colonization. Here, we describe how our collaborative tree-ring research process led to more accurate and ethical research expectations, questions, methods, and interpretations.

Tree-rings are valuable records of disturbance regimes that can guide landscape management by providing evidence of historical fire frequency, severity, extent, and drivers (Daniels et al. 2017). Tree-rings are often combined with other long-term proxy data (e.g. paleoecological records) for a more holistic understanding of historical fire dynamics (Swetnam et al. 1999). Increasingly, non-Indigenous natural scientists (including dendrochronologists) are also interested in incorporating Indigenous knowledge to help inform our understanding of historical fire dynamics (Guiterman et al. 2019; Larson et al. 2020; Roos et al. 2021). However, treating Indigenous knowledge as just another proxy record that must be validated by natural science overlooks the complex dimensions of Indigenous fire stewardship, such as spirituality, respect, and reciprocity (Lake and Christianson 2019). Furthermore, if not undertaken in collaboration with Indigenous peoples, tree-ring (and other paleoecological) research can perpetuate the power imbalances inherent in colonization by excluding Indigenous peoples from interpreting and managing landscapes (Mistry and Berardi 2016; Fernández-Llamazares et al. 2021). Here, we describe the evolution of our collaborative tree-ring research in British Columbia (BC), Canada, since 2016 as an archaeologist (WS) for the *T'exelc* (Williams Lake First Nation, an Indigenous community*) and as non-Indigenous natural scientists (KCG and LDD). This collaborative research took place at *Ne Sextsine*, a 6000-hectare forest in the *T'exelc* traditional territory that has been continuously stewarded since time immemorial.

Building a collaborative research context

Across BC, Indigenous fire stewardship was, and continues to be, spatiotemporally complex (Lake and Christianson 2019; Lewis et al. 2018). Nevertheless, over 100 years of colonial fire governance enacted on unceded Indigenous territories has excluded Indigenous peoples from decision-making, despite being strongly connected to place and invested in the future (Lake and Christianson 2019; Hoffman et al. accepted manuscript; Copes-Gerbitz et al. accepted manuscript). The legal implementation of the United Nations Declaration on the Rights of Indigenous Peoples in Canada and BC, however, provides an obligation to uphold Indigenous rights and advance reconciliation (Wong et al. 2020). Thus, as researchers in BC (KCG and LDD), it is our ethical duty to undertake collaborative tree-ring research with Indigenous peoples.

Our collaboration began on invitation from a non-Indigenous gatekeeper who is a well-respected member of the local community and undertakes forest management guided by Indigenous and natural science. This gatekeeper was familiar with our tree-ring fire histories and was entrusted by the *T'exelc* to manage *Ne Sextsine*. In 2016, this gatekeeper introduced us (KCG and LDD) to the elected Chief and Council, who then introduced us to members of the Natural Resources Department, including an archaeologist (WS), who became a key collaborator, and the Elder Council. All groups expressed interest in building a research collaboration. Through eight community meetings and six months spent in the community over the next three years (by KCG), we co-developed our research questions guided by the interests of Elders and forest managers – including, but not limited to, how Indigenous land and fire stewardship shaped the historical landscape through time and how this stewardship can inform future management. Our agreed research practices, including guiding questions, data ownership and confidentiality, and expectations of researchers (such as publications), were outlined in a signed Memorandum of Understanding between the elected *T'exelc* Chief, the *Ne Sextsine* forest manager, and the researchers. At the time, this level of engagement was beyond the requirements of our university's research ethics process, but we felt it was imperative for maintaining reciprocal trust and respect. Today, researchers at the University of British Columbia are required to formalize legally binding agreements with Indigenous community partners before collaborative research can begin.

Co-developing sampling methods

A key element of our collaborative research was co-developing data collection methods (Wong et al. 2020). Tree-ring research is inherently extractive because we access land and collect, remove, and usually archive material at research institutions. To address this challenge, the sampling methods were guided by archaeological best practice (by WS) and the *T'exelc* Elders. This included avoiding culturally modified trees and archaeological sites that are protected by the BC Forest and Range Practices Act and the Heritage Conservation Act. However, these legal frameworks have limitations, such as no protection for sites dating after 1846 (the year in which BC claimed sovereignty) and a lack of comprehensive site records (Schaepe et al. 2020). Given these limitations, WS and the Elders specifically provided permission

Figure 1: Fire-scarred tree with at least 12 visible fire scars at *Ne Sextsine*. Although this tree could have been "convenience" sampled, we intentionally left it intact as it was the sole fire-scarred tree located along an important travel corridor for the *T'exelc* (photo credit: Kelsey Copes-Gerbitz).

*The Constitution of Canada recognizes three groups of Indigenous peoples, including First Nations, Métis, and Inuit.

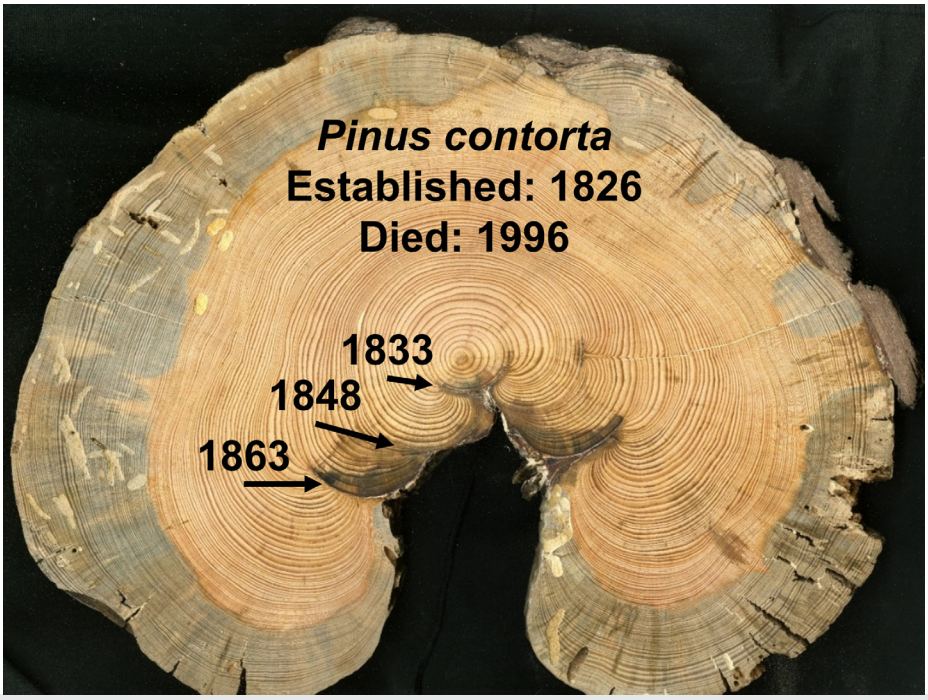

Figure 2: Tree with fire scars in 1833, 1848, and 1863. A distinct lack of fire after 1863 is a result of colonization, the stories of which were shared by Elders through our collaboration (Copes-Gerbitz et al. 2021) (photo credit: Kelsey Copes-Gerbitz).

to sample in areas that were culturally important, but not protected by law. WS also developed a protocol for KCG to simultaneously inventory potential archaeological sites given our systematic sampling across *Ne Sextsine*.

One primary conundrum was how to ethically sample fire-scarred trees. If a fire scar has formed because of Indigenous ignitions, does that make it a legally protected, culturally modified tree? Advice given to WS suggested there are no legal protections—but we agreed that it may be unethical to sample without attending to cultural values. Through our collaboration, we learned that the intentional use of landscape fire at *Ne Sextsine* was considered a "lost practice" by Elders (Copes-Gerbitz et al. 2021), such that we would not know the location of intentional fires in advance of sampling. Instead, based on WS's guidance, the researchers prioritized dead trees (stumps, logs, and snags) for sampling, and received permission from WS for each partial section of a live tree (Cochrane and Daniels 2008). Ultimately, we left approximately 80% (n = 43) of live trees with visible fire scars untouched, including one site that was excluded from sampling, to ensure we did not disturb any archaeological sites or potentially unique cultural trees (Fig. 1). The digital archive of scanned samples will be held by both the researchers and the *T'exelc*, while the physical fire scar samples will be returned to *T'exelc* care. This reflexive sampling approach ensured that we upheld our ethical commitments, exceeding legal responsibilities.

Interpretations grounded in our collaboration

In our opinion, a key outcome of this collaboration was the way in which it guided our interpretation of the fire history and management recommendations. We learned directly from the Elders who spent their youth at *Ne Sextsine* about diverse values that underpinned their enduring connection to place (Copes-Gerbitz et al. 2021). These values, and the stewardship used to maintain them, inevitably shaped the fire history embedded in the tree-rings. Thus, our interpretations do not rely solely on quantitative fire history metrics (such as frequency and severity) or on discounting other potential fire regime controls (such as fuels, topography, or climate). Rather, we center the Elders' stories and highlight the ways in which colonization interrupted the spatiotemporally heterogenous *T'exelc* stewardship (Fig. 2; Copes-Gerbitz et al. unpublished manuscript). This interpretation ensured that Indigenous knowledge and natural science were both important ways of understanding fire history and avoided the pitfalls of potentially erasing the complexity of Indigenous fire stewardship if it is subsumed into natural science research (Bohensky and Maru 2011). Furthermore, in our collaboration, we followed principles from an action-oriented approach known as "walking on two legs" that helps natural scientists support Indigenous-led restoration of fire-adapted landscapes (Dickson-Hoyle et al. 2021). Ultimately, our management recommendations stress the importance of returning *T'exelc* stewardship and decision-making to *Ne Sextsine*.

On reflection, our collaboration helped more accurately and ethically interpret the historical fire regime recorded in tree-rings. It also enriched the history of *Ne Sextsine*, complementing *T'exelc* Elders' stories with tree-rings and providing a foundation for future archaeological investigations, such as where physical evidence no longer remains (e.g. summer fishing camps and berry patches), but oral stories and tree-rings indicate occupation prior to 1846. Importantly, it also helped the Elders reconnect with a meaningful place that many had not visited in decades (Copes-Gerbitz et al. 2021). Our collaboration was indeed a reflexive and iterative process, not a checklist that can be applied directly to other collaborations or contexts. However, as other researchers have done (Mistry and Berardi 2016; Wong et al. 2020; Dickson-Hoyle et al. 2021), we emphasize the importance of humility, respect, and long-term, ongoing trust-building as central elements of our research collaboration. We continue to have much to learn from the original Indigenous stewards and are grateful for their generosity in sharing their wisdom.

AFFILIATIONS

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