




REVIEW

Three brothers in biology: bugs, birds, books, conservation, and politics

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Abstract

Three Cannings brothers describe their intertwined but separate careers in Canadian biology: Rob as an entomologist, Syd as an entomologist and conservation biologist, and Dick as an ornithologist and politician. They emphasise the influence on their lives of the British Columbia's Okanagan Valley where they grew up, the naturalist family in which they were raised, and the mentors who inspired them in their work. Bird study and nature interpretation in BC Parks were early enthusiasms and influences. Biological research, museum work, nature conservation, public education, and writing have dominated their careers. In Dick's case, his public life has culminated in a decade of Canadian federal politics as a member of Parliament.

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Rob

Syd, Dick, and I were surprised and honoured to be invited to write about our careers in biology—I guess it *is* unusual to see three brothers so closely associated in their biological work (Fig. 1). It reminds me of 1984 when the three of us were birding in the hills of Chiapas, Mexico, and a troop of little kids followed us through the forest, shouting *¡tres hermanos! ¡tres hermanos!* Imagine how strange we looked to them, with our bushy red beards and long red hair, our backpacks, and binoculars. So here we are—the three of us, 40 years later—looking a lot different.

This account is in three parts—each developed by one of us, with much mixing of events and themes: family, birds, BC Parks, natural history, university, mentoring, museums, communication, conservation, and politics (Fig. 2).

Our careers were deeply affected by our childhood home—the Okanagan Valley in southern British Columbia (Fig. 3; Supplementary material, Figs. S1, S2). Its diversity and uniqueness in Canada molded our attitudes towards what is important to us. The Canadian part of the Okanagan watershed ranges from about 20 to 100 km wide and extends almost 200 km north from the border with the United States of America; it's full of grasslands, cliffs, big lakes, marshes, mountain forests, and alpine tundra.

For decades, we've documented this richness and have enjoyed educating others about it. But like other lovely places, much of the native habitat of the Okanagan has been damaged through development. Because of this, its conservation has always been close to our hearts. This valley

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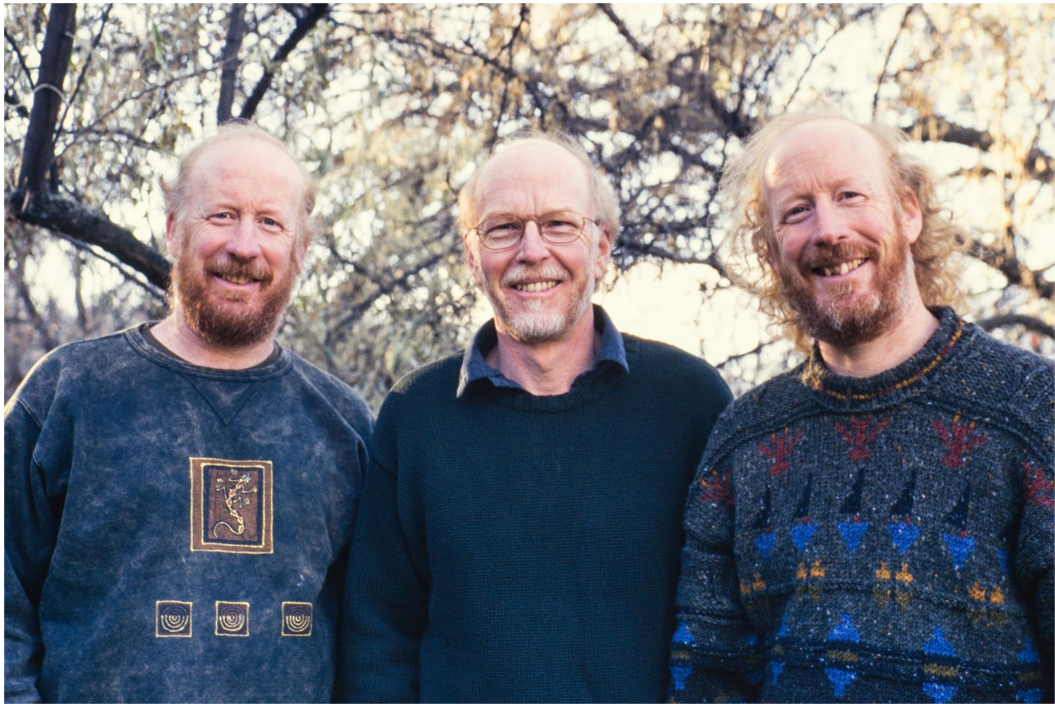


Figure 1. The three brothers: Dick, Rob, and Syd Cannings, Penticton, British Columbia, December 1997. Photo by Steve Cannings.

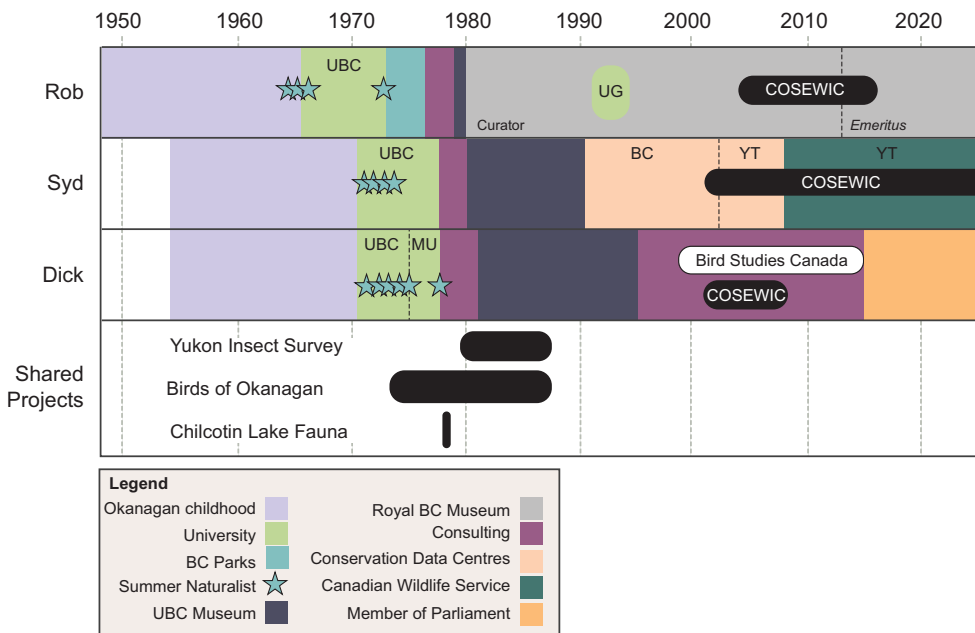


Figure 2. Timeline for the careers of Rob, Syd, and Dick Cannings. Abbreviations: BC, British Columbia; COSEWIC, Committee on the Status of Endangered Wildlife in Canada; MU, Memorial University of Newfoundland; UBC, University of British Columbia; UG, University of Guelph; YT, Yukon Territory.



Figure 3. Dick, Rob, and Syd Cannings, Vaseux Creek Canyon, British Columbia, about 1962. Photo by Steve Cannings.

defined our interests, but those interests have expanded to include many other landscapes in many other places.

Family

The back fence of our Penticton family home borders a grassland (Supplementary material, Fig. S3). It stretches to wooded hills and creek valleys. As kids, we hiked across this magical landscape, searching for birds, insects, and other fascinating things. The three of us shared much and fed off each other's knowledge.

We were encouraged in our appreciation of natural history by our father and mother, lifelong naturalists, who also were born and raised in the valley (Fig. 4). Mom's family were fruit growers; she was an avid gardener and, for a time, a librarian. Bette, our sister, is also a librarian, a searcher for information—so there really are four of us in the business. Bette never wanted to be a biologist, but she loved her books and music.

When we asked innumerable questions as kids, our Mom's love of books prompted the family mantra—"Look it up!"

For many years, Dad was the photographer at the Agriculture Canada research station in Summerland (Supplementary material, Fig. S4). The research station became his link with the academic world, and the scientists there influenced our early interest in biology.

Dad was a well-known nature photographer and published many photographs in books and magazines, such as *Nature Canada*. He presented countless slide shows at schools, service clubs, and naturalist gatherings, always promoting conservation causes. He was a force in the preservation of the Okanagan Valley's natural areas. He made several nature movies for the Canadian Broadcasting Corporation television show "Klahanie", wrote a regular column



Figure 4. Steve and Jean Cannings, August 1993, Penticton, British Columbia. This is their version of the iconic painting by Grant Wood: American Gothic–Canadian Gothic. Photo by Rob Cannings.

called “Naturalist Notebook” in *BC Outdoors* magazine, dabbled in scientific writing (Cannings 1972f, 1987), and was a pretty good artist. To his surprise, when he was 85, he was awarded an honorary doctorate by Okanagan University College (Kelowna, British Columbia) for his contributions to the knowledge of Okanagan natural history, his achievements in the valley’s conservation, and his tireless efforts in public education (Cannings *et al.* 2004b; Supplementary material, Fig. S5). To us, he was an inspiration. Others felt the same.

Nature was our focus, especially birds—our family was obsessed with birds. We birded everywhere we could (Fig. 5). We documented our local discoveries, from nests of the long-billed curlew, *Numenius americanus* Bechstein (Charadriiformes: Scolopacidae) (Cannings 1958), to the breeding of rare flammulated owls, *Psiloscoops flammeolus* (Kaup) (Strigiformes: Strigidae) (Cannings and Cannings 1982).

Every day, for almost six decades, Dad kept meticulous notes on natural history events, particularly bird sightings, without knowing if they would ever be used (Fig. 6). Today, he’d be deep into eBird (<https://ebird.org/>) and iNaturalist (<https://inaturalist.ca>). Fortunately, his labours weren’t in vain—his notes formed the basis of our book, *The Birds of the Okanagan Valley* (Cannings *et al.* 1987).

Our home at the edge of the grasslands and pine woods began as a small fruit orchard and evolved into a wildlife garden (Supplementary material, Fig. S6). It attracted everything from bears to birds and from insects to rattlesnakes and became a magnet for naturalists, students, ornithologists, botanists, writers, broadcasters, and tour groups from all over the world. Anyone who wanted to see the special birds or landscapes of the Okanagan seemed to end up at our house.



Figure 5. Dick (left) and Syd Cannings, about four years old, 1958: birding began early. Photo by Steve Cannings.



Figure 6. Steve Cannings writing in his notebooks in the family garden, Penticton, British Columbia, 1998. Photo by Bette Cannings.

University of British Columbia

As an undergraduate at the University of British Columbia (Vancouver, British Columbia) in the late 1960s, I was greatly influenced and inspired by Geoff Scudder, a renowned entomologist and teacher in the Zoology Department (Cannings 2006; Cannings *et al.* 2023; Supplementary material Fig. S7). I eagerly took all his courses, from entomology to vertebrate morphology and evolution. Geoff supervised my Master's degree research on chironomid midges in saline lakes in the grasslands of the Chilcotin Plateau in central British Columbia (Supplementary material, Fig. S8). I studied how different midge assemblages correlated with varying salinities and other chemical characteristics (Cannings and Scudder 1978, 1979). I excitedly described my first new species, *Chironomus athalassicus* Cannings (Diptera: Chironomidae) (Cannings 1975a). From those graduate student days until well into my retirement, Geoff and I regularly published together (Cannings *et al.* 2001; Cannings and Scudder 2001; Scudder and Cannings 2009; Pohl *et al.* 2015).

In 1978, Dick, Syd, and I returned to those beautiful Chilcotin grasslands and lakes for our first major scientific project together (Supplementary material, Fig. S9). Geoff Scudder hired us part-time to collect aquatic invertebrates for future biodiversity studies (Supplementary material, Fig. S10). We spent six memorable months collecting, and on our own time while living cramped in a small trailer, we worked on *The Birds of the Okanagan Valley* (Cannings *et al.* 1987). We also studied the Odonata of the lakes (Cannings and Cannings 1987) and, in particular, examined the distribution of the damselfly genus *Lestes* Leach (Odonata: Lestidae) in different habitats (Cannings *et al.* 1980), which mirrored my earlier work on chironomids. Dick published a little study of nesting horned larks, *Eremophila alpestris* (Linnaeus) (Passeriformes: Alaudidae), complementing his work for his Master's thesis far to the east in Newfoundland (Cannings 1981b).

The Birds of the Okanagan Valley book project

The Birds of the Okanagan Valley (Cannings *et al.* 1987) book project took much of our spare time during the 1970s and 80s. We asked Dad to be a co-author, but he modestly declined, saying something like: "I'm old and you're young; I don't need the recognition." The valley has been a focal point for Canadian ornithology since the late 1800s, so we amassed stacks of data, including 130 000 specimen and sight records. Breeding information came mainly from the BC Nest Records Scheme at the Provincial Museum (now Royal British Columbia Museum; Victoria, British Columbia). Trends in bird populations and land use were a major theme, and the historical diaries of Okanagan bird artist Allan Brooks were invaluable. Many of his sketches enhance the book.

The publication is a detailed study of the 307 bird species then recorded in the Okanagan Valley. Species accounts focused on seasonal status, distribution, and breeding chronology. A seasonal histogram was constructed for most species. We produced the manuscript in the days before desktop computers—all the text and the many graphs were produced by hand (Supplementary material, Fig. S11). When we finished the first draft in 1984, we took off on a long, celebratory birding adventure to southern Mexico.

British Columbia Parks Branch

British Columbia's wonderful provincial parks played a significant role in our development as biologists (Supplementary material, Fig. S12). We all worked as summer park naturalists. The rich mixture of the natural world and public education sharpened our commitment to nature interpretation and conservation (Supplementary material, Fig. S13).

Dad was friends with several managers in the Parks Branch, including Yorke Edwards, who developed the province's naturalist program in the 1950s (Cannings *et al.* 2020; Cannings 2021; Supplementary material, Fig. S14). Edwards was a patient mentor. He hired me as a park naturalist

when I was still in high school, and during the following few summers, I revelled in environments as diverse as Miracle Beach, Manning, and Shuswap Lake provincial parks. When Edwards moved to the Canadian Wildlife Service and began a series of nature centres across Canada, I went, too, in 1969 becoming one of the first naturalists at Wye Marsh, Ontario. Edwards later linked my parks and museum lives: in the mid-1970s, he returned to British Columbia to direct the Provincial Museum where, years later, I was to work for him again.

After finishing my Master's degree in science, I worked at the BC Parks headquarters (Victoria, British Columbia), assessing the potential of naturalist programs in parks, especially newly created ones (Cannings 1975b). I travelled widely, often in the wilderness (Supplementary material, Fig. S15). I inventoried plants and animals, designed trails and educational signs, and argued with engineers about the best placement of campsites and parking lots.

Provincial Museum/Royal British Columbia Museum

Working in a museum was always my dream. I coveted the curator of entomology position at the Provincial Museum in Victoria, now called the Royal British Columbia Museum. The museum has been a part of my life since I was a little boy, when I identified salamanders, frogs, and snakes using the old museum handbooks that stood in a row on our family's bookshelves. In the late 1970s, the curator was planning to retire, so I worked hard to improve my resumé. To help my cause, I wrote a dragonfly handbook for the museum (Cannings and Stuart 1977), designed exhibits for several museums, and curated the Spencer Entomological Collection at the University of British Columbia for a year. In 1980, my dream came true—I got the job (Supplementary material, Fig. S16).

I have worked at the museum for five decades, more than three of them as curator of Entomology (Supplementary material, Fig. S17). I also led the museum's natural history section. I am now a curator emeritus, having retired in 2013, but I continue research and curation and still dabble in scientific illustration (Supplementary material, Fig. S18). I have focused on Odonata and Diptera, especially the Asilidae, but I believe a museum curator should have broad interests, contributing knowledge about a wide range of organisms to a diverse cross-section of people, from the general public to scientists and naturalists, teachers, and students. Therefore, I've published on many orders, from Mantodea (Cannings 2007) and Neuroptera (Cannings and Cannings 2006) to Coleoptera (Cannings *et al.* 2010) and Lepidoptera (Pohl *et al.* 2015). I'm especially interested in documenting species arriving in British Columbia from elsewhere, both native ones coming from other parts of North America (Cannings and Scudder 2009; Cannings *et al.* 2019) and alien introductions from other continents (Copley and Cannings 2005; Cannings *et al.* 2007a; Cannings and Gibson 2019).

My interests in general natural history and parks interpretation have led me in diverse directions but particularly towards popularising insects through public education. Education in museums takes many forms, from identifying insects for the public to school programs, but exhibits are probably the most challenging. I curated many, including ones on British Columbia ecology, dragonfly biology (Supplementary material, Fig. S19), alien species, insect diversity, the biodiversity crisis, museum research, and a bizarre one called *Giant Robotic Insects* (2003–2004). Producing virtual exhibits, too, was part of the job (Cannings *et al.* 2004a).

Museum research: Odonata. I've studied Odonata for 50 years. I have loved dragonflies ever since my early days wading in Okanagan ponds. My Master's degree studies on saline lakes brought me back to them, and I produced that museum handbook in 1977. Dragonflies are big, beautiful, and exotic-looking, and they have fascinating behaviour, so they readily attract the attention of the casual observer. I can't think of a better group to use for museum education about insects, especially for kids. There was plenty to learn scientifically, too. I concentrated on biogeography and faunistics



Figure 7. Royal British Columbia Museum's Brooks Peninsula Project, northwest coast of Vancouver Island, British Columbia. Rob Cannings at Cape Cook Lagoon, August 1981. Photo by Syd Cannings.

(Cannings and Cannings 1994; Cannings 2012, 2014a, 2019), taxonomy (Cannings and Garrison 1991; Simaika and Cannings 2004; Cannings *et al.* 2024), the description of larvae (Cannings and Doerksen 1979; Cannings 1981a, 1982), and conservation biology (Cannings 2002a; Cannings *et al.* 2007b).

International collaboration is vital in scientific research. From Borneo to Namibia to Paris, from Costa Rica to Japan to Vladivostok, Russia, I've collected, presented papers, and discussed world conservation issues. Since the mid-1970s, I've been active in the international research community—sitting on the boards of directors of the International Dragonfly Society and the Dragonfly Society of the Americas and serving as the Canadian representative on the dragonfly committee of the International Union for the Conservation of Nature (Supplementary material, Fig. S20). Most recently, an Italian research team and I used the extensive Royal British Columbia Museum collection to study how latitude and temperature affect Odonata community structure (Cerini *et al.* 2021). I also joined Algerian and South African colleagues in an examination of the effects of climate change and drought on an endangered North African damselfly (Khelifa *et al.* 2021a) and, in a second study, looked at how an endemic damselfly faced rapid agricultural transformation of its habitat (Khelifa *et al.* 2021b).

Exciting museum field projects with large dragonfly components included the Brooks Peninsula Expedition (1981), gathering evidence for an ice-free refugium on the remote west coast of Vancouver Island, British Columbia (Cannings and Cannings 1983, 1997a; Fig. 7); the Yukon Insect Survey (1979–1997; Cannings and Cannings 1997b), and especially the museum's Living Landscapes project, partnered with the BC Ministry of Environment, which intensively

inventoried the province's species between 1996 and 2005 for conservation purposes (Cannings *et al.* 2007b, 2008). We visited more than 1500 sites, collected 20 000 specimens, and modified the conservation status of many species. We also increased the known range of most species and gained new knowledge about the habitat requirements of many (Supplementary material, Fig. S21). We linked Odonata species presence to wetland plant associations recently classified by provincial forestry researchers (Cannings 2023). Dozens of volunteers played a big role in this inventory, so I wrote a little field guide (Cannings 2002b) to help them identify their quarry.

The COVID pandemic has been rough on us all. Thanks to Bruce Archibald of the Beaty Biodiversity Museum at the University of British Columbia (Supplementary material, Fig. S22), I discovered the world of fossil Odonata. Even during the bleakest months, Bruce's extraordinary energy and enthusiasm immersed me in this subject, so challenging and so different from my studies of today's dragonflies (Supplementary material, Fig. S23). Now we know something about the Odonata fauna of the Eocene of British Columbia and Washington State, United States of America (Archibald and Cannings 2019), and we even described a new suborder of damselfly-like Odonata with globular, rather than laterally expanded, heads (Archibald *et al.* 2021). This latter study includes the new family Whetwhetaksidae, whose name comes from $\acute{x}^w\acute{a}t\acute{x}^w\acute{a}t\acute{a}q\acute{s}$, a word suggested by elders of the Colville Indian tribe of northern Washington State, meaning "dragonfly-like" insect in their Coville–Okanagan (*nsyilxcən*) language.

Museum research: Asilidae. Growing up in the Okanagan stimulated my love of insects of grasslands and arid habitats. Robber flies (Diptera: Asilidae), which are diverse in those places, excited me. In the early 1980s, no one in Canada was studying them, so I plunged in happily. My Yukon adventures showed that *Lasiopogon* is the world's most northerly asilid genus, with the Nearctic and Palearctic faunas showing fascinating relationships across the Bering Strait. The systematics of these flies were a perfect subject for my doctorate degree (Cannings 2002c). For years, I had been trying to convince my superiors at the Royal British Columbia Museum to give me time to pursue a Ph.D.; by 1991, they agreed, and I headed to the University of Guelph (Guelph, Ontario) to study with Steve Marshall. Monty Wood, that wonderful dipterologist from the Canadian National Collection of Insects, Arachnids and Nematodes (Ottawa, Ontario), and Eric Fisher, the premier North American asilid worker, were my thesis advisors, and both have been wonderful mentors (Fig. 8). I collected far and wide, from California, United States of America, to Québec, Canada, and from the Alps in Europe to far-eastern Russia in Asia. The well-known robber fly expert, Pavel Lehr, was a huge help to me in Vladivostok, Russia (Supplementary material, Fig. S24), providing hundreds of specimens for my study from Siberia and the Russian far-east. Milan Hradsky from the Czech Republic (Supplementary material, Fig. S25) was also a goldmine of information and specimens. I'm still revising more *Lasiopogon* species groups with Tristan McKnight of the University of Arizona (Tucson, Arizona, United States of America; Supplementary material, Fig. S26); we're emphasising both morphology and molecules in our phylogenies (McKnight and Cannings 2020).

Other asilids and their biology continue to intrigue me, especially in taxonomy (Cannings 1993a, 1996b; and Cannings 2017) and faunistic studies (Cannings 1989a, 1997, 2014b). I described *Efferia okanaganana* Cannings (Cannings 2011; Supplementary material, Fig. S27), a species known from only a few grasslands in and near the Okanagan Valley. I first discovered this species mixed with specimens of a close relative in the Canadian National Collection; I then collected new specimens in the localities where these old ones had been found. This rare robber fly, living in disappearing habitat where I grew up, is close to my heart and is now designated as "endangered" nationally (COSEWIC 2011a). I also spend a lot of time identifying robber flies on iNaturalist.



Figure 8. Rob Cannings with some of his doctoral examining committee, Guelph, Ontario. October 1999. Left to right: Steve Marshall, Eric Fisher, Monty Wood, and Rob Cannings. Photo by Rob Cannings.

Mentoring. I've had many fine mentors—few things are more important to a young biologist than encouragement from an expert. I've tried to pay back the generosity of my mentors by involving others in biological adventures, such as helping naturalists and students publish their insect observations in scientific journals (Borkent and Cannings 2004; Cannings and Simaika 2005; Cannings and Roberts 2007; Cannings and Pym 2017). For me, it's satisfying and fun; for them it's rewarding and is probably their first publication. It might even inspire a career in biology. You have probably had mentors, too. As my generous friend, Monty Wood (Supplementary material, Fig. S28), said to me, "Return the favour." I hope you'll try to inspire the next generation in entomology. Inspire them to meet the unprecedented climate challenges and the other environmental troubles of our uncertain world.

I'd like to finish with a story about another of my mentors, Jim Grant (Supplementary material, Fig. S29). Jim worked for the Canadian Forest Service in the Okanagan and was an extraordinary naturalist and entomologist (Cannings 1986a). A friend of my father, he was the first professional to encourage my fascination with insects. Jim often dropped by our home with entomological treasures—when I was 11 years old, he left a monarch caterpillar, *Danaus plexippus* (Linnaeus) (Lepidoptera: Nymphalidae), at our doorstep. Arriving home later in the day to find the treasure he left me, I was thrilled—I had read about this iconic butterfly in books, but it was the first one I'd ever seen.

I carefully reared that butterfly (Supplementary material, Fig. S30). To my relief, the adult finally emerged. Of course, you know what happened next—the entomologist's moral dilemma—should I let the butterfly go or put it in my collection? In the end, the collecting urge triumphed. Guiltily, I carefully labelled the butterfly as Jim had taught me. So much for conservation!

About 20 years later, an amazing coincidence happened when I was curator of the Spencer Entomological Museum at the University of British Columbia. Walter Lazorko, a retired medical

doctor and expert coleopterist, frequently worked in the collection (Supplementary material, Fig. S31). He was a distinguished looking European gentleman—proper, rather morose, pessimistic. Walter had been through a lot. In the chaos of the spring of 1945, he'd smuggled his huge beetle collection across war-torn Europe from Lviv, Ukraine, to Austria and then brought it to Canada. One day, while we were lamenting the state of amateur entomology in BC, he started talking about his friend, Jim Grant, my old Okanagan mentor.

“There should be more people like Jim”, said Walter, “He always encouraged kids—there would be more young entomologists if more of us were like Jim.”

Walter could get excited in a gloomy sort of way. “Why,” he went on, “once when I was on a collecting trip with Jim at Penticton, way back about 1960, we found a monarch butterfly larva on a milkweed plant—very rare! Jim said, ‘I know a young boy who would love to have this.’ Jim and I drove to the boy’s house, but the family wasn’t home, so we left the caterpillar in a bag on the door handle.”

Walter’s story stunned me. The caterpillar on the door was a family legend. “Walter,” I said, “that boy was *me*.” Walter was even more flabbergasted, almost disbelieving. After a long silence, tears ran down his cheeks, and he said with conviction, “You see, *then* you were a small boy, and now you’re an entomologist—that’s what Jim did for you.” Both incidents, the caterpillar on the door and the lunchtime conversation in the museum, still choke me up.

Later, when I was president of the Entomological Society of British Columbia, I helped create an award for the best Master’s student paper delivered at our annual meeting. It’s called the James Grant Award in honour of his dedication to inspiring youth.

A small act can go a long way in stimulating the quest for knowledge in children and adults alike.

Syd

Park naturalist

The three of us were British Columbia provincial park naturalists for several summers. Although those days are long gone, we’re all still naturalists—curious about everything in our environment, whether it’s owls, dragonflies, sedges, or rocks (Supplementary material, Fig. S32).

My time as a park naturalist was formative for me. On my first working day in Mount Robson Provincial Park, my supervisor asked me bluntly, “Cannings, what do you know besides birds?” The first summer in that Rocky Mountain job changed me from a birder to an all-round biologist and ecologist. It also forced me to speak in public—I was not a natural. It taught me the value of science communication, and it taught me that many people are eager to learn about nature (Supplementary material, Fig. S33).

An aside here: There is a long history of tension between ‘natural history’ and ‘ecology’ or ‘biology.’ Natural history is often discounted as simply observation. I remember a university professor complaining after hearing Dan Janzen, the well-known champion of Costa Rican biodiversity, talk about the wonderful ecology of that country: “It’s all just natural history.” On the other hand, I also remember Charley Krebs, one of the giants of experimental ecology, insisting that all of us at the Yukon’s Kluane Lake Research Station contribute to the daily log of natural history observations, even as he devised grand experiments in the boreal forest. Being observant in nature provides insights that allow you to ask all the right questions in biology and gives you joy at the same time. And joy is what keeps us going.

University of British Columbia

At first, I didn’t want to be a biologist. Not because that wasn’t what I really wanted to do, but because I wanted to be different from my brothers. I contemplated majoring in physics, but I quickly saw the light and dove deep into biology.



Figure 9. John Spence, Murray Isman, and Syd Cannings on a water boatman (Hemiptera: Corixidae) collecting trip to Riske Creek in British Columbia's Chilcotin Region, 1976. Photo by Syd Cannings.

Like Rob, I was inspired by Geoff Scudder (Supplementary material, Fig. S34), not because he was an entomologist, but because he spoke passionately about evolution, biogeography, and taxonomy. In my third year at the University of British Columbia, he directed me in a study of biogeographic patterns in western North America, and I was hooked. When it came time to choose a graduate program, I asked Geoff to recommend a university where I could study the biogeography of birds, but he convinced me to stay in his lab and study something completely different—the cuticular permeability of water boatmen (Hemiptera: Corixidae) and how that varies with salinity and temperature (Cannings *et al.* 1988). This research evolved into more of a physiological study and, at times, I regretted choosing that topic. But despite long hours in the lab, I also travelled to the Chilcotin grasslands with future entomology all-stars like Murray Isman and John Spence to collect my bugs (Fig. 9). Although my thesis was an imperfect fit, my graduate studies clearly taught me that my main interest is biogeography and evolution, and more importantly, I discovered that I'd definitely rather work in the field than in the lab. After completing my Master's degree, I was underemployed, working in a sequence of research assistant jobs. In 1979, Geoff Scudder hired me for the last of these temporary jobs—a summer surveying Yukon insects. That job changed my life.

Yukon Insect Survey

Not only did my new job focus on field work, but it was in the Yukon. I spent a summer at Kluane National Park, with side trips the length and breadth of the Yukon Territory (Supplementary material, Fig. S35). I learned all about unglaciated Beringia first-hand, and I was hooked on the North.

This is where I really learned how to collect insects. I remember Geoff visiting in mid-July, examining the specimens in my Schmitt box, saying “Is that all you've got?” With Geoff, you

learned the value of volume collecting! Over the years, he taught me much about collecting and collections, their purpose, and their value (Scudder and Cannings 1979, 1994; Cannings *et al.* 2001).

Rob had lured Dick and me into studying dragonflies, and in the Yukon, all three of us collected and documented their distribution (Cannings and Cannings 1980, 1997b; Cannings *et al.* 1991). I especially searched for the elusive treeline emerald, *Somatochlora sahlbergi* Tryböm (Odonata: Corduliidae) (Supplementary material, Fig. S36). We were excited to discover that this Eurasian species was common in the northern valleys along the Dempster Highway. We redescribed the larva and its habitat (Cannings and Cannings 1985) and discovered that the species hybridises with its close North American congeners, the ringed emerald, *S. albicincta* Burmeister, and the Hudsonian emerald, *S. hudsonica* Selys. Our research shows that treeline emeralds are likely relatively new immigrants to North America; the females have difficulty in recognising males of the other two species as different from those of their own and can mate with them in error. Similarly, female ringed and Hudsonian emeralds apparently make the same mistake with treeline emerald males. A terrific Beringian story! And Rob's still prodding me to get the hybridisation paper written. . . .

We returned to the Yukon for part of every summer through the 1980s. The three brothers were reunited in 1983, when we had a glorious time in the far north, at Old Crow on the Porcupine River (Supplementary material, Figs. S37, S38, S39) and on Herschel Island in the Beaufort Sea. This is the heart of unglaciated Beringia, where the biota was broadly connected to the Old World for the cold periods of the Pleistocene, and still has a distinctly Asian flavour.

Herschel Island, or Qikiqtaruk, is a magical place off the coast of Yukon's North Slope (Supplementary material, Fig. S40). In the past, it was an active whaling station, with a Hudson's Bay post, RCMP barracks, and a church. All were long abandoned when we visited in 1983, and we set up a temporary workspace in the old Royal Canadian Mounted Police building (Supplementary material, Fig. S41). Today, some of the buildings have been restored and there is an active park ranger staff, and visiting researchers come from around the world. We managed to get stuck on the island for an extra week because of fog and a cautious (thankfully) helicopter pilot, during which time we ran out of food. Luckily for us, a generous Inuvialuit woman was also there for the summer with her extended family—she was netting Arctic char in the bay and deep-frying donuts, so we were never in danger of starving.

In 1984 and 1987, I also participated, with other entomologists, in several marvelous expeditions by helicopter to remote, unglaciated regions in the Yukon: the British Mountains, the North Slope, and the northern Richardson Mountains (Fig. 10). We sampled and documented the insect and mite faunas of these exhilarating regions, hiking over Arctic terrain and trying to avoid horse flies and grizzlies.

The Yukon survey was the inspiration of the Biological Survey of Canada, a group of entomologists dedicated to documenting Canadian biodiversity that included Rob and, even later, me. The culmination of the project was a wonderful book summarising the biogeographic story of the Yukon as told by its insects (Danks and Downes 1997). We contributed chapters on the dragonflies (Cannings and Cannings 1997b) and robber flies (Cannings 1997).

Spencer Entomological Museum

When I returned south from the Yukon, I landed my first permanent job. Rob had been working as the curator of the Spencer Entomological Museum (University of British Columbia) but, in early 1980, had moved to the BC Provincial Museum in Victoria. Geoff Scudder, who directed the university's museum, offered the open spot to me. Before I started, I thought the curatorial work would be repetitive. How wrong I was! Of course, moving pins around all day long is somewhat routine, but I knew so little about insects—I learned every day, with every drawer reshuffled, with every incoming loan. It was the best introduction to insect diversity and the best introduction to entomologists around the continent. Among other projects, I became interested in



Figure 10. The 1987 entomological expedition into the northern Richardson Mountains (Manuel Creek): Left to right: Steve Marshall, Jim Troubridge, Val Behan-Pelletier, Ron Norris, Mary Behan, Monty Wood, Michal Polak, and Syd Cannings. Photo by Syd Cannings.

insects active on snow: wingless crane flies, *Chionea* Dalman (Diptera: Limoniidae), snow scorpionflies, *Boreus* Latreille (Mecoptera: Boreidae), and winter stoneflies (Plecoptera: Capniidae) and published some papers on that subject (Cannings 1987c, 1987d, 1989b).

Amazingly, Dick landed the equivalent job in the vertebrate museum, just down the hall. Imagine the confusion of visitors.

Nature education and writing in Vancouver

At the same time, I was active in the Vancouver Natural History Society and was arm-twisted to become president and, afterwards, president of the Federation of BC Naturalists, the organisation that coordinates the activities of all the naturalist clubs and societies in the province. Although these weren't big environmental nongovernmental organisations, the experience introduced me to people-wrangling, conservation campaigns, and the politics of conservation. I learned a lot from mentors like Bert Brink (Supplementary material, Fig. S42), a plant scientist at the University of British Columbia, an icon of British Columbia conservation, and an expert in the art of quiet diplomacy. He reminded me a lot of my dad.

I especially loved helping to produce the Vancouver society's journal, *Discovery*, including writing some articles about insects aimed at naturalists (*e.g.*, Cannings 1985, 1986d, e, 1987e) and

then pushed the British Columbia organisation to create its own journal, *Cordillera* (Supplementary material, Fig. S43). The Royal British Columbia Museum was another sponsor of the journal, and Rob and Yorke Edwards served on the editorial board. We also wrote for *Cordillera* (Cannings 1995, 1996a, 1998a). The journal was fabulous while it lasted but ultimately foundered on financial shoals.

During this time, Dick became the guest bird expert on a Canadian Broadcasting Corporation radio question-and-answer program, and it was often opened to other natural history subjects, such as insects. I (and sometimes Rob) was the ‘everything else’ answerer. Through this phone-in program, we became known regionally. This notoriety led to a friend at the Vancouver Community College (Vancouver) asking Dick and me if we would teach a course on the natural history of British Columbia.

Teaching this course forced us to decide what the natural history of British Columbia actually was, from the geological beginnings of the region to its diverse ecosystems of today, to climate change and the future. We assembled stacks of Kodak slide carousels and pages and pages of notes. But when students began asking, “Where’s the textbook?” we had to answer, “No one has written it.” A couple of years passed before we realised that we had everything available to produce such a book, and we pitched the idea to a local publisher.

That book (Cannings and Cannings 1996, 2004, 2015) took a few years to write and produce, but it vastly broadened our natural history horizons and was immensely satisfying. It won the Canadian Science Writers’ Association’s Science in Society Award and the British Columbia Bookseller’s Choice Award for 1996, and we went on to put out two entirely new editions in 2004 and 2015 (Supplementary material, Fig. S44). We also expanded some of the chapters of the book into separate books on geology, mountain ecology, marine life, and freshwater systems, and we wrote a natural history guide to British Columbia highway routes (Cannings and Cannings 2013b).

British Columbia Conservation Data Centre

While we were working on the natural history book, I left the university for a job as the zoologist for the new British Columbia Conservation Data Centre (BCCDC) in the provincial government in Victoria. The conservation data centre was part of the United States Nature Conservancy’s Natural Heritage Programs (now NatureServe). Suddenly I was a generalist again, but I also became an expert on assessing the conservation status of not only insects but other organisms, too—quite a different skill set. I loved this job because (like my previous job as an entomology curator) I was working with smart, dedicated people and learning new things every day. I helped develop the red and blue lists of British Columbia animals, and we published detailed reports on species of conservation concern (Cannings and Ptolemy 1998; Cannings *et al.* 1999; Fraser *et al.* 1999). With Geoff Scudder, I developed inventory priorities for rare terrestrial and freshwater invertebrates (Scudder and Cannings 1994). Later, I collaborated with other NatureServe colleagues on a report documenting Canadian flora and fauna of global conservation concern (Cannings *et al.* 2005b).

Yukon conservation biology

Our conservation data centre botanist had also worked in the Yukon, and occasionally, we would look at each other and say, “If only they had a conservation data centre in the Yukon.” Happily, in 2003, that happened—the Canadian Wildlife Service, with funds coming from the newly minted *Species at Risk Act*, hired me to coordinate the new Yukon Conservation Data Centre for its first three years.

I loved working in the Yukon and meeting all sorts of amazing biologists there, but I also soon learned that I'd rather be a biologist than a manager, reminding me that Rob once declared, after he'd tried to manage the botanists and ornithologists at the Royal British Columbia Museum, "I want to be remembered for my monographs, not my memos." When the three years were up, I returned to the Canadian Wildlife Service as a biologist. This is where I really belonged (Supplementary material, Fig. S45).

For 20 years, I've worked in the Yukon with the wildlife service, studying everything from endemic plants to insects, birds, and caribou. Being a government biologist now involves a lot of collaboration with First Nations as well, which is a fascinating and rewarding part of the work. Because of my previous life as an entomologist, I became the agency's *de facto* national bumble bee expert, and I've worked with several entomologists across North America on these charismatic microfauna—a group I must say that I completely ignored in the 1980s, thinking that they were already well known. As part of that work, I led the development of two federal recovery documents for bumble bees at risk (Environment and Climate Change Canada 2023a, 2023b; Supplementary material, Fig. S46), and I'm now working on two more. I have had strong connections to the Royal British Columbia Museum, providing thousands of Yukon specimens to their collections every year, ensuring that our budget covers the cost of labelling, identifying, accessioning, and housing the specimens. With a small group of other biologists, I am building a natural history collection at Yukon University, Whitehorse, Yukon. I also work with the committee that tackles the General Status of Wildlife in Canada report every five years (wildspecies.ca), a task that requires, among other things, funding for databasing entomological collections throughout the country so that we can document the distribution and population trends of vast numbers of insect species. In May 2024, I retired from that fabulous wildlife service job, but I remain in the Yukon, still involved in many entomological projects.

Committee on the Status of Endangered Wildlife in Canada

I'll finish with a few words about the Committee on the Status of Endangered Wildlife in Canada, COSEWIC, which I often introduce to people as "the best committee ever." This committee of biologists assesses all the species at risk in Canada. The main committee meets twice a year to review reports and assign statuses, but it relies on the work of numerous subcommittees that bring forward proposals for birds, insects, plants, and other groups (Supplementary material, Fig. S47). Rob and I both sat on the Arthropods Species Specialist Subcommittee for many years (I'm still on it), and Dick was a co-chair of the Birds Subcommittee for eight years. For 12 years, until my retirement, I was one of the two Canadian Wildlife Service representatives on the main committee. The three of us have written status reports over the years: Rob, Dick and I wrote one on the olive clubtail dragonfly, *Stylurus olivaceus* (Selys) (Odonata: Gomphidae) (COSEWIC 2011b), and Rob produced another on his very own Okanagan Efferia robber fly, *Efferia okanagana* (COSEWIC 2011a), from Okanagan grasslands. I authored a third report on the dune tachinid fly, *Germaria angustata* (Zetterstedt) (Diptera: Tachinidae) (COSEWIC 2011c), one of Monty Wood's favourite Yukon specialties, as well as the federal management plan for this fly (Supplementary material, Fig. S48).

I loved this committee. In addition to learning new things every time I read a report, I was privileged to work with more than 50 Canadian biologists who all love the great breadth of natural history.

The truth is, all three of us have been very privileged and fortunate in so many ways—in our family, our opportunities, our mentors, and our work. We've been able to do what we love. And maybe we've made a bit of a difference.

Dick

Rob and Syd have explained in detail about our shared history, including the University of British Columbia, BC Parks, and COSEWIC. In a dichotomous identification key, I would separate out from my brothers on three main characters:

1. I concentrated on birds in my graduate work and professional life;
2. I have spent much of my professional life self-employed;
3. And, somehow, I ended up as a politician.

Park naturalist

Like Rob and Syd, my experience as a park naturalist in six summers from 1971 to 1977 had a huge impact on my life. I would particularly single out working with expert birders George Sirk and Michael Shepard in Shuswap Lake Provincial Park (Scotch Creek, British Columbia) as a time when my interest in, and knowledge of, birds rose to a higher level than it had been earlier. That summer also produced my first scientific publications, both on birds: one on the indigo bunting, *Passerina cyanea* (Linnaeus) (Passeriformes: Cardinalidae), in British Columbia (Cannings 1974) and another on the breeding of the flammulated owl, *Psilosops flammeolus* (Strigidae) in the province (Cannings *et al.* 1978).

University: British Columbia and Newfoundland

At the University of British Columbia, I wrote my undergraduate honours thesis on the homing behaviour of Townsend's voles, *Microtus townsendii* (Bachman) (Rodentia: Cricetidae), (Supplementary material, Fig. S49) and deer mice, *Peromyscus maniculatus* (J.A. Wagner) (Rodentia: Cricetidae), under the supervision of Dennis Chitty, a true giant in animal ecology and a wonderful mentor. I toyed with the idea of continuing graduate studies in homing behaviour but ended up completing a Master's thesis on horned lark (Supplementary material, Fig. S50) breeding ecology at the Memorial University of Newfoundland in St. John's, Newfoundland and Labrador, Canada (Cannings and Threlfall 1981).

Newfoundland is about as far away from British Columbia as you can get and still be in Canada, and I have to admit, adventure was part of the attraction of the place. But I was also intrigued by my mother's family history there. My grandparents had moved to British Columbia in 1910 from Harbour Grace, Newfoundland, and no-one from that large, extended Okanagan family had ever returned to Newfoundland. Wouldn't it be wonderful to reconnect with the Munns, a well-known maritime merchant family, and learn about my origins?

Although studying in St. John's was interesting enough, I enjoyed the field work on larks even more. I lived in the lighthouse at Cape St. Mary's (Supplementary material, Fig. S51), a remote southern outpost that, at the time, was a long, rough drive from the university campus. The cape is famous for its large breeding colonies of northern gannets, *Morus bassanus* (Linnaeus) (Suliformes: Sulidae), black-legged kittiwakes, *Rissa tridactyla* (Linnaeus) (Charadriiformes: Laridae), common murre, *Uria aalge* (Pontoppidan), and thick-billed murre, *U. lomvia* (Linnaeus) (Charadriiformes: Alcidae) (Supplementary material, Fig. S52). The barrens and the fog are beautiful. My neighbours at the cape were two lightkeepers and their families. Both were fascinating characters who spoke very different versions of the Newfoundland English. The head lightkeeper was from the Burin Peninsula on the far side of Placentia Bay and spoke an old west country English dialect; the assistant lightkeeper was from Point Lance, a few coves over from the light, and spoke "Cape Shore", a strong Irish dialect. Several times, in jest I assume, I was called over to translate between them.

To be honest, I learned a lot more about people, culture, and language in Newfoundland than I did about songbird breeding ecology. I still have a deep love of Celtic music: when I returned to British Columbia, I dusted off my violin and learned a few fiddle tunes.



Figure 11. Dick Canning with a northern saw-whet owl, *Aegolius acadicus* (Gmelin) (Strigiformes: Strigidae), at nest, Max Lake, Penticton, British Columbia, April 1989. Photo by Steve Canning.

Cowan Vertebrate Museum and bird research

After receiving my Master's degree, I returned to the University of British Columbia and happily worked as the curator of the Cowan Vertebrate Museum for 17 years. I considered studying for a doctorate but discovered that would require me to resign my university position and be unable to return to it after obtaining the degree. So, I kept the museum job but studied birds as much as possible in addition to my curatorial duties—researching the breeding ecology of small owls (Cannings 1987a, 1993b, 1994a; Marks *et al.* 1989, 1999; Morgan *et al.* 1993; Gill and Cannings 1997; Cannings and Angell 2001; Davis and Cannings 2008; Fig. 11) and the taxonomy of flycatchers (Howell and Cannings 1992; Rush *et al.* 2009). I published papers and notes on the distribution and conservation of British Columbia birds (Vallée and Cannings 1983; Cannings 1987b, 1990a, 1990b, 1994b; Butler and Cannings 1989) and dabbled in entomology (Cannings and Cannings 1979; Cannings 1986b; 1986c, Cannings *et al.* 1991).

I taught annual field ecology courses for the University of British Columbia, mainly in the Yukon (Supplementary material, Fig. S53) and Costa Rica and, every year, led a nature tour somewhere in the world for the continuing education programs at the University of British Columbia, Vancouver Community College, and Capilano University, North Vancouver, British Columbia. Those programs cemented the importance of environmental and natural history education in my life.

Okanagan biological consultant

I missed the Okanagan, and in 1995, my wife Margaret and I quit our university jobs—she worked at the Museum of Anthropology—and moved with our young children back to the Okanagan Valley.

For 20 years, I was self-employed as a biological consultant, working on biodiversity monitoring with local First Nations and wildlife ecology studies for forestry companies, writing bird distribution and taxonomy catalogues (Cannings 1998b), and coordinating ecosystem

recovery teams and endangered species surveys and reports. The last included COSEWIC status reports for the white-headed woodpecker, *Leuconotopicus albolarvatus* (Cassin) (Piciformes: Picidae) (COSEWIC 2000a), sage thrasher, *Oreoscoptes montanus* (Townsend) (Passeriformes: Mimidae) (COSEWIC 2000b), yellow-breasted chat, *Icteria virens* (Linnaeus) (Passeriformes: Icteriidae) (COSEWIC 2000c), flammulated owl (Supplementary material, Fig. S54; COSEWIC 2010), olive clubtail, *Stylurus olivaceus* (Odonata: Gomphidae) (COSEWIC 2011b), western screech-owl, *Megascops kennicottii* (Elliot) (Strigiformes: Strigidae) (COSEWIC 2012), horned lark (COSEWIC 2018a), and vesper sparrow, *Pooecetes gramineus* (Gmelin) (Passeriformes: Passerellidae) (COSEWIC 2018b).

For a definitely different experience, I served on the British Columbia Environmental Appeal Board and the Forest Appeals Commission, two judicial boards that provided some real education from lawyers, judges, and engineers. I also learned to listen carefully to the points of view of the appellants and to make fair and thoughtful decisions—more good experience for my future role as a politician.

From 1999 to 2015, I worked part-time as a national program scientist for Birds Canada, then known as Bird Studies Canada. I ran the Christmas Bird Count program across the country (Supplementary material, Fig. S55). With the Cornell Lab of Ornithology (Cornell University, Ithaca, New York, United States of America), I developed the eBird program (<https://ebird.org/>) from its inception and organised it in Canada—eBird is one of the world's largest online biodiversity-related science projects. In addition, I developed bird survey protocols (Takats *et al.* 2001; Badzinski *et al.* 2006) and helped manage the BC Breeding Bird Atlas (Davidson *et al.* 2015) and the BC Nocturnal Owl Survey.

Book author

As a consultant, I could pick and choose what projects to accept, and I was often working on 10 or more distinctly different projects simultaneously. I wrote several books during that time (Supplementary material, Fig. S56), including ones on the natural history of the Rocky Mountains (Cannings 2005), the Okanagan Valley (Cannings 2009b), and Vancouver (Osborne and Cannings 2006); bird field guides (Cannings 2009a; Cannings *et al.* 2005a, 2016), and other bird titles (Cannings 2007b; Hobbs and Cannings 2007). I was particularly happy and proud to collaborate with my son Russell on two bird-finding guides (Cannings and Cannings 2013a, 2017). I also found that writing books is deeply fulfilling work, whether they sell prolifically or not.

Board member

From 2006 to 2015, I served on the national board of the Nature Conservancy of Canada, a volunteer position that became one of the most fulfilling things that I've ever done (Supplementary material, Fig. S57). There's nothing like buying a 100 000-acre mountain range to feel that you're really accomplishing something for conservation.

On a personal level, that experience added to the national scope of my environmental and ecological knowledge. It also increased the national network of contacts I'd acquired at Birds Canada. I was one of only two biologists on the Nature Conservancy of Canada board, whereas the rest were CEOs of large corporations or simply billionaires. That work gave me a real education in how billionaires and CEOs see the world. Working together with the Westons, McCains, and Trudeau gave me a lot of confidence in dealing with some of the high-powered people I would later meet as a politician.

About 20 years ago, I became involved in the initiative to create a national park in the dry grasslands of the south Okanagan Valley (Supplementary material, Fig. S58), and through that painfully slow and very political process—still ongoing—I began to see the value of interacting with politicians.



Figure 12. Dick Canning at an NDP rally with party leader Jagmeet Singh in Penticton, British Columbia, during the 2019 federal election campaign. Photo by Gord Goble.

The political life

I never thought I would, should, or could be a politician until someone in the British Columbia New Democratic Party (NDP) called me and asked if I would be interested in running as a candidate in the next provincial election. I had no idea when that election was scheduled, and I wasn't even a member of the party at the time. I was flattered, but I politely declined because I was comfortable in my relatively quiet and fulfilling life as a biologist.

It was my wife Margaret and a few of my friends who convinced me that I should give it a try because we do need more scientists in our legislatures. I ran for the British Columbia NDP in the provincial electoral district of Penticton in that 2013 election. I lost, but by the end of the campaign, I was hooked, and when asked six months later to contest the 2015 federal election, I agreed. And that time, it worked (Fig. 12). I'm now in my third term as a Member of Parliament representing the riding of South Okanagan–West Kootenay in Canada's Parliament (Supplementary material, Fig. S59).

I am in Ottawa (Ontario, Canada) half of the year. I spent six years on the Natural Resources Committee talking a lot about pipelines, nuclear power, forestry, and mining (Supplementary material, Fig. S60). I have other roles now, including climate adaptation, international trade, small business, tourism, and science and research.

I'm well known now as the biologist in the House of Commons, and many other Members and ministers come to me for advice on related issues, but I would be happier if there were more of us there. I have led bioblitzes and bird walks on Parliament Hill (Ottawa) and have tried to introduce my addiction to iNaturalist to other Members of Parliament, especially while on parliamentary business to other countries such as Albania, Argentina, Chile, Ghana, Cameroon, and Malta. Whenever I'm back home in Penticton, I turn on my black light and photograph moths and other

insects on the sheet and prowl the garden for bees, wasps, and flies on the flowers to post on iNaturalist. This pastime provides respite from the pressures of politics and keeps me learning more about natural history every day.

I've managed to change national policy on a few occasions, notably fixing a big hole in Canada's *Species at Risk Act* that had allowed governments to do absolutely nothing for years about species assessed as at risk by COSEWIC. In 2017, I proposed a private Member's bill that forced the government to consider the environmental impact of building materials used in federal infrastructure—that bill finally became law in October 2023. I also tabled a private Member's bill in December 2021 entitled the Canadian Environmental Bill of Rights that would give every Canadian the right to live in a clean, healthy environment and would provide powers that would help people ensure those rights were maintained. Unfortunately, that bill was defeated in the House of Commons in December 2023.

Being a Member of Parliament is undoubtedly one of the most wonderful jobs in the country (Supplementary material, Fig. S61). It is terrifically intense but extraordinarily interesting, and I would urge all of you to keep part of your mind open to running for office sometime in your life. Now, more than ever, in all countries, we desperately need scientists active in every level of government.

Again, as Rob has said, the three of us were surprised and honoured to be invited to present the stories of our careers in biology at the Entomology 2022 conference in Vancouver. You can see that our paths, although intertwined, also diverged. There are many paths through the woods and meadows of biology, whether they are through an academic or other career. Humanity needs people exploring all those paths towards knowledge, conservation, and a better future.

Thank you, *merci, lim' limpt*¹ (Supplementary material, Fig. S62).

Supplementary material. For supplementary material accompanying this paper visit <https://doi.org/10.4039/tce.2024.42>

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¹*Lim' limpt* translates as “thank you” in the *nsyilxcən* language of the Syilx Okanagan First Peoples.

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