RETROSPECTIVE

David William Schindler (1940–2021)

Trailblazing aquatic researcher, advocate, and whole-ecosystem experimentalist

By **Vincent L. St. Louis[1], Sherry L. Schiff[2], Carol A. Kelly[3]**

David William Schindler, innovative ecologist, died on 4 March at the age of 80. Dave documented humanity's impact on global freshwaters with seminal research on eutrophication, acid rain, climate change, organic contaminants, and oil sands mining. He then used his formidable energy and dedication to advocate for regulation of harmful industrial practices and to educate the public about why these regulations were needed.

Dave was born in Fargo, North Dakota, on 3 August 1940 but raised near Barnesville, Minnesota. He enrolled in an engineering physics program at North Dakota State University in 1958, but a chance reading of Charles Elton's book *The Ecology of Invasions by Animals and Plants* during a summer biology internship changed his life forever. Switching majors, he earned his bachelor's degree in zoology in 1962. He then pursued his PhD in ecology with Elton as a Rhodes scholar at the University of Oxford, studying energy relations in aquatic food chains. Just 2 years after receiving his doctorate in 1966, he was scouted to become the first scientific director of the Experimental Lakes Area (ELA), a Canadian field station newly created for the purpose of using whole-ecosystem manipulations to address freshwater problems of international concern. In 1989, he left to become the Killam Memorial Chair and Professor of Ecology at the University of Alberta, a position he held until 2013. Thereafter, although nominally retired, Dave continued uninterrupted in his scientific research and advocacy. He was inspired by his wife, ecologist Suzanne Bayley, and his three children.

Dave's singular success arose from his early recognition that complex ecosystems function in ways not predictable from smaller bottle and aquarium experiments and that the whole system therefore needs to serve as the unit of experimentation. When tasked with bringing this approach to life at the ELA, a set of 58 headwater lakes in northern Ontario, he intuitively assembled a team with expertise in hydrology, lake physics, biogeochemistry, microbiology, plankton, benthic invertebrates, and both small and large fish. He established a year-round boot camp for scientists to do one-of-a-kind collaborative freshwater research. Science was discussed at communal meals, in boats, in laboratories, and on the swimming dock. As Dave was a habitual early riser, it was an unfortunate scientist who did not bring their best ideas to breakfast.

By changing only one factor at a time, Dave was able to study the cascading effects of that change through different parts of the lake ecosystem and, crucially, to elucidate the underlying mechanisms of change. Early whole-lake experiments demonstrated that phosphorus was the limiting nutrient for photosynthesis in lakes (nitrogen and carbon could easily be obtained from the atmosphere) and that limiting phosphorus inputs would therefore solve eutrophication. By adding sulfuric or nitric acids to lakes, he showed that small decreases in pH alone could disrupt food chains, leading to starvation of fish. These efforts resulted in two of the most iconic photographs in freshwater research. One photo showed that the side of a divided two-basin lake receiving experimental phosphorus additions turned pea green from an algal bloom. The second photo showed a gaunt lake trout from an experimentally acidified lake. Dave used these photos to rally public support and force needed legislation.

While at the ELA, Dave also fortuitously began amassing the world's largest dataset on climate change impacts on freshwaters through the basic monitoring of unmanipulated reference watersheds, which has continued now for more than 50 years as Earth has warmed. An initial publication after only 20 years provided an early preview of the effects of warming on boreal lakes.

The Alberta oil sands industry claimed that petroleum-related compounds in the Athabasca River were all natural, but Dave was instinctively skeptical. His ensuing studies showed that the industry was a regional source of organic contaminants and metals. At a news conference, Dave showcased fish with unusual tumors downriver of the oil sands developments, and this kind of easily understood public demonstration led to the establishment of an independent inquiry.

Unfettered by societal norms, Dave freely followed his innate scientific intuition. He had no patience for half-baked ideas, political wrangling, pessimistic whining, or experimental roadblocks. At the same time, Dave was a strong supporter of fledgling scientists, empowering even undergraduate summer students to contribute as equals. He taught us that ruffling feathers probably meant you were actually getting somewhere, and he reassured us with his pithy maxim that "Science bats last," meaning that scientific evidence will always prevail.

Dave had energy to burn. An avid woodworker, canoer, hunter, fisherman, and mountain biker, he was always happiest outdoors. He and Suzanne also competitively raced the multitudes of champion sled dogs they raised.

A prodigious communicator of his scientific research, Dave published more than 350 papers. He received upward of 100 prestigious awards, including the first Stockholm Water Prize, and was made an Officer of the Order of Canada. Each year, he gave dozens of presentations, many of them public talks, and unscripted interviews on television and radio. He was also a vocal champion for Canadian Indigenous communities affected by the broader population's impacts on their treaty lands and traditional freshwater resources.

To many, Dave seemed larger than life. His research fundamentally changed freshwater science and the lives of generations of students. We each had the good fortune of having Dave as a mentor, colleague, and friend for more than 40 years. Dave's scientific and public legacy remains as both an inspiration and a call to action. ■

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PHOTO: JOHN ULAN

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