

SOUNDWORK

Water Rhythms: Listening to the Cascading Effects of Climate Change on the Glaciers of British Columbia and Beyond

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GLACIERS AND ICE SHEETS are the world's water towers. Less than 3 percent of water on Earth is freshwater, and of this freshwater 99 percent comes from the ice (Hock et al. 2019). The rivers that run from glaciers to the sea are the tie that binds societies and cultures to the landscape (e.g., Carey et al. 2017; Orlove et al. 2019). As glaciers worldwide shrink and disappear in response to a warming world, the availability and quality of freshwater is threatened for the billions of people and our more-than-human kin who live downstream (Huss et al. 2017; Immerzeel et al. 2020).

The predominant means by which scientists study and communicate these impacts of climate change on glaciers and rivers has been through the use of visible data (think of the satellite imagery manipulated in Google Earth Engine or time-lapse photographs used in the film *Extreme Ice*). While such images (still or moving) can evoke visceral responses to the disappearing ice and other cascading effects of climate change, they cannot capture the magnitude of these effects on our bodies, on all of our senses.

Over the past few decades, the emerging interdisciplinary field of sound studies (e.g., Schafer 1994; Truax 2001) and, in particular, the discipline of acoustic ecology (e.g., Pijanowski et al. 2011; Wrightson 2000) has introduced an attention to sound and listening, and the emotional landscapes that arise when engaging in listening practices (Doughty and Drozdowski 2022), that counterbalances the dominance of the visible as the primary sense through which we understand the world. In so doing,

acoustic ecologists and sonic geographers have opened the way for new empirical approaches to documenting and understanding the natural world (e.g., Gallagher 2015). Sound recordings can provide insights into the audible components of places, just as images convey information about their visible components (e.g., Osborne et al. 2021). Soundscapes hence complement written text and images, adding sensory dimensions and details beyond the visible (Gallagher and Prior 2014). As Bernie Krause (2013) argues, “a soundscape is worth a thousand pictures.”

Science tends to be reductionist. We take these beautiful, complex, interconnected systems, such as the earth system, and reduce them to statistical correlations, lines on a graph, or a waveform on an oscilloscope. As a consequence, we lose much of the knowledge Nature is imparting to us. We also lose our extra-rational connection to the landscape and to our more-than-human kin (e.g., Haraway 1989; Kimmerer 2013). The use of environmental field recordings to create soundscapes and sonic compositions, on the other hand, can stimulate new territories for interdisciplinary collaboration between scientists, artists, and composers by bringing art and science together in dialogue. By conjoining sound, art, and science, we can seek to gain new, more embodied and place-based understandings of our entanglements with the landscapes we inhabit and shape.

As a climate and landscape scientist, my passion is to understand and capture how glaciers respond to climate change, and how glacier changes affect landscapes, waterscapes, and people. The sonic composition presented here, *Water Rhythms*, a collaboration with composer and sound artist Susie Ibarra, is one such attempt to explore the invisible, audible impacts of a changing climate on our landscapes, our cultures, and our humanity. The composition is the story of climate change as told by the ice and water. It is also the acoustic story of our entanglements with a changing climate and changing landscapes of our own making. Through *Water Rhythms*, we invite listeners into embodied experiences of how the lives of the ice, the mountains, the rivers, and the people who dwell among them are intertwined.

The urge to capture these sounds of glacier and meltwater change came into being while working at Bridge Glacier in the Chilcotin mountains of southern British Columbia. One of the tools that glaciologists use to try to understand what is happening under the ice and in the water is the hydrophone, an underwater microphone that collects acoustic signals from the bed. We had placed a hydrophone in the outlet stream at Bridge Glacier and were listening to the meltwater that was gushing out of the



Figure 1. Meltwater tunnel, Bridge Glacier, Lillooet Icefield, BC. Photo courtesy of author, 2021.

glacier at the end of a hot summer day. Listening to the sounds of the air bubbles in the water and the rocks tumbling down the streambed, I was mesmerized by the rhythmic and tonal stories being told by the melting ice. I was also overcome with this sense of solastalgia, of longing and loss for these landscapes that were changing (Albrecht et al. 2007). For I realized in that moment that the sounds that I was listening to were shifting and disappearing as the climate continued to warm and the glacier quickly retreated.

I pondered how we could explore these sounds as a means of telling the story of climate change, of the disappearing ice and its impact on the people living in its shadows. The idea was conceived of following the sounds of the water and the sediments carried within it as it flows from the mountains to the sea, using field recordings collected from both above and below the ice and the outlet rivers.

For the past five years we have been sonically mapping glaciers and their runoff from the mountaintops to the ocean in some of the world's most important and vulnerable water towers (Immerzeel et al. 2020), including the Lillooet and Pemberton icefields in the BC Coast Mountains as well as the Himalayas and the Greenland Ice Sheet. Along the way, we also capture the sounds of the river cultures, both human and more than human, that have evolved around our communal lifeblood –



Figure 2. Author recording under the ice at Bridge Glacier, Lillooet Icefield, BC. Pphoto courtesy of Flavien Beaud, 2021.

freshwater. In this soundwork, we take the stories collected from many of these rivers and bring them together into one acoustic journey that represents all the stories and journeys of meltwater from the glaciers, through the mountains to the lowlands and ultimately to the sea.

0:00

The journey starts at the glacier toe, as the wind and sun melt the ice from both the surface and from underneath the glacier every summer melt season to feed the rivers downstream. The water that melts at the glacier surface moves down the ice face, flowing through cracks and crevasses down to the glacier bed and melting tunnels and caves under the ice. As air temperatures rise and the ice at the surface continues to melt, the drips and flow of water into the tunnels and caves become more voluminous, coalescing into stream. Along the ice edge, the air in these caves also warms up, and the melting ice drips faster and faster.

5:40

Contained in the water as it exits the glacier and tumbles down the steep mountain slopes in cascades and waterfalls are air bubbles and sediments, from sand to boulders, those staccato clicks and clacks and low rumbles that one can hear in the underwater recordings. These sounds



Figure 3. S. Ibarra listening underwater in outlet stream at Easton Glacier, Mount Baker, Cascade Mountains. Photo courtesy of author, 2017.

are indicative of the power of the water as it roars downhill, carving out the landscape and carrying away the pieces of the mountains to deposit them into the sea. As the climate warms, these sounds are shifting, becoming louder in places and softer in others, telling the story of how the amount of water and glacial debris, and their power to erode and reshape the land, is changing with time.

10:53

One idea that we are trying to capture in *Water Rhythms* is that of peak water (e.g., Huss and Hock, 2018). When the glaciers first start to shrink and retreat, they produce more runoff every melt season. We hear more water and more sediment moving through the river system, growing louder and more cacophonous. Over decades of continued ice loss, however, those water tanks are being depleted. Hence, over the years the acoustic properties also change, and the rivers become less thunderous, with shorter periods of turbulent flow. In some regions, such as the Columbia Mountains of southeast British Columbia, we have already passed peak water (Moore et al. 2020). Soon we may have to live in a world without these rhythms at all.



Figure 4. People bathing at dawn along the Ganges River far downstream of Satopanth Glacier, Varanasi, India. Photo courtesy of Rajesh Kumar Singh.

14:23

As we descend the river from the mountain uplands to the lowlands, the water moves from cascading down steep slopes and waterfalls to flowing across flat, broad floodplains, slowing down and getting more organized, more rhythmic. As the water becomes more organized, the communities around the rivers become more established and the ecosystems more rich and diverse because the rivers have become stable and, hence, more reliable. On the banks of these rivers we find sacred spaces and village sites, where people have been engaging with the water for thousands of years. We find temples, where people come daily to purify and cleanse themselves with the water, and to bless and send the dead to the next realm. We find fish traps built over millennia from which to source food. We find languages and musical traditions that become more lilting, more tonal, softer and smoother than those of the uplands.

We are entangled with the river, with the glacier water. The same rhythms of glacial meltwater that flow from the mountains to the sea flow through our bodies, our histories, and our music. They have precise rhythms, a precise tempo, hovering around 130 beats per minute. These tempos match our heartbeats at birth. They also match the sweet spot at which music from all over the world is created and played. When one listens to the water, one can hear beats and rhythms from many different

cultures and languages. The geophony of the water is in sync with the anthrophony of the communities along its banks.

19:50

The journey ends where the river enters the sea to start a different journey, a new cycle.

Freshwater is the tie that binds human societies and cultures to the landscape. As the ice disappears, these water rhythms are also shifting and fading from view. A world losing its flowing freshwater is not only a world of increasing climatic and ecological precarity but a world losing its music, its culture, and its humanity. Hence, listening to the story of the melting ice is listening to the story of ourselves.

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