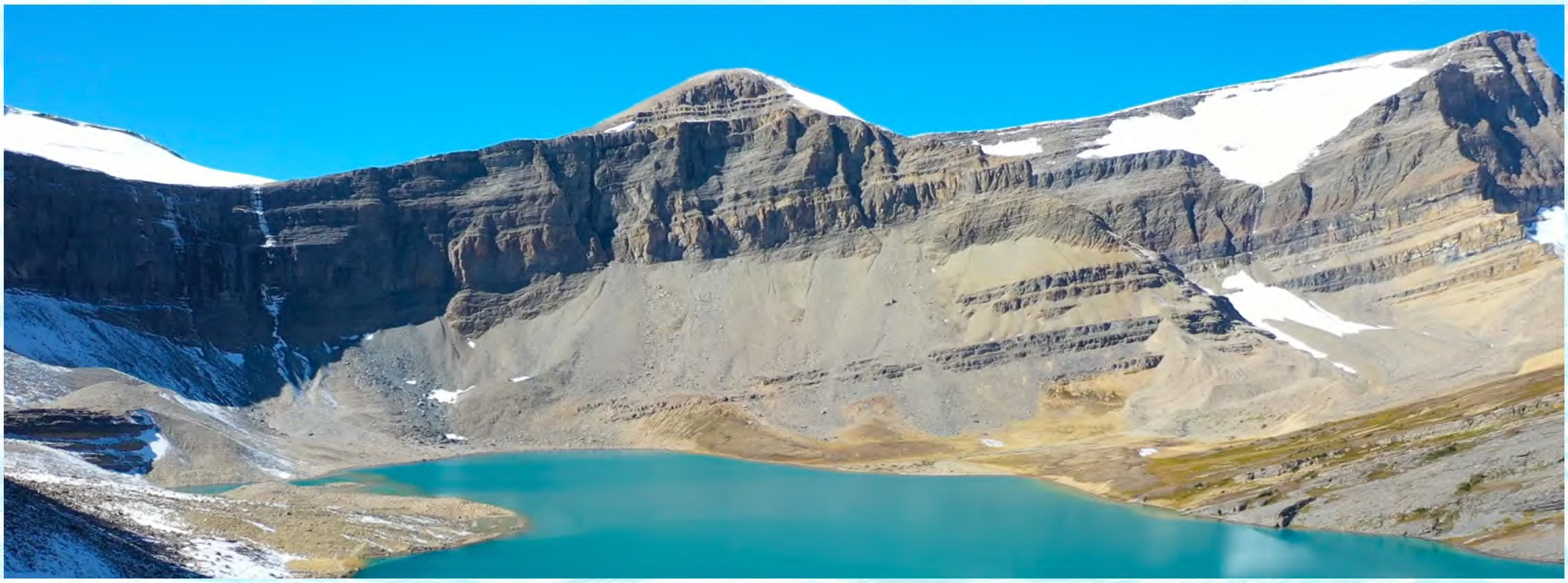
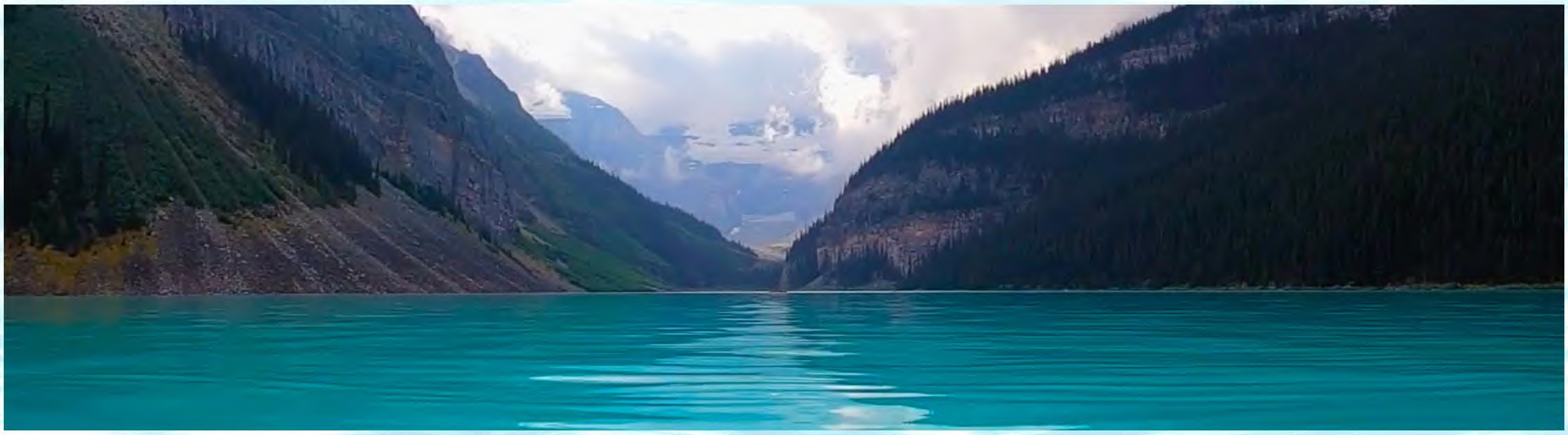
Losing Blue Science Backgrounder

Each summer for the last 17 years, limnologists Janet Fischer and Mark Olson have laced up their hiking boots and loaded up their packs with scientific equipment to study lakes in Canada's Rocky Mountains. Their work, carefully documenting the changes in lakes that they view as old friends, has become a labour of love. Both on the trail and along the lakeshore, Fischer and Olson have had countless conversations with visitors who are intrigued by the exquisite colours of glacially fed lakes and concerned by the threats that mountain lakes face in a changing climate.



This experience inspired them to approach Canmore-based filmmaker Leanne Allison to make a short film about it. They had two stipulations: they didn't want it to be a traditional science documentary, and they didn't want to be in it. Still, they remain an integral part of the film ***Losing Blue***—and the science behind the otherworldly blues of ancient mountain lakes.



With the passage of time, the movement of glaciers over bedrock creates finely ground rock flour, which is delivered to lakes via meltwater. These suspended particles—which Fischer and Olson's sensors measure as turbidity, and which our eyes see as cloudiness—absorb some blue light from the sun, but more importantly scatter blue and green light back to our eyes. Thus, glacially fed lakes look turquoise or emerald, and they can even appear to glow on sunny days (especially when viewed from above).

The precise colour depends on the amount of rock flour delivered by glacial meltwater, which in turn can depend on the time of year (glacial melt peaks in late July and early August) and the size of the glacier. Consequently, glacially fed lakes are highly sensitive to climate change through effects on meltwater inputs. Enhanced glacial melt may initially increase rock-flour inputs, making lakes cloudier (i.e., more turbid).

However, continued glacier shrinkage ultimately decreases meltwater inputs and reduces the delivery of rock flour. As water clarity increases, lake features such as temperature and algal productivity also change. But the most visually striking effect of glacial shrinkage is that lakes lose their spectacular and iconic turquoise colour.

Facts

- Seventy percent of Western Canada's 17,000 glaciers are predicted to disappear by 2100 (Clarke et al. 2015).
- Analysis of satellite images indicates that the current rate of ice area loss has increased sevenfold since just 2010 (Bevington and Menounos 2022).
- According to glaciologist Garry Clarke: "The present-day shrinkage of mountain glaciers is shocking but easy to ignore—we can still recognize familiar landscapes. If we had X-ray vision we would see that the true situation is much worse. Most of the surviving glaciers are now thin and unable to withstand more decades of melting."

- Banff National Park draws over 4 million visitors from around the world each year. The Canadian Rocky Mountain Parks are designated as a UNESCO World Heritage Site. Because glacially fed lakes will be in a period of rapid transition over the course of the next one to two human generations, grandchildren of today's visitors are likely to note marked changes in colour should they compare their lake photographs to those of their grandparents.
- Lake Louise is one of the most photographed sites in Canada, and one of the most photographed lakes in the world. In summer, Lake Louise receives up to 15,000 visitors per day.

Bios

Mark Olson and Janet Fischer are a husband-and-wife team who study the ecology of mountain lakes. Together with their undergraduate students from Franklin & Marshall College and their two children, Mark and Janet have worked systematically over the last 17 years to build a unique long-term dataset for a set of lakes in Yoho and Banff National Parks. During this time, they have carefully documented the effects of catchment characteristics such as glacial and vegetation cover on water transparency, a key lake feature that's linked to colour.

Mark and Janet have recently expanded their research to include high-frequency monitoring of lakes using advanced sensors. Their project aims to understand how and why lake transparency varies across time scales, from short-term changes in response to rain events to long-term changes in catchments caused by melting glaciers, lengthening growing seasons and advancing treelines. They also study the effects of these changes on the unique plankton that inhabit mountain lakes.

Janet M. Fischer
Professor of Biology

Mark H. Olson
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Further Reading

Bevington, A.R., and B. Menounos. "Accelerated change in the glaciated environments of western Canada revealed through trend analysis of optical satellite imagery." Remote Sensing of Environment 270 (March 2022): 12862. sciencedirect.com/science/article/pii/S0034425721005824?via%3Dihub

Clarke, G.K.C., A.H. Jarosch, F.A. Anslow, V. Radić, and B. Menounos. "Projected deglaciation of western Canada in the twenty-first century." Nature Geoscience 8 (May 2015): 372–377. nature.com/articles/ngeo2407

Oleksy, I.A., et al. "Heterogenous controls on lake color and trends across the high-elevation U.S. Rocky Mountain region." Environmental Research Letters 17, no. 10 (October 2022): 104041. iopscience.iop.org/article/10.1088/1748-9326/ac939c

Olson, M.H., et al. "Landscape-scale regulators of water transparency in mountain lakes: implications of projected glacial loss." Canadian Journal of Fisheries and Aquatic Sciences 75, no. 7 (September 2017): 1169–1176. cdnsciencepub.com/doi/10.1139/cjfas-2017-0215

Sommaruga, R. "When glaciers and ice sheets melt: consequences for planktonic organisms." Journal of Plankton Research 37, no. 3 (May/June 2015): 509–518. doi.org/10.1093/plankt/fbv027