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THE CANADIAN SOCIETY OF ENVIRONMENTAL BIOLOGISTS Bulletin

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- *Technical Writing Series - Paragraphs Have Purpose*
- *“Black Swan Summer: Tipping Climate and Biodiversity Destruction”*
- *Book Review - Especially Babe*
- *Considering Lag Times in Environmental Science and Management – An Essay to Engage Environmental Biologists*



CSEB Bulletin SCBE

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Front Cover: Angela Holzapfel, fisheries Biologist with Golder Associates Ltd., angling for Lake Trout, Arctic Char, and Arctic Grayling upstream and downstream of a falls on the Thelon River, Nunavut, as part of baseline studies for the Areva Kiggivik Project, August, 2009. Photo credit - Francine Audy, Golder Associates Ltd.

Back Cover Top and Insert: Northern Flicker (*Colaptes auratus*) in back yard, Edmonton, AB, August 29, 2021. Bottom: American Crow (*Corvus brachyrhynchos*), Edmonton, AB. Photo Credits: Gary Ash, CSEB Alberta Chapter member.

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CSEB BULLETIN 2021

Vol. 78, Number 3, Fall 2021

The Canadian Society of Environmental Biologists Bulletin is a quarterly publication. The Bulletin keeps members informed of the Society's activities and updates members on the current affairs and advances in the field of environmental biology. This publication draws together the widely diverse group of Canadian environmental biologists through a national exchange of ideas. Members are invited to contribute papers, photos or announcements that are of a national biological and environmental interest. Letters to the editor are welcome. This is a volunteer non-profit organization and we rely on your participation to make the Bulletin a productive forum for ideas and discussion.

All business correspondence, changes of address, undeliverable copies and membership applications should be sent to: CSEB National Office, P.O. Box 962, Station F, Toronto, ON, M4Y 2N9. **Editorial correspondence:** Gary Ash, Editor, e-mail: garyash@shaw.ca.

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LE BULLETIN de la SCBE 2021

Vol. 78, Numéro 3, Automne 2021

Le Bulletin de la SCBE est une publication trimestrielle de la Société Canadienne des Biologistes de l'Environnement. Le Bulletin informe les membres des activités de la Société sur événements courant ainsi que les progrès qui font en sciences de l'environnement. Par un échange d'idées au niveau national, cette publication intéresse un groupe très diversifié d'environnementalistes Canadien. Les membres sont invités à contribuer des articles, photos (noir et blanc) ou des messages qui sont d'intérêt nationale en sciences biologiques et environnementales. Les lettres à l'éditeur sont bienvenues.

Tout la correspondance d'affaires, y compris les abonnements, les changements d'adresse, les exemplaires retournés et les formulaires: CSEB National Office, P.O. Box 962, Station F, Toronto, ON, M4Y 2N9. **Les lettres à l'éditeur:** Gary Ash, Editor, Courriel: garyash@shaw.ca

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The views expressed herein are the writer's of the articles and are not necessarily endorsed by CSEB, which welcomes a broad range of viewpoints. To submit a piece for consideration, email newslettereditor@cseb-scbe.org.

The Canadian Society of Environmental Biologists**CSEB OBJECTIVES**

The Canadian Society of Environmental Biologists (CSEB) is a national non-profit organization. Its primary objectives are:

- to further the conservation of Canadian natural resources.
- to ensure the prudent management of these resources to minimize environmental effects.
- to maintain high professional standards in education, research and management related to natural resources and the environment.

OBJECTIFS de la SOCIÉTÉ

La Société Canadienne des Biologistes de l'Environnement (SCBE) est une organisation nationale sans but lucratif. Ses objectifs premiers sont:

- de conserver les ressources naturelles canadiennes.
- d'assurer l'aménagement rationnel de ces ressources tout en minimisant les effets sur l'environnement.
- de maintenir des normes professionnels élevés en enseignement, recherche, et aménagement en relation avec la notion de durabilité des ressources naturelles et de l'environnement, et cela pour le bénéfice de la communauté.

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NATIONAL News

PRESIDENT'S Report

By Curt Schroeder, CSEB President

Perhaps one of the most obvious environmental stories of summer 2021 concerned the extreme weather across most of Canada. "Heat Dome" became part of the daily lexicon, and this weather pattern had serious consequences including wildfires in western provinces and drought in the prairie regions. Hundreds died as a result of this weather phenomena. Temperature records were set in British Columbia, Saskatchewan, and other regions of Canada. The latest IPCC report came out at the same time warning of a "Code Red for Humanity". Much of Europe experienced similar high temperature related impacts.

Environmental change at the moment is dominating much of the news, and the discipline of environmental biology and research will undoubtedly be affected. When reading the web pages of many university biology departments, I see many publications with subject titles that are climate related. Living with nature and learning to adapt are major themes of our current human history, with the COVID pandemic only serving to reinforce this point.

We need better news at the largest scale!

CSEB BULLETIN CONTRIBUTIONS NEEDED

Contributions of articles or news items are needed for the Winter 2021 edition of the CSEB Bulletin. Deadline for submission is 15 November 2021. Please send your submission to Gary Ash, CSEB Bulletin Editor at garyash@shaw.ca.

CSEB VOLUNTEERS NEEDED

Website Assistant:

CSEB requires a volunteer to assist our Webmaster Brian Free with managing the CSEB Website. You should be familiar with using WordPress for website management, and able to gather relevant material for posting on the site. It would also be useful to have experience with MailChimp for sending out webinar and other notices, but training can be provided. For more information, please contact Brian Free at bfree@cseb-scbe.org.

For more information, contact President Curt Schroeder at schroederc@saskpolytech.ca.

SCIENCE TIDBITS

Submitted by John Retallack, CSEB Alberta Member

Birds

Blue Heron – Long Duration Flier

Who knew?

In the spring of 2019, a female great blue heron (*Ardea herodias*) was fitted with a GPS transmitter by biologists from the Maine Department of Inland Fisheries and Wildlife in partnership with researcher Dr. John Brzorad from Lenoir-Rhyne University.

After a spring 2020 migration north to the east coast of Canada that stayed close to land, the tagged heron then logged a 68-hour non-stop flight from Chaleur Bay, Quebec (near Campbellton, NB) to Georgia in the USA. The heron left her post-breeding feeding area on October 8, 2020, headed far offshore and after a continuous flight that took her close to Bermuda, she landed on October 11 on the southern tip of Cumberland Island on the Georgia coast. She then gradually moved to the Everglades in south Florida.

Last year, this heron traveled more-or-less the same route but stayed a bit closer to the USA coast and arrived near Jacksonville, Florida, 38 hours after departure (about 2300 km continuous flight). During that flight, the average speed was 62 kph, with a maximum speed of 107 kph. The average elevation during the flight was 185 m, whereas the maximum elevation was 946 m. After a couple of days to refuel, she left Florida and spent a couple more days in the Bahamas before continuing her southern journey and arrived at the final over-wintering destination near Guajaco Uno, on the northeast coast of Cuba (north of Guantanamo Bay).

And in Related News:

A bar-tailed godwit (*Limosa lapponica*) has recently logged a non-stop journey from Alaska to New Zealand (about 12,200 km) and set a new world record for the longest logged continuous flight by a bird. The bird left southwest Alaska on September 16, 2020 and, after flying over open-ocean for the entire flight, arrived in north New Zealand (near Auckland) 11 days later. The previous record holder (2007) was also a bar-tailed godwit.

Lyrebirds as Terrestrial Ecosystem Engineers

Researchers from La Trobe University in Australia (led by Alex C. Maisey) have been studying Superb lyrebirds (*Menura novaehollandiae*) in the Central Highlands, west of Melbourne in the state of Victoria. They have determined (*Ecological Applications*, August 18, 2020) that, in the course of foraging, a single lyrebird can move an average of 156 Mg/ha of litter and soil per year. Further, they have concluded that foraging activity

by lyrebirds contributes significantly to the ecological health of the forests by cycling nutrients, maintaining soil-dwelling invertebrates, and even assisting with post-fire recovery.

Ducks May Eat and Disperse Viable Fish Eggs

Adam Lovas-Kiss et al. (MTA Centre for Ecological Research, Danube Research Institute in Hungary) found that a small percentage of fertilized eggs of two species of invasive carp could survive the journey through the guts of mallards (*Anas platyrhynchos*).

Vincze and her research team fed fertilized eggs of common carp (*Cyprinus carpio*) and Prussian carp (*Carassius gibelio*) to captive populations of mallard ducks (*Proceedings of the National Academy of Sciences*, July 07, 2020). Of the thousands of eggs fed to the ducks 0.2% of the eggs remained viable at the exit from the digestive tract one to four hours later.

While not definitive and focused only on carp/mallard relationships, the researchers suggest that, given the large number of water birds targeting spawning fish, feeding birds may present an important mechanism for spreading fish to new habitats.

Projectile Poop Bombs From Penguins

I always thought the distribution of nests in penguin colonies was based on pecking distances. Maybe not!

In 2003, during a research trip to Antarctica, Victor Benno Meyer-Rochow observed the ability of nesting Adelie penguins (*Pygoscelis adeliae*) to project their feces a considerable distance from their nests. Apart from keeping their nesting areas clean, the projectile distance also seemed to correspond with the distances separating other penguin nests, more or less!

Follow up research by Dr. Meyer-Rochow and Jozsef Gal on the physics of projectile pooping in Adelie penguins earned them the 2005 Ig Nobel Prize for fluid dynamics.

Another team of researchers from Kochi University in Japan has expanded on the original findings. Led by Hiroyuki Tajima, the team, using Humboldt penguins (*Spheniscus humboldti*), were able to refine the findings and establish the revised distance of travel of the fecal bombs at up to 134 cm (properly corrected for viscosity of the fluid and factoring in air resistance, of course). They also concluded Meyer-Rochow and Gal had underestimated the pressures involved...rectal pressures were, in fact, up to 28.2 kPa, 1.4 times those found in the original studies.

Practical applications of environmental research are always appreciated. In this case, Tajima notes their work has allowed those who care for penguins in zoos or conduct field research to establish suitable safety zones to help ensure they keep well out of range!

Canadian Ecotoxicity Workshop (CEW)

CEW will take place in Halifax, NS October 3-6, 2021.

For information, see <http://ecotoxcan.ca/>

TECHNICAL WRITING SERIES

Submitted by Sean Mitchell, CSEB BC Director

Paragraphs Have Purpose: Using Them to Strategic Advantage

Often when we write, we focus on our words and sentences; we use these as the principal tools to convey our thoughts. And they are of great importance, no question of that. But when we focus too much on one thing, we may lose sight of other important characteristics. One of these ignored features is the paragraph — that collection of sentences that provides structure and flow to our writing. The paragraphs you create can and should be used strategically to emphasize and support your persuasive argument. A paragraph is much more than a block of text; it is an invitation to read (when length and white space are considered); it can be a deterrent (when too long, too regular, too repetitive); its structure can hammer your point home. It is within the paragraph that we form space for engaging creative word use and sentence structure. The paragraph provides the context for every word in it; it fences in our thoughts for clear communication.

Given its importance and multifaceted roles, thought should be given to paragraph structure. Writers and style guides provide counsel on accomplishing effective structure; I present five principles distilled from this advice.

Principle 1: Each paragraph needs to be tightly focused around a single main point or subject. Only one. Readers are easily led astray by irrelevance and tangents. Keep these out of your paragraphs. If you cannot clearly articulate how a given sentence relates to the subject of the paragraph, delete it. Be ruthless. Clear communication is about the reader staying with you on each step of your journey, about keeping the reader with you. Each paragraph serves as a stop on our journey where we are pointing out something of importance, just as we would on a guided hike. So each paragraph has to have something significant to say... but without meandering or introducing material that makes the reader ask “why are you telling me this?”

Principle 2: Each paragraph needs to be coherent. Within the single subject of the paragraph, each sentence needs to, obviously, relate to the subject. It must also relate — clearly and evidently — to the sentences immediately preceding and following. Envision the sentences as the railroad cars of a train. Each is coupled to the one ahead and to the one behind. If the coupling is weak or broken, the cars following it may get abandoned. Consider the following passage as an example of coherence:

“Antimony in soils of ranchlands may be toxic to grasses and so affect distribution and health of vegetation. Antimony uptake is controlled by environmental conditions, with it being sequestered in graminoid root and stem cells. Other metals — such as chromium, vanadium, and arsenic — may interact synergistically with antimony, either reducing or enhancing toxic effects to the plants. Complicating our understanding of antimony absorption, soil chemistry and conditions also influence growing conditions of the crop; this interaction precludes simple cause-and-effect understanding. Though antimony is only one of the suite of metals affecting cereal health, it is a critical one to monitor in the grasslands of North America.”

I trust you will agree that the sentences flow one into the other with each being a logical consequence of what has come before (i.e., my train cars are coupled). I hope also that you noticed the repeat of the word *antimony* in each sentence. That is an obvious, heavy-handed, repetitive, boring, and condescending way of ensuring cohesion — continuously and explicitly reminding the reader of the central subject. Did you, however, also notice the repetition of the concept of grass and grassland in each sentence (i.e., vegetation, graminoid, plants, crop, cereal)? That is subtle, light-touch, variable, interesting, and respectful of the reader's intelligence. Use of synonyms is a valuable way to create cohesion within your paragraph, to nudgily remind your reader what you are talking about and how all of the sentences relate. Of course, this example is exaggerated; one would not try to repeat the word in every sentence. But using synonyms, say in two or three of seven sentences in a paragraph, provides the reader landmarks to orient the reader to the subject of the paragraph. This provides cohesion.

Principle 3: Paragraph length is very important to readability. Typical or recommended length for a standard paragraph is 100–200 words or 4–6 sentences. But this may vary a great deal to achieve specific effects. The recommended length is a great place to start and from which to then purposely depart for strategic reasons.

Longer paragraphs (more than 200 words) are valuable to explore nuanced ideas or explain complex concepts, but they can appear intimidating on the page as a large block of text that needs to be waded through. Use them when necessary but sparingly. The reader won't mind a few long passages as he or she knows they are necessary for that particular exploration or explanation. Short paragraphs, in contrast, scream out that whatever they have to say is very important — these are the actors on the stage that constantly try to upstage all other characters. Excessive use of short paragraphs (3–4 lines of text or less) badly break up the flow, create jarring reading, do not allow room to develop a thought, and imply that every point is important. Then the reader struggles to determine what is truly critical among the many paragraphs screaming their importance.

Paragraphs can also be used to break up text on the page and create white space around them. One or two long paragraphs on a page appear blocky, imposing, and uncomfortable to read, giving our reader a sense that he or she has to wade through our boggy prose — not the impression we want to portray. Many short paragraphs, on the other hand, is like a bumpy road: our journey is jarring and uncomfortable. We want the page to be inviting.

Through strategic use of average length, long paragraphs, and short ones, the writer can clearly show what is supporting evidence (in the longer paragraphs) and what is critically important (short paragraphs). The fun though, comes in playing with these. Recognizing the roles of different length paragraphs, we can purposely use contrast to powerfully emphasize a point, perhaps using a long paragraph followed immediately by a brief one. The contents of the short one are then emphasized by the contrast with what came before. Try it yourself in your own writing: purposely create a short paragraph of two or three sentences after a particularly long and elaborate one — does it emphasize and highlight your point?

Principle 4: The first sentence of a paragraph plays a special role. This beginning sentence is equivalent to the engine of the metaphorical train cars. It pulls the remaining sentences along and provides the motive power for the paragraph. Similar to the train, sometimes it does not have to work that hard — when on flat terrain or lightly loaded — but other times, such as in the mountains or when the load is heavy, it requires greater power to accomplish its task. The first sentence also needs to link to the preceding paragraph, providing a bridge for the reader to move from the previous subject to the new one. Clearly this line has multiple roles and carries a lot of weight. Bearing in mind the roles of this sentence, how can you craft one that jumps out at the reader?

Principle 5: The final sentence of the paragraph is the most emphatic. Psychologists that study written communication tell us that the final sentence in a paragraph is the most memorable to the reader. It is the one they will retain. The strategic writer will use this knowledge wisely. This last bit of text can be valuable to summarize the point of the paragraph; raise a question to be answered in the following paragraph, or emphasize a take-home message. If you wish to further increase its effectiveness, contrast a short final sentence with a purposely constructed long sentence just before it — the juxtaposition of the short after the long, and the short being the final sentence, compels the reader to believe that it must be very important. As I have just done here.

As with many writing techniques, exploiting the final sentence needs to be used strategically. Not every paragraph needs to place such responsibility on this tail string. Often it can be downplayed in order to lull the reader into a pattern, then when you hit them with a powerful final sentence, it truly stands out. It clearly becomes the most important line in the whole section of the report. Overuse of emphasis on the final line of a paragraph will denude it of effectiveness.

The above five guidelines should serve you well in crafting paragraphs. Paragraphs are crafted, they are not simply an unconsidered collection of sentences. Purposely use long ones for complex or nuanced ideas and short ones for driving a point home. Vary lengths purposely to create interesting flow and reading, and create a page with white space. Ensure only one thought per paragraph; if you stray outside that thought, cut unconnected material. Use synonyms (selectively) to help ensure cohesion to your paragraphs. Pay particular attention to your first and last sentences; how can you make them fulfill their purposes — whether to link to the previous paragraph or to drive home the message of the current paragraph — more effectively?

The strategic technical writer worries as much about his paragraph construction as his word choice or sentence structure. Recognize these passages for what they are: powerful tools to help you send your message to the reader.

Next column: Lists — the invasive species let loose in the veldt of technical writing.

Considering Lag Times in Environmental Science and Management – An Essay to Engage Environmental Biologists

by Peter G. Wells¹, CSEB Member

¹ This is an early draft on the topic. It has not yet been read by others or been peer-reviewed. Timely comments are welcomed.

This essay was stimulated by reflections on how long it can take for our respective societies across the globe to deal with important, often dire, environmental challenges such as pollution, habitat and biodiversity loss, and climate change. The reader familiar with environmental history¹ will know that this is not a new concern — some problems have been dealt with quickly, but many others known for ages, not so quickly. Given the range of problems faced against a backdrop of a still expanding human population and threatening climate change, there is considerable urgency to having, dare I say, a timely discussion on lag times.

Some key questions in this context emerge — what is the basis for the lag or delay in addressing key environmental problems? What role does time play in our fight against environmental pollution and a myriad of other stresses faced by our land, water, and the many species living there? Can we afford the time spent in recognizing and fully documenting the seriousness of a problem before acting upon it in a serious way?² How do we (society) reduce the time between recognizing and verifying a problem and ensuring that there is a meaningful policy and management response to it, along with proof that the response was effective?

Delving into the topic after many years of cogitation and notation, it is clear that this concern and some of the questions posed above are not new (see Owen et al. 2014; Varjopuro et al. 2014; Hering 2018; amongst others, and footnote 1), are multi-dimensional, and have been raised a number of times recently in the context of both environmental and human health (see the bibliography).

Given our combined knowledge of new and persistent environmental problems, the topic deserves the attention of environmental biologists such as members of the CSEB, and especially some follow-up action on problems with a Canadian context. We need to understand the different types of lag times, the history of delay (or not) addressing some of the critical Canadian problems, and how to overcome the barriers (from knowledge to policy and management) to ensure timely and effective responses to them.

For many decades, the topic or concept of lag times has been lurking behind the scenes in ecotoxicology (e.g., why do some chemically-induced effects on organisms show up long after exposures to non-lethal concentrations have ceased?), and more broadly in environmental biology (e.g., why did it take so long to recognize and accept the role of wolves as apex predators in our northern habitats?). It is important to our basic understanding of how anthropogenic chemicals, especially POPs or persistent organic chemicals (e.g., PCBs), act upon organisms and ecosystems, and to our ability to apply what we know and understand in a timely (sic) fashion to critical chemical and other

environmental threats. In this context, lag time can be considered to be the time between the onset of a stimulus or event and the response of the receptor(s) to it. The concept is not trivial, nor just confined to ecotoxicology, but until quite recently (see the bibliography³), it has not been well considered in environmental science and management. The topic is much broader than originally conceived (by this author, at least!), as clearly shown by the recent literature.

As well, the current COVID 19 crisis or pandemic has highlighted the problem of lag times. It has been a true emergency but not entirely unexpected given the past history of pandemics. The fast response to this crisis in some countries (not all) shows that recognition of a true crisis, happening or pending, mobilizes and focuses both the science community and the policy and decision makers, and action is quickly taken. This rapid response has happened previously in major conflicts (e.g., WWII – atomic bomb development) and similar human health crises (e.g., Ebola in Africa, SARS in Canada, foot and mouth disease in the UK, algal toxin outbreaks in eastern Canada). The coronavirus response by agencies and governments clearly shows that science and the needs of the public health agencies are rapidly driving the political, policy and decision making activities, not the other way around. The time to significant action is short. It is a clear one-way flow of information, driven by the observations on the ground. It points to one principle — the urgency with which information is required for the “right” policy decisions, and in this case, health care action, reduces the time between understanding the problem (the virus) and acting on it (the vaccine).

In contrast to an urgent health crisis, a slow response to some key environmental threats (e.g., climate change, low level chemical contamination, habitat and biodiversity loss, reduction in aquifers in SW USA), with some marked exceptions where response was rapid (e.g., ozone depletion and CFCs, organotins, algal toxins, Hg in shellfish, acid rain), has put life on the planet into a perilous situation.

Climate change is clearly “the poster child” in this discussion about time. Despite the work of the IPCC (the Intergovernmental Panel on Climate Change) over the past three decades, there has been a delay in sufficient meaningful global response to the crisis, despite the efforts in some countries to reduce emissions and switch to alternative energy sources. This slow response has been recognized (note the American climate envoy, John Kerry’s, recent talk — Kerry 2021) and now, hopefully, it will be addressed this year with the upcoming meeting in Glasgow, Scotland.

Another example much in the news is that of litter (plastics) in the ocean and the many risks posed to marine life. This issue was studied in the 1960s and early 1970s (Cundell 1974) and observed in the 1960s by the explorer Thor Heyerdahl in his various ocean voyages, as he observed huge quantities of litter caught in surface current windrows (Heyerdahl 1971). It has been described in many ocean assessment reports (see www.gesamp.org). Yet it

¹ Key readings on environmental history include Easterbrook 1995; Markam 1994; McNeill 2000; Merchant 2002; Ponting 2007; and Worster 1977. Reading even one of them gives some context to this essay and some pause for thought as to our collective progress or not in our fight to maintain a liveable planet.

² “Rome is burning” while we watch, as this literally is occurring this summer in numerous locations with huge forest fires in Ontario and western Canada, as well as elsewhere. Have we abandoned the precautionary principle and not acted in the absence of complete information for serious problems?

³ See especially the reports (EEA 2001,2013) and the excellent book by Bowen et al. (2014).

took until the early part of this century, with the discovery of ocean gyres in the Pacific Ocean filled with floating plastics, for society at different levels (general public to the politicians and the United Nations) to wake up and respond.

Hence, a truly urgent situation can completely remove the barriers between knowledge about a problem (the flow of scientific information) and the needs of and actions by policy makers. As mentioned above, this happened in several environmental situations since the mid- 20th century (e.g., ozone depletion and CFCs; organotin, DDT and Hg pollution; algal toxins; long range transport of acid rain; right whales and ship collisions/entanglement). It is clearly happening now, on a day to day basis, with the COVID 19 pandemic, climate change, and plastics in the oceans. Policy and management response to a crisis can be very fast and even effective, if it is deemed serious enough by the decision makers in government.

Unfortunately, this is not always the case, as not all problems are deemed urgent, especially if humans are not being affected. The reasons why are worth evaluating. First, what are the different sorts of time lags or delays? Clearly, lag or delay times exist at several points in the management cycle, as one moves from detection of a problem through to its management and resolution. A framework (**Figure 1**) for addressing the scope and implications of time lags or delays has been developed, with references to relevant examples.

Clearly, time is a major factor at every stage of understanding, addressing and resolving environmental problems. The environmental implications of time lags for addressing serious

problems are many and often severe in terms of impact on ecosystem and/or human health. Climate change is probably the top example; it was recognized as occurring due to human influences back in the 1960s, yet it took until the 1990s under the IPCC for assessments and some action to take place. Action to this day globally is considered insufficient and too slow, despite some progress in several countries (e.g. Germany, UK). Reactions to other issues, such as deteriorating water quality, the health effects of some contaminants (e.g. herbicides such as glyphosates), and the needs for biodiversity conservation, have also been slow, with examples in Canada. In contrast, if human welfare has been at stake (CFCs and ozone depletion, algal toxins, mercury poisoning, lead in gasoline, release of radionuclides), responses have generally been very fast and generally effective.

If action is slow, why? Where are the barriers? The framework gives some ideas of where they occur and of the wide scope of the problem. This needs to be more widely recognized, outside of scientific and academic literature/circles. Only widespread discussion and cooperation will reduce critical time lags on problems yet unresolved. Especially on climate change and biodiversity conservation, across the planet, time is of the essence!

To conclude, I initially approached this topic as an aquatic toxicologist, realizing that exposure of organisms to toxicants often led to delayed effects, depending upon the chemical, its concentration, the species and life stage, and the length of time of its exposure. Clearly, the literature shows that the topic is much broader and more complex, covering many aspects of environmental science, information, policy and management,

Figure 1. Types of lag (delay) times, with links to key references found to date, 8-21.

1. Scientific:
 - a. Detecting and recognizing problems (Grandjean 2018, Hellou 2011, Wood and Foot 1981).
 - b. Acquiring sufficient information and knowledge about a problem or a process (DeSombre 2005, FWW 2019, Mulhern 2020, Pahl et al. 2014, Rudnick 1989).
 - c. In pollution studies, considering multiple organism responses in toxicity tests, lethal or sub-lethal (Cairns and Niederlehner 1994).
 - d. Acquiring sufficient expertise and equipment to address problems.
 - e. Monitoring ecosystem response and recovery, post-management., post-control (EPA 2008, Ghidoni 2017, Hastings 2016, Hamilton 2011, Mueller, Hamilton and Doole 2015, Samset et al. 2020, Vero et al. 2017).
2. Information and communication
 - a. Analysing the data and publishing the results (Cairns and Niederlehner 1994).
 - b. Writing for the right audience.
 - c. Policy and decision making.
 - d. Accepting the scientific evidence and advice.
 - e. Making a decision in the light of various options and considerations, including economic and political (Bretschger and Smulders 2018) .
3. Managerial and institutional action.
 - a. Regulatory acceptance of the science and its techniques (Cairns and Niederlehner 1994).
 - b. Interaction with industry, agriculture, etc. to address the problem.
 - c. Establishing new programs to address and resolve the problem, including adaptive management (Anon. 2019, Baird 2009, Hastings 2016).
 - d. Managing, using the precautionary approach (Baird 2009, EEA 2001, 2013, Owen et al. 2014).
 - e. Establishing monitoring to verify problem resolution (Angor et al. 2018, Anon. 2020, Bristow and Brumbelow 2006, Hastings 2016, Kim et al. 2020, Varjopuro et al. 2014).
 - f. Recognizing societal time scales (Goldberg 1977).
4. Legal and Ethical
 - a. Establishing new laws, regulations, guidelines, etc. within national jurisdictions.
 - b. Establishing a legal framework to address problems of global significance (DeSombre 2005, Karlsson and Gilek 2019).
 - c. Considering and accepting the ethical dimensions of the issues (Brown 2001).

and deserves a more in-depth analysis. As well, my perspective has greatly benefited from being part of an inter-disciplinary research team at Dalhousie University, studying the enablers and barriers to the use and influence of information to resolve marine environmental problems (www.eiui.ca). Time lags deserve scrutiny from many angles and by many players.

To conclude, this essay's role is to initiate a discussion within the CSEB. A concerted effort to reduce lag times for effective action is needed on many critical problems discussed recently in the pages of the CSEB Bulletin. **So CSEB members — take up the banner and add your voice to this discussion from your perspective. Time is short, especially with climate change upon us!**

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REGIONAL News

BRITISH COLUMBIA News

Submitted by Loys Maingon, CSEB BC Director

"Black Swan Summer: Tipping Climate and Biodiversity Destruction"

"...getting back to normal is a rhetoric of distraction"

- Mark Blyth¹

Last year, in the depth of COVID-19, BC's government hired over 5,000 tree planters to plant 310 million trees to the tune of over \$140 million as part of Canada's planned carbon off-set plan to plant 2 billion trees at a cost of \$3 billion.² Politicians touted this as an "unprecedented reforestation" that would "increase carbon capture in BC's forests to combat climate change."³ Then hubris came, as it always does, unheralded like an Afghani debacle. How much carbon will dead trees capture in a new world of climate extremes?

Climate change came this summer in an unprecedented western drought that swept the western United States and British Columbia, reaching record temperatures that set the town of Lytton and the municipality of Monte Lake on fire and called for the evacuation of many more.⁴ To date, the province has recorded 1,537 forest fires that have consumed 859,183 hectares. These statistics compare with BC's worst year in forest fires (2017) and are set to exceed them.⁵ As the experience of firefighters in California and Oregon had previously born out, this year's BC fires are notably far more aggressive than anything experienced to date.⁶

Over the past month, fresh water temperatures in once productive coastal salmon rivers on Vancouver Island have soared from a previous average of 15°C to between 25 and 29°C, compromising the numbers and viability of both returning spawners and outgoing Coho Salmon fry. This is consistent with what has been observed from California to Alaska, with returning salmon observed to be greatly weakened by exposure to higher water temperatures and the concomitant lower oxygen levels.⁷ Temperatures in the Okanagan rivers were reported to be exceeding 23°C.⁸ These temperatures and their impact on the food chains of the Salish Sea may also be related to the unprecedented disappearance of J-pod Southern resident orcas from the Salish Sea, for the first time in memory.⁹

The marine environment has been as heavily hit as the terrestrial environment. A report of mass die-off of billions of coastal organisms by UBC's Chris Harley¹⁰ caught the attention of the national and international press as scenes out of "a post-apocalyptic movie."¹¹ Commercial and wild mussels and oysters were literally cooked on site.¹² Although most people may view these shoreline organisms only as economic resources for the food industry, they play a far more important role as the cornerstones of filter feeder processing chains, which maintain water quality and control deadly algal and bacterial blooms. One might

simply consider the impact of this summer's heat dome as just another isolated incident; however, it has already had broader ramifications for the bacterial ecology of the coast with a notable 10-fold increase in the incidence of *Vibrio cholerae*.¹³ While an outbreak of cholera in March 2018 caused consternation and was called "a unique situation,"¹⁴ a "black swan" shamefully blamed on First Nations' poor hygiene, today's 10-fold outbreak is treated as perfectly normal and comes with dubious re-assurances that the shellfish industry has this well under control.¹⁵

There should no longer be any doubt that black swan events are becoming as common as the Coast's traditional white trumpeter swans, and are here to stay and multiply for future generations. There is no normal to return to unless we pretend that life-threatening extremes will inevitably become acceptable normals, or worse yet, that the political will can be mustered to reckon with the impacts of a life threatening economy that has brought us the dubious blessings of climate change.

In spite of all the talk about sustainability, resilience, and the millions of dollars poured into the restoration of fish habitat, the reality is that the mantra of endless development and business as usual has collapsed much of BC's original salmon habitat. Climate change is just the proverbial straw that breaks the camel's back. A recent study by Riley Finn at UBC has found that there has been a loss of about 64% of salmon habitat in the lower mainland: "It maps where an estimated 85 per cent of floodplain is dried up or inaccessible to salmon due to dikes, along with 1,700 kilometres of streams thought to be "completely lost" due to in-filling and barriers such as dams and road culverts."¹⁶ Similar mapping could undoubtedly be done across most of the developed and clearcut areas of British Columbia.

Again, we have promoted an economy of endless growth while claiming that we could also retain a productive environment. Should we really have expected that, as DFO proclaimed for decades, we can "return salmon to historic highs" as we destroyed 64% of the best salmon habitat?

There is an important lesson to be learnt from the salmon collapse. Namely, that governments will not hesitate to mesmerize the public with promises of technological programs that will make unsustainable economic development somehow sustainable. It is just a distraction.

Notwithstanding all the nursery and genetic technology that we have deployed to compensate for those losses and maintain the social illusion of "normality", we continue to witness the collapse of salmon populations across BC. That governments will pretext that all would be well were it not for climate change, fails to acknowledge that this same economy, which destroys the natural world, has also driven climate change. As the record

of Riley Finn's research shows, technological solutions are no substitute for the productive complexity of a rich and biodiverse environment. Once lost, the salmon and the benefits that mankind gets from biodiversity are lost forever. It is better to preserve than to try to fix and compensate in hindsight.

The disastrous environmental and social costs of the post-1945 economy of endless growth were modelled in 1972 in *Limits to Growth*. Fifty years on the hypothetical scenarios of *Limits to Growth* are proving to have been consistent with the empirically observed trends of real world data. Indeed, in a report by Gaya Herrington entitled "*Update to Limits to Growth: Comparing the World3 Model with Empirical Data*" in the *Journal of Industrial Ecology* Herrington confirms that we are well on track for societal collapse by about 2040, largely because we have been — and continue to be — unable to break with a "business-as-usual" mindset, for the past 50 years.¹⁷ *Limits to Growth* presented reasoned scenarios on the course that humanity was taking. It was a moderate call for the need to transform the economy, our energy systems, our reproductive rates, and our consumption of natural resources. It simply required a shift in what economists sold as "normal" expectations. There was, in fact, nothing normal about the destruction of our life-support system. *Limits to Growth* was a commonsense choice, made even more relevant by unfolding events fifty years later. It provided a long-term roadmap with broad choices for an easily achievable smooth social transformation that should have been complete by 2000. The choices now are far more limited.

The release of the Sixth IPCC Global Assessment Report (*AR6 Climate Change 2021: The Physical Science Basis*),¹⁸ which drew instant international consternation, with the Secretary General of the United Nations, Alberto Guterres, calling this "a code red for humanity,"¹⁹ is in fact a non-sequitur that merely confirms the irreversibility of impacts that have been known to be in the making for the past 50 years. The tedium of repeating the obvious is such that lead scientists who authored this and previous reports are already noting that they have no intention of continuing to prepare IPCC reports. There is no point in writing reports that neither politicians nor mainstream public seem neither to understand nor care to take the steps necessary to avert a global catastrophe.²⁰ Once again we are told that we are on track to reach 1.5°C by 2030. To avert disaster, we need to stop all fossil fuel development immediately and transform society on a dime.²¹ In the days prior to the release of AR6, ground-breaking reports indicated that we are either dangerously close to tipping points or are seeing the beginning of irreversible changes such as the slowing down of Atlantic meridional overturning circulation (AMOC), which would have dangerous global consequences. This has been a growing concern since the early 1990s²².

While AR6 is undoubtedly important, from an informational point of view, the smaller and less publicized joint report of the IPCC and the IPBES (*Biodiversity and Climate Change Workshop Report*) released in early June may be much more important. This report is the first joint statement from the Intergovernmental Platform on Climate Change and the Intergovernmental Platform on Biodiversity and Ecosystem Services. It is the first explicit statement that while, until now, the climate and biodiversity crises have been approached separately, it is clear that the climate crisis and the biodiversity crisis are really one joint crisis. Just solving

the fossil-fuel crisis will not shift the damage done by unlimited development and the destruction of ecosystems. Neither the climate crisis nor the biodiversity crisis can be addressed unless they are addressed together:

"Human-caused climate change is increasingly threatening nature and its contributions to people, including its ability to help mitigate climate change. The warmer the world gets, the less food, drinking water and other key contributions nature can make to our lives, in many regions" said Prof. Hans-Otto Pörtner, co-chair of the Scientific Steering Committee.

*"Changes in biodiversity, in turn, affect climate, especially through impacts on nitrogen, carbon and water cycles," he said. "The evidence is clear: a sustainable global future for people and nature is still achievable, but it requires transformative change with rapid and far-reaching actions of a type never before attempted, building on ambitious emissions reductions. Solving some of the strong and apparently unavoidable trade-offs between climate and biodiversity will entail a profound collective shift of individual and shared values concerning nature – such as moving away from the conception of economic progress based solely on GDP growth, to one that balances human development with multiple values of nature for a good quality of life, while not overshooting biophysical and social limits."*²³

To make that shift, politicians and economists need to understand that nature is a living world that sustains vital biotic processes, and that to sustain those processes, its integrity must be protected for the well-being of future generations. It not just a "bunch of resources" for the well-being of commerce.

The failure of BC's successive governments to understand the importance of the biotic world in the regulation of climate change is evident in its continued failed forest management policies. The proof is always in the pudding. An aerial view of the endless clearcuts over BC, the collapse of old-growth and the hydrological impact of forestry are the pudding that the policies of ministry of "Forests, Lands, and Natural Resources Operations" have bequeathed to British Columbians. As we experience this year's drought, it is instructive to contemplate the state of our forests and consider that recent research shows that in Coast Range Mountains, streamflow in 45 year-old forests is 50% less than in 110 year old forests.²⁴ As proposed by the "biotic pump model," forests produce water and "flying rivers" essential to our climate (see <https://interestingengineering.com/theory-claims-that-forests-not-only-create-rain-but-also-wind>). Forty-years is the accepted forestry logging cycle. That means 50% less water into the hydrological cycle and 50% less water for fisheries. And that does not consider what the magnitude of the loss might be in a comparison with the hydrological output of millennial old growth forests that are being pulped under "Forests, Lands, Natural Resources Operations" policies. In light of this research, it is to be expected that our rivers are drying up and their waters are running at 25 degrees centigrade after we have destroyed our once millennial forests? It is then no wonder that FLNRO policies have resulted in a renewed, and very ugly, "war in the woods."

While the Horgan government has recently opened, with much fanfare, a new clean energy technology centre to "battle climate change,"²⁵ as it planted millions of seedlings without anticipating the impact of a mega-drought, the expectation that we can return to a normal that was never either normal nor sustainable, is just misguided. Events over the past four years have completely

outstripped BC's "Clean Energy Plan," which critics now view as completely antiquated and out of step with the changing needs of future generations.²⁶ This is particularly significant because it is consistent with this government's animosity to science and its refusal to follow the guidance of even the scientific panels it appoints, as documented with regards to its failure to respect the findings of the Old-growth Scientific Panel.²⁷

BC planted 310 million trees in 2020 to reforest vast areas of industrial clearcuts. It did so on two broad false assumptions. First, that trees are just a crop for the production of lumber that sustains the "forest industry." Second, that future climate conditions would resemble "normal" climate conditions that have prevailed over the past 100 years or more. Planting did not make provisions for an extreme extensive drought that kills seedlings before they can establish themselves and adult trees unadapted to these extremes. Trends in the accelerated decline of the Pacific Maritime forests and tree die-backs that were seen to have increased by 17% by 2009 have only continued to increase. For BC, the Pacific maritime component accounts for 40% of our lumber production. It now appears that as of 2021, 30% of the Pacific maritime forest has been lost to climate change.²⁸ Therefore, even the second growth forests are now in jeopardy.

Though the numbers are not yet out, the drought of 2021 will undoubtedly increase that mortality rate and act as a major driver of ecosystem re-organization. The major cause of tree mortality is extreme drought.²⁹ The trees were planted on the assumption that we would "return to normal". They are as unlikely to survive, as the coho of our rivers and the shellfish of our coasts. As noted, "This way of thinking is perhaps as dangerous as the climate crisis itself."³⁰

The old-growth forests are known to be major sinks of biodiversity. They are associated with the production of "flying rivers" that form and drive some of the major sources of rainfall around the world. As per the IPCC and IPBES report on biodiversity and climate change, the preservation of old-growth biodiversity is not just an exclusive concern with regard to Bolsonaro's policies in the Amazon. The policies of BC's government raise equal concerns, as demonstrated by a recent research paper by Dominick DellaSala et al. entitled "Red-Listed Ecosystem Status of Interior Wetbelt and Inland Temperate Rainforest of British Columbia, Canada,"³¹ which concludes that this ecosystem is headed for collapse due to FLNRO's logging practices, and that resident listed species are headed for extirpation.

Concern for the status of biodiversity in old-growth forests on Vancouver Island reached new heights this summer when in mid-May, a resident researcher Dr. Royann Petrell discovered that the Caycuse to Port Renfrew area was home to a previously undocumented population of Western Screech owls (*Megascops kennicottii*).³² The discovery of this threatened species raised red flags for Dr. John Neilson (COSEWIC, retired), particularly after the release of the Nahmint ruling which found that BC Timber Sales was issuing logging permits in old-growth areas without carrying out due diligence biodiversity surveys for endangered and listed species. Neilson discovered that no information could be found as to the presence or absence of species present, listed or otherwise in the controversial Ada'itsx (Fairy Creek) area that was set to be logged. Neilson sought permission to access the

area from the Pachedaht parties and FLNRO. He contacted me to organize a group of biologists and naturalists with Jim Cuthbert and carry out a series of short surveys to document the area's potential species diversity. To that end, we set up an iNaturalist page to capture and upload whatever information might have been previously collected on species at Fairy Creek (<https://www.inaturalist.org/projects/fairy-creek-research>). In May, there was only one report (a red-legged frog, *Rana aurora*).

The area was then, and continues to be, the subject of a logging controversy. As determined by the judgment of Justice Douglas Thompson in Supreme Court of BC, as all BC citizens who were not authorized by the government or who were not employees of Teal Jones, we were illegally blocked by the RCMP from exercising our right to scientific inquiry.³³ Nevertheless, we were granted passage by Chief Victor Peters and were able to carry out three short surveys. To date, the surveys have yielded 321 species, 16 of which are "Vulnerable" species of concern. The list and attached concerns can be found in **Figure 1**.

The list of 320 species and 16 listed species was compiled after a mere 20 hours work during which access was obstructed by the RCMP, with helicopters being constantly flown over the area to harass protesters. That also harassed sensitive faunal species. Setting aside the importance of identifying species at risk, this project raises some important questions about the ongoing government-sanctioned destruction of biodiversity in BC. The Fairy Creek area is less than 100 km from Victoria, that is from the offices of both the Ministry of Environment and the "Forests,

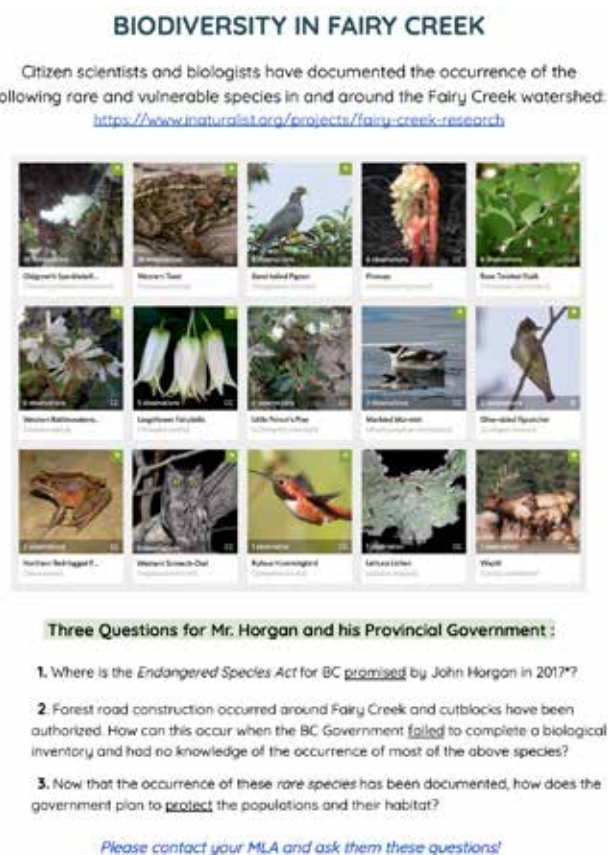


Figure 1: Poster of 15 listed species found at Ada'itsx (Fairy Creek) in 2021

Lands, and Natural Resources Operations”, yet no records seem to have existed of these endangered species, before licenses to clearcut and destroy these habitats were granted. It is not clear how well-staffed ministries that are responsible for both the inventory of species-at-risk and the protection of species-at-risk could apparently have been so extensively unaware of the state of species richness under their care. This is not just a “Fairy Creek” problem. This would appear to be a pervasive problem across all of BC. We talk of biodiversity, while destroying untold hectares of forest habitat without carrying out species inventories to determine what is to be lost. To protect the interests of the logging industry, this government, as others before it, delays the passage of a “Species at Risk Act” that would protect biodiversity. In fact, “Forests, Lands, Natural Resources Operations” is currently engaged in projects to design protocols to protect some species at risk, in consultation with the forest industry. In other words, if BC ever enacts a “Species-at-risk” legislation, as promised, it will probably look like the chicken house designed by the foxes.

Perhaps of greatest relevance among the 16 species found was that of *Pseudocyphellaria rainierensis* (Old-growth Specklebelly). On the plus side, this blue-listed endemic, which is considered extremely rare and endangered in the United States, but only “vulnerable” and “of special concern” in BC, where very few populations have been found, is the subject of a special agreement with the government of Canada “to secure long-term protection for the known populations and habitats of oldgrowth specklebelly”.³⁴ This lichen is specific to old-growth and is known to be extremely sensitive to disturbance. Very special forestry restrictive directives apply throughout the West Coast for this species. Under BC Timber Sales guidelines, the prescription calls for a minimal of 200+ metre setback from any population identified. Again, on the plus side, its bluish thallus with a pinkish underside make it one of the easiest lichens to identify. BC Timber Sales provides its clients and licensees with identification cards for that purpose. On the down side, the find is in a cutblock in which Teal-Jones put its roads right through the population, trisecting the distribution and providing for no setbacks or protections whatsoever.

The population found at Fairy Creek is a new population of *Pseudocyphellaria rainierensis*. It was found in a Teal-Jones cutblock by Natashasha Lavdovsky, a young artist interested in lichen dyes, on trees fallen by Teal-Jones (pictures and account can be found in a recent article “*Artist finds new population of rare imperilled lichen at Fairy Creek*”).³⁵ This lichen is extremely special because it is associated with very old well-established old-growth forests. The noted Canadian lichenologist, Trevor Goward, is quoted on this matter. He notes that in his estimate, if this lichen is present, the forest is likely to be among the oldest in Canada, it is not just an “ancient forest,” it is an, in Goward’s words, an “antique forest.” BC has very few populations of this lichen. Most consist of only of 2-10 individuals. At last count, Lavdovsky found about 55 trees with about 12-20 individuals per tree. This is, or rather was, Canada’s largest population of this rare species. It is now fully endangered by Teal-Jones’ activities and lack of due diligence, and by “Forests, Lands, Natural Resources Operations” outright negligence. A formal complaint against Teal Jones has been lodged with BC Forest Practices Board. This will probably wind its way through the system for the next three

years. In the interim, “Forests, Lands, and Natural Resources Operations” continues to support the interests of Teal-Jones, and this population is expected to be part of the 80 percent of the old growth that will simply end up as pulp. Only 20 percent of an old-growth forest is actually converted to lumber.³⁶

It might be possible to rescue this population if the “Forests, Lands, Natural Resources Operations” cared for Species-at-Risk and for biodiversity. Regrettably, Maingon and Neilson found that they were stonewalled by the minister and staff responsible for “Species-at-Risk” in the “Ministry of Forests, Lands and Natural Resource Operations.” Communication required a complaint through the provincial Ombudsperson, as letters and calls went unanswered. Although “Species-at-Risk” is housed in the “Forests, Lands, and Natural Resources Operations”, there seems to be very little concern for the management of species at risk, possibly less than there is for climate change. In fact, given the conclusion of recent IPCC and IPBES *Biodiversity and Climate Change Workshop Report* that climate change and biodiversity are inextricably intertwined, the “Species-at-Risk” portfolio has no place in “Forests, Lands, and Natural Resources Operations.” This is a ministry in perpetual conflict of interest. It cannot serve both the interests of forestry companies and protect biodiversity in British Columbia.

The findings at Fairy Creek demonstrate Forests, Lands, and Natural Resources Operations’ inability to protect even clearly recognized rare species such as Old-growth Specklebelly. Logically, the portfolio needs to be re-located in the “Ministry of Environment and Climate Change,” where the interests of nature and climate change will not be corrupted by conflicts of interest.

Governments come, governments go, but it is business as usual in BC, and it is normal to destroy endangered species while bragging about our great technological investments that will sustain an unsustainable way of life that we see increasingly impoverished every day. We should be thankful for those 800+ mainly young and indigenous people who get arrested by a “progressive” social democrat government, because they have understood that the illusion of getting back to normal is indeed more dangerous than climate change itself. It endangers us all!

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ALBERTA News

Submitted by Brian Free, CSEB Alberta Regional Director

The Alberta government has a number of public engagements underway on environmental topics. The government's web site has a link to public engagement (<https://www.alberta.ca/public-engagement.aspx>) and a search of — Topics: Environment and Status: Open and Opportunity to Get Involved: Public — produces a long list of engagements. This is an opportunity for Alberta biologists to add their science-based opinion to the mix. Here are six topics found on August 16:

Bison Conservation Agreement: Agreement with the federal government to protect and conserve the Ronald Lake and Wabasca wood bison herds.

Bow River Reservoir Options: Gathering feedback over the next two years on three possible options to help reduce the effects of flooding and drought along the Bow River by increasing water storage capacity.

Coal Policy: A new advisory committee on this controversial policy is accepting input from the public.

Milk River Fish Recovery Plan: This heavily used river is shared with the State of Montana. A draft recovery plan is being developed for the stonecat, western silvery minnow, and Rocky Mountain sculpin.

North Saskatchewan Region Surface Water Quality Management Framework: As part of the North Saskatchewan Regional Plan, a surface water quality management framework is being developed for the North Saskatchewan and Battle Rivers.

Upper Athabasca Region Surface Water Quality Management: A surface water quality management framework is also being developed for the Athabasca River from its headwaters in Jasper National Park to a point upstream of the oil sands region.

Alberta CSEB members should check this website for opportunities that interest them. If you'd like to help prepare a submission on behalf of the CSEB, please contact your Alberta Director, Brian Free at bfree.x@shaw.ca.

SASKATCHEWAN News

Submitted by Curt Schroeder, CSEB President and Saskatchewan Member

To say that the coronavirus pandemic is throwing universities all over the world for a loop would be an understatement. Many continue to scramble to transition to online teaching and to ensure student wellbeing in these unprecedented times. At the University of Regina's Faculty of Science in Canada, however, these are challenges that they are tackling head-on with success.

Professors in the faculty can take much of the credit for this, thanks to their flexible approach in dealing with the crisis. More than just academic support, they are offering help to students faced with pandemic-related financial woes or otherwise, on top of the everyday stresses of being a university student.

All members of the Faculty of Science are going the extra mile in this aspect, and with ingenuity too. The study of sciences involves a significant number of hours in the lab. When the university had to pivot, suddenly and quickly, to teaching online earlier this year, how did they make sure students did not lose out on this cornerstone of science education?

University of Regina, Faculty of Science

Source: University of Regina, Faculty of Science

Luckily for biology laboratory instructor Heather Dietz, she has her prior experience as an online student and the support of like-minded co-instructors to leverage on. Most science courses and labs are now taught online, apart from a very small number of research-based courses, to prevent the spread of COVID-19. Dietz and her colleagues are undeterred by this, seeing this as an opportunity to innovate their lab-based microbiology courses instead. “We are less concerned with presenting many concepts and more concerned with ‘deep dives’ into far fewer topics,” Dietz explains.

As not all students can access scheduled virtual classes easily, they are now limited to a maximum of 90 minutes. Classes are more discussion-based too, instead of one-way lectures. Dietz has also made her remotely-delivered microbiology courses at “zero additional cost” to students. “We have removed the (artificial) distinction between traditional lectures and labs, and have created a far more relevant and student-centred course. In addition, transparency, humility, honesty, flexibility, and kindness go a long way in creating this student-centred remote learning community,” Dietz adds.

Hands-on learning during a pandemic

Lab classes are important for science students as they solidify practical skills and the intellectual culture of the discipline. How can science courses such as biology and genetics be effectively taught when everything is online and students can't access the facilities they need?

Instructors at the University of Regina's Faculty of Science have found ways around that. In her microbiology class, Dietz's students receive a package that lets them perform techniques they learn from text- and video-based procedures using tools provided in the home kit. Students get to design and set up their own Winogradsky column experiment at home, a low-risk experiment that has been a staple of studies in microbial ecology for over a century, using their own recycled plastic drink containers, and mud or soil.

Other faculty, like Maria Davis, who teaches Plant Physiology and Genetics, are similarly harnessing the potential of the “at-home lab”. For one experiment related to root nodulation, the faculty supplies pea seeds and nutrient packages to students to conduct experiments in their own homes. This serves as an “independent replication,” according to Davis, as well as a lesson in collaborative science as the data analysis will be based on the combined data set collected from the 90 students enrolled in this class.

University of Regina, Faculty of Science

Source: University of Regina, Faculty of Science

“I am doing this in the hopes of getting students more engaged in class as they get to perform hands-on work and gather data from their own homes. The students will ask questions relating to root nodulation in an agriculturally relevant plant (the pea) using local soils,” she explains.

If students aren't able to perform this experiment at home, Davis gives them the option of an alternative assessment, where they reflect on their experience and share any artwork or writings that are a product of their metacognition activity.

Fostering a supportive online community at the University of Regina

Just because they are now in different corners of the globe doesn't mean the Faculty of Science can't offer emotional support to their students in need. One of Dietz's primary goals when remote learning began was to create an inclusive online community through the use of asynchronous discussion groups, live breakout discussions, and pre-recorded student videos. Distance should not be a reason students can't get to know each other better, she believes.

“To supplement the University of Regina's course management system, and to make the student experience a little more fun — or at least less formal — we use Kahoot! for informal game show competitions and for formative assessment polls. We use the Flipgrid video platform as an asynchronous way to check in with students and to support students. Students are also able to support and encourage each other using Flipgrid,” Dietz shares.

As for Davis, the pandemic taught her that being flexible and inclusive makes students feel supported and welcomed. She says, “In my welcome video, I took some time to provide my students with some tips to help reduce stress. I will be sure to keep reminding students of these during the semester with my weekly ‘What's on this week’ videos.”

Professors are also always there to offer a virtual listening ear or shoulder to cry on. Dietz says, “I'm not an expert in psychology, but I am a good listener for those students who have the courage to talk to an instructor. For students who need more help than I can provide, I refer them to someone who can help.”

Interesting Article

Chasing Northern Pike under Ice: Long-Distance Movements Following Catch-and-Release Ice Angling

by Christopher M. Somers, Una Goncin, Shayna Hamilton, Michelle Chupik, Ryan Fisher

<https://doi.org/10.1002/nafm.10638>

Abstract: Catch-and-release ice angling is a popular recreational activity, but little is known about the postrelease behavior of fish in the winter. Cold water temperatures and an ambush hunting strategy may constrain Northern Pike (*Esox lucius*), limiting their postrelease movements to a small area near the capture location. We used manual acoustic telemetry to track 15 Northern Pike ranging from 56 to 98.5 cm total length for up to 7 d after catch-and-release ice angling in Buffalo Pound Lake, Saskatchewan, Canada. All of the fish but one moved unexpectedly long distances of several km over the tracking period. For the fish that were

tracked over all 7 d, path lengths traveled ranged from 1.4 to 18.4 km. The minimum daily distance traveled ranged from 0 to 4.6 km and varied significantly by tracking day; the fish moved shorter distances on day 4 post-release. There was a significant interaction between fish size and day post-release; larger fish moved shorter minimum daily distances and dispersed shorter distances from the release site over the first 2 d of tracking. In contrast, by 5 d after release, both the largest and smallest fish had dispersed the longest distances from the release site and intermediate-sized fish dispersed the least. The cumulative path length traveled by day 5 of tracking did not reveal any significant size-based patterns. Our study raises the possibility that relatively large movements may be common for Northern Pike in the winter despite cold water temperatures and their expected foraging behaviour. In addition, post-release behaviour varies with fish size. Habitat and space requirements for Northern Pike in the winter can encompass much larger areas and more habitat features than has been previously envisioned.

MANITOBA News

Submitted by Robert Stedwill, CSEB Vice President

Manitoba Wetland Purchased by Conservation Charity

More than a hundred acres of natural wetland near Brandon, Man., will now be protected by the Nature Conservancy of Canada.

Announced on July 13th, the Nature Conservancy of Canada (NCC) is doubling the size of its Douglas Marsh protected area by purchasing an additional 115 new hectares.

The conservation charity said marshes like the Douglas Marsh act as the earth's sponges, regulating water flow through the year. It said the new purchase ensures that the largest wetland system in the Assiniboine Delta can continue to help nourish and protect its neighbours from spring melts and summer droughts.

According to the NCC, Douglas Marsh not only receives water from surrounding lands, but it is also one of the few locations where the waters of the Assiniboine Delta aquifer occur at the surface, playing a critical role in sustaining and protecting the water quality of the aquifer.

The eco non-profit said in addition to protecting wetlands, Douglas Marsh also has a stretch of upland native prairie, one of the most endangered terrestrial ecosystems on the planet.

The marsh has also been designated an Important Bird Area and is home to Species at Risk Act (SARA)-listed species.

"Protecting nature has important benefits for human health, biodiversity, and the fight against climate change. Douglas Marsh's wetlands and native prairie, which provide habitat for many important species at risk, including the yellow rail, will now be protected for future generations. By working with partners like the Nature Conservancy of Canada, we are creating a cleaner, healthier future for our children and grandchildren," said Terry Duguid, parliamentary secretary to the Minister of Environment and Climate Change, in a news release.

The NCC said it will partner with the Central Assiniboine Watershed District to establish a marsh and bird lookout area for visitors.

The marsh purchase was a combination effort between the NCC, Central Assiniboine Watershed District, private donors, and funding from the Government of Canada as part of Canada's Nature Fund.

"This significant conservation achievement is a result of the support that NCC receives from our donors. The securement of this magnificent property is an example of what we can do together to make sure that we conserve this habitat for generations to come," Josh Dillabough, NCC's natural area manager for Douglas Marsh, said in a release.

Source: CTV News, July 13, 2021

ATLANTIC News

By Peter Wells, CSEB Atlantic Member

Environmental and natural resource issues continue to be reported almost daily in Nova Scotia. The wide range of issues is remarkable, pointing to a societal awareness of the importance of the environment and the dedication of local reporters researching and writing the articles. There are also some good news stories and events across the province, related to conservation and biodiversity protection.

The dominant environmental issues follow. The under-handed delisting of the ecologically unique Owls Head Provincial Park has dominated the news, has been part of the provincial election discussions, and has led to demonstrations in downtown Halifax. Sadly, the group that took the government to court lost the case, with the Supreme Court saying that the Premier and his department at the time did not do anything illegal (McPhee 2021). Hopefully the fight to protect this unique coastal ecosystem will continue. Infilling the Halifax Harbour's Northwest Arm has become an issue, as a wealthy homeowner wants to extend his property into the sea, despite the protests of fishermen and sailors (Anningson 2021; Lambie 2021a,b). Deforestation continues unabated and is visible from some of our most travelled highways; the future of crown land is at stake (Beswick 2021b). Herbicide use along power lines is being opposed due to concerns for wildlife and people (Smith 2021b); the active ingredient in Aspect herbicide is 2,4-D. Fisheries are, of course, in and out of the news, from the issue of lobster fishing out of season by indigenous peoples, to the seeming absence of workable plans to rebuild cod stocks (Smith 2021a). Water quality is a concern, due to outbreaks of blue green "algae" in local lakes (Campbell 2021b), to arsenic runoff from old mine sites (Beswick 2021b). And of course, open pen fish aquaculture concerns continue (Dean-Simmons 2021a; Farquharson 2021).


On the positive side, the endangered piping plovers seem to be doing better this year (Johnson 2021); bat populations seem to be doing better in some locations (Peddle 2021a); innovative whale rescue and protection programs continue (Beswick 2021c, Campbell 2021d; Ziafati 2021); more coastal lands are being

protected by the NS Nature Trust (Campbell 2021c); talks are happening on the prospect of having an urban national park (Munroe 2021a), building on citizen led initiatives to protect local wilderness around metro Halifax; an LNG plant proposed for the eastern shore was cancelled; and new water control structures are being planned for marshes, so far in NB (Cole 2021b), as well as repairs to dykes protecting both marshes and highway and rail infrastructure (Cole 2021a).

One of the most positive signs of society caring more for nature has been more people walking, cycling, and in general getting out into our parks and other natural areas, during the Covid crisis (Stevens 2021). There are also activities of new environmental groups, such as the Cliffs of Fundy UNESCO Geopark which is sponsoring beach cleanups in the Minas Basin of the Bay of Fundy, given that ocean litter remains a major concern. May this engagement of citizens continue, for the protection of species, habitats, and human health!

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Upcoming CSEB Research Webinar

Several CSEB Research Webinars are planned over the coming months.

Check the [CSEB Website](#) in for the dates and times of the fall/winter series of webinars.

If you are willing to give a webinar on one of your monitoring or research programs, or have suggestions for future webinars, please contact Dr. Loys Maingon at tsolumresearch@gmail.com.

CSEB VOLUNTEERS NEEDED

Social Media Coordinator:

CSEB requires a volunteer to manage our social media (e.g., Facebook, Twitter, etc.). The volunteer should be familiar with social media, have a good command of the English language, and willing to spend the time to post new items, keep the social media current, and communicate with our members. Awareness of environmental biology issues would be an asset.

If interested, please contact President Curt Schroeder at schroederc@saskpolytech.ca.

Regional Directors

CSEB Requires Regional Directors for the following Regions:

Alberta (1), Saskatchewan (1), Manitoba (2), Ontario (1), Quebec (2), Atlantic (2), and Territories (2).

Duties involve promoting CSEB in the Region, participating in monthly Board conference calls (1 hour/mo), and providing regional news for the CSEB Bulletin four times per year.

For more information, contact President Curt Schroeder at schroederc@saskpolytech.ca.

TERRITORIES News

Submitted by Anne Wilson, CSEB Territories Director

I hope this finds all in good health and spirits, as we go into the Fall with ongoing changes in the global pandemic bringing some uncertainty. The summer has been one of weather extremes, and has flown by! Travel is still restricted into the territories, and the ability to do field work can be complicated. I am very much looking forward to the day when borders are fully open again!

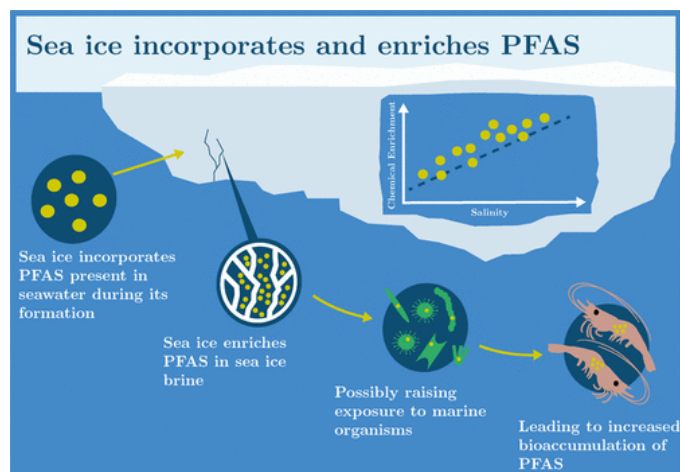
I have been thinking about all the changes being observed in the North, especially with respect to sea ice. There have been recent news articles raising concerns with the effects of climate change on polynyas, and about tracking the breakup of the ice shelf on Ellesmere Island. Not surprising, with the recent release of the Intergovernmental Panel on Climate Change's Sixth Assessment Report there is further indication that the North is facing accelerating change in both climate and sea ice conditions. Some of the highlights extracted from the technical summary of the report (available at <https://www.ipcc.ch/report/ar6/wg1/>) are as follows:

- The Arctic Ocean is projected to become practically sea ice-free in late summer under high CO₂ emissions scenarios by the end of the 21st century (high confidence). It is virtually certain that further warming will lead to further reductions of Northern Hemisphere snow cover, and there is high confidence that this is also the case for near-surface permafrost volume. Glaciers will continue to lose mass at least for several decades even if global temperature is stabilized (very high confidence).
- Over recent decades, widespread loss of snow and ice has been observed, and several elements of the cryosphere are now in states unseen in centuries (high confidence). Human influence was very likely the main driver of observed reductions in Arctic sea ice since the late 1970s (with late-summer sea ice loss likely unprecedented for at least 1000 years) and the widespread retreat of glaciers (unprecedented in at least the last 2,000 years, medium confidence).
- Current Arctic sea ice coverage levels (both annual and late summer) are at their lowest since at least 1850 (high confidence),
- In permafrost regions, increases in ground temperatures in the upper 30 m over the past three to four decades have been widespread (high confidence). For each additional 1°C of warming (up to 4°C above the 1850–1900 level), the global volume of perennially frozen ground to 3 m below the surface is projected to decrease by about 25% relative to the present volume (medium confidence). However, these decreases may be underestimated due to an incomplete representation of relevant physical processes.
- It is virtually certain that surface warming in the Arctic will continue to be more pronounced than the global average warming over the 21st century. An intensification of the polar water cycle will increase mean precipitation, with

precipitation intensity becoming stronger and more likely to be rainfall rather than snowfall (high confidence).

- There is high confidence in future glacier and ice sheet loss, permafrost warming, decreasing permafrost extent, and decreasing seasonal duration and extent of snow cover in the Arctic. Decline in seasonal sea ice coverage along the majority of the Arctic coastline in recent decades is projected to continue, contributing to an increase in coastal hazards (including open water storm surge, coastal erosion, and flooding).

Melting sea ice can also have other implications, such as for marine water quality. A recent study published in *Environmental Science and Technology* looked at the behaviour of specific long-range air transport contaminants in sea ice (Investigating the Uptake and Fate of Poly- and Perfluoroalkylated Substances (PFAS) in Sea Ice Using an Experimental Sea Ice Chamber <https://pubs.acs.org/doi/10.1021/acs.est.1c01645>) and found that these compounds were incorporated into sea ice during formation. Chemical enrichment occurred in the saline brine channels, which then acted as a source of concentrated PFAS in melting sea ice; in the Arctic Ocean, this is typically the one-year ice, which is dominant due to global warming.



(Diagram from <https://pubs.acs.org/doi/10.1021/acs.est.1c01645>)

Northern News

Remediation activity continues at the historic Giant Mine, which is dealing with a legacy of arsenic stored underground. Extensive monitoring is ongoing for terrestrial components, air and water quality, along with Indigenous engagement.

Environmental assessments and regulatory processes in the North continue, with activity slowing down somewhat over summer as people take time to go out on the land. Some of the current reviews include the following:

- The Prairie Creek zinc mine is proceeding to technical meetings and public hearings in fall for a production Water Licence and permits. This site was originally developed in the early 1980s but abandoned on the brink of operations; the owners walked away and left a time capsule of buildings, tools, vehicles, and exploration developments. The current

owners have been doing exploration on the site since the early 1990s, and in the interim, the mine site has been surrounded by the expanded Nahanni National Park. There is substantial interest in this project, as it is upstream of the park boundary and development carries risks with respect to waste management and contaminants.

- Pine Point Mining Limited has submitted an application to mine the historic Pine Point site lead-zinc deposits, located near Hay River, NWT. This project is undergoing an environmental assessment. Management of brackish/poor quality groundwater is expected to be an issue. Scoping of the EA is underway. The company is doing a hydrogeological testing program to identify groundwater flows and behaviour in the karst terrain.
- The City of Yellowknife is renewing its municipal Water Licence, with hearings scheduled for mid-September. The main concern lies with phosphorus loadings to what was once an ultra-oligotrophic receiving waterbody, and how to halt further nutrient discharges and remediate areas that are now hyper-eutrophic. Historic practices are difficult to change, but it is important to improve on them.
- The Baffinland Iron Ore mine expansion environmental assessment hearings will resume in November, following COVID-related delays. The Water Licence amendment process, also much-delayed, is scheduled to start immediately following the hearings. Baffinland has applied to increase production in order for the project to remain economically feasible. Concerns include effects on marine mammals and sea birds, and increases in emissions, given the increased shipping involved.

Closing

If you are connected to activities in the Yukon, Northwest Territories, or Nunavut, doing work north of 60 that you would like to highlight in the newsletter, or running some seminars or other training opportunities, please let us know. The CSEB provides a valuable networking and communication forum, and a voice for biologists on any issues to be raised. There is also the option of instigating other CSEB activities — both of the fun and/or of the educational variety — with colleagues in the North. Please email your thoughts to Anne Wilson at anne.wilson@ec.gc.ca. There is also an opening for another Territories Director — please contact Curt Schroeder or myself if you would like to take on this role!

Check out the CSEB Video at
<http://youtu.be/J7cOuDbBf9c> or
<https://www.youtube.com/watch?v=J7cOuDbBf9c>

BOOK Review

Submitted by Bob Gainer, CSEB Alberta Member



Especially Babe

by R. Ross Annett Tree Frog Press, Edmonton Alberta. 1978.

"You're always writing about the North like you love it more than where you live now, but you have lived here a lot longer. You should write about this place. And don't include me in your book review" suggested my wife. She is always right, I am always wrong, I will never do it again, I'm sorry (and then I bend my head down and look up imploring), please forgive

me....? That is my secret for her staying married to me for 40 years. I know I am not the only "trained" husband out there.

Ross Annett is probably Canada's most read author. Before television, people used to read a lot more, especially "pulp fiction" in dailies, weeklies, monthlies, yearly's in magazines, newspapers, journals, comic books; anything they could get their hands on. It was a giant market. Annett (and Robert Service) was one of these writers. He started at an early age in Ontario before WWI, enlisted and survived to write about it, got married and had children, became a teacher, moved around several small towns in Alberta, became a Principal in Consort in the mid 1930s (about 1 hour northeast of where I live and home to KD Laing and the two Kroeger boys of Nickleback fame). Consort is part of Alberta's "Special Areas" or "Badlands" or just "Areas", the part of the Province that was most severely devastated by the "Dirty Thirties" or "Great Depression." By today's standards, this area in 1935 was the most unthinkably poor and desperate place to live, even compared to Africa and India or, even Siberian gulags.

Annett looked around and wrote about the people in Town. He copied the lives of the strongest "characters", their manner and speech. The actual locale he copied was Jenner, a town farther south in the Areas where he had worked before. He wrote about the human spirit in the face of incredibly difficult economic times. He called this article "It's Gotta Rain Sometime," sent it off to the Saturday Evening Post and, bingo, hit the cash pot (he had written many hundreds of articles before for mere pittance, this was \$500, nearly half a year's salary). He quit teaching and wrote subsequent instalments using the same characters and formulae for the next 25 years until television did in him and the Saturday Evening Post. Several other authors had jumped on the bandwagon, copying his formulae but none as loved as Annett. Later WO Mitchell copied his formulae but in book form and became a much more known author in Canada than Annett, but not read as much. The Post was American with 10 times the

"TV" audience of Canada, which was hundreds more times that of the book buying audience in both countries. In 1942, Appleton Century published the first 13 of Annett's stories in book form but because of the War effort and people's reluctance to buy books, it didn't sell until 1978 when a Hippie Dippy publisher in Edmonton was offered the rights and did an excellent job (I know these people personally).

With Annett's book as an excuse, I would like to give my condensed version of the geography, habitat, and history of the "Areas" or Badlands, the recent history of pronghorn (*Antilocapra americana*) here, and what I feel are misconceptions of the northernmost herd.

What does this book mean to me? I met Annett several times. His grand-daughter married my brother. Annett was a very nice man in his 80s when I knew him, well mannered and well spoken but absolutely



Photo Source: Wikipedia

dependent on his wife for financial affairs. Put as many drinks in his hand as you wanted and they would disappear. Like many writers it seems, he was meant to be penniless. Money was like water in his hands.

What else does this book mean to me? The indomitable human spirit in the face of incredible adversity is what my mother's family faced here during the 1920s. In 1919, my grandfather contracted the Spanish flu, survived it but developed Parkinson's disease. He managed to provide for his wife and four kids until 1929 when they took a boxcar and "a kick in the ass" according to my mother, out of the Areas to eventually end up in Edmonton. Here her poor mother had an invalid husband and four kids to care for until his death in 1940. All the kids had jobs (forced child labour) and their mother took in boarders until WWII when the three oldest were conscripted; my mother started nursing in Grand Prairie to support the construction of the Alcan Highway and her 12 year-old brother was a cook's helper on the same project. My father and his siblings were also conscripted. When my mother died at the age of almost 90, she was still bitter that none of her relatives in Ontario, nobody in Alberta or the rest of the Country, were willing to help them in the 1930s. Conscript them, yes.

What else does this book mean to me? Growing up in the Edmonton area, born at the end of the war living in Edmonton's row of tar paper shacks for enlisted families called the "Huts," over two thousand of us in a space the size of three soccer fields until I was seven, then working as a hired farm hand as a teenager during the summers. By today's standards, the work was excessively long and hard, and the pay unbelievably low, eventually I ended up working for Al Oeming, as most prominent western Canadian biologists did when they were young. For several springs, he would send me down to the Hanna area to

find newborn pronghorn fawns that could be picked up, put in a gunny sack, and taken back to the farm to be put in with a herd of nanny goats. Oeming could obtain licenses for them like a hunter for shooting them. I got to know the Hanna area well, know the type of country to go looking for pronghorns in, and developed a passion for the region.

Twenty years later I took over a mixed animal veterinary practise in Hanna and got to know the countryside even better, especially as I had a small private aircraft from my time in the North to now fly over the countryside on the lookout for pronghorns, especially in the winter. When my oldest son married a girl from the Lucky Lake area, 200 km east of me in the Saskatchewan dry belt, and my daughter spent over 4 years in Saskatoon doing a PhD in soil toxicology, I got to know the Saskatchewan dry belt as well and of course I paid attention to its abundance and distribution of pronghorn. I probably know the northernmost pronghorn abundance and distribution better than anyone else.

What this book means to me is that this is the general area where I live now, on a small farm a little south of Hanna, the capital of the “Areas” or “Badlands”, a Provincially operated municipal like district with elected councillors (I was elected for one term) in Alberta’s hardest hit region economically from the twenties to seventies, where there are hardly any trees and even the grass is hard to find sometimes, where the Red Deer River flows through with all its spectacular gulley (water) erosion, dinosaur beds, dinosaur fossils, dinosaur diggers, dinosaur museums, and where bad girls can have bad boyfriends (note to wife). Consort is on the northern edge, Jenner on the southern edge, Hanna on the western edge, and the Saskatchewan border on the eastern edge.

This “dry belt” in Alberta actually continues another 150 km east into Saskatchewan but they did not form a giant “Special Area” as they were not as hard hit and were able to utilize the Federal PFRA programs. It had not been as aggressively settled at the start and the poor land unsuitable for cultivation was only portions of several Rural Municipal Areas that were mostly used as community pastures and not a tax base. Starting in the 1930s, several Federal Government programs, notably PFRA, slowed their cultivation.

A native elder told Palliser, the first European to explore and evaluate this area, that you “have to be more than half coyote to survive on the Canadian prairies and more than half of what is left has to be rattlesnake to survive in the Badlands.” This sounds like much of what Annett was describing. For over 75 years, the fur trade had been busy and well established north of the North Saskatchewan River in the northwest, essentially all the way to the Arctic, but the lack of water, beaver, and the threat of the extremely warlike Blackfoot kept the Canadian fur traders out of southern Alberta and Saskatchewan, but not well-armed Americans based in Fort Benton on the Missouri River. The British Colonial government in England knew this, and sponsored Palliser’s expedition. Palliser’s report in 1862 described the southern prairies, the Palliser Triangle, as being poorly fit for cultivation and the center, the Badlands as completely unfit. The beaver and the rest of the fur trade was relatively poor, and the Blackfoot unfriendly. There were no natural or mineral resources

of any value other than buffalo; its meat was supporting the northern fur trade in the form of pemmican, and local natives — some years, and some years not. It was not a region worth bothering with.

The American Civil war ended in 1863 and Lincoln wanted his country united east to west as he had done north to south, but first he had to have a mass hanging of Sioux in Minnesota, because they weren’t part of the plan. The Sioux were plenty unhappy, moved north onto the western plains and into Canada to get away from the eastern Americans. The Sioux and their allies dominated wherever they went. The Brits knew what was going on south of the border and in 1867, incorporated Canada with Rupert’s Land given to it (not the actual land, only the commercial resources from the land but Sir John A. had a uniquely Canadian way of misleading us). When Sir John A.’s government proceeded to treat the Red River region as their colony, we got the first Louis in 1869, the brilliant Louis who wrote the *Manitoba Act* of 1870 that was passed immediately by Parliament. Sir John A. ignored most of its conditions, charged Louis with murder, and chased him into Montana for 15 years. Meanwhile the Americans had got their first railroad across the country in 1869, the elimination of buffalo was underway, and the Army was forcing the Natives onto Reservations. After Custer’s reverse massacre in 1876, the natives all knew, especially the Sioux, that it was get on a Reservation or you had a visit from the hostile Army. By now, the buffalo were getting scarce.

In Canada, Sir John A. had formed the Northwest Mounted Police just in time to deal with Sitting Bull and most of his Sioux that had crossed the “Medicine Line” into Canada to escape the American Army. The Army wanted a second chance to show them who was boss. Sitting Bull tried to convince Crowfoot and the Blackfoot to join the Sioux against the Americans but the NWMP convinced Crowfoot to sign Treaty 7 in 1877 with their “Great Grandmother” (Queen Victoria) and Canada instead. Sitting Bull gave up to the Americans shortly afterwards. Not enough credit was given to the NWMP (and Sir John A.). The American whisky peddlers and wolfers left without a word, the Canadian Pacific railroad reached the Rockies in 1883, the area was surveyed, and most of the population in the Red River area had moved to the Prince Albert area (Batoche). Again Sir John A. ignored their *Manitoba Act* rights, and in 1884, the second Riel rebellion started all over again, only with the not so brilliant Louis in charge. Now he considered himself David, son of God, Sir John A. owed him \$100K for past promises and offences, etc., and he didn’t really care about his people or their rights. A lot of people actually got killed this time, and Louis got hung along with almost 20 natives who Sir John A. had let starve rather than observe their treaty rights (mostly Assinibone, Canadian Sioux).

It only took 25 years after Lincoln had started the “settlement” of the West for it to happen, approximately 1865-90, with Canada being dragged along with what was happening south of the border. That is in an incredibly short time for such an enormous area, larger than Europe and almost as large as Asia, for such a cultural revolution. These other areas had hundreds if not thousands of years, not 25 years, to sort out their cultural differences. This is

probably some of the reason for our present day north American native non-native disharmony. In Siberia, about the same time as North America, the Europeans invaded and set up their trade and commerce relationship based on the fur trade that continues today. They did not go the next step and give them treaties and native reserves in return for the confiscation of their land. Siberia is full of mining activity and to some extent farming but if native land was interfered with they were properly compensated and still are today.

After Sir John A. created the treaties and reserve system, the southwestern most area of the prairies wasn't ready for homesteaders yet, and it was leased to large cattle outfits from the American west, some as large as 10,000 head, for about 20 years. In the severe winter of 1906-1907, almost 100% of the cattle died, the grass overgrew, and there was a gigantic grass fire that burned much of the soil. Instead of dealing with this mess properly, the Federal Government sold the land to eager homesteaders as they had started doing five years previously to the surrounding area. By the early 1920s, most people had left the driest of the dry, the area that is now the Suffield Military Reserve (near Jenner) and the area north along Berry Creek. Eventually this expanded to include over 10 million acres of abandoned farmland in southeast Alberta. There was no tax base, the municipalities (almost 40) were all broke and couldn't provide services (roads, schools, hospitals, police, etc.), and most important, the Federal Government wasn't collecting anything. The original idea was to plunder the west like it was a colony of the east. The west would provide raw materials at bargain basement prices and taxes, and the east would provide manufactured goods at inflated prices, and administration. The plundering of this region was noticeably disappointing.

In less than 20 years, the Federal Government had created this disaster, worse than their dealings with the natives, so in 1930, they decided to give the prairies their long overdue land and mineral rights and dumped this gigantic receivership problem on the province. OS Longman, the Alberta deputy minister of Municipal Affairs, appointed to deal with the mess, described this region as follows:

"The greatest human tragedy in Canada. The extent of human wastage caused by the attempted cultivation of the extreme drought areas of Alberta will never be measured. A life sized saga of frothy boosterism, lightning expansion and utter miscalculation of death, destitution, depopulation and environmental destruction."

To deal with this problem, Longman had to minimize its harm to the Province. He could not borrow money, he reduced wind erosion by stopping cultivation, he planted crested wheat grass where there had been cultivation, and he encouraged people to leave. To stay, people had to acknowledge that they were not entitled to provincial and municipal services. Much of this he copied from PFRA. Essentially he depopulated the area except for the few homesteaders that could make use of the "free range" for grazing horses, cattle, and some sheep. The power to do this came from the *Special Areas Act* that created the "socialized" municipal like district called the Special Areas, part of the Ministry of Municipal Affairs.

North America was the hardest hit region during the depression, and in 1930, the American Congress passed the Smoot-Hawley trade bill that cut off trade with Canada. That made Canada the hardest hit. In his campaign for re election, Mackenzie King vowed he would not spend "one red five cent piece in an area of the country that did not elect enough Liberals" and the prairies were the hardest hit in Canada. It is estimated that 1.5 million unmarried men were left abandoned on the prairies. In his book *"The Great Depression"*, Pierre Berton called the treatment of the prairies at this time by the Federal Government "their biggest shame of all times". The Ukraine had Stalin and the Canadian prairies had MacKenzie King. As soon as WWII started, in the time it took to say "conscription but not conscription", the prairie boys were on the European front lines. The Brits loved King for such a prompt and gracious sacrifice but they couldn't understand the low booing that came from the back of the Canadian troops the one time King inspected them.

Almost 100 years later, living in the Areas is now comfortable. We have basically all the amenities. The size of the Areas has been approximately halved to 5.1 million acres, and the population is still getting smaller, now about 4,500 people rural and about the same urban (Hanna, Consort, Oyen). It is well supplied with schools, hospitals and roads. Most other services are available including cell phones, wireless broadband, and several paved airports (small, no scheduled services). But it came slower because of the careful, controlled management of the land and developments as prescribed by Longman. The Areas is well endowed with coal, natural gas, and oil, which the people started benefiting from in the 1970s in the form of roads, some municipal services, jobs, taxes to the Areas, and compensation to land owners (much reduced now since 2015). Not only does the farming community benefit directly in this way, but many of them work in these industries to supplement their farm income. This benefits the small businesses in the urban communities (I was a small town veterinarian for almost 25 years in Hanna).

Before the prairies were "settled", there would have been a well-established pronghorn population complementing the buffalo population on the Canadian prairies. I don't know of an estimate but it would be at least what it is estimated to be now of circa 30,000 animals. They are an easy animal to hunt if you know a few tricks and would have supplemented every hungry native and settler's source of meat, especially when settlers were desperate and starving. Shortly after the turn of the 20th century, the pronghorn population was estimated at 100 animals in Canada. There were a few conservation programs but the pronghorn numbers never really did start to climb until the depopulation of the Areas meant they were not in need of poaching. By the 1950s, they were probably as plentiful as now, basically because of so few people living in southeastern Alberta. Deer, elk, and moose numbers have also increased because there is much less interest in their meat value. Now if you are poor and hungry, you can go to the grocery store and get meat in nice little packages that the government will pay for. No fuss and bother of hunting, butchering, cutting and wrapping, storing, or paying for meat.

North of the American border, there are essentially two pronghorn herds — the herd that is never north of the east flowing Red Deer

River that becomes the east flowing South Saskatchewan River at the Alberta Saskatchewan border, and the northernmost herd that is north of these rivers at least part of the time. These rivers are natural barriers to pronghorn movements. If pronghorn feel pressured, they will cross them, usually at night on the bridges. I don't know of anyone describing their swimming ability and their relatively tiny feet dislike wet or soft ground. If there is a particularly bad winter, there is a well recognized corridor that pronghorn use to funnel down across the bridges near the north south Highway 41 in Alberta (along the Saskatchewan border) that continues south across Highway 1 near Dunsmore and further south along the Eagle Butte road to Montana. Depending on the winter, much of the northernmost herd may head south of the International border, but most years, few cross the Red Deer/South Saskatchewan rivers. Prior to 2010, few would cross the farther north barrier, the east west Highways 9/7 (with the adjoining CN rail line and page wire fence, both removed in 2015), the busy vehicle route between Calgary and Saskatoon.

The herd of pronghorn that summers north of the Red Deer River in Alberta and north of the South Saskatchewan River in Saskatchewan has the south-central Alberta Saskatchewan border as its approximate north-south center, and Alberta Highway 9 and Saskatchewan Highway 7 its east west center. Four rivers form the natural boundaries of this bowl shape range. The western edge is the Red Deer River flowing south 16 km east of the city of Red Deer for 100 km before turning eastward. The southern edge is the Red Deer River flowing eastward approximately 150 km to join the South Saskatchewan River. The combined river flows eastward another 150 km before flowing northward. Just to the north of the Town of Red Deer, the Battle River flows in a north east direction for approximately 200 km to join the North Saskatchewan River at the Battlefords. The North Saskatchewan flows mostly eastward for approximately 100 km to almost join the north flowing South Saskatchewan River north of Saskatoon, which has been flowing northward for approximately 200 km after flowing eastward from joining the Red Deer River. A maximum area of approximately 200 km north-south by 300 km east-west, essentially the northern part of Palliser's triangle.

The paved, east-west Highways are less effective but still barriers to pronghorn's north-south movements. The busiest is Highway 9 in Alberta and the connected Highway 7 in Saskatchewan, followed by Highway 12 in Alberta and the connected Highway 41 in Saskatchewan (this route still has a rail line and adjoining page wire fence). Another factor is the landscape and vegetation changes as one leaves the center of the bowl. The landscape tends to be more trees, taller grass, and rolling hills that has fewer numbers of pronghorn. Visually acute pronghorn want to keep an eye on other pronghorn, coyotes, and trophy hunters. Their preference is towards the central part of this range, what was originally a treeless, semi-arid mixed short grassland native prairie "Badlands". Today, even the Badlands is mostly cultivated because of new farming techniques (zero till meaning fertilizer, herbicides, and pesticides replace the previous summer fallow and tillage), new crops and drought resistant crop varieties, and incredibly efficient (and comfortable compared to my farm hand days over 60 years ago) farm equipment. Native prairie still exists

where equipment can't be used because of landforms or because the soil is just too poor, but it is probably less than 15% of the total area. There is a tendency for the regions with the highest proportions of native prairie to dryland cultivation to have fewer pronghorn, so the species preference is not just for wide open vistas but also for dryland farming.

Before the Crow Rate was abolished in 1995 that triggered a change in grain growing, 70% of the grain harvest in this area was hard spring wheat. Now wheat is less than 20% and that includes the new wheat varieties with less protein but much greater yields and drought tolerance. Canola accounts for as much as 40%, and other crops — peas, beans, pulses, and durum wheat — are very abundant. On the Saskatchewan side, the cultivation is more advanced, and native prairie is at a minimum. On the Alberta side, the soil is poorer, the rainfall less dependable, and there are larger areas of native prairie that still aren't worth cultivating. The greatest abundance of pronghorn are on the Saskatchewan side with Kindersley more or less the center. This is also a big part of the Province's source of lentils that makes it the world's largest producer. The most abundant region for pronghorn on the Alberta side has more or less Hanna as a center. The least abundant regions for pronghorns are to the west, north, and east, away from the center of the "Badlands" bowl where the landscape is less open, and the very epicenter, where there is no dryland farming and only native prairie.

Most people think pronghorn are a form of goat, and they are often called "speed goats", "government goats", etc. upright with long legs and neck, but they frighten like sheep. If something is pressuring them, they get restless and agitated. If one starts heading off somewhere, especially an older doe, they all start to follow. If she starts to run, they all run, usually headlong eventually onto the country roads where the travelling is the best. They go under fences not jump them. Travelling seems to satisfy their high strung, over reactive, irrational need to do something when they are being pressured. Their legs are long, their feet are tiny, and they run upright; they are designed for speed on firm, dry conditions. They cannot paw the snow nearly as well as horses or caribou, or shovel it with their faces like buffalo, or eat browse above the snow like moose or muskox. They cannot have their food covered by a blanket of snow for more than a few days.

Most people also think pronghorn have goat like eating habits, picky browsers, or forb eaters. Teeth are the best indicator of a species diet. O'Gara and Yoakum (2004, 2006) points out that pronghorn molars are the enormous "grinders" typical of grazers that are exposed to grit off the ground, especially when overgrazed, as opposed to the smaller, shorter, more pointed "browser" teeth with little grit in their diet. Also, their digestive system (rumen and reticulum) and their dietary preferences are very much more generalist or grazer, sheep like. They sweep up food from the ground, almost like vacuum cleaners, rather than selective pickers of what is not on the ground. This would explain their attraction for the more widespread, diverse and available cultivated foodstuff rather than the limited, specific selection of native prairie with silver sage. To me, wide open vistas is more important to pronghorn than food selection.

It is an axiom of pronghorn management that the severity of the winter determines their overall numbers. Several studies of pronghorn eating habits have suggested they need native prairie with big bush, silver sage (*Artemisia cana*) to survive, especially during severe winters. Obviously this is a myth. In Canada, along the Montana border are huge tracts of Crown land and National and Provincial Parks that is still native prairie with an abundance of silver sage, yet if it is an especially severe winter, pronghorn will continue farther south to the much greater area of dryland farming in Montana. The following spring they reverse their movements and drift northward. Most of them travel 300 km or more to be north of the “rivers”, presumably to fawn where they were born or to return where they grew up, despite the fact they are passing through and leaving behind an abundance of native prairie and silver sage to enter an area that is mostly cultivated dryland farming with no silver sage. North of the Red Deer and South Saskatchewan river valleys, there is a negligible amount of silver sage (pasture sage *A. frigida* is quite common whereas *A. ludoviciana*, *A. absinthium*, and *A. campestris* are much less so, none of which anyone has ever suggested pronghorn seek). Depending upon the severity of the storms or winter, there has always been a percentage of the herd that stays north of these rivers, anywhere from an estimated 10% to 90%, and this northern portion has survived most winters (in a few severe winters, their survivorship was definitely not as good as most winters) without silver sage.

Many of the studies that referred to pronghorn being dependent upon silver sage to survive a winter were based on post mortems done during big winter die offs in Wyoming. Their rumens were jammed with silver sage, which made it look like they were seeking it out. In actual fact it was probably because it was all that was available above the snow cover. Silver sage is a coarse browse, a poorly digestible forage for sheep or grazers. The whole idea of the extremely pungent sage smell is to discourage animals from eating it, the reason it is so successful as an “increaser” during overgrazing; a food of last resort not a preferential need. O’Gara and Yoakum (2004) describes their feeding habits as “opportunistic foragers feeding on grasses, forbs, or shrubs depending on palatability and availability...Comparison of diet compositions among populations or locations may be misleading if not accommodated for similar ecosystems, biomes (three different types), and conditions”. People that say pronghorn are dependent on silver sage for winter survival don’t recognize O’Gara and Yoakum’s sentiments.

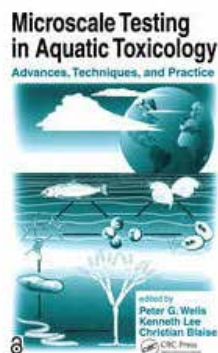
The myth that pronghorn need silver sage to survive winter is inconsistent with a portion of them overwintering successfully for most of the years I have lived in this area north of the northern limit of this plant species. The only places where silver sage is found is in the protected river bottoms of the Red Deer/South Saskatchewan rivers and their south facing slopes (a few adjacent drainage areas north of the rivers also has these plants). Of the 35 winters that I have flown and driven along these rivers, I have never seen any attraction of these animals to this plant. Pronghorn will sometimes be in the river bottoms but on irrigated pivots with exposed cultivated foodstuff on the ground.

This is a very low key form of study, but traveling by road and air and living in this area for almost 35 years and visiting for much longer, having an abiding interest in pronghorn abundance and distribution, and having a more than adequate range management level of plant identification, I can say unequivocally that the northernmost pronghorn herd does not depend on silver sage for overwintering in this part of the world.

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BOOK OF INTEREST



Microscale Testing in Aquatic Toxicology (Now Open Access)

Advances, Techniques, and Practice (1997)

Edited By Peter G. Wells, Kenneth Lee, Christian Blaise.

A key book in aquatic toxicology is now available Open Access, through Taylor and Francis, CRC Press, and Routledge Ltd, UK. This book – Microscale Testing in Aquatic Toxicology – Advances, Techniques, and Practice, edited by P.G.Wells, K. Lee, and C. Blaise, and published in 1998, covers the vast range of small scale tests that can be used in research, regulatory testing, and aquatic monitoring in fresh and marine waters. Supplemented by more recently published methods, it remains a gold mine of useful methods for the front-line aquatic pollution specialist and toxicologist in the battle against water pollution. Highly read and cited (114 times, 8-21), it should be of interest to environmental biologists coast to coast, as well as students in the environmental sciences.

<https://doi.org/10.1201/9780203747193>

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